

The Decline of Sparta and a Lesson for Today

Athina Lorentziadi

Abstract— In 479 BCE, under the leadership of Sparta, the united Greek army defeated the massive invading armed force of the powerful Persian empire. Yet, in the course of two centuries, the once mighty state of Sparta experienced a dramatic downfall of its power due to a sharp population decline. By 245 BCE, full-citizens of Sparta numbered less than seven hundred. The aim of this study is to examine how the shortage of manpower could have been averted by instituting radical social changes promoting social advancement. The extent of the demographic collapse of Sparta is indirectly assessed by examining data from various historical sources about the size of the Spartan army in the course of time. Using mathematical modelling, a curve approximating the time series of the number of Spartiate soldiers is fitted. This model allows us to design a social reform program which, if implemented, would maintain the military power of Sparta. The policy suggested would initiate upward social mobility and integration, providing selectively full-citizen status with annual emancipations. The program would defuse tensions and avoid revolts at minimum opposition. Had Spartan leaders adopted the proposed reform, turning point historical events of the fourth century BCE, such as the Theban military successes, the rise of the Macedonian empire and the campaigns of Alexander the Great, may have taken a completely different course. In addition, the impact of the implementation of social mobility in Sparta on the philosophy of Plato and Aristotle and in the subsequent formation of political theory would be tremendous. Today's nations face similar challenges, suffering from severe population ageing and shrinkage of their economically active manpower. The study provides support to migration replacement policies, which could be applied to maintain competency and competitiveness of the labor force and secure social stability and economic growth in the long-run.

Keywords— Historical demography, Population ageing, Replacement migration, Ancient Greek history.

I. Introduction

The need to maintain a powerful army was of vital importance to the society of the ancient city-state of Sparta as military virtue and discipline were the most important qualities that the austere Spartan society lived by. From early childhood, every citizen known as a Spartiate received mental and physical training for a life-long military service; it “was intended to make them obey the superiors in command, endure hardships, and able to conquer in battle” (Plutarch *Lycurgus* 16). Consequently, for the Spartiates “war was just a break from the preparation for war” (Plutarch *Lycurgus* 22). The Spartan army was always prepared for battle with only two choices: win or die.

The Spartan army was always prepared for battle with only two choices: win or die. In fact, as the Greek historian Plutarch (*Moralia*, 241F.16) notes, a Spartan would return home from the battle field either holding his shield or carried dead on his shield. At the same time, the purpose of this mighty military machine was to protect the state from an internal enemy, the helots, who were slaves needed as labor for the agricultural Spartan economy.

In the period between the sixth and third century BCE, the population of Sparta experienced a sharp demographic decline. Aristotle (*Politics* 1270 A 33-34) attributed the downfall of the once mighty state to “oligantropia”, a Greek word referring to a small number of men. The socially segregated city-state was unable to sustain the eroding depopulation and shortage of manpower, ultimately leading to its collapse.

Aristotle believed that the cause for the decline in the number of citizens was the inheritance system, creating unequal distribution of the land. So as to underpin the maldistribution, he pointed out that, as a result of bequeaths and dowries, women controlled almost 40% of the country (Aristotle *Politics* 1270A 25-26). As in other societies of the classical world, population decline was probably not the result of low fertility (Caldwell 2004). In this respect, Cawkwell (1983) argued that the cause for the decline of Sparta was the inability to innovate and upgrade its military strategy and the art of war, as exhibited in the devastating battle of Leuktra against Thebes in 471 BCE. Nevertheless, the fact that in this battle Spartiates in twelve-deep rank fought against a fifty-deep Theban army, indicates that apart from military maneuvering and tactics, the shortage of manpower played a critical role in their defeat.

According to Thomas Figueira (1986), Sparta in the fifth century BCE could either expand the Spartiate class appropriately distributing landownership (*klêros*) or allow the holding of multiple property allotments. Figueira (1986) continues by noting that Spartans “seemed to have chosen the latter alternative” and “opted for a demographic policy leading to slow natural increase in Spartiate numbers rather than enacting enfranchisements to restore their strength of c. 480”. The aim of this study is to entertain the former alternative and investigate how the collapse of the ruling class could have been averted. In our analysis, the demographic decline of ancient Sparta is reconstructed by examining the decrease of the size of its army, as documented by different historical sources. On the basis of this quantitative analysis, a concrete program of social advancement and integration of individuals who belonged to lower social classes is outlined. The policy which is proposed ensures that Sparta would be able to maintain the size of its army at the high level that it enjoyed in 479 BCE, when the Spartiates leading an army of Greek city states successfully defended Greece against an invasion of the mighty Persian empire. The proposed social advancement policy would gradually implement drastic but necessary reforms, which would invigorate its citizen body. In retrospect

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and compared to other fruitless attempts for social reform which occurred during the third century BCE, the policy, which is outlined in our study, would have effectively addressed and in-time prevented the decline of Sparta.

A recent radical stream of research has challenged the traditional view of Sparta being an oppressive military society (Hodkinson 2006, Hodkinson 2015). If this controversial perspective of a non-authoritarian Spartan society is accurate, then, the social reforms of upward mobility which are proposed in this article would have been implemented far more easily and would have met considerably less resistance from the existing ruling class, compared to the realization of the same scenario under a totalitarian social landscape. For consistency, we will follow only the traditional approach about Sparta and develop the proposed social reform policy under this framework.

Many countries today are bound to face similar challenges due to their growing ageing population. To counter population ageing, migration replacement has been proposed as a demographic policy of increasing net immigration rate. The term was first introduced by a United Nations report (2001), which presented estimates about the required number of new immigrants. The projections were extraordinary high and resulted in an unsustainable population growth. For example, to maintain the work force at the level of 1995, the annual net immigrant inflow for Germany should be approximately 3.5 million, which would create a population size of 299 million by 2050. For this reason, migration replacement has raised significant criticism about its practical aspects and consequences (Coleman 2001). Targeted migration replacement, however, can provide a feasible response against population aging, which may be preferred in comparison to other types of policies aiming to increase the fertility rate (Bou-Habib 2019). Fuchs et al. (2014) examined projections for replacement migration as a means to compensate for a declining labor force in Germany.

The policy of social mobility at a planned sustainable low rate recommended for the society of ancient Sparta renders support for the potentiality of migration replacement. It would be beneficial to examine the implementation of similar policies, granting immigrants the opportunity to receive full-citizen status and allow social advancement, under a carefully planned and restrictive selection process. At the same time, the state should provide adequate support to those enfranchised to enhance their economic integration leading to stronger social stability. These initiatives ensure that the economically active labor force remains proficient and the economy is strong enough to compete in the global environment. The institution of such policies could prevent the drift to a similar demise as the demographic collapse experienced by ancient Sparta.

The paper is organized as follows. Section 2 provides a general background about the Spartan society, the sporadic and rather limited opportunities for social advancement, and the unsuccessful social reforms which were instituted in the third century BCE. Section 3 examines the causes of demographic decline experienced by ancient Sparta. Section 4 presents the available data about the size of the Spartiate army as provided by various historical sources and supported by

recent research literature. In Section 5 a quantitative approach allows the fitting of a curve which describes the Spartiate army size and its evolution in time. The quantitative analysis continues in section 6 investigating programs that would ensure the maintenance of the size of the Spartiate army at the level of 479 BCE. Section 7 explicitly presents the implementation of the proposed policy of social reform that Sparta could have instituted during the fifth century BCE to discontinue the harsh depopulation that it experienced. Section 8 discusses how the proposal made for ancient Sparta postulates a valuable lesson for today's societies within the context of replacement migration. Section 9 concludes with a summary and short discussion on the findings.

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II. Spartan Society

A. Helot population

Based on yield and consumption data, Scheidel (2003) estimated the total number of able-bodied male helots to be between 17,700 and 55,800 at the early fifth century BCE. The wide range of this estimate is due to the imprecise estimation process and the limited available data. In the battle of Plataea, every Spartan warrior was accompanied by seven helots (Herodotus 9.28.2), highlighting the large ratio of the helot population over Spartan citizens. Figueira (2003) gave an account of different estimates of this ratio by various researchers and according to these estimates helots could have been from as many as seven up to twenty-nine times the Spartan citizens, although the lower end of this range appears to be more likely (Figueira 2003).

To keep the slave population figure under control, helots were regularly persecuted and killed by young Spartiates during an event known as "Kryptiai". Moreover, the state declared a perennial war against the helots, so that their murder was not considered illegal (Plutarch *Lycurgus* 28). During the Peloponnesian war, two thousand helots, who willingly accepted the invitation to be conscripted, were massively massacred, as they were considered to be the bravest and, therefore, the most prone to revolt (Thucydides 4.80.3-4).

Until 425 BCE, although helots were present in the battle field mainly as attendants, they did not serve as heavy infantry. Their recruitment as hoplites would “undermine the Spartiate’s position as the warrior elite” (Hunt 1998). In the late fourth century BCE, helots were only occasionally included as a separate group of hoplites in the Spartan army, primarily for distant military campaigns, so that there would be fewer helots staying in Sparta (Thucydides 4.80.5). In 424 BCE, Brasidas enlisted 700 helots in the Thrace expedition and, in 413 BCE, 600 helots were sent to fight in Sicily (Thucydides 6.19.3). As a result, emancipation was exceptionally extended for those few who served in the military. Yet, the possibility of fully integrating helots into the Lakedaimonian army under a systematic scheme was never adopted. In fact, the whole slave population, especially the one of the region of Messinia, was viewed with hostility and suspicion and was treated stringently.

B. Social advancement in the Spartan Society

For a significantly long time period, social mobility in ancient Sparta was non-existent. The ruling class was the Spartiates, who were citizens with equal rights among themselves and for this reason, they were called *Homoioi*, which translates to “similar” (in status). Each Spartiate possessed an allotment of land, *klêros*, which was cultivated by helots, and provided the means to pay the obligatory mess dues for membership to the elite ruling class. It remains debatable whether land tenure was hereditary or allocated by the state, since historical sources appear to be in conflict on this matter (Hodkinson 1986).

The class of *Perioikoi* consisted of free non-citizens with a higher status than helots. Since Spartiates were not allowed to engage in economic activities, *perioikoi* were active in trade and production. Although they were separately enrolled, *perioikoi* participated in the army and fought together with the Spartiates. A comparatively small percentage of *perioikoi* had the honor to serve in the same units together with Spartan citizens (Hawkins 2011).

In the fourth century BCE, the social landscape of Sparta was characterized by dramatic changes. The ratio of enlisted *perioikoi* with respect to Spartiate hoplites increased in an effort to compensate for the shortage in manpower (Cawkwell 1983). Helots, on the other hand, were socially segregated. The class of *Neodamodeis* appeared in the late 400 BCE (Cawkwell 1983) and consisted of helots who served in the army and were freed. In spite of the fact that *neodamodeis* reflected a form of upward social mobility, the social class did not enjoy full citizen rights. The *Hypomeiones* (inferiors) was an additional new separate class which emerged in the fourth century BCE and consisted of citizens who had lost their rights because they were no longer able to sustain land and pay their mess contributions. Cowardice in battle may have been another reason for being demoted to the class of *hypomeiones*. These lower class non-citizens together with the *Nothoi*, illegitimate Spartiate children, served in the army.

In the 390’s BCE, the unsuccessful attempt of a coup by Kinadon, an educated and highly respected military officer who belonged to the class of *hypomeiones*, exhibits the explosive perils of social unrest due to lack of social advancement. It is noteworthy that when questioned about his motives Kinadon responded that he wished to be inferior to nobody in Sparta (Xenophon *Hellenica* 3.3.11). Two other failed conspiracies which occurred in 370/369 BCE (Plutarch *Agesilaos* 32.3-6) most likely involved in critical roles *hypomeiones* (Hawkins 2011).

The helots’ desire for social advancement is also evident when in 369 BCE while Sparta was at the verge of complete destruction by Thebes, over 6000 helots chose to accept the offer of Sparta to become hoplites in exchange for their freedom, rather than becoming dissidents to the approaching Theban army (Xenophon *Hellenica* 6.5.28 f). The loyalty of the helots to the Spartan system confirms that their revolts aimed at social advancement and not at a complete overthrow of the Spartan state (Cawkwell 1983). Similarly, some sporadic individual *perioikoi* became deserters, which occurred at the same period, are mainly attributed to immediate economic concerns rather than long-term disaffection to the Spartiate ruling class (Hawkins 2011).

In general, Sparta remained a particularly closed society to any exogenous population inflow, making it practically impossible to counter the shortage of manpower, without the institution of radical measures for social advancement of lower classes to the elite ruling class.

C. Social reform in Sparta during the third century BCE

The depopulation of Sparta continued into the third century BCE. At that time, King Agis IV proposed a program of redistribution of land together with cancellation of debts. In particular, the reform entailed the creation of a total of 1950 lots of land, which would be assigned to *perioikoi* and to *Mothakes*, the off-springs of Spartiate fathers and helot mothers, who had received Spartan education, enjoyed good health and were not aged (Plutarch *Agis* 9). This policy met great opposition and although debts were cancelled, land division was never materialized. Four years later, after a brief mockery trial, King Agis IV was executed.

Eventually, the division of land was implemented by Cleomenes III in 227 BCE (Plutarch *Cleomenes* 11). As a result, helots became full Spartan citizens, instigating the development of an army of 4000 hoplites. Unfortunately, the reform policy was instituted too late to be effective. Five years later, Sparta was completely defeated by its enemies, Macedonia and the Achaean League, and Cleomenes III fled to Egypt, where he committed suicide in 219 BCE.

III. Causes of demographic decline

The causes of demographic decline are not easily traced. It is possible that the destructive earthquake of 464 BCE

triggered a harsh depopulation (Figueira 1986). With an estimated 7.2 surface wave magnitude (Armijo 1999), the earthquake may have caused as many as 20,000 Lakedaimonians to perish because of the collapse of buildings, according to Diodorus Siculus (7 XI 63). The immediate consequence was a revolt of the helots, which escalated to the Third Messenian War and ended up with the defeat of the helots. The long term impact was that many allotments of land, *klêroi*, remained vacant, which may have ultimately led to multiple holdings of *klêroi* by a few (Aristotle *Politics* 1370a).

The actual significance of the earthquake of 464 BCE to Spartan depopulation is debatable (Valzania 1996). Apparently, the original size of 9,000 *klêroi* assigned to Spartan citizens at the foundation of the city by Lycurgus (Plutarch *Lycurgus* 8) had been reduced to 8,000 Spartiates in the fifth century BCE (Herodotus 7.234.2). The population decline was probably present well before the fifth century but due to its exponential effect, it may have been unnoticed at its initial stage. The earthquake casualties accelerated the population downfall trend which had already started in the archaic period.

In the fourth century BCE, Sparta entered into a spiral in which a large number of full right citizens were unable to pay their compulsory mess dues and, as a result, they were socially down-graded to the class of *hypomiones*. The reason may have been natural disasters causing bad harvest or some other misfortune, but in most cases they can be traced in shortage of helot labor due to flight or revolt (Figueira 1984). To cover the soldier needs for military campaign, helots were conscripted and in exchange became *neodamodeis*, thus creating a shortage of labor, which further undermined the capacity of Spartiates to pay their contributions.

Hodkinson (2009) argued that Spartiates chose to limit the number of legitimate children in order to avoid division of their land inheritance, which could lead to their children losing the citizen status. Plutarch (*Agis* 5.2-5.4) claims that the law instituted by Epitadeus, which allowed abandoning of inheritance and donations caused the concentration of land allotments to only a few. As a result, mal-distribution of land was exacerbated and resulted in further shrinkage of the Spartiate population. It is noteworthy, however, that the historical existence of the Epitadeus law, which strangely enough is not mentioned by Aristotle or Xenophon, remains questionable (Schütrumpf 1987, Hodkinson 1986). Moreover, Plutarch (*Agis* 5.1) refers to money inflow after the Peloponnesian War as a factor, which accelerated inequality. The effect of the accumulation of wealth and the exposure to overseas military activity in the crisis of Sparta is explored by Hodkinson (1993).

iv. Size of the Spartan Army: a historical account

The size of the army followed the demographic decline of the general population of Sparta. The available data can be traced in the following historical sources:

- I. According to Plutarch, Lycurgus, the legendary founder of the institutions of the Spartan state divided the land of Sparta in 9000 equal shares “to as many genuine Spartiates” (Plutarch *Lycurgus* 8). Although the dating of the life of Lycurgus remains controversial (Encyclopaedia Britannica 1911), it appears that he most likely lived within the ninth century BCE. Therefore, in the year **850 BCE**, the number of Spartiates, who could serve in the army, is estimated to be c. **9000**. This appears to be consistent with Aristotle’s statement that initially at the time of the reign of kings, Spartans numbered 10,000 (Aristotle *Politics* 1270A), although this figure appears to be most likely rounded and inexact (Scheidel 2003, Figueira 2003).
- II. In the early sixth century, Spartiates engaged in territorial expansion through war with considerable casualties (Herodotus 1.82.3-7, 3.54.1-56.1) and through emigration for the development of colonies (Herodotus 5.42.2). In particular, Figueira (1983) conjectured that possibly as many as 1,000 Spartiates followed Dorieus in the expedition to the west. Mainly due to this evidence, Figueira (1983) argued convincingly that Sparta initially exhibited a population growth, similar to the development pattern of other city-states during the archaic period. Along this line, for c. **650 BCE**, we set an upper bound for the manpower of not more than **11,000** Spartiates.
- III. In the text of the ancient historian Herodotus, in **479 BCE** the exiled king of Sparta Demaratus estimated the total number of Spartan hoplites to be approximately **8,000** (Herodotus *Histories* 7.234). This is consistent with the number of 5000 Spartiates, who in 479 BCE took part in the battle of Plataea, along with 5000 Perioikoi and accompanied by 35,000 helots (Herodotus 9.28.2). Moreover, in 490 BCE, just after the battle of Marathon, Sparta sent a force of 2000 hoplites to aid the Athenians against a Persian invasion (Herodotus *Histories* 6.120). Based on the speed of their deployment and in view of similar expeditions which required endurance (Xenophon *Hellenica* 4.5.14), it may be assumed that this group consisted of the younger (first ten-year classes) hoplites (Figueira 1986). If this assumption is accurate, the number of soldiers of this military force appears to be in line with the above total size of army of 480 BCE.
- IV. For the battle of Mantinea in **418 BCE**, Thucydides provided a detailed calculation of the Spartan army (Thucydides 5.68.3). The number of military units were: 7 (*lokhoi*) x 4 (*pentekostiai* per *lokhos*) x 4 (*enomotiai* per *pentekostia*) = 112 units. Each unit was on the average 8 men deep and each line had 4 soldiers. It follows that the total comes to 3,584 hoplites. Thucydides confirms this derivation by stating that the total front of the army was 448 soldiers with a depth of 8 men, producing again 3,584 hoplites for the total size of the Spartan army. Figueira (1983) argued that one of the seven *lokhoi*

consisted of the freed helots who followed Brasidas in the Thrace expedition, known as Brasidian soldiers. Thucydides, however, clearly distinguishes the Spartan army (*Lakedaimonioi*) from the Brasidian soldiers (5.67.1), and his listing specifically refers only to *Lakedaimonioi*. It should be noted that the Spartan army in the battle field marched in minus one sixth of the elder and youngest who were sent back to Sparta (Thucydides 5.64.2 and 5.64.3). Assuming roughly half of the army were Perioikoi, similarly to the battle of Plataea, it may be concluded that the number of Spartiates who fought was roughly 1792 hoplites. Therefore, together with the force sent to Sparta, the complete army should have been almost c. **2150** hoplites.

- V. At the battle of Leuktra in **371 BCE**, the number of Spartiates according to Xenophon (*Hellenica* 6.4.15) was 700. The remaining 2 regiments (*morai*) were stationed at Sparta (Xenophon *Hellenica* 6.4.17). Given that the total number of *morai* was six, this implies that the total number of Spartiate hoplites were **1050**.
- VI. In **245 BCE**, there were not more than **700** Spartiates, as stated by Plutarh (Agis 5).

Ancient historical sources provide some additional data points, which could serve as upper bounds for the total number of available hoplites:

- i. The Spartan force captured by the Athenians on the island Sphacteria in 425 BCE were 292 men out of which 120 were Spartiates (Thucydides 4.38.5). As a result, the ratio of Spartiates with respect to the total number of hoplites, which included the Perioikoi, was 41%. Considering that the group of soldiers in Sphacteria was randomly chosen, this percentage has been used as an estimate of the participation of Spartiates in the total Spartan army (Figueira 1983). However, this calculation is problematic since the number of hoplites initially landed and trapped on the island was 420 (Thucydides 4.10.5). Consequently, those captured did not include the casualties of 128 men, and there is no knowledge about the number of Spartiates killed during the siege. As a result, it is not possible to estimate the percentage of Spartiates at the initial force, without knowing how many of the casualties were Spartiates. Figueira (1983) assumed that Spartiate casualties were proportionately the same as those captured so that Spartiates represented almost 2,755 hoplites. In fact, this figure is double the size of the army as mentioned by Thucydides, which has been considered a flaw in the reliability of the text (Toynbee 1969, Figueira 1983). This approach has raised considerable controversy (Cawkwell 1983). In any case, the exact size of the Spartan army in the military engagement at Pylos and its structure, given the emergency situation under which it operated, can only be conjectured and does not allow us to draw safe conclusions about the precise number of Spartiate hoplites.

- ii. In **394 BCE**, at the battle of Nemea the Spartan army consisted of 6,000 hoplites along with 600 horsemen (Xenophon *Hellenica* 4.2.16). The exact number of Spartiates who were present in this battle is debatable. Lazenby (2012) suggests an approximate size of 4,800 citizen hoplites. A more reasonable estimate may be 2,300 Spartans (Sapin 2007). Figueira (1986) argued that the Spartan army involved 2 *morai* (regiments) of Spartiates and, in the early fourth century BCE, each *mora* had roughly 900 soldiers. Therefore, following Figueira (1986), the total number of Spartiate hoplites (including their officers) would be **not more than 1,833** hoplites while the rest were mainly Perioikoi.
- iii. Aristotle states that the number of Spartiates had decreased to less than 1,000 (Aristotle *Politics* 1270a 37-39). Most likely *Politics* was written at the time that Aristotle was teaching at the Lycaeam at Athens, between 335 and 323 BCE. Thus, an army size of **not more than 1,000** Spartiate hoplites corresponding to c. **329 BCE** is considered.

Although there are no precise demographic data, Hansen (2011) supported that the population of an ancient Greek city-state can be reasonably assumed to be around twelve times the number of its hoplites. Given the singularity of the Spartan state in terms of its social and military organization, the validity of this estimate of the size of the Spartate population is doubtful.

v. Reconstruction of the Spartiate army size

Our analysis makes use of the data set of Section 4, which should always be considered with caution regarding its reliability, as in many cases, the data points represent rough estimates, sometimes cited by non-contemporary ancient historians on the basis of pre-existing and unverified information. Political motivation may have also played some role and increased the biasedness of the reported data (Hodkinson 1986). In order to reconstruct the size of the Spartiate army, a quantitative model will be formulated. The size of the army of Spartiates is denoted by $P(t)$, where t is a time variable starting from the year 850 BCE. The available data of Section 4 is summarized in Table I.

TABLE I.

<i>Size of the Spartiate army by historical sources</i>				
<i>Observation</i>	<i>Year (BCE)</i>	<i>Time in years</i>	<i>t</i>	<i>Number of hoplites</i>
1	850	0	0	9000
2	650	100	0.2479	≤ 11000
3	479	369	0.6132	8000
4	418	432	0.7140	2150
5	394	456	0.7537	≤ 1833
6	371	479	0.7917	1050
7	329	521	0.8612	≤ 1000
8	245	605	1	700

For the time period of 605 years (between 850 BCE and 245 BCE) that we consider, the time variable t is measured as $t = (850 - \text{year})/605$. Therefore, t takes values from 0 to 1.

We fitted a logistic regression curve:

$$\Pi(t) = 2P(0)/[1 + \exp(at + bt^2 + ct^3)]$$

where a , b and c are constants. This functional form was selected due to the reverse S-curve pattern exhibited by the data. At time $t=0$, it is clear that $\Pi(0) = P(0)$. Moreover, the rate of change for the function $\Pi(t)$ is

$$d\Pi(t)/dt = -\Pi(t)(2P(0) - \Pi(t))(a + 2bt + 3ct^2)/2P(0)$$

Intuitively, according to this model, the population size drops proportionately both to the size of the population and to the population decline already suffered. Moreover, the quadratic factor $a + 2bt + 3ct^2$ magnifies further the rate of change as t increases. The parameter a expresses the fixed drop in time, which is linearly decreased by the parameter $2b$. Finally, the parameter $3c$ provides diminishing returns introducing a quadratic term in the time dependence of the rate of change of $\Pi(t)$.

We have numerically fitted the above model by minimizing the sum of square differences of $P(t)$ from $\Pi(t)$, for the five data points where exact numbers of $P(t)$ are provided: $S = (P(t_1) - \Pi(t_1))^2 + (P(t_3) - \Pi(t_3))^2 + (P(t_4) - \Pi(t_4))^2 + (P(t_6) - \Pi(t_6))^2 + (P(t_8) - \Pi(t_8))^2 = (9000 - \Pi(0))^2 + (8000 - \Pi(0.6132))^2 + (2150 - \Pi(0.714))^2 + (1050 - \Pi(0.7917))^2 + (700 - \Pi(1))^2$.

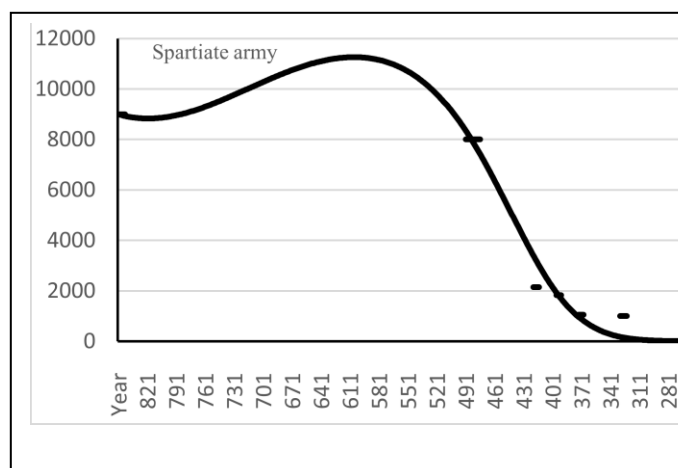
Further, we imposed the non-linear constraints:

$$\Pi(t_2) = \Pi(0.2479) \leq 11000$$

$$\Pi(t_5) = \Pi(0.7537) \leq 1833$$

$$\Pi(t_7) = \Pi(0.8612) \leq 1000$$

To determine the parameters a , b and c , the numerical calculations were carried out by Solver of Microsoft Excel. The values found by implementing this quadratic programming method were $a = 1.54$, $b = -17.07$ and $c = 25.02$. The fitted curve of $\Pi(t)$ and the available data points (which are magnified to represent small horizontal lines) are



depicted in Figure 1.

Figure 1. Spartiate army as fitted by $\Pi(t)$ from 850 BCE to 245 BCE.

We observe that the fitted curve $\Pi(t)$ exhibits an initial upward movement, which is consistent with the population growth experienced by Sparta during the archaic period of the seventh and early sixth century BCE. Starting from the middle of the sixth century BCE, Spartiate army exhibited a gradual decline, which became accelerated during the fifth century BCE. As discussed before, the sharp demographic decline may be related to the heavy casualties of the earthquake of 461 BCE. The decay continued into the first quarter of the fourth century BCE. These trends appear to be adequately captured by the fitted curve $\Pi(t)$.

After the battle of Leuktra in 371 BCE, the Spartiate army exhibited remarkable resilience. Figuera (1983) claimed that the military activity of Sparta after 371 BCE indicates a capacity of the army comparable to the one before the battle of Leuktra. The cause is presumed to be the addition of many soldiers from the class of *hypomeiones* together with mercenaries (Figueira 1983). Our fitted curve $\Pi(t)$ does not reflect these exogenous contributions to the army size, as it mainly reflects the trend which characterized the Spartan army in the pre-Leuktra period. The struggle to deal with low manpower, led Sparta, in the third century BCE, to unsuccessfully attempt to increase the ranks of its army by expanding its citizen base. Without these measures, the army size would have dropped dramatically reaching extremely low levels, as projected by our curve.

VI. Programs to maintain military power

The decline of the size of the Spartiate army did not receive proper attention by the Spartan political leadership during the fifth century BCE. In the late fifth and early fourth century BCE the inflow of soldiers belonging to lower classes into the Spartan army (including some helots) was extremely limited, unsystematic and infrequent. Finally, the late fourth and especially the third century, radical social reforms were established too late to be effective. It is our belief that a system of social mobility, which would encourage enrollment to the Spartiate army of a considerable number of soldiers from the class of *perioikoi* and from the large pool of helots, would enable Sparta to survive and retain its military power, if it had been initiated early enough.

The number of new soldiers, who should be enlisted in the Spartiate army at year T , which is denoted by $N(T)$ is considered. At the victorious battle of Plataea, in 479 BCE, Sparta projected exceptional military leadership and power completely overwhelming the massive invading Persian army. The purpose of the proposed program would be to maintain the existing military power at the time of the battle of Plataea, which was 8,000 hoplites, as discussed in Section 4. Given the resistance in the implementation of such a radical policy of upward social movement, the level of military might of 479 BCE appears to strike a balance between the need to preserve a strong army and the political feasibility of this reform.

For the period, from 479 BCE to 431 BCE, which corresponds to the beginning of the Peloponnesian war, we aim to estimate the additional hoplites needed every year so that the total army size would remain at the level of 8,000 men. On the basis of the analysis of Section 5, the function $\Pi(t)$ can serve as a proxy for the actual size of the Spartiate army at time t , as it historically evolved. Therefore, the annual rate of decline of $\Pi(t)$ provides an estimate of the percentage decline which historically occurred in the military might of Sparta. In particular, for year T the annual percentage decline in the army size from the previous year $T+1$ is estimated to be

$$d(T) = 1 - \Pi[(850 - T)/605]/\Pi[(850 - T - 1)/605]$$

We assume that with the additional inflow of hoplites, the Spartiate army would exhibit a percentage rate of decline $d(T)$, which is consistent to its estimated historical decline. Therefore, the requirement for additional hoplites at year T would be precisely $N(T) = 8000 d(T)$. On this basis, the estimate of additional hoplites $N(T)$ needed every year from 479 BCE to 431 BCE have been derived.

VII. Formulation of a policy of social reform in Sparta

The specific program which was derived in Section 6, can be formulated as a social reform policy and be implemented as follows. Immediately after the battle of Plataea in 479 BCE, 45 *perioikoi* would be granted full-citizenship rights and status. Given that the total number of Spartan casualties were 90 (Herodotus *Histories* 9.70.5) and half of the army comprised of Spartiates, it may be deduced that the enfranchised *perioikoi* would roughly be as many as the number of Spartiates who fell in the battle field. The loss of the 300 men, who vanished in the battle of Thermopylae a year earlier, in 480 BCE, would provide additional support to the initiation of this emancipation program. The individuals chosen would be precisely those that fought bravely in the battle of Plataea and, therefore, deserved to receive this exceptional honor.

Subsequently, every year until 431 BCE, a small group of *perioikoi* of size ranging from 67 to 139 would be selected to become Spartiate citizens. In the same year, an equal number of helots would be upgraded to the status of *perioikoi*, allowing upward mobility to those regarded as exceptionally productive and useful to the state. As a result, in a period of 48 years a total of 4849 *perioikoi* would become Spartiate citizens. Under this program, at the beginning of the Peloponnesian War against Athens in the year 431 BCE, the Spartiate army would still number 8000 hoplites, maintaining the same size as almost half a century before. On the contrary, without the implementation of the proposed policy, it is estimated according to our model that the military strength of Sparta in 431 BCE would be reduced to approximately 4196 warriors.

Membership to the elite ruling class of Sparta required the possession of land property and enough helots as labor to enable the payment of mess contributions. For this reason, the Spartan state should provide to each newly enfranchised

citizen the means to maintain the Spartiate status. Aristotle (*Politics* 1270a 29-30) specifically mentions that the area of Lakonia could support up to 1500 cavalry and 30,000 hoplites. Therefore, it appears to be feasible that the state could allocate and endow sufficient land ownership to the new Spartiate citizens, thus introducing new *klêroi*. A scheme of redistribution of properties or granting of existing state owned *kleroi* would be implemented. In particular, additional estates could be created by a more efficient distribution of existing *klêroi*, ensuring that Spartiates with multiply property allotments would contribute part of their land. Moreover, land owned by women would be more heavily levied to compensate for the elevated percentage of properties possessed by the female population. This measure would alleviate the apparent contradiction between a shrinking male citizen body, caused by insufficient land ownership, and the exceptionally high percentage of land tenancy by women, as reported by Aristotle (*Politics* 1270A 25-26). Alternatively, the required land for the new *klêroi* could come from territorial expansion by conquest, similarly to the creation of new *klêroi* at Thyreatis during the sixth century BCE (Herodotus 1.82.2). It should be stressed that the added land lots did not have to be equal to the existing *kleroi*, as marked differences in wealth may have already been present in Sparta (Hodkinson 1986).

To provide the required labor for agricultural use of the new *klêroi*, helots would be provided by the state. Under the scenario of the institution of the reforms previously outlined, there would be no need to enlist helots in the army in exchange of enfranchisement, and, therefore, the class of *neodamodeis* would not have emerged in the late fifth century BCE. Helot population, without the outflow of the *neodamodeis*, would adequately provide labor in the cultivation of the new *kleroi*. On the other hand, in case of labor shortage, it would be relatively easy, as in other Greek states, to acquire new slaves by war or trade, given the economic growth and accumulation of wealth, which followed the Persian wars.

Enfranchised individuals should adhere to the laws of Sparta and would have to undergo through a short but accelerated formal program, which would resemble *paideia* as received by each Spartiate. Later on in the history of Sparta, similar financial support was provided to the *mothakes*, who were considered foster-brothers to Spartiates, allowing them to participate to the formal education system, known as *paideia* (Hawkins 2011).

The policy which was outlined is consistent to the solution to the population decline of Sparta implied by Aristotle: "There is a tradition that, in the days of their ancient kings, they were in the habit of giving the rights of citizenship to strangers, and therefore, in spite of their long wars, no lack of population was experienced by them" (*Politics* 1270a35).

Lazenby (2012) argued that incorporating *perioikoi* into the Spartiate army would weaken its fighting capacity due to lack of training. In our proposed program, however, the few selected skillful *perioikoi* would have most likely demonstrated superior performance in the battle field. Moreover, they would certainly be expected to fully

participate in the formal drills along with Spartiate hoplites. Therefore, it would be reasonable to assume that the capacity of the army would not suffer significantly by those enlisted, while it may have even been enhanced.

Demoted Spartiates, who were unable to pay their mess contribution, who would appear later on during the fourth century BCE as the class of *hypomeiones*, would be ideal candidates for upward mobility, as they had usually gone through the formal Spartiate education (Hawkins 2011), and, therefore, their integration would be relatively easy. On the other hand, consistent with the Spartan laws, cowardice in the battle field would continue to be prohibitive in re-installing the status of a full right citizen.

The policy of upward mobility in a selective program of emancipations would not compromise the dogma of superiority in military skill on which the ruling class claimed its superior status (Lazenby 2012, Hawkins 2011). The inclusion of the most able *perioikoi* fighters in the full citizen class would be seen as an act of affirming that Spartiates are indisputably the best warriors. Historically, Sparta chose to strictly prohibit upward mobility to the full right citizen class of Spartiates and resorted to an increasing reliance to its lower class population and mercenaries to maintain its military might. Progressively, freed helots, *perioikoi* and *hypomeiones* were asked to fight closer to the front ranks of the army, undertaking an increasingly higher risk in the battle field. Without the possibility of elevation to the ruling class, however, there was limited motivation to assume this additional risk. On the contrary, the proposed reforms would motivate enfranchised soldiers to excel in the battle field so as to reciprocate for the emancipation which was graciously granted to them by the Spartan state.

The proposed policy would have two important beneficial effects. First, as intended, it would maintain the military power of Sparta at the level of 479 BCE, when it accomplished its greatest military victory. On a second level, it would allow social advancement, encouraging both *perioikoi* and helots to demonstrate exceptional performance and excellence in order to be among those selected. Another benefit of the social reform would be to defuse tensions and avoid revolts especially by helots or *hypomeiones*. Indeed, mutinies, such as the conspiracy of Kinadon, would certainly be averted.

At the initial state of implementation, some resistance to the newly instituted policy should be expected from owners of large properties, who would be more drastically affected by the foreseen re-allocation of land. It should be stressed that the proposed social mobility policy would be extended within a long period of time with gradual and restricted in number annual emancipations. In this way, the economic impact would be evenly distributed in time. Moreover, social integration would be relatively smooth and traditional values of the Spartan society would not be drastically altered. As a result, it is expected that the implementation of the social upgrading policy would meet in the long run relatively small opposition, which is in vast contrast with the violent reaction to the unsuccessful social reforms of the third century BCE.

VIII. A lesson for today

In almost every country in the world the population is ageing, producing a shrinking active labor force (UN World Population Ageing Report 2015). For instance, according to data from the World Bank (World Bank Group nd a), in 2017, the group of people over 65 in the U.S. represented 15% of the population while in 1960 its percentage was 9%. At the same time, population growth is declining world-wide; many European countries, such as Italy, Greece and Hungary, as well as Japan, exhibit negative growth rates (World Bank Group nd b). By the end of the twenty-first century, the declining economically active population in many countries will resemble the Aristotelian "*oliganthropia*", which led to the collapse of the once mighty Sparta.

The integration of an upward social mobility program as a method to reverse Sparta's course to demise, can potentially apply to many countries with a growing ageing population.

Replacement migration programs extend to immigrants the opportunity to become full citizens. Our analysis showed that such a policy under a carefully planned and restrictive selection scheme, could potentially serve as a means to maintain a competent labor force. This points-based immigration system

Indeed, the route of history may well have been quite different if the Spartan leaders had decided to act early

would be based on distinct skills and competencies needed by the respective economy.

The replacement migration program needs to be implemented at an inflow rate, which yields a sustainable population growth. Our analysis for the case of ancient Sparta provides support that a reasonable migrant stream for ageing adjustment may be possible. Moreover, similarly to the proposed policy for Sparta, governments should provide adequate support to new citizens to ensure that they will be properly integrated into the society in economically viable terms. State funding could be in the form of tax breaks, scholarships for education, grants for personal growth or subsidy provisions, and it should be extended for a specific time period. Funds for this venture would be appropriated either by a slight increase in taxation which would be eventually compensated by the growth of the economy due to a stronger labor market.

Under points-based replacement migration, a refreshing new dynamic group would be properly integrated into the ageing population, rejuvenating the existing social and economic environment. Moreover, social stability and economic growth would be substantially strengthened. The benefits of the countries which will implement such policies will be to maintain and enhance their competitiveness within the global economy. The trend, challenges and benefits of such replacement programs to compensate for a declining labor force are discussed by van Nimwegen and van der Erf (2010).

IX. Conclusions

The paper has examined the decline of the size of the Spartiate army which ultimately led to the collapse of Sparta. Based on historical evidence, the number of hoplites in different events corresponding to different eras were recorded. In this way, a proxy of the evolution of the Spartiate army through time was constructed. A sustainable program of social mobility, which would allow new enlistments and ensure that the mighty Spartan army would maintain its military efficiency, was proposed. The implementation of this program would bring additional benefits to the Spartan society enhancing stability and encouraging excellence. Had the proposed policy been instituted during the fifth century BCE, Sparta would have maintained its status as the most powerful state in Greece. Indeed, the route of history may well have been quite different if the Spartan leaders had decided to act early along the lines recommended in this paper. Historical events which occurred in the fourth century BCE, such as the Theban military successes and the rise of the Macedonian state, may have taken a completely different course. Moreover, the implementation of social mobility would have a profound effect on the philosophy of Plato and Aristotle and would greatly influence the subsequent formation of the theory of politics.

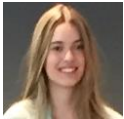
Many nations of the twenty-first century face challenges similar to the ones Sparta dealt with almost 2,500 years ago. The increasing ageing population and the low, or even negative, population growth rates have resulted in a decline in the economic active labor force capable of altering the world dominance. Upward social mobility and integration at a sustainable rate as the one proposed for the ancient state of Sparta can serve as an effective policy for states to ensure that increasing population ageing will not lead to decay and eventual collapse.

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