# Dynastic cycle: A generic structure describing resource allocation in political economies, markets and firms

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**Abstract**

A generic system embodies basic principles and insights that are common to a set of diverse cases and situations. For example, a generic system called “limits to growth” captures the constraints experienced by an organization due to the scarcity of an important resource. Its manifestations range from the tragedy of Easter Island to rise and decline of People Express Airline to the spotty performance of early peer-to-peer music networks. This paper presents a new generic system that we name the dynastic cycle system. It is based on a stylized model of events from the Chinese history. It describes resource allocation between social, asocial and control uses in a variety of institutions, including political economies, markets and firms that experience cyclical behavior and homeostasis symbolizing low levels of performance. Numerical simulations with the model are used to test several policy scenarios.

Keywords: system dynamics, political economy, dynastic cycle, systems, simulation

## Introduction

Availability and use of resources affects institutional performance, whether the institution is a country, an economy, an organization or a firm. Because institutional decision makers act in the presence of externalities, feedbacks, constrained capacity and delays, resource misallocations and system instability are quite common. It is, therefore, desirable to identify the shared characteristics of resource allocation decisions and to describe generic policy frameworks for avoiding resource misallocation and instability in a variety of societal institutions.

Within the field of operations research, resource allocation problems are formalized as mathematical models, which are seen as “idealized representations” of reality (Hillier and Lieberman, 1972). Some well-known metaphorical models are: the diet problem, the shortest route problem (also known as the traveling salesman problem), the transportation problem, and the assignment problem (Hillier and Lieberman, 1972). Similar canonical models are found in other threads of modeling closely related to operations research. In system dynamics, for example, Morecroft et al. (Morecroft *et al.*, 1995) offer a model of two showers that share a water source. The model, which is a metaphor of competition for common resource, is used to explain difficulties experienced by a real-life international manufacturing firm.

As Krugman (Krugman, 1993) points out, socio-economic systems are also understood in terms of metaphorical models. Indeed, perfect market, competition, monopoly, equilibrium growth, etc., are all highly stylized abstract concepts that are often applied to more complex situation. Usher (Usher, 1989) presented a model of a dynastic cycle in ancient China. The model was later extended by Feichtinger and colleagues (Feichtinger and Novak, 1994; Feichtinger *et al.*, 1996). The distinctive feature of the dynastic cycle models is the presence of three resources framed as metaphorical populations of farmers, bandits and soldiers. Farmers are the only productive resource, while bandits plunder farmers and soldiers are hired to protect farmers. Such models produce cycles which are interpreted as oscillations between anarchy and tyranny.

While early models of the dynastic cycle captured the interdependence between populations, they did not include the capacity constraint, nor did they adequately address the dynamic patterns of behavior the system generates and their relevance to pervasive problems and policies. In this paper, we extend previous models in three ways. Firstly, we add the capacity constraint and explore its effect on the performance of the system. Secondly, we explore both the dynamic behavior and the homeostasis of the system under various policy regimes. Thirdly, we demonstrate that the underlying structure of the modified model is generic and contains elements that are common to political economies, markets and industries. Within system dynamics, sets of basic principles and insights common to diverse cases and situations are called generic structures (Lane, 1998). Hence, we suggest that the dynastic cycle model is an embodiment of a generic structure that describes a wide range of situations.

In the following section, we review early models of the dynastic cycle. We then present a formal computer model. A numerical implementation of the model is used for exploring the dysfunctions in political and economic institutions. We conclude that while a dynamic equilibrium can exist in a dynastic cycle system, the disturbance of this equilibrium will create oscillatory behavior. Finally, we recast the model as a generic structure before concluding in the last section.

## Dynastic cycles

Over the four millennia of Chinese history, at least thirty three distinct political regimes, or dynasties, ruled the country (Rodzinski, 1984: 437). A regime succession was usually accompanied by a decline in economic well-being of the country and general lack of order. The succeeding dynasty would typically improve the economic situation and restore order but eventually follow its predecessor's path of decline. Historians of China have dubbed the country's fluctuations in political and economic conditions a dynastic cycle.

There have been several formal attempts to explain the dynastic cycle. Usher (Usher, 1989) introduced a three-class framework, which consisted of the interacting populations of rulers, farmers, and bandits. In his model, population of peasants grows according to the birth and mortality rates which are linked to the economic conditions and the casualties inflicted by bandits. This simple model oscillates between two states: anarchy and despotism. In anarchy, there are few rulers and the main players are the farmers and the bandits. In despotism, all three groups have significant presence.

Feichtinger and Novak (Feichtinger and Novak, 1994) applied game-theoretic analysis to the same three-class framework. Rulers and bandits compete for the wealth of farmers. Rulers receive utility by collecting taxes from farmers and bandits receive utility by plundering the farmers. The appropriations by bandits are proportional to the wealth of farmers and are positively related to the plundering effort. Rulers attempt to prevent bandits from plundering. Rulers and bandits maximize their inter-temporal net utilities. By solving the optimization problem numerically, the authors showed the existence of a stable limit cycle solution.

Feichtinger et al. (Feichtinger *et al.*, 1996) extended earlier models to three dimensions. The distinct and non-mixing groups of rulers, soldiers and farmers interact in the predator-pray fashion: farmers are prey exploited by soldiers and bandits. The number of soldiers is positively related to the population of bandits. The growth of the farmer population is affected by mortality, which is a sum of the direct deaths from bandits and indirect deaths due to taxation by soldiers. The growth rate of the bandit population is proportional to the amount of the loot less the natural death rate and the casualties inflicted by soldiers.

While the above mentioned models capture the interdependence of competing resources, they do not address the issue of constrained capacity. In the following section we present an extension of the model in this direction.

# A Model of the dynastic cycle system

Following earlier leads, the model is populated by three classes: farmers, bandits, and soldiers. The class populations are state variables. We use $F$ for denoting the stock of farmers, $B$ for bandits, and $S$ for soldiers.

Farmers grow produce $Y_F = A_F \cdot K^{\alpha} F^{\beta}$, where $A_F$ is the productivity of farmers, $K$ is land, $F$ is the farmer population, and $0 < \alpha < 1$ and $0 < \beta < 1$ are corresponding elasticities of land and labor. We assume $\beta = 1 - \alpha$. The aggregate farmer disposable income is $I_F = Y_F - T - L$, where $T$ is the tax collection by soldiers and $L$ is the bandit appropriations. The disposable income per farmer is $i_F = I_F / F$. Averaged over a time constant of two years, it creates a perception of disposable income per farmer, $\overline{i_F}$, which is adjusted according to the following exponential averaging process:

$$\frac{d\overline{i_F}}{dt} = \frac{i_F - \overline{i_F}}{2}$$

A portion of the farmer produce is collected as tax to support an army of soldiers, $S$. Each solder costs $c$ to maintain, which determines the needed amount of tax: $T^* = c \cdot S$. Tax collection, $T$, can, however, deviate from the needed amount: $T = T^* \cdot e$. Here factor

$e$ is the economic well-being of a farmer. It is measured as the ratio of the perceived disposable income per farmer, $\bar{i}_F$, to the normal farmer income, $\tilde{i}_F$:

$$e = \frac{\bar{i}_F}{\tilde{i}_F}$$

Some farmer produce is looted by bandits. Loot per bandit, $l$, deviates from some typical level $\tilde{l}$ : $l = \tilde{l} \cdot e$ . This formulation implies that the loot is greater when peasants are doing well, and the loot is smaller when the economic conditions of peasants are poor. The aggregate bandit appropriations are $L = l \cdot B$, where $B$ is the population of bandits.

Following a broad interpretation, the bandit category also includes those extracting rent through bribes and levies and those engaged in forbidden production, such as gambling, gun running, prostitution and narcotic drugs. If $A_B$ is productivity of bandits engaged in forbidden production, then the non-legitimate production of bandits is $Y_B = A_B \cdot B$ .

The aggregate disposable income of bandits, therefore, is $I_B = L + Y_B$. The disposable income per bandit is $i_B = I_B / B$. Historic earnings create a perception of the income that a bandit can earn. We model the perception formation as an exponential averaging process with a time constant of two years: the change in the perceived disposable income per bandit, $\bar{i}_B$, is

$$\frac{d\bar{i}_B}{dt} = \frac{i_B - \bar{i}_B}{2}$$

Existence of bandits poses threat to society, which we measure with index $\gamma$:

$$\gamma = b_\gamma \frac{B}{F + S}$$

where $b_\gamma$ is a marginal threat from a bandit, which we assume to be constant.

The threat to society dictates the desired size of the army. The desired number of soldiers, $S^*$, is also dependent on the financial resources available for their support $T$ and the cost per soldier $c$:

$$S^* = \gamma \frac{T}{c}$$

The actual number of soldiers, $S$, is adjusted according to the following equations:

$$\frac{dS}{dt} = r_S$$

$$r_S = a_S^{in} \cdot F \cdot \left(S^*/S\right) - a_S^{out} \cdot S \big/ \left(S^*/S\right)$$

where $r_S$ is the solder recruitment and attrition rate. The first element in $r_S$ is the inflow of soldiers and the second element is the outflow of soldiers. Soldiers are hired from the population of farmers. When soldiers retire, they return to farming. Soldier inflow and outflow include first order controls. Parameters $a_S^{in}$ and $a_S^{out}$ are required in order to balance the inflow and outflow in a steady state.

Bandits come from the ranks of farmers. Some farmers are encouraged to turn to banditry when they perceive that banditry may provide them with better income than farming. This is measured by the farmer perceived relative income, which is a fraction of the perceived disposable income per farmer to the perceived disposable income per bandit: $i = \bar{i}_F / \bar{i}_B$ . Soldiers assure state control over the population. The extent of the control is measured in the model as a fraction: $\psi = b_\psi S / (F + B)$ . Parameter $b_\psi$ is the marginal state control achieved with each soldier.

We assume that there are some normal flows between the populations of farmers and bandits, that is, there are always some farmers turning to banditry and some bandits who return to farming. In a steady state the two flows are balanced. State control serves as a deterrent for the farmers to move to banditry, while it encourages the bandits to become farmers. A formulation that captures this recruitment and attrition dynamic is:

$$\frac{dB}{dt} = r_B$$

$$r_B = a_B^{in} \cdot \frac{F}{i \cdot \psi} - a_B^{out} \cdot B \cdot i \cdot \psi$$

The first element in $r_B$ is the flow from the stock of farmers to the stock of bandits and the second element is the flow from the stock of bandits to the stock of farmers. Parameters $a_B^{in}$ and $a_B^{out}$ balance the flows in a steady state.

The farming population is governed by the equation:

$$\frac{dF}{dt} = r_S - r_B \tag{1.1}$$

where $r_S$ is the net flow into the population of soldiers and $r_B$ is the net flow into the population of bandits.

The model was implemented in the simulation software *ithink* (available from ISEE Systems: http://www.hps-inc.com/). A graphical representation of the above-described model, as drawn by *ithink*, is shown in Figure 1. The diagram is a convenient visual way of representing equations, which adds to the transparency of the model. Following notation typical of system dynamics (Lane, 2000), stocks are shown as rectangles, flows are drawn as valve symbols, and parameters and intermediate computations are circles. Arrows indicate mathematical relationships between variables. To read more about the system dynamics methodology, one may start with Wolstenholme (Wolstenholme, 1982), which introduced system dynamics to the operations research audience of this journal. A comprehensive one-volume reference on system dynamics is Sterman (Sterman, 2000).

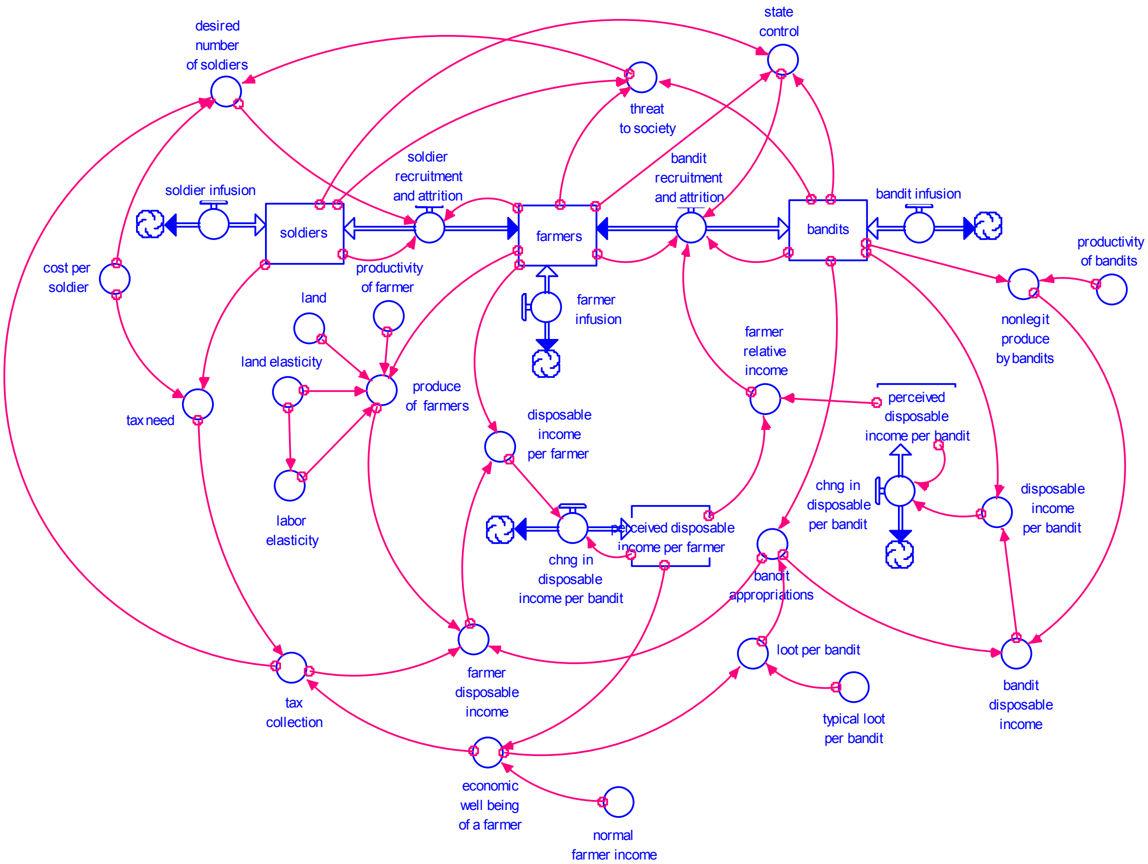


Figure 1: Stock and flow pictorial representation of the model

## Numeric simulation experiments

One of the benefits of system dynamics is that the methodology allows the flexibility necessary to design and test performance measures for systems when such measures may not exist in the original system (Wolstenholme, 1990: 111). To describe the state of the dynamic cycle system, we define two indexes: "freedoms" and "economic legitimacy." Freedoms is a ratio of farmers to the sum of bandits and soldiers: $\phi = a_\phi \cdot F/(S+B)$. Parameter $a_\phi$ is a normalization constant, which ensures that the value of the index is one in the steady state. The economic legitimacy index compares the volume of economic activity by farmers to the scope of the economic activity of bandits: $\lambda = a_\lambda Y_F / I_B$. Normalization factor $a_\lambda$ ensures that the index is equal one in the steady state. A phase plot of these two indexes defines the economic and political health of a society or an organization.

We initialized the model in equilibrium with 100 farmers, 10 bandits and 10 soldiers. Equilibrium values of the model are summarized in Table 1. For experiments, we disturbed the equilibrium in two ways: 1) by infusing a fixed number of additional members into the various population stocks; and 2) by changing the parameters representing the various productivities and scaling factors. Parameter sensitivity analysis of the generic system provides insights into entry points for change. Each change is interpreted in terms of a related policy event. The model is simulated using the Runge-Kutta method. The results of our experiments are discussed below.

Table 1: Equilibrium values

| Parameter | Definition | Value |
|---|---|---|
| $F$ | Farmers | 100 |
| $S$ | Soldiers | 10 |
| $B$ | Bandits | 10 |
| $c$ | Cost per soldier | 1.5 |
| $K$ | Land | 100 |
| $\alpha$ | Land elasticity | 0.7 |
| $A_F$ | Productivity of farmers | 1.2 |
| $A_B$ | Productivity of bandits | 0.5 |
| $\bar{i}_B$ | Perceived disposable income per bandit | 1 |
| $\bar{i}_F$ | Perceived disposable income per farmer | 1 |
| $\tilde{i}_F$ | Normal farmer income | 1 |
| $\tilde{l}$ | Typical loot per bandit | 0.5 |
| $a_\phi$ | Normalization constant | 20/100 |
| $a_\lambda$ | Normalization constant | 10/120 |
| $b_\gamma$ | Normalization constant | 110/10 |
| $b_\psi$ | Normalization constant | 110/10 |
| $a_B^{in}$ | Normalization constant | 0.01 |
| $a_B^{out}$ | Normalization constant | 0.1 |
| $a_S^{in}$ | Normalization constant | 0.01 |
| $a_S^{out}$ | Normalization constant | 0.1 |

## Population infusion

In this experiment, 5 units were infused in one of the stocks of farmers, bandits and soldiers population. Five units represent an almost 4.2 percent increase in the total initial population. Farmer infusion would correspond to population growth with fixed resources in a political economy or use of overtime in a company with fixed capitalization. Soldier infusion would imply expansion of government role in a political economy or expansion of administration in an organization. Bandit infusion would imply an externally supported growth in insurgent activity or a growth of parasitic or asocial subeconomies (such as businesses receiving special concessions or privileges supported by public funds) in a political system or recruitment of people to cook books, and exploit customers, employees or shareholders in a company.

The consequent changes in the political and economic health of the organization are summarized in a phase diagram in Figure 2. Economic legitimacy index is plotted against the horizontal axis and the freedom index is plotted against the vertical axis. The system is in the initial equilibrium in point (1,1).

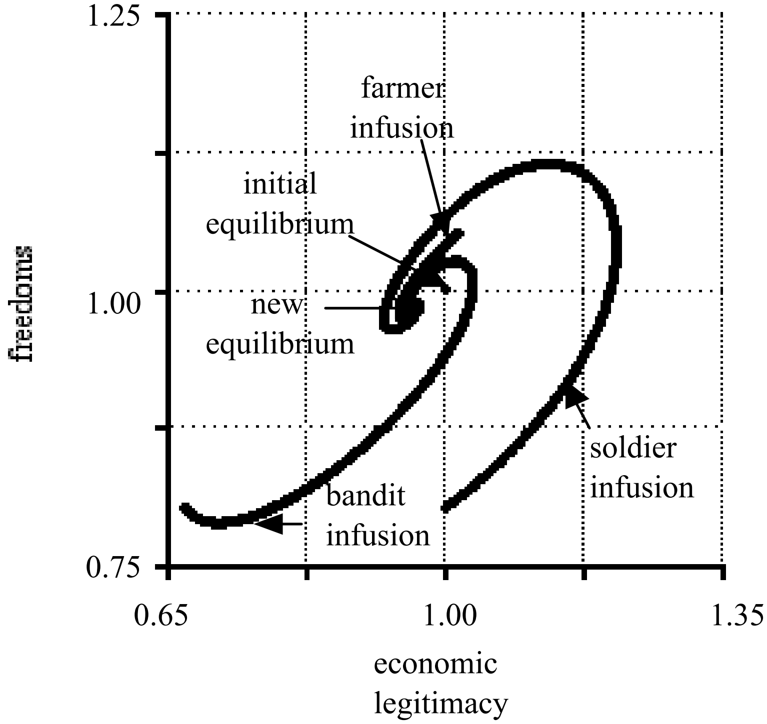


Figure 2: Dynamic behavior and homeostasis with infusion of 5 units in various population categories.

The end equilibrium for all cases is independent of the stock where the infusion was initially made and depends on the volume of the infusion, whereas, each infusion creates a unique path to the new equilibrium. We observe that the organization is worse off in the new equilibrium, since both freedoms and economic legitimacy are reduced. The change can be understood with the help of Figure 3, which gives major causal relationships of the model. Increase in the farmer population does not yield a proportionate increase in the produce due to land constraint and diminishing marginal productivity. The consequent decline in disposable income per farmer results in some defections into banditry, with concomitant hiring of additional soldiers – yielding lowering of legitimate produce, increase in bandit appropriations, increase in non-legitimate production and increase in taxes to support additional soldiers. With a higher proportion of population engaged in banditry and soldering than the initial proportions, freedoms in a political economy and worker autonomy and citizenship in a firm would suffer.

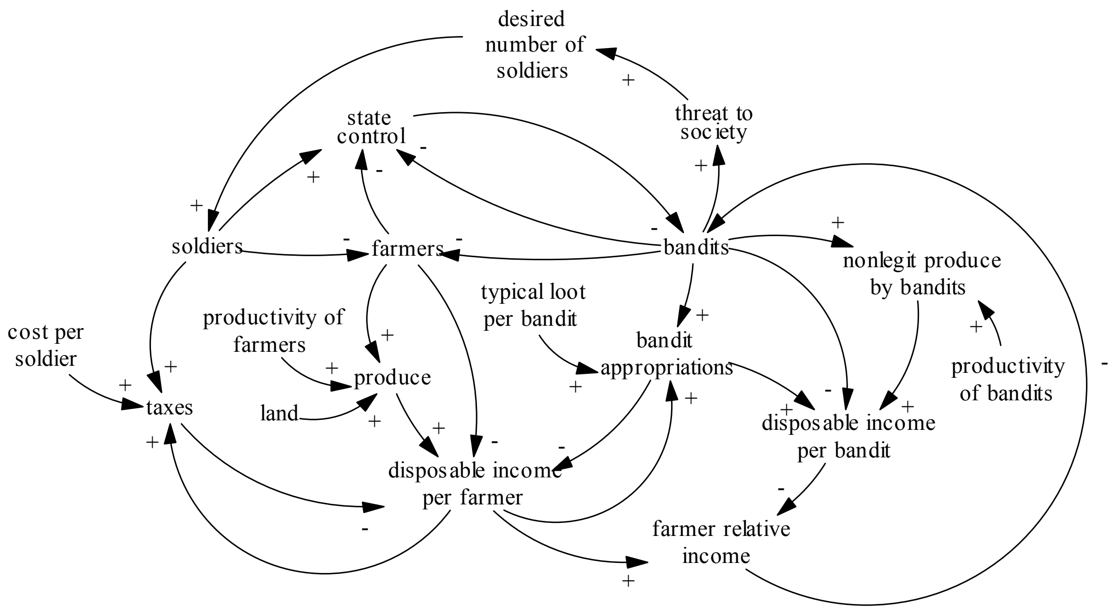


Figure 3: Simplified feedback structure of the model

As for the paths to the new equilibrium, soldier infusion will initially reduce freedoms, but the enhanced state control resulting from a larger body of soldiers will encourage defections away from banditry, thus moving the economy towards a higher level of legitimacy. Both reduction in banditry and the inability to collect the taxes needed for supporting the expanded soldier body will lead to their attrition into the farmer population, thus increasing freedoms and further raising the share of legitimate produce. The growing economy, however, allows the remaining bandits to increase their loot, while a reduction in their number also increases their per capita income, which makes it attractive for the farmers to start defecting into banditry. This starts a turnaround in both freedoms and legitimacy that moves the system towards its new equilibrium at lower levels of economic legitimacy and freedoms.

Farmer infusion initially increases legitimacy as well as freedoms since it increases the share of legitimate produce while also limiting the proportion of control institutions in the system. Increased produce and higher disposable income per farmer raise the loot opportunities for the bandits while reduced control encourages defections into banditry. Hence, the system rather quickly converges to its new equilibrium.

Bandit infusion initially decreases both economic legitimacy and freedoms. The increased threat to society resulting from this infusion calls for increasing the body of soldiers, which further suppresses freedoms. A decline in per capita income of bandits resulting from the infusion leads to an increase in farmer relative income. This, combined with increasing state control resulting from hiring of more soldiers, creates defections away from banditry and into farming and moves the system towards greater economic legitimacy and higher freedoms. However, as the marginal increase in the farmer production starts diminishing, banditry becomes more attractive again and begins to draw defections, which also fuel soldier hiring, thus moving the system back towards its new equilibrium.

We find that with a resource constraint, increase in any population beyond equilibrium yields suboptimal conditions. Increase in control beyond an optimal level warranted by the resources may create economic growth in the short run, but this growth cannot be sustained. Likewise, an expansion in legitimate production portfolio may increase general welfare in the short run, but the economy would return to a suboptimal equilibrium. Last, an increase in non-legitimate activity may initially drastically reduce welfare, but this will be a temporary condition and the system will return to a suboptimal equilibrium. Thus another lesson to be learnt is that expansion beyond the state afforded by resources will always lead to a suboptimal condition, no matter what path of growth is adopted.

### Sensitivity to policy-related parameters

We tested the sensitivity of the model to 20 percent increase in the following parameters:

1) productivity of farmers, which simulated technological growth;
2) land parameter, which corresponded to the discoveries of additional resources or their acquisition through colonization;
3) typical loot per bandit, meant to emulate an extension of the scope of the parasitic/asocial subeconomy through collusion with the government, public acceptance or external assistance;
4) productivity of bandits that imitated increased yields in the non-legitimate production process, possibly through collusion with government or external assistance, or through use of improved technology;
5) cost per soldier, which mimicked an increase in compensation or other privileges of the ruling personnel or increased capital costs of control infrastructure.

Each simulation started in equilibrium with the default values of its parameters (Table 1). The consequent changes in the political and economic health of the organization are summarized in Figure 4.

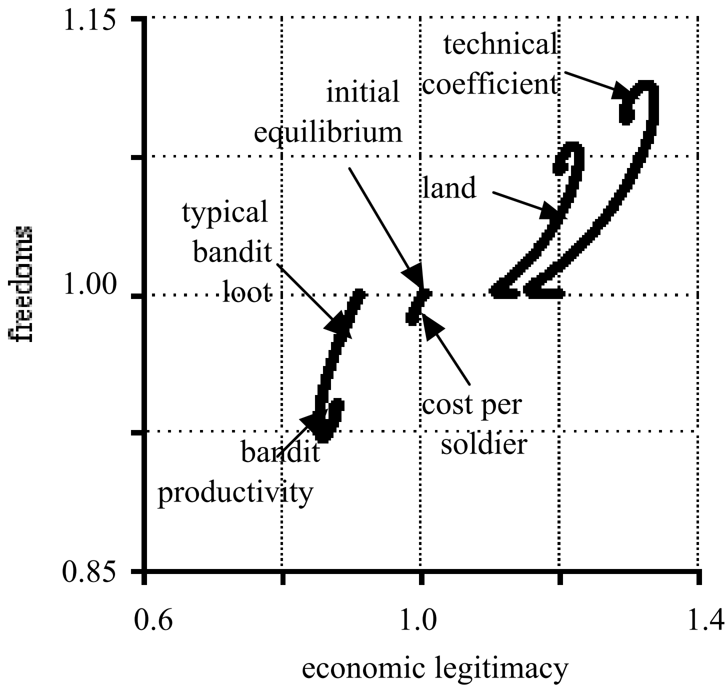


Figure 4: Dynamic behavior and homeostasis with 20% increase in policy-related parameters

Increasing production possibilities, either through technological improvements or through acquisition of new resources will increase the size of the legitimate economy providing greater economic legitimacy. This also increases loot per bandit, which causes the economic legitimacy to retract some. Improved farmer income resulting from increase in legitimate production, however draws bandits into farming. A reduction in the number of bandits also decreases the need for the control instruments and some of the soldiers can be released into the farmer's pool. Thus, the economy subsequently moves towards offering both greater freedoms, and more economic legitimacy. The crowding of the farmers sector, however, reduces income in it making banditry attractive again. As farmers move back into banditry, more soldiers need to be hired, which takes away more of the production. The system comes to a new balance at a higher level of legitimacy and freedoms than the initial level. The new homeostasis depends, of course, on the degree of technological growth achieved or the volume of additional resources acquired.

The effects of an increase in bandit productivity and loot per bandit almost coincide since both make banditry more attractive while also increasing the relative size of the non-legitimate economy. Defections into banditry require subsequent hiring of soldiers to maintain control, which further reduces farmer income because of the hike in taxation. Subsequently, economic legitimacy and freedoms are reduced. Crowding of the bandits sector and a reduction in bandit appropriations due to diminishing produce turn things around – moving the economy to a new equilibrium at a lower level of welfare in terms of freedoms and economic legitimacy.

An increase in the cost per soldier will move the system to a lower level of legitimacy and freedoms. Increased soldier cost reduces disposable income per farmer making banditry relatively more attractive than farming. As a result, some of the farmers are drawn to banditry. This requires hiring more soldiers to control the bandits, which further reduces farmer income. The society is worse off in the new equilibrium.

The results of our simulation experiments are summarized in Table 2.

Table 2: Summary of experiments

| Experiment | Policy instrument | Change | Effect |
|---|---|---|---|
| Population infusion | Farmer population, $F$ | + 5 units | All infusions converge to the same new equilibrium, even though each infusion creates a unique path. In the new equilibrium, freedoms and economic legitimacy are reduced. |
| | Soldier population, $S$ | + 5 units | |
| | Bandit population, $B$ | + 5 units | |
| Sensitivity | Productivity of farmers, $A_F$ | +20% | A new equilibrium is achieved at a higher level of economic legitimacy and freedoms. |
| | Land, $K$ | +20% | A new equilibrium is achieved at a higher level of economic legitimacy and freedoms. |
| | Typical loot per bandit, $\tilde{l}$ | +20% | A new equilibrium is achieved at a lower level of economic legitimacy and freedoms. |
| | Productivity of bandits, $A_B$ | +20% | A new equilibrium is achieved at a lower level of economic legitimacy and freedoms. |
| | Cost per soldier, $c$ | +20% | A new equilibrium is achieved at a lower level of economic legitimacy and freedoms. |

# Dynastic cycle system as a generic structure

Forrester, who originated the system dynamics methodology, has often stated his belief that a small number of pervasive generic structures can describe the majority of real-life situations (Forrester, 1980: 18). System dynamics has identified a number of such generic structures, which it expresses as: canonical situation models, abstracted microstructures, and counter intuitive system archetypes (Lane and Smart, 1996). Table 3 shows examples of such generic structures.

Canonical models are representative computer models that incorporate explicit stock and flow structure. Forrester produced a series of early canonical models. A market growth model (Forrester, 1968) described a generalized case of new product launch and distribution. A model of urban development (Forrester, 1969) was offered as a basic methodology for social analysis. The "World Model" (Forrester, 1971) was a general theory of the resource use on the planet.

Microstructures are representative computer models that also incorporate the stock and flow structure, but are smaller than canonical models. Each microstructure explains some specific mode of behavior: exponential growth, overshoot and collapse, exploding oscillations, damped oscillations, etc. Abstracted microstructures are the building blocks of larger models including the canonical models (Lane and Smart, 1996). Andersen and Richardson (Richardson and Andersen, 1980: 99) offered a catalogue of abstracted microstructures (they referred to them as elementary structures). Eberlein and Hines (Eberlein and Hines, 1996) offered a set of abstracted microstructures; they refer to the microstructures as molecules.

System archetypes do not include stocks and flows. They are feedback maps representing mental models (Senge, 1990). They can assist in understanding the behavior of complex systems and in devising solutions to problems that arise in such systems. An archetype can also facilitate the communication of simulation results, especially to a policy oriented non-technical audience (Lane, 1998). To aid in the selection of an appropriate archetype for a given situation, the archetype family tree can be used (Senge *et al.*, 1994). For example, the limits to growth archetype can be adapted to explain the Easter Island tragedy (Mahon, 1997) and the spotty performance of early peer-to-peer music networks (Pavlov and Saeed, 2004).

Table 3: Examples of generic structures

| | Generic structures | |
|---|---|---|
| Canonical situation models | Abstracted microstructures (Richardson and Andersen, 1980: 100) | System archetypes (Senge, 1990) |
| • Product launch (Forrester, 1968)<br>• Urban development (Forrester, 1969)<br>• Commodity production cycles (Meadows 1970)<br>• Ambitious product development (Graham, 1988)<br>• Economic growth and income distributions in a developing country (Saeed, 1994) | • A first order positive loop<br>• First-order negative loop<br>• Overshoot and oscillation<br>• Pure exploding oscillation<br>• Pure damped oscillation | • Limits to growth (also known as Limits to Success)<br>• Shifting the Burden<br>• Eroding Goals<br>• Escalation<br>• Success to the Successful<br>• Tragedy of the Commons<br>• Fixes that Fail (also known as Fixes that Backfire)<br>• Growth and Underinvestment<br>• Accidental Adversaries<br>• Attractiveness Principle |

Following Lane's terminology, our dynastic cycle model can be classified as a canonical situation model. When stripped of case-specific details, it is reduced to the level of abstract microstructure, as shown in Figure 5. Table 4 matches the generic resource allocation structure to some cases, which are explained below.

At the macro level, Saeed (Saeed 1988, 1994) suggested that resource distribution between production and renting institutions of an economy underlie income distribution patterns. Resource allocation between economic and control resources in an authoritarian political system can also be described by the structure (Saeed, 1986; Saeed, 1990). Under such conditions, the political economy vacillates between despotic rule and anarchy. The anarchy state begets a habitat for terrorism. Pavlov, Radzicki and Saeed (Pavlov *et al.*, 2005) explain the influence a superpower may have on a developing country using a similar generic structure.

Table 4: Selected cases subsuming the dynastic cycle structure

| **Case description** | **Social use** | **Control use** | **Asocial use** |
|---|---|---|---|
| Dynastic cycle model | Farmers | Soldiers | Bandits |
| A university or an innovation organization (Saeed 1996, 1998) | Faculty | Administration | Bureaucracy |
| A manufacturing firm (Andersen and Sturis 1988) | Manufacturing | | Sales |
| New realities in Central Asia (Saeed, 2003) | Legitimate economy | Authoritarian institutions, military, civil administration | Non-legitimate economy, terrorists, dissidents |
| Developing country political economies (Saeed 1986, 1990) | Economic resources | Control resources | Dissidence |
| Global political economy (Pavlov *et al.*, 2005) | Economic assistance | Military and security operations | Global terrorists |
| Peer-to-peer file sharing networks (Pavlov and Saeed, 2004) | Subscribers | | Free riders |
| A dual economic system (Saeed, 1988; Saeed, 1994) | Economic production | | Rent appropriation |
| Long term economic growth (Day, 2001) | Economic production | Infrastructure | |

There are several examples at the organizational level. Andersen and Sturis (Andersen and Sturis, 1988) describe the generic structure for the case of a manufacturing firm. In their model, a fixed number of employees are transferred between production and sales. A university may need to decide on the allocation of financial resources between administration and faculty (Saeed 1996). Professional and administrative groups compete for resources in an innovation organization (Saeed 1998). The production of an organization depends on the stock and productivity of its professional resource (for example, research stuff, professors, or consultants). However, there is also clearly a need for supporting administrative staff. An organization continuously balances the allocation of resources between these two uses in attempts of achieving organizational objectives, but may suffer an imbalance over the course of change.

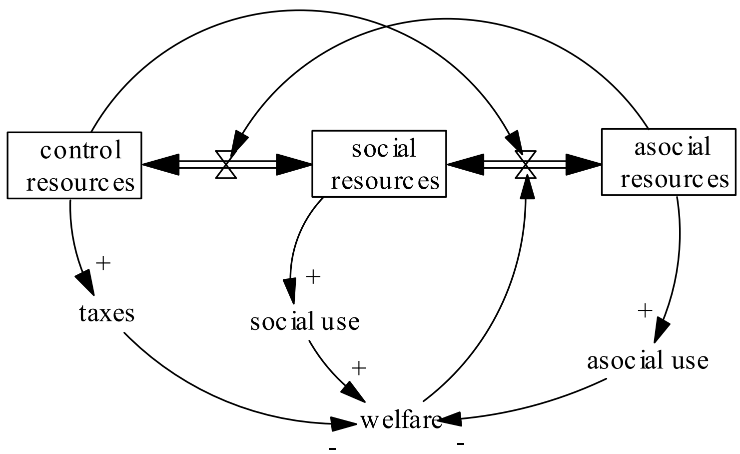


Figure 5: Generic structure of resource allocation

## Conclusion

Our model, as well as its predecessors, formalizes systems in which some resources are used for productive activities, some resources are engaged in parasitic/asocial activities and then some resources are allocated to attempts to limit the parasitic/asocial activity. The distinctive feature of our model is the presence of three resources framed as metaphorical populations of farmers, bandits and soldiers. Farmers are the only productive resource, while bandits plunder farmers and soldiers are hired to protect farmers. Such an economy produces cycles which are interpreted as oscillations between anarchy and tyranny.

Even though we took the clues for this paper in historic China, the framework developed here is applicable to the analysis of the political economies of high interest, such as Middle East and Central Asia. It can also be applied to the performance of the newly emerging markets, such as P2P and ecommerce, and to policy design for rejuvenating dysfunctional industrial sectors and firms where performance is sagging due to misallocation of resources. Moreover, the generic system can serve as a starting point for further policy investigations for specific real life cases. For example, in the realm of software world: software designers, hackers and computer security experts perform the roles of social use, asocial use and control respectively. In case of environmental management, resources must be allocated between activities that create preparedness for a disaster (soldiers) and those that avoid the disaster (farmers).

Our model has, however, several limiting assumptions that should be recognized when its underlying concept is applied to specific cases. For example, the model does not address collusion between soldiers and bandits, which has often been observed both in history and in some developing countries (Economist, 2005). It also does not address sustained population growth and the resource constraints on it, nor does it subsume reformist movements that would often precede exacerbation of resource misallocation in a political economy. Finally, it excludes learning processes that may change decision rules governing the resource allocation process. These limiting assumptions should be relaxed to develop specialized models related to specific issues to which our proposed archetype is applied.

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