Athens vs Sparta
ethical choices for sustainability

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Abstract

Critical decisions need to be made to face global crises. Modeling and simulation can help to make these decisions effective and shared. Ethical issues are involved in this process and should be included for better quality decisions. Looking at the past could help us to cast light on how ethical choices can be important in resolving critical situations. For this purpose, we have chosen the metaphor of the evolutions of Athens and Sparta: These ancient Greek city-states show opposed paradigms in policies and life-style, but only one proves itself stable and lasting. Surprisingly, it's not the city-state we all would had lived in. Human activities in both city-states caused, in time, internal instabilities. Crises that will be solved through expansionist policies, migrations and colonies settlement. Athens faced seven migrations in less than five centuries. Instead, Sparta, after its first (and only) migration event, introduced corrective actions to contrast instabilities. The change is ascribed to the "mythical" lawgiver Lycurgus, but it could likely be the consequence of a shared vision. A simulation model fitting the two city-states behavior has been developed, and its structure comprises seven interconnected sectors. The paper includes model description and its interpretation, a brief overview on ethics in modeling, and a note on our project "ethics in the evolution of societies".

Keywords: Athens and Sparta, Lycurgus' laws, ethics in modeling, critical decisions, sustainability, system dynamics, discourse ethics.

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Introduction

Sustainability problems afflict present-days societies. These problems force to a change in our life-style and solutions have been proposed in order to make this change acceptable and shared.

To this end, new models of production and consumption[1] have been tested, but their outcome is still not in line with expectations, particularly since global reality is complex and cannot be limited within the boundary of the productive sector.

Operations Research (OR hereafter) presents tools to analyze these problems, as well as to verify efficiency and consequences of policies, particularly allowing inclusion within the process not only of politicians and decision-makers, but also of citizens for their approval. Citizens which, meanwhile, become source of knowledge and information, providing in these sessions essential data to make more clear the big picture.[2]

The System Dynamics (SD) methodology starting with *Urban Dynamics* (Forrester, 1969) and *The Limits to Growth* (Meadows *et al.*, 1972) has always been in the first line of this front.[3]

As can be seen in the next session, crises that are crossing our societies have a non-negligible ethical connotation, as well as serious ethical implications inhere in the feasible solutions. So, tools for studying and solving global crises should take in account these issues.

This call to ethics in order to solve or at least mitigate the mentioned problems has been accepted, and nowadays Business Ethics (BE) and Corporate Social Responsibility (CSR) are flourishing disciplines.[4]

Authors' proposal intends to show how an ethical choice is necessary for paradgmatic shift towards sustainability and that such a choice is conceptually "simple" as well as its implementation into the logic of the evaluation/validation tools. An "ethical choice" must be intended as a set of decisions aimed to pursue and attain the good or, better still, the good of everyone.

In order to make such a proposal effective, it has been choosen a provocative exemplification inherent to a well-known past:[5] A model of the ancient Greek city-states of Sparta and Athens has been developed and the compared resulting paths show how social instabilities in Sparta are solved through an ethical choice (the so-called Lycurgus' laws), whereas Athens' unsustainabilities lead to expansionist policies and to frequent population emigrations.[6]

The paper describes the city-states SD model and discusses the interpretation of the above mentioned ethical choice from the point of view both of the sustainable development and of its implementation within the logic of the model.

Ethics in Modeling

At the light of the problems which are threatening humankind, two of the most influential philosophers have claimed for a new ethics, since the nature of such

problems is absolutely new therefore both decisions that we should make and behaviors that we should undertake concern ethical issues never faced in the past.[7] This new ethical thought has been called "the imperative of responsibility".

Another eminent thinker (Habermas, 1992) devoted his attention to how make such decisions rational, equitable and shared within a participatory deliberative democracy, and his methodological proposal has been called Discourse Ethics (DE). DE aroused much interest in the fields of management science, political science and social science, particularly for its merging with the practice of stakeholder engagement in CSR (Noland and Phillips, 2010), as well as with public debates in the environment conflicts (O'Hara, 1996).

Unfortunately, implemetation of ethical issues is not a simple task, even so it is not always well defined the meaning of ethics, therefore it is not clear what actions, behaviors, decisions and choices could be considered ethical. Moral philosophy theories, classifying and explaining various approaches to ethics, come to the aid of this arduous task:[8]

- **utilitarianism**/**consequentialism** judges an action in terms of its effects and consequences;
- **deontology**, on the contrary, judges it in itself and such a statement comprises the Kantian categorical imperative and the universality principle;
- **virtue ethics** and **communitarianism** state that ethical principles that lead to "the good life" should be developed within a community and not be generated by an individualistic vision.

OR world, starting with Boulding (1966) and Ackoff (1974), never neglets the question of ethical isssues, not only as far as the deontology of professional activities is concerned. An ample debate within the OR community has been collected in an edited book (Wallace, 1994). The conclusion of such a debate was oriented to leave ethics outside the model but restricted into the modeling process that should be objective, rigorous, impartial, unbiased, and explicit. The main intent of this advice is to avoid the risk to build nonsense because, treating ethical issues, such a risk is rather high since they are not only difficult to be defined, but, also arduous and problematic to be quantified in their real parameters.

However, more recently some voices rise to claim "ethics within model" and also "beyond" (Le Menestrel and Van Wassenhove, 2004), though not hiding difficulties inherent the task itself (Brocklesby, 2009).[9] The advantages of "ethics within model" would result in the opportunity of structuring ethical issues relationships (behaviors, decisions) and observing effects and consequences of such hypotheses, whereas, on the "beyond" side, advantages would concern equity and equidistance in the participative processes of model results interpretation.

Moreover, Mingers (2011, § 4) suggests that DE could be operationalized under an OR approach and that DE comprises aspects of the three above mentioned ethical approaches.

Also SD community, which is part of the OR galaxy, has devoted its attention to ethical issues in respect to:

- deontological issues (Gallo, 2004);
- exploring relationship between ethics and SD world (Pruyt and Kwakkel, 2007);
- an overview of modeling esemplifications, and an explanation of the violence in the human societies (Kunsch *et al*., 2007);

- behavioral application (Geistauts *et al*., 2009);
- the category of 'Ethics & Equity' in the archive of the MetaSD blog.[10]

Looking at the Past

Reasons to look back

There are good reasons for turning our attention to the Past.

It is (and has always been) a wise way to figure out the present time and foresee what could happen. It is not for nothing that the ancient Romans are used to teach: *Historia magistra vitæ*.[11]

Moreover, the Past is a subject which, more than others, can arouse the curiosity of an audience, so it could become a source of effective exemplifications for heuristic and educational proposals.

There are also reasons concerning the modeling process. The socio-economic systems of the past are less complex, simplifying model building, as well as sensitive parameters identification and explanatory hypotheses validation. Therefore, models of the past become a virtual laboratory for studying social systems. Besides, history assures a full knowledge of the reference mode and this positively affects the model validation process reliability and consequently the heuristic proposal credibility.

Since its inception, SD methodology has provided applications of historical events,[12] respecting in its incursion into the soft-sciences the criteria of epistemological validity (Helmer and Rescher, 1959).

What's more, curiosity of audience could increase if the metaphor tied to the Past is presented as a formal model or, better still, as a game or "flight-simulator". Besides, the possibility that everyone could tune the parameters or propose to modify the internal relationships represents not only a supplementary step of model validation, but also a strong form of involvement which should corroborate the heuristics implied into the historical exemplification.

Another aspect concerns the role that the historical subject could play in the practices of participation within the phases of model building and model interpretation. These practices are typical of group model building (GMB) and mediateted modeling (MM) processes.[13] According to us, the GMB/MM procedures should start with a discussion of a concept model (Richardson, 2006) related to the past (remote or near) but presenting analogies with the "argument of the day". Such a proposed situation is less emotionally involving: No direct interests are pending. So it should aid both to overcome the mistrust among stakeholders, and to consider more rationally the investigated problem. The proposed additional step to GMB could be defined a tuning phase of psychological alignment. So, the debates/discussions on the present days questions should become easier, fostering the convergence process which is the main aim of GMB (Rouwette, 2003). Obviously, the proposal seems suitable also for the environmental conflicts solution.

This idea has sprung observing that significant methodological discussions within the SD community have as subject applications to historical events, to humanities or other soft-sciences,[14] and hardly ever to nowadays professional disciplines. Evidently, a lower involvement in direct interests or in professional reputation enables debate, discussion, criticism not only to come out, but also to get off on the right foot in terms of mutual recognition/respect.

Athens & Sparta, a bit of History

Athens and Sparta are two of the most important city-states in the Mediterranean Sea that characterized the Western civilization development in the first millennium BC.

In the school-textbooks, Athens is depicted as the cradle of democracy and exalted for its high level live-style and for its successes in arts, culture, architecture, etc. Whereas Sparta is mentioned as synonym of indigence, despotism, warlikeness, ignorance, and closed minds.[15] And these judgements are strongly impressed in the collective imagination.

However, subtle historiographic analyses tend to modify these opinions.[16] Athens' high level of life-style and a great disparity among its inhabitants gave rise to conditions of political and economical instabilities which had been overcome with expansionist policies and frequent emigration phases that led to the settlement of colonies. Instead, Sparta lived in the same epoch a remarkable internal stability, showing many aspects of an equitable society. Besides, the deterrent function of its great display of military strength assured a long-lasting peace condition. So, Sparta reached, although at the cost of an acceptable frugality, a satisfactory level of socio-environmental sustainability,[17] that the other Greek city-states will never be able to attain.

Fig. A - A chart of the ancient Greece in the 400's BC.[18]

How has all this been possible? At its beginning, Sparta also experienced an internal crisis that could be solved only by an emigration of part of its inhabitants. After this negative experience, drastic measures had been taken in order to avoid that the conditions generating the unwanted instabilities could repeat themselves. Such measures were prevailingly aimed to limit the economic and demographic growth,[19] joined however to law provisions for both mantaining a satisfying level of equity inside the city-state and governing in a "democratic" manner.[20]

Such corrective measures have been ascribed to the "mythical" lawgiver Lycurgus, whose existence has never been proven, but it would likely be that, experiencied and

handed down the seriousness of both the emigration event and the critical conditions of its causation, such sustainability oriented measures (that now we define ethical, since they pursued the good of everyone) had been shared by a large part of Spartan inhabitants.

Fig. B - A "portrait" of Lycurgus.[21]

The A-S model

The simulation model of Athens and Sparta, here described, has been called "The A-S model". Considering its frequent mention along the text, it may be that we refers to it as "A-S" for short.

The A-S purpose

Why a formal model of the just told piece of history?

Even though we think that modeling and simulation (especially the SD approach) could be excellent conceptual tools aiding historians' work[22] (Hosler et al., 1977; Low, 1981; Renfrew, 1987), the A-S purpose is not to cast better light into the above described events. Instead, A-S has been conceived as a two fold test:

1. "Heuristic": is the formal model of the proposed metaphor effective enough to persuade decision-makers and public opinion of usefulness and benefits of ethical decisions to be taken?
2. Methodological: may the ethical choice be conveniently expressed in order to produce the evolutionary discontinuity fitting the reference mode, in terms of simple logical operations in the model, as simple were the Lycurgian corrective measures?

In other words, as has been said in the previous section, lessons from the Past are always meaningful. Building a model of these lessons means to replicate the invitation to reflect, but in a new attactive fashion corroborating the heuristic and educational value of its contents. Besides, a model allows everyone both to better understand the

kernel of the problem and to be involved modifying parameters and structure, becoming a powerful tool for insight and intercommunication. But if the tuned parameters, that allow the model to show the intended results which could make possible the shift towards sustainability, deal with ethical concerns, then not only our working hypothesis (ethics plus OR as conceptual tools to reach sustainability) is validated, but also citizens and decision-makers could be persuaded by our proposal expressed as a metaphor.

Anyway, A-S represents an opportunity to reflect on both the limits of formalization of soft-sciences and on some issues concernig sustainability, starting with life-styles. For skeptics, too.

Comparison with Forrester's Urban Dynamics

A way of introducing the model may be a comparison with Forrester's (1969) well-known *Urban Dynamics* (UD hereafter). Actually, both seek to be general theories of the city's long-term evolution. However, we chose to build the model from scratch, and not to adapt the socio-economic relationships of Athens and Sparta to the UD framework as in the Zubrow's (1981) representation of ancient Rome, in order to include some particular elements we consider significant to investigate: Emigrations, trade, wealth, shipyard, etc.

The six UD assumptions, quoted by Zubrow (*id*., p. 158), will be the guiding thread for the comparison and are summarized in Table 1.

Assumptions	*Urban Dynamics*	Athens & Sparta
areal	the city is limited by its geographical boundaries	the urban area and its countryside constitute a whole which is limited by unalterable boundaries
systemic	the urban area is an economic, social, ideological and geographic system	the urban area is a socio-economic system, characterized by the invariant culture of dominant classes, set in a geographical scenario
distributive	population, enterprise and housing are divided into three separate categories on the basis of their economic value	Only population is divided in classes: • Lords, who do not contribute to the wealth production; • Farmers, who produce foods; • Emerging class, who are engaged in non-food production and trade; • Slaves, who constitute labor, capital and also a means of trade. Housing and enterprise are not considered. Production is assumed to be proportional to labor, depending, as consumption does, on previously produced wealth.
	In total there are nine main state-variables, coincidentally the same number as in the UD model.	
attractiveness	it concerns houses availability and the labor exchange between urban and country areas	the drift of labor from the country is simply caused by surplus food production or by saturation of productive land, which results in converting farmers into emerging class. The converse moves slaves from the city to the country, or more precisely from serving the Lords to food production

enviromental	it is limitless, i.e. capable of supplying or absorbing people and goods to and from the city without saturation	it includes its own countryside, which is limited in productive land and human capability; however its environment is assumed limitless for the exchange of food, goods and slaves
	In both cases, such an assumption simplifies the model by allowing the system to be treated as closed, because the environment is formed by infinite capacity.	
non-competitive	The assumption of non-competition between cities completes the closed-system hypothesis	
	non-competitive	war and trade are considered competitive only in terms of internal effects that may be affected by random noise. In other words, in both cases it is the internal structure of the system that determines the city behavior, i.e. the dynamics is generated endogenously.

Table 1 – Comparison between the model assumptions of *Urban Dynamics* and Athens & Sparta

As above stated, UD and A-S models concern different processes. The former focuses on growth and stagnation of the urban area and does not seem to vary with starting conditions and scenario characteristics. The latter is dedicated to the generation of internal instability in order to obtain macro events such as emigrations. A non-negligible common aspect is that the origin of both urban area and city-state is not considered.

Methodological issues

Modeling systems belonging to the so-called soft-science is an undertaking that always requires caution. Besides, authoritative warnings could have dissuaded us.[23]

However, we have preferred to take the risk, since the soft parameters of the A-S model, such as "trade aptitude" and "conservative tendency" represent essential working hypotheses.

For this exacting task, we have chosen the System Dynamics approach (Forrester, 1961, 1968; Coyle, 1977, 1996; Richardson and Pugh, 1981; Sterman, 2000) for the following reasons:

- it combines simplicity and rigor at the same time;
- the feedback loop representation fits our semi-closed system;
- its proven capacity of building simulation models for testing theories (Hanneman 1988; Schwaninger and Grösser, 2008) of almost every science;[24]
- the availability of conceptualization tools, as well as graphic description tools which make easier the model building process and the model communication;
- documented experiences with soft variables;
- the feasibility of linking discrete-events (Coyle, 1985);[25]
- availability of visualization tools for real-time documentation of hypotheses testing effects (Smith *et al*., 2001; Frotjold, 2006);
- the methodology is easy to learn and the developed models are quickly understood even by scholars with a limited mathematical background.

The A-S model has been developed within the COSMIC modeling environment[26] (Coyle, 1994), and the source code is available in the supporting materials section of the SD Conference web-page.[27]

In our simulation runs, the integration step, i.e. the sampling interval, has been set to a quarter of year and appears consistent, considering that the system includes some parameters, such as food production, birth and death rate, that are identifiable only yearly.[28]

What's more, the difference equation mode, embedded in the SD tools, allows the treatment of some peculiar features, such as non-linearities, feedback, smoothing, delays, even without sound knowledge of these elements in terms of Control Theory.

Obviously. a model cannot fully represent the complexity inherent to historical events, neither it can cover the multiplicity of their concauses, as historians, starting with Tacitus, remind us. However, A-S helps to investigate the basic relationships within the city-state and the resulting 500 years path of main variables reflects *grosso modo* what Herodotus, Thucydides, and Xenophon handed down to us.

The significant aspects of the A-S model will be examined in the next subsections.

The model general structure

The simulation loop consists of four main subsystems:

- production and consumption, which produce the trade base;
- trade and war, which produce wealth;
- wealth distribution and use, which produce savings and social effects;
- population dynamics.

Figure 1 shows a logical diagram of the model subsystems with the main functional interconnection. According to the Automatic Control-type block diagram, the line with arrows are variables and blocks are computations.

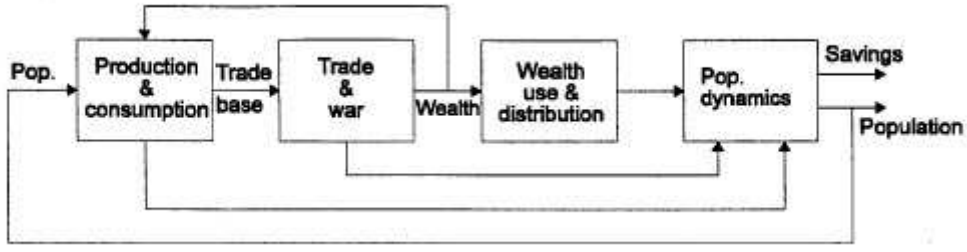

Fig. 1 - Block diagram of the A-S subsystems.

The characterizations of the A-S model, i.e. the identification of the critical parameters to determining the city-states behavior, such as trade aptitude and the dominant classes' capacity for self-preservation, as well as the geographical constraints, are stated off-line.

The economic framework: production & consumption, trade, wealth and war

Yearly per capita (YpC) starting consumption is assumed to be the economic gauge and corresponds to the minimum requirement of well being, which may be estimated as the current value of 365 grams of gold. Another fundamental value is the average cost of a slave and of its freeing. YpC food production is assumed to be about twice the base and YpC production of other commodities to be a little more, in order to obtain a system capable of producing wealth. Consumption and production indices change with the yearly produced wealth.

Slave productivity is less than that of free people, but the percentage of slave population involved in productive activities is higher. Production minus consumption determines the *surplus* which is assumed as the trade base, but trade begins when a certain threshold is reached and its volume also depends on the available labor (of the emerging class). Profit changes with trade duration and war results.

War itself is a cost, both in the way of materials and loss of production due to the labor participation. War duration depends on trade duration; and its intensity, expressed by the number of warriors involved, depends on the trade value. The effect of war on the population is given by the ensuing mortality. War duration causes a certain number of battles with a random result. Each victory increases trade profit whereas defeats reduce it.

The trade base multiplied by the factor computed by the trade and war result, minus war cost, gives the yearly wealth. Yearly wealth is distributed among Lords, Emerging class and lord Slaves according to "self-preservation" capacity (from 1 of slaves to a minimum of 7 for Lords). Lords use half share of their wealth (or at least the same amount as their yearly consumption) in the activities of their role, that means a return also for the city-state; the remaining value is converted into slaves and savings. If their share is insufficient, the difference is obtained from savings and the sale of slaves, and the number of Lords decreases by a 7 years ramp. The same procedure is applied to the Emerging class share. The Slave class utilizes savings for liberation. Moreover, the number of Slaves in the city-state represents itself an economic value.

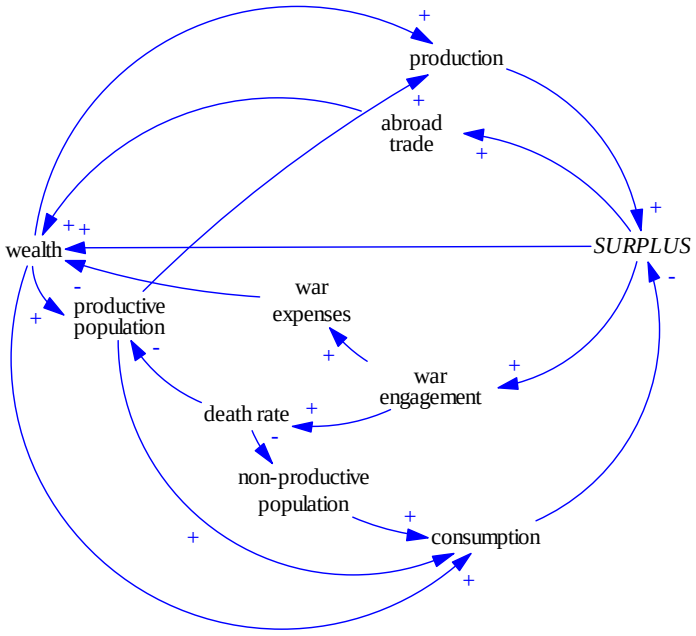

Fig. 2- The main cause-effects relationships within the economic system of the ancient city-states.

Summarizing, there are five economic state variables:

- savings of Lords,
- savings of Emerging class,
- savings of lord Slaves,
- the Public Savings,[29]
- Slaves belonging to Lords, plus Slaves belonging to the Emerging class.

It's worth noting that all these processes are driven by few soft parameters (aptitude to trade and characterisation of social classes), as well as geographic factors (arable land, soil fertility, reserves of raw materials, difficulty of land communications).

The other main state variables of the A-S model deal with the population amount, and are:

- Lords,
- Emerging class,
- Farmers
- the total number of Slaves.

Therefore state variables are expressed in terms of population or economic values, and this allows an easy dimensional consistency validation.

Figure 2 shows a highly aggregate causal loop diagram (CLD) of the city-state economic system as conceptualized in the A-S model.

Population dynamics

As stated above, population in the A-S model is represented as five classes:

- Lords,
- Emergent class,
- Farmers,
- Slaves belonging to Lords,
- Slaves belonging to the Emerging class.

The differentiation operated within the slaves class reflects their roles of both consumers/producers and economic value (for their owners).

Further specifications within social classes allow quantifying groups that the A-S model includes:

- warriors,
- seamen,
- traders.

Every class have a different net rate of demographic growth, while the aggregate balance also depends on:

- fall in the birth-rate,
- additional mortality.

Other factors contribute to modify the population structure:

- changings of class
- emigration events.

The complex mechanism which determines the dynamic of population within the A-S model is summarized in Table 2.

		Classes			
		Lords	Emergent Cl	Farmers	Slaves
Increasing Factors:					
	Birth Rate	H	M	L	L
	from Lord class		*(1)		Exp
	from Emerging class	*			Exp
	from Farmer class		*(2) & (4)		Exp & (1)
	from Slave class		*(3)		
	Bought abroad				*
Decreasing Factors:					
	Death Rate	M	M	M	M
	New Born	K & Exp	Exp	Exp	
	Lords activities[30]				*
	War[31]	*	*	*	
	Trade[32]		*		
	Class change	*	*	*	*
	Sale to Foreign				*
	Liberation				*
	Emigration[33]	*	*	*	*

Legenda:
H = High, M = Medium, L = Low;
K = Killing, Exp = Exposure[34];
(1) = Poverty, (2) = Food Surplus, (3) = Freeing, (4) = Productive Land Limit
* = Possible change of class

Table 2 – Synoptic table of population dynamics

Emigrations

Emigration is a phenomenon endogenously generated within the city-state. It occurs when socio-economic crises become unsustainable. Such a crises are caused by productive land saturation, overpopulation, and conflicts between dominant class (lords) and emerging class (traders).[35]

The expulsion process prevailingly concerns the emerging class and their slaves. The dominant class allocates its own resources to make effective the migration phase.

Emigration process may be a non simple achievement in many aspects, not the least the encounters in the new territory with local inhabitants.

Anyway, emigrations are a stabilizing event that brings back the city-state sustainability to a tolerable level.

Migration phenomenon is a discontinuity along the city-state evolutionary path that could be modeled as discrete-event within a continuous-time approach (Coyle 1985).

The conditions within A-S to activate the emigration phase are:

- a number of traders and workers of the emerging class sufficient to cause conflicts with the dominant class;
- a number of worker and farmers sufficient to saturate the exploitable resources.

The consequences of emigration affect the city-state in these terms:

- direct costs;
- a decrease of farmers becoming warrior to convoy the migrants;
- a decrease of traders, part of which forced to migrate, as well as their slaves, that are considered, for the city-state, an economic value, too.

All these effects make lower the city-state wealth, at least until emergent class activities will fully resume.

A causal loop diagram (CLD) shows the emigration aggregated effects on the city-states' base elements (Fig. 3).

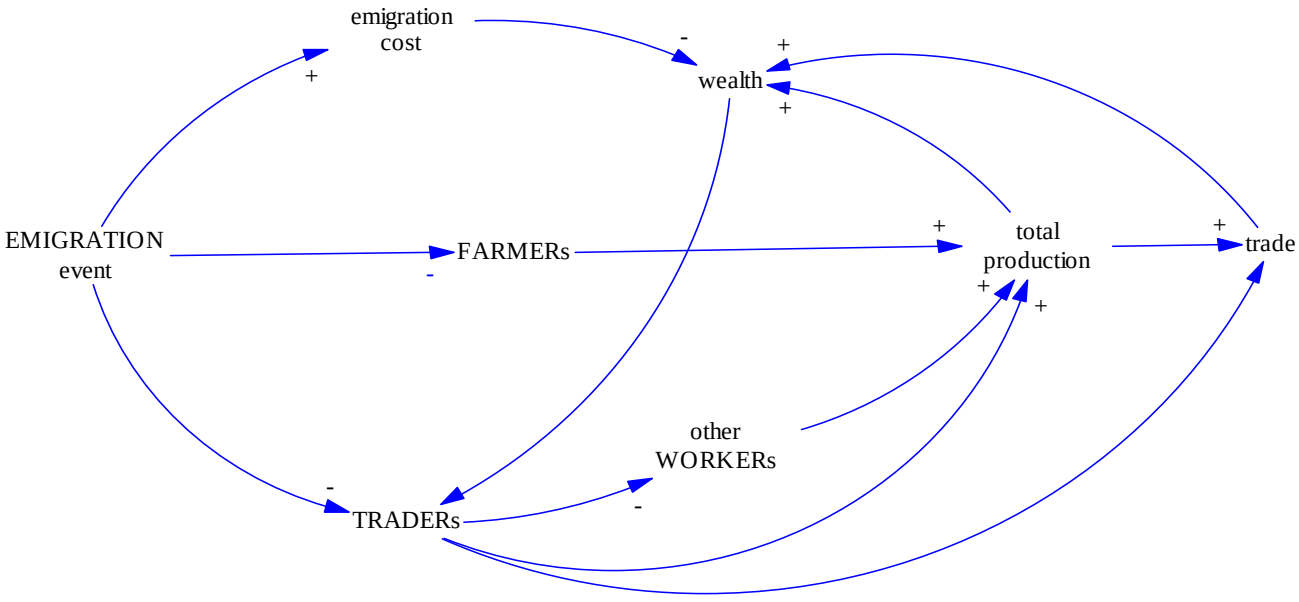

Fig. 3 - The emigration effects on the city-state.

Differences in modeling the two city-states

As well-known, Athens and Sparta are quite different. A consistent modeling process would take into account of this aspect. In our case, the differentiation factors, characterizing the city-state, deal with:

- the initial value of the already mentioned state variables;
- constant parameters related to:
    - the size of available productive land,
    - the mortality rate of traders. It depends on risks inherent the kind of their travels,
    - the aptitude to trade. It also represents the theshold above which the level of production demands commercial travel abroad,
    - degree of *grandeur* of the classes of Lords and Emergents respectively, seen as inclination to self-preservation; this is a cultural factor with an economic impact,
    - migration factor, estabilishing the share of Emerging class which abandons the city-state during the migration process,
    - the maximum number of battles yearly affordable;
- table lookup values related to:
    - profit factor in trading,
    - war duration,
    - additional death rate due to the prolongation of the war.

Fully aware of these differentiations, the authors chose to assign to these factors the same value for both city-states: The average figures between the Athens and Sparta. The reason of this choice depends on the need to have a generic model of city-state to which to apply our "ethical hypothesis". In fact, if the ethical choice experimentally works, then it will be more persuasive towards decision-makers and public opinion if based on a generic model, since the "generic" choice excludes that the achieved result could have been driven by the specific characterization of Sparta.

Simulation results have been reassuring: The generic model shows patterns similar to the specific ones (both Athens and Sparta).

The model presents other two differences between Athens and Sparta. The first one is quite marginal and deals with the halving of a coefficient in calculating both the income per capita and the public savings.

The second one is rather more complex and deals with the shipbuilding activities.

The shipyard of Sparta has been modeled as a quite simple structure because there was no reason to zoom into, since this city-state historically presents one only emigration, is settled 25 miles away from sea, and its trading activities abroad can be considered insignificant. On the contrary, the structure of the Athens' shipbuilding deserved more attention, since this city-state bases on sea its foremost activities: Trading, naval sea control to protect trading, emigrations[36] and colonization.

Some information on the modeled structure of the Athens shipyard may be found in the next subsection.

The shipyard

Ability to navigate is a very important peculiarity for the city-states in the ancient Mediterranean Sea. It supports trading and war activities, as well as emigrations and colonies settlement. So, shipbuilding process assumes a non-marginal role, at least as far as Athens is concerned.

As previously stated, the process of shipbuilding in Athens and Sparta has been modeled following two rather different structures cause the opposed way to look at sea of the two city-states.

The structure of the Athens shipyard has been modeled taking into account that the functionality and the efficiency of vessels are very relevant for the success of the city-state, and critical for its survival. So, the modeling process includes the technological innovation generating the succession of new types of vessels: *Triaconter*, *penteconter*, *bireme*, and *trireme*. The dynamics of the life-cycle of the vessel types resembles the Kuhnian scientific paradigms' one (Kuhn, 1962), whose formal model (Sterman and Wittenberg, 1999) has been a valuable heuristic modeling guide. This dynamics is depicted in the time-graph of Fig. 7.

A schematization of the most significant relationships governing the Athenian shipyard processes are reported in Figure 4, whereas Fig. 5 shows a time-graphs related to the vessels amount dynamics and Fig. 6 the engaged crew.

Instead, the building process of new vessels in Sparta is quite simple. The structure of the Spartan shipyard model is shown in the stock&flow diagram of Fig. 8.

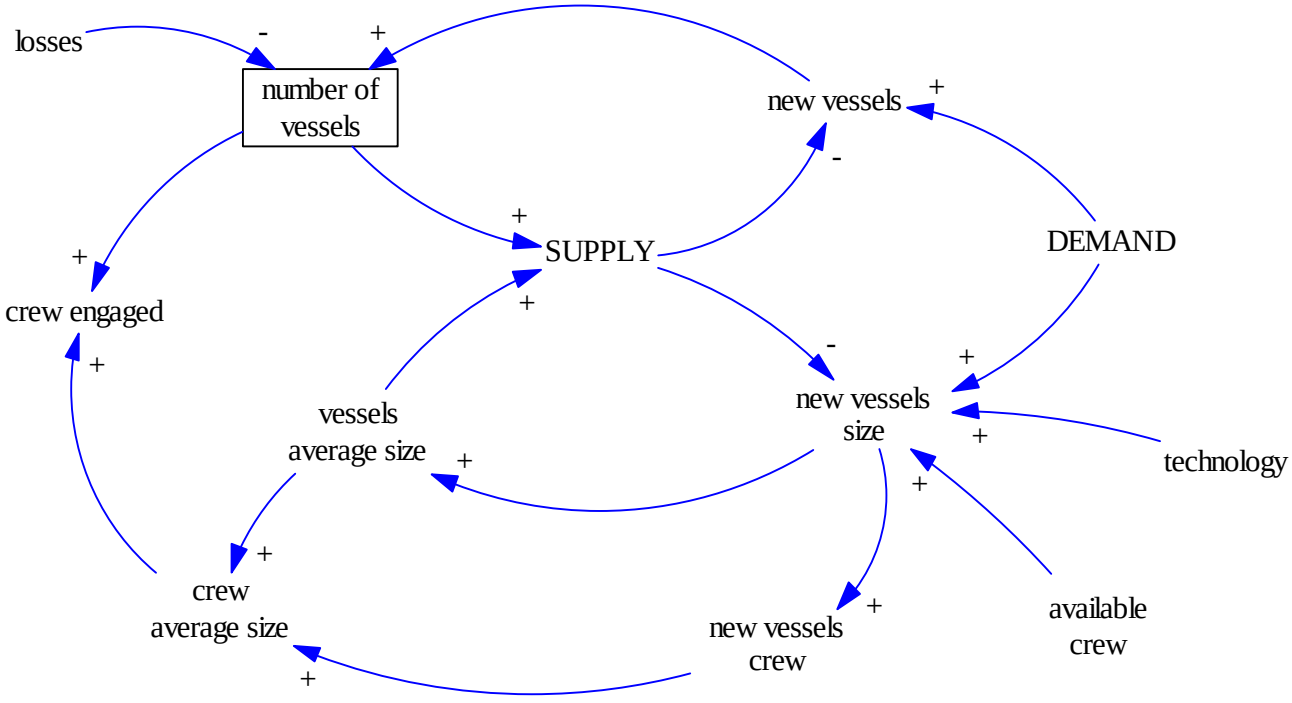

Fig. 4 – The main relationships inside the Athenian shipyard

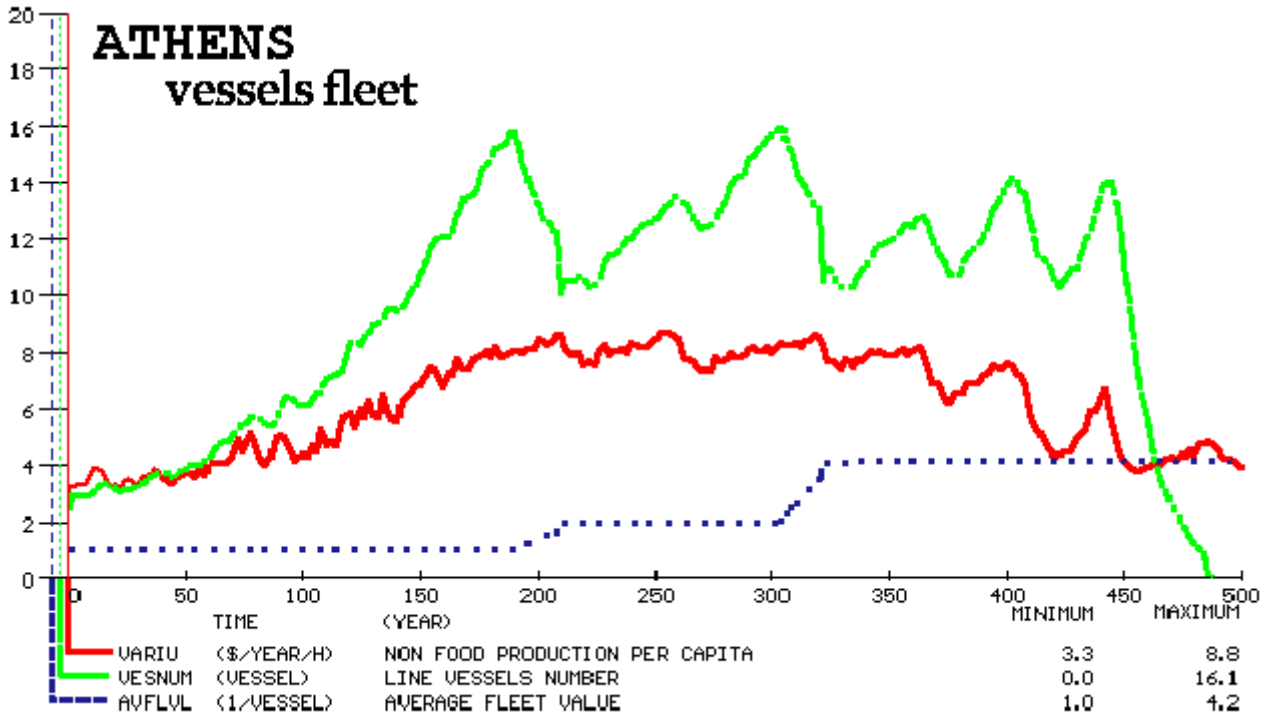

Fig. 5 – The amount of Athenian vessels along the 500 years time horizon.

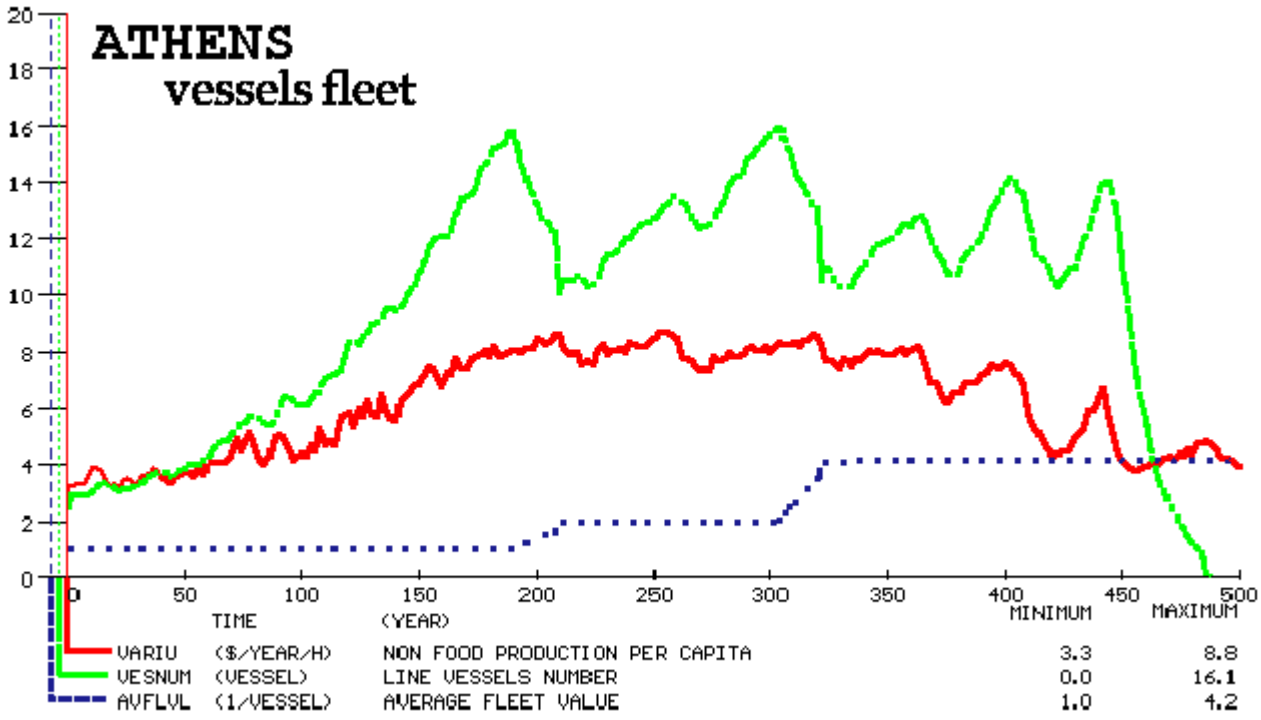

Fig. 6 – Crew engaged in Athenian vessels along the 500 years time horizon.

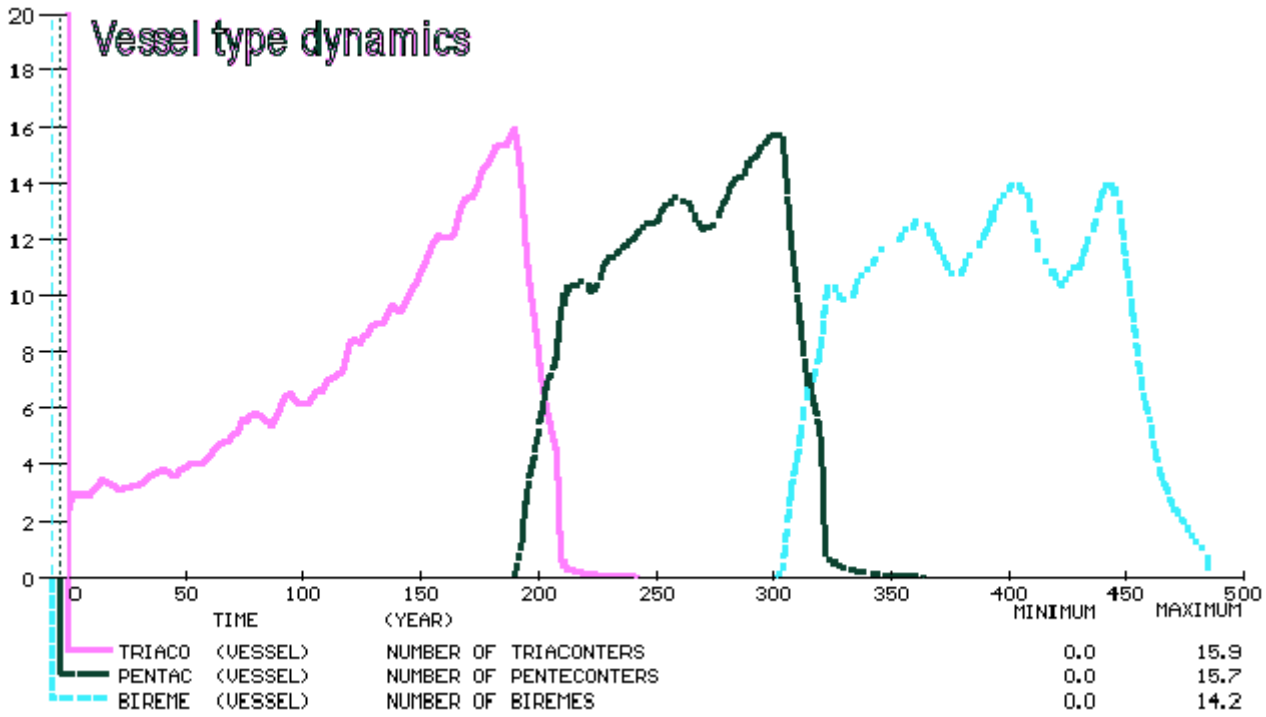

Fig. 7 – Changes in vessel type:
Life-cycle of Triaconter - Penteconter - Bireme.

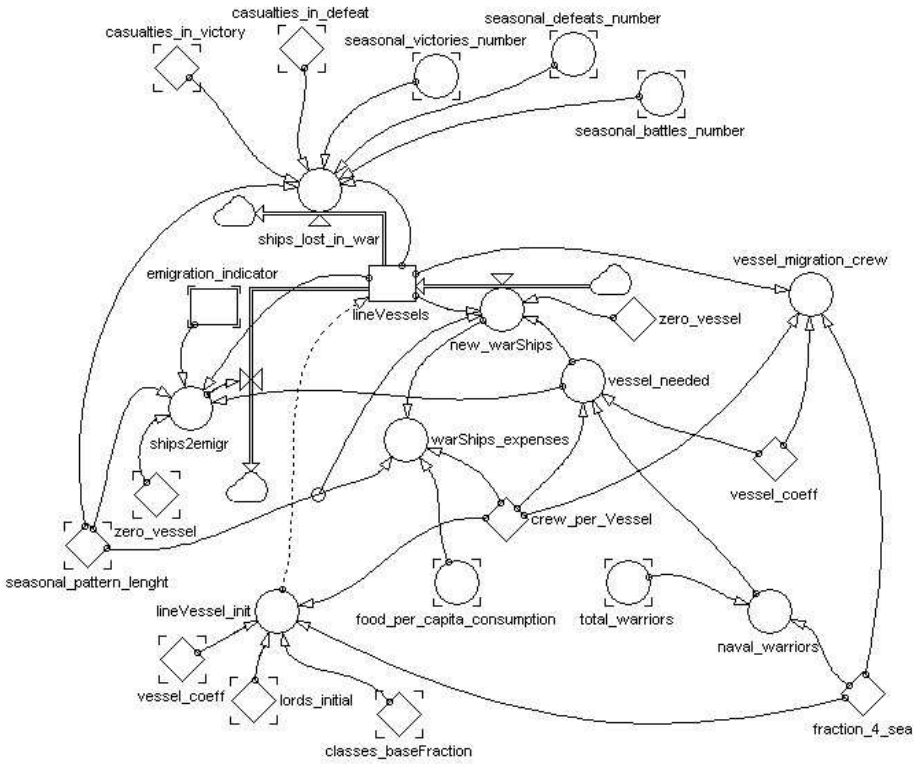

Fig. 8 – Stock&Flow diagram of a shipbuilding process
in a generic city-state, Sparta included.

The ethical choice:
the Lycurgian laws

As have seen, emigration is the solution to the sustainability crisis of the city-state. But, since both internal instabilities and emigrations are unwanted events, Sparta, after its first negative experience,[37] decided to avoid that the conditions generating instabilities could repeat themselves, and acted directly on their causes, namely reducing economic and demographic growth factors. Such measures covered:

- a decrease on non-food productivity per worker;
- an increment of mortality due to a strenuous military training.

The taken measures, that made the change in the Spartan society possible, took the name from the "mythical" lawgiver Lycurgus, whose existence has never been proven, but it could likely be that, experiencied and handed down the seriousness of crises and emigration event, such measures have been shared by a large part of the inhabitants.

As consequence, Sparta becomes a quasi zero-growth society.[38] Production and consumptions are well-balanced and at a sufficient level, even though frugal. Sparta, as self-sufficient city-state, have no need to carry out expansionist policies. Moreover, income redistribution may be considered at that time sufficiently equitable, and its military power discourages aggressions from the outside. All these peculiarities will assure centuries of both internal stabilty and peace.

Indeed, historians' opinions on Sparta differ, but, considering the present-day sustainability crises, this example from the past should not be forgotten.

It should be noted that the so-called Lycurgus' laws produced a drastic change in the life-style of the city-state, and such measures were rather simple also under the point of view of their implementation, and that their effects were in conformity with the expectations, and longlasting.

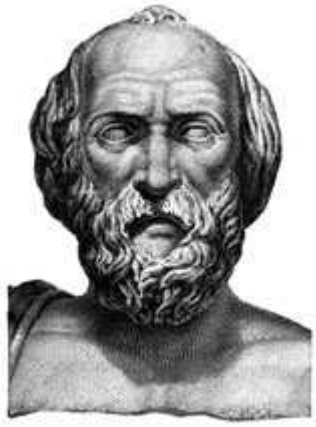

Fig. C - A herma of Lycurgus[39]

Such measures were not easy to be taken, but they were aimed to pursue and attain the good of all the inhabitants. So, we define Lycirgus' laws "the ethical choice".

The ethical choice proves itself to be a "simple" one also from the viewpoint of its implementation within the model: It has been sufficient to tune a couple of parameters after the occurrence of the first emigration phase for achieving the expected stabilizations, so avoiding that the emigration conditions could be reproduced.

The model parameters involved in the ethical choice are:

- the farmers birth rate (it decreases because the military training weakens the farmers);
- the ratio of recruited farmers and traders.

The aggregate effects of ethical choice on Sparta are summarized in Fig. 9.

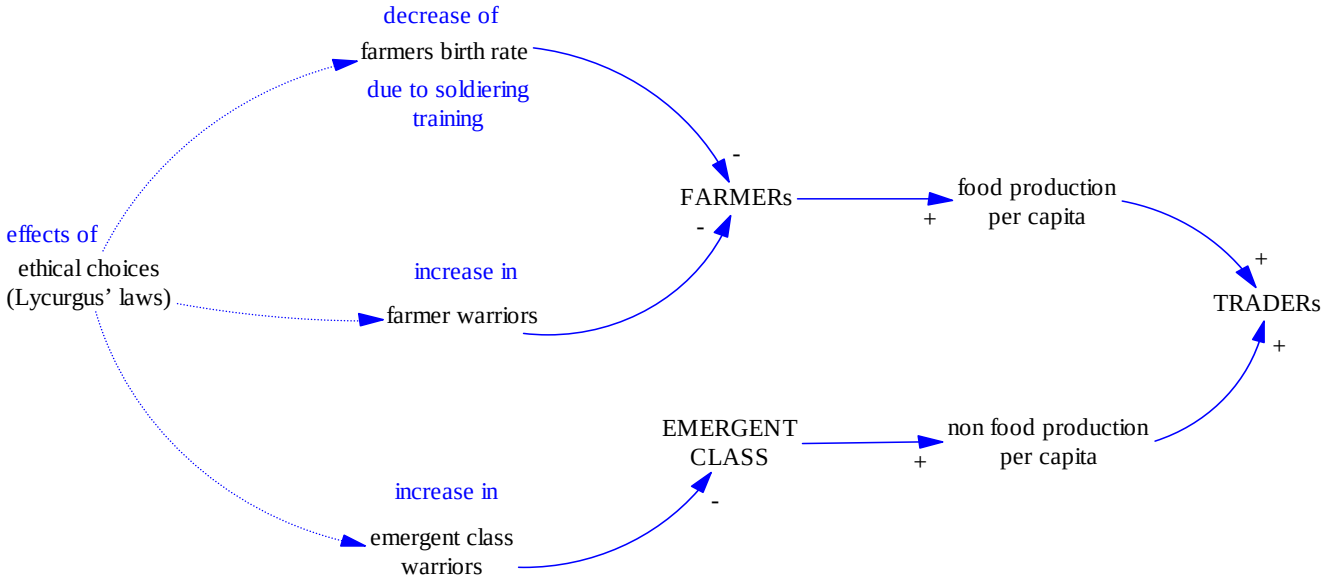

Fig. 9 – Effects of the ethical choice on Sparta society.

Simulation results

Simulation results fit data of the reference time horizon and support the expectations hypotheses.

Along the the considered period of 500 years, Athens shows seven emigrations deducible from the "saw tooth" pattern in the time-graph of population dynamics in Figure 10, whereas the ethical choice effects limit Sparta (Fig. 11) at an only emigration event.

It is worth to note that the period of first emigration *grosso modo* coincides for both city-states and the initial transient depends on some arbitrary initial value.

The balance between the social classes shows a right ratio and the population level at the end of simulation run is equivalent to estimations in the days of Thermopylae battle as quoted by Herodotus.

Also, the ethical choice effects on the economic sector are plausible: The final savings of Sparta (Fig. 13) are less in comparison with the Athens' ones (Fig. 12), but more equally distributed among the social classes.

The "Public Saving" variable, shown in two wealth plots (Figg. 12 and 13), represents the city-state economical value.[40] It has been used for historiographic validation and does not affect the model dynamics.[41]

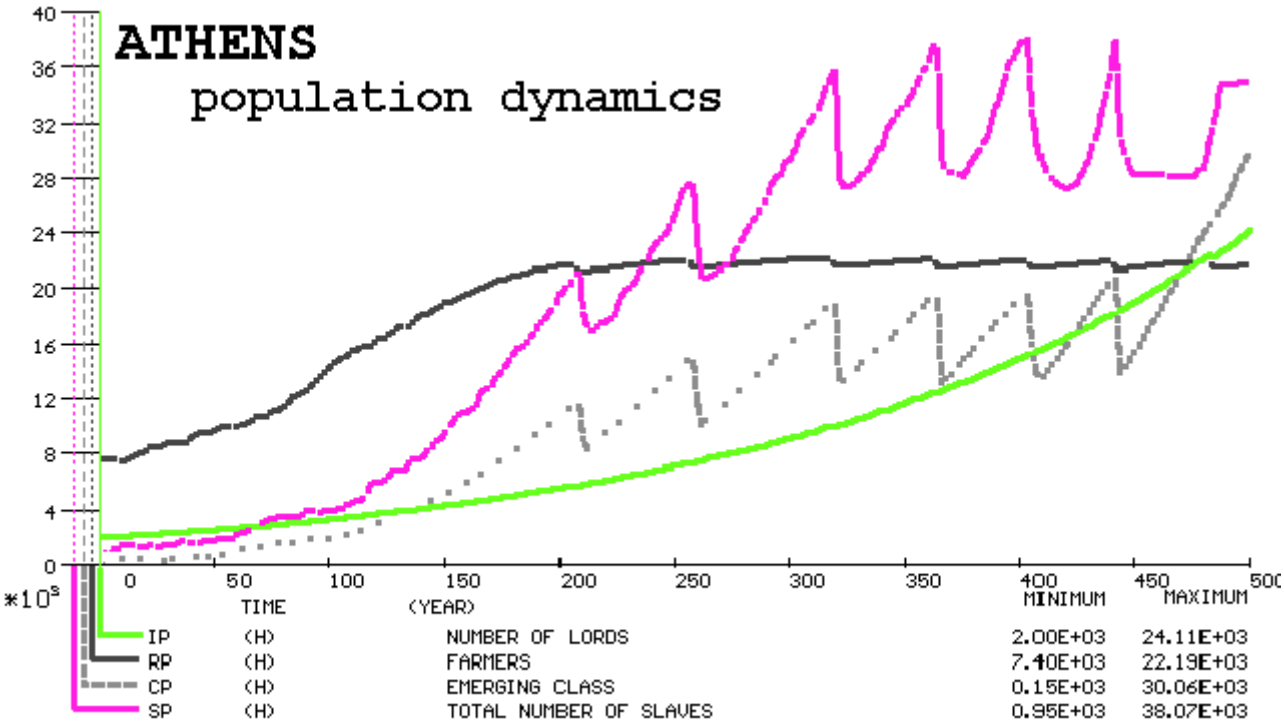

Fig. n. 10 – Athens' population dynamics

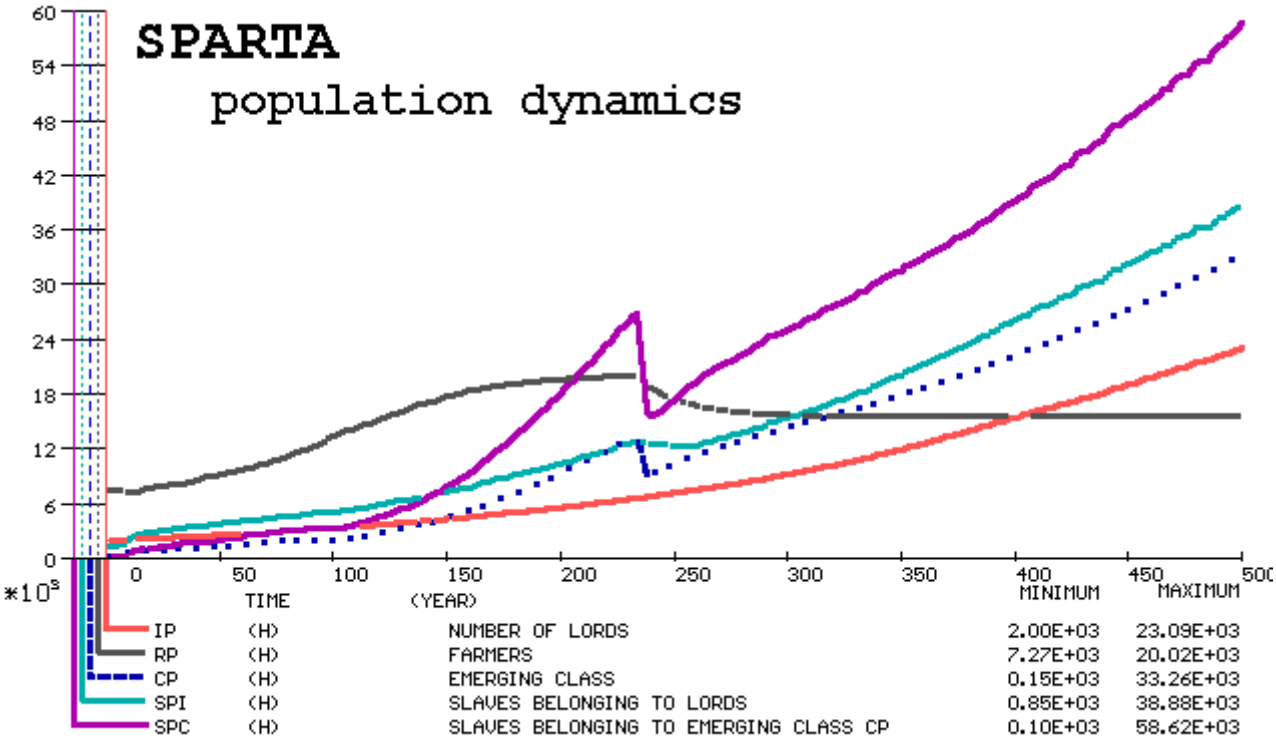

Fig. n. 11 – Sparta population dynamics

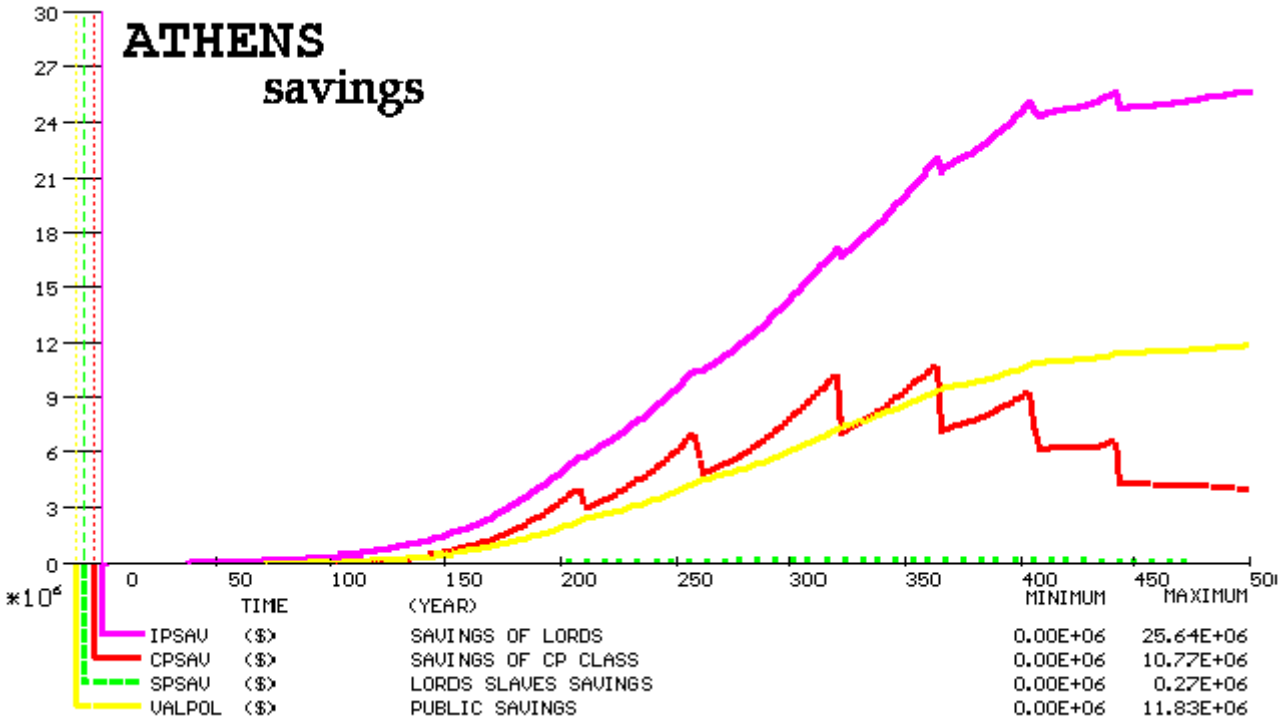

Fig. n. 12 – Athens' population savings

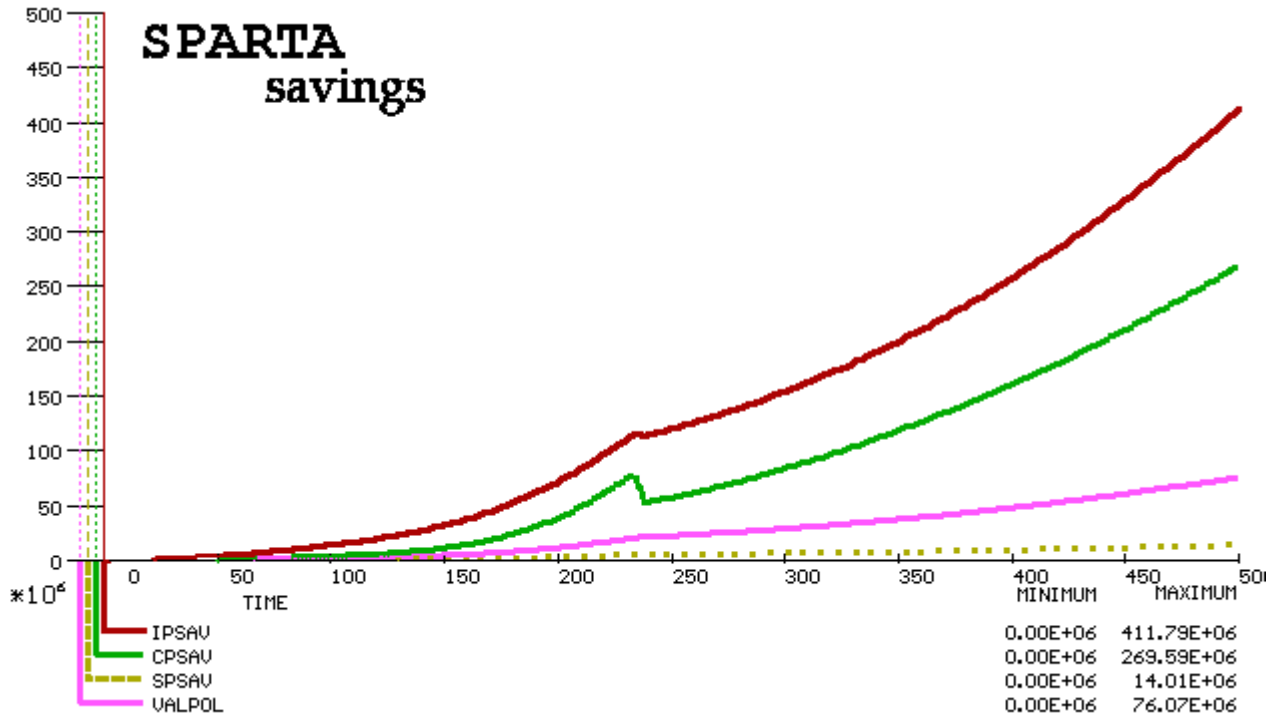

Fig. n. 13 – Sparta population savings

Further steps

The A-S model will be ported to a SD simulation language freely redistributable in order to facilitate communication and evaluation. The structure of both city-states will be normalized further on, and, if the simulation language will allow it, such a structure will be represented as a two dimensions matrix. Then, A-S will be adapted for "gaming sessions" to allow a wide testing to determine if the "ethical choice" metaphor effectively works fine. Afterwards, multicriteria analysis tools will be linked to A-S in order to improve the quality of the evaluation sessions (Brans et al., 1998).

Feedbacks received during the first presentation phase will be useful to rethink the model, in particular, updating interpretative criteria to now-a-days categories of judgment, for better explaining the dynamics of conflicts and the logic of decision. Anyway, events and dynamics in the new A-S must be "explained" within the model and not predetermined. This also concerns (i) the "ethical choice", (ii) some city-state characterization parameters that must become variables, and (iii) the social dynamics (including conflicts) that should also be affected by the ethical behavior of population. And this new functional characterizations should make the "gaming" version more effective.

The EES project

The A-S model is the first step of a project named "Ethics in the Evolution of Societies" (EES) devoted to studying the influence of ethical behavior and the ethical choices in the evolution of societies. It is a question that we consider very important, but up to now it has been somewhat disregarded. Toynbee (1934), too, in his monumental work on the evolution of civilizations considers as ethical issues only the moral obbligation describing the factors which enables dominant classes to rule minorities.

So, we intend to collect several society paths, "interpreted" at the light of ethical behaviors and ethichal choices. Then, such paths will be implemented as formal model and simulation game, starting from qualitative concept models (Richardson, 2006; Ghaffarzadegan *et al*., 2011) of well-known paradigmatic examples:

- the Maya collapse (Hosler *et al*., 1977);
- the tragedy of Commons (Anderson, 1974; Ostrom, 1990);
- the confutation of Mandeville's (1714) *Fable of the Bees* (or *Private Vices, Publick Benefits*);
- the collapse of Easter Island (Sterman, 2000, pp.125-127; Diamond, 2005; Turkgulu, 2008);
- Mahatma Gandhi's non-violent civil disobedience;
- arms race escalation (L.F. Richardson, 1993);
- etc.

The purpose of the project is not only educational, pedagogic, heuristic, i.e. to point out the weight of ethics in the development of societies with its relevant implications starting from survival till quality of life, but also to be effective in decision-making, acting as auxiliary tool within the above mentioned developing processes, like stakeholder engagement and GMB.

Case studies will be implemented in a multi-methodological approach (SD, agent-besed modeling and simulation, game theory, etc.). In this way, the "ethical" proposal

should be percived as more sound and convincing, corroborating the underlying "message".

The ambitious final aim of the project could be the building of an "operational" theory (Schwaninger and Grösser, 2008) of ethics in the evolution of societies.

EES is on open project: Everyone's contributions are welcome.

Conclusion

A model (named A-S) replicating 500 years evolution of the ancient city-states of Athens and Sparta has been presented. Such a model fits the pattern of the economic and demographic known variables, as well as gives an account of social conflicts, instabilities, emigrations, and, in a certain kind way, also of war activities and colonies settlement.

The chosen methodological approach (SD) has proved itself effective not only for "the specialty of the house" (feedback loops, non-linearities, etc.), but also for treating the evolutionary discontinuities (modeled as discrete events).

The model building process has reflected the operationalization of parameters and variables as suggested by Schwaninger and Grösser (2008) in Theory Building, as well as by Mingers (2011) in Discorse Ethics.

So, we suppose that the "methodological" test[42] has been passed, even though are waiting confirmation both from feedbacks of the SD community and from the disaggregation process in the new model.

A-S is also an occasion to discuss about the importance of looking at the past for finding solution to the nowadays sustainability problems. In this context, it has been tried to show that the ethical issues of the problem could play a non-marginal role and that such issues present a rather "simple" connotation both in the decisions to be made (the corrective measures) and in their implementation within the model.

From the point of view of theory-building, the A-S model could be defined "phenomenological", since developed on observations, whereas from the viewpoint of ethics in modeling (Wallace, 1994), it belongs to the category of "ethics within model", though in an implicit way, since the model deals with ethical behaviors and choices that however are not endogenously generated, but we don't despair that A-S could become soon both an explicit one, i.e. such behaviors and decisions should be the consequence of the relationships within the model and not predetermined, and, when it will be "played" in preliminary sessions of stakeholder engagement, A-S could be also considered a helpful tool belonging to the class of "ethics beyond model".

In respect of the "heuristic" test[43], it has not been carried out, yet. Such a test is the true challenge of our proposal. This "socialization" phase will be arranged as soon as A-S will be fully developed as "game" and combined with visualization tools.

Finally, emphasis on the Sparta ethical choice could mean an our marked preference for the frugality of that life-style[44]. Well, it's not true. We would not dislike a better quality of life at all. Even though fully aware of Forrester's warning that the expression "sustainable development" is nothing else than an oxymoron, we have never stopped dreaming a society with the positive aspects of Athens. So, a sustainable way out between the stability of Sparta (zero growth) and the "good life" of Athens, it would be seeked ceaselessly. In this endeavor, modeling and simulation tools linked to ethical principles, aiding to find the best choice and its sharing, will play a fundamental role.

Notes

1. Among others, the product service systems (PSS) (Roy, 2000; Tukker and Tischner, 2006), in which a system-dynamicist took a specific interest (Oliva, 2000; Oliva and Kallenberg, 2003).
2. A survey on the efficiency of formal models in research projects for evaluation of environment change may be found in Siebenhüner and Barth (2005).
3. There is an ample SD literature dealing with this subject. Here, it is possible to mention only some references to the main threads: Modeling the envinronment (Ford, 1999), mediated modeling (MM) (van den Belt, 2004; Antunes *et al*., 2006), group model building (GMB) (Vennix, 1996), environmental conflicts (Stave, 2002), etc. It is also worth to note that the SD approach has been adopted by one of the co-founders of the Ecological Economics movements (Costanza and Ruth, 1998).
4. See, for instance, Knez-Riedl *et al*. (2006), Maclagan (1999) and Zink (2005), and SD applications may be found (Bivona and Herrera Daza, 2008; *id*., 2009). Moreover, some system-dynamicists (Elias *et al*., 2000; *id*., 2001; Richardson and Andersen, 2010) show interest in the stakeholder theory (Freeman, 1984) that is the basic pillar of CSR.
5. Provocative, since our interpretation goes against consolidated beliefs and, just for this reason, it attracts the attention, and, also if rejected, the proposed exemplification induces in any case to some reflection.
6. Westbound Greek colonization is an explicit consequence of expansionist policies and migratory events.
7. They are Hans Jonas (1984) and Zygmunt Bauman (2004). Most of Bauman's ethical considerations in the sustainability field are based on the works of Paul and Ann Ehrlich on equity relationship between population and resources. Jonas' thought could be more easily grasped through some his interview collected in a volume (Jonas, 1993).
8. For a more detailed introduction to these theories, see Mingers (2011, § 2.1).
9. There is also a more radical movement that sets its priority on the critical issues of the systems instead of their technical and practical essence, and has been called Critical Systems Thinking (Jackson, 1991).
10. http://blog.metasd.com/category/ethics-equity/ (accessed 03/31/2011).
11. History master of life.
12. For instance, Maya collapse (Hosler *et al*., 1977), Anasazi disappearance from the Colorado Plateau (Low, 1981), the archaeological reconstructions (Renfrew, 1987), and the evolution of the ancient Mediterranean city-states (Piattelli *et al*., 1994).
13. For GMB, see for instance, Vennix (1996) and, for MM, van den Belt (2004).
14. The list includes:
    - the sociology of science with the Kuhnian theory of scientific revolution (Sterman, 1981, 1985, 1992; Wittenberg, 1990, 1992; Barlas, 1992; Radzicki, 1992). The discussion led some authors to converge (Wittenberg and Sterman, 1992, 1993; Sterman and Wittenberg, 1999);
    - the Maya collapse (Hosler et al., 1977; Coyle 2000);
    - the primitive agricultural society of Tsembaga studied by the anthropologist R. Rappaport (Shantzis & Behrens, 1973; Kampmann, 1991);
    - the Shakespearean drama of Hamlet (Hopkins, 1992; Haslett, 2004).

15. For instance, the term laconic derives from Laconia, the region where Sparta was settled.
16. See, for instance, the framework depicted by Jeffrey Lumb at the Charles Sturt University website http://www.hsc.csu.edu.au/ancient_history/societies/greece/ (accessed 03/04/2011).
17. Sparta sustanainability condition lasted about three centuries. Then, after the Peloponnesian War, the socio-political frame changed in a radical manner.
18. The chart has been taken from the History-Howstuffworks website http://history.howstuffworks.com/ancient-greece/ancient-greece3.htm (accesed 3/15/2011).
19. Among others, a strenuous military training for a large part of male inhabitants, that increases the death rate and, at the same time, strengthens the defence power.
20. See an excerpt of how the ancient Greek historian Xenophon describes such measures in the website of the California State University http://www.csun.edu/~hcfll004/sparta-a.html (accessed 03/02/2011).
21. The Lycurgus' "portrait" has been taken from the already mentioned website of the California State University. Such a relief is part of the decoration of the Chamber of the House of Representatives in the United States Capitol building, Washington, D.C.
22. Modeling and simulation are considered, at last, one of the ancillary disciplines of History.
23. Popper (1961) proves the intrinsic limits of historiographic theories, whereas Coyle (2000) on soft variables suggests that it is better to limit us to the qualitative approach of Systems Thinking, rather than to produce non-sense.
24. The spectrum goes from economics (Schuster 1973, Low 1980) to psychology (Wegman 1977), passing through anthropology (Shantzis and Behrens 1973), philosophy of history (Torrealdea and Grana 1984), sociology of science (Sterman 1985), etc.
25. In our case, ethical choice, migrations, and naval battles are discontinuities and occurences which need such a treatment.
26. COSMIC is a DYNAMO-like language (Richardson and Pugh, 1981; Pugh, 1983) developed by R.G. Coyle.
27. http://www.systemdynamics.org/conferences/current/index.htm
28. In the ancient times, war and trade were seasonal activities.
29. "Public Savings" is an economic institution comparable to the modern Treasury.
30. The Lords' activities such as war and trade result in a certain level of slave mortality.
31. War involves the Lords population only as a ritual manifestation. It affects the Emerging and Farmer classes according to its extension, which stems from the level of trade. The basic parameters are 5% of deaths in the case of victory and 14% for defeat. The actual war duration depends on random noise, as does the victory/defeat sequence.
32. Trade is considered as an onshore or offshore activity outside the city-state, performed by the Emerging class only.
33. Emigration involves in a prevailing degree the Emerging class and its Slaves, because social instability is explained by an increase in the Emerging class population compared to the number of Lords.
34. Exposure, namely the abandonment of infants, was applied mainly to new-born females and is explained as a balancing mechanism between males and females, as the latter were not affected by an equivalent level of risk.

35. The objectives of the dominant class are the same ones of the city-state itself: Survival, maintaining power, growth. The emerging class fosters survival and growth but its expansion may lead to social conflict in the struggle for power.
36. The 500 years time horizon considered in our experimentations comprises seven emigrations.
37. The only one Spartan emigration originated the colony of Tarentum, which did not meet with the influence of Lycurgus' laws.
38. Toynbee (1970) in his monumental work on the evolution of civilizations classifies Sparta as an "arrested" society, like Polynesians, Eskimos, Osmanlis, and Nomads.
39. This herma of Lycurgus has been taken from Wikipedia http://en.wikipedia.org/wiki/File:Lycurgus.jpg.
40. Public Savings are comparable to the modern Treasury; their aim is to finance civil works, war campaigns, and states of emergency.
41. According to the first days of System Dynamics terminology, it may be considered as a supplementary variable.
42. As explained in "A-S purpose" section, the methodological test concerns the feasibility of modeling historical events in a suitable way, and particularly the "ethical choice".
43. Again, as in "A-S purpose" section, the "heuristic" test concerns the involvement of citizens and decision-makers in the validation process of our proposal relating to historical analogies and the ethical choice.
44. An excessive admiration of Sparta is called laconophilia.

Supporting information

The source code of the A-S model and the poster of this presentation are available in the supporting materials section of the SD Conference web-page.[27]

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The metaphor of Athens and Sparta is a Professor Mauro L. Piattelli's thought.
The authors, following his wake, are very grateful to him.

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