



# Economics in Age of Empires II: Bringing Games into the Classroom

Games have become ubiquitous in our lives. Sometimes we play them without even realizing it. Likewise, economics is everywhere and its matters are so pervasive that sometimes we fail to recognize them. Combining games and economics should help us understand both better and should provide economics instructors with a virtually infinite set of tools that they can use to effectively engage their students. This article shows that many elements from the strategy video game Age of Empires II can be used to exemplify topics from microeconomics and macroeconomics. We also provide sample questions to illustrate the transition from textbook-based to game-based testing.

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## 1. Introduction

In economics and many other disciplines, teaching methods have been changing naturally as technology has evolved and also out of the need to improve student engagement. One of the key ingredients for increasing student participation is using relatable examples that illustrate and illuminate theoretical topics.

In this article, we propose a complement to the traditional teaching practices used in principles of economics. Specifically, we show how a wide range of economic concepts can be explained using elements from any version of the real-time video strategy game *Age of Empires II*.<sup>1</sup> Our approach has several benefits, from making the class fun and attracting students' attention to simple implementation and good alignment with the curriculum. Furthermore, it helps students visualize abstract concepts used in economics without using too much class time.

The paper is organized as follows. In section 2, we review the literature on game-based teaching and learning. In section 3, we present the gameplay mechanics of *Age of Empires II*. Section 4 includes brief descriptions and learning outcomes (hereafter, LO) for 21 topics that are reflected in the game and that are further analyzed in Appendix B. These examples, which can be used for the introductory chapters or over an entire principles of economics course, are worded less formally, as if presented directly to students. To check their understanding of the concepts, we suggest a dual testing approach: one based on textbook information, and the other based on our examples. To show how instructors can transition between the two, each topic is followed by a pair of questions, one for each type. Finally, section 5 provides brief concluding remarks and announces plans for assessing the contribution of our approach to improving student engagement and performance.

## 2. Literature Review

Incorporating elements of (or even entire) computer games into classroom activities dates back more than 50 years. For instance, as Papadakis (2018) points out, many who have grown up in the American education system have played various versions of the survival game *Oregon Trail* to learn about our geography and history.

Games have become a major part of today's culture. ESA (2022) reports that two in three Americans were playing video games in 2022 and that nine out of ten increased their playtime after the start of the COVID-19 pandemic. Furthermore, 53 percent of the respondents play 7+ hours per week.<sup>2</sup> Barr and Copeland-Stewart (2022) also observed a change in gaming behaviors due to COVID-19, with an increase in the time spent playing in 71 percent of their sample. Importantly, most of their respondents indicate a positive impact of games on their well-being.

Psychologically, games generate different emotions in people, such as competitiveness, happiness, curiosity, and frustration (see Mitchell & Savill-Smith, 2004). Some of these emotions may increase engagement and motivation for learning. Given that the current Generation-Z students have been exposed to video games since early childhood, educators have been thinking of ways to include them in the classroom. Mitchell and Savill-Smith (2004) provide a broad literature review of video game uses in education. They report benefits such as long-term student retention, treating attention deficit, and providing learning opportunities in contexts

<sup>1</sup> *Age of Empires II* © Microsoft Corporation. *Economics in Age of Empires II: Bringing Games into the Classroom* was created under Microsoft's "[Game Content Usage Rules](#)" using assets from *Age of Empires II* and it is not endorsed by or affiliated with Microsoft.

<sup>2</sup> The full report is available [here](#).

that are attractive and relevant to learners. McLaren et al. (2017) reveal that sixth graders who play a video game to learn certain mathematical concepts show an improvement in immediate as well as delayed testing. Moreover, Mayer (2014) investigates the educational value of games and finds that classroom gamification may be more effective than traditional teaching in fields like mathematics, science, and second language.

The use of game elements in economics has not been as prevalent as other innovative teaching methods such as hands-on and role-based learning (Settlage & Wollscheid, 2019), or extracting economic concepts from movies (Wooten & White, 2018), TV shows (Wooten & Lynch, 2022; Klein & Klein, 2023), music (Jaeger & Wooten, 2022), or comic books (O’Roark, 2017). Based on a categorization by Ulicsak and Williamson (2010), most of the games used in economics courses are classified as either educational (i.e., designed only for the classroom, such as those proposed by Lawson and Lawson (2010) and Fabian (2021)) or educational leisure games (i.e., can be played in the classroom and at home, such as those proposed by Lewis, Wardrip-Fruin, & Whitehead, 2012). The Age of Empires series falls into the latter category, and, to our knowledge, no other study has employed it in the economics education field.

### **3. The Mechanics of Age of Empires II**

Microsoft’s Age of Empires II is a real-time strategy (RTS) video game, with the action set throughout medieval times, covering a timeframe of roughly 1,000 years, historically from the Middle Ages (or the post-classical period) to the Renaissance (or the Age of Discovery). The game is rated T/Teen, for mild blood, mild language, and violence, by the Entertainment Software Rating Board (ESRB). It has had multiple versions, which correlate with improvements in hardware over time. The latest one, Age of Empires II: Definitive Edition, offers 4K Ultra HD graphics, fully remastered audio, and new content (campaigns, civilizations, etc.), and can be currently played on Windows PC and Xbox.

Standard multiplayer sessions of Age of Empires II start in the Dark Age, with each player typically having a town center, three villagers, and one scout.<sup>3</sup> The goal, in the usual “conquest” mode, is to defeat all enemies. While strategies to reach that goal vary from player to player, and they also depend on the opponents’ skills and actions, they generally assume building a thriving economy that can support powerful military forces.

To create additional villagers, who mainly gather resources and construct/repair civilian and military buildings, one needs to spend 50 units of food (and 25 play seconds) for each of them, build enough houses (each requiring 25 units of wood and build time), and not exceed the population limit (which includes soldiers and sailors) selected in Game Settings. While employing villagers is almost instantaneous, improving their skills requires costly town center or university upgrades, which allow them to transport more resources and to move or build faster. They can also be more productive if they have immediate access to mining camps, lumber camps, or mills, which cost 100 units of wood and a certain construction time for each building. We want to point out that a villager who spends time building any of them (e.g., 35 seconds for a mill) cannot perform other tasks simultaneously.

The natural resources in the game include wildlife, fruit bushes, arable land, forests, gold and stone deposits, etc. While the arable land on farms and the fish in traps are renewable sources of food (although the structures require wood and construction time to build), the vast majority of the other natural resources are nonrenewable. For instance, while trees are generally abundant, they cannot be replanted, and they do not regenerate if cut down or destroyed.

Advancing to higher levels (i.e., from the Dark Age to Feudal, then Castle, and, finally,

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<sup>3</sup> A single-player match against computer (AI) players proceeds similarly.

Imperial), players have access to new technologies, which allow their economies to be more productive, assuming that certain amounts of resources have been spent to research them. For instance, innovations at lumber camps, in the form of double-bit axes, usually cost 50 units of wood, 100 units of food, and 25 seconds of training time, and result in villagers/lumberjacks being able to chop wood 20 percent faster.

Building markets (typically for 175 units of wood and construction time) enables players to buy/sell resources (i.e., wood, food, and stone) using gold as commodity money, to collect gold by trading with other players (using trade carts), to possibly share the allies' line of sight, to pay tribute of resources to others, and to research trade upgrades that reduce/eliminate tribute fees or decrease commodity trading fees. Interestingly, commodity market prices are global, in the sense that the buy/sell orders from all players influence the prices of wood, food, and stone at individual markets.

To create military forces, players need to assign villagers to build barracks (for infantry), stables (for cavalry), and archery ranges (for ranged units), each typically requiring 175 units of wood and construction time. Additionally, docks can be built (for 150 units of wood) to produce warships, siege workshops (for 200 units of wood) to construct siege weapons, and castles (usually for 650 units of stone) to create unique military units and trebuchets. For many upgrades, a popular destination is the blacksmith, which is used to improve all of the above and more (e.g., towers, town centers, etc.).

For anyone new to Age of Empires II (or for those who have not recently played it), the game description in this section should be a good primer to understanding and benefiting from our examples in Appendix B. We would recommend instructors who plan to use them as a teaching tool, to install the game and play a few single or multi-player sessions, at least until they are comfortable enough with running a flourishing economy. This initial preparation, which may take a few hours (depending on prior experience with similar games), should take place before teaching the topics presented in the next section and Appendix B. We also encourage our readers to use the links to video tutorials and guidelines listed in Appendix A, to further familiarize themselves and their students with the gameplay and with the similarities between economic decisions and ideas in Age of Empires II and basic economic principles or models. Playing the game or watching those clips, students can easily see, for instance, how increases in the demand for food result in rising food prices, and increases in the supply of wood lead to lower wood prices.

#### **4. Economic Topics in Age of Empires II**

In the three panels of Table 1, we introduce 21 examples of economic topics (T01 – T21) that are immediately related to the Age of Empires II strategy video game. We include brief descriptions and learning outcomes to make it easier for instructors to check the alignment of their curricula with our examples. Also, for easier implementation, we present them in an order that roughly resembles that of popular principles of economics textbooks, such as Mankiw (2020) and Mateer & Coppock (2023). Seven of our topics can be taught in both microeconomics and macroeconomics courses (see Panel A), another seven exclusively in microeconomics (see Panel B), and the remaining seven exclusively in macroeconomics (see Panel C). This balanced approach, with 14 topics each, should be beneficial for instructors who teach both microeconomics and macroeconomics and want to standardize the experience for their students, especially if they do not use a textbook.

Table 1. Economic Topics Reflected in Age of Empires II

## Panel A. Microeconomics and Macroeconomics

Topic #	Description	Learning Outcomes
T01	<i>Decisions Imply Trade-Offs</i> shows that, given limited economic resources, everyone needs to give up something to get something else.	LO 1.1: Recognize trade-offs faced by individuals and by an entire society. LO 1.2: Explain why scarcity of resources leads to decisions that require trade-offs.
T02	<i>Production Possibilities Frontier (PPF)</i> graphically illustrates the possible combinations of output that can be obtained in an economy, given the available factors of production and technological knowledge.	LO 2.1: Illustrate the PPF for a hypothetical economy producing two goods or services. LO 2.2: Compare and contrast various production choices depending on their location relative to a PPF.
T03	<i>The Benevolent Social Planner</i> describes a hypothetical decision-maker who intends to maximize some measure of economic well-being of a society while acting like a supreme dictator.	LO 3.1: Define the concept of a benevolent social planner. LO 3.2: Find ways in which a social planner can maximize a nation's welfare.
T04	<i>National Defense and the Free-Rider Problem</i> explains how some nations benefit from the protection given by a military alliance, without fairly contributing to it, thus exemplifying the free-rider concept.	LO 4.1: Describe a situation in which individuals or nations do not pay for a shared resource but still get to enjoy its rewards. LO 4.2: Find a solution to the free-rider problem.
T05	<i>Opportunity Costs</i> illustrates what one must give up, that is, the sacrifices that need to be made, to obtain something else.	LO 5.1: Define the concept of opportunity cost with the scarcity assumption. LO 5.2: Calculate opportunity costs in various scenarios.
T06	<i>Returns to Scale</i> exemplifies cases where production functions exhibit constant, decreasing, or increasing returns to scale, and where decreasing returns may be chosen, despite the apparent disadvantage.	LO 6.1: Compare constant, decreasing, and increasing returns to scale. LO 6.2: Determine whether a given production function has constant returns to scale.
T07	<i>Potential Gains from Trade</i> explains how the concept of comparative advantage can be used to determine product specialization choices that prove to be mutually beneficial to trading partners.	LO 7.1: Define comparative advantage. LO 7.2: Illustrate how specialization and trade can help two nations achieve a higher total output and level of consumption than with self-sufficiency.

## Panel B. Microeconomics

Topic #	Description	Learning Outcomes
T08	<i>Explicit versus Implicit Costs and Accounting versus Economic Profit</i> compares and exemplifies costs that involve an outflow of some form of money, versus costs that do not. It also shows how the former is included in the calculation of both accounting and economic profits, while the latter is only in the economic profit.	LO 8.1: Compare and calculate explicit and implicit costs. LO 8.2: Compare and calculate accounting and economic profit.
T09	<i>Fixed versus Variable Costs</i> illustrates costs that do not vary and costs that do vary with the quantity of output being produced.	LO 9.1: Define and calculate fixed costs. LO 9.2: Define and calculate variable costs.
T10	<i>Sunk Costs</i> explains how some costs have already been incurred and cannot be recovered, and, therefore, they should not influence future decisions.	LO 10.1: Define sunk costs. LO 10.2: Show why sunk costs should not impact rational decision-making.
T11	<i>Making Decisions at the Margin</i> exemplifies how rational people compare marginal benefits and marginal costs when making decisions, aiming to maximize their objectives.	LO 11.1: Recognize the difference between marginal thinking and full-value thinking. LO 11.2: Illustrate how rational people compare marginal benefits and marginal costs in their decision-making process.
T12	<i>Humans (and Artificial Intelligence) React to Incentives</i> shows that, given motivation in the form of rewards, punishments, etc., people (and machines programmed by people) act in certain ways.	LO 12.1: Show how incentives affect people's behavior. LO 12.2: Compare how different people respond to incentives as they pursue their self-interests.
T13	<i>Pure Coordination, Assurance, and the Battle of the Sexes Games</i> exemplifies three major types of coordination games used in game theory.	LO 13.1: Identify whether a strategic game has a dominant strategy given a payoff matrix. LO 13.2: Find differences and similarities between pure coordination, assurance, and battle of the sexes games.
T14	<i>Signaling and Screening to Counteract Asymmetric Information</i> describes two devices that can be used to offset some of the disadvantages generated by asymmetric information.	LO 14.1: Describe the signaling and screening devices used in a given scenario. LO 14.2: Illustrate how signaling and screening may remedy some of the effects of asymmetric information.

## Panel C. Macroeconomics

Topic #	Description	Learning Outcomes
T15	<i>Productivity and Economic Growth</i> illustrates the main determinants of productivity and how the economy can grow faster by improving productivity.	LO 15.1: Identify the main determinants of productivity in a given scenario. LO 15.2: Explain how improvements in the determinants of productivity can lead to economic growth.
T16	<i>The Catch-up Effect</i> shows that poorer economies tend to grow faster than richer ones, thus reducing the per capita income gap that separates them.	LO 16.1: Describe the catch-up effect theory. LO 16.2: Find ways in which developing nations can enhance their catch-up efforts.
T17	<i>Prices Rise If the Money Supply Increases Too Much</i> explains how a strong increase in the quantity of money available in the economy, larger than the one in total output, leads to rises in the overall demand and, consequently, in prices.	LO 17.1: Describe the notions of overall demand, inflation, and money supply. LO 17.2: Show how increases in the money supply cause inflationary pressures on the economy.
T18	<i>Closed Economy</i> exemplifies an economy that does not interact with other economies, and thus has no imports and no exports (hence, zero net exports).	LO 18.1: Define a closed economy. LO 18.2: Illustrate how a closed economy operates.
T19	<i>Business Cycles</i> illustrates irregular and mostly unpredictable fluctuations in economic activity (including production and employment), between periods of economic downturn and upturn.	LO 19.1: Describe a business cycle and its phases. LO 19.2: Examine how various economic indicators change as an economy goes through the business cycles.
T20	<i>No or Low Unemployment in a Command Economy</i> shows that, different from a market economy where allocation of resources results from the decentralized interactions of buyers and sellers, in a command economy allocation of resources (including labor) results from the decisions of central planners. They usually expect all people who can work to be employed (disregarding the loss of efficiency), which explains the very low unemployment.	LO 20.1: Estimate frictional, structural, and cyclical unemployment in a command economy. LO 20.2: Show why command economies can have better control of unemployment levels than free-market economies.
T21	<i>Short-Run Tradeoff between Inflation and Unemployment</i> exemplifies how, in the short run, economic measures meant to reduce price inflation may result in greater unemployment, or conversely, implementing policies to lower unemployment may result in greater inflation.	LO 21.1: Explain why theoretically there is a short-run relationship between unemployment and inflation. LO 21.2: Describe how a policy aimed at reducing unemployment can increase inflation in the short run.

We provide detailed examples in Appendix B, which starts with a quick reference guide that summarizes and classifies them according to the three panels in Table 1. Before introducing any of these examples to their students, instructors may first consider providing them with a broader theoretical background, and then encourage them to play a session to identify the related economic concept/component.<sup>4</sup> Afterward, to check their students' understanding of the economic notions, instructors may find it useful to prepare quizzes, which could include our sample of two (per example) multiple-choice/true-or-false questions: one strictly based on textbook theory and one based on the video game.<sup>5</sup> This teaching strategy offers fun and engaging learning opportunities, aimed at improving student participation and performance.

## **5. Conclusions**

The research on the implementation of video games in undergraduate education looks promising, even though, so far, they have rarely been used in economics classes. In his comprehensive literature review, Papadakis (2018) notes that many studies confirm digital games as effective learning tools, as well as promoters of student engagement, motivation, social interaction, and teamwork. The goal of our paper is to show that economics, despite being characterized by many as "dismal" and difficult, is well-reflected in video games, which are an important part of today's culture, due to their appeal to the majority of people.

Specifically, we illustrate how using elements from the real-time strategy video game *Age of Empires II* can make economic themes more relatable, entertaining, and engaging for our students. After presenting the gameplay in section 3, we provide brief descriptions and learning outcomes, as well as detailed examples for 21 microeconomics and/or macroeconomic topics. We also suggest sample questions designed to test students' understanding of both theoretical and game-based economic content. For our readers interested in visualizing the very popular world of *Age of Empires II* and its intersection with economics, we recommend several links in Appendix A. While using examples from video games can be daunting and overwhelming for many teachers, we argue that the lesson guides provided in this paper can be easily and seamlessly integrated, with a low time cost. Another potential concern is that female students might be less familiar with video games, and consequently less open to adopting them as part of their learning. However, ESA (2022) reports that 48 percent of video game players identify as female, which indicates a small gender gap.

Our students' positive reactions to examples from *Age of Empires II*, meant to illuminate certain abstract concepts, have encouraged us to expand our pool of topics reflected in the game. Nevertheless, further research is needed to statistically assess the effectiveness of this pedagogical technique on student engagement and performance.

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<sup>4</sup> Alternatively, instructors may introduce an example first, ask students to identify the economic concept/component, and then provide a broader theoretical background.

<sup>5</sup> To hide the answer key from students, the solutions to the multiple-choice/true-or-false questions are only available upon request.



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## **Appendix A. Video Tutorials and Guidelines for Age of Empires II**

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<b>Content</b>	<b>Location</b>
Learn to play	<a href="https://www.ageofempires.com/learn-to-play/getting-started-aoe2/">https://www.ageofempires.com/learn-to-play/getting-started-aoe2/</a>
Beginner guide to the first 15 villagers	<a href="https://youtu.be/O7zaXjaJVWM">https://youtu.be/O7zaXjaJVWM</a>
Beginner guide to military counters	<a href="https://youtu.be/ZSv2TR8h0sM">https://youtu.be/ZSv2TR8h0sM</a>
Economics: inflation and time value of money	<a href="https://youtu.be/GHbP-veRpk4">https://youtu.be/GHbP-veRpk4</a>
Economic upgrades: research and technology	<a href="https://youtu.be/WbC9Zhrtmhk">https://youtu.be/WbC9Zhrtmhk</a>
Building walls: costs versus benefits	<a href="https://youtu.be/siglJusm_OY">https://youtu.be/siglJusm_OY</a>
More in-depth analyses	<a href="https://www.youtube.com/@SpiritOfTheLaw">https://www.youtube.com/@SpiritOfTheLaw</a>

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## Appendix B. Economics in Age of Empires II

### Quick-Reference Guide

Topic	Microeconomics	Macroeconomics
T01. Decisions Imply Trade-Offs	X	X
T02. Production Possibilities Frontier (PPF)	X	X
T03. The Benevolent Social Planner	X	X
T04. National Defense and the Free-Rider Problem	X	X
T05. Opportunity Costs	X	X
T06. Returns to Scale	X	X
T07. Potential Gains from Trade	X	X
T08. Explicit versus Implicit Costs and Accounting versus Economic Profit	X	
T09. Fixed versus Variable Costs	X	
T10. Sunk Costs	X	
T11. Making Decisions at the Margin	X	
T12. Humans (and Artificial Intelligence) React to Incentives	X	
T13. Pure Coordination, Assurance, and the Battle of the Sexes Games	X	
T14. Signaling and Screening to Counteract Asymmetric Information	X	
T15. Productivity and Economic Growth		X
T16. The Catch-up Effect		X
T17. Prices Rise If the Money Supply Increases Too Much		X
T18. Closed Economy		X
T19. Business Cycles		X
T20. No or Low Unemployment in a Command Economy		X
T21. Short-Run Tradeoff Between Inflation and Unemployment		X

### T01. Decisions Imply Trade-Offs

#### 1. Example:

Three of the most important decisions in Age of Empires II are how early to start creating military buildings (e.g., barracks, archery ranges, stables, etc.) and units (e.g., halberdiers, archers, knights, etc.), how many of each (i.e., quantity), and which upgrades to perform (i.e., quality). These three decisions share a crucial characteristic: implementing them leads to the

consumption of vital resources that could otherwise be used to develop the economy. We easily recognize here the classic “guns versus butter” trade-off. One could wait until the economy is flourishing, but that exposes that player to the huge risk of not being ready for a surprise attack by their enemies. Moreover, waiting implies a lack of readiness to attack, which allows opponents to develop both economically and as a military force. At the same time, preparing a good defensive structure and/or attack units utilizes limited resources which are significantly scarcer in the early stages of the game. The best approach is to not neglect either, to balance the two by making decisions at the margin.

2. Questions:

1. A possible trade-off faced by any nation is one between

- A. Economic growth and environment.
- B. Exports and imports.
- C. Parks and recreation.
- D. All of the above.

2. In Age of Empires II, creating a stronger military contributes directly to a flourishing economy.

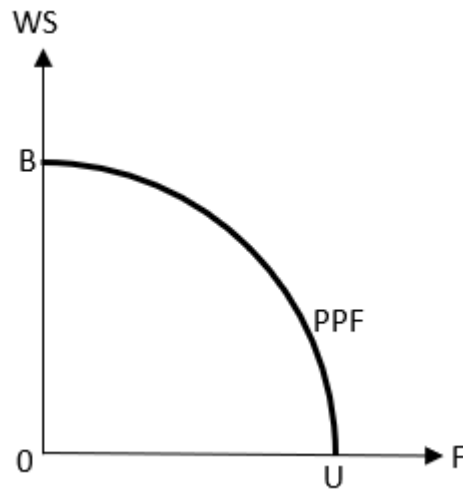
- A. True.
- B. False.

**T02. Production Possibilities Frontier (PPF)**

1. Example:

In Age of Empires II, creating many types of units requires spending certain amounts of food ( $F$ ), while constructing various buildings requires spending certain amounts of wood and/or stone ( $WS$ ). If players want to maximize unit production, then they will employ all available villagers in food production (point  $U$  on the graph in Figure 1). Conversely, if they want to maximize building production, then they will employ all available villagers in wood/stone production (point  $B$  on the graph in Figure 1). Alternatively, as is usually the case, various optimal combinations of food and wood/stone can be obtained in any time interval, efficiently using all available resources. These combinations, together with  $U$  and  $B$ , form the so-called *Production Possibilities Frontier (PPF)*. Note that to produce more food, one needs to forgo some amount of wood/stone (and vice versa). This sacrifice explains why the *PPF* is negatively sloped.

Figure 1. A Production Possibilities Frontier



2. Questions:

1. A combination outside the Production Possibilities Frontier (PPF) is

- A. Inefficient and can never be achieved.
- B. Currently unattainable and can be achieved only if the PPF shifts or rotates outward.
- C. Currently inefficient and can be achieved only if the PPF shifts or rotates outward.
- D. Efficient and currently attainable.

2. What change in the Production Possibilities Frontier (PPF) shows that an upgrade in Age of Empires II allows villagers to produce food and wood 20 percent faster?

- A. A shift to the left in the PPF.
- B. A shift to the right in the PPF.
- C. A rotation of the PPF around the maximum possible quantity of food.
- D. A rotation of the PPF around the maximum possible quantity of wood.

**T03. The Benevolent Social Planner**

1. Example:

Playing Age of Empires II, you realize that you make almost all decisions for your realm.

Moreover, you know everything about your units: their tasks, their health status, and their skills (or human capital). You also have complete control over their very existence: you can heal them, you can create additional units or, on the contrary, kill any of your units. Therefore, without ever feeling bad about it, you have become a supreme dictator. However, you want your economy and your empire to grow, so your interests are aligned with those of your realm. Your success in the game depends on the economic prosperity and the military might of your civilization. Economists have a nicer description of your authoritarian position, that of a *benevolent social planner*.

## 2. Questions:

### 1. A benevolent social planner is

- A. An authoritarian leader focused only on his and his supporters' welfare.
- B. A democratic leader focused on his and his people's welfare.
- C. An authoritarian leader focused on his and his people's welfare.
- D. A democratic leader focused only on his and his supporters' welfare.

### 2. In Age of Empires II, more successful players strengthen their economy by making decisions that are detrimental to their villagers.

- A. True.
- B. False

## T04. National Defense and the Free-Rider Problem

### 1. Example:

At any point in time, the expenditure on national defense, expressed as a percentage of the gross domestic product, varies greatly among the North Atlantic Treaty Organization (NATO) countries. The majority of members are still below the two percent minimum threshold set by the Alliance in 2006.<sup>6</sup> As a consequence, it can be argued that these members enjoy military protection without fully contributing to the Alliance, which is an example of the free-rider problem.

In Age of Empires II, you may be tempted to focus on developing your own economy and on performing many of the very expensive technological and societal upgrades, while neglecting the military units, buildings, and upgrades. If you or your allies are attacked by your enemies, then you will depend for defense on your allies who have spent a significant share of resources for this purpose. While this free-rider example mirrors the defensive purpose of NATO, it is also easy to imagine the need to participate alongside your allies in conquering other realms or recovering relics to ensure a win or avoid a defeat. Not being able to contribute significantly to the campaign while enjoying the resulting benefits qualifies you again as a free rider.

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<sup>6</sup> [Funding NATO](#), 14 April 2023.

2. Questions:

1. Which of the following describes the free rider problem?

- A. Three roommates want to buy a new table but cannot afford it. If there were a fourth roommate, they could afford it, but there is not.
- B. Three roommates can buy a new table if they share the cost equally. They value the benefit from the table less than the cost, so they do not buy it.
- C. Three roommates can buy a new table if they share the cost equally, but they cannot figure out how to divide it after they are no longer roommates. So, they do not buy it.
- D. Three roommates want to own a new table, but one of them decides not to contribute, given that the other two have already paid for it.

2. In Age of Empires II, your allies are more satisfied with you being a free rider.

- A. True
- B. False

**T05. Opportunity Costs**

1. Example:

If you want to generate more gold than what can be produced solely by mining, then you can consider, for instance, two options: create additional villagers and assign them to chop wood to be sold at the market, or create trade carts and send them to other players' markets. It is not immediately obvious which of the two involves greater sacrifices per unit of gold collected at an existing market. Usually, the former option involves spending 50 units of food for each villager, not allowing them to work on anything other than wood production (except, potentially, to first build a lumber camp which requires 100 units of wood), ensuring that enough houses are available to shelter them, possibly limiting the creation of other economic or military units (if the maximum number is reached), and reducing the availability of trees on the map. Generally, the latter option involves spending 100 units of wood and 50 of gold for each trade cart, the same constraints in terms of housing and maximum population, endangering these land trading units if they pass by enemy military forces, and possibly not being able to use them (temporarily or permanently) if the allies' markets get destroyed.

Experienced players tend to prefer the former alternative in shorter games if they need more gold (e.g., for upgrades or military units), or if they want to rebalance their economies, and they choose the latter for longer games, if they can build markets further apart (which entails greater profit), on relatively safe trade routes. This tells us that, per unit of gold, what you give up (i.e., the opportunity cost) with the former option is lower in the short or medium run, but greater in the long run than with the latter.



2. Questions:

1. It takes you half an hour to complete any math assignment and one hour to complete any economics assignment. What is the opportunity cost of you doing two math assignments?

- A. 1 economics assignment.
- B. 1/2 economics assignment.
- C. 2 economics assignments.
- D. 1 math assignment.

2. In Age of Empires II, the opportunity cost of efficiently producing stone includes

- A. 50 units of food for each stone miner created.
- B. 100 units of wood to build a mining camp.
- C. Not allowing stone miners to produce something else.
- D. All of the above.

### T06. Returns to Scale

1. Example:

What happens if the quantities of inputs used in production are doubled? Or, more generally, if we multiply all inputs by any strictly positive multiplier ( $m$ ), do we obtain an output that is  $m$  times the original value? The answer depends on whether our production function exhibits constant returns to scale or not. Age of Empires II offers examples of both.

For instance, if we assign exactly one builder to individually construct a castle, using a hammer and 650 units of stone, then multiplying all inputs by the same  $m$ , we obtain  $m$  castles after 200 play seconds, indicating constant returns to scale.

However, if we assign multiple builders to jointly construct one castle at a time, then, as can be seen in Table 2, the output will increase by a factor that is less than the input multiplier ( $m > 1$ ), indicating decreasing returns to scale. Here, the production function is assumed to take the following simplified form:  $Y = f(L, K)$ , where  $L$  (labor) is the number of builders, and  $K$  (physical capital) is the number of hammers they use. Given that each builder uses exactly one hammer, it follows that  $L = K = N$ . For example, employing four builders together (and four hammers) results in fewer than four castles in 200 play seconds, that is, fewer than 12 in 600 seconds. The output multiplier is equal to 2 at that level. To obtain 12 castles in 600 seconds, we need to have  $N = 10$ . Even in the presence of decreasing returns to scale, players may still choose to employ multiple builders as a single group, if finishing a construction faster is very important.

Table 2. Decreasing Returns to Scale

<b>N</b>	<b>Output in 600 Play Seconds</b>	<b>Output Multiplier</b>
1	3	1.00
2	4	1.33
3	5	1.67
4	6	2.00
5	7	2.33
6	8	2.67
7	9	3.00
8	10	3.33
9	11	3.67
10	12	4.00

2. Questions:

1. If all inputs go up by 8 percent and output increases by 10 percent, we have

- A. Constant returns to scale.
- B. Increasing returns to scale.
- C. Decreasing returns to scale.
- D. Estimated returns to scale.

2. In Age of Empires II, five builders, each equipped with a hammer, can construct seven castles in 10 play minutes, and 10 can construct 12 in the same amount of time. The production function then exhibits

- A. Constant returns of scale.
- B. Decreasing returns of scale.
- C. Increasing returns of scale.
- D. All of the above.

### T07. Potential Gains from Trade

1. Example:

Suppose that the players are in the Feudal Age, that they have already built markets, and that the Celts are allied with the Slavs. The Celts, compared to the Slavs, have better lumberjacks and worse farmers. The Celts can produce 32.3 units of wood per minute, but their farmers can produce only 22.9 units of food per minute. At the same time, the Slavs can produce only 28.1 units of wood per minute, but their farmers can produce 25.6 units of food per minute. Therefore, the Celts have a comparative advantage in producing wood, while the Slavs have a comparative advantage in producing food. Consequently, the two can consider specializing

in the good with a relatively lower opportunity cost and then can use diplomacy to trade the two goods. What decreases such potential gains from trade is the so-called “tribute fee” applied to each transaction, which can nonetheless be later reduced (from 30 to 20 percent using the “coinage” upgrade) or even eliminated (using “banking” in the Imperial Age).

## 2. Questions:

1. You and your friend open a bakery. You can produce 10 cookies in one hour, while your friend can only produce 9 cookies. You can produce 1 cake in one hour, while your friend needs 2 hours for one cake. You have

- A. A comparative advantage in producing cookies, but not cake.
- B. A comparative advantage in producing cake, but not cookies.
- C. A comparative advantage in producing both.
- D. A comparative advantage in producing neither.

2. Assume that in Age of Empires II, Britons are better than Franks at producing wood and stone. Britons have a lower opportunity cost of producing wood, while the Franks have a lower opportunity cost of producing stone. Based on this information

- A. Britons should specialize in producing stone, while Franks in producing wood, and then they should trade the two resources.
- B. Britons should specialize in producing wood, while Franks in producing stone, and then they should trade the two resources.
- C. Britons cannot benefit from trade with Franks, given that they are better at producing both resources.
- D. Countries cannot engage in trade if they want to develop their economies.

## **T08. Explicit versus Implicit Costs and Accounting versus Economic Profit**

### 1. Example:

In Age of Empires II, the Portuguese can build one or more of the so-called feitorias, which generate food, wood, stone, and gold automatically, that is, without assigning villagers to work there and without depleting the non-renewable resources. At the same time, each feitoria takes up 20 of the limited population.

The explicit costs to build a feitoria are modest, at 250 units of gold and 250 units of stone. At first glance, these unique buildings seem to be very profitable. However, different from accounting profit, for which only explicit costs are subtracted from total revenue, economic profit subtracts all opportunity costs, both explicit and implicit.

The opportunity cost of reducing the population by 20 with every feitoria is not the only sacrifice involved in building one. The 20 “invisible” workers need four houses, which require 100 units of wood and 100 in-game seconds to construct (with one builder). If we also consider the feitoria construction time, we add 120 seconds (no upgrades are assumed), which could be used, say, to produce food instead. So, the implicit costs include the forgone resources and

alternative production. Taking all opportunity costs into consideration, experienced players tend to avoid building feitorias on land maps rich in natural resources.

2. Questions:

1. Victoria makes \$100,000 a year as a computer programmer. She decides to resign and follow her passion for baking. She opens a bakery. In this case, the implicit costs are

- A. The costs with capital equipment such as ovens, mixers, pots, etc.
- B. The costs with ingredients such as milk, sugar, flour, etc.
- C. The \$100,000 Victoria would have earned had she kept her old job.
- D. Total revenues minus economic profit.

2. You use 100 units of food to create two miners in Age of Empires II, and you assign them to gather gold. The implicit cost is

- A. 100 units of food, while the explicit cost is the stone that they do not gather.
- B. The stone that they do not gather, while the explicit cost is 100 units of food.
- C. Economically irrelevant.
- D. Zero whenever explicit costs are positive.

### **T09. Fixed versus Variable Costs**

1. Example:

A player who has access to a small patch of forest can build a lumber camp and create several villagers to work as lumberjacks. To construct the lumber camp, there is a fixed cost of 100 units of wood (and 35 seconds of builder time), that does not vary with the quantity of output (wood here) produced. If the player wants to generate more (less) wood, then more (fewer) lumberjacks will be created, each costing 50 units of food. These are called variable costs because they vary with the quantity of output being produced.

2. Questions:

1. Fixed costs \_\_\_\_\_ as output increases, while variable costs \_\_\_\_\_ as output increases.

- A. Stay the same, always increase.
- B. Stay the same, always decrease.
- C. Always increase, stay the same.
- D. Always decrease, stay the same.

2. To produce more stone in Age of Empires II, you need to create more villagers. The

food resource that is spent to create them is an example of

- A. Feast costs.
- B. Fixed costs.
- C. Variable costs.
- D. None of the above.

### **T10. Sunk Costs**

1. Example:

At the beginning of the game, you found fruit/forage bushes and spent 100 units of wood (and builders' time) to construct a mill nearby, to increase the gathering rates by minimizing the time foragers need to spend getting to and from their drop-off points. Once the bushes are depleted, your decision about whether to use the mill to deposit food from farms, how many farms to build, and which farm upgrades to make should not be based on what you have spent on the mill: that is a sunk cost, which will remain unchanged irrespective of those future decisions.

2. Questions:

1 Which of the following *best* describes a sunk cost?

- A. A future underwater investment.
- B. A past expense that is not recoverable.
- C. An expense that can be recovered if reported by the end of the year.
- D. A cost that always needs to be considered in the decision-making process.

2. You used 150 units of wood to build a dock in Age of Empires II. As you advance to the next age, you wonder whether you should also build trade boats to make use of that dock. The wood that you spent building the dock is a sunk cost because

- A. Even the Titanic sank.
- B. Boats are prone to sinking.
- C. Your investment cannot be recovered and should not influence your future decision on building trade boats.
- D. All of the above.

### **T11. Making Decisions at the Margin**

1. Example:

When thinking about creating villagers (beyond the usual three given by default at the

start), the question is not whether to have such units or not, but rather whether to have, for instance, one additional farmer or one additional stone miner. Simplifying, at any point in time, you click the “create villager” button at the town center if you value that worker more than the 50 units of food that you spend to generate one. More precisely, you create additional villagers as long as the marginal benefit (e.g., the extra food or stone they produce) is at least as large as the marginal cost (e.g., 50 units of food and exacerbating housing/population restrictions).

## 2. Questions:

1. You are currently bingeing a new Netflix show. Around midnight, you try to decide whether you should watch one more episode or go to sleep. How do you make a rational decision?

- A. If the marginal benefit of watching an extra episode is greater than the marginal cost, then you watch it.
- B. If the marginal benefit of watching an extra episode is greater than the marginal cost, then you go to sleep.
- C. If the show is really good, the costs and benefits do not matter anymore.
- D. You ask your roommate to decide for you.

2. In Age of Empires II, deciding to create an additional lumberjack means that

- A. The average villager gathers more units of wood than gold in the same amount of time.
- B. You value the wood gathered by that lumberjack more than 50 units of food spent to create the lumberjack.
- C. Forests are not an important natural resource.
- D. You are out of good ideas.

## **T12. Humans (and Artificial Intelligence) React to Incentives**

### 1. Example:

When there are more than two players in a game and teams are not locked, it may be beneficial to use diplomacy to, at least temporarily, attract allies. What may motivate them to accept your alliance proposal are the potential gains from trade (establishing trade routes between markets), greater combined military power (which can be used to eliminate a foe), shared line of sight (“knowledge is power”), and, when dealing with artificial intelligence, it may ask you to send a tribute of resources. Refusing your alliance proposal means that their military units will be attacked automatically, whenever they are in your proximity.

Note that, while the former type of incentive acts as a reward, the latter type acts as a punishment. There can also be cases where neither of these two forms of incentives applies completely. For instance, when players buy large quantities of a resource from their markets, the price of that resource becomes greater for everyone, possibly motivating some to collect it directly, instead of buying it.

2. Questions:

1. Catherine would like to see an improvement in her son's grades. She could

- A. Reward him when he earns a good grade.
- B. Confiscate one of his favorite video games when he earns a bad grade.
- C. Both A and B could work.
- D. None of the above.

2. In Age of Empires II, gains from trade are an incentive to accept an alliance with another player.

- A. True.
- B. False.

**T13. Pure Coordination, Assurance, and the Battle of the Sexes Games**

1. Example:

Generally, success in an Age of Empires II multiplayer session is when enemies are defeated by conquest. Imagine a scenario with two teams of two, where players are not allowed to communicate with one another. You and your ally can eliminate one of the two enemies, but only if you coordinate on the same one. Consider the following three cases (see Table 3), where the two strategies for each player are to attack Enemy 1 or to attack Enemy 2, and where the first payoff number in the game matrix corresponds to the row player (You) and the second to the column player (Your Ally).

Table 3. Three Types of Coordination Games

Case 1: Pure Coordination

		Your Ally	
		Enemy 1	Enemy 2
You	Enemy 1	1, 1	0, 0
	Enemy 2	0, 0	1, 1

Case 2: Assurance (or Stag Hunt)

		Your Ally	
		Enemy 1	Enemy 2
You	Enemy 1	3, 3	0, 1
	Enemy 2	1, 0	2, 2

Case 3: Battle of the Sexes

		Your Ally	
		Enemy 1	Enemy 2
You	Enemy 1	2, 1	0, 0
	Enemy 2	0, 0	1, 2

In all three cases, neither you nor your ally has a dominant strategy.<sup>7</sup> Also, in all three cases, there are two pure-strategy Nash equilibria when the two players coordinate, given that neither would be willing to switch on their own to the other strategy. Failure to coordinate results in an unsuccessful attack and, consequently, in lower payoffs.

What differentiates the three scenarios is the preference for a particular Nash equilibrium:

- In Case 1 (a *pure coordination game*), the two players are indifferent between the two Nash equilibria, given the identical payoffs. The odds of coordination increase if there is a focal (also known as Schelling) point, such as a foe's color on the map being the same as that of a rival university.
- In Case 2 (an *assurance game*, also known as a *stag hunt game*), both prefer the equilibrium where they both attack Enemy 1. In this asymmetric coordination game, both need *assurance* that the other will choose the preferred alternative, which becomes a natural focal point. However, choosing to attack Enemy 2 helps them avoid a possible null payoff. So, due to risk aversion, the two may end up converging on the less-preferred Nash equilibrium. We see here how low risks are associated with low expected returns. Note that the greater numerical payoffs of the preferred equilibrium can be explained by various factors, such as a shared animosity towards that adversary, or a greater

<sup>7</sup> Simply put, a dominant strategy is a strategy that is uniformly better, no matter what the other player chooses.



probability of completely defeating that opponent. Also, the anti-diagonal payoffs equal to one can be explained by the utility of weakening a neighboring opponent.

- In Case 3 (a *battle of the sexes game*), each of the two players prefers to coordinate on a different equilibrium. Possible reasons may be proximity to their realm, different animosity, provocations, etc. What is important in this scenario is that the two avoid miscoordination that follows from both playing their respective *tough* (i.e., as in the preferred Nash equilibrium) or *weak* (i.e., as in the less preferred Nash equilibrium) strategies. That would result in null payoffs for both of them.

## 2. Questions:

1. In two-way traffic, driving on the same side of the road, either left or right, is an example of

- A. A chicken game.
- B. A pure coordination game.
- C. A battle of the sexes game.
- D. A prisoners' dilemma game.

2. You and your friend play Age of Empires II against two other opponents. You both derive the same level of utility from defeating any of the other two but winning requires that you coordinate your attacks. This situation describes a

- A. Pure coordination game.
- B. Assurance game.
- C. Battle of the sexes game.
- D. Asymmetric coordination game.

## T14. Signaling and Screening to Counteract Asymmetric Information

### 1. Example:

Let us assume that the best way forward in an Age of Empires II game is to quickly form an alliance with one of the other players and then attack the others. However, at least two problems may arise in such cases.

First, you (who are more informed of your military force) need to convince that player that you are indeed the best choice for an alliance, given that the overall score displayed on the screen is not a very good measure of immediate military strength.

Second, a player may not know if the other one who has proposed an alliance (the privately informed party) is trustworthy and not planning to switch the diplomatic stance to blindsides the less informed.

What could solve the first problem is sending a credible signal to the less informed party. You could, for instance, make a large group of paladins visible by placing them close to

that player's buildings. This signaling strategy is costly because, while paladins are one of the strongest and fastest types of units, they are also very expensive. It is, however, more costly for other players who are less developed to send such a signal, because the necessary upgrades and the unit costs to create paladins imply greater economic sacrifices for them.

What could solve the second problem is asking the more informed party to pay a certain tribute, as a screening device. A trustworthy ally would not oppose, given the zero-sum transaction for the alliance (ignoring tribute fees). An opponent who plans a betrayal would not want to weaken themselves, while strengthening the less informed, by providing them with additional resources.

## 2. Questions:

1. Your firm produces a very durable electric lawn mower and offers its customers a very generous warranty. This is an example of

- A. A signal.
- B. A screening device.
- C. Both A and B are correct.
- D. None of the above.

2. In Age of Empires II, asking another player to pay tribute to you is an effective screening device to determine whether they are true to their proposed alliance.

- A. True.
- B. False.

## **T15. Productivity and Economic Growth**

### 1. Example:

To defeat others, a good strategy needs to be accompanied by a powerful military force. To build the latter, your economy needs to grow fast and efficiently, with the key ingredient being high productivity. The main determinants of productivity are well-reflected in the game, as explained below. In economics textbooks, a typical production function is modeled as follows:  $Y=A \times f(L, K, H, N)$ , where  $L$ ,  $K$ ,  $H$ ,  $N$ , and  $A$  represent labor, physical capital, human capital, natural resources, and available technology, respectively. Labor is provided by villagers whose main tasks are to gather food, wood, stone, and gold, and to construct and repair civilian and military buildings. Examples of physical capital include mining camps, lumber camps, and mills. Human capital takes the form of town center or university upgrades that improve the villagers' skills, allowing them to move faster, carry more resources, or construct buildings faster. Natural resources include fruit bushes, wildlife, forests, arable land, stone and gold deposits, and so on. Every new age gives players access to new technologies. For instance, when it comes to lumber camps, innovations in the form of double-bit axes, bow saws, or two-man saws, help lumberjacks chop wood increasingly faster. Continuing with the same good, productivity improvements can also result (for any given  $L$ ) from having multiple lumber camps next to multiple forests

( $K/L \uparrow$ ), upgrading the villagers' skills ( $H/L \uparrow$ ) or increasing your access to forests ( $N/L \uparrow$ ).

2. Questions:

1. Old McDonald is trying to increase the productivity of his farm. To accomplish that, he can

- A. Buy more farming tools and equipment.
- B. Provide his workers with additional training.
- C. Learn how to better rotate his crops.
- D. All of the above.

2. In Age of Empires II, examples of physical capital and human capital are, respectively

- A. The strength of villagers and their kindness towards animals.
- B. Skills acquired by villagers through upgrades and a lumber camp.
- C. A lumber camp and skills acquired by villagers through upgrades.
- D. None of the above.

### T16. The Catch-up Effect

1. Example:

Imagine the following scenario: After a long battle against an enemy your economy is in very bad shape. Your lumber camps, mining camps, mills, and farms have been destroyed. Currently, your production of wood, stone, gold, and food is insignificant. At the same time, some other players (in a multiplayer session) have not been affected by wars and their physical capital has not suffered damage. As you start accumulating capital, say, by building camps and mills next to relevant natural resources, your productivity and production will grow significantly faster than those of the other players who already have high stocks of capital. Therefore, you can reduce the gap that separates you from them, a phenomenon that is called the *catch-up effect*.

2. Questions:

1. Which of the following is an example of the catch-up effect?

- A. A rich country has more potential for growth than a poor country.
- B. A poor country has more potential for growth than a rich country.
- C. A very poor country will stay poor forever, therefore it has no potential for growth.
- D. The cycle of poverty prevents poor countries from ever growing.

2. In Age of Empires II, the catch-up effect can be illustrated

- A. Using tomatoes, spices, and a blender.
- B. After a devastating war, a player rebuilds the destroyed structures and grows the economy faster than other players not affected by war.
- C. Moving military units to the north side of the map.
- D. Garrisoning villagers inside town centers or castles.

### **T17. Prices Rise if the Money Supply Increases Too Much**

1. Example:

Suppose you have accumulated very large quantities of gold (commodity money) from mining, relics, or trading with allies. You may decide to use some of it immediately to buy food, wood, and stone so that you can build a wonder. The construction requires a whopping 1,000 units of wood, stone, and gold. Moreover, if you want to complete it fast, you need to create many extra workers, for 50 units of food each. As you buy these resources from the market, the significant increase in demand will lead to rising prices. So, a surge in the quantity of money available in the economy, beyond the increase in total output, leads to a rise in overall demand and consequently, to an increase in prices.

2. Questions:

1. After the end of the First World War, Germany faced very high reparation payments. To meet this burden, in addition to the costs of war and payments to striking workers, the government printed increasingly more money. This led to

- A. Hyperinflation.
- B. Faster growth of the economy.
- C. More wealth for everybody.
- D. More trust in the political system.

2. In Age of Empires II, increasing the demand for resources at markets, as more gold becomes available, does *not* push prices up.

- A. True.
- B. False.

### **T18. Closed Economy**

1. Example:

While today we cannot find completely closed economies in real life, in Age of Empires II that is entirely possible. Some players may prefer to be self-sufficient and focus on ways to

increase their economies' output without trading with other players. With no exports and no imports, their net exports are equal to zero. Such players will not send trade carts/cogs to other markets/docks (by land/sea) and will not use the diplomacy menu to send/receive resources.

2. Questions:

1. In a closed economy

- A. International trade and international capital flows are encouraged.
- B. The government protects domestic businesses from international competition.
- C. There is increased vulnerability to external shocks, such as global economic crises or political instability in other countries.
- D. As domestic companies do not face competition from foreign businesses, there is more incentive for innovation and an increase in efficiency.

2. In Age of Empires II, a closed economy is one that

- A. Does not trade with other nations.
- B. Has a fortified wall built around its boundaries.
- C. Does not have access to large bodies of water.
- D. Does not contribute to attacks on other nations.

## **T19. Business Cycles**

1. Example:

In Age of Empires II, the most likely reason for downturns in economic activity, other than neglect, is being under sustained attack by opponents. To protect villagers from being easily killed, you can garrison them inside town centers, towers, or castles, thus interrupting the production of goods and increasing unemployment. If and when the danger passes, villagers are sent back to work, and, possibly, additional ones will be created to make the economy recover and grow again. Such fluctuations in economic activity are irregular in magnitude and duration, as they depend on the strategies used by all relevant players in the game (yourself, your allies, and your enemies). Given that generally you do not know in advance when you are about to be attacked, we can also add that these fluctuations are largely unpredictable. Successful players usually manage economies that oscillate around upward long-run trends, which is in line with what we notice in real life.

2. Questions:

1. During a recession, a country experiences

- A. An increase in unemployment and an outward shift in the Production Possibilities Frontier.
- B. An increase in the total output of goods and services, and an increase in unemployment.

C. An increase in unemployment and a movement to a point below the Production Possibilities Frontier.

D. A decrease in the total output of goods and services, and a decrease in unemployment.

2. In Age of Empires II, your economy grows at a predictable and constant rate.

A. True.

B. False.

## **T20. No or Low Unemployment in a Command Economy**

1. Example:

Command (or centrally-planned) economies have been characterized as having very low unemployment. Every working-age individual who can work is supposed to be a productive member of society (irrespective of the possible inefficiencies). Any player in Age of Empires II wants exactly that, to not allow villagers to stay idle for any significant amount of time. What makes it possible is the immediate transition between tasks. For example, a builder can instantly become a lumberjack once the lumber camp is built.

Frictional unemployment is largely non-existent. However, in the absence of scouts (or similar units), stone miners, for instance, may remain frictionally unemployed until they find new stone outcroppings. Note that these deposits are invisible until the map is explored.

Structural unemployment is even rarer, but we can still find examples. For instance, if the sole reason for creating monks is to convert enemy buildings (or enemy monks), then the existing ones will stay unemployed until the redemption (or atonement) upgrades are performed.

Cyclical unemployment is more likely, as it is mainly associated with wars. Garrisoning villagers inside buildings (for protection) interrupts their work. However, they may contribute to defending those buildings and that excludes them from the civilian labor force.

2. Questions:

1. Consider an economy in which a group of researchers has developed a software platform that finds the perfect job for you as soon as you enter all required personal information. The government makes its use mandatory for all people trying to find a job. This country experiences

A. Zero frictional unemployment.

B. High frictional unemployment.

C. Increased natural unemployment.

D. Zero natural unemployment.

2. In Age of Empires II, idle villagers best exemplify

- A. Well-rested and productive workers.
- B. Unemployed people.
- C. Retired people.
- D. People who are not in the labor force.

### **T21. Short-Run Tradeoff Between Inflation and Unemployment**

1. Example:

Suppose you want to build a few watch towers to defend the south-west side of your realm. For each watch tower, you need 50 units of wood and 125 units of stone. You have your builders (villagers) ready to start construction when you realize that you do not have sufficient wood/stone available. Your builders are temporarily idle, or unemployed. If you do not want to wait until enough wood/stone is produced, then, in the short run, you can buy the needed resources from the market, and reduce (or even eliminate) unemployment. However, the increase in demand will drive their prices up, causing inflation.

2. Questions:

1. An economy is experiencing high rates of inflation. As policies are enacted to reduce it

- A. Unemployment is also expected to decrease.
- B. Unemployment is expected to increase.
- C. Unemployment is not expected to change.
- D. They will be ineffective because policymakers cannot influence market prices.

2. To not allow villagers to stay unemployed for longer periods, necessary resources can be bought from markets, but that increases their prices in Age of Empires II.

- A. True.
- B. False.