Political Equality, Coalition Formation, and Economic Performance in Autocracies

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Autocracies have diverse records of economic growth. This paper provides a theory of endogenous coalition formation to explain economic performance in autocracy. The nature of the ruling coalition that the autocrat relies on to rule the society and extract rents affects the degree of inclusiveness of the autocracy's political and economic institutions that ultimately determines economic performance. A stable ruling coalition has to be invasion-proof --- i.e., being able to resist invasion from outside --- and coalition-proof --- i.e., being able to prevent split from inside. In a political environment where side payments are allowed to buy political support, a ruling coalition is coalition-proof if and only if it satisfies Condition E, i.e., every pair of its member groups holds similar levels of political power relative to the power of the autocrat. When more pairs of groups satisfy Condition E in a society, the ultimate ruling coalition becomes more inclusive and societal output is increased.

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1. Introduction

In a carefully executed empirical study, Glaeser, La Porta, Lopez-de-Silanes, and Shleifer (2004) find that after World War II, those once low-income countries that have managed substantial catch-up often started with autocracy and transited to democracy only after their income reached sufficiently high levels. Most of those countries are in East Asia. Of course, autocracy does not guarantee high economic performance. As a matter of fact, autocracies have more diverse records of economic performance than democracies. Among the 135 countries covered by the Maddison Project Database 2018, autocracies registered an average growth rate of 1.79% and a standard deviation of 1.50% in the period 1960 – 2010. As a comparison, democracies reached a higher growth rate of 2.33%, but had a smaller standard deviation of 0.52% in the same period.[1] So, what explains the diverse economic performance among autocracies?

An immediate candidate for the answer is regime stability. Olson (1993) and McGuire and Olson (1996) use the metaphor of stationary bandits to show how stability of a dictator's tenure can induce him to adopt pro-growth policies. Different from roving bandits --- bandits who loot and leave --- stationary bandits stay in one place and have the incentive to replace looting by taxation. Relieved by the random looting of roving bandits, people have more incentive to conduct long-term investment. As a result, the economy obtains a higher output. Besley and Kudamatsu (2007) present a similar idea. They show that when the power of the selectorate --- the body of people who are entitled to determine who is going to be the leader --- does not depend on the leader being in office, its threat of replacing the leader becomes credible and the leader chooses strategically to adopt growth-friendly policies. Using the length of a party in office as the indicator for the security of the selectorate, Besley and Kudamatsu have found supporting evidence from their dataset of autocracies. The secure power of the selectorate is an indicator for

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[1] The Maddison Project Database: https://www.rug.nl/ggdc/historicaldevelopment/maddison/releases/maddison-project-database-2018. The definition of democracy/autocracy is the same as it is in Acemoglu and others (2014). The dataset of Acemoglu and others (2014) is not used because it covers a shorter period than the Maddison Project Database.

regime stability. Furthering this line of argument, Gehlbach and Keefer (2011 and 2012) hypothesize and test that institutionalization (specifically, information sharing) within the ruling party drives better performance among autocracies.

This line of explanation, however, does not provide the conditions that foster regime stability, nor does it tell us how the autocrat secures her power in an environment where no credible institution she can rely on. This paper aims at combining these two aspects to put forward a theory of endogenous coalition formation in autocracy and study what kind of distribution of political power in society is necessary and sufficient to allow the autocrat to form a ruling coalition that is as inclusive as possible and thus promotes higher outputs. One of the most significant results coming out of the model is that the ruling coalition becomes more inclusive when political power is distributed more equally in society. This result is consistent with the idea of the political scientist Meredith Woo-Cumings when she tried to explain the economic success of Taiwan and Korea (Woo-Cumings, 1997). She put her emphasis on the role played by an amiable social structure in Taiwan and Korea, paradoxically, created by the Japanese colonial rule. The Japanese colonists intentionally restricted the growth of the landed class in its two colonies because they feared that this class would become a brewer for nationalist sentiments and organized upheavals against their colonial rule. "This discontinuity had a powerful leveling effect, equalizing incomes more than in most developing countries and providing a fertile ground for instituting effective interventionist states, which were given a relatively free hand to forge a developmental coalition as they saw fit." (Woo-Cumings, 1997; p. 331). Next, I will present the results of explorative statistical exercises based on the Maddison Project Database 2018 to support the role of a politically more equal society.

It is readily admitted that it is difficult to measure the distribution of political power in society. To do that, one has to identify political groups and then find a way to measure their political power. In many cases, neither is possible. However, most autocracies have only recently emerged from a traditional society and their political grouping is often based on the traditional social and economic structure. In this regard, land ownership is undoubtedly the most significant factor. Galor, Moav, and Vollrath (2009) theorize and empirically test that a skewed land distribution hindered the spread of public high schools

in the United States in the 19th and 20th centuries. Their explanation is that agriculture does not need well-educated laborers so large land owners blocked public high schools by wielding their political influence. Following the idea of Galor et al. (2009), here I use the land Gini coefficient to indicate the skewedness of the initial distribution of political power. The dataset of land Gini coefficients of 1960 compiled by Deininger and Olinto (2000) is by far the most complete in the literature. It includes 60 countries among which 39 countries started as autocracy in 1960 and lasted for a substantial period of time.[2] A more unequal distribution of land entails the existence of a strong landed class that is able to capture the government. As shown by Galor et al. (2009), this can retard economic growth in the long run. Therefore, here I study the growth of the 39 countries in the period 1960 – 2010 even though some of them transited to democracy in between.[3] Figure 1 then plots the relationship between the land Gini coefficient (%) in 1960 and the average growth rate (%) in the period 1960 – 2010 for the 39 autocracies. There is a clear negative relationship between the two variables. The trend line gives a coefficient of 0.0334 between the land Gini and average growth rate. This means that an increase of one standard deviation (15.78) in the land Gini would cause the average growth rate to decrease by 0.53 percentage points, which is 27.8% of the average growth rate of the 39 autocracies in the period 1960 – 2010.

[Figure 1 about here]

A more serious econometric exercise confirms the above result. To fully utilize the data, here I run a growth regression with all the 60 countries for the period 1960 – 2010. The regression imposes the same estimate for the initial per-capita GDP and a common constant for all the countries, but allows different estimates of the land Gini for democracy and autocracy. The result is:

$$Growth\ rate_{1960-2010} = -0.289 \ln GDPPC_{1960} - 0.024 Gini_{1960} + 0.009 Gini_{1960} \times D + 5.864$$

$$(1.75) \qquad\qquad (2.28) \qquad\quad (2.22) \qquad\qquad (3.45)$$

In the equation, *Growth rate*$_{1960\text{-}2010}$ is the average growth rate in the period 1960 – 2010, *GDPPC*$_{1960}$ is per-capita GDP in 1960, *Gini*$_{1960}$ is the land Gini coefficient in 1960, and *D* is a dummy variable standing for democracy. The number in each parenthesis is the *t* value of the estimate above it. The R^2 of the regression is 0.169. The coefficient of the land Gini is significant and negative, but it is smaller than in the scattered figure, apparently because the initial per-capita GDP is controlled. The coefficient of the interaction term between the Gini and *D* is significantly positive, indicating that land distribution had a smaller, but still negative impact in democracies than in autocracies.

The above results show that a skewed land distribution is detrimental for social output in both democracy and autocracy. One of the reasons why it is more so in autocracy than in democracy is perhaps that an autocracy does not offer credible institutions that are able to harness the damages of political struggles. My theoretical modeling starts from this premise.

In a weak institutional environment where there is no credible institution that simultaneously secures and constrains her power, the autocrat hangs her survival on an often delicate equilibrium of power in which she forms an alliance with some sections of society. Although sheer terror may allow military dictators to linger for a while, long-lasting autocrats have to resort to more rational means to support their survival. Forming a ruling coalition with other political groups is one of them. On the other hand, an autocrat extracts rents from her rule. Collusion with her allies is a convenient and easily-hidden way of extraction. The most common practice in the real world is to set up rents by giving government-controlled resources and regulatory privileges to selected groups. This way, the autocrat not only consolidates political support, but also finds a convenient way to extract rents.[4]

The nature and scope of the autocrat's alliance thus can play a significant role in determining an autocracy's economic performance. This alliance is not fixed in most societies, but changes in accordance with the socio-economic and political conditions in a country. In a society with an unequal distribution of political power, a few powerful

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[4] The Suharto period (1964-1997) in Indonesia is one example. A more recent example is the princelings and their family businesses in China before the anticorruption campaign was started (Chen and Kung, 2017). In both cases, the top leaders enriched themselves and their families by giving political and business privileges to selected business people and local officials.

political groups can capture the autocrat. Rents are confined to a small number of groups and the societal economic output is not optimal. A more powerful autocrat—either equipped by superior military power or protected by a strong party—is more able to accommodate more social groups in her ruling coalition, to maximize her rents as well as to secure her rule. Consequently, the society with a more equal distribution of power or a more powerful autocrat is more likely to function as if it had become more inclusive. Under certain conditions, the ruling coalition can include all the social groups, and the autocrat would act as if she were *disinterested* with respect to societal conflicts of interests and would advance the interests of the entire society.[5]

My contribution to the literature is two folds. First, I offer a theoretical explanation for the heterogeneous performances among autocracies that highlights the role of more equal distribution of political to allow the autocrat to form a more inclusive ruling coalition. While it provides a micro-foundation for the theory of regime stability, my model goes beyond by integrating social conditions, endogenous coalition formation and economic output in a coherent model.[6] Second, my model of endogenous coalition formation extends the literature on coalition formation in autocracy. Acemoglu, Egorov, and Sonin (2009) provide a theory of coalition formation in autocracy with political power as the only shaping force. My model adds economic benefits as a second force that affects coalition formation.[7] As such, my model can be applied to other general settings where political economy is the concern.

My work is related to the large body of political-economy literature on the causal relationship between inequality and economic growth in democracies (e.g., Alesina and Rodrik, 1994; Benabou, 2000; Esteban and Ray, 2006; Renzo, 2007; Galor, et al., 2009).

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[5] In aesthetics, disinterestedness is a formal concept that bears three interpretations: the observer is uninterested in the object; the observer does not bring in his own experiences and mental feelings when he appreciates the object; and the observer does not bring in his own pursuits or interests when he forms his opinions or takes actions about the object (Rind, 2002). My notion of a disinterested government is close to the second interpretation. That is, a disinterested autocrat is disinterested not because she does not have an interest in the society; she is disinterested only in the sense that she does not take a personal stance when it comes to the distribution of resources between social groups.

[6] Svolik (2009) proposes a thesis that studying the dynamics of the ruling coalition is enough to understand autocratic stability and the un-enfranchised are mostly irrelevant. This thesis is not consistent with empirical findings; to the very least, it does not tell us how the ruling coalition is formed.

[7] One of the key assumptions (axioms) Acemoglu et al. (2009) make is that individuals (groups) eliminated from the current ruling coalition cannot rejoin it. This assumption may be applied only to a small number of settings (such as the early years of the Soviet Union). In most cases, political groups possess the ability to form a new coalition if they are excluded from the current ruling coalition. My model takes into account this possibility.

My contribution is to first theoretically establish this relationship in autocracies. The key difference in concern between democracy and autocracy is that in a democracy the leader's survival is determined by a set of preset electoral rules, but in an autocracy that hangs on the coalition between the leader and certain political groups, so its political dynamism is different from that in a democracy.[8]

Next in Section 2, I will illustrate the idea of my model in the case of two political groups. In particular, I will define the condition of equal distribution of political power (Condition E) --- i.e., the pair of political groups holds similar levels of political power relative to the power of the autocrat --- that is conducive for a more disinterested autocrat (government) to emerge. In Sections 3 and 4, I will then extend the model to the case of many political groups. In this case, the stability of a ruling coalition becomes crucial. A stable ruling coalition has to be invasion-proof --- i.e., being able to resist invasion from outside --- and coalition-proof --- i.e., being able to prevent split from inside. Section 3 studies the clean political environment where side payments are not allowed to buy political support and Section 4 studies a corrupt political environment where that is allowed. It will turn out that better economic performance is easier to obtain in a corrupt environment than in a clean environment. In a corrupt environment, a ruling coalition is coalition-proof if and only if it satisfies Condition E. When more pairs of groups satisfy Condition E in a society, the ultimate ruling coalition becomes more inclusive and societal output is increased.

2. An Illustration with the Case of Two Political Groups

Consider a society of an autocrat and two political groups. The autocrat runs the government (subsequently, I will use *government* and *autocrat* interchangeably) and is indispensible.[9] The autocrat and each political group, respectively, possess a fixed amount of political power. Let the autocrat's power be denoted by v_0, and the power of

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[8] Padro-i-Miquel (2007) presents a model of "rule by fear" to show that in an ethnically divided society, a national ruler can exploit the delicate balance of power between his own ethnic group and other groups to extract from his own people. This analysis, though, may only be applied to Africa where ethnic divide is one of the defining forces in politics.

[9] My model is intended to examine the societal conditions for a disinterested government to emerge, so it will abstract from the potential differences among the candidates who could become the autocrat. Under this assumption, change of the autocrat does not change the model's results. See A1 in Section 3 for details.

the two political groups by v_1 and v_2. Here political power is defined in the Machiavellian sense, i.e., possessing a larger political power enables a group (autocrat) to defeat other groups with a smaller political power. The country is run by a ruling coalition (RC) comprising the autocrat and one or both political groups (member groups). The autocrat possesses a fixed amount of resources (either physical and financial resources or regulatory privileges) that she either consumes or distributes to the member groups in the RC. The allocation of resources is group-specific, so the resources are represented as club goods in the model. Individuals in political groups are engaged in separate production processes using their own stocks of capital K_i, $i = 1, 2$ and the club good—if their group is in the RC—to produce a final good by a concave production function. This good contains the extra gains offered by membership in the RC.

The two social groups first decide whether they would separately or form an alliance to work with the autocrat to form the RC. To ensure that the autocrat allocates the resources to them, the member groups jointly have to be stronger than the autocrat. So a necessary condition for a "benign" autocrat—an autocrat who distributes her resources—is the following non-dictatorial condition:

(ND) $v_1 + v_2 > v_0$.

The autocrat and the member groups share the final good in a Nash bargaining in which their political powers are their bargaining powers. As a result, the share of autocrat and the share of the member groups as a whole are proportional to their political powers. Within each group, individuals get their shares according to the marginal products of their private capital. It is easy to show that the autocrat's income increases in the sum of the member groups' capital stocks and decreases in their sum of political powers and each individual's income increases in the sum of the member groups' political powers and his own stock of capital, but decreases in the sum of other individuals' capital stocks.[10]

Notice that the autocrat and the member groups have opposite interests in the RC: the autocrat wants to add to the RC an extra group with a larger stock of capital and a smaller political power and the member groups just want the opposite. The tradeoff between

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[10] This will be formally shown in the next section.

political power and the stock of capital adds complexity to coalition formation. In the case those two parameters are uncorrelated—an assumption I maintain throughout the paper—it seems that no definite conclusion can be made regarding what kinds of characteristics are required for both groups to be admitted to the RC. However, it is surprising to find that the following condition is necessary and sufficient to guarantee that both groups are included in the RC once Condition ND holds:

(E) $v_0 > |v_i - v_j|$, $\forall i \neq j$.

Figure 2 illustrates Condition ND and Condition E for the case of two political groups. The shaded area is defined by Condition E, and the heavily shaded area is excluded by Condition ND. The lightly shaded area then defines the equality tube in which both groups are included in the RC and the government behaves in a disinterested fashion. Social output is the highest in the equality tube. Two observations are worth mentioning about the equality tube. First, it becomes wider when the autocrat becomes more powerful. That is, a more powerful autocrat admits more heterogeneous social groups. Second, a politically more equal society—in the figure, v_1 and v_2 are distributed more close to the 45 degree line—is more likely to create a disinterested government even if when the government has limited power (so the equality tube is narrower). Those two features are the essential results of this paper.

[Figure 2 about here]

The necessity of Condition E is obvious: if it fails, then one group can defeat the coalition of the autocrat and the other group. In this case, the government is *biased* because it allocates all its resources to the powerful group. By the nature of the production technology, societal output does not reach the highest level.

The sufficiency of Condition E is trickier. Suppose that group 1 is more powerful than group 2 and wants to exclude group 2 from the RC. Notice that group 1 wants to exclude group 1 only because its gain from adding group 2's power to their joint bargaining power against the autocrat does not offset its loss from adding group 2's stock of capital to share the club good. However, group 1's net loss is exactly the net gain of the autocrat.

As a result, she has an incentive to form an alliance with group 2 to force group 1 to admit group 2, and Condition E allows that happen.

In the case of many political groups, things become more complicated. Member groups in the RC have to worry about invasion from outside and split from within. To obtain stability, the RC has to be invasion-proof and coalition-proof. We will see that Condition E is sufficient and necessary to maintain stability in the RC if a group is allowed to bribe other groups when it faces the risk of being excluded. This is a powerful proposition because Condition E only involves pairwise comparisons among political groups. The size of the set of political groups satisfying Condition E is a measure of political equality (relative to the power of the autocrat) in a society. The larger that size, the more equal the society. So given her power, an autocrat would become more inclusive in her resource allocation when the society becomes politically more equal.

In the next section, I will first examine the case of a clean political environment in which side payments are not allowed. Its main purpose is to set up the formal model and define the key concepts of invasion-proofness and coalition-proofness.

3. Coalition Formation in a Clean Political Environment

3.1 The setup

The society that I formally consider comprises an autocrat and n (social-) political groups. The autocrat controls the state apparatus and allocates publically owned resources in the society. A political group is defined as an organization that is capable of forming and taking coherent collective actions. Let $N = \{1, 2, \ldots, n\}$ be the set of the political groups. I will also use it to denote the society. For simplicity, I assume that the size of population is equal in each group and normalize its measure to 1. The autocrat, indexed by 0, controls the government. So $I = N \bigcup \{0\}$ is the set of all political groups and the autocrat. Because my theory focuses on the conditions of the society that define political coalition, I abstract from intragroup dynamics that could lead to the classic problems associated with collective action. In addition, I make the following assumption:

A1. The autocrat is autonomous in the sense that she is free to choose her allies. [11]

To the extent that the autocrat mainly derives her power from the state apparatus, every autocrat is the same in terms of political competition. It makes no difference for any political group when one autocrat is replaced by another. Therefore, A1 can be treated as to imply that the autocrat would not be replaced. This allows me to focus on the main question of this paper: what kinds of economic and political conditions are needed to induce an autocrat to pay more attention to raise a country's economic output? Throughout the model, I will then treat the autocrat as if she would not be replaced.

The ability of forming collective action can be different between groups. I define *political power* as a group's ability to organize collective action, such as maintaining coherence within the group, exerting influence on others, conducting propaganda, waging protests and upheavals, and, in the case of the autocrat, suppressing revolts. Let v_i denote the political power of group $i \in I$. A group with a larger power can defeat a group with a smaller power when conflicts arise between them.

Note that the autocrat is not necessarily more powerful than other political groups. To rule, she can form a coalition with other political groups.

D1. A coalition is a collection of political groups and the autocrat that is able to take collective actions. It is a non-empty subset of *I*.

By this definition, a coalition acts as if it were just one political group. Because groups in a coalition can take uniform actions, it is meaningful to define the political power of a coalition. In subsequent text, the power of a coalition *A* is denoted by *P(A)*.

A coalition that includes both political groups and the autocrat is called a *ruling coalition* (RC). An RC controls the government and, thus, is able to rule. In the case of an autocrat possessing superior power, such that $v_0 > P(N)$, a personal dictatorship emerges. In that case, this paper's analysis is rendered useless. To a lesser extent, the autocrat can still do whatever she wants in an RC if the other members cannot jointly constrain her.

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[11] A1 follows Skocpol (1979)'s notion of the autonomous state. However, the issues under the study of this paper are much narrower than Skocpol's thesis. Skocpol's main purpose is to reopen the possibility of treating the state as an entity that has its own logic of action, as opposed to one being passively defined by the democratic process. Here I only examine how the behavior of the state---run by an autocrat---is shaped by social and political conditions in society.

Member groups have to constrain the autocrat to make their participation in the coalition meaningful. To illustrate this idea, I make the following assumption:

A2. The autocrat can only allocate resources to member groups in the RC.

Essentially, A2 says that the autocrat is captured by the member groups in the RC. In return, the autocrat is protected by the coalition and is able to extract rents from its member groups. So there is an implicit exchange of support and rent extraction. With A2, I proceed to provide a formal definition of RCs:

D2. A coalition RC is a ruling coalition if it satisfies the following three conditions: (1) $0 \in RC$, (2) $C = RC \bigcap N \neq \varnothing$, and (3) $P(C) > v_0$.

In subsequent text, I will use RC to denote a generic ruling coalition and $C = RC \bigcap N \neq \varnothing$ to denote its members other than the autocrat. There can be many RCs in I because the autocrat can choose among many coalitions in N. The set of all feasible RCs is denoted by RC. AN RC can form through political interactions or explicit material exchanges (briberies). In this section, I study the case that material exchanges are not allowed to buy political support.

D3. A clean political environment is an I in which explicit political briberies are absent.

In reality, political bribery is widely observed in autocracies. I study a clean political environment to highlight some of the tradeoffs facing the autocrat when she forms coalitions and makes decisions about resource allocation. In the next section, I will extend the model to the more realistic case that bribery is allowed.

On the economic side, only citizens are engaged in production while the autocrat is not. People in the same political group are endowed with the same amount of physical capital. Let it be K_i for people in group $i \in N$. Note that K_i can be different in different groups. Its relationship with political power is complicated in reality. While it is often the case that politically more powerful groups have larger stocks of capital, it is not uncommon to find that less wealthier groups can be politically powerful (think about the revolutions in Europe and Asia), or vice versa. This paper thus makes a neutrality assumption:

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A3. Capital stock and political power are independently distributed among political groups.

The autocrat controls a certain amount of resources, G, which she will transform into club goods and will allocate to people in her ruling coalition. As mentioned above, let RC denote that coalition and C denote its member groups other than the autocrat. Further, let G_i be the amount of club goods received by each individual in group $i \in C$.[12] Obviously, $\sum_{i \in RC} G_i = G$. The production technology of each person in group $i \in N$, regardless whether the person belongs to RC, takes the following form of constant elasticity of substitution (CES):

$$(1)\ Y_i = A\left[K_i^{\alpha} + (G_i \times D\{i \in C\})^{\alpha} \right]^{\frac{1}{\alpha}}, A > 0,\ 0 < \alpha < 1,\ i \in N,$$

where $D\{i \in C\}$ is a dichotomous variable (taking values 0 and 1) that indicates whether group i belongs to C. That is, people in RC use both their own capital and the club good allocated by the autocrat to produce output, whereas people outside RC only use their own capital to produce. Indeed, the production technology used by people outside RC degenerates into the so-called AK technology. Given his own stock of capital, an individual prefers being included by RC, and naturally, members of RC prefer more club goods, although the marginal product of club goods declines.

The autocrat's extraction is modeled as a tax on the output of RC. While other ways can be taken to model the tax rate, it is more sensible to model it as an outcome of political bargaining between the autocrat and the member groups as a whole, because maintaining the RC is in both the autocrat's and member groups' interests. Assuming that the outside option (i.e., when no agreement is reached and the RC is broken) gives zero income to the autocrat and the member groups, the Nash bargaining model then immediately gives us the following result about the tax rate s:

$$s = \frac{v_0}{v_0 + P(C)}.$$

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[12] Because each person is endowed with the same amount of capital and, as will shortly be introduced, has the same production technology, it is easy to envision that each person in the same group should have the same amount of club goods.

Naturally, the share given to the member groups is $1 - s$. After the distribution, the final product is consumed by the autocrat and member groups.

3.2 Allocation of club goods in RCs

At this point, I define the order of events as follows. First, nature chooses the autocrat and allots her political power and resources. Nature also allots every citizen political power and capital. Second, coalitions in N are formed and compete to form an RC with the autocrat. Third, once a stable RC is formed, the autocrat transforms her resources into club goods and allocates them to the other member groups of her RC. Fourth, individuals make independent production using their own capital and club goods received by their group. Fifth, once production is finished, the autocrat and the other members of her RC share the output of that RC. People not included in the RC retain all of their output.

Note that coalition formation is affected by how the autocrat allocates club goods in her RC and how the output is shared in that RC. Therefore, I first study the allocation of club goods in a given RC. I start by noting that both the autocrat and the member groups want to see a larger output. Thus the autocrat solves the following constrained maximization problem when she allocates the club good in RC:

(2) $\underset{\{G_i\}_{i \in C}}{Max} \sum_{i \in C} Y_i$

$$\text{s.t. } Y_i = A\left[K_i^{\alpha} + G_i^{\alpha} \right]^{\frac{1}{\alpha}}, \ \sum_{i \in C} G_i = G.$$

Solving this problem, it is straightforward to obtain the following result:

(3) $G_i = \left(K_i / K_C \right) G$, where $K_C = \sum_{i \in C} K_i$.

This result is very intuitive. To maximize the total output, the autocrat wants to equalize the marginal product of the club good among individuals. Because capital and the club good are symmetric in the production technology, this result is only achieved when a person's share of the club good is equal to her share of capital.

Individual income in RC is:

(4) $Y_i = (1-s)AK_i \left[1 + \left(G / K_C \right)^\alpha \right]^{\frac{1}{\alpha}}, \ \forall i \in C$.

Obviously, a person's income increases in his own capital stock. However, at the collective level, there are two countervailing forces. A larger collective power $P(C)$ raises everyone's income by suppressing s, but a larger sum of capital K_C reduces a given person's income. The second result is derived from the proportionality between a person's share of the club good and his share of capital stock.

Individual output outside RC is AK_i, which is smaller than the individual output in RC for given K_i. But because the autocrat gets a cut, an individual may get a smaller income in an RC than staying outside. To fix the idea, though, I make the following assumption to rule out this possibility:

A4. Everyone enjoys higher income in an RC than what he gets outside.

Individual income in RC (including the income of the autocrat) will be denoted by $Y_i(RC)$, $\forall i \in RC$, and the distribution of income will be denoted by $\{Y_i(RC)\}_{i \in RC}$. The total output of RC is the sum of individual output:

(5) $Y_C = AK_C \left[1 + \left(G / K_C \right)^\alpha \right]^{\frac{1}{\alpha}}$,

which can be easily shown to increase in K_C. The autocrat then receives the following:

(6) $Y_0 = sY_C$.

It increases in K_C, but decreases in $P(C)$.

3.3 The contract curve

The above analysis has shown that the income of individual members of RC critically depends on two aggregate variables, K_C and $P(C)$. Subsequently, I call the combination $(K_C, P(C))$ "the characteristic of RC." The analysis in the previous subsection showed that the autocrat and the member groups have opposite interests regarding the characteristic of RC. Now the results are stated in the following lemma:

Lemma 1. In an $RC \in \mathcal{RC}$, (1) given $P(C)$, a larger K_C increases RC's total output and the autocrat's income, but makes the members in C worse off; and (2) given K_C, a larger $P(C)$ reduces the autocrat's income, but makes the members in C better off.

For a given RC, its characteristic is unique. Changes happen when the RC (1) admits new members so its size increases, (2) kicks out some of its members so its size decreases, or (3) replaces some of its members with outsiders. In the last case, the RC is said to be "invaded" and the outsiders are called "invaders" in the subsequent text. Any change to the characteristic results in a new RC. According to the analysis in Section 3.2, the remaining member groups are either all better off or all worse off.

Lemma 2. For two ruling coalitions, RC, $RC' \in \mathcal{RC}$, suppose $C \cap C' \neq \varnothing$, $C \neq C'$. Then $\forall i \in C \cap C'$, only one of the three cases will happen: (a) $Y_i(RC') > Y_i(RC)$, (b) $Y_i(RC') < Y_i(RC)$, or (c) $Y_i(RC') = Y_i(RC)$.

Proof. Given its capital stock, a member group's income is only related to the characteristic of RC, as stated by Equation (4). Therefore, in terms of the direction of effect, members in $C \cap C'$ are equally affected by any change happening to RC. Q.E.D.

In addition to make every member in $C \cap C'$ better off, the new RC may also make the autocrat better off. In this case, a Pareto improvement has occurred.

D4. For two ruling coalitions, RC, $RC' \in \mathcal{RC}$, suppose $C \cap C' \neq \varnothing$, $C \neq C'$. RC' is a Pareto improvement of RC if (a) $Y_i(RC') \geq Y_i(RC)$, $\forall i \in RC \cap RC'$ and (b) $\exists j \in RC \cap RC', Y_j(RC') > Y_j(RC)$.[13]

According to Lemma 2, Condition (b) holds in one of the following three scenarios: i) $Y_0(RC') > Y_0(RC)$; ii) $Y_j(RC') > Y_j(RC)$, $\forall j \in C \cap C'$; or iii) both. According to Lemma 1, whether a Pareto improvement happens depends solely on the changes happening to the characteristics of the two RCs. Figure 3 illustrates the situation. In the $(P(C), K_C)$ space, the figure presents the (income) indifference curves of the autocrat and a generic

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[13] D4 does not define global Pareto improvement because members in $RC \setminus (RC \cap RC')$ are worse off. The concept of Pareto optimum is borrowed here to describe a situation when mutual improvements of the autocrats and member groups are exhausted in coalition formation.

group, $i \in C$, in RC based on Equations (6) and (4), respectively. Because of Lemma 2, group i represents all the member groups in $C \cap C'$. The autocrat's indifference curves bend toward northwest of larger K_C and smaller $P(C)$; group i's indifference curves bend toward southeast of larger $P(C)$ and smaller K_C. So their interests conflict with each other. However, there could be room for Pareto improvement when C's membership changes, but group i is kept. For example, suppose RC's characteristic is x in the figure. Then the shaded area defined by the autocrat and group i's indifference curves going through x is the area of Pareto improvement. That is, a new ruling coalition RC', $C' \cap C \neq \varnothing$ can be constructed such that $i \in C' \cap C$ and the characteristic of RC' $(P(C'), K_{C'})$ falls in the area of Pareto improvement. Improvement only disappears at the points where one of the autocrat's indifference curves is tangent with one of group i's. The line linking all the tangent points is the contract curve between the autocrat and coalitions of political groups that are potentially able to form an RC with the autocrat. On the contract curve, Pareto optimum is obtained.

[Figure 3 about here]

D5. A ruling coalition $RC \in \mathcal{RC}$ reaches Pareto optimum in a sub-society $A \subseteq I$ if there is no other ruling coalition $RC' \subset A$ such that $C' \cap C \neq \varnothing$, $C \neq C'$ and RC' is a Pareto improvement of RC.

Simply put, an RC is Pareto optimal if it cannot improve the welfare of its existing members by altering its membership. By construction, an RC implies a contract between the autocrat and an existing coalition of political groups. It is intuitive to reason that the contract should be Pareto optimal. It turns out that the situation is more complicated than this simple reasoning. However, it is useful to state the definition of the contract curve here:

D6. The contract curve of a sub-society $A \subseteq I$ is the set of all Pareto-optimal RCs in A.[14]

3.4 Invasion-proof RCs

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[14] The contract curve can be "thick" in the sense that it has a width, because N is countable and the distribution of $(P(C), K_C)$ is discrete.

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There can be many potential RCs in a society; however, they may not be stable. An RC faces challenges from both outside and inside. Outside an RC, the threat is that politically more powerful coalitions may replace the entire RC or invade it by replacing some of its groups. Inside an RC, member groups may form smaller coalitions to exclude some members, thus threatening internal stability. To prevent splits, an RC cannot be too big or too diverse, which generally sets the maximum size of an RC. To defeat external threats, an RC cannot be too small or too weak. For a given distribution of political power in the society, external stability then generally sets the minimum size of an RC. This subsection studies external stability, while the next subsection studies internal stability.

To fence off external threats, an RC has to be stronger than any other coalition in the society. Clearly, the RC comprising N and the autocrat is invincible. In a society of a very unequal distribution of political power, an RC comprising the autocrat, the strongest group and perhaps a small number of weaker groups may also be invincible. In a society of completely equal distribution of political power, any coalition comprising the autocrat and half of the political groups is invincible. In societies that fall in-between, anything can happen. Worse than that, invincibility does not guarantee stability for an RC because its members may defect if an alliance of outsiders, or invaders, offers them a higher income. Obviously, the invaders also benefit if their coalition with the defectors can become a new RC (by capturing the autocrat). An RC can only survive if it can resist invasion. In that case, such an RC is invasion-proof.

D7. A ruling coalition $RC \in \mathcal{RC}$ is invasion-proof with respect to $A \subseteq I$ if there is not a $C' \subset A \bigcap N$ with its corresponding ruling coalition $RC' \in \mathcal{RC}$, such that

(a) $C' \not\subset C$, $C \not\subset C', C' \neq C$;

(b) $Y_i(RC') \geq Y_i(RC)$, $\forall i \in S = RC' \bigcap RC$;

(c) Let $W \subseteq S$, such that $\forall i \in W$, $Y_i(RC') > Y_i(RC)$, then

$P(C' \backslash C' \bigcap C) + P(W) > P(RC \backslash S)$.

Condition (a) states that *C*' contains at least one invader who replaces at least one member of *C*.[15] Condition (b) says that none of the remaining members of *RC*, including the autocrat, should be made worse off. Then, by Condition (c), the parties that are made strictly better off by *C*'—the invaders ($C' \backslash C' \bigcap C$) and whatever groups, including the autocrat, whose income is increased—should be able to defeat the excluded groups (*RC\S*). The autocrat never belongs to *RC\S* because she is always needed. Not all the old members of *RC* need to be made better off. In particular, the autocrat's income may decline in *C*', but she is willing to stay because she would end up with nothing when she quit. It is possible that the invaders are the only groups whose income is increased, in which case *W* is empty.

An RC can be invincible but not invasion-proof; but it is definitely not invasion-proof if it is not invincible. In fact, $C' \bigcap C$ can be empty in D7, in which case invasion-proofness becomes invincibility. Therefore, invasion-proofness fully describes external stability. To illustrate invasion-proof RCs, let us study two examples.

Example 1. A society comprises four political groups whose political powers are $\{v_1, v_2, v_3, v_4\} = \{4, 5, 10, 16\}$ and whose stocks of capital are $\{K_1, K_2, K_3, K_4\} = \{32, 20, 10, 8\}$. The autocrat possesses a political power of 12. There are many invincible RCs, but the number of invasion-proof RCs is limited. Any RC that excludes the politically strongest and economically poorest group, group 4, is not invasion-proof. Take as example the RC comprising the other three groups and the autocrat, denoted by {4, 5, 10; 12}, where the numbers are the powers of the parties. Then, group 4 can replace any group in this RC to benefit the remaining two groups. The autocrat is hurt and may want to form alliance with the ousted group against the invasion. However, this alliance is less powerful than the alliance of group 4 and the other two groups. So {4, 5, 10; 12} is not invasion-proof. It is easy to check that any RC that includes the politically weakest and economically wealthiest group, group 1, is not invasion-proof either. The only invasion-

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[15] The definition excludes the case that *C*' is formed by merely adding some new groups to *C*. As one will see, a RC of larger size increases its total output. Therefore, new members would always be allowed to join the RC if they were allowed to bribe its old members regardless what kind of political structure existed in the society. Later on, I will extend the model to allow for bribery. Forming *C*' by adding some groups to *C* then becomes a trivial case. Therefore, it is excluded from the very beginning.

proof RC with three political groups is the RC excluding group 1.[16] Because this group has the smallest political power but the largest capital stock, its invasion will benefit the autocrat and hurt any other remaining group. However, the sum of its political power and the autocrat's political power is smaller than the sum of political power of the other three groups, so invasion is impossible.

The reader may notice that in Example 1, more powerful groups have smaller stocks of capital, so excluding the wealthiest and least powerful group, group 1, is feasible. If group 1's political power is at least as large as 19 so that the sum of political power of its alliance with the autocrat is at least 31, which is the sum of political power of the other three groups, then the invasion-proof RC in Example 1 is no longer invasion-proof.

It is also possible to construct examples in which invasion-proof RCs are not Pareto optimal because the potential losers are very powerful. The following example is a case at point.

Example 2. A society comprises four political groups whose political powers are $\{v_1, v_2, v_3, v_4\} = \{4, 4, 4, 25\}$ and whose stocks of capital are $\{K_1, K_2, K_3, K_4\} = \{8, 8, 8, 50\}$. The autocrat still possesses a political power of 12. To fix the idea, let A be 1 and α be 0.5 in the production technology. Because group 4 is more powerful than the alliance of the autocrat and all the other three groups, any RC containing group 4 is invasion-proof. However, a Pareto improvement can be obtained if group 4 is replaced by any other group outside the RC. Take $\{4, 4, 25; 12\}$ as an example. Table 1, taking group 1 as the group initially excluded, shows that it can be improved by $\{4, 4, 4; 12\}$. When group 4 is replaced by group 1, $P(C)$ declines so the autocrat is improved but the remaining two groups are hurt; but K_C also declines so the autocrat is hurt and the remaining two groups are improved. The net outcome, though, is that both the autocrat and the remaining two groups are improved. The autocrat's loss due to a smaller K_C is more than compensated by his gain due to a smaller $P(C)$; the reverse is true for the remaining two groups. This example shows that a politically powerful group can block Pareto improvements of the autocrat and the other groups.

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[16] It remains a question whether it can be split. This is the concern when we study coalition-proof RCs.

Table 1. The distribution of income for Example 2

	RC: {4, 4, 25; 12} Wealth: {8, 8, 50}	RC: {4, 4, 4; 12} Wealth: {8, 8, 8}
Y_0	42.31	43.91
Y_1		14.63
Y_2	14.10	14.63
Y_3	14.10	14.63
Y_4	88.15	
Y_C	158.66	87.82

The example hints that in a society with relative political equality, Pareto optimum is always obtained. The following theorem gives the exact result:

Theorem 1. Every invasion-proof $RC \in \mathcal{RC}$ is on the contract curve of $A \subseteq I$ if and only if Condition E holds, i.e., $\forall i, k \in A \bigcap N$

(E) $v_0 > |v_i - v_k|$.

Proof. To prove the sufficiency of Condition E , suppose $RC \in \mathcal{RC}$ is invasion-proof, but is not on the contract curve. Then let its characteristic be x in Figure 3. By Condition E , we can always find $k \in C$ and $j \notin C$ such that $v_j + v_0 > v_k$ and the characteristic of the new ruling coalition $RC' = \{j\} \bigcup (RC \setminus k)$ moves along the indifference curves of its members, to x' in the case of a generic group i. So $Y_i(RC') = Y_i(RC)$, $\forall i \in RC \bigcap RC'$, but the autocrat enjoys a higher income and is willing to form an alliance with group j to defeat group k. This contradicts that RC is invasion-proof. To prove the necessity of Condition E , it suffices to prove the inverse negative proposition. Suppose that there are $k \in C$ and $j \notin C$ such that $v_j + v_0 \leq v_k$. But it is possible that group k is the only group that group j can replace to improve the income of the autocrat and the other groups in C, and $v_j + v_0 \leq v_k$ prevent the replacement from happening. Q.E.D.

Therefore, under Condition E, Pareto optimum is always obtained, so the autocrat and the member groups always have conflicting interests in an invasion-proof RC. If replacing a member by a new member or adding a new member benefits one party, it has to hurt the other party.

3.5 Coalition-proof RCs

Let's now turn to internal stability. In game theory literature, "strong equilibrium" was the first solution concept proposed for coalition-proof Nash equilibrium (Aumann 1959). A strong equilibrium is a Nash equilibrium in which no coalition can make every player better off. However, studies have found that it is very difficult to obtain strong equilibria because they do not require that the coalitions be stable. A weaker concept of coalition-proof Nash equilibrium then is introduced to require that coalitions themselves be equilibrium outcomes (Bernheim, Peleg, and Whinston 1987). Following this weaker concept, I define a coalition-proof RC as the following:

D8. A ruling coalition $RC \in \mathcal{RC}$ is coalition-proof if there is no $RC' \subset RC$ that is invasion-proof with respect to RC.

Groups form a sub-coalition C' to obtain a larger income for each of its members. Therefore, C' prefers excluding members of C who have larger capital stocks but smaller political powers. However, the autocrat may also want to exclude some members of C who have larger political powers but small capital stocks. The following lemma shows that the autocrat will be hurt when the size of C is reduced.

Lemma 3. In a ruling coalition $RC \in \mathcal{RC}$, there is no ruling coalition $RC' \subset RC$ that makes the autocrat strictly better off.

Proof. Let $C' \subset C$ be a strict subset of C, and let $RC' = C' \bigcup \{0\}$ be its associated RC. According to Lemma 1, $Y_{C'}$ is definitely smaller than Y_C. Therefore, either the autocrat or the members of C will be hurt. RC' makes the members of C' strictly worse off if it makes the autocrat strictly better off. Of course, the members in $C \setminus C'$ strictly lose because they are expelled from the ruling coalition. So the only winner is the autocrat. But for RC to qualify as a ruling coalition, $P(C) > v_0$ has to hold, which means that RC' will be blocked by C from the very beginning. Q.E.D.

As a result, only members of C have the incentive to split RC. For RC to be coalition-proof, a coalition must exist between the autocrat and $C'' \subseteq C \setminus C'$ that can defeat or

invade a tempting $C' \subset C$. This coalition requires a certain degree of political equality in C. Consider the following example:

Example 3. The original RC is $RC = \{4, 10, 12; 15\}$. The capital stocks of the three political groups are $\{10, 8, 4\}$. Group 1 has the smallest political power and the largest capital stock, so groups 2 and 3 prefer a new ruling coalition $RC' = \{10, 12; 15\}$. Because the sum of capital $K_{C'}$ declines substantially and $P(C')$ does not decline much, the reader can verify that the autocrat loses. However, $P(C')$ is larger than the sum of power of the autocrat and group 1. Therefore, RC is not coalition-proof. This failure occurs because group 1 is politically too weak compared with the other two groups.

However, an RC with groups of more or less equal political powers can be coalition-proof. The following example illustrates this point.

Example 4. A society comprises an autocrat whose political power is 15 and seven political groups whose political powers are $\{10, 6, 4, 3, 3, 3, 2\}$. There are many RCs, but some of them are not coalition-proof. For example, $\{10, 6, 3, 2; 15\}$ is an RC, but it is not coalition-proof because $\{10, 6, 3\}$ is invincible. There are also many coalition-proof RCs. For example, $\{6, 3, 3, 3; 15\}$, $\{6, 4, 3, 3; 15\}$, and $\{6, 4, 3, 2; 15\}$ are all coalition-proof. An interesting feature of those three RCs is that they do not include group 1, the most powerful group, because once group 1 is included, it has the incentive to set up a viable sub-coalition.

For a general result, I have the following theorem:

Theorem 2. An $RC \in \mathcal{RC}$ is coalition-proof if and only if $\forall i \in C$, such that the following condition holds:

(D) $v_i + v_0 > P(C \setminus i)$.

Proof. To prove the sufficiency of Condition D, let $C' \subset C$ be a strict subset of C. By Lemma 3 and Corollary 1, the RC built by C', RC' only benefits the members of C' and hurts the autocrat. As a result, the autocrat is willing to form an alliance with $C \setminus C'$ against C'. Condition D then ensures that the alliance can always defeat C'. That is, RC' is not invasion-proof. The necessity of Condition D is simple to prove once one realizes

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that C' can exclude any one group to dissolve RC. Condition D is necessary for the expelled group to join with the autocrat to defeat C'. Q.E.D.

3.6 The society and the disinterested government

The results obtained so far enable me to describe a stable ruling coalition, which will be called the ultimate ruling coalition (URC), in a society.

D9. A URC is a ruling coalition that is invasion-proof and coalition-proof.

There are still many potential URCs in a society. The primary interest of this paper is under what condition the whole society can be a URC. The following theorem, which is an immediate result of Theorem 1, specifies the condition:

Theorem 3. Let $RC = N \bigcup \{0\}$. It is the only URC if and only if Condition D holds for $\forall i \in N$.

Proof. Because RC includes all members of N, it is obviously invincible and invasion-proof. According to Theorem 1, Condition D guarantees that RC is coalition-proof. So RC is the only URC. Q.E.D.

When $RC = N \bigcup \{0\}$ is a URC, the government led by the autocrat is a disinterested government in the sense that its resource allocation has become as inclusive as possible. In contrast, a government is biased when the URC contains a strictly subset of N.

Theorem 4. Under the disinterested government, society produces the highest output.

Proof. Because individual output outside the URC is strictly smaller than individual output in the URC, by Lemma 1, a society with a larger URC produces higher total output. The URC under the disinterested government contains the largest number of political groups, so the society reaches the highest output. Q.E.D.

Condition D first of all requires a very powerful autocrat despite it also implies a certain degree of equality among political groups. Theorem 3 demands that the condition hold with respect to the entire society. This is a highly stringent demand. It is needed because direct material incentives are not allowed to win political support. In the next section, the condition can be drastically relaxed when bribery is allowed in political transactions.

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4. Coalition Formation in a Corrupt Political Environment

A political environment is corrupt if material payments (briberies) are allowed to gain political support. Technically, bribery in an RC results in a perturbation of its income distribution. Obviously, for bribery to be feasible, the sum of the perturbed income cannot be higher than the original sum of income. Formally, for RC, let $\{\tilde{Y}_i(RC)\}_{i \in RC}$ be a perturbation of $\{Y_i(RC)\}_{i \in RC}$.

D10. For a ruling coalition $RC \in \mathcal{RC}$, a perturbation of income $\{\tilde{Y}_i(RC)\}_{i \in RC}$ is feasible if and only if $\sum_{i \in RC} \tilde{Y}_i(RC) \leq Y_C$.

Compared with a clean political environment, defection becomes harder in a corrupt political environment because defectors can be bought out. This buyout makes it easier for an RC to remain coalition-proof. The following definition modifies D7:

D7'. In a corrupt political environment, a ruling coalition $RC \in \mathcal{RC}$ is invasion-proof with respect to $A \subseteq I$ if there is not a $C' \subset A \bigcap N$ with its corresponding ruling coalition $RC' \in \mathcal{RC}$ and a feasible perturbation of income in RC', $\{\tilde{Y}_i(RC')\}_{i \in RC'}$, such that for any feasible perturbation of income in RC, $\{\tilde{Y}_i(RC)\}_{i \in RC}$

(a) $C' \not\subset C$, $C \not\subset C'$, $C' \neq C$;

(b) $\tilde{Y}_i(RC') \geq \tilde{Y}_i(RC)$, $\forall i \in S = RC' \bigcap RC$;

(c) Let $W \subseteq S$, such that $\forall i \in W$, $Y_i(RC') > Y_i(RC)$, then

$$P(C \setminus C' \bigcap C) + P(W) > P(RC \setminus S).$$

The changes happen in conditions (b) and (c). The invaders can make offers of bribery to certain members of RC, and the potential losers of RC can make counter offers. For the

invaders to win, their final and feasible offer has to win over any feasible counter offer made by the potential losers of RC.[17]

The three lemmas and theorem 1 still hold in a corrupt political environment. The condition for coalition-proof RCs, however, is drastically reduced to Condition E in the RCs themselves.

Theorem 5. In a corrupt political environment, an $RC \in \mathcal{RC}$ is coalition-proof if and only if Condition E holds, i.e., $\forall i, k \in C$

(E) $\quad v_0 > |v_i - v_k|$.

Proof. I first prove the sufficiency of Condition E by way of contradiction. Suppose there is $RC' \subset RC$ that is invasion-proof. To show the contradiction, I proceed in two steps.

First, I show that there exist group $i \in C \setminus C'$ and group $k \in C'$ such that $K_i > K_k$. Because RC' is invasion-proof, it is on the contract curve of C, according to Theorem 1. In Figure 4, a, b, …, z are the possible characteristics of RC'. At a, the autocrat receives the highest income and the member groups in C' get the lowest income; at z, the opposite happens. However, all the characteristics other than z will be defeated by a sub-coalition of C'. For example, suppose characteristic a is realized when group m is excluded from C and characteristic b is realized when group q is excluded from C. Then group m can talk with the groups other than q to replace the latter by itself to raise those groups' income. Group m can also bribe the autocrat and, because of Condition E, the alliance of group m and the autocrat can beat group q. Therefore, the only possible characteristic of C' is z and any change to the membership of C' will hurt its remaining members. Then, if for every $i \in C \setminus C'$ and every $k \in C'$, $K_i \leq K_k$, then it must be the case for $i \in C \setminus C'$ and $k \in C'$, $v_i \leq v_k$, because otherwise a replacement of a group $k \in C'$ by a group $i \in C \setminus C'$ will increase the income of the other groups in C'. However, the case $v_i \leq v_k$ and $K_i \leq K_k$ for every $i \in C \setminus C'$ and every $k \in C'$ violates A3 because it imposes a correlation

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relationship between political power and capital stock. Therefore, there must be at least an $i \in C \setminus C'$ and a $k \in C'$ such that $K_i > K_k$.

Next, I show that RC' is not invasion-proof. For that, identify $i \in C \setminus C'$ and a $k \in C'$ such that $K_i > K_k$ and replace group k by group i. Let the new RC be denoted by $RC'' = \{i\} \cup RC' \setminus \{k\}$. Its characteristic moves up along the contract curve toward a. The autocrat's income automatically increases, that is, $Y_0(RC'') > Y_0(RC')$ because RC'' moves up along the contract curve. Also, because $K_i > K_k$, Lemma 1 guarantees that the sum of output also increases, that is, $Y_{C''} > Y_{C'}$. Therefore, for any perturbation $\left\{ \tilde{Y}_j(RC') \right\}_{j \in RC'}$ of RC', there is a perturbation of RC'', for example, $\left\{ \tilde{Y}_j(RC'') \right\}_{j \in RC''}$, such that $\tilde{Y}_j(RC'') \geq \tilde{Y}_j(RC')$, $\forall j \in C' \setminus \{k\}$. This means that the alliance of group i and the autocrat, under Condition E, can invade RC', thus the contradiction.

To prove the necessity of Condition E, assume that there are two groups $i, m \in C$, such that $v_i + v_0 \leq v_m$. Also, suppose $K_i > K_m$. Then, if group i is excluded by C', group m can be the only group that group i can replace to build $RC'' = \{i\} \cup RC' \setminus \{m\}$, such that $Y_0(RC'') > Y_0(RC')$ (all other members of RC'' lose naturally). But $v_i + v_0 \leq v_m$ means that the alliance of group i and the autocrat cannot replace group m. Q.E.D.

[Figure 4 about here]

Similar to Theorem 3, a direct corollary of Theorem 5 is the following:

Theorem 6. In a corrupt political environment, $RC = N \cup \{0\}$ is the only URC if and only if Condition E holds for $\forall i, k \in N$.

The proof is similar to that of Theorem 3. Because Condition E is less stringent than Condition D, a disinterested government can more easily emerge in a corrupt political environment than in a clean political environment. Apparently, Theorem 4 still holds. So it is easier to obtain optimal economic output in a corrupt environment than in a clean environment. This result is paradoxical in light of the conventional wisdom that often advocates a cleaner political environment. The root cause is the lack of constitutional commitment in an autocracy. The autocrat has to rely on his or her coalition to rule. In a

clean environment, the coalition has to solely rely on its political power to maintain stability, whereas in a corrupt environment, bribery allows for buying support from potential deviators. So politically, the coalition does not need to be as strong as in a clean environment.

One may think that a politically more equal society tends to produce a more inclusive URC and, thus, a higher economic output. The difficulty, though, is how to define political equality beyond Condition E. The share of the pairs of political groups falling in the Equality Tube is a likely candidate for the measure of political equality. Subsequently, it will be called the Equality Index, or *EI*. However, a larger *EI* does not guarantee a more inclusive URC. For example, a society N_1 = {30, 3, 3, 3, 3, 3} is more equal than a society N_2 = {30, 30, 25, 3, 3, 3} because N_1 has an *EI* of 0.67 and N_2 has an *EI* of 0.40. In fact, two sub-societies in N_2, {30, 30, 25} and {3, 3, 3} have members who satisfy Condition E only within their respective sub-societies. However, the URC for N_1 is {30; 10}, that is, the autocrat is captured by only one group, but the URC for N_2 is {30, 30, 25; 10}, which is obviously more inclusive. The problem with N_1 is that group 1 is overly strong in that none of its pairs with other groups falls in the Equality Tube. The following lemma strengthens the role of the strongest group:

Lemma 4. In a corrupt political environment, the strongest political group has to be in the URC unless it is the least wealthy group in the society.

Proof. By way of contradiction, suppose the strongest group, group *m*, is not in the URC. Then group *m* can pick up a group, group *j*, in the URC, such that K_j is smaller than K_m, and replace it. When that occurs, the total output in the coalition increases. Therefore, group *m* can offer a bribery scheme that beats any counter offer by the old URC. That is, the URC is not invasion-proof, which is a contradiction. Q.E.D.

To continue, I define sub-societies of equals as the following:

D11. In society *N*, $E \subset N$ is a sub-society of equals if every pair of its members satisfies Condition E.

The number of all possible pairs in *N* is C_n^2. Let E_M be the sub-society of equals that includes the strongest group of *N*, and let *m* be the number of its members. The ratio

$EI = C_m^2 / C_n^2 = m(m-1)/n(n-1)$ increases in m/n for a fixed n and, therefore, can serve as an index of inclusiveness. Lemma 4 and the following theorem show that a larger EI implies a larger economic output for N.

Theorem 7. With a corrupt political environment, a society N will obtain a larger output when E_M has a larger EI.

Proof. According to Lemma 4, a URC has to include the strongest group; and according to Theorem 5, that URC includes all and only the members of E_M. Because a larger EI implies that more political groups are included in the URC, the total output of N increases. Q.E.D.

5. Conclusion

This paper studies how political equality in a society can lead to inclusive political and economic institutions that are conducive to better economic performance in autocracies. In addition to contributing to the literature of coalition formation and the causal relationship between equality and growth, its results highlight the role of social revolutions in paving the way for sustainable growth in a country. The high performers after World War II are concentrated in East Asia, where revolution either happened endogenously (in the case of mainland China) or was imposed by outsiders (Taiwan, South Korea, and to some extent Japan). Notwithstanding their colorful ideological faces, revolutions in East Asia have accomplished the same thing, that is, to get rid of the old social-political structure that was rooted in the agrarian economy and to set up a new, and often more equal, social-political structure that is friendly to industrial growth. Revolutions in East Asia have been an integral part of the modernization process that started in Europe in the 17th century. Many European countries had revolutions. Historical studies have found that those revolutions played a critical role in promoting capitalist growth in Europe. The classical work by North and Weingast (1989) shows that the Glorious Revolution ignited England's capitalist growth by establishing constitutional rules that served as a commitment device for the king to protect the interests of the commercial class. Acemoglu et al. (2009) provide an interesting study about the consequences of the French invasion in the aftermath of the French Revolution, "French invasion removed the legal and economic barriers that had protected the nobility, clergy,

guilds, and urban oligarchies and established the principle of equality before the law." (abstract) Consequently, the areas once occupied by the French armies experienced a faster pace of urbanization and economic growth in later years.

In contrast, none of the low performers in Asia had a genuine revolution. Without revolution, the old social-political structure survived and continued to protect strong political groups whose interests are in the agrarian economy. In addition, personalized and status-based social relations have been brought into and crippled modern political life; the resulted clientelistic politics hinders the expansion of the capitalist economy.

A seemingly outlier is India, which did not have a social revolution, but has managed to reach respectable growth in the past three decades. However, India's growth has been more brought about by its vibrant states and much less by the federal government, which many commentators believe is dysfunctional. Political fragmentation, often delineated by religion and caste, has prevented India from acting on a more meritocratic basis.[18] The hidden costs of India's old social structure probably are underestimated. India will have a brighter future if this old structure is displaced by a modern structure.

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[18] For example, when commenting on the difference between China and India, two leading Indian scholars, Devesh Kapur and Avind Subramanian said: "It is well worth remembering that the difference in the economic performance between China and India is not the extent to which each has turned to markets, because both have. Rather, the Chinese Communist Party-state, as an economic institution, is more responsive, more meritocratic, and more skilled in human capital than the Indian state. Rebuilding the Indian state on firmer foundations may well determine not just what future India will have, but whether it has a future." *Business Standard*, September 6, 2013.

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Figure 1 Initial Land Distribution and Long-run Growth: Scattered Plot
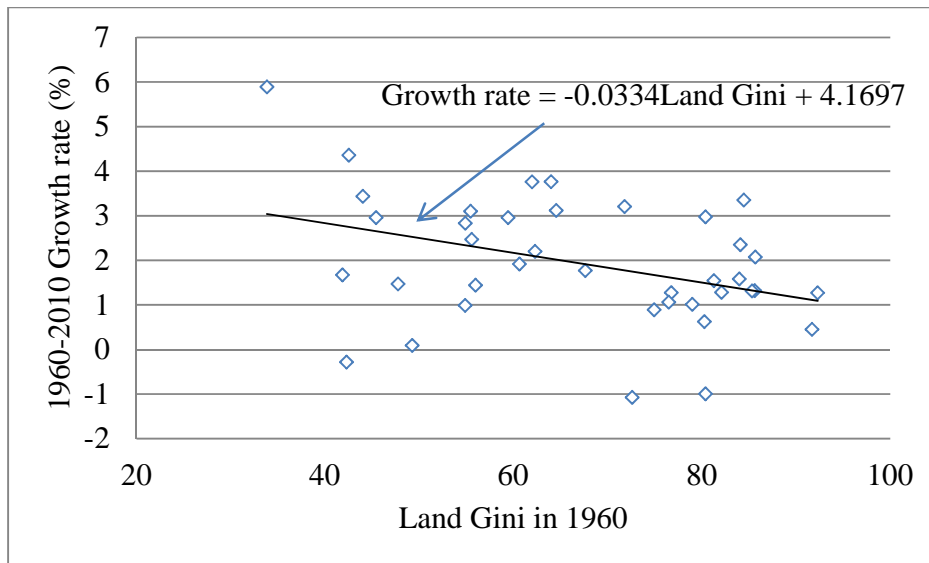
Notes: The figure includes 39 countries that started as autocracy in 1960 and lasted for a substantial number of years in the period 1960 – 2010. The vertical axis is the average growth rate between 1960 and 2010. Land Gini coefficients come from Deininger and Olinto (2000), other data come from the Maddison Project Database.
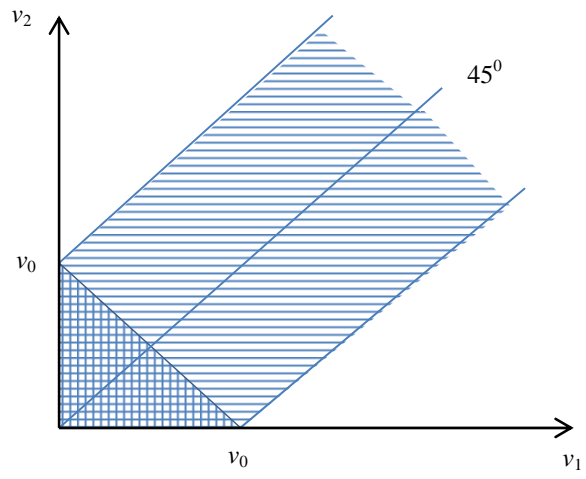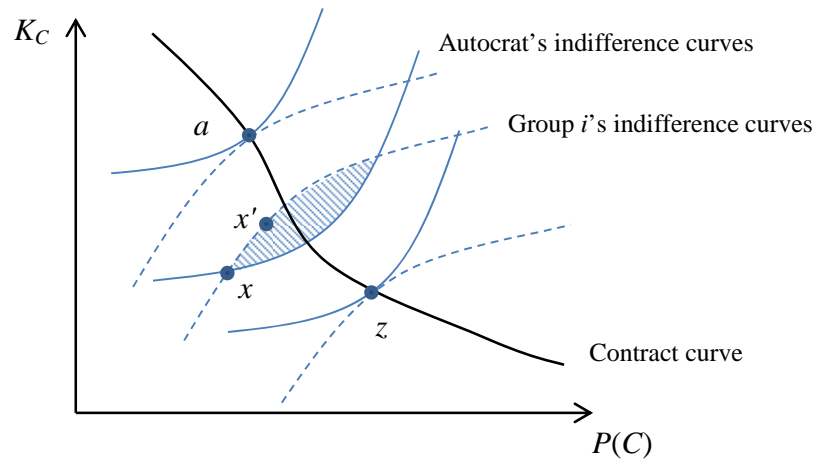
Figure 2. The Equality Tube

Figure 3. The Contract Curve

Figure 4. Invasion-proof Sub-Coalitions