Military Competition and Size and Composition of Economy and Government

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ABSTRACT:

This paper uses a formal model to analyze the effects of military competition between states on the size and composition of the economy and the government. Great economies of scale in warfare and even distributions of military capability among the contestants generate intense interstate rivalry, strong concern for relative economic and military capability. Consequently, there is a larger economy and government and an increasing share of the military in the economy. However, if there are diseconomies of scale in the provision of public intermediate inputs, intense military competition between states actually increases the relative size of the civilian public sector relative to that of the military. The paper then studies how waves of military technological revolutions affected military competition between states and the size and composition of economy and government in history.

1. INTRODUCTION

This paper uses a formal model to analyze the relationship between international military competition and the size and composition of the economy and government. The model builds on the current anarchy and conflicts literature. Anarchy is the fragmented political order where there are at least two contestants to resources and they may use brute force to settle the contest. In other words, anarchy is a lack of property rights regime, as argued in Bush (1974), Hirshleifer (1988, 1989, 1991, 1995), Tullock (1971, 1972, 1974, 1980), Grossman (2001, 2002), Grossman and Kim (1995) and Alesina and Spolaore (2005). The model follows the formulation of Hirshleifer (1988, 1989, 1991, 1995) that the ratio of military capability between the contestants decides the probability of victory between them or their respective share of contested resources captured and secured. The resources contested could either be land, maritime territory, population or accessibility to sea lanes. States go to war or military contest short of war or pursue diplomatic bargaining in the shadow of war for such resources, even when survival is not at stake. The winner secures a larger share of the contested resources and, in the extreme case, the winner takes all. The model adds to the current anarchy and conflict literature by modeling the effect of international military competition on the size and composition of the economy and government.

The argument that international military competition leads to better economic performance is named the Hume-Kant hypothesis. The Hume-Kant hypothesis argues that international military competition between states and political authorities, such as that exists within the European competitive state system, leads to innovations and superior economic growth, according to Bernholz and Vaubel eds. (2004, p. 1-17). This is the X-efficiency of microeconomics at the grandest level. Among the many prominent adherents of the Hume-Kant Hypothesis are Smith (1776, Vol. 2, 253), Gibbon (1787, Vol. VI, Chapter 38: 328), Weber (1923, p. 249), Wesson (1967, 1978), Baechler (1975), Jones (1974, 1981, 1988, 1990), Kennedy (1987), North (1995, 1998), Weiss and Hobson (1995), Bernholz, Streit and Vaubel eds. (1998) and Bernholz and Vaubel eds. (2004). North (1995, p. 26) comments: "……Even the relative failures in western Europe played an essential role in European development and were more successful than China

or Islam because of competitive pressures." This paper adds to the above literature by a formal model that analyzes the effects of international military competition on the size and composition of the economic and government.

An important feature of modern economy is rise of the service state originated in Europe. The modern service state intervenes intensively and extensively in the economy and provides myriad public intermediate inputs to boost productivity. There was a rising share of the public sector in the economy as per capita income increased. This is the Wagner's Law in public finance studied in Bird (1971), Webber and Wildavsky (1986), Breton (1989) and West (1991). Furthermore, non military public expenditures grew faster than military expenditures during the rise of Europe even though military expenditures were ballooning and warfare was conducted on a larger and larger scale. The result was the civilianization of the European states despite the intense international military competition. This is termed the civilianization paradox of war making and state making by Tilly (1992, p. 122-124). Tilly (1992, p. 122) puts it this way: "The state-transforming processes we have surveyed produced a surprising result: civilianization of government. The result is surprising because the expansion of military force drove the processes of state formation." This paper contributes further insights to the above literature by analyzing how changes in the economies of scale in the application of force could lead to changes in the size and composition of the economy and government.

2. THE MODEL.

There are two unitary states. In period zero, nature decides the respective endowment and military and economic-fiscal efficiency of the states, the utility functions of the states, the conflict technology and the production technology. In period one, the states allocate the endowment between direct consumption and input into production. From the output of production, the states allocate between consumption and military expenditures. In period two, the military spending of the states decide their probability of winning the military contest between them.

The utility functions of State 1 and State 2 are separable and composed of three parts:

$$\pi_1 = \alpha P + \beta \ln C_1 + \gamma \ln L_1 \tag{1}$$

$$\pi_2 = \alpha(1 - P) + \beta \ln C_2 + \gamma \ln L_2 \tag{2}$$

$\gamma \ln L_i$ is the direct consumption component of the utility function. It is derived from consuming the endowed resources directly and L_i is the level of the endowed resources directly consumed. $\beta \ln C_i$ is the indirect consumption component of the utility function for consuming the production of the economy and C_i is the amount of production consumed. αP and $\alpha(1 - P)$ are the security component of the utility function. P is the probability of victory by State 1 in a military conflict or contest short of war between State 1 and 2. α is the stake of the military contest.

The probability of victory by State 1 in a military conflict or contest short of war between State 1 and 2 is

$$P = \frac{(q_1 F_1)^m}{(q_1 F_1)^m + (q_2 F_2)^m} \tag{3}$$

This is the Tullock-Hirshleifer ratio form of conflict technology function or power function. P is the probability that State 1 will emerge triumphant in a military confrontation with State 2. Alternatively, P means the share of the prize of the conflict that State 1 will capture in a military contest with State 2. F_1 is the level of military expenditures of State 1 and F_2 is the level of military expenditures of State 2. q_1 is the efficiency of State 1 in turning military expenditures into effective military capability and q_2 is the efficiency of State 2 in turning military expenditures into effective military capability. Therefore, $q_1 F_1$ is the military capability of State 1 and $q_2 F_2$ is the military capability of State 2. m is the mass factor. m measures the returns to scale in conflicts. A larger mass factor enhances the relative advantage of the bigger contestant. If a larger force can more easily overwhelm a smaller force, for instance, when there is offensive advantage, then m is larger.

The budget constraints facing State 1 and 2 are:

$$L_i + I_i = E_i \tag{4}$$

$$C_i + F_i = Y_i(I_i) \tag{5}$$

I_1 is the level of production inputs supplied by State 1. $Y_1(I_1)$ is the production level resulted from such provisions of inputs by the state. State contributes to production through the provisions of public intermediate inputs. Public intermediate inputs include physical infrastructures such as roads, light houses, street lights as well as services and intangible public goods provided by the state such as enforcement of law and order, the creation and maintenance of a sound monetary and financial system, the organization and sponsorship of overseas expeditions for commercial purposes as well as efforts to aid educational, scientific and technological advances. Public intermediate inputs raise the productivity of the economy.

Production function is:

$$Y_i(I_i) = A_i I_i^h \tag{6}$$

h is scale factor. A_1 is the economic-fiscal efficiency of State 1 and A_2 is the economic-fiscal efficiency of State 2. We assume $0 < m, h, \alpha, \beta, \gamma, q_1, q_2, A_1, A_2 < \infty$.

Substituting the constraints into the objective functions we have:

$$\max_{F_1, I_1} \pi_1 = \alpha \frac{(q_1 F_1)^m}{(q_1 F_1)^m + (q_2 F_2)^m} + \beta \ln(A_1 I_1^h - F_1) + \gamma \ln(E_1 - I_1) \tag{7}$$

The first order conditions are:

$$\frac{\partial \pi_1}{\partial F_1} = \alpha m P(1-P) F_1^{-1} - \frac{\beta}{A_1 I_1^h - F_1} = 0 \tag{8}$$

$$\frac{\partial \pi_1}{\partial I_1} = \frac{A_1 \beta h I_1^{h-1}}{A_1 I_1^h - F_1} - \frac{\gamma}{E_1 - I_1} = 0 \tag{9}$$

Similarly State 2 solves

$$\max_{F_2, I_2} \pi_2 = \alpha \frac{(q_2 F_2)^m}{(q_1 F_1)^m + (q_2 F_2)^m} + \beta \ln(A_2 I_2^h - F_2) + \gamma \ln(E_2 - I_2) \tag{10}$$

The first order conditions are:

$$\frac{\partial \pi_2}{\partial F_2} = \alpha m P(1-P)F_2^{-1} - \frac{\beta}{A_2 I_2^h - F_2} = 0 \tag{11}$$

$$\frac{\partial \pi_2}{\partial I_2} = \frac{A_2 \beta h I_2^{h-1}}{A_2 I_2^h - F_2} - \frac{\gamma}{E_2 - I_2} = 0 \tag{12}$$

Using the first order conditions, we have

$$\frac{F_1}{F_2} = \frac{Y_1}{Y_2} = \frac{A_1}{A_2}\left(\frac{I_1}{I_2}\right)^h = \frac{A_1}{A_2}\left(\frac{E_1}{E_2}\right)^h \tag{13}$$

$$R \equiv \left(\frac{q_1}{q_2}\frac{A_1}{A_2}\right)\left(\frac{E_1}{E_2}\right)^h \tag{14}$$

R is the ratio of military capability between the two states. The probability of victory by State 1 in a military contest with State 2 is therefore

$$P = \frac{R^m}{R^m + 1} = \frac{\left(\frac{q_1}{q_2}\frac{A_1}{A_2}\right)^m\left(\frac{E_1}{E_2}\right)^{mh}}{\left(\frac{q_1}{q_2}\frac{A_1}{A_2}\right)^m\left(\frac{E_1}{E_2}\right)^{mh} + 1} \tag{15}$$

3. COMPARATIVE STATICS.

Without loss of generality we focus our analysis on State 1. From previous results, we have

$$I_1 = \left[\frac{h\beta(R^m+1)^2 + h\alpha m R^m}{(\gamma + h\beta)(R^m+1)^2 + h\alpha m R^m}\right]E_1 \tag{16}$$

$$F_1 = A_1 E_1^h \left[\frac{\alpha m R^m}{\beta(R^m+1)^2 + \alpha m R^m}\right]\left[\frac{h\beta(R^m+1)^2 + h\alpha m R^m}{(\gamma + h\beta)(R^m+1)^2 + h\alpha m R^m}\right]^h \tag{17}$$

Proposition 1:

States care about relative economic and military strength and differences in growth rates of

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military efficiency, economic efficiency and size of controlled resources.

Proof:

Using the Envelope theorem, the first order conditions, and $\dfrac{\partial R}{\partial q_2} = -Rq_2^{-1}$, $\dfrac{\partial R}{\partial A_2} = -RA_2^{-1}$,

$\dfrac{\partial R}{\partial E_2} = -RE_2^{-1}$, $\dfrac{\partial R}{\partial q_1} = -Rq_1^{-1}$, and that in equilibrium, $P = \dfrac{R^m}{R^m + 1}$, we have

$$dπ_1 = \alpha \dfrac{\partial P}{\partial R} \dfrac{F_1}{Y_1} \dfrac{I_1}{E_1} \left[\begin{array}{l} \left(\dfrac{dq_1}{q_1} - \dfrac{dq_2}{q_2}\right) + \left(\dfrac{Y_1}{F_1} - 1\right)\dfrac{dA_1}{A_1} + \left(\dfrac{dA_1}{A_1} - \dfrac{dA_2}{A_2}\right) \\ + h\left(\left(\left(\dfrac{Y_1}{F_1} - 1\right)\left(\dfrac{E_1}{I_1} - 1\right) + \left(\dfrac{Y_1}{F_1} - 1\right) + \left(\dfrac{E_1}{I_1} - 1\right)\right)\dfrac{dE_1}{E_1} + \left(\dfrac{dE_1}{E_1} - \dfrac{dE_2}{E_2}\right)\right) \end{array} \right] \tag{18}$$

Q.E.D.

International military competition is not merely a contest of military valor and equipment. It is also a test of fiscal strength and economic might. There arises the concern for relative economic capability and efficiency.[1]

Proposition 2:

The provision of public intermediate inputs, the size of production, the size of the military, the share of the military in production and the concern for relative economic and military strength (in terms of growth rates) are at their maximum when the rivals are equal in military capability.

Proof:

$$\dfrac{\partial\left(\dfrac{I_1}{E_1}\right)}{\partial R} = \dfrac{hm^2 \gamma \alpha R^{m-1}\left(1 - R^{2m}\right)}{\left((\gamma + h\beta)(R^m + 1)^2 + h\alpha m R^m\right)^2} \tag{19}$$

$$\dfrac{\partial\left(\dfrac{F_1}{Y_1}\right)}{\partial R} = \dfrac{\alpha m^2 \beta R^{m-1}\left(1 - R^{2m}\right)}{\left(\beta(R^m + 1)^2 + \alpha m R^m\right)^2} \tag{20}$$

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1 Refer to Grieco (1988a, 1988b, 1990), Baldwin (1993), Gowa (1989, 1994) and Gowa and Mansfield (1993).

$$\frac{\partial F_1}{\partial R} = Y_1 \frac{\partial\left(\dfrac{F_1}{Y_1}\right)}{\partial R} + \left(\frac{F_1}{Y_1}\right)\frac{\partial Y_1}{\partial R} \tag{21}$$

From equation 18 and note that

$$\frac{\partial\left(\dfrac{Y_1}{F_1}-1\right)}{\partial R} = -\left(\frac{F_1}{Y_1}\right)^{-2}\frac{\partial\left(\dfrac{F_1}{Y_1}\right)}{\partial R} \tag{22}$$

and

$$\frac{\partial\left(\dfrac{Y_1}{F_1}\dfrac{E_1}{I_1}-1\right)}{\partial R} = -\left(\frac{F_1}{Y_1}\frac{I_1}{E_1}\right)^{-2}\left[\frac{I_1}{E_1}\frac{\partial\left(\dfrac{F_1}{Y_1}\right)}{\partial R}+\frac{F_1}{Y_1}\frac{\partial\left(\dfrac{I_1}{E_1}\right)}{\partial R}\right] \tag{23}$$

The above are positive for $R < 1$, zero for $R = 1$, and negative for $R > 1$.

Q.E.D.

Only among equals are there real contests. If the difference in capability is too great, then there will not be any real contest and anarchy itself might give way to hierarchy, as analyzed in Hirshleifer (1995). The more closely matched the two rivals are, the greater the concern for relative economic and military strength. When rivals are equally matched, the incentive to outdo each other is at its greatest. States in the state system are therefore keenly aware of the strategic importance of the relative capabilities of the constituent units. For instance, the concept of balance of power invariably entered the mind of statesmen in the ancient Greek city state system, the medieval Italian city state system and the modern European state system.2

Proposition 3:

An increase in the mass factor results in a higher (lower) level of public intermediate input, a larger (smaller) share of the military in the economy, and a larger (smaller) economy & greater (smaller) concern for relative economic and military strength when rivals are about equal

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2 The Peloponnesian War (B.C. 431 to B.C. 404) was caused by the wary that Greek city states had about the ascendancy of Athenian power. Refer to Thucydides, Blanco and Roberts (1998).

(greatly unequal) in military capability.

Proof:

$$\frac{\partial\left(\frac{I_1}{E_1}\right)}{\partial m} = \frac{\left(\gamma\alpha h R^m\right)\left[\left(R^m+1\right)^2 + m\left(1-R^{2m}\right)\ln R\right]}{\left(\left(\gamma+h\beta\right)\left(R^m+1\right)^2 + h\alpha m R^m\right)^2} \tag{24}$$

$$\frac{\partial\left(\frac{F_1}{Y_1}\right)}{\partial m} = \frac{\left(\alpha\beta R^m\right)\left[\left(R^m+1\right)^2 + m\left(1-R^{2m}\right)\ln R\right]}{\left(\beta\left(R^m+1\right)^2 + \alpha m R^m\right)^2} \tag{25}$$

$$\frac{\partial F_1}{\partial m} = \frac{\partial\left(\frac{F_1}{Y_1}Y_1\right)}{\partial m} = Y_1\frac{\partial\left(\frac{F_1}{Y_1}\right)}{\partial m} + \left(\frac{F_1}{Y_1}\right)\frac{\partial Y_1}{\partial m} \tag{26}$$

From equation 18 and note that

$$\frac{\partial\left(\frac{Y_1}{F_1}-1\right)}{\partial m} = -\left(\frac{F_1}{Y_1}\right)^{-2}\frac{\partial\left(\frac{F_1}{Y_1}\right)}{\partial m} \tag{27}$$

and

$$\frac{\partial\left(\frac{Y_1}{F_1}\frac{E_1}{I_1}-1\right)}{\partial m} = -\left(\frac{F_1}{Y_1}\frac{I_1}{E_1}\right)^{-2}\left[\frac{I_1}{E_1}\frac{\partial\left(\frac{F_1}{Y_1}\right)}{\partial m} + \frac{F_1}{Y_1}\frac{\partial\left(\frac{I_1}{E_1}\right)}{\partial m}\right] \tag{28}$$

The above are negative for R close to zero or very large and positive for R close to one.

Q.E.D.

An increase in the economies of scale in conflict has two effects on the marginal effect of relative military capability on probability of victory. One is the scaling effect and the other is the unbalancing effect.

$$\frac{\partial^2 P}{\partial R\partial m} = \frac{R^{m-1}}{\left(R^m+1\right)^2} + \frac{mR^{m-1}\left(1-R^m\right)}{\left(R^m+1\right)^3}\ln R \tag{29}$$

In equation 29, the first term on the right-hand side is the scaling effect and the second term is

the unbalancing effect. By the scaling effect, given an increase in mass factor both players try to increase their fighting forces as size confers greater advantage. By the unbalancing effect, the bigger player becomes more powerful and the weaker player weaker given the greater economies of scale in conflict. The unbalancing effect makes both players put in less effort in fighting. The greater the asymmetry in capability, the greater the unbalancing effect. The unbalancing effect is zero if the two rivals have equal capability. Therefore, if there is a rough balance (great disparity) in the relative capability of the contestants, then an increase in economies of scale in conflict increases (reduces) the concern for relative capability since the scaling effect dominates (is dominated by) the unbalancing effect. That is, the total effect is negative for R close to zero or very large and positive for R close to one.

Not all state systems exhibit the same level of concern for relative economic and military strength nor all empires are equally entrenched and complacent. For state systems with very low mass factor such as the pre modern Southeast Asia due to difficult terrains and vast distance separating states, there was a low level of concern for relative military and economic capability. For empires facing a low mass factor such as the medieval empires of Tang China and Umayyad Caliphate, there would be greater concern for relative military and economic capability than empires facing a high mass factor such as the universal empires of the late classical era or the continental size gunpowder empires of the modern era.

Proposition 4:

When public intermediate input has decreasing returns to scale in the production function and the two rivals are about equal (very unequal) in military capability, an increase in the mass factor cause the public sector to become larger (smaller).

Proof:

$$
\frac{\partial\left(\frac{I_1}{Y_1}\right)}{\partial m} = A_1^{-1} E_1^{1-h} (1-h) \left[\frac{h\beta\left(R^m+1\right)^2 + h\alpha m R^m}{(\gamma+h\beta)\left(R^m+1\right)^2 + h\alpha m R^m} \right]^{-h} \left[\frac{\left(\gamma\alpha h R^m\right)\left[\left(R^m+1\right)^2 + m\left(1-R^{2m}\right)\ln R\right]}{\left((\gamma+h\beta)\left(R^m+1\right)^2 + h\alpha m R^m\right)^2} \right]
$$

(30)

If $h < 1$ and $\left[\left(R^m + 1 \right)^2 + m \left(1 - R^{2m} \right) \ln R \right] > 0$ (<0), then $\dfrac{\partial \left(\dfrac{I_1}{Y_1} \right)}{\partial m} > 0$ (<0).

Q.E.D.

Greater economies of scale in conflicts lead to larger scale of warfare in a state system and thereby generate higher demand for revenue to support the military. As a response, the state puts in more efforts to boost the productivity of the economy. If public intermediate inputs has decreasing returns to scale in the production function, then the increase in production is slower than the increase in public intermediate input. There arises the famous Wagner's Law in public finance: the rising share of the public sector in the economy that accompanies the increase in per capita income. On the other hand, in an imperial order, an increase in the economies of scale in conflicts dampens military contests between the empire and marginal states at the fringe. The empire becomes more secure and complacent. Consequently, the empire puts in less effort in supporting the functioning of the economy. If public intermediate inputs has decreasing returns to scale in the production function, then the decrease in production is slower than the decrease in public intermediate input, and there is a declining share of the public sector in the economy. This explains the lethargic gunpowder empires that provided little services to the economy as observed by Jones (1981, 1988, 1990).

In a state system, if the increase in the economies of scale in conflicts goes far enough, then ultimately there will be the civilianization paradox of war making and state making: the expansions of the scale of warfare and the military produce the surprising result of the civilianization of government.

Proposition 5:
When the two rivals are about equal in military capability and there are decreasing returns to scale in the provision of public intermediate inputs, if the mass factor is sufficiently large then an increase in the mass factor causes a declining share of the military in the public sector.

Proof:

$$\frac{\partial\left(\frac{F_1}{I_1}\right)}{\partial m} = AE^{h-1}\left[\frac{h\beta(R^m+1)^2 + h\alpha m R^m}{(\gamma+h\beta)(R^m+1)^2 + h\alpha m R^m}\right]^{h-1}\left[\frac{\alpha R^m}{\left(\beta(R^m+1)^2 + \alpha m R^m\right)^2}\right]$$

$$\times\left[\beta+(h-1)\frac{mh^2\gamma\alpha R^m}{(\gamma+h\beta)(R^m+1)^2 + h\alpha m R^m}\right]\left[(R^m+1)^2 + m(1-R^{2m})\ln R\right]$$

(31)

For R close to one, $\left[(R^m+1)^2 + m(1-R^{2m})\ln R\right] > 0$ and an increase in m results in a larger

$$\frac{mh^2\gamma\alpha R^m}{(\gamma+h\beta)(R^m+1)^2 + h\alpha m R^m}$$. Given that $(h-1) < 0$, if m is large enough such

that $\left[\beta+\frac{m(h-1)h^2\gamma\alpha R^m}{(\gamma+h\beta)(R^m+1)^2 + h\alpha m R^m}\right] < 0$, then $\frac{\partial\left(\frac{F_1}{I_1}\right)}{\partial m} < 0$.

Q.E.D.

To support a larger military given the larger scale of warfare, the state requires a larger economy. Yet, there are diseconomies of scale in the provisions of public intermediate inputs. Consequently, the size of the civilian public sector has to be drastically increased and there arose the civilianization paradox.

5. CASE STUDIES FROM WORLD HISOTRY

I.   Ancient Middle Eastern Leadership.

Unlike the open and fragmented Greater Mesopotamia, the enclosed and isolated Nile valley was conducive to the consolidation of an empire. Consequently, Mesopotamia retained her state system for further six centuries after the establishment of the Egyptian Empire. Besides, the series of empires in Greater Mesopotamia from the twenty fourth century BC onwards facilitated by the use of bronze weapons were never as secure as the Egyptian Empire which was over

1,300 years old before she suffered her first major invasion. The effects of such differences on innovations and development were rather obvious: the so-called ancient Middle Eastern leadership in the early phase of human civilized history, from c. a. B. C. 3500 to c. a. B. C. 1000, as studied in Stavrianos (1982).

The Middle Eastern leadership was manifested in many ways. The region invented the first writing system, the Cuneiform, as well as the alphabetical writing. It produced the earliest law codes and much literature of high value, such as the Code of Hammurabi. Other evidence of the better economic performance of Mesopotamia include city planning, the first irrigation system in the world to redirect mountain spring water and the constant improvements in technology. It developed advanced metallurgy techniques for working with bronze, lead, silver, gold and iron. All these achievements showed the interests of the Mesopotamian states in furthering economic development and an increased role of civil bureaucracy in the economy and the state.

Cultural and scientific achievements were great as well. A great part mathematical and astronomical science owed its beginnings to the Mesopotamians. An example was the sexagesimal system which was used for all types of calculations and is still used for the clock in all around the world. Mesopotamia invented the wheel. The manufacture of glass was a major technological breakthrough. Other technological advances included glazed pottery and bricks. Assyrian knowledge of the planets of our solar system led to accurate predictions of solar and lunar eclipses, as documented by Haywood (1997, p. 44-45).

II.   Classical Pluralism.

The use of horse drawn war chariots and iron weapons changed the geopolitical landscape of the ancient world. From around 700 to 300 BC, the Neo-Assyrian Empire, the Neo-Babylonian Empire and the Achaemenid Persian Empire ruled over the whole Middle East. The weight of the empires stalled the developmental momentum in the old seats of early civilizations. Economy of the region slowly declined. In sharp contrast to the bursts of innovations of the earlier era, the Middle East could boast of no major advances during this era. In contrast, the Chinese, Indian

and Greek civilizations were city state systems or territorial state systems. The dynamism of these state systems produced the splendid classical achievements of the Chinese, Greek (and Hellenistic) and Indian civilizations. Their representatives were Confucius, Socrates and Buddha. Consequently, the ancient Near Eastern leadership ended and world history entered the pluralism of classical period.

During this era, land warfare of the largest scale was seen in China. The rise of heavy infantry led to more frequent and larger scale warfare in China from the Spring and Autumn Era to the Era of Contending States. It was common for warring states to mobilize hundreds of thousands of soldiers or even close to a million troops and fight over extensive spaces for years. This could not be done without a very high degree of fiscal strength and economic achievements. There was a growth of government and civilian control of the military was established: an ancient example of the civilization paradox of war making and state making, as studied in Hui (2005).

III.   Indian Classical Golden Age.

The invention and use of iron in military increased competition in the state systems of the classical world and ultimately transformed them into gigantic universal empires. The Mediterranean world came under the Roman Empire. In China, the Chin and Han dynasty reigned supreme. In Persia, it was the Parthian then the Sasanian Empire. Military capability and economic-fiscal might between these empires and the outside groups were of vast distances. Great asymmetry in capability dampened competition and resulted in stagnation and decline. The vigor and splendors of the preceding state systems soon disappeared. There was a retrenchment of government too. The Han Dynasty of China, for instance, practiced the Taoist minimalist approach to government and the Confucian small government policy.

The exception was India. Given the fragmented geography of India, the powerful and gigantic Mauryan Empire lasted only about a century and a half. Then it was a fragmented and competitive state system in India, from around BC 200 to AD 300. Then the Gupta Empire came. The Gupta Empire, largely confined to Northern India and more decentralized than the Mauryan

Empire, ruled from 320 AD to 720 AD, with effective rule from 320 AD to around 500 AD. It was constantly challenged by Southern Indian states and the nomads from the Northwest, as studied in Stavrianos (1982, p. 134-137). During this period, the Indian civilization was propelled to the pinnacle of its classical golden age. Sanskrit learning was revived to serve as a lingua franca. Sanskrit literature flourished. States took strong interests in development. Hindu laws were codified, producing the authoritative Hindu Law Books (dharmashastra), the foremost of them being the Code of Manu. In art, after a long period of Hellenistic influence, there emerged an indigenous Indian style. The decimal place system of numerical notation, one of the great inventions of the human mind, emerged in India by A.D. 270. There was a flourishing international trade, to the West, Southeast Asia and China. Indian culture spread abroad, especially to Southeast Asia. A greater India emerged. Buddhism, with its accompanying art forms, flowed like a mighty torrent into China, Korea and Japan and Central Asia.

IV.   Abbasid Golden Age and Sung Puzzle.

Around A.D. 200-500, there was a decline in the economies of scale in warfare due to the rise of cavalry. The classical empires retreated or dissolved. Nomadic hordes advanced at the expense of the settled societies, as documented in Dudley (1990, 1991, 1992), Keegan (1993) and McNeill (1982). During the medieval era, political fragmentation was the norm in Europe, Middle East, India and China. Myriads smaller kingdoms and short-life empires came and went.

The Islamic world under the Abbasid Caliphate (A.D. 750 to A.D. 1258) operated under a state system. The greatest Islamic achievements were the products of this era: the Abbasid Golden Age.3 This period experienced the Arab agricultural revolution with the widespread diffusion of new crops and the promotion of new or the rehabilitation of old irrigation systems, as studied in Watson (1974). Trade was thriving and Arabian traders were at the center of the global trading network, according to Abu-Lughod (1989). Islamic merchants pioneered many innovations in business organization and finance, including the double entry book keeping, the pooling of

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3 Refer to Wesson (1978, p. 93-95), Armstrong (2000, p. 45-81) and Sonn (2004, chapter 2) and Bernholz (2004, p. 184 to 193) in Bernholze and Vaubel ed. (2004).

capital through partnerships and the use of letters of credit and promissory notes that facilitated long distance trade. There were great literary achievements and science and mathematics advanced to a very high level.

Political fragmentation was the norm in China in the millennium after the collapse of Han Dynasty. During this period, there was more creativity in commercial, cultural, technological and institutional arenas. These developments culminated during the Sung era. During the Sung era, there was sustained growth in per capita income for four centuries. The economy prospered with elaborate internal and external trading networks. Sung China was the industrial center of the global trading system and the most advanced economy. There were many innovations in production technology including the water-powered hemp-spinning machine, the movable printing press and the compass, as documented in Graham (1973), Cipolla (1967, 101-2) and Elvin (1973). According to Harrison (1972, p. 290), the total Chinese output of iron at the close of the eleventh century A.D. was approximately the same as the entire production of Europe in 1700. The porcelains manufactured during the Sung dynasty were the best in quality and design. Cultural achievements were equally great. The most important works of Neo-Confucianism were done in the Sung dynasty. Poetry and other literary works also flourished. Such miraculous performance was not repeated in the powerful and unified Ming and Ching periods, as studied in Jones (1981, p. 202). The achievements were therefore termed the Sung puzzle.

Sung era China was a tri-polar state system. During Sung era, large scale warfare was the rule. The scale of the militaries was greater than that in Europe before the Napoleonic wars. Sung China maintained a large military-industry complex to tap technological prowess for the military. The state intervened extensively in the economy to boost productivity and raise revenue for supporting the gigantic military-industry complex. Consequently, Sung China manifested the civilianization paradox: the large scale warfare stimulated the growth of the bureaucracy which overshadowed and overpowered the military.

V.   European Miracle.

The gunpowder military revolution increased the economies of scale in warfare and brought forth lasting continental size empires. This process began around A.D. 1200 and gathered momentum especially around A.D. 1400. In China, the Mongolian Yuan dynasty reigned from A. D. 1279 to A. D. 1368 and was succeeded by the Chinese Ming dynasty which reigned from A. D. 1368 to A. D. 1644. Then the Manchurian Ching dynasty ruled from A. D. 1644 to A. D. 1911. In India, the gun powder empires were the Sultanate of Delhi and the Mughul Empire (A. D. 1526 to 1858). The Ottoman Turks established the gun powder Ottoman Empire in Middle East and Southeastern Europe in A. D. 1350. There was a series of gunpowder imperial regimes centered on Persia, including the Ikhanate, the Timurid Empire and the Saffavid Empire. In Japan, there was the Tokugawa Shogunate.

A similarity between these gunpowder empires was that they controlled an extensive territory or sphere of influence and had practically nothing to fear. They were complacent, lethargic states or revenue pumps, as noted by Jones (1981, 1988). They offered very few overhead services necessary for the proper functioning of the economy and society. They governments were too small to be able to penetrate and mobilize the society for state purposes as well as simply too inefficient and corrupted. They were in general isolationist and anti commerce or did not put much emphasis on commerce or economic development. Consequently, the developmental momentum of the medieval era on these diverse lands died out. In fact, before the arrival of the Europeans, these gunpowder empires were entering into some kind of a synchronized decline. Asian trade was in general shrinking, according to Simkin (1968, p. 258-9) and Jones (1981, p. 170).

Of the major civilizations, only the geographically fragmented Europe escaped the fate of the gunpowder empires. The gunpowder military revolution caused petty feudal estates and principalities to be consolidated into national states which continuously engaged each other in large scale warfare or other forms of interstate rivalry. The perpetual and intense interstate power struggles produced positive effects on the development of Europe, economic, political, social and cultural. According to North (1995, p. 13-17; 1998, p. 16-19), military technological changes since late medieval era that raised the scale of warfare in Europe led to greater revenue

demand on the state and pushed the state to provide more public intermediate inputs and better institutions including property rights regime. The absolutist states formulated forward-looking policies. Statesmen and scholars produced mercantilism for guiding public policy. Private individuals published exhortations to purposeful development. The English measured themselves by their successful Dutch cousins. France in turn was driven by her rivalry with England to promote manufacturing. The rivalry with Prussia led Austria to reform her laws and public administration. Russia under Peter the Great forcefully westernized and modernized to join the rank of the great powers. The interstate rivalry caused the European states to outdo each other in almost all fields of human endeavors: overseas explorations, manufacturing, scientific enquiries, technological innovations as well as improvements in laws, public administrations and the overall institutions of the state. In their effort to outdo each other, the European states produced the great cultural, economic, political and social achievements that we called industrialization and modernization.

The two key features of a modern society, the modern service state and the civilian control of the military were the results of this intense interstate rivalry. To support the massive military establishments ushered in by the gunpowder military revolution, states in Europe greatly expanded their services to the economy to boost productivity and raise revenue. This resulted in the well-known Wagner's law in public finance of a rise share of public sector in the economy as per capita income increases, a topic studied in Bird (1971). In fact, the expansion of the service state stimulated by the increasing scale in warfare went so far in Europe that it led to the civilianization paradox of war making and state making observed by Tilly (1992): the greater scale of warfare actually resulted in a smaller share of the military in the public sector in terms of both budget size and number of personnel and the civilian control of the military.

6. CONCLUSIONS.

The model demonstrates the effects of military technology and international military competition on the size and composition of the economy and government. Case studies from world history affirm the insights generated by the model. Therefore there should be more research on this

topic.

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