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# THE COLLAPSE OF THE ÚNĚTICE CULTURE: ECONOMIC EXPLANATION BASED ON THE “DUTCH DISEASE”

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## Abstract

*Most explanations of social collapse highlight the ecological strain or the role of economic stratification but they hardly try to establish a link between the origins of prosperity and the causes of collapse. Our purpose is to establish such link, i.e. to provide an explanation of collapse based on the origin of prosperity. For cultures of the Bronze Age, the prosperity came from metalworking, i.e. initially from a mining boom and then to the subsequent activities (bronze production) it allowed. In such context, the collapse can be the result of an economic crisis known in modern economic analysis as the “Dutch Disease”, a term that broadly refers to the harmful consequences of large increases in a country’s income. Such explanation is particularly well suited to spell out the collapse of a Central European Early Bronze Age culture, the Únětice culture (2300-1600 B.C.).*

**Keywords:** Bronze Age, Dutch Disease, Central Europe, Social collapse, Únětice culture, metalworking

**JEL Classifications:** N53, Q33, O13, E30

## Introduction

The literature about the Bronze Age in Eurasia (3300-1200 B.C.) is extensive and covers a broad range of topics. Among the latter, scholars have focussed their attention on two main topics. The first one is about the socio-economic transformations that cultures and civilizations have undergone during that period. Before the Bronze Age, i.e. during the Neolithic period, the economy was mainly based on agropastoralism. Craft productions (pottery, weaving) were present but secondary. The society was quite unequal. With the introduction of metalworking (copper, then bronze and iron later) two main changes have been introduced. On the one hand, the economy which was mono-sectoral became bi-sectoral, leading to new interactions and interdependences between agriculture and the new sector, namely metallurgy. On the other hand, trade – which existed during the Neolithic and even before – became more regular, at a regional level but also on long-distance. While agriculture was possible and present everywhere in Eurasia, metalworking was dependent on the existence of metal ores. Since the latter were not ubiquitous and even rare – especially tin ores, which are necessary for bronze production – trade of raw materials became compulsory. Similarly, during the Early Bronze Age, bronze was produced in few locations and thus the diffusion of bronze products by trade also became necessary. At the social level, the extraction, production and trade of bronze goods contributed greatly to the stratification of the society between elites and commoners, leading to the so-called “complex societies”.

The second topic of interest for scholars is about the collapse of Bronze Age cultures and civilizations (Drews, 1993). Most of these collapses occurred during the Late Bronze Age and have concerned south-east Europe – the Aegean region with the Mycenaean kingdoms where widespread disasters occurred during the early 12th century B.C. In this region and after a hiatus, the Late Bronze Age was replaced by the isolated village cultures of the so-called Greek Dark Ages. Many collapses also occurred during the Late Bronze Age in the Near-East: the Hittite empire collapsed and many other large cities were destroyed, such as Ugarit (in modern Syria) around 1200 B.C., Troy (in modern northwestern Turkey) around 1250 B.C., and Meggido (in modern north-central Israel) around 1130 B.C. As stated by Drews (1993: 4), these collapses have unambiguously occurred since "Within a period of forty to fifty years at the end of the thirteenth and the beginning of the twelfth century almost every significant city in the eastern Mediterranean world was destroyed, many of them never to be occupied again". Although these collapses were numerous, there is no unique theory able to explain their origin. This is partly due to the definition used by archaeologists to define a collapse "as a break or dramatic shift in material culture, whether that refers to decoration patterns, burial rites or settlement patterns among others" (Kneisel et al., 2012: 267), i.e. collapse appears to be a lack of archaeological evidence. Thus, there are in the literature various theories put forward to explain the situation of collapse, many of them are compatible with each other (Tainter, 1988). Some of these theories are based on (external) environmental causes (climate change, drought, volcanoes - especially the Thera or Santorini eruption which occurred around 1500 B.C. and is often considered as the main cause of the Minoan collapse). Others rely on (internal) cultural factors such as migrations, wars, plagues, over-exploitation of land and other natural resources. There is also a socio-economic explanation: the growing complexity and specialization of the Late Bronze Age political, economic, and social organization is seen as a weakness that could explain such a widespread collapse that was able to render the Bronze Age civilizations incapable of recovery.

Most of the previous explanations of collapse share a common shortcoming: they do not try to establish a link between the origins of prosperity and the causes of collapse, except through the relatively vague concept of "social complexity". Our purpose is to establish such link, i.e. to provide an explanation of collapse based on the origin of prosperity. For cultures of the Bronze Age, the prosperity came from metalworking, i.e. initially from a mining boom and then to the subsequent activities (bronze production) it allowed. In such context, the collapse can be the result of an economic crisis known in modern economic analysis as the "Dutch Disease" (DD), a term that broadly refers to the harmful consequences of large increases in a country's income (Corden and Neary, 1982). Such explanation seems to us particularly well suited to explain the collapse of a central European Early Bronze Age culture (EBA), the Únětice culture (2300-1600 B.C.).

The Únětice culture, commonly known and associated with Nebra Sky Disk, is currently considered to be part of a wider pan-European cultural phenomenon, arising gradually between the third and second millennium B.C. The development of the Únětice culture was based on bronze production, the latter requiring copper and tin. While copper is widely found, the sole source of tin in central Europe is the Erzgebirge (Ore Mountains) in Bohemia, where the Únětice culture was located (at the present-day border between Germany and Czech Republic). Contrary to the southeastern Europe and Near-Eastern cultures which collapsed during the Late Bronze Age, the Únětice culture was not a palace economy (Svizzero and Tisdell, 2015), even if its society was complex. After eight centuries of prosperity, this culture disappeared around 1600 B.C., i.e. at the transition between the EBA and the Middle Bronze Age. It is thus likely that the discovery and the exploitation of tin mines by people of the Únětice culture constitutes a prehistoric case of DD.

The paper is organized as follows. The main traits of social collapse theories are presented in section 2. The Early Bronze Age economies and societies are overviewed in section 3. Section 4 is devoted to the study of the development and the subsequent collapse of the Únětice culture. In section 5 is provided the detailed analysis of the three sectors of the Úněticean economy. The link between the bronze boom and the resulting Dutch Disease is explained in section 6. Section 7 concludes.

### **Theories of Social Collapse**

Advanced civilizations are featured by a long-term trend toward greater levels of social complexity, political organization, and economic specialization, with the development of more complex and capable technologies supporting ever-growing population, all sustained by the mobilization of ever-increasing quantities of material, energy, and information. However, this long-term trend has often been severely disrupted by a precipitous collapse, often during several centuries (Tainter, 1988).

#### *Characterizing Social Collapse*

According to Butzer and Endfield (2012: 3628), societal collapse “represents transformation at a large social or spatial scale, with long-term impact on combinations of interdependent variables: (i) environmental change and resilience; (ii) demography or settlement; (iii) socioeconomic patterns; (iv) political or societal structures; and (v) ideology or cultural memory”.

The characteristics of societies after collapse may be summarized as follows. At the political level, one may expect a breakdown of authority and central control. At the economic level, central storage facilities may be abandoned, along with centralized redistribution of goods and foodstuffs, or market exchange. Both long distance and local trade may be markedly reduced, and craft specialization end or decline. Subsistence and material needs come to be met largely on the basis of local self-sufficiency. Concerning population and settlements, there is typically a marked, rapid reduction in population size and density, and many settlements are concurrently abandoned.

The analysis of historical collapses led many authors (e.g. Frank et al., 1993; Chase-Dunn and Hall, 1997) to assume that the process of rise-and-collapse was actually a recurrent cycle found throughout history. For that purpose, most of them (e.g. Kristiansen, 2014) used a World System Theory as proposed by Wallerstein (2011 [1974]), adapting this approach to pre-capitalist societies. Many historical examples of collapses exist and the decline of the Roman empire is probably the most famous. Yet, some important collapses have also occurred before the latter, e.g. the Minoan and Mycenaean Civilizations, and before that the history of Mesopotamia presents a series of rises and declines (Yoffee, 2004: chapter 6).

#### *The Major Themes in the Explanation of Collapse*

Thus social collapses are quite common in history and therefore many explanations have been proposed in the literature for each specific case of collapse. Despite their large number, it is possible to identify two separate important features which seem to appear across so many societies that have collapsed (Motesharrei et al., 2014).

The first feature is the ecological strain, i.e. the stretching of resources due to the strain placed on the ecological carrying capacity. Diamond (2005) provides an extensive analysis of putative environmental collapse in an historical perspective. He identifies a five-point framework of possible contributing factors, including environmental damage, climate change, hostile neighbors, friendly trade partners and the society's responses to its environmental

problems, which always proves significant. Thus, even if the climate change is not concerned, the damage to environment may appear as the main cause of some cases of collapse.

The second explanation of collapse, economic stratification, finds mainly (but not exclusively) its roots in Marxist analysis and has been extensively applied to various historical epochs, such as, for instance, to the transition from feudalism to capitalism (Brenner, 1976). Economic and social inequalities, and therefore the role of leaders, elites and the ideology are at the core of this second explanation of social collapse (Yoffee, 2004: chapter 6).

Of course the previous distinction between the two explanations of collapse is quite artificial. In fact, collapse is multi-causal and rarely abrupt. The Old World case studies (Butzer, 2012) – ranging from early historical times to the threshold of globalization – help to highlight the full palette of socio-ecological variables and the roles they play in the preconditioning, triggering and reconstituting processes.

### *Collapse and Social Complexity*

For Tainter (1988:4), “A society has collapsed when it displays a rapid, significant loss of an established level of sociopolitical complexity”. In other words, in order to qualify a social collapse it is first necessary that the society under study had developed toward a significant level of complexity. According to Tainter (1988: 24), “Complexity is generally understood to refer to such things as the size of a society, the number and distinctiveness of its parts, the variety of specialized social roles that it incorporates, the number of distinct social personalities present, and the variety of mechanisms for organizing these into a coherent, functioning whole. Augmenting any of these dimensions increases the complexity of a society”. As it is stated through the previous definition, the development of complexity is a continuous variable, and so is its reverse. In other words collapse is a process of decline in complexity: a society that has collapsed is suddenly smaller, less differentiated and heterogeneous, characterized by fewer specialized parts, it displays less social differentiation, and it is able to exercise less control over the behavior of its members.

### **Economies and Societies of the Early Bronze Age**

The Bronze Age is a period that spans from 3300 to 1200 B.C.. It begins in the last centuries of the fourth millennium B.C. in the Near East and the Aegean, around the middle of the third millennium B.C. in the northern Balkans and the Carpathian Basin, and around 2300 B.C. in Central Europe (Roberts et al., 2009). Worldwide, it generally followed directly the Neolithic period, but in some parts of the world, the Chalcolithic (Copper Age, or Eneolithic) served as a transition from the Neolithic to the Bronze Age. In Europe, it started with the Early Bronze Age (EBA). In the temperate Central Europe it was located from the Rhine to the Dnester and from the south border of Poland south to the northern edge of Mediterranean Europe.

### *Economic Development and Complex Societies*

For the European continent, the EBA is a period with major and widespread social and economic transformations which are an amplification of some trends that began during the earlier period. Indeed, between the Early and the Late Neolithic, major changes had occurred about the economy of subsistence as well as in the economy (in its broad sense). Concerning the economy of subsistence, this change has been introduced and labeled by Sherratt (1981) as the “Secondary Products Revolution”. Concerning the economy as a whole, during the

fourth and the third millennia, several technological and logistical systems, which had been developing for several millennia already, reached a key level of maturity leading to three major changes associated with wealth-generation Bogucki (2011). First, copper and then bronze metallurgy led to the production of durable goods which were both functional, valued, and recyclable. Second, critical transportation infrastructure (paths, trails, boats and watercrafts, wheeled vehicles and wagons), mainly associated with trade networks, have been built. Third, once animal traction for pulling wagons and ploughs came into widespread use in central Europe, then people incurred specific capital investment in uneaten oxen used for traction. Thus, by the end of the Bronze Age, prehistoric society in much of Europe was indeed different from that of the Neolithic. All these changes set the stage of the earliest “complex societies” in temperate Europe. Moreover, it is also a commonplace of prehistory that the development of the metals industry is closely linked to the growth of social complexity (Childe, 1930).

### *Bronze Metallurgy, Trade Networks and the Elites*

The overall period is characterized by the full adoption of bronze in many regions, though the place and time of the introduction and development of bronze technology was not universally synchronous. The Bronze Age was a time of extensive use of metals. Man-made tin bronze technology requires a set of production techniques. The ability to cast dozens of artifacts from a single mold makes it possible to speak of true manufacturing as opposed to the individual crafting of each piece. Such emergent specialization would have had profound significance for the agrarian economy, still largely composed of self-sufficient households.

Bronze is an alloy of copper with a small quantity of another element, most commonly tin but sometimes arsenic. Copper sources are widely distributed in the mountainous zones of Europe, and Central Europe was probably supplied from the eastern Alpine area, the Harz Mountains in central Germany, the northern Carpathians in eastern Slovakia, and the eastern Carpathians in Transylvania. Whereas copper sources are frequent, known tin sources are rare (Ottaway and Roberts, 2008). Major sources of tin in Europe are found in Cornwall (Great Britain) and around Bohemian Erzgebirge, or “Ore mountains” on the present-day border between Germany and the Czech Republic. Less significant deposits of tin are in France (Brittany, Massif Central) and northwestern Iberia (Galicia). Tin must be mined (mainly as the tin oxide ore, cassiterite) and smelted separately, then added to molten copper to make bronze alloy. Because tin was rare, it was necessary to bring it from a considerable distance to others areas, for instance into east-central Europe. Although some prestigious objects were traded on long-distance during the Mesolithic and the Neolithic periods, the long-distance trading networks have been considerably developed during the Bronze Age and were made by boats but also through wheeled vehicles. Because copper and tin are distributed unevenly, the desire for raw materials bound together European society in a metals trade; such trade was now systematic and thus it deeply contributed to integrate the continuing staple economies of Europe and beyond.

The control of copper and tin mines and the subsequent trade in these commodities led to a more powerful elite. Indeed, elites had exclusive access to high-valued goods, such as bronze weapons or ornaments. Moreover, the elites begin to position themselves on the landscape to control access to different resources, such as mines and trade roads. Consequently, the society was increasingly differentiated into elites and commoners. In other words, it is clear that social organization was becoming increasingly complex throughout Europe during the Bronze Age because copper and then bronze gave the emergent elites a useful and rare raw material whose control enabled them to consolidate their power as well as a perfect vehicle for display (Kristiansen and Earle, 2014; Earle et al., 2015).

## **Early Bronze Age in Central Europe : Rise and Collapse of the Únětice Culture**

In the Early Bronze Age there were, aside from the Aegean, three important cultural centers in Europe - southeastern Spain, Britain, and central Europe. The Early Bronze Age of central Europe can be divided up into an early phase from about 2300 to 2000 B.C. and a later phase from about 2000 to 1600 B.C. The Middle Bronze Age spanned the time between about 1600 and 1350 B.C.. The Bronze Age culture of the Danubian region is called Aunjetitz (Únětice) after an important site in Bohemia. The Únětice culture (2300-1600) is the EBA in Central Europe. It is followed by the middle Bronze Age Tumulus culture (1600-1200 B.C.) and then by the Late Bronze Age Urnfield culture (1300-700 B.C.).

### *The Development of the Únětice Culture*

The central European Únětice culture was distributed around the Erzgebirge, or “Ore mountains”, on the present-day border between Germany and the Czech Republic. The Ore Mountains is the only European region where copper and tin ores are found in the same place. The origins of this Únětice culture were multiple. The elements of which it was composed include the basic local Neolithic and Copper Age, northern influences which were mostly Corded, the Bell Beaker invasion, and metallurgy from Anatolia and the Aegean, coming directly overland. Bronze production on a significant scale first appeared in about 2300 B.C. in the Early Bronze Age central European Únětice culture, including evidence of the use of the cast-on technique. According to Kienlin (2013: 420-421), in central Europe (Únětice), the move to tin bronze was a gradual process that only came to an end well into the second millennium B.C. (around 1800/1700 B.C.). So, from 2300 to 1800/1700 B.C., it is likely that Únětice people have casted various alloys of copper with metals other than tin (arsenical copper, then fahlore copper). After 1800/1700 they produced tin bronze and then they collapsed around 1600 B.C.

The general Únětice development indicates crucial societal processes of change such as the organization of a trade system for metals, and an increase in social differentiation. From 2200 to 1800 B.C., an increase in social inequality is proven by an increase in the incorporation of surplus goods recorded in individual graves. The beginning and expansion of a new society able to produce, re-use, modify and distribute bronze on a large scale was built upon new social arrangements where inequality was institutionalized into the hierarchy of statuses. Both changes are probably linked since the control over metallurgical processes as well as on the supra-regional traffic of goods could be the causal factors for social inequality.

### *The Collapse of the Únětice Culture: Evidence and Potential Explanations*

Around 1600 B.C. occurred a decrease in settlement remains which hinted at crises with differing reaction regional patterns. In southwestern and southern Únětice settlement regions, it led to an increase of fortifications and their continuation until the Middle Bronze Age. In the northern regions of the Únětice settlement areas was recorded the discontinuation of settlement systems. In other words, it is possible from the previous observations to reach two conclusions (Müller, 2012). First, around 1600 B.C. – i.e. at the beginning of the Middle Bronze Age - the Únětice culture exhibits an interrupted course of development which can be interpreted as a case of collapse. Evidence of this collapse is confirmed by scientific data as well as by archaeological material (Kneisel, 2012). Second, since the EBA in central Europe is featured – at the sub-regional level - by qualitatively differing development dynamics –

including potentially a collapse – the latter as well as the other dynamics cannot be explained by a common tendency such as the one implied, in particular, by climate change.

Both conclusions leave open a central question: what are the causes of the economic collapse of Únětice groups? Numerous and various explanations of the collapse are theoretically possible. As for any other collapse, the study of this one has led to two main groups of explanations: ecological and socioeconomic ones.

Since metallurgy was at the center of the development of the Únětice culture, one may wonder whether changes in access to natural resources (other than metal ores) lead to the economic collapse? For instance, exhaustive use of long-cultivated fertile lands can lead to collapse. This may have occurred especially because the EBA was notably marked by extended deforestation (for agricultural purpose as well as for supporting metallurgy), the spread of pasture and arable land. Thus, after some centuries of intense cultivation and woodland clearing, the over-exploitation of natural resources may have likely contributed to the almost abrupt and general end of the Únětice culture. However, and according to Kneisel (2012: 227), it is improbable that changes in natural environment were the sole cause of the disruption in settlement.

Many economic reasons of the collapse can be considered. One possible reason for collapse could be the exhaustion of tin reserves or those which could be mined economically. However this explanation is not relevant for the tin reserves of the Ore Mountains; indeed these deposits even saw greater exploitation after the Bronze Age, e.g. when they fell under Roman control between the third century B.C. and the first century AD. Overproduction of bronze could also explain the collapse. Indeed, one of the most striking phenomena of the Bronze Age is the deposition of metalwork in hoards, including the burial of ingots and fragmented objects. For instance, after a long period of use the celestial disk from Nebra (the “Nebra sky disk”) was deposited in the earth around 1600 B.C.. One interpretation of these hoards is that they could be a withdrawal from circulation as the result of overproduction beyond the propensity of local consumption. However, the practice of hoarding intended could also be interpreted as an offering for gods, denying an explanation of the collapse based on overproduction. Metal hoards may even be interpreted as a set of objects intended for recycling which occurred, on the contrary, in case of underproduction. Jaeger and Czebreszuk (2010) provide an overview of the various interpretations of metal hoards. Changed trade routes is also a possible explanation. During the EBA (2300-1600 B.C.), the Danube became an important axis of exchange along which objects and information about new technologies were exchanged. In the Middle Bronze Age (1600-1350 B.C.) this axis of trade shifted (Szeverény, 2004: 28-29). With this shift, central Europe, and more specifically the area of the Únětice culture, has had less connections with the other European regions. It is however unclear whether this changed trade route is a cause or a consequence of the Úněticean collapse. Finally, Müller (2012) provides a socio-economic explanation of this collapse based on an interplay between central and peripheral areas.

We provide an alternative explanation of the collapse of the Únětice culture based on an economic mechanism – namely the Dutch Disease (DD). The economic analysis of DD has been first proposed by Corden and Neary (1982). This term refers to changes in the structure of production that are predicted to occur in the wake of a favorable shock, such as discovery of a large natural resource (copper and tin ores in our case). Such structural changes are expected to include, in particular, a contraction or stagnation of other tradable sectors of the economy (the agriculture in our case), and to be accompanied by an appreciation of the country’s real exchange rate (in our case it could be an appreciation of the relative price between bronze items and other valuable goods that were traded in exchange and on long-distance, e.g. salt, gold, amber, furs).



## The Úněticean Economy

If a country discovers substantial amounts of natural resources - oil, gas or other natural commodity such as copper and tin ores in our case – it is usually believed that this discovery will have positive effects. Indeed, the country will begin to export these goods, causing a substantial increase in GDP. In turn, this will improve tax revenues, improve the current account and create employment opportunities. But, often countries who discovered such natural resources have gained much less than we usually might expect. The problem occurs if the Dutch Disease (DD) happens. The DD refers to the problems associated with a rapid increase in the production of raw materials causing a decline in other sectors of the economy. The term was coined in the 1970s to describe the decline of the manufacturing sector in the Netherlands after the discovery of a large natural gas field in 1959.

After the seminal work of Corden and Neary (1982) who provided the economic analysis of this phenomenon, the DD has been applied to various historical context, some are recent, such as the 2000-2010 mining boom in Australia (Corden, 2012), the Russian oil and gas discoveries from the 2000 (Dobryanskaya & Turkisch, 2010), or the Nigerian oil economy (Otaha, 2012). Others DD cases belong to the recent past, such as the Australian gold rush of the 19<sup>th</sup> century, or to the past, such as the inflow of American treasures into the 16<sup>th</sup> century Spain (Forsyth and Nicholas, 1983).

We assume in the sequel that the Úněticean economy had three economic sectors, two are tradable sectors and one is a non-tradable sector.

### *The Non-Tradable Sector*

The non-tradable sector encompasses various economic activities, including the production of goods and services. These produced goods are non traded over long-distance for many reasons : they can be perishable (some food resources), fragile (potteries) or abundant in every region (wood and firewood) and thus their long-distance trade is non-profitable. Services are even more various. They refer to building activities related to habitat (dwellings), fortifications (ditches, walls), animal husbandry (enclosures), transport infrastructures (paths, trails), religion and expressive culture (shrines, temples, burials, tumulus or barrows). Services also refer to other activities which can be daily (cooking, providing firewood). These daily activities hugely increased once mining have started. Indeed, the specialized communities carrying out the actual mining were dependent on others for food production and for the procurement of the huge amount of wood that was needed during cracking the rocks, extraction, supporting the shafts, and smelting the ores. Services also refer to more occasional activities, such as during rituals and ceremonies (priests, dancers,...).

It is likely that most non-tradable goods and services – as previously described – were consumed by the elite. Both goods and services provided in this sector are mainly produced by use of labor. An important feature of the goods and services of the non-tradable sector is that, because they are non-traded with other regions, their prices are determined by domestic supply and demand.

### *Agriculture, the “Lagging Sector”*

The first of the two tradable sectors, called in the sequel “the non-booming” or “lagging sector”, corresponds in our case to agriculture. In the Únětice culture, agriculture was primarily based on the cultivation of cereals and pluses (Pokutta, 2014). All these agricultural products are non-perishable and thus can be stored and traded. With the spread of the cart,

oxen and horses used for traction, and boats, the technology of moving goods improved considerably in the fourth millennium and this trend continues in the EBA. Therefore, these products could be traded, at least locally, i.e. between one culture (e.g. Únětice) and other cultures located in its proximate vicinity. Indeed the bulk transport of agricultural foods on long distance was unlikely due to transport difficulties. Besides crops cultivation, the Úněticean agriculture was increasingly based on complex exploitation of domestic animals. The major domestic animals - reared for their meat as well as for their secondary products (dairy products, woolen textiles, hides) - included cattle, sheep, goat and horse. Whereas the trade of crops was difficult on long distance, transportation – transhumance - was not a problem for the long-distance trade of domestic animals. For instance Sjögren and Price (2013) have provided evidence - through isotopic analysis of animals bones remains - of domestic animals mobility over long-distance during the Neolithic in Scandinavia.

Because these agricultural products – crops and mainly domestic animals - were traded between geographically distant cultures, their prices were exogenous to the Úněticean economy, i.e. they were determined by the trade (supply and demand) occurring at the inter-economies level (or market).

### *Mining and Metallurgy, the “Booming Sector”*

The second of the two tradable sectors, called in the sequel “the booming sector”, consists of the economic activities associated with metals (copper, tin and bronze). These activities are mining, i.e. the extraction of copper and tin ores from the “Ore mountains” (Pearce, 2004). They also include metallurgy, i.e. the transformation of metal ores in bronze items which can be semi-finished products (ring ingots) or finished products (weapons, tools, ornaments, vessels). Ingots seem to be intermediate forms well suited for transport and easy to cast, serving mainly the purpose of enabling the movement of the raw material to a smith’s workshop. Both groups of these bronze products were traded locally but also on long-distance, over hundreds of kilometers. The so-called ring ingots of the EBA show a remarkable uniformity in their weight (usually 180–200 grams), which might suggest that they played the role of standard weights and units of exchange within a pre-monetary economic system.

All these bronze products were probably traded for other valuable products such as luxury goods, e.g. gold and silver, furs and textiles, ornaments (e.g. made from amber, faience, and shells of Mediterranean origins), possibly foodstuffs and surely salt. Concerning the price of bronze products, we may consider two different and chronologically subsequent situations.

At the beginning of the EBA, bronze was rare, mainly because tin was rare. It was produced in few locations across Europe. Indeed, three major metalworking provinces may be discerned in the Early Bronze Age: a Danubian group in the north Alpine area; the Únětice province in central Germany, Bohemia, Moravia, and western Poland; and a Carpathian group in Slovakia with strong ties to more southerly centers within the Carpathian Basin. Moreover, bronze was rare because the technology required to produce it was probably known by few people and kept secret. Therefore, the bronze producers of the Únětice culture were probably acting as a monopoly (an oligopoly in fact) in Central Europe, especially because the sole source of tin in Central Europe was the Erzgebirge (Ore Mountains) in Bohemia. They were thus characterized by a lack of economic competition, a lack of viable substitute goods, and the existence of a high monopoly price well above the firm’s marginal cost that leads to a high monopoly profit. These profits contributed to the stratification of the Únětice culture and the emergence of an elite associated with bronze metallurgy. The social ranking and behavioral manifestation of differences between members of EBA Úněticean communities lead to the creation of the princely graves phenomenon, richly furnished tombs,

where the hierarchical status distinctions of the deceased were paired with their envisioned affiliation to tribal elites. Two famous burial mounds are located in Saxo-Thuringia in central Germany. At Leubingen, a barrow about 35 meters in diameter and 8–9 meters high; the other famous barrow near Helmsdorf had a similar size. Furthermore, a number of different settlement types – which emerged in the later phase of the EBA - also gives evidence of an increase in social complexity. Indeed, besides hamlets and villages, a special class – the elite – was located on hill-top sites and along important trade routes, with larger settlements and impressive fortifications (Szeverény, 2004).

During the EBA and the transition to the Middle Bronze Age, the production of bronze products strongly increased in Europe. Indeed, more cooper and tin mines had been discovered and the technology of bronze production spread rapidly and widely by cultural diffusion. Indeed, exchange networks of raw materials and finished products also provided a framework for the flow of information through which important inventions, innovations and new technologies spread throughout Europe. For instance during the EBA, the Danube became an important axis of exchange – between the Near-East and Northern Europe, and throughout central Europe - along which objects and information about new technologies were exchanged. All these changes led to more competition between bronze producers belonging to different cultures. Then, at the end of the EBA, it is more likely that the price of bronze was exogenous to Úněticean producers, i.e. was determined by trade at the inter-economies level (or market). In other words, by the Bronze Age Central Europe also had become part of a much larger exchange network that is sometimes labeled a “prehistoric world-system” (Szeverény, 2004: 27-28).

### **The Úněticean Bronze Boom and the Dutch Disease**

From the beginning to the end of the EBA, the discovery of cooper and tin ores, and the production and trade of bronze products can be considered as a “Bronze boom” experienced by the Únětice economy. Such boom corresponds to a case of DD and it finally led to the collapse of the Únětice economy. In order to explain how this process occurred, we first consider both sides of the market economy.

On the supply-side, the discovery and the exploitation of metal ores means an exogenous increase in the value of the booming sector’s output which, in turn, raises the marginal product of labor in that sector and thus the real wage earned by workers of this sector. This implies a shift of labor from the two remaining sectors, the non-tradable and the lagging ones. In the latter, i.e. in the agricultural sector, a contraction of the output results from the fact that some workers were drawing away and allocates to the booming sector. There is thus a “resource movement effect” leading to a direct deindustrialization (in fact a decline of agriculture output). In the non-tradable sector, the departure of some workers leads to a lower supply of output, thus to an excess demand for non-tradables, and then to an increase in the price of the non-traded goods. Since the prices of the traded goods (from the booming sector as well as from the lagging sector) are set exogenously – as a result of trade between cultures – the rise in the prices of non-tradables is equivalent to a reduction of the purchasing power (or, equivalently, to an increase of the general price level, and if there were monies in our model, to an appreciation of the real exchange rate) for people of the Únětice culture compared to people belonging to the neighboring cultures.

On the demand-side, the boom leads to increased income at home and therefore to an increase demand for all goods, be they produced locally or imported from other cultures. This is the “spending effect”. It adds an extra demand of non-tradables goods, implies an additional increase of the prices of non-tradables and leads to another reduction of purchasing power since prices in the two traded sectors are set exogenously, so they cannot change. Moreover,

labor shifts from the lagging sector to the non-tradable sector, resulting in a contraction of the lagging sector : this is the indirect deindustrialization.

From both sides of the market, the two effects – the resource movement effect and the spending effect - have the same consequences on the agricultural sector. Labor shift away from agriculture, the agricultural output declines and therefore this sector is clearly the lagging sector. This decline was likely to be strong because both effects were probably strong during the Bronze Age. In the analysis of the DD in modern economies, the “resource movement effect” is usually considered to be negligible because the natural resources sector is capital intensive, i.e. it hires few people. Such conclusion does not hold for the Bronze Age because all sectors – including the mining one – were labor intensive; so, the resource movement effect might be strong in that period. The strength of the spending effect depends on the propensity to consume services as well as non-traded goods, but services were more important. During the Bronze Age, most services – at least the most expensive ones – were consumed by the elite, as it may be expected according to Engel’s laws. Thus the propensity to consume non-tradable products and services was high, leading to a strong spending effect. Because both effects were strong, the resulting decline of the agricultural output was likely to be severe and has triggered the collapse of the Únětice culture. In the booming sector, after its initial increase – due to the discovery of metal ores – the output continues to increase since it absorbs labor coming from the other sectors, mainly from agriculture. The change in non-tradable output is unclear, i.e. the output may increase or decrease, but this has no major impact on the existence and extent of the DD.

## Conclusions

The mining boom has had two main negative consequences on the people of the Únětice culture. First, their purchasing power has decreased. For the elite, this was not a major problem because their income had increased with the mining boom. For the other people, especially those who were working in the agriculture sector, their life became more difficult, in particular for the poorest ones. In addition, and this is the second consequence, the output of the agricultural sector has declined. Both consequences have therefore negatively affected the agricultural sector which has finally almost disappeared, triggering the collapse of the whole Únětice culture.

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