

## Chapter 11

### Conclusion and Summary

This study had the goal of constructing a theory with which to understand the relative rise and decline of Great Powers in the industrial era. After reviewing the economic and political science literature, I concluded that existing theories of rise and decline are lacking for deficient major reasons.

First, a logically consistent definition of a Great Power does not exist. Even though Great Powers are the most important nations in the international system, there is no measure that can be used to distinguish between Great Powers and nonGreat Powers. By carefully constructing measures of power, I proposed methods of determining the set of nations that are the Great Powers.

Second, theories of rise and decline of nations in general rely on the concepts of property rights, diminishing returns, and technological change that are not capable of explaining the phenomena of variation among nations through time. In the case of property rights, both Robert Gilpin and Douglass North use historical examples that would indicate the greater importance of the political distribution of power within a nation.

Both Gilpin and North also continually refer to technological change as an important factor for growth, as do neoclassical economists. In the case of the concept of technological change, the problem is not that the concept does not have the potential to be a powerful explanatory variable; the problem is that technological change becomes an exogenous force that cannot itself be explained or accounted for.

Finally, both Gilpin and the neoclassical growth economists assume that the concept of diminishing returns is an important one for explaining economic phenomena. However, it is impossible to explain why something increases, as in the case of economic growth, by referring only to a concept that involves decrease, as in the case of diminishing returns. As Solow showed, technological change must be invoked in order to overcome the contradiction, but neoclassical economists have not been able to explain technological change.

Scholars are led to the door of technological change without entering the house. The reason for this reluctance is that these scholars do not attempt to explain or explore the realm of production because they focus on the nature of exchange. By contrast, this study focuses on the processes of production, and by doing so, is able to explain technological change, and thereby rise and decline, in a more satisfactory manner than before.

In order to explain production and its role in the international system, it is necessary to confront the problem of the complexity of social systems. Gilpin, North, and the neoclassical economists attempt to simplify reality by assuming a system of homogeneous elements, which can be described according to aggregate behavior. This methodology was originally inspired in the nineteenth century by the fields of classical and statistical mechanics in physics. However, the field of biology and its several subfields, as well as other historical sciences, have fruitfully applied a methodology of looking at their domains of reality as made up of a hierarchy of systems. These systems are made up of components that are not homogeneous, but heterogeneous. When a system is heterogeneous, it is necessary to disaggregate the various measures of the

system. Each of these different kinds of elements in such a system often fulfill different kinds of functions within the system. I constructed a general model of systems, based on the work of international relations theorist Kenneth Waltz, that stressed the different functions that different parts of a system may perform.

Adding to Waltz's model, I proposed that some systems *allocate* the output of a system, and some systems *generate* that output. The work of economists (and Waltz) concentrate on the allocational aspect of systems. In order to understand production, however, it is necessary to concentrate on the generative aspect of systems. Systems that generate contain stages or steps in a sequence or cycle of elements, each element fulfilling a separate function in the process of generating output. By contrast, allocative systems contain similar elements which can be measured according to one standard. A system containing both a generative and allocative subsystem, therefore, includes both a set of elements which are different, and an output which can be measured and allocated according to a standard of measure.

A generative system often contains a tripartite structure, that is, there is a *metagenerator* stage that generates itself, a *generator* stage that uses a metagenerator to create generators, and an *output* stage that uses a generator to produce output. Because of the metagenerator stage, exponential growth is possible. Thus, there is a positive feedback process within generative systems that accounts for the growth of many systems. Negative feedback operates in a generative system by requiring the balanced growth of all components.

By contrast, an allocative system contains a possible positive feedback process in which one element or set of elements controls or comes to contain more and more of the

other elements. In an allocative system, negative feedback operates by preventing this snowballing accumulation by any one element or set of elements.

Thus, to understand a system, one must understand the systems that are the elements of the system under consideration, one must find a measure that is common among all elements of the system, the functions (including generative and allocative functions) must be determined, and the positive and negative feedback processes must be ascertained.

In addition, some elements in a system have greater capability to cause change than other elements. The process of growth is nonlinear; that is, a change in one element may have a greater than proportional impact on the other parts of the system. When change in an element in a generative system creates greater change in the system as a whole than change in other elements, the element has greater causal capability, according to my theory of systems.

By focusing on the generative function, the concept of time becomes important, because a sequence or cycle orders elements in time. Because of the explicit integration of the concept of time in the definitions, the discussion of change within systems becomes easier. By contrast, neoclassical economists and social scientists in general are often more interested in equilibrium, which directs attention to static phenomena, than change. Since rising and declining are processes of change, a methodology in which change remains central is appropriate.

The theory of a system was used as a template to construct theories of particular systems of interest, and in particular, theories of political systems, economic systems, and systems of political economy. In turn, these particular theories of systems were used to

generate hypotheses. By conceiving of reality as a hierarchy of systems, the complexity of social systems can be simplified enough to aid in comprehension, while retaining the detail required to understand the system as a whole.

In order to understand a complex social reality, there must be some criterion for dividing that reality into categories. I chose material categories, and thus the political domain encompasses control over space through time, while the economic domain encompasses the transformation of matter/energy through time. The political economic domain therefore encompasses all of material social reality.

A domestic political system contains a generative subsystem, the state, which has a tripartite structure. The state elites generate themselves, and are used to generate the bureaucracy, which generates the final output, the means of violence. Control is allocated within a polity monopolistically by the state.

An international political system, on the other hand, has no generative subsystem, and is equivalent to Waltz's conception of an international system, that is, it is an allocative system. I gave a definition of a Great Power that can be used to understand an international political system: Great Powers, collectively, control the reallocation of territory within the international political system.

An economic system, like a domestic political system, contains a generative subsystem. This subsystem generates the goods and services of an economy, while the allocative subsystem distributes those goods and services. The generative subsystem of an economic system I called a production system.

Understanding the production system is the key to understanding technological change as well as the capabilities upon which national power is based; and therefore the

production system is the single most important cause of the rise and decline of Great Powers. In neoclassical economics and much of the scholarship in political science, the production system is considered to be a homogenous mass of capability, with no useful distinctions among its parts. The production system is considered to be a “black box.” The intention of this study is similar to one expressed by Nathan Rosenberg, in the preface of his seminal work on technology and economics, *Inside the Black Box*: “The purpose of this book is to break open and to examine the contents of the black box into which technological change has been consigned by economists” (Rosenberg 1982, vii). This study has also examined the contents of the black box into which *production* has been consigned.

In order to undertake this endeavor, I examined the inner workings of the production system. First, I identified four categories of production – structural, material, energy-converting, and informational. Every technology can be categorized into one of these categories of production. Production requires all four categories, and they are mutually beneficial. Thus, technological advance in one category reverberates throughout the other three, and then back to the first category.

Second, I identified a tripartite generative sequence within the production system. In the reproduction machinery stage, classes of machinery are produced using those same classes of machinery, such as machine tools, steel-making machinery, electricity-generating turbines, and semiconductor-making equipment. These reproduction machineries are metagenerators, as defined above. They are used in the next stage, the production machinery stage, to make production machinery, which is used in the next stage, the final production stage, to make the goods and services that people use.

The reproductive nature of reproduction machinery gives industrial economies great economic power to generate goods and services through time. Because these machines reproduce themselves, economic growth has been exponential since the start of the Industrial Revolution. They enable a positive feedback process of growth to occur. Any technological change that occurs in the reproduction machinery sectors has a greater impact than any other change in the production system. Changes in the production machinery sectors are the second most important kinds of changes in the production system.

By combining the four categories of production with the three stages of production, I modeled the production system as containing twelve production system niches, presented in a diagram called a production matrix. If a production system contains all of these niches, it reaps the benefits of the positive feedback processes within both the stages and categories of production.

The production system is composed of niches, and each niche contains, among other factors of production, a capital system. This capital system is also a tripartite generative sequence. Researchers add to a stock of knowledge, and teach more researchers. Researchers and the stock of knowledge are used in the next stage to produce engineers, who use the stock of knowledge to design machinery. Skilled production workers and operational managers use these designs to build the machinery which constitutes the physical capital, along with physical structures and natural resources, which is used to generate the output of all of the niches of the production system.

These human capital workers – researcher/teachers, engineers, and skilled production workers – are the agents of technological change. Support for their efforts, in the form of resources and access to one another, is critical if technological change is to occur. These people are constantly innovating-by-doing, creating new methods of production by being intimately involved in the production process itself.

One of the most important functions of an explanatory framework, such as the one offered in this study, is to direct the attention of scholars to particular sets of phenomena that the framework leads the scholars to conclude are among the most important phenomena. In this study, the role of human capital workers has been emphasized. These professions, and especially the engineers and production workers, are only rarely examined. In addition, the literature on technological innovation has tended not to be based on a solid understanding of the crucial role of production in the innovative process.

By constructing a systems-based framework, it was possible in this study to construct a useful measure that can be applied across all of the elements of the production system. I devised three such measures – expenditure, value-added, and capital assets measures. Using these measures, I diagrammed a tripartite input-output model, which can be used to simulate a production system. The capital assets measure is the most important measure, because physical and human capital is the generative substance of a production system.

Thus, by using my theory of systems, I have been able to construct a theory of production that both models the complexity of production and allows for comprehension and analysis. Technological change is not a homogenous entity; it is specific to its

position in the system of production, and its influences and influence are dependent on the structure of the system of production.

Once the production system is specified, several aspects of the rise and decline of Great Powers become manageable. The rest of the economic system, the retail/wholesale and financial systems, are used to allocate that which the production system generates. The domestic system of political economy, or nation, is composed of an economic system, the state as specified in the theory of political systems, and the population. The economic system has the function of transforming matter/energy, and the political system has the function of controlling the space. The economy needs the state for protection and enforcement of laws, and the state needs the economy for the resources with which to operate. A nation is therefore composed of two functions, the economic and political, which are mutually reinforcing.

A critical class of machinery that is constructed by reproduction machinery is destruction machinery, or military equipment, which is used by the state to control its territory and to either project power against other nations or protect itself against military force. Destruction machinery can only exist in the realm of political economy; it is neither purely political, because it is a produced good, but it is not purely economic, because its purpose is to control space.

The concept of a domestic system of political economy is based on the concepts of its components, which are themselves systems. Since destruction machinery is critical in a political system, and reproduction and production machinery are critical in the economic system, within a system of political economy capabilities can be measured by accounting for all three kinds of machinery. The distribution of capabilities among

nations can be measured in several ways, all based on the capital assets that are contained within the territory of a nation. In other words, the power of a nation is based on its human and physical capital.

The Great Powers of the industrial era have been those nations that have collectively controlled the change in allocation of territory because the Great Powers are those nations that have controlled, within their territories, the global reproduction, production, and destruction machinery niches. This is my fourth hypothesis of systems of political economy. This definition is made possible because of the theories of systems which preceded its introduction. It is therefore built on a solid theoretical base and can be measured, unlike the definitions of a Great Power catalogued in Chapter One.

By constructing a standard measure of political economic capabilities, it is possible to understand some of the processes of the international system of political economy. If the power of a nation is stronger than one of its neighbors, it may attempt to conquer that nation and integrate its production system into its own. Thus empowered, the conquering nation has a greater capability to conquer yet more nations, and so on, until a balance of power forms. This snowballing accumulation of power is the manifestation of the positive feedback process that is possible within the international system, and has accounted for much of the state formation of Great Powers throughout history.

The political economic power of a Great Power has generally risen since the advent of the modern nation. In a modern nation, there is a balance among its subsystems, that is, the state, the production system, the financial system and the population. Because of this balance, a negative feedback process operates such that the

state, financial system and population are unable to deplete the nation to the point of absolute decline. Instead, decline has generally been relative. This is because, unencumbered, the growth-enhancing positive feedback processes within a nation are very powerful.

The positive feedback processes of the production system are the engine of growth upon which rise ultimately depends. The financial system forms a positive feedback loop with the production system, ideally recycling resources into the appropriate sectors of the production system. The state then forms a positive feedback loop with the entire economic system, feeding resources and management into the economic system.

This balance is made possible by at least a partial control of the economic system over the state in the form of some sort of democracy, and a management of the state over the financial system. Without this balance, the state has the power to deplete the production system to the point of absolute decline, as occurred in totalitarian systems of political economy.

Great Powers have evolved over the centuries in terms of the structure of their domestic systems of political economy. Starting with a partial democratic system, they have also had to grow in size so that all the niches of a production system can be contained within the nation, usually in the form of a nation-state. They have had to industrialize in order to survive in an industrial international system, and the state has become involved in the management and maintenance of the production system which makes industrial power possible.

As the Great Powers have evolved, so have all the other nations, which have either adapted or been conquered and dominated. The process of rise and decline continues, as the structures and processes of the production systems, capital systems, political systems, and systems of political economy are changed through constant innovation of the elements of the system.

This system of systems, as proposed in this study, provides the opportunity to model the processes of rise and decline as they occurred in the industrial era. Standards have been proposed with which to measure the relative power of nations and Great Powers, and with which to simulate the operation of particular systems, such as capital system, the production system, the economic system, and the domestic system of political economy. It is also possible to simulate the international processes of political economy using the measures and system models as developed in this study.

In order to model the complexity of the processes of rise and decline, I started by conceiving of reality as being divided among levels, as a hierarchy of domains. Each level is composed of elements which exist at level below; thus, the concept of a hierarchy of domains led to the concept of systems composed of elements. A system composed of elements, in turn, can be functionally differentiated, since the elements can encompass different functions. Once there is functional differentiation, it is possible to conceive of sequences through time composed of the functioning of different elements. Production can therefore be modeled, because production must occur in a sequence of functionally differentiated steps through time. Once production occurs, reproduction is possible, because reproduction is the production of a class of objects by a similarly produced class

of objects. Therefore, a positive feedback, exponential process is possible, and therefore growth in general can be explained.

Economic growth leads to absolute national rise, and those nations and Great Powers that grow faster rise relative to those which grow more slowly. This study has proceeded through the following conceptual sequence in an effort to understand rise and decline: Levels of systems → elements within systems → functional differentiation of elements → sequence of functions → production of output → reproduction of generators → positive feedback processes → growth of systems → relative rise of elements (Great Powers) within a constantly evolving system (the international system of political economy).

The most important single cause of the rise of a Great Power (or any nation) is the growth of the production system (as I claimed in my sixth hypothesis about systems of political economy). The most important single cause of the rise of a production system is the growth of the reproduction machinery niches, the production machinery niches, and the final production systems, respectively. The growth of these stages of production must all occur within an environment of the balanced growth of the structural, material, energy-converting, and informational categories of production. The single most important cause of the growth of these niches (as well as others) is the performance of their capital subsystems, which are based on the human capital workers. In order of importance, these human capital workers are researchers, engineers, and skilled production workers (including operational managers).

The financial system is indirectly important because of the way in which the financial system redirects resources back into the production system. The state is

indirectly important because of the protection it offers to the economic system as a whole and because the state manages the various subsystems of the economic system, most critically the production system. Finally, rise and decline of a particular nation or Great Power is relative to all of the other nations or Great Powers of a particular period of time. The international system is a cause of rise or decline because of the opportunities or constraints existing in its structure, and the actions taken by the leaders of nations within the context of that structure.

A framework has been established with which to explain the causes of the relative rise and decline of Great Powers in the industrial era. Further research is needed to validate the hypotheses advanced in this study, so that this framework may be used as an alternative to the theories offered by scholars in the past. Clearly, this new research should focus on the processes by which nations enhance their power to create wealth.

## Summary of System Theories

This section is provided as a reference for the concepts developed in the previous chapters. In particular, this section records the particulars of the various systems and hypotheses proposed.

### PART 1: SYSTEMS

Because the causes of the rise and decline of Great Powers are very complex, it was necessary to construct a theory of systems which could be used to construct theories of particular systems.

A system was described as being composed of the following (from Ch. 4):

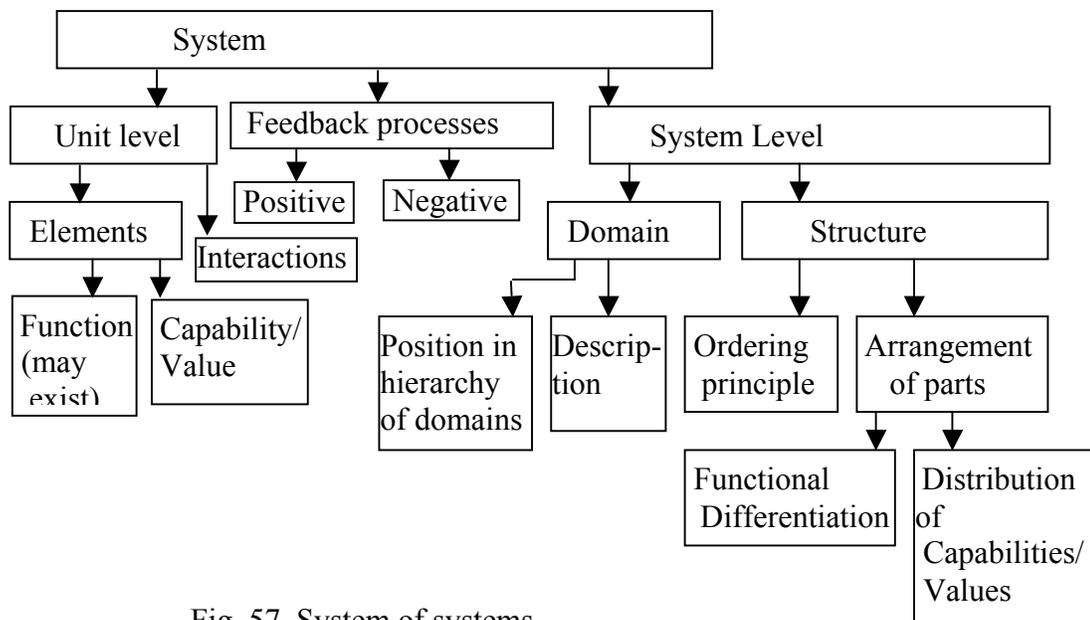


Fig. 57. System of systems.

By conceiving of reality as a hierarchy of domains, I was able to divide social reality into a system of systems, with the following structure:

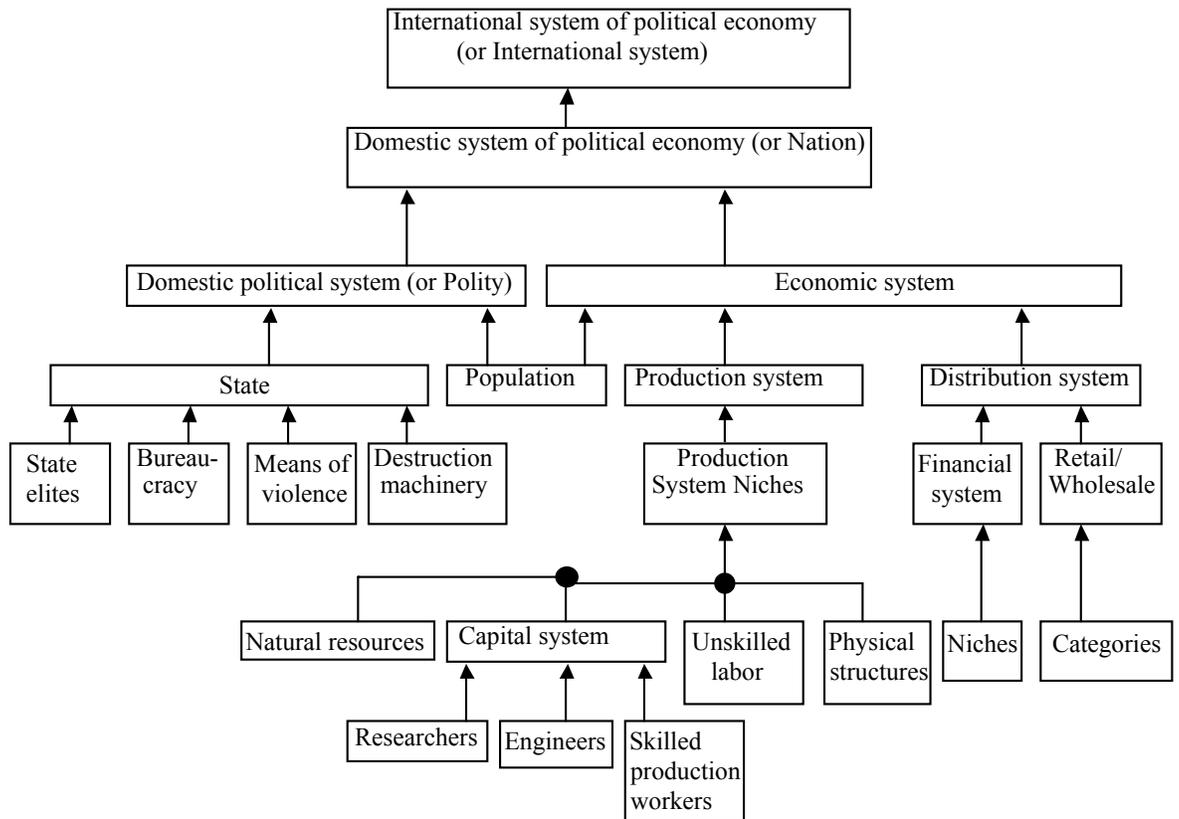


Fig. 58. Full specification of hierarchy of political economy.

There are seven levels in this hierarchy of domains. Each component, except at the top and bottom, are both systems at one level and elements of a system at the level above. The system of the international political economy is the top level, which is made up of elements which consist of domestic systems of political economy, in other words, nations. Nations are composed of two subsystems, a political subsystem and an economic subsystem; this is the level of social subdomains. Below political and economic systems we have the level of domestic political economic *systems*. Below these are *subsystems* of domestic political economy, such as the production system and the state. The next two levels are, for the most part, specific to elements of the production system: first, the factors of production

compose every element of a production system; second, the capital system, which is a factor of production, is composed of human capital workers.

Since most components of the hierarchy of domains are systems, and each system, as shown on the first diagram of this chapter, is composed of many systemic elements, a large number of systemic elements have been presented in chapters five through eleven. In the next two pages, I present tables which state the various elements of most of the systems discussed in this study. I indicate the following aspects of the system: whether the system is allocative, generative or both; what kind of ordering principle or principles may be used (cycles and sequences are the two types of ordering in time, and “func set” is an abbreviation of “functional set”); in the case of a functional differentiation among elements, the types of elements are listed, and if there is no functional differentiation, only the one type of element is shown; the measure of the distribution of capabilities; the causal capability of the elements; the description of the domain of the system; the positive and negative feedback process or processes at work; and finally, the definition of power for a system, if applicable.





## **PART TWO: HYPOTHESES**

The theory of systems, as shown in chapter 4, yielded many systemic elements which were used to construct theories of specific systems, as shown in the previous two pages. Thus, my theory of systems was used to generate theories of specific systems. In turn, I used the theories of political, economic, and political economic systems to generate many hypotheses. The following summarize these hypotheses, which are numbered for each system:

The following are the hypotheses about political systems:

- 1) A dictatorship will impose greater violence on the population than a democracy.
- 2) Great Powers are those polities that, collectively, control the change in the allocation of territory and the associated resources among polities
- 3) A balance of power is a reaction to a positive feedback process in an international system
- 4) Most large polities have been created as a result of the positive feedback process of conquest, and many wars are caused by this process.

The following are the hypotheses about economic systems:

- 1) There is a positive feedback process of technological change among the four categories of production
- 2) It is because of the ability of the reproduction machinery to be mutually causative and reproductive that economic output has increased exponentially since the advent of the Industrial Revolution
- 3) There is an ordering of the capability to cause technological change within the production system which reflects the sequence of stages of production, from reproduction machinery as the most powerful source of technological change, to production machinery as less powerful, and to the final production stage as least powerful
- 4) There is an inherent contradiction between the causal capability of machinery industries and their relative capabilities as measured by expenditure or revenue generation, and because of this discrepancy, industrial economies are in constant danger of suboptimal technological change
- 5) Nations rise economically by moving up the stages of production in terms of competence, from production to production machinery to reproduction machinery. Nations decline by moving down those same stages of production, first losing competence in reproduction machinery, then in production machinery, and lastly in final production.
- 6) A complete production system is greater than the sum of its parts; both the stages and categories of production participate in a mutually self-reinforcing, positive feedback process of production and technological

change. There is a negative feedback process within a complete production system because there must be a balanced pattern of growth among all niches.

- 7) Part of the cause of innovation is production, or innovating-by-doing.
- 8) Innovations depend on the level of resources directed toward the innovators, in the form of income, educational facilities, and research/work facilities
- 9) Innovation is encouraged by the wide distribution of access to the various forms of capital, be they the stock of knowledge, designs, or machines, or their human counterparts, researchers, engineers, and skilled production workers. In other words, the free flow of people and ideas is an important determinant of technological innovation
- 10) As a production system of a nation continues to grow and generate more and more output, more and more economic power accrues to the financial system because the financial system is able to control a larger and larger amount of output

The following are the hypotheses about systems of political economy:

- 1) A Great Power must have a complete system of political economy, or it will cease to be a Great Power

- 2) Great Powers must possess the productive resources necessary to generate a large enough quantity of military power necessary to fight effectively in a war involving all Great Powers.
- 3) Because of the importance of reproduction machinery for the creation of destruction machinery, and the importance of final production goods and services in order to feed and cloth the armed forces of the nation, the state has generally had a motivation to recycle resources back into the production system
- 4) The Great Powers of the industrial era have been those nations that have collectively controlled the change in allocation of territory because the Great Powers are those nations that have controlled, within their territories, the global reproduction, production, and destruction machinery niches
- 5) There is a distribution of political economic causal capability within the machinery sectors of the nation, from reproduction machinery niches to production machinery niches to destruction machinery industries, respectively
- 6) The most important single cause of the rise of a Great Power (or any nation) is the growth of the production system.
- 7) The establishment of the modern state prevented the depletion cycle from leading to absolute decline; nations with a modern state do not decline absolutely, they only decline relatively. Modern nations usually rise absolutely because of the expansion cycle.

- 8) Partial to full control by the economic system over the choice of some or all state elites, plus partial control of the state over the financial system, results in a situation that allows for the dominance of the expansionary cycle within a nation.
- 9) There is some territorial size for a system of political economy, which is both big enough to encompass all niches of a production system, but small enough to allow for intense interactions among the human capital workers who are responsible for the output and development of those niches.