Booklet #2

Booklet Series "Be in charge of your life cycle"

INVESTING IN YOUR FUTURE: EDUCATIONAL CHOICES

ANGLE

www.angle-cerp.carloalberto.org

This booklet is number two in a series of five booklets that aim at improving economic and financial literacy of young people. Economic and Financial Literacy is basic knowledge possibly to be acquired early in life to make individual financial decisions better informed and more effective. This applies particularly to decisions that have long-term consequences and require thinking in terms of the individuals' complete life cycle. Although the five booklets are connected and refer to each other, each of them can be read independently of the others.

The first booklet in the series provides a general introduction on the concepts needed to make financial decisions over the life cycle. The other four booklets cover the most important economic decisions relevant at various stages of the life cycle. The second booklet (this booklet) is about educational choices, such as the decision when to leave school and enter the labour market or how much effort to invest in studying. Booklet 3 deals with the economics of saving and borrowing and what to do with money that is saved. Booklet 4 discusses many aspects of what is often one of the most important financial decisions in people's lives: the purchase and financing of their own house. Finally, Booklet 5 is about pensions and financial security after retirement.

The five booklets are part of the project "A network game for lifecycle education" (ANGLE), funded by the Erasmus+ programme of the EU. This project aims at promoting and enhancing Europe's younger generations' financial and economic literacy. It adopts a life-cycle perspective to help the young to consider a long-time horizon and to think about the future consequences of their decisions. In addition to the booklets, ANGLE focuses on creating a board game that helps the young to improve their financial and economic skills through active involvement and participation. Reading the booklets is an excellent preparation for playing the game. Also for readers who do not play the game, however, they help to make people more conscious and skilled in making important economic and financial decisions.

The booklet has been realised by Arthur van Soest of **Tilburg University**

Realised with the financial support of the European Union – **Erasmus+** programme

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Co-funded by the Erasmus+ Programme of the European Union

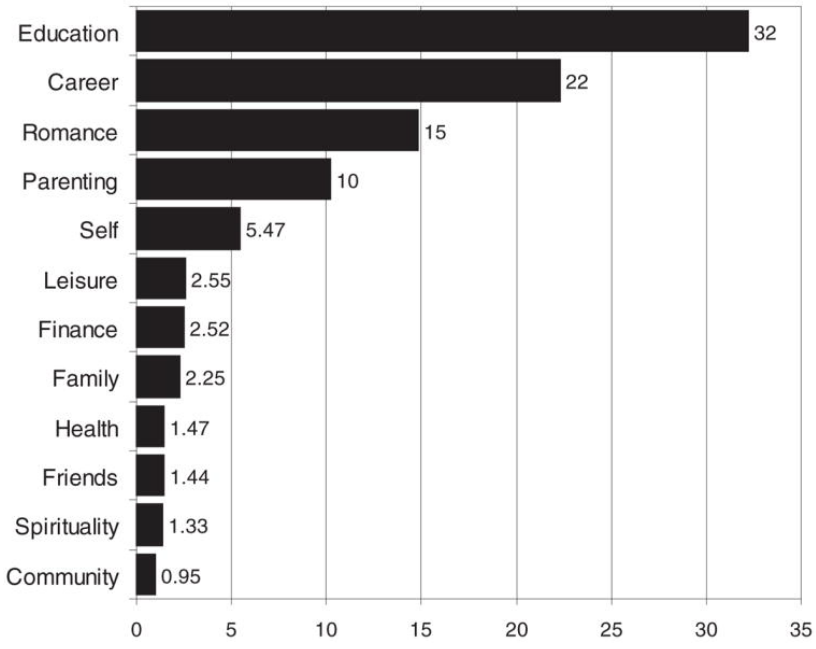
Booklet 2

INVESTING IN YOUR FUTURE
Educational choices

'If only I had worked harder in college…'

Educational choices are important but also difficult. A survey of academic papers shows that 32% of people have regrets about one or more of their past educational choices, a percentage that is higher than for other domains of life (see the figure below).

Figure 1 Proportion of Regrets (%)



Source: N. J. Roese and A. Summerville, 'What We Regret Most... and Why.' *Personality and Social Psychology Bulletin,* 2005, 31(9): 1273–1285. https://doi.org/10.1177/0146167205274693.

The purpose of this booklet is to help young people to make rational educational choices at different stages of their educational career. These educational choices have far-reaching consequences, both in the short run and in the longer run. They are among the most important choices people make during their lives,

not only from an economic point of view, but also in relation to their social contacts and networks, the nature of the jobs they will have during their career, their other daily activities, and so on.
The central theme is the *life cycle perspective*: Educational choices involve *trade-offs between short-term sacrifices (and gains) and expected gains (or losses) in the future*. Here the future means the complete remaining lifetime, from school and labour market entry to the full working career and even until after retirement. We focus on economic aspects, but the *non-economic aspects are equally important*. Not everyone will be interested in studying business administration or in a labour market career in the financial industry, even though that may offer the best perspective for high future earnings.

A second important aspect is *uncertainty*. When you decide on the subject you want to study or on how much effort to invest in your studies, you do not know the exact consequences of the decision you make for your study performance or for your future employment chances and future earnings. Instead, if you want to know whether an educational investment is profitable, you will have to work with *probabilities* or *expected outcomes* that depend on the choices that you make.

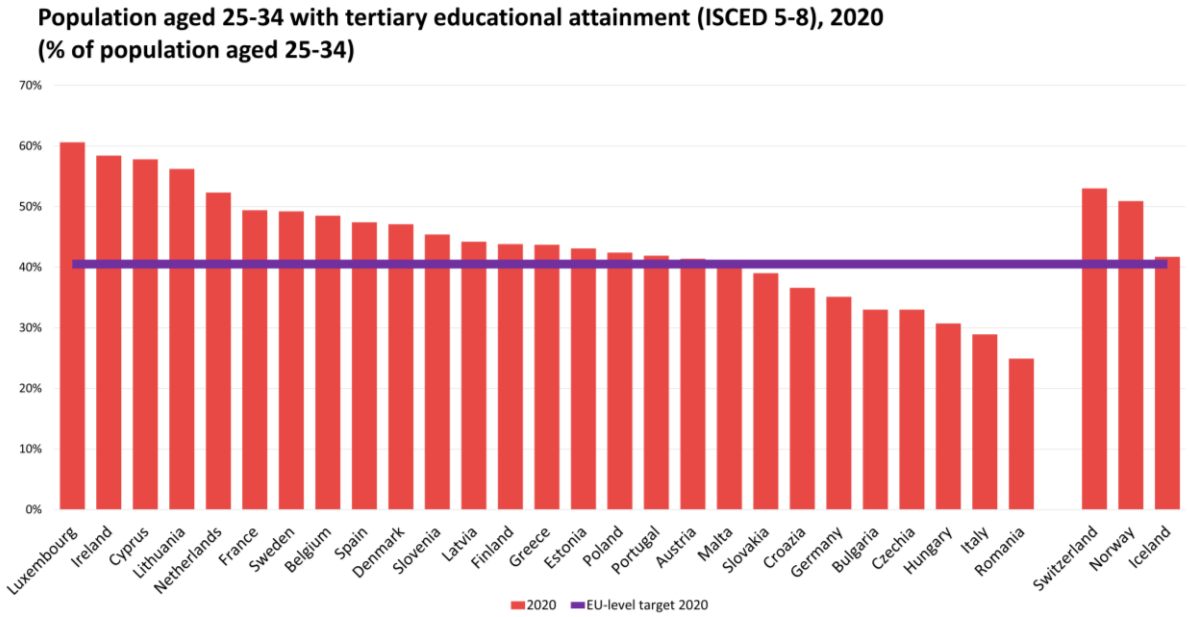
In this booklet, we follow some young individuals over time and discuss the decision problems they face at several stages of their educational careers. We focus on two decisions. We start in high school, where students must decide how much effort to put into their studies. The second decision is at the end of high school, on whether to continue full-time education and, if so, in which subject and at which level. The next two sections sketch the situation of a student facing a given decision in a specific context. The arguments for and against certain choices will be discussed in some detail. Exercises are used to understand how to make these kinds of trade-offs in stylized (but sometimes already rather complicated) situations.

Many other decisions also need to be made, such as how much effort to put into undergraduate studies or the decision to continue with graduate studies or enter the labour market when finishing undergraduate studies. Since these decisions largely require the same conceptual approach, we do not analyse them in detail. At the end of the booklet, we summarize the most important aspects of the typical decisions individuals face during their educational career. One thing we want to emphasize is that we focus on the economic aspects of the decisions.

There are also non-economic aspects that may be important in practice, but we do not explicitly consider them here (see also 🕮 Booklet 1).

Throughout this booklet, we present figures with stylized facts about education in Europe and in Organisation for Economic Co-operation and Development (OECD) countries.

Figure 2 **Tertiary education**, also referred to as **third-level**, **third-stage,** or **post-secondary education**, is the educational level following the completion of secondary education. The World Bank, for example, defines tertiary education as including universities as well as trade schools and colleges.



Source: Eurostat (2021), Eurostat statistics explained – Educational attainment statistics. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Educational_attainment_statistics

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Exercise 1 Use Figure 2 to answer the following questions.

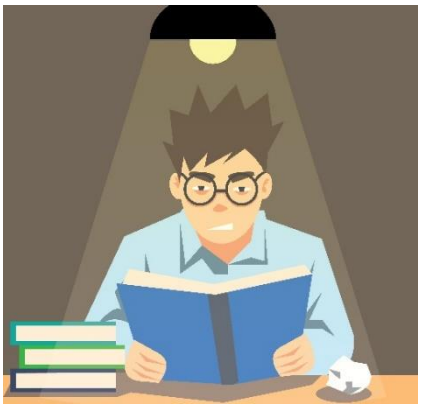
a. What is the fraction of the population aged 25–34 in the European Union (EU) with tertiary education?
b. For the 25–34 age group, which EU country has the **highest** fraction with tertiary education? And the **lowest** fraction?

Answers a. 40% (see the histogram bar to the far left). b. Luxembourg (approximately 60%) and Romania (around 25%)

1. High school students and effort

1.1 Peter's decision problem: To study or not to study

In general, Peter is an industrious high school student, aged 15 and still almost two years from taking his final exams. He does his homework and prepares for tests, but still has time to hang out with friends, play tennis, or enjoy himself with his favourite computer game. He has an English test tomorrow and wants to prepare tonight. However, his best friend invites him to come over and watch an important match of their favourite football team, together with some other friends. Peter is not really into football, but does enjoy watching it with friends. What should he do? Let's assume his parents do not interfere!



OR?

This is a very basic decision problem but already illustrates the trade-off between short-run and longer-run gains and losses. In this case, the short run is tonight. Watching the football match with friends is more fun than studying English (a least in Peter's view). The longer run is tomorrow and beyond. If Peter studies tonight, he will definitely pass the test, but, if he watches the football match instead, he will certainly flunk the test. How bad that is depends on the context. What would *you* choose in each of the following settings?

a. *Work now or feel embarrassed.*

   Flunking the test may reduce his grade average in English, but Peter generally does so well that he will still have a good grade for English at the end of the year. He will feel embarrassed for a few hours, since the teacher will ask him why he flunked the test, and he will also have to explain this to his parents. They will be unpleasantly surprised, but there will not be any further consequences.

b. *Work now or work in the summer.*
English is not Peter's favourite subject. His test results until now have been rather poor, and there is a good chance that his final grade will be insufficient. Doing well in the current test will probably help avoid this outcome. The rules of Peter's school imply that an insufficient grade at the end of the year means that he will be forced to take a summer course in English, which he would really hate to do, but it is still six months away and he might still get a sufficient grade, even if he flunks the test.

c. *Work now or repeat the whole year.*
English is Peter's least favourite subject. His test results until now have been poor, and there is a good chance that his final grade will be insufficient. Doing well in the current test will probably help to avoid this outcome. An insufficient grade at the end of the year means that Peter will be forced to repeat the whole year, extending his high school period by one year.

If Peter is short-sighted, he only cares about today and not at all about the future (starting tomorrow). In that case, he will choose to hang out with his friends, irrespective of the context in each of the three settings, a, b, and c. Essentially, he will not attach any weight to the future consequences of today's decision. Short-sighted behaviour is, of course, a very extreme case. Most people do attach some weight to the consequences of their decisions, particularly if these consequences already matter within a few days. The decision then depends on the *trade-off* between today's gains and the losses in the future. It then matters how large these losses will be.

SHORT-SIGHTED BEHAVIOUR

Short-sighted means not able to clearly see things that are far away or unable to understand or account for the future consequences of current decisions.

In economic terms, it means that zero weight is given to the change in future utility that a current decision can imply. Consequently, the decision is based only upon its immediate consequences.

In setting a, the future loss of not studying seems very limited. I think I would take it for granted and flunk the test, but Peter may feel differently about this. In economic terms, setting a is straightforward: on the one hand, the decision depends on the utility gain, now, from hanging out with friends instead of

studying. On the other hand, what matters is the utility loss next week (when Peter learns the result for his test) from flunking the test. The weight of the latter will probably be reduced, since most people care more about today's than about next week's utility. In economic terms, this is called the *time preference*, and the weight is called the discount factor.

DISCOUNT FACTOR

The discount factor is a calculation of the present value of future happiness, or, more specifically, it is used to measure how much people will care about a period in the future as compared to today.

In economic terms, it is the weight given to utility at some time in the future. The weight is usually lower the farther away the time considered.

Example: You can choose between attending a party today, with a utility of 50, or a bigger party next week, with a utility of 60. Your one-week discount factor is 0.95.

Since 50 < 0.95 x 60, you will choose to wait for next week's party.

Note the similarity with an interest rate (see 📖 Booklet 1): if the weekly interest rate is 5%, then receiving €100 next week is equivalent to receiving 1/(1 + 0.05)100 = €95 now. But when the interest rate is determined in the financial markets, the discount factor says something about individual preferences. The discount rate is high (close to one) for very patient individuals, but lower for impatient individuals, who care much more about today than about the future. For a short-sighted person, the discount factor is zero.

The table below illustrates the decision problem in setting a with the trade-off that Peter needs to make.

	Studying	Not studying
Today	Utility of studying	Utility of hanging out with friends
Future (next week)	Satisfaction of passing the test x Discount factor	Embarrassment of flunking the test x Discount factor

In setting b, the loss seems a lot more serious. In this case, Peter must compare one night of fun with a few weeks of extra studying in the summer. The summer is still some months off, but, unless Peter's time preference is very high, the future gains of studying for the test will probably outweigh the loss of not being able to watch the football match with friends. There is an additional complication,

however: it is *uncertain* whether the final grade at the end of the year will be sufficient, both in the case of studying for the test and in the case of not studying. In this case, Peter should not only account for the discount factor, but should also weigh the utility or disutility of each possible outcome with the probability of this outcome occurring. In this case, Peter will have to work with the expected utility values for each of the two decisions he can make.

EXPECTED UTILITY

Expected utility is the weighted average of the possible utility values, using the probabilities of the outcomes as weights. It is used to attach a utility value to an uncertain outcome.

Example: You can choose between a certain reward with a utility of 50 or a lottery that produces a utility of 30 with probability of 0.6 and a utility of 90 with a probability of 0.4.

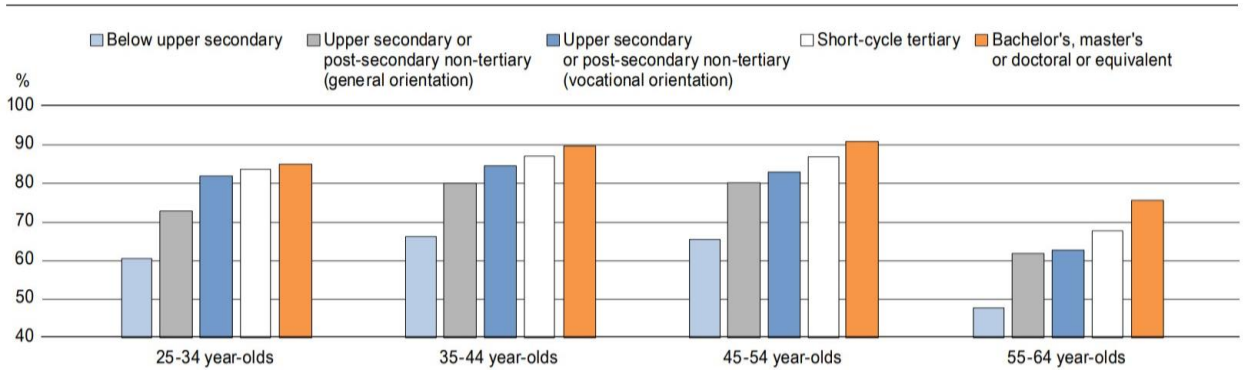
Since 50 < 0.6 x 30 + 0.4 x 90 (= 54), you will choose the lottery.

If the probability of an insufficient grade at the end of the year is small anyhow, even if Peter flunks tomorrow's test, and if taking the summer course is not such a terrible thing after all, then it may still be optimal for Peter to flunk tomorrow's test. The decision thus depends on quite a few factors: the utility differences now and in the future, the probabilities of a sufficient grade when flunking and not flunking the test, and the discount factor (see the table below).

	Studying	Not studying
Today	Utility of studying	Utility of hanging out with friends
Expectation for the future (next summer)	Utility of free time in the summer x Probability of a sufficient grade when passing the test x Discount factor + Utility of having to take the summer course x Probability of an insufficient grade when passing the test x Discount factor	Utility of free time in the summer x Probability of a sufficient grade when flunking the test x Discount factor + Utility of having to take the summer course x Probability of an insufficient grade when flunking the test x Discount factor

In setting c, the negative long-run consequences can be much more severe than in setting b. The potential utility difference between not repeating and having to repeat a year (studying an extra year, doing everything for a second time, joining a new class without your current schoolmates, etc.) seems very large. Even if the chances of this happening are low, the expected utility difference will outweigh the gain of hanging out with friends for one night. Almost every rational decision maker should try to avoid this outcome and spend the evening studying instead of watching football.

Figure 3 Employment rates by age group, educational attainment and orientation (2019)



Source: OECD (2020), Education at a Glance Database, https://stats.oecd.org/

Exercise 2 Figure 3 shows that employment rates increase with education level. In OECD countries, how much higher is the likelihood of being employed for those aged 25–34 with tertiary education compared to those without secondary education? More than 15 percentage points, 15 percentage points, or less than 15 percentage points?

Answer Among those with tertiary education, more than 80% of the age group 25–34 are employed (white and orange histogram bars), but among those with less than a secondary education, this proportion is only 60% (light blue bar). Therefore, the difference is certainly more than 15 percentage points.

1.2 The general case

In general, high school students must decide how much time and effort to spend on studying. This is a much more difficult decision problem than Peter's problem sketched above, but the main idea is similar. Students will make a trade-off between the short-term cost of studying and not being able to spend time on things that they may enjoy more and the potential long-term benefits of good

grades, less work in the near future, or better study and career opportunities in the long run. The future gains of studying are uncertain, and students will have a hard time figuring out their probability distribution. Instead of solving the optimization problem, they will probably use some rule of thumb, such as studying at least on hour per day or not going out the two evenings before an important test.

Parents can have better insight into the long-term benefits of education and may push their children to study more by changing the short-run incentives. For example, they may promise immediate rewards for studying hard or for obtaining a good test grade. This changes the decision problem from making a long-run trade-off with uncertain future gains to a short-run decision problem where the future gains are concrete and much less uncertain.

Exercise 3 A decision problem under uncertainty faced by Angela

Angela must decide how many hours she wants spend studying for an important test. The result of the test will be known next week. Angela's one-week discount factor is 0.90. She has no idea about the long-term consequences for her final grades or future educational opportunities. Still, she knows that she will feel happier for a while if she passes the test than if she does not.

To make the trade-off, Angela imagines that things will all happen this week. Her unhappiness if flunking the test would certainly outweigh the utility loss of studying for three hours instead of enjoying leisure time, but it would not outweigh the utility loss of studying for five hours. Thinking about this a bit more carefully, she thinks that the disutility of flunking the test is about the same as the utility of four hours of leisure instead of studying. If we set the utility of one hour of leisure to 100, then the utility of passing would be 400 if the test result is known immediately. Discounting with 0.9 for the time difference of one week means that the utility of 400 next week is equivalent to a utility of 0.9 x 400 = 360 this week.

a. Assume that Angela knows for sure that she needs to study four hours to pass the test. Will she study or not? Describe the trade-off in discounted utility terms.

b. Assume Angela's parents want to motivate her studying and promise her a reward if she passes the test. The reward will be given immediately when the test result is known. Its utility is equivalent to the utility of one hour of leisure (100). Will the reward change Angela's decision in a?

c. Now assume that studying less than three hours has a probability zero of passing the test and studying 4 hours has a probability 0.9 of passing (instead of a probability of one in a and b). The reward is still there. Will Angela decide to study (for four hours)?

In reality, the probability of passing the test depends on hours of study as follows:

Hours of study	0	1	2	3	4	5
Probability of passing the test	0	0.2	0.5	0.8	0.9	1

d. How many hours would Angela decide to study without parents' reward? Zero, one, two, three, four, or five hours?

e. Does the reward from her parents change your answer to the previous question?

f. Anne is much more concerned with the present and less with the future and has a discount rate of 0.60 instead of 0.90. How will your answers to the previous question change if the decision is not Angela's but Anne's?

Answers

a. Not studying has a utility of 4 x 100 = 400 now. Studying gives a utility of 400 next week, equivalent to 0.9 x 400 = 360 now. So the decision will be not to study.

b. Not studying has a utility of 4 x 100 = 400 now. Studying gives a utility of 400 + 100 = 500 next week, equivalent to 0.9 x 500 = 450 now. So the decision will be to study. The reward is effective!

c. Not studying gives a utility of 4 x 100 = 400 now. Studying gives an expected utility of 0.9 x (400 +100) = 450 next week, equivalent to 0.9 x 450 = 405 now. So Angela will study.

d. Without the reward, the required calculations are added to the table below:

Hours of studying	0	1	2	3	4	5
Probability of passing the test	0	0.2	0.5	0.8	0.9	1
Utility now (compared to studying 5 hours)	500	400	300	200	100	0
Utility next week (compared to flunking with certainty)	0	80	200	320	360	400
Expected utility next week, discounted	0	72	180	288	324	360
Expected discounted total utility	500	472	480	488	424	360

The highest expected utility is obtained with zero hours of studying.

e. With the reward, the required calculations are as follows:

Hours of studying	0	1	2	3	4	5
Probability of passing the test	0	0.2	0.5	0.8	0.9	1
Utility now (compared to studying 5 hours)	500	400	300	200	100	0
Utility next week (compared to flunking with certainty)	0	100	250	400	450	500
Expected utility next week, discounted	0	90	225	360	405	450
Expected discounted total utility	500	490	525	560	505	450

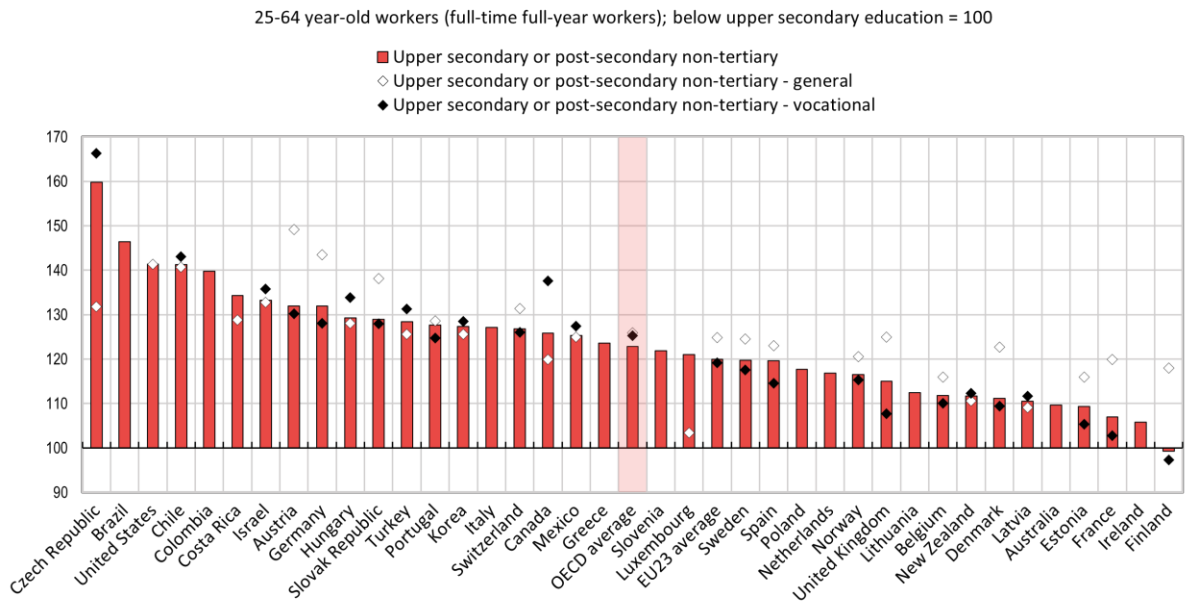
The highest expected utility is now obtained with three hours of studying.

f. For Anne, the calculations are the following (with the reward):

Hours of studying	0	1	2	3	4	5
Probability of passing the test	0	0.2	0.5	0.8	0.9	1
Utility now (compared to studying 5 hours)	500	400	300	200	100	0
Utility next week (compared to flunking with certainty)	0	100	250	400	450	500
Expected utility next week, discounted	0	60	150	240	270	300
Expected discounted total utility	500	460	450	440	370	300

Anne is so short-sighted that she will not study, despite the extra reward.

Figure 4 Relative earnings of adults with higher education compared to the earnings of adults with lower (below upper secondary) education (2018)



Source: OECD, Education at a Glance 2020.

Exercise 4 **Upper secondary education** is the level just below tertiary education. Figure 4 shows that earnings increase with the education level. In OECD countries, how much higher are the average earnings of full-time employees with at least an upper secondary education compared to the earnings of full-time employees with less than an upper secondary education?

Answer The answer is indicated by the blue histogram bar in the middle of the chart (OECD average). Its height is approximately 125, indicating that the difference is around 25%.

2. What to do after high school?

2.1 Mary's decision: Go to university or find a job?

Mary is in her final year of high school. She is confident that she will pass the final exams with flying colours. She has started thinking about what to do next year after the exams and a well-deserved vacation of two months. She is considering two options. She can find a job and not go to university, or she can go to university. She must also decide which subject she wants to study if she

decides to go to the university, but this is a no brainer: her favourite subject is communication sciences.

OR?

Mary understands that her choice will have long-term consequences. In principle, she knows that she has the possibility of reconsidering her decision and, for example, work for one year and then go to university. She also understands, however, that changing her mind after September will be costly, and therefore she does not want to take this possibility into account when making her decision. She knows that spending her time on studying is not necessarily as enjoyable as paid work may be, but she does not have a prior on which of the two is more satisfying. The same applies to differences in job satisfaction during the remainder of her labour market career, depending on the type of job she gets if she does or does not go to university. Mary has therefore decided to ignore all these non-economic aspects and to base her decision exclusively on economic arguments: she will carry out a cost–benefit analysis, comparing the cost of further education with the discounted value of future benefits.

DISCOUNTING

Discounting is determining how much money paid or received at some given time in the future is worth today.

Example: You will receive a payment of €1,000 three years from now. The annual discount factor is 0.95. The present value of the future payment of €1,000 is 0.95^3 x 1,000 = €857.38

If Mary decides not to go to university and to immediately enter the labour market, there are no costs of further education. She is confident that she will immediately find a job and will never be unemployed. The net present value (NPV) of this choice will be the sum of the discounted net (after tax) earnings during her labour market career (the next 40 years).

NET PRESENT VALUE (NPV)

Net present value (NPV) is the value of all future net incomes over the entire career, discounted to the present.

Example: Assume that after-tax earnings will remain constant at €30,000 per year, starting this year and lasting 40 years. With a discount factor of 0.95, the NPV is

$$NPV = 30{,}000 + 0.95 \times 30{,}000 + 0.95^2 \times 30{,}000 + \cdots + 0.95^{39} \times 30{,}000$$

The first term is this year's net income, which is not discounted because it is paid this year. The final term is the net income 39 years from now, discounted with a factor of 0.9539 = 0.1353, since it is paid only 39 years from now.

For this calculation, it is convenient to use the formula for the sum of a geometric series:

$$1 + r + r^2 + \cdots + r^N = (1 - r^{N+1})/(1 - r), \quad \text{for any number } r \neq 1$$

Taking r = 0.95, this yields

$$NPV = 30{,}000 \times (1 + 0.95 + 0.95^2 + \cdots + 0.95^{39}) =$$
$$= 30{,}000 \times (1 - 0.95^{40})/(1 - 0.95) = €522{,}893$$

NPV analysis is a form of intrinsic valuation, also used extensively by firms to determine the value of an investment project. In this case, discounting uses the interest rate instead of the discount factor.

Example: An investment project requires spending €1,000 now. In return, it will lead to a profit of €600 in each of the next three years. With an interest rate of 0.05 per year, the NPV of this project is

$$NPV = -1000 + \frac{600}{1.05} + \frac{600}{1.05^2} + \frac{600}{1.05^3} = 634$$

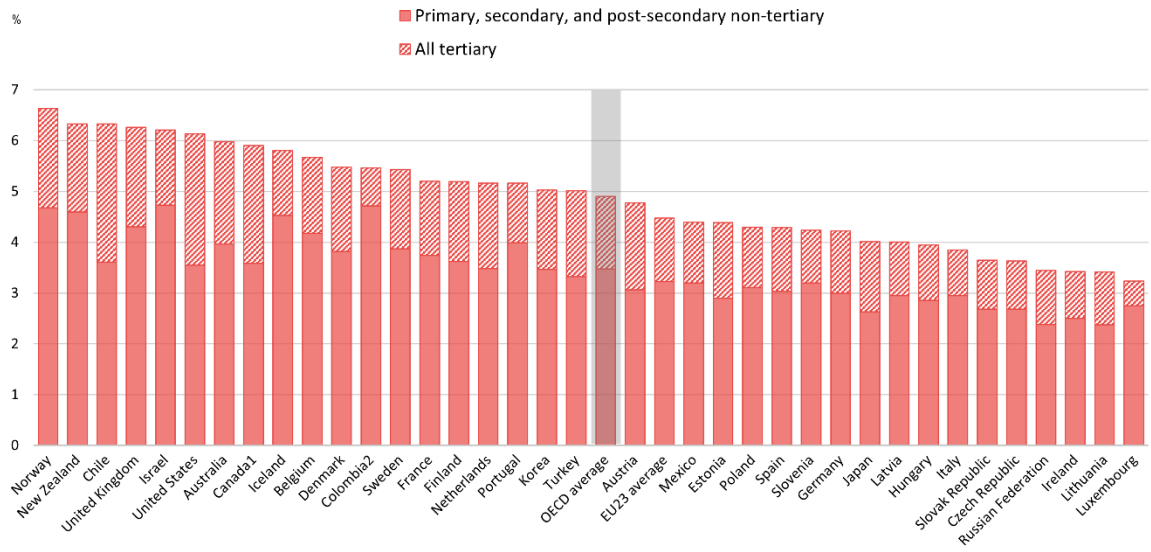
Since the NPV is positive, the project is profitable.

If Mary decides to go to university, she will have to pay tuition fees and will not receive any earnings for the next five years (the time needed for her studies). She will need a study loan to cover these costs and will have to pay it back after she has graduated. On the other hand, her earnings after graduation will no doubt exceed her earnings if she does not go to university.

It seems clear that Mary's decision will depend on several factors. The first is the extra annual earnings if she decides to go to university. This comes back every year of her future labour market career and will therefore be quite important. Even a small earnings difference will matter if it is obtained in each of the next 40 years.

The second factor is the cost of studying and of obtaining a study loan. Tuition fees vary across countries but are typically much lower in the EU than in the United Kingdom or the United States. This helps to motivate adolescents to go to university in the EU. Similarly, many countries offer student loans with low interest rates or grants that do not have to be paid back at all. This reduces the cost of studying and makes it possible for even adolescents from poor families to go to university.

Figure 5 Total expenditures on educational institutions as a percentage of the gross domestic product (GDP – the total value of everything the country produces)



Source: OECD, Education at a Glance, 2020

Exercise 5 Use Figure 5 to answer the following questions.

a. What percentage of GDP was spent on educational institutions, on average, in OECD countries?
b. Which country in the EU spent the **highest** percentage of GDP on educational institutions?
c. Which country in the EU spent the **lowest** percentage of GDP on educational institutions?

Answers

a. 4.9% (see the histogram bar in the middle of the chart). b. Austria. c. Luxembourg.

Exercise 6 **Optional** (for those who are not afraid to do some serious calculations). The calculations use the information in the box on the Net Present Value.

Assume that Mary uses an annual discount factor of 0.95. Studying will take five years (years 1, 2, … , 5). During this period, she can use a study loan to cover the tuition fee (€2,000 per year) and living expenses (€10,000). She will have to pay back the loan after her studies. The payment is €3,000 for 20 years (years 6, 7, …, 25).

If Mary decides not to go to university, her annual earnings will be €25,000 for 50 years (years 1, 2, …, 50, her whole labour market career). If she goes to university, her annual earnings will be €35,000 for 45 years (years 6, 7, …, 50).

a. Without doing any calculations, what do you think is the optimal choice?

b. Calculate the NPV of future income if Mary decides not to go to university.

c. If Mary decides to go to university, what will be her income in the first five years that you can use to compute the NPV? €10,000 or €12,000? Why?

d. Calculate the NPV if Mary decides to go to university.

e. What is the optimal decision? (NB: To make things easier, we did not account for the pension consequences of the decision; see Booklet 5.)

f. Does the conclusion change if the loan comes with substantial interest, implying that Mary has to pay back €4,000 instead of €3,000 each year for 20 years?

Answers

a. Since 45 years is such a long time, my guess would be that the salary gain of €10,000 per year will dominate the costs of studying and the costs of forgone earnings. So I would guess that Mary will choose to go to university.

b. $25{,}000 \times (1 + 0.95 + 0.95^2 + \cdots + 0.95^{49}) = 25{,}000 \times (1 - 0.95^{50})/(1 - 0.95) = €461{,}527$.

c. €10,000, since Mary cannot use the €2,000 herself, since this is immediately used to pay the tuition fee.

d. For the first five years we obtain $€10{,}000 \times (1 + 0.95 + \cdots + 0.95^4) = €45{,}244$. For the next 20 years (years 6 to 25, when the student loan has to be paid back) we have $(€35{,}000 - €3{,}000) \times (0.95^5 + \cdots + 0.95^{24}) = €32{,}000 \times 0.95^5 \times (1 + \cdots + 0.95^{19}) = €24{,}761 \times (1 - 0.95^{20})/(1 - 0.95) = €24{,}761 \times 12.83 = €317{,}691$. For the remaining 25 years (years 26,

27, …, 50) we have €35,000 x (0.95^{25} + ⋯ + 0.95^{49}) = €35,000 x 0.95^{25} x (1+ ⋯ + 0.95^{24}) = €140,311. So the total is 45,244 + 317,691 + 140,311 = €503,246.

e. Since €503,246 > €461,527, the optimal decision is to go to university.

f. No. There is no need for new calculations, since the difference will be the present value of €1,000 during the years 6, 7, …, 25. This is less than €20,000 (due to discounting), so the present value of going to university will still be higher than that of not going to university.

2.2 Uncertainty

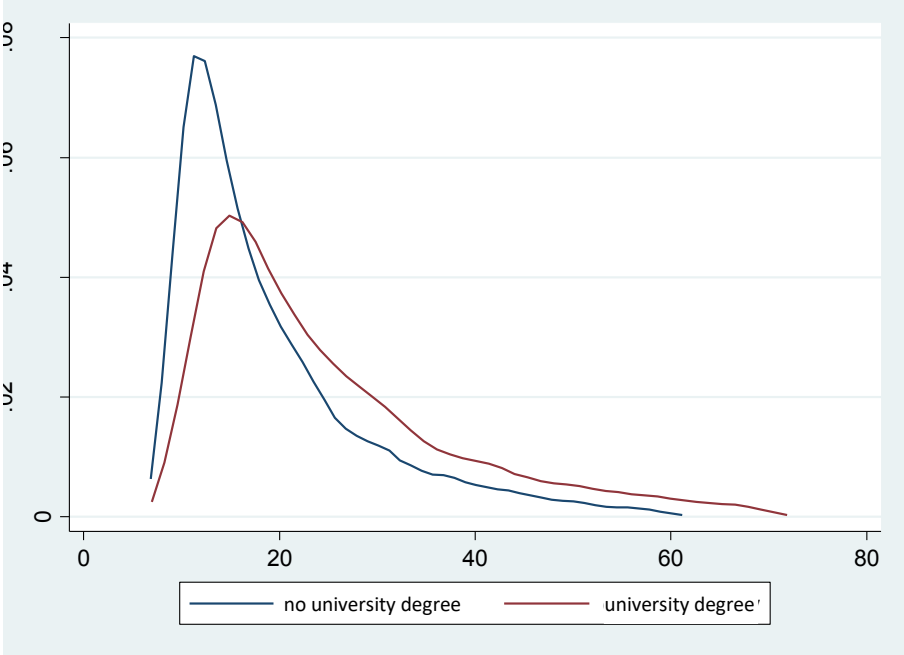
In Mary's case, there was no uncertainty at all (or perhaps we should say that Mary ignored the uncertainty). This is almost never realistic: if you decide not to go to university, you must look for a job, and there is no guarantee that you will immediately find one. Once you have a job, there is often a chance that your contract will not be extended, that the company you work for goes bankrupt, or that, for one reason or another, you lose the job and become unemployed. If you become unemployed, you will not know how much time it will take to find a new job. The wage you will earn is also not certain. It can be fixed in the first year once you have found a job, but then it will depend on, for example, being promoted or not in further years. Moreover, if you must look for a new job when becoming unemployed, the wage in that new job is even more uncertain.

If you decide to go to university, you will face the same type of uncertainties concerning unemployment and earnings, but the probabilities will be different. For example, it is a stylized fact that higher education reduces the chances of becoming unemployed and increases the chances of finding a new job once you are unemployed after all. Wages are uncertain, but they likely will be higher than if you had decided not to go to university. To make an adequate trade-off, you will need information on the *distribution* of wages of university graduates and non-university graduates, which you can use to determine your own wage expectations in both cases. This kind of information can be summarized as in the figure below.

This figure illustrates the distributions of wages (in thousands of euros, before tax) of employees without a university degree and of employees who graduated from a university. The figure shows that, for non-graduates, the density is more

concentrated among lower wages than for university graduates. Average wages are €21,000 and €28,000 for the two groups (you can figure out for yourself which average is for which group). Among non-university graduates, 50% earn more than €16,000 per year and 10% earn more than €37,000. Among university graduates, 50% earn more than €21.500 and 10% earn more than €50,000. In other words, it is clear that a university graduate typically earns more than a non-graduate (although there is no guarantee, since the distributions overlap).

Figure 6 Wage distribution (in thousands of euros, before tax)



To make her decision, Mary can work with the average wages (€21,000 and €28,000) or, if she remembers what she learned in her statistics classes, with the modal wages (€15,000 and €18,000), that is, the wages for which the densities reach their maximum. If she is a very sophisticated decision maker, she can even take other features of the distribution into account, such as the chances of earning a very high or very low wage. In case she is risk averse, for example, she can attach a lot of importance to the probability of obtaining a wage lower than €10,000.

Another source of uncertainty in the case of choosing to go to university is whether Mary will be successful there. There may be a positive probability that

she will fail and not obtain her diploma. In that case, she will have to settle for a fall-back option. Perhaps she can then enter the labour market under similar conditions as when she does not attend university, but she will have lost the earnings and must repay the study loan for the years she spent at university.

To take account of the uncertainty, Mary can use the *expected NPV* of each choice instead of the *NPV*. Similar to the expected utility calculation in the previous section, this means that she will take the weighted average of the possible values of the NPV, using the probabilities as weights.

Exercise 7 Decisions under uncertainty

You have a test tomorrow and must make a trade-off between studying tonight or going to a party. If you study, the chances of passing the test are 0.8; if you go to the party, the chances are 0.2. You compare the expected utilities of studying and not studying tonight, but they are the same – you really cannot say which is better.

a. Then you think what your best friend would do. She has the same chances of passing the test as you have, but she has a smaller discount factor than you. What will she do? Study, go to the party, or, just like you, she cannot say and is indifferent?

b. Now suppose your parents offer you a ticket for a concert of your favourite band next Saturday under the condition that you pass the test. What will you decide? Study, go to the party, or can you still not say?

c. Now forget about your parents' intervention. Instead, you receive an email from the teacher saying she will certainly not ask questions about the most difficult topic. This

changes your chances of passing the test to 0.9 if you study, but the chances remain 0.2 if you don't study. What will you do? Study, go to the party, or can you still not say?

Answers

a. Your best friend will go to the party. A smaller discount factor means she attaches less weight to the future and therefore attaches less importance to the expected future utility gain of studying.

b. Study. The tickets increase the utility of passing the test, which is multiplied by the probability of passing. Since this probability is higher in the case of studying than in the case of not studying, the expected utility in the case of studying increases more than the expected value in the case of not studying.

c. Study. The information raises the expected utility in the case of studying but does not change anything in the case of not studying.

Exercise 8 Exercise 6 continued, again **optional** and only for those who are not afraid of some serious calculations

Consider Exercise 6, but now account for the possibility that, after three years of studying, Mary does not obtain the necessary study points and is forced to leave university without a diploma. Assume she then enters the labour market and earns €25,000 per year (the same wage she earns if she does not try university at all), but now for 47 instead of 50 years. She must pay back the three years of study loan under the same conditions as before, but with a lower amount (€1,800 each year for 20 years, starting immediately after leaving university, that is, in year 4).

a. Take it as a given that Mary will have to leave the university after three years, without a diploma. Compute the NPV of all her future income under that condition.

b. Now assume that the probability of Mary leaving university without diploma is p. Compute the expected NPV of all her future income as a function of p.

c. Assume Mary maximizes the expected NPV. What is Mary's optimal choice if the probability that she will leave the university without a diploma is 0.3? What if it is smaller than 0.3?

d. Determine Mary's optimal decision for each value of p.

Answers

a. If Mary has to leave university after three years, the NPV is as follows. For the first three years, it is €10,000 x $(1 + 0.95 + 0.95^2)$ = €28,525; for the next 20 years (years 4 to 23), it is (€25,000 – €1,800) x $(0.95^3 + \cdots + 0.95^{22})$ = €23,200 x 0.95^3 x $(1 + \cdots + 0.95^{19})$ = €19,891 x $(1 - 0.95^{20})/(1 - 0.95)$ = €255,203. For the remaining 27 years (years 24, 25, …, 50), we have €25,000 x $(0.95^{23} + \cdots + 0.95^{49})$ = €25,000 x 0.95^{23} x $(1+ \cdots + 0.95^{26})$ = €7,684 x 14.993 = €115,205. So the total is 28,525 + 255,203 + 115,205 = €398,933.

b. If Mary manages to get her degree, the NPV is as we computed in Exercise 6: €503,246. If she does not get a degree and must leave after three years, the NPV is €398,933. The expected NPV of going to university is p x 398,933 + $(1 - p)$ x 503,246.

c. Mary will decide to go to university if the expected NPV of going is larger than the NPV of not going, computed in Exercise 6: €461,527. If she goes to university, the expected NPV for p = 0.3 is 0.3 x 398,933 + 0.7 x 503,246 = €471,952. Since this is larger than the NPV of not going, Mary will go to university. For smaller probabilities such as 0.1 or 0.2, the expected NPV of going to university will be even larger, so the optimal decision is also to go to university.

d. The expected NPV of the two options is the same if p x 398,933 + $(1 - p)$ x 503,246 = 461,527. This is the case if 503,246 – 461,527 = p *x (*503,246 – 398,933), so if p = 41,719/104,313 = 0.400. For $p < 0.400$, Mary will go to university; for $p > 0.400$, she will not go to university. (For p = 0.400, she would be indifferent.)

THE MAIN ISSUES

- Education is an investment in human capital.

- If successful, education increases career opportunities. This leads to higher expected earnings, lower probabilities of involuntary unemployment or shorter unemployment spells, opportunities to find a job with attractive characteristics, and so forth.

- It is important to realize that these investment returns are long-lasting. One's working career is typically much longer than the period of full-time education before entering the labour market. On the other hand, these returns are not realized immediately, but only after a number of years.

- To make good decisions, students should evaluate their decisions as an investment project, accounting for all the consequences of their decisions in future periods. Ideally, they will use life cycle planning and discounting and summing up utility and income over several (often many) periods. Educational councillors, parents, friends, and so on, can help students with these difficult decision processes.

- Studying is costly, because of tuition fees, the cost of living, study loans, fewer opportunities to do paid work and make money, and so forth. Individuals must make a trade-off between these costs and the future benefits in terms of higher wages, corrected for the costs of interest or paying back the study loan.

- Students need to deal with *risk*, which enters educational investment decisions in many ways. The choice for a certain type or level of education should account for the likelihood of dropping out and the implications of doing so. Moreover, the returns to education are not certain. Completing an educational programme changes the chances of obtaining a good job, but it *does not provide guarantees*. Conceptually, students need to think in terms of *expected lifetime utility*.

- Schooling decisions are made sequentially. Students should be aware of the option value of future opportunities, particularly at the earlier stages of their educational careers. For example, 14-year-old high school students may not have any idea of which subject they want to study yet. Nonetheless, in many countries, they must already make choices, such as whether to take math at a basic level or at a more advanced level. To keep their options open and to have the opportunity to choose a study in physics or engineering, they may want to choose the advanced level, even though there is also a good chance that, when the time comes, they will be more interested in studying law.

- Utility does not only depend on income and costs. Students should realize that their educational choices also affect their well-being through other channels. There is more to it than just the economic aspects! Education choices have a huge impact on the ways students use their time during education, during their labour market career, and perhaps even after that. These choices affect the *social networks* they build through fellow students and fellow workers.

Realized with the financial support of the European Union - Erasmus+ project n. 2020-1-IT02-KA203-079758

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