How Nations Evolve: Political Accountability and Developmental Trajectories*

Liu Liu†

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Abstract

We study how the developmental trajectory of a nation is determined by the endogenous evolution of political accountability. We analyze a dynamic game between citizens and a government with privately known type (benevolent or opportunistic) and hidden action. To diversify sector-specific economic risks, citizens invest in private sectors and expect the government to invest tax revenue into public sectors. Political risk arises as an opportunistic government may confiscate tax revenue with positive probability. The government is however constrained by political accountability enforced through the adjustment of public trust from Bayesian citizens, who may gradually learn about the government's type as informational efficiency gets improved in the development process. We derive the unique Markov perfect equilibrium of the game, and show how the joint evolution of political accountability and the equilibrium strategy of an opportunistic government determines the developmental trajectory of a nation. Our results offer an explanation for the rise of "vicious" or "virtuous" economic and political circles. As an extension, we also discuss self-fulfilling political transition.

Key Words: political accountability, economic development, signal precision, public trust, political transition, developmental trajectories

JEL classification: C73, D72, O11, P16

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†University of Zurich, liu.liu@econ.uzh.ch

1 Introduction

How does the evolution of a nation unravel into certain economic and political developmental trajectory? Scholars have emphasized various driving forces that led to diverging development paths (Hall and Jones (1999), Acemoglu and Robinson (2001), Besley and Persson (2011), Acemoglu and Robinson (2012)). But the endogeneity of a uniform long run driving force has yet to be established. This paper provides an answer to this question centering on the endogenous evolution of political accountability and governments' adaptation strategy.

Political accountability is the citizens' ability to hold the governments accountable for their actions (Adserà et al. (2003)). It thus requires that citizens are responsive to available information and appropriately update their opinions so as to correctly reward and punish the incumbent (Key (1966)). With the aid of a dynamic political economy model, we characterize citizens' responses to information in the following way. There is information asymmetry regarding the latter's type (benevolent or opportunistic). An opportunistic government retains the option of predation. Citizens receive noisy signals of the government's choice and make political inferences of the government's type. Here we introduce an important feature of the signal: *informational efficiency*, or in another word, signal precision. The same signal at different stages of economic development can convey information about the quality of the government with different precision, affecting citizens' ability to hold the government accountable. For instance, a Swiss citizen would complain about the inefficiency of the public transportation system if the trams or buses arrived late, while in Ukraine bus punctuality would be less of a concern. In our paper, this feature is modelled such that a bad signal is more precise in revealing the political risk from an opportunistic government in a more developed economy. We assume citizens are Bayesian players. They thus update their beliefs about the incumbent's type with signals carrying changing precision. We call this belief public trust as in Phelan (2006).[1] Political accountability in this paper is then enforced through the adjustment of public trust from the citizens at all stages of economic development. Therefore, political accountability is determined by the levels of both informational efficiency and public trust, with the former directly affected by economic development.

We document some facts in support of the above arguments. First, citizens are sophisticated enough to make political inferences but rely on the signal precision. In Chen and Yang (2016), they find that survivors from the Great Chinese Famine inferred the government's liability from personal hunger experiences, and there were divergent interpretations of the famine as different drought conditions amplified the noise associated with the starvation experiences as a signal for the government's trustworthiness. Second, economic development fosters political accountability. Direct observations in history include economic development followed by revolutions or

[1] In canonical political agency models featuring information asymmetry, it is also called reputation (Besley (2007)). In some papers, it is called public trust (Phelan (2006)), or long-term credibility (Lu (2013)), or institutional grievance (Dorsch and Maarek (2015)).

political instability.[2] For example, preceded the Reformation, the English, French, American and Russian revolutions all feature an economic improvement first (Huntington (1968)).[3] Recent anti-corruption movement in developing countries such as China and Brazil is also a reflection of increasing accountability. Third, prevailing public trust affects the effectiveness of political accountability. Nunn et al. (2016) shows that citizens in high trust societies are less likely to attribute blame for poor macroeconomic performance to their politicians.

To establish the link between economic development and informational efficiency, we build on Acemoglu and Zilibotti (1997) and introduce an economic imperative for citizens to diversify sector-specific risks. We assume that to diversify risks, citizens invest savings into private sectors that are activated with enough investment and expect the government to invest tax revenue into public sectors. In a fully developed economy, private sectors are all activated, a bad outcome is completely attributed to predation from an opportunistic government. However, with economic underdevelopment and the same bad signal, citizens cannot rule out the possibility of risks from inactive private sectors, i.e., economic underdevelopment, hence the informational inefficiency.

An economy develops as capital accumulates from the investment return and opens the gate to more sectors and more risk diversification opportunities. On nations' development paths, ancient economies built mainly on subsistence farming. During the industrial revolution, sectors such as mining, construction and manufacturing were developed. Modern economic expansion of industrialized countries witnessed new sectors providing services, finance and technology. Economies are better equipped against risks with the engagement of more sectors. If citizens can effectively discipline the governments, public sectors can deliver good services for the well-functioning of the private economy against risks such as power outages.

We now proceed to governments' adaptation strategy. The adaptation argument is adopted from Huntington (1968).[4] Besides the constraint from political accountability, an opportunistic government faces various tradeoffs and adapts accordingly as the size of predation gain, the levels of informational efficiency and public trust change in the development process. We demonstrate these tradeoffs and track the adaptation strategy of an opportunistic government in equilibrium. Citizens have rational political expectations of the governments' strategy and update their trust, while an opportunistic government maximizes its self-interest with rational anticipation of the

[2] From this point of view, construction of redistributive conflicts in the canonical model of Acemoglu and Robinson (2001) relies on business cycle shocks to generate a timing when the poor is endowed with large capacities to hold the elite accountable.

[3] "It was precisely in those parts... where there had been most improvement that popular discontent ran highest" (de Tocqueville (1955)).

[4] "A governmental organ that can successfully adapt itself to changed functions, such as the British Crown in eighteenth and nineteenth centuries, is more of an institution than one which cannot, such as the French monarchy in the eighteenth and nineteenth centuries." In fact, the evolution of governments' strategy that self-regulates in accordance with the political accountability is the evolution of institutions as institutions are stable, valued, recurring patterns of behaviour (Huntington (1968)).

optimal actions taken in the continuation games.

At the early stage of economic development, an opportunistic government restrains from predation in anticipation of larger future predation gains. While predation gain continues to increase as an economy develops, economic development exhibits a non-monotonic effect on an opportunistic government's predatory incentive due to variations in informational efficiency. At the early stage, a good signal is most likely to be interpreted by the citizens as indicative of a benevolent government, while a bad signal is considered as imprecise in revealing an opportunistic one. Therefore, at this stage, trust building is effective but political accountability is low. However, since predation gain is small when the economy is underdeveloped, an opportunistic government often trades predation gain for trust building. In the expansion stage, predation becomes more attractive. Informational efficiency of a good signal is significantly reduced thus trust building becomes less tempting. Moreover, the precision of a bad signal, and hence political accountability, is improved but to a limited extent. An opportunistic government thus confiscates most often at this stage. The high level of corruption observed in some middle income countries nowadays can confirm this prediction of our paper. If an economy enters a maturity stage, citizens can detect the political risk revealed by a bad signal much more efficiently as informational efficiency of a bad signal is greatly improved at this stage. Despite the sizable predation gains, an opportunistic government mimicks often as a result of increasing political accountability. As is observed in reality, high political accountability is an important feature of most industrialized and democratized countries. Last but not the least, extreme political optimism (very high trust) relieves pressure from political accountability and encourages predation, while extreme political pessimism (very low trust) incurs excessive accountability to withhold and also encourages predation despite the fall in public trust. Besides, extreme trust levels adjust slowly, creating even stronger incentives for predation. This explains the emergence of a high level of corruption at the peak but also at the end of some dynasties such as the major Chinese dynasties in history.

In the Markov Perfect Equilibrium (MPE), we obtain two areas of pure strategy of no predation where the level of economic development is either very low or very high (and public trust is not too low or high); two areas of pure strategy of predation where there is extreme political optimism or pessimism (and the economy is in the expansion or maturity stage); one area of mixed strategy of mimicking that is U-shaped as an economy develops and inversely U-shaped as public trust increases.[5] Governments' actions further impact economic development and citizens respond to economic outcomes by updating their trust. A new environment of political accountability is thus formed and an opportunistic government further adapts to it. In this way, we complete the circle between political accountability and opportunistic governments' adaptation as illustrated in Figure 1.

Luck affects a nation's development.[6] But we are particularly interested in how

[5] There is another small area of mixed strategy which we discuss in Section §4.2.

[6] This is the driver in Acemoglu and Zilibotti (1997). We keep this channel open but we further

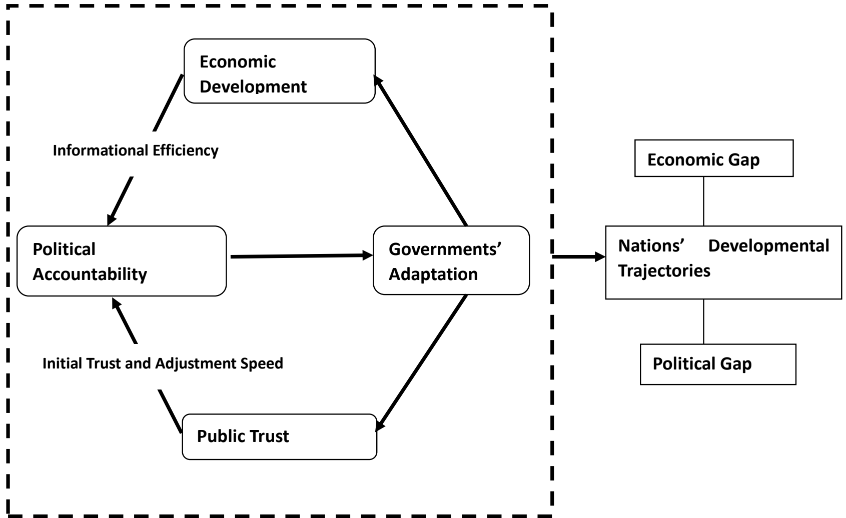


Figure 1: Framework

the joint evolution of political accountability and governments' adaptation determines nations' developmental trajectories. Perhaps the most important characteristic of various development paths is the political and economic gaps across countries and over time. Historically, there is the general observation that democracy was very rare before the industrial revolution. Across countries, starting from mid-1950s, economists noticed the economic gap between rich and poor nations.[7] While "in politics as in economics the gap between developed political systems and underdeveloped political systems has broadened,... this political gap resembles and is related to the economic gap (Huntington (1968))." Our paper explains these gaps with the "vicious" or "virtuous" political and economic circle that can arise in the model. We emphasize two results. First, an opportunistic government expropriates the economy most often in the expansion stage, which can cause the country to fall into the middle income trap. Second, in the maturity stage with increasing political accountability, the governments opt for mimicking more often due to high accountability, which further increases economic prosperity and political accountability. When trust level is not too low, democracy can thus be consolidated. As an extension, we also discuss self-fulfilling political transition when there is strategic complementarity between players.

Our paper connects to various streams of economic literature. First, it is a political agency model where both moral hazard and selection operate. Political accountability first appears in Barro (1973) and Ferejohn (1986) from electoral discipline. The canonical model has a setting where elections both discipline and sort the politicians. However, the solution concept is Perfect Bayesian Equilibrium as when the simple setting is extended to infinite periods, "reputation does not affect the politician's incentive" (Besley (2007)). Politicians' strategy is simply determined by the level of

introduce the dynamic game so that the other mechanisms as shown in Figure 1 are the main focus.

[7] "...economic inequalities between developed and underdeveloped countries have been increasing" (Myrdal (1957)).

exogenous material gain. Our main departure from it is the endogeneity of the material gain and the reputation which in our context is the public trust. Other papers that center on political accountability feature more complicated settings. Maskin and Tirole (2001) introduces different motivations of the officials and different modes of government in a two period model for welfare analysis and discussions on constitutional design. Benhabib and Przeworski (2010) in a dynamic framework introduce an additional criminal accountability if transgression is flagrant. They distinguish and compute the effects of these accountability mechanisms on economic growth. Our paper abstracts from these specific discussions, but relies less on assumptions of external factors, and focuses instead on endogenizing political accountability with state variables and thus Markov strategy.

Our paper is closely related with the reputation literature, especially its applications in political economy, such as Phelan (2006), Azam et al. (2009) and Lu (2013). They share the same feature in terms of their equilibrium dynamics: if reputation (trust) increases, the probability of predation from an opportunistic government also increases. Our paper enriches the equilibrium dynamics by incorporating other mechanisms that interact with the reputation (trust) channel. By improving informational efficiency, economic development determines opportunistic governments' strategy together with the reputation concern. This is realized through the endogenous generation of the signal distribution. In these three papers, observable action of predation is assumed and conditional probabilities of the signals on the non-predation path vary with trust and governments' strategy. In our paper, we assume unobservable actions and conditional probabilities on every equilibrium path vary with capital, trust and governments' strategy. The assumption of unobservable actions and the linkage between signal precision and the state variables incurs a cost of multiple equilibria if there is strategic complementarity. In order to derive a unique MPE, we abstract from strategic complementarity in the basic setting and discuss multiple equilibria as an extension. Lu (2013) in particular derives different types of MPE with alternative configurations of reputation (state variable) and time preferences (parameter) of both types of the government. We also derive different types of MPE as capital and trust levels vary and both of them are state variables, but in our paper the benevolent government is a mechanic type.

As has been mentioned, in our model, information is transmitted into political process (Lohmann (1994), Piketty (1999)) through economic development. This paper adds to the channels through which economic development can affect information revelation. Acemoglu and Zilibotti (1999) proposes a model where information is generated by repetition of activities which can be constrained by the scarcity of capital. Principal-agent relations become more efficient as the economy accumulates capital and economic sectors expand for a high-level activity. In Jaimovich (2011), entrepreneurial skills are private information. Economic development brings sectoral variety, which facilitates the self-selection of talents to sectors and enables the provision of more satisfactory credit contracts. The credit market efficiency in turn spurs innovation and contributes to economic development. What distinguishes our model from these papers is the micro foundation of the interaction between information revelation and economic development. In particular, ours is implemented in a dynamic game where information revelation not only is affected by economic development but also can be controlled by Markov strategy through signal jamming.

Our paper complements the institutionalist theories of development and political transition (Acemoglu and Robinson (2001), Acemoglu and Robinson (2012)) where democratization is realized in an economy that features income inequality and revolutionary threat can be triggered by adverse business cycle shocks. Our model does not address distributional conflicts but focuses on political accountability. Moreover, transitions are triggered by endogenous improvement of informational efficiency rather than exogenous business cycle shocks. This literature has emphasized the importance of good governance for long term development (Mauro (1995), Easterly and Levine (1997), Hall and Jones (1999), Acemoglu and Robinson (2012)).[8] Our argument is in line with them. In addition to institutions, we emphasize citizens' beliefs (public trust) and heterogeneity in government types. In addition to political transitions, we extend the analysis into long run political and economic development paths. However, our model generates self-fulfilling political transition in a similar way as is discussed in Acemoglu and Robinson (2001). Bidner and Francois (2013) seeks to explain political transitions by studying the endogenous emergence of political accountability. A sequence of good leaders can modify citizens' beliefs about the standards of accountability, and thereby leads voters to expect accountable leaders in future. Then voters are willing to throw out poorly acting leaders today. Therefore, good leadership can lead to democratic consolidation. In contrast to their paper, we center on the evolution instead of the emergence of political accountability; democratic consolidation is achieved by virtuous political and economic circle through governments' adaptation; we also only assume that citizens rationally update their belief by observing the outcomes of governments' actions while their paper directly allows governments' actions to impact citizens' belief.

There are two novelties in this paper which the literature to the best of my knowledge has not yet attempted. Firstly, exogenous distribution of signals is commonly assumed in the literature, whereas we introduce the endogeneity of the signal distribution, which enriches the economic dynamics. By linking economic development to the endogenous generation of the signal distribution, we can study the evolution of political accountability and trust building where citizens rely on precision of the signals. In political agency models where information asymmetry is modeled (Phelan (2006), Azam et al. (2009), Lu (2013), Dorsch and Maarek (2015)), either exogenous conditional distribution of signals or observable action is assumed. It also differs from Acemoglu and Robinson (2001)'s canonical model where threat comes from revolt but its cost is affected by exogenous shocks. The second is to construct and solve Markov strategy numerically over the set of two state variables. The technical complexity

[8] Acemoglu and Robinson (2012) propose a theory of why nations fail. They first discuss the distinction between extractive and inclusive economic and political institutions then explain how history has shaped institutional trajectories of nations. Our model supports the viewpoint of extractive and inclusive institutions and generates enough endogeneity as a complement to offer an insight into the co-evolution of history and institutions.

lies in that, to solve different types of MPE, we need to obtain value functions of discrete actions first, assuming the equilibrium strategy which is a continuous choice is known. However, the equilibrium strategy in turn can only be solved subject to constraints imposed on value functions of discrete choice.

The rest of the paper is organized as follows. Section §2 introduces the basic setting of the model and the elements of the game, in particular the details of the signal structure. Section §3 presents players' optimization problems and defines the Markov Perfect Equilibrium. In Section §4 we discuss the properties of the Markov strategy, solve the strategy numerically and analyze the equilibrium dynamics. Nations' developmental trajectories are then simulated. Section §5 discusses self-fulfilling multiple equilibria as an extension. Section §6 concludes. All the proofs, programming details and extra discussions are in the Appendices.

2 The Model

We introduce the basic setting and provide an overview of the game with timing in Section §2.1. Details of the building blocks are provided in Section §2.2 – Section §2.4.

2.1 Players, Actions and Timing

We consider a dynamic game with a long-lived player (*government*) and a continuum of short-lived players (*citizens*). Time is discrete and indexed by $t = 0, 1, ..., \infty$. The government has a private and persistent type $\theta \in \{G, B\}$ (good or bad, benevolent or opportunistic, etc.). At $t = 0$, citizens are endowed with a prior belief of the government's type, the initial public trust. With probability p_0, they trust that the current government is benevolent. If p_0 is high (low), it reflects political optimism (pessimism). In each period $t = 1, ..., \infty$, a new cohort of citizens is born. Citizens in every period are homogeneous in our model.

We assume that the short-lived citizens in each period t have a warm glow preference characterized by the utility function

$$U(c_t, b_t) = u(c_t) + \log b_t,$$

where c_t is period-t consumption, and $b_t \geq 0$ is their bequest to the next generation's citizens. As we will illustrate in more details later, the bequest b_t will depend on a state variable of the economy j_t, citizens' saving decision s_t and an action a taken by the government. In the beginning of period $t \geq 0$, citizens receive a wage w_t by inelastically supplying a unit of labor ($l_t = 1$) to a final good sector. A fraction τ of the citizens' wage will be taxed away by the government, where the tax rate $\tau \in [\underline{\tau}, \bar{\tau}]$ is exogenously given (see Section §2.3). Additionally, the citizens earn a capital gain of $(1 + r_t)k_t$, where r_t is the rate of return on capital net of depreciation, and k_t is the amount of capital accumulated in the economy. Given the income, citizens aim to maximize their utility by making consumption and saving decisions (c_t, s_t) subject to the budget constraint

$$c_t \leq (1-\tau)w_t + (1+r_t)k_t - s_t, \tag{BB}$$

and the law of motion is $k_{t+1} = b_t$, with $k_0 \geq 0$ being exogenously given.

The economic fundamental in each period $t = 1, ..., \infty$ is fully characterized by a state of nature j_t, which is an i.i.d. draw from the uniform distribution over $[0,1]$ and will only realize at the end of the period. Uncertainty in j_t is the source of economic risks. To diversify the economic risks, as in Acemoglu and Zilibotti (1997), citizens in the model economy can invest in a continuum of intermediate sectors $\ell \in [0,1]$, which we further divide into a set of private sectors $[0, 1-\gamma]$ and a set of public sectors $(1-\gamma, 1]$. A sector ℓ will be *active* if and only if it receives at least an amount $M_\ell \geq 0$ of investment (see Section §2.2 for more details), and it will act the same as a canonical Arrow security for state ℓ whenever it opens up. We assume that the citizens can only invest in the private sectors with their saving (s_t), while the government can only invest in the public sectors with its tax revenue (τw_t). The marginal return of the citizens' saving is determined by the players' investment decisions and the economic fundamental: If the state turns out to be j_t and the sector $\ell = j_t$ is active in that period, the citizens will receive a high return (q_H) for every unit of their saving. Otherwise the return will be low $(q_L < q_H)$. This in turns determines whether the bequest of the period-t citizen is large $(b_t = q_H s_t)$ or small $(b_t = q_L s_t)$. For more details of players' actions, investment return and possible scenarios, see Section §2.4.

In our model, a benevolent or type G government simply commits to invest all the tax revenue into the public sector ($a = I$, *protection*) in every period. In contrast, an opportunistic or type B government can choose to confiscate and consume all its tax revenue ($a = NI$, *predation*) instead of investing it as the citizens would prefer. We assume that neither the government's action nor the realized state of the economy is observable to the citizens. However, by observing the public signal of the investment return $q \in \{q_L, q_H\}$ on his saving, the citizens can still update his belief about the government's type, and this posterior belief will then be inherited by the next period's citizens. Let p_t be the posterior belief, i.e. public trust, in the beginning of period t. Other things equal, the government always prefers being more trusted by the citizens. In particular, the government receives a flow benefit $\psi(p_t)$ if the citizens trust him with $\Pr(\theta = G) = p_t$ when he enters the stage game in period t, where ψ is a strictly increasing function. Let a_t denote the action taken by the government in period t. The stage payoff of the government is given by

$$v_t(a_t, p_t) = \begin{cases} \tau w_t + \psi(p_t) & \text{if } \; a_t = NI, \\ \psi(p_t) & \text{if } \; a_t = I. \end{cases}$$

Note that the government takes an action if and only if j_t occurs in a public sector $\ell = j_t$ (see Section §2.4). For simplicity, in the rest of the paper, we denote both the state of nature j and the sector $\ell = j$ with j, i.e. sector j covers an *economic risk* from the uncertainty of state j_t at period t. An opportunistic government's strategy is σ–the probability that it chooses protection. If $p_t < 1$ and $\sigma_t < 1$, the citizen believes there is a *political risk* of expropriation. If $p_t = 0$, an opportunistic government is exposed and overthrown.

The timing of the game is summarized as follows and portrayed in Figure 2:

1. A new government privately knows its type θ which cannot be communicated to the citizens during the reign. The first generation of citizens is endowed with an initial trust of the government's type p_0 and an initial capital stock k_0.

2. In the beginning of every period t, $t = 0, 1, ...$, citizens inherit the bequest in the form of capital k_t and an updated belief p_t. They become capital owners and are all employed in a production sector of the final good, earn wage w_t, receive capital return r_t and pay the tax at rate τ. Then they make a saving decision s_t and invest their saving into the active private sectors.

3. The government collects tax revenue and chooses between predation and protection, aware that citizens will hold it accountable for the outcome. If predation is chosen, all the tax revenue is consumed and there will be no investment in the public sectors. If protection is chosen, then all the tax revenue will be invested into the public sectors.

4. After saving and investment decisions have been made, a state of nature j is realized. Citizens observe the signal q_t of high or low return on their saving.

5. Based on the inherited trust, citizens update their belief of the government's quality p_{t+1}, leave their investment return (in the form of capital) to their children as a bequest. If $p_{t+1} > 0$, a new generation of citizens inherits p_{t+1} and k_{t+1} and a new round starts...

6. If $p_{t+1} = 0$, the government will be overthrown and the economy will rebound with an endowment of k_0 and p_0 for a new government.

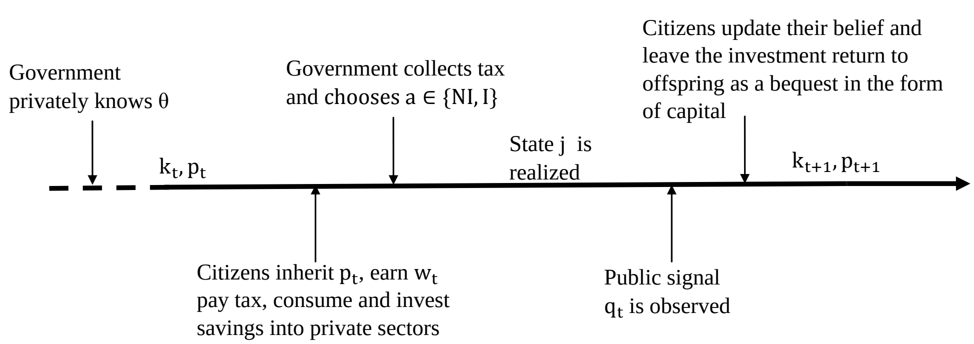


Figure 2: Time line

2.2 Intermediate Sectors and Minimum Size Requirement

As has been mentioned, there is a continuum of equally likely states of nature on the unit interval $J \in [0, 1]$, and every period only one of the states $j \in J$ is realized. If an intermediate sector j is activated with investment at period t, we consider the economic risk from the uncertainty of the states is covered at state j. If sector j is not active, the economy is exposed to the risk of occurrence of state j.

The $1-\gamma$ private sectors can include farming, mining, etc. The γ public sectors provide services like infrastructure, and insure the citizens against risks such as wide-scale power outages which can disrupt the functioning of the private sectors. Therefore, citizens receive a high return q_H on their investment as long as a sector j is active for the state j, whether it is public or private. Section §2.3 provides more information.

As has been mentioned, some sectors can only be activated if they receive sufficient investment. This is adopted from Acemoglu and Zilibotti (1997) where they assume a minimum size requirement: investment in certain sectors requires a minimum size which is like a start-up cost. We further assume the distribution of minimum size requirement in our economy as follows. The γ public sectors have no minimum size requirement: $M_j = 0, \forall j \in [1-\gamma, 1]$. Therefore, the government either invests in every public sector or there is zero public sector investment. The private sectors' minimum size requirement is constant (see Figure 3): $M_j = D, \forall j \in [0, 1-\gamma]$, $D > 0$. The ranking of sectors from lower to higher size occurs without loss of generality. But the specification of the minimum size requirement affects the expansion speed of the private economy. If we assume other forms of minimum size requirement, for instance, a linear specification $M_j = D * j, \forall j \in [0, 1-\gamma]$, $D > 0$, then in this case the private economy expands quickly as the activation of the first sectors requires less investment.

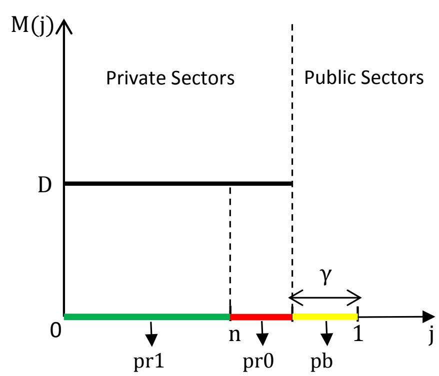


Figure 3: Minimum Size Requirement $M(j)$

In every period t, constrained by the minimum size requirement, a subset of the $1-\gamma$ private sectors is activated with investment, and we let n_t denote its size as shown in Figure 3. Then we can group states of nature by their corresponding sectors. Let ω_j denote the set of state j's type: $\omega_j = \{pr1, pr0, pb\}$. $pr1$ is a state in one of the active private sectors; $pr0$ is a state in one of the inactive private sectors. If $\omega_{j_t} = pr0$, by the ranking of the sectors, we have $n_t < j_t < 1 - \gamma$. pb is a state in the public sectors (see Figure 3). Clearly, the occurrence probability of each type is $\{n_t, 1 - n_t - \gamma, \gamma\}$ at period t. Risks of the economy are fully diversified if all sectors are activated.

The assumption of zero minimum size requirement on the public sectors has two implications. First, it restricts the set of ω to three elements and simplifies our setting. If j_t occurs in a public sector, it is not feasible that this sector is inactive due to insufficient tax revenue. Clearly, as long as the tax rate τ is positive, the sole culprit of no investment in public sectors is predation from an opportunistic government. Second, it justifies citizens' demand for a benevolent government. Pareto improvement can be achieved under certain conditions if sectors with zero minimum size requirement are allocated to a benevolent government compared with a competitive market of only private sectors with the same distribution of minimum size requirement (see Appendix D).

As an economy develops, capital k_t accumulates and citizens save more (see Section §3.1), the private sectors thus expand with more diversification opportunities. Efficiency requires that all private sectors are activated. We assume an upper bound $\bar{D}$ for D so that the private economy will eventually realize a full scale open-up, i.e. $n_t = 1 - \gamma$, before capital accumulates to the steady state level k^* (see Section §3.1).

2.3 Production and Taxation

The production function $F(z, k, l)$ of the final good is Cobb-Douglas in capital k and labor l. z is the technology and a constant. Capital and labor markets are competitive. As has been mentioned, labor supply $l_t = 1$ is inelastic and the government levies a tax rate of τ on the wage. This assumption rules out the possibility for citizens' labor participation choice to be affected by the government's strategy. For analysis based on such possibility, see Phelan (2006) and Azam et al. (2009). Citizens provide labor in the final good production, receive the wage w_t and capital return r_t, and pay the tax.

The function of the private sectors is to transform saving s_t into capital k_{t+1} which can be employed in next period' production. Therefore the capital good is different from the final good. s_t is invested into the n_t active private sectors. The investment return is either high or low in the form of capital and passed along to the offspring as a bequest. Citizens thus become capital owners at the beginning of the next period .

The function of the public sectors is to provide insurance to the activities in the private sectors against risks from the public sectors. Hence we can think of investment in public sectors as the establishment of a welfare system. The benefit of the welfare system takes the form of a high return on citizens' private investment. Thus the quantity of tax revenue invested into the public sectors does not directly affect the outcome, but the activation of the γ size public sectors matters for a high return with a higher probability. Instead of assuming public sectors' production externality or nonlinear effects on the probability of a high return, we assume linearly additive probability to simplify the analysis.

An exogenous tax rate falls in the range of $[\underline{\tau},\ \bar{\tau}]$ to meet two requirements. First, as the quantity of taxation does not directly affect the risk diversification result, taxation needs not be heavy; moreover, as has been mentioned, Pareto improvement can be achieved under certain conditions when there is a benevolent government (see Appendix D). Second, sufficient state capacity is required to establish the welfare system. With the assumption of the exogenous τ, as an economy grows, more tax revenue is invested into public sectors for the establishment of a welfare system. In reality, expansion of public sectors with economic growth is typically observed. Therefore we impose a lower bound on tax rate only to exclude the possibility that an economy can take advantage of a large multiplier effect on economic growth from a small amount of investment in the public sectors.

2.4 Investment and Signals

As each sector generates the same marginal investment return, citizens' saving is equally invested into the n_t active private sectors at period t. We assume that every unit of citizens' saving enjoys an investment return instead of only their investment in the sector which covers the realized state.[9] As has been mentioned, the size of the bequest and thus k_{t+1} depend on the outcome of citizens' investment. As the actions of the government and the realization of the state j_t are both unobservable to the citizens, there can be various scenarios that lead to the same outcome but citizens only observe the signal $q \in \{q_L, q_H\}$.

Table 1: Two outcomes of Investment Return (Signals) and Five Scenarios

Result	Scenarios		
High rate of return q_H	1. $\omega_j = pr1$	2. $\omega_j = pb$ and $\theta = G$	3. $\omega_j = pb$, $\theta = B$ and $a = I$
Probability	n	$p\gamma$	$(1-p)\sigma\gamma$
Low rate of return q_L	4. $\omega_j = pr0$	5. $\omega_j = pb$, $\theta = B$ and $a = NI$	
Probability	$1-n-\gamma$	$(1-p)(1-\sigma)\gamma$	

We categorize five scenarios into two groups by the rate of return on citizens' investment in Table 1. Citizens enjoy a high rate of return q_H on their saving if the following scenarios occur: 1. a state of nature is realized in an active private sector

[9]There is also a technical concern in making this assumption. Welfare comparison is complicated when we consider a return only on the investment in one sector. A welfare improvement from risk diversification can be offset by a decrease in the average investment when more sectors are activated.

($\omega_j = pr1$); 2. a state of nature occurs in public sectors and a benevolent government is in charge ($\omega_j = pb$ and $\theta = G$); 3. a state of nature occurs in public sectors and an opportunistic government chooses protection ($\omega_j = pb$, $\theta = B$ and $a = I$).

A low rate of return q_L can be generated in two scenarios: 1. a state of nature occurs in the inactive private sectors ($\omega_j = pr0$); 2. a state of nature occurs in the public sectors and an opportunistic government chooses predation ($\omega_j = pb$, $\theta = B$ and $a = NI$). The low return q_L is a function of n: $q_L(n)$, which allows flexibility in depicting economic recessions. For example, $q'_L(n) < 0$ increases the volatility of the economy as it expands. We assume $q_L(n) > 0$, thus a low return will not deplete all resources. Both q_H and $q_L(n)$ affect the development speed through capital accumulation and depletion.

In summary, the probability of observing the two signals, or the distribution of the signals is (Table 1 shows the occurrence probability of each scenario):

$$\begin{cases} q_H & \text{prob } n_t + (p_t + (1 - p_t)\sigma_t)\gamma, \\ \\ q_L & \text{prob } 1 - n_t - (p_t + (1 - p_t)\sigma_t)\gamma. \end{cases}$$

Information asymmetry in this context is richer than in the standard literature: other than the existence of hidden information and action, the distribution of signals also depends on the state variables $n(k_t)$ and p_t. Citizens can not observe any of ω_j, θ and a directly. They only observe the signal $q \in \{q_L, q_H\}$ but are aware of the level of economic development summarized in $n(k_t)$, hence if there is economic development, there is room left for variations in signal precision. We call signal precision *informational efficiency* and define it as the precision of a good (bad) outcome in signalling a good (bad) government (see more details in Section §3.2). Moreover, the signal distribution is also affected by opportunistic governments' strategy σ_t, thus there is room for signal jamming.

For simplicity, we denote $\mu_t = p_t + (1 - p_t)\sigma_t$ as the government's reputation, which is the conditional probability of high return q_H, i.e., an action of protection (either from a benevolent or an opportunistic government), if a state j occurs in public sectors with probability γ.

3 The Game

Now we analyze the dynamic game in detail. The state variables in the economy is a 3-tuple (ω_{j_t}, k_t, p_t). An opportunistic government's strategy is $\sigma(k_t, p_t)$ and takes an action if and only if $\omega_{j_t} = pb$. We study the players' problems in Section §3.1. As k_t, p_t and $\sigma(k_t, p_t)$ all affect the generation of a signal, citizens weigh political and economic risks differently at different (ω_{j_t}, k_t, p_t). Consequently political accountability is also different at different (ω_{j_t}, k_t, p_t). Bayesian updating thus plays an important role and we discuss it in Section §3.2 and Section §3.3. In Section §3.4 we define the equilibrium. Opportunistic governments adapt to changing environment of informational efficiency and public trust with the Markov strategy $\sigma(k_t, p_t)$ to maximize its self-interest. A Markov Perfect Equilibrium thus features a $\sigma(k_t, p_t)$ that meets both the political expectation of citizens and the optimization of the opportunistic government. Separating, semi-separating and pooling equilibrium can occur at different (k_t, p_t).

3.1 Players' Problems

Government We have specified an opportunistic government's stage payoff in Section §2.1. Conditional on a state of nature in private sectors $\omega_{j_t} = pr1$ or $pr0$, the government cannot take any action. But the government still acquires the flow benefit $\psi(p_t)$. Conditional on a state of nature in the public sectors $\omega_{j_t} = pb$, if an opportunistic government chooses predation, its payoff $v_{pb|a=NI}$ is $\phi(k_t) + \psi(p_t)$. $\phi(k_t)$ is the tax revenue τw_t. The stage payoff of an action of protection $v_{pb|a=I}$ is just $\psi(p_t)$, thus we have:

$$v(k_t, p_t|\omega_{j_t}, a_t) = \begin{cases} \phi(k_t) + \psi(p_t) & \omega_{j_t} = pb \ \& \ a_t = NI, \\ \\ \psi(p_t) & \omega_{j_t} = pr1 \text{ or } \omega_{j_t} = pr0 \text{ or } \omega_{j_t} = pb \ \& \ a_t = I. \end{cases}$$

In the form of $\psi(p_t) = -\eta(1-p_t)^2, \eta > 0$, the government faces a distrust cost when p_t is smaller than 1. The interpretation of this cost could be broad. It could be thought of as shrinking "ego rents" (Rogoff (1990)) when the government loses popularity. It could also capture the idea of mounting scale of rebellion and damage to the economy with decreasing trust, or any activity from citizens, e.g., street protest, that is not modelled but the overall impact on the government takes form of this function given that citizens' belief is a common knowledge (Phelan (2006)). Or it simply reflects poor governance in creating the evil of a culture of political corruption in which the public trust is eroded.[10] η is a measure of trust premium.

Citizens As has been mentioned, the citizens have a warm glow preference $U(c_t, b_t)$. Citizens equally invest $\frac{s_t}{n_t}$ into each of the private sectors that are opened. Probabilities of q_H and q_L returns are provided in Section §2.4. The return on the entire saving is $q_H s_t$ ($q_L(n_t)s_t$). Therefore the citizens' maximization problems is:

$$\begin{aligned} &\max_{b_t} \ \ U(c_t, b_t) \\ \equiv &\max_{s_t} \ \ u(c_t) + (n_t + \mu_t\gamma)\log q_H s_t + (1 - n_t - \mu_t\gamma)\log q_L(n_t)s_t \\ &s.t. \ \ \ c_t \le (1-\tau)w_t + (1+r_t)k_t - s_t \end{aligned}$$

$u(c_t)$ is strictly concave, increasing and differentiable. For simplicity, we assume that capital fully depreciates after use in production. With log utility of investment

[10] de Jouvenel (1963) views "essential function of public authorities" as one to "increase the mutual trust prevailing at the heart of the social whole."

return, we abstract from the case where citizens' saving decision is affected by their belief of the government's type or the government's strategy. In our extension in Section §5, we include the interaction between government's strategy and citizens' saving decision and discuss self-fulfilling multiple equilibria.

The saving decision is therefore $s_t = s(k_t)$, a function merely of capital level, concave and strictly increasing in k_t. Capital's law of motion is thus:

$$k_{t+1} = b_t = \begin{cases} q_H s_t & \text{prob } n_t + (p_t + (1-p_t)\sigma_t)\gamma \\ \\ q_L(n_t) s_t & \text{prob } 1 - n_t - (p_t + (1-p_t)\sigma_t)\gamma \end{cases}$$

By equating minimum size requirement M_j and the investment amount in each active sector $\frac{s_t}{n_t}$, we obtain the equilibrium number of sectors that are active at period t: $n_t = \frac{s_t}{D}$. Therefore, at a higher level of capital, more private sectors are activated and fewer economic risks occur. The law of motion of capital also shows that higher levels of capital and reputation together can reduce economic and political risks, and an economy can thus evolve on a high return path with a high probability, which implies that the interaction between political and economic development is important. We can solve the steady state k^* as an economy develops on the high return path. As the production function is Cobb-Douglas, there is another quasi-steady state k_L^* if $k < k_L^*$ and the economy develops on a path of low return. If $k \geq k_L^*$, the development path is still stochastic depending on the realization of political and economic uncertainty.

When capital reaches a threshold capital level $\bar{k} = (1-\gamma) * D$, $n_t = 1 - \gamma$, all private sectors are activated and risks are fully diversified. By imposing $\bar{k} < k^*$ to ensure this threshold is met earlier than the steady state k^*, we obtain $\bar{D}$.

3.2 Informational Efficiency, Trust and Signal Jamming

As political and economic uncertainties both can result in a good (bad) outcome, citizens can only assess information and update trust with their knowledge of the level of economic development after observing of the public signal $q_t \in \{q_H, q_L\}$. This knowledge helps them assess the quality of the signal and make political inferences about the quality of the government. Political accountability thus relies on informational efficiency. The distribution generating process of q_t is affected by the levels of capital stock k_t and public trust p_t as well as governments' strategy $\sigma(k_t, p_t)$ as is analyzed in Section §2.4. They respectively impact political accountability through informational efficiency, initial trust and adjustment speed, and signal jamming.

Informational efficiency of a bad signal is different from that of a good signal. The efficiency of a bad signal increases with economic development while the efficiency of a good signal decreases with economic development. As an economy develops, economic risks are reduced, a bad signal becomes more precise in revealing the political risk from an opportunistic government if the political risk is not controlled by the government.

Thus economic development improves the informational efficiency of a bad signal and political accountability. Similarly, economic underdevelopment means higher probability of a bad outcome, thus observation of a good signal when capital stock is lower will be interpreted by the citizens as more precise in revealing a benevolent government. We call this process trust building when citizens' trust goes up due to a good signal. The precision decreases when economic risks are gradually reduced in the development process.

As public trust is transmitted from generation to generation, citizens' assessment of political risk is also affected by their prepossession p_t, which can be traced back to the bias in initial trust p_0. Moreover, due to the inherent property of Bayesian updating, the adjustment speed is also affected by the level of p_t. Therefore, effectiveness of political accountability also depends on the prevailing trust level.

An opportunistic government's strategy also affects the quality of the signals. More mimicking from an opportunistic government adds noise to the signals and the quality of the signal becomes lower. Therefore, political accountability will be hampered and trust building will be ineffective if the citizens believe there is signal jamming from the opportunistic governments' action of mimicking.

3.3 Bayesian Updating

The rich mechanisms that affect the information assessment is embodied in the Bayesian updating process. It is also the law of motion for public trust. Signal q_t is automatically observed by the citizens and in our setting, $q_t \neq \emptyset$ every period. Based on an observation of q_H or q_L return at period t, the posterior belief at period $t+1$ is:

$$\begin{aligned}
p^H_{t+1}(k_t, p_t) &= \frac{p_t(n_t(k_t)+\gamma)}{p_t(n_t(k_t)+\gamma)+(1-p_t)(n_t(k_t)+\gamma\sigma(k_t,p_t))}, \\
p^L_{t+1}(k_t, p_t) &= \frac{p_t(1-n_t(k_t)-\gamma)}{p_t(1-n_t(k_t)-\gamma)+(1-p_t)(1-n_t(k_t)-\gamma\sigma(k_t,p_t))}.
\end{aligned}$$

The Bayesian updating is completely endogenous given the endogenous distribution of the public signal. We do comparative statics analysis to gain some initial intuition of how capital stock k_t, public trust p_t and governments' strategy $\sigma(k_t, p_t)$ impact political accountability through informational efficiency, initial trust, adjustment speed and signal jamming. For now, we exclude $k = 0$, $p = 0$, $p = 1$ and $k \geq \bar{k}$ and leave them for later analysis.

Proposition 1. *1. The outcome of $\{q_H, q_L\}$ determines the direction where public trust moves: $p'^H \geq p$, $p'^L \leq p$; 2. With a higher mimicking probability, a government is less accredited for a high return but less blamed for a low return: $\frac{\partial p'^H}{\partial \sigma} < 0$, $\frac{\partial p'^L}{\partial \sigma} > 0$; 3. Trust building: public trust increases most when an economy is least developed. As an economy develops, it increases less and at a lower speed: $\frac{\partial p'^H}{\partial n} < 0$, $\frac{\partial^2 p'^H}{\partial n^2} < 0$; 4. Political accountability: public trust decreases least when an economy is least* *developed. As an economy develops, it decreases more and at a faster speed:* $\frac{\partial p'^L}{\partial n} < 0$, $\frac{\partial^2 p'^L}{\partial n^2} > 0$*; 5. Extreme political optimism and pessimism adjust very slowly: if* $p \to 0$ *or* $p \to 1$, $\frac{\partial p'}{\partial \sigma} \to 0$, $\frac{\partial p'}{\partial n} \to 0$.

The effects from p_t and $\sigma(k_t, p_t)$ are shown in the left panel of Figure 4 and the effect of $n(k_t)$ is shown in the right panel. n_t is an increasing function of k_t alone, thus its effect on p_{t+1} reflects the effect of capital accumulation (economic development) on p_{t+1}.

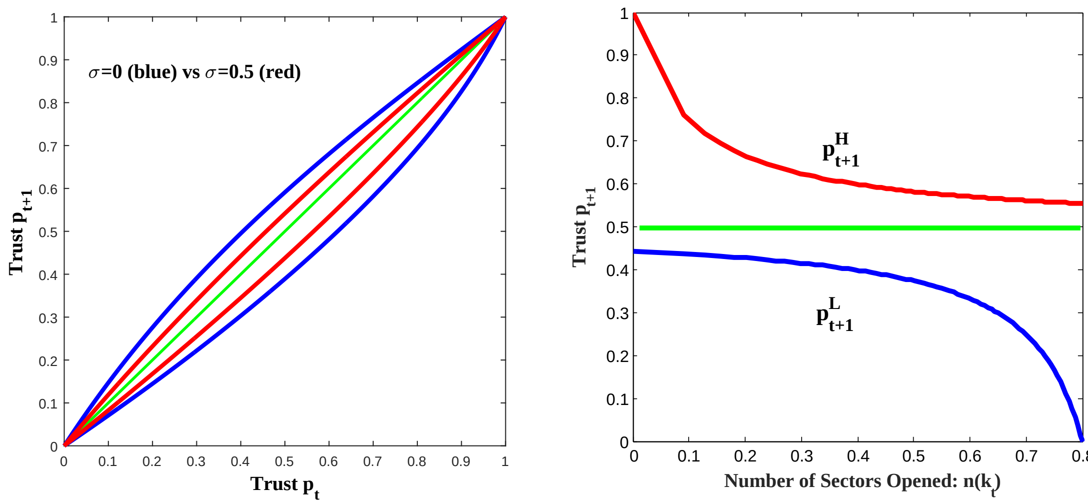


Figure 4: k, p and σ's impacts on Bayesian updating

If $\sigma(k,p) \neq 1$, $p_t \neq 1$ and $p_t \neq 0$, then $p^H_{t+1} > p_t$ and $p^L_{t+1} < p_t$. In case of a high return, trust goes up as long as there is the possibility of political risk. Similarly, public trust falls in case of a low return. In the right panel of Figure 4, we call the red line the "trust building" line as it shows the increase in public trust in case of a good signal and the blue line the "political accountability" line as it shows the decrease in public trust in case of a bad signal.

$p^H_{t+1}(k_t, p_t)$ is strictly decreasing in $\sigma(k_t, p_t)$ and n_t. In Section §2.4, it has been shown that a high return has three sources. Citizens have to distinguish between a benevolent government and two other possibilities: an opportunistic government choosing protection with probability $\sigma(k_t, p_t)$ or the expansion of the private sectors leading to a high return with probability n_t. Therefore, when it is more likely that the latter two will take place, the precision of the good signal decreases and trust building becomes less effective, and public trust is updated to a lower level in case of a good signal.

$p^L_{t+1}(k_t, p_t)$ is strictly increasing in $\sigma(k_t, p_t)$ but decreasing in n_t. Similarly, if citizens observe a low return, they expect it either from an opportunistic government's choice of protection or from risks uncovered by the active private sectors. Citizens attribute the low return less to an opportunistic government when they believe it chooses protection with a higher probability $\sigma(k_t, p_t)$. And as an economy grows, n_t

is larger, it is less likely that a low return occurs in an inactive private sector, and public trust falls more with the improvement in precision of a bad signal.

When an economy is least developed, the credit of a high return is attributed most to the government and a low return is least blamed on the government. Therefore trust building at this stage is most effective while political accountability is least effective. Another important feature of the updating process is shown in the second order derivatives. As an economy expands, n_t is larger, p^H_{t+1} not only increases to a lower level but also increases more slowly. p^L_{t+1} not only decreases to a lower level but also decreases faster. Therefore, with economic development, trust building becomes increasingly less effective and political accountability becomes increasingly effective. The gap between posterior belief in different situations of a high return and a low return is first increasing and then decreasing.

Last but not the least, if $k < \bar{k}$, the effects of $\sigma(k_t, p_t)$ and n_t approach zero if the level of public trust is extreme. Therefore, extreme political optimism and pessimism tend to last and cannot be easily affected.

We adopt Sequential Equilibrium[11] concept for information sets: $\{q_t : q_t = q_L, k \geq \bar{k}\}$ where Bayes' rule does not apply. In this way, there exists a unique posterior belief: $p'^L = 0$ for this information set.[12]

When $p = 0$, it is an absorbing stage and serves only as a high cost.[13] We assume $p_0 \neq 0$. If $k > \bar{k}$ and the economy suffers from predation, p will fall to zero and stay in this absorbing stage. We assume the highest expected lifetime value $V_{pb}(k'^L, 0)$ in this stage for the opportunistic government is equal to the cost of an overturn. Thus a new government emerges after p falls to zero and economy can rebound with an endowment of k_0. To overthrow the government will cost all resources left which is in the range of $[q_L(\bar{k})s(\bar{k}), q_L(k^*)s(k^*)]$. We also assume $p_0 \neq 1$ because $p = 1$ is also an absorbing stage but will never be reached if $p_0 \neq 1$.

3.4 Markov Perfect Equilibrium

Denote by $V_{\omega_j}(k, p)$ the expected lifetime payoff to an opportunistic government associated with strategy $\sigma(k, p)$ if a state of nature j occurs. When $\omega_j = pr1$ or $pr0$,

[11] Sequential Equilibrium (Kreps and Wilson (1982)) is defined as: if there exists a sequence of completely (strictly, totally) mixed strategy profiles $\{\sigma_i\}$ such that $\lim_{k\to\infty}(\sigma_i, p_i) = (\sigma, p)$, where p_i is the system of beliefs derived from σ_i using Bayes' rule.

[12] If we adopt *PBE*, then there exists a continuum of equilibria where $p'^L \in [0, \hat{p})$, $\hat{p} \equiv \sup\{p' : V^{NI}(k, p, p') \leq V^I(k, p, p)\}$.

[13] An opportunistic government will always choose predation if $p = 0$.

$a = \emptyset$. Therefore, the function $V_{\omega_j}(k,p)$ can be defined recursively as[14]:

$$\begin{aligned}
V_{pb}(k,p) &= (1-\sigma(k,p))V_{pb}^{NI}(k,p) + \sigma(k,p)V_{pb}^{I}(k,p) \\
&= (1-\sigma(k,p))\Big[v^{NI}(k,p) + \beta\int V_{\omega_j'}(k'^L(k), p'^L(k,p,\sigma(k,p)))f(\omega_j'|k'^L(k))dj\Big] \\
&\quad +\sigma(k,p)\Big[v^{I}(k,p) + \beta\int V_{\omega_j'}(k'^H(k), p'^H(k,p,\sigma(k,p)))f(\omega_j'|k'^H(k))dj\Big], \\
V_{pr1}(k,p) &= v_{pr1}(k,p) + \beta\int V_{\omega_j'}(k'^H(k), p'^H(k,p,\sigma(k,p)))f(\omega_j'|k'^H(k))dj, \\
V_{pr0}(k,p) &= v_{pr0}(k,p) + \beta\int V_{\omega_j'}(k'^L(k), p'^L(k,p,\sigma(k,p)))f(\omega_j'|k'^L(k))dj.
\end{aligned}$$

where $v^{NI}(k,p) = \phi(k) + \psi(p)$, $v^{I}(k,p) = v_{pr1}(k,p) = v_{pr0}(k,p) = \psi(p)$, and

$$\begin{aligned}
& \int V_{\omega_j'}(k'^L(k), p'^L(k,p,\sigma(k,p)))f(\omega_j'|k'^L(k))dj \\
= \ & n'(k'^L)V_{pr1}(k'^L(k), p'^L(k,p,\sigma(k,p))) + (1-n'(k'^L(k))-\gamma)V_{pr0}(k'^L(k), p'^L(k,p,\sigma(k,p))) \\
& +\gamma V_{pb}(k'^L(k), p'^L(k,p,\sigma(k,p))), \\
& \int V_{\omega_j'}(k'^H(k), p'^H(k,p,\sigma(k,p)))f(\omega_j'|k'^H(k))dj \\
= \ & n'(k'^H)V_{pr1}(k'^H(k), p'^H(k,p,\sigma(k,p))) + (1-n'(k'^H(k))-\gamma)V_{pr0}(k'^H(k), p'^H(k,p,\sigma(k,p))) \\
& +\gamma V_{pb}(k'^H(k), p'^H(k,p,\sigma(k,p))).
\end{aligned}$$

Given a public history, h^t, which consists of a sequence of past signals $q^t \equiv \{q_{\hat{t}}\}_{\hat{t}\in[0,t]}$, the government's private history, $h^t_{gov} \equiv (h^t, a^t, \theta)$, $a^t \equiv \{a_{\hat{t}}\}_{\hat{t}\in[0,t]}$, a strategy $\sigma(k_t,p_t)$ forms an *Equilibrium* if and only if at any period t, given k_t and p_t,

- the opportunistic government maximizes his intertemporal payoff $V_{pb}(k_t,p_t)$ with this strategy, specifically,

$$\begin{cases}
\sigma(k_t,p_t) = 1 & if \quad V_{pb}^{NI}(k_t,p_t) \le V_{pb}^{I}(k_t,p_t) \\
\sigma(k_t,p_t) \in (0,1) & if \quad V_{pb}^{NI}(k_t,p_t) = V_{pb}^{I}(k_t,p_t) \\
\sigma(k_t,p_t) = 0 & if \quad V_{pb}^{NI}(k_t,p_t) \ge V_{pb}^{I}(k_t,p_t)
\end{cases}$$

- the citizens maximize their two-period utility $U(c_t,b_t)$ and update their belief according to Bayes' Rule with $\sigma(k_t,p_t)$,
- k_t evolves according to the law of motion.

In this *Markov perfect equilibrium*, if the Markov strategy $\sigma(k_t,p_t) > 0$, protection is weakly preferred to predation; if $\sigma(k_t,p_t) < 1$, predation is weakly preferred to

[14] $V_{pb}(k,p) = \max_{a\in\{NI,I\}}\{v(k,p,a) + \beta\int V_{\omega_j'}(k'(k,a), p'(k,p,\hat{\sigma}(k,p),a))f(\omega_j'|k'(k,a))dj\}$ is used in programming and proof of existence and uniqueness of the MPE where $\hat{\sigma}(k,p)$ is the citizens' belief. In equilibrium it is equal to $\sigma(k,p)$.

protection; when $\sigma(k_t, p_t) = 0$ or 1, we have a pure strategy; when $\sigma(k_t, p_t) \in (0, 1)$, the opportunistic government is indifferent between predation and protection and uses a mixed strategy.

The complexity in solving this equilibrium is that $V^a_{\omega_j}(k_t, p_t)$ can only be obtained when equilibrium strategy $\sigma(k_t, p_t)$ is known, however, the equilibrium strategy in turn can only be solved subject to equilibrium conditions imposed on ${V_{pb}^{NI}}(k_t, p_t) \lesseqgtr V^I_{pb}(k_t, p_t)$. We provide proof of existence and uniqueness of the MPE and the numerical procedures to solve this equilibrium in the Appendices.

Theorem 1. *The Markov perfect equilibrium exists and is unique. The Markov strategy $\sigma(k, p)$ is unique.*

Proof. See Appendix A.

4 Equilibrium Analysis

In Section §4.1 and Section §4.2, we analyze the properties of an opportunistic government's equilibrium strategy based on information summarized into the two state variables k_t and p_t, and its rational anticipation of the optimal actions taken in the continuation games (Maskin and Tirole (2001)). An opportunistic government faces various tradeoffs: current predation gain versus future predation gain, or benefits from trust building, or costs from a high political accountability, or extreme levels of public trust. Nations' developmental trajectories are then formed as economic uncertainties determined by the level of economic development and political uncertainties from the government's adaptation unravel. We simulate nations' developmental trajectories in Section §4.3. There are several propositions and we leave the proofs all to Appendix B.

4.1 Markov Strategy

Proposition 2. *It is with probability 1 that capital accumulation will reach $\bar{k}$.*

Proof. See Appendix B.

This proposition establishes that despite the uncertainty from economic and political risks, the private sectors will eventually reach full-scale open-up.

Proposition 3. *An opportunistic government evaluates the following tradeoffs and chooses an adaptation strategy. The relative value of predation against protection is captured by:*

$$d \approx \underbrace{\phi(k)}_{\textit{Immediate Predation Gain}} + \beta\{\underbrace{\gamma[\phi(k'^L(k)) - \phi(k'^H(k))]}_{\textit{Future Predation Gain}} + \underbrace{[n'^L(k)\phi(k'^L(k)) - n'^H(k)\phi(k'^H(k))]}_{\textit{Future Economic Risks}}$$
$$+ \underbrace{[\psi(p'^L(k, p, \sigma(k, p))) - \psi(p'^H(k, p, \sigma(k, p))]}_{\textit{Future Distrust Cost}}\}$$

Proof. An opportunistic government's maximization problem features a combination of discrete choice and continuous policy function. Moreover with the definition of equilibrium pure strategy, there are inequality conditions in the optimization problem. We approximate $d \equiv V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)$ in Appendix B.

This proposition shows the tradeoffs an opportunistic government faces. If it chooses action NI, it benefits from immediate predation gain at three opportunity costs. First, $k'^L < k'^H$, conditional on $\omega_{j'} = pb$, there is a smaller future predation gain as a consequence of economic recession, while there would be more resources to extract if currently the government chose protection. Second, as $k'^L < k'^H$, $n(k'^L) < n(k'^H)$, there is also a higher chance that an economy is exposed to economic risks as fewer private sectors are activated in the next period. Public trust also falls in case $\omega_{j'} = pr0$. Therefore, this item also reflects the distrust cost, only in capital's term. Third, $p'^L < p'^H$, public trust declines in case of predation and increases in case of protection, which is another opportunity cost for an action of predation.

At different levels of capital and public trust, the main tradeoff is different. In particular, we are interested in the evolution of political accountability, which is captured by the term of distrust cost $\psi(p'^L(k,p,\sigma(k,p))) - \psi(p'^H(k,p,\sigma(k,p)))$.[15] And it is through this term that an opportunistic government employs $\sigma(k,p)$ to balance cost and benefit.

We define three stages of strategy. If $d < 0$ and $\sigma(k,p) = 1$, it is a *Protection Stage*; If $d > 0$ and $\sigma(k,p) = 0$, it is a *Predation Stage*; If $d = 0$ and $\sigma(k,p) \in (0,1)$, it is a *Trust Exploitation Stage*.

4.1.1 Protection Stage

In this stage, an opportunistic government always chooses the pure strategy of protection. Pooling equilibrium arises in two cases. First, political accountability is very high so that an opportunistic government faces a high distrust cost, an extreme political pessimism, from the off-equilibrium path. Second, immediate predation gain is less tempting than future predation gain.

For analysis, we first divide the $k - p$ space into three areas. Assuming $\sigma = 1$ in them, we will have: 1. $k \geq \bar{k}$, $k'^H \geq \bar{k}$, $p'^L = 0$; 2. $k < \bar{k}$, $k'^H \geq \bar{k}$, $p'^L = p'^H$; 3. $k < \bar{k}$, $k'^H < \bar{k}$, $p'^L = p'^H$. We then check the validity of each case:

1. The first area is where $k \geq \bar{k}$, and choosing protection leads to even higher capital level $k'^H \geq \bar{k}$ while choosing predation immediately exposes an opportunistic government and $p'^L = 0$.

Proposition 4 (Cost from full political accountability)**.** *$\exists \underline{\eta} > 0$, if $\eta > \underline{\eta}$, then $\forall$ $k \geq \bar{k}$, $\exists \tilde{p_k}$, such that if $k \geq \bar{k}$ and $p \geq \tilde{p_k}$, an opportunistic government always chooses $\sigma(k,p) = 1$.*

[15] Future economic risk also reflects such cost. Since it functions in the same way as the distrust cost, extra analysis of it is omitted.

Proof. See Appendix B.

This proposition is related with the tradeoff between the predation gain and the cost from full political accountability. η determines the marginal cost of public distrust. This proposition states that as long as the punishment is severe enough, an opportunistic government always avoids direct exposure after economic risks have been fully diversified. As capital stock exceeds $\bar{k}$, informational efficiency of a bad signal is achieved and citizens hold the government completely accountable for any low return. An opportunistic government will not trade non-exposure for predation gain and permanently zero trust when current trust level is not too low. The expected lifetime payoff from a relative political optimism[16] is more higher than the value of cashing out and getting toppled under extreme political pessimism. (We discuss extreme political pessimism in Proposition 7.)

We denote this area where protection is always chosen due to full political accountability as π (see Figure 5a). Since $k'^H > k > \bar{k}$, π is an absorbing stage. Industrialized and democratized countries with relatively high trust exhibit such political stability and democracy is consolidated.

In the following analysis, we restrict ourselves to the situation where the trust premium η is high enough so that pooling equilibrium exists when $k > \bar{k}$.

2. The second area is where $k < \bar{k}$, and choosing protection leads to $k'^H \geq \bar{k}$ and (k'^H, p'^H) in region π. If an opportunistic government' strategy in this area is $\sigma = 1$, then $p'^L = p'^H$.

Proposition 5 (Existence of mixed strategy)**.** *At states (k, p) close to π, an opportunistic government will choose neither pure strategy of protection nor pure strategy of predation.*

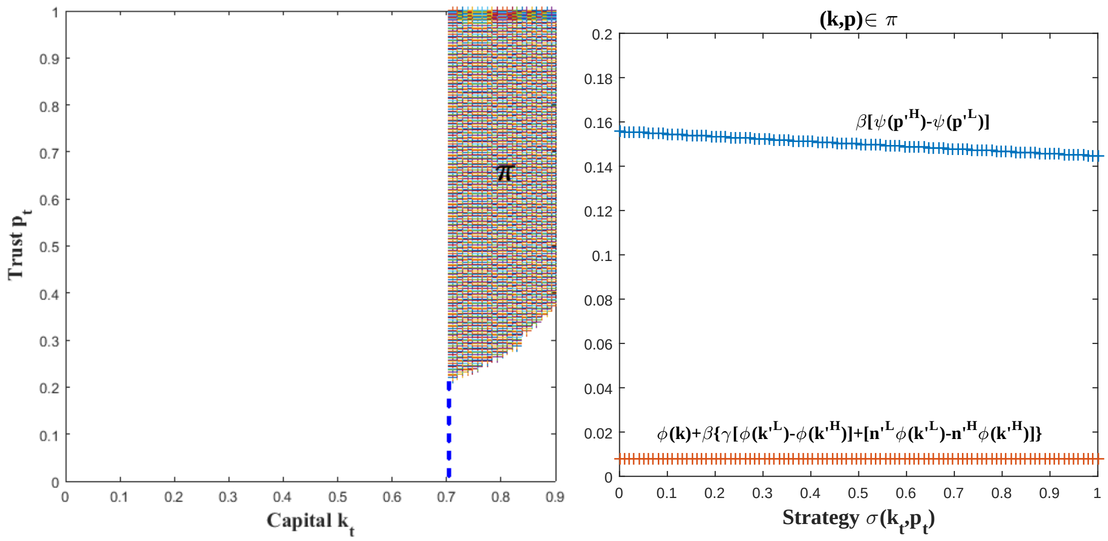
Proof. See Appendix B.

This proposition establishes that there always exists a mixed strategy area. If $p'^L = p'^H$, there is no opportunity distrust cost at all, an opportunistic government always has an incentive for predation. However, when an economy develops to approach full risk diversification, the informational efficiency of a bad signal is high, a pure strategy of predation thus comes at the cost of fast falling public trust due to a high political accountability, hence a mixed strategy is employed.

3. The third area is where $k < \bar{k}$, and choosing protection leads to $k'^H < \bar{k}$, outside region π. If an opportunistic government's strategy in this area is $\sigma = 1$, then $p'^L = p'^H$.

Proposition 6 (Immediate predation gain v.s. future predation gain)**.** *Assuming Inada conditions of the production function $F(z, k, l)$, there exists a $\underline{k}$, such that if $k < \underline{k}$, an opportunistic government always chooses $\sigma(k, p) = 1$.*

[16]Note that when all economic risks are diversified and the government refrains from predation, capital will keep growing until it reaches k^*, but public trust will remain at the level at which the government starts to choose the pure strategy of protection forever. In another word, citizens will not believe in the government more than they do just after all sectors are activated.



(a) (b)

Figure 5: Area π: No Predation due to Full Political Accountability

Note: We regroup items in d, and compare $\phi(k) + \beta\{\gamma[\phi(k'^L) - \phi(k'^H)] + [n'^L\phi(k'^L) - n'^H\phi(k'^H)]\}$ v.s. $\beta[\psi(p'^H) - \psi(p'^L)]$[a]. We can think of the former as the net predation gain. As shown in Figure 5b, the opportunity distrust cost is a decreasing function of $\sigma(k, p)$ because the more an opportunistic government mimicks, the more a signal is jammed and the harder for citizens to detect the government's type. Thus belief is updated at a smaller step[b] and divergence between p'^H and p'^L is smaller. Since the distrust cost is larger than net predation gain at all σ, pure strategy of protection is chosen.

[a] This is merely for illustration, if we extend d to infinite periods, the analysis is the same.

[b] In π, p'^L is always 0, but p'^H is smaller if σ is larger.

Proof. See Appendix B.

This proposition is related with the tradeoff between immediate predation gain and future predation gain. It states that when capital level is very low, marginal return of capital is high. Immediate predation gain is less tempting than a larger future predation gain at a higher level of capital stock.[17] An opportunistic government chooses to protect the economy to grow more in expectation of a larger size of future predation gain.

4.1.2 Predation Stage

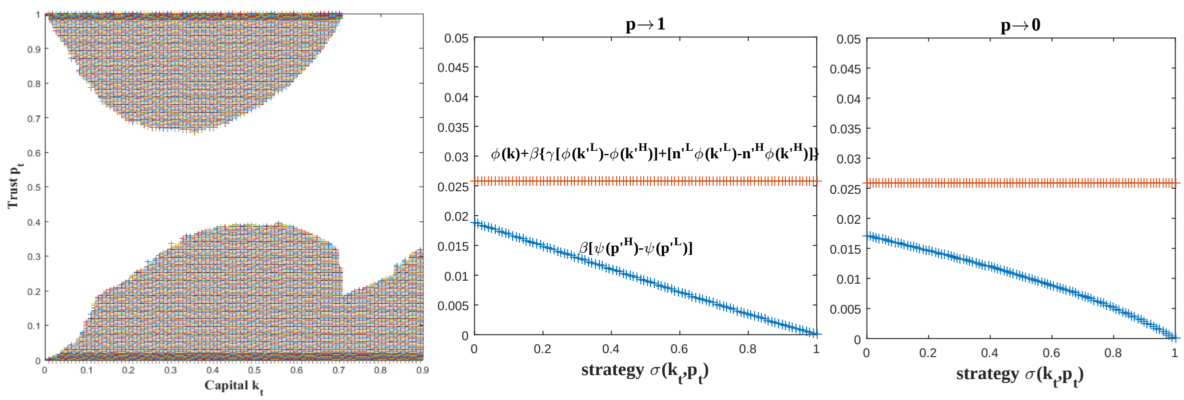
In this stage, an opportunistic government always chooses the pure strategy of predation. Separating equilibrium arises when political optimism or pessimism is extreme and mimicking becomes ineffective.

[17] When capital level is very low, output increases even if an economic risk is not covered, since $k'^L = q_L(k)s(k), q_L(k) > 0$ and $s(k)$ is concave.

Proposition 7 (Extreme political optimism and pessimism)**.** *For every* $k \in \{k : k > \underline{k}\ \&\ (k,p) \notin \pi\}$, *there exists a* $\underline{p}_k$ *such that if* $p < \underline{p}_k$, *an opportunistic government always chooses* $\sigma(k,p) = 0$. *For every* $k \in \{k : \underline{k} < k < \bar{k}\}$, *there exists a* $\bar{p}_k$ *such that if* $p > \bar{p}_k$, *an opportunistic government always chooses* $\sigma(k,p) = 0$.

Proof. See Appendix B.

This proposition establishes an opportunistic government's strategy of adaptation when it faces two other tradeoffs (see Figure 6a). If $p \to 1(0)$, $p' \to 1(0)$. Therefore, political optimism and pessimism tend to last. It can come from a strong bias in the initial trust. An opportunistic government is less motivated to strengthen political optimism or rescue pessimism at the cost of predation gain when the force from the trend itself is strong. Moreover, Proposition 1 shows that political optimism and pessimism adjust slowly when they reach a peak thus further foster the motivation of predation. Note that even if $k > \bar{k}$, as long as public trust is not sufficiently high, an opportunistic government still chooses predation despite the cost of exposure and removal from power. This complements Proposition 4.



(a) (b)

Figure 6: Predation under Extreme Political Optimism and Pessimism

Note: net predation gain is larger than distrust cost at all σ because the extreme level adjusts slowly. Figure 6b shows that the pure strategy of predation will be chosen.

4.1.3 Trust Exploitation Stage

In this stage, an opportunistic government mixes between predation and protection. When predation gain is attractive, exposure is not an immediate threat and public (dis)trust is not extreme, a mixed strategy of mimicking affects distrust cost efficiently therefore public trust is exploited.

Proposition 8 (Semi-pooling equilibrium)**.** $\forall (k,p) \in \{(k,p) : k > \underline{k}$ *and* $p \in (\underline{p_k}, \bar{p_k})$ *and* $(k,p) \notin \pi\}$, *there exists a* $\sigma(k,p) \in (0,1)$ *such that an opportunistic government is indifferent between choosing predation and protection.*

Proof. See Appendix B.

After we have established Proposition 2–Proposition 7, this proposition, based on the property of continuity of equilibrium strategy established in Theorem 1, shows the areas where continuous mixed strategy is employed. Figure 7 illustrates the unique Markov strategy and fully characterizes the types of MPE that arise for alternative combinations of capital k_t and public trust p_t. It is shown that the area of mixed strategy exists before and after capital level reaches $\bar{k}$. Moreover, this area exhibits significant variations. For the numerical procedures, see Appendix C.

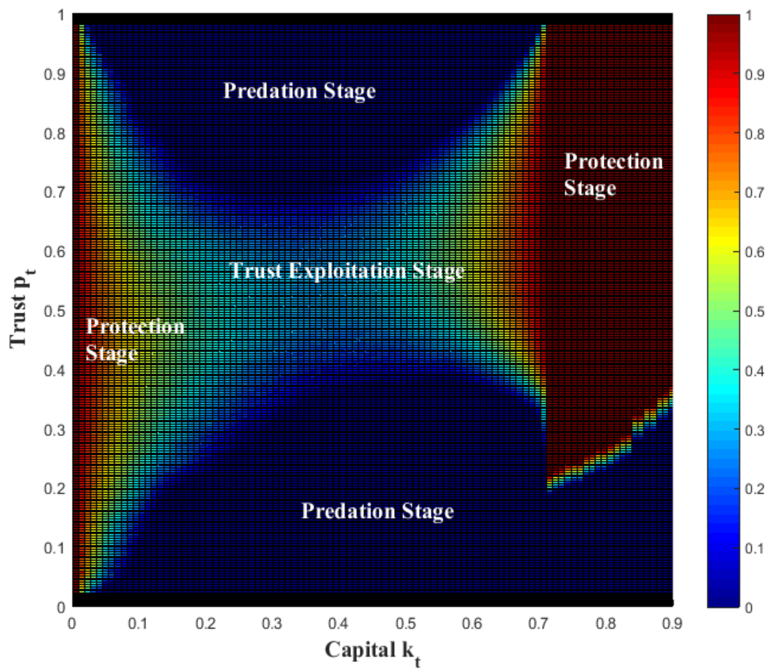


Figure 7: Equilibrium Markov Strategy $\sigma(k_t, p_t)$

Note: An opportunistic government's strategy of adaptation $\sigma(k, p)$ varies from 0 to 1. 0 is a pure strategy of predation, 1 is a pure strategy of protection.

4.2 Indifference Curves

For properties of the equilibrium strategy, we study the indifference curves of mixed strategy in the Trust Exploitation Stage along the dimensions of capital and trust respectively. Capital accumulation brings momentum to political accountability through improvement of informational efficiency of the bad signal. From pessimism to optimism, effectiveness of political accountability also varies.

Proposition 9 (U-shaped strategy along the k dimension)**.** *$\forall p$, if $\underline{p_k} < p < \bar{p_k}$, there exists a $\hat{k}_p$ such that if $\underline{k} < k < \hat{k}_p$, $\sigma(k,p)$ decreases in k; if $\hat{k}_p < k < \bar{k}$, $\sigma(k,p)$ increases in k.*

Proof. See Appendix B.

At a given level of public trust and before risks are fully diversified, the indifference curves IC_k (an opportunistic government is indifferent between predation and protection) show the variations in mixed strategy as capital accumulates. When capital stock is small, predation gains are small. However, as Proposition 1 shows, trust building is effective due to the high informational efficiency of a good signal. Economic risks are high when the economy is underdeveloped, and a signal of q_H thus is considered by the citizens as most precise in revealing a benevolent government at this early stage of economic development. Aware of that, an opportunistic government is encouraged to build trust at a low predation cost. Thus at the early stage, opportunistic governments mimick with a high probability. Political accountability is low due to informational inefficiency of the bad signal, but small predation gain is unattractive compared with the trust premium.

As capital accumulates in the expansion stage, predation gains grow. The properties of second order derivatives in Proposition 1 imply that the gap between p'^H and p'^L in case of a high return and a low return becomes smaller: the increase of p'^H is losing momentum quickly while the decrease of p'^L is merely starting to gain momentum. Therefore, when informational efficiency of both the good and bad signals is relatively low, trust building is unattractive and political accountability is low. Consequently, the opportunistic government goes after the predation gains more.

When capital approaches $\bar{k}$ in the maturity stage, the economy approaches full risk diversification and the informational efficiency of a bad signal is greatly improved. A signal of q_L becomes more precise in revealing an opportunistic government if political risk is not controlled by the government. More specifically, the gap between p'^L and p'^H will again grow, this time due to increasing momentum in the fall of public trust if there is a bad outcome, as political accountability is improved by economic development. When the costs from increasing political accountability exceed increasing predation gains, the opportunistic government will pool with the benevolent ones more often as a result.

Figure 8 shows the U-shaped indifference curves of mixed strategy as capital accumulates.

Proposition 10 (Inversely U-shaped strategy along the p dimension)**.** *$\forall k$, if $\underline{k} < k < \bar{k}$, there exists a $\hat{p_k}$ such that if $\underline{p_k} < p < \hat{p_k}$, $\sigma(k,p)$ increases in p; if $\hat{p_k} < p < \bar{p}_k$, $\sigma(k,p)$ decreases in p.*

Proof. See Appendix B.

At a given level of capital stock and before risks are fully diversified, citizens respond to signals more when public trust is at the middle level. Political accountability is higher accordingly. Therefore, an opportunistic government will mimick more often when public trust is at the middle level and less as it shifts towards political optimism and pessimism. Figure 9 shows the inversely U-shaped indifference curves of mixed strategy as public trust increases.

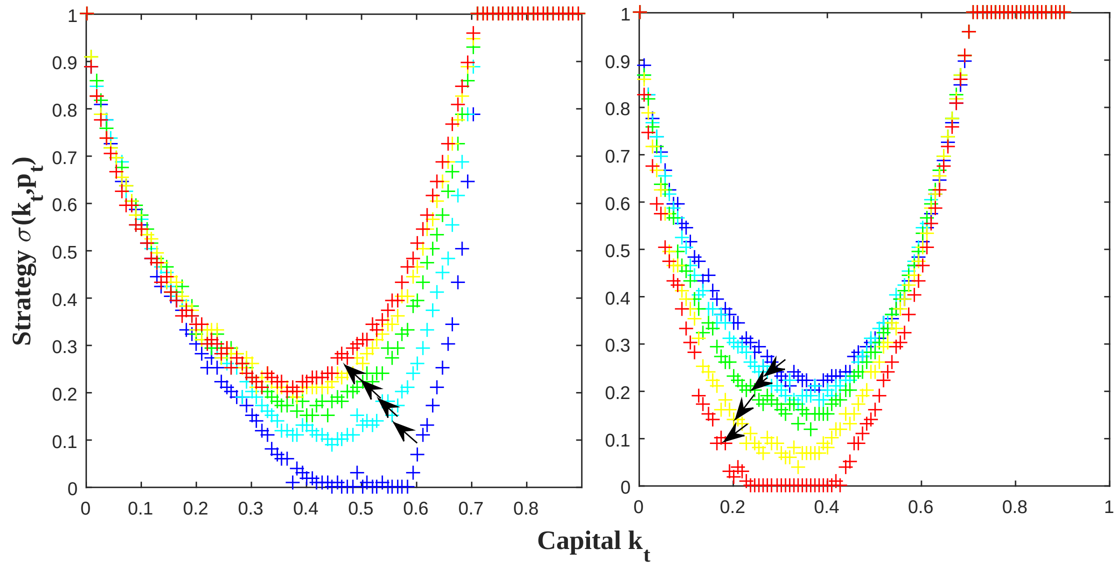


Figure 8: Indifference Curves IC_k

Note: p increases in the direction of the arrow. The left panel shows the variations of strategy as p increases when $\underline{p_k} < p < \hat{p_k}$, and the right panel shows the variations of strategy as p increases when $\hat{p_k} < p < \bar{p}_k$. See below for further discussions on strategy along the p dimension.

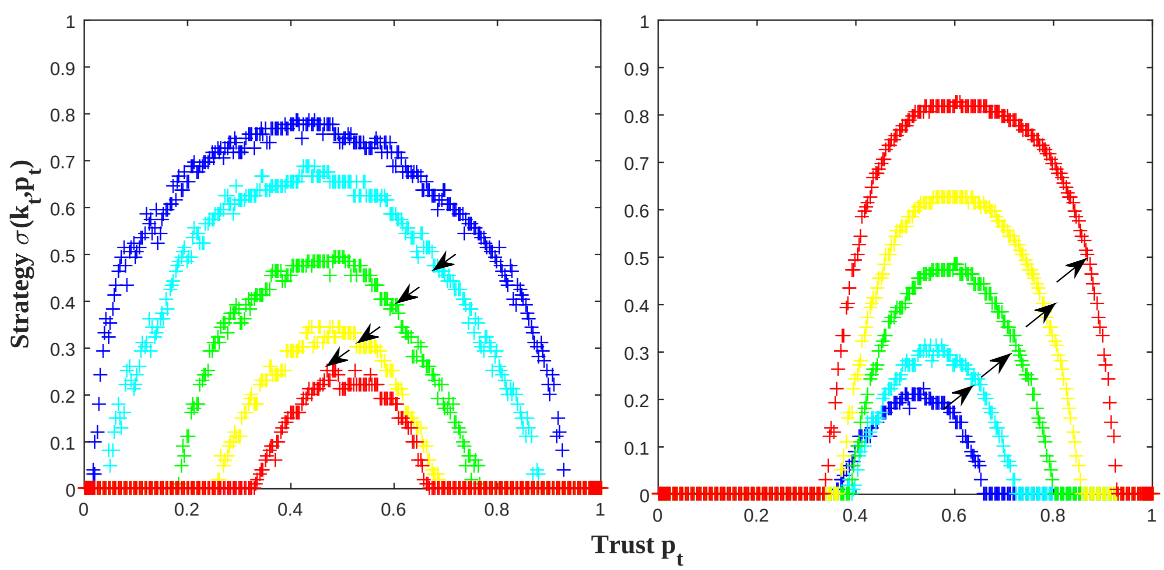


Figure 9: Indifference Curves IC_p

Note: k increases in the direction of the arrow. The left panel shows the variations of strategy as k increases when $\underline{k} < k < \hat{k_p}$, and the right panel shows the variations of strategy as k increases when $\hat{k_p} < k < \bar{k}$.

Proposition 11 (Political instability after full economic risk diversification)**.** *If $k > \bar{k}$ and $\underline{p_k} < p < \tilde{p_k}$, $\sigma(k, p)$ increases in p and decreases in k.*

Proof. See Appendix B.

After economic risks are fully diversified, if public trust is not too high or too low, there are higher predation gains as capital accumulates, encouraging the government to mimick less often. If public trust is higher, $p'^L = 0$, p'^H is higher and the opportunity distrust cost is higher, encouraging the government to mimick more often.

4.3 Developmental Trajectories

Under the reign of an opportunistic government, the equilibrium developmental trajectory of an economy exhibits various features other than higher variability of output in the early stage of economic development as is discussed in Acemoglu and Zilibotti (1997).[18]

First, at the early stage or after a big recession, rent seeking is not profitable and an economy grows or recovers slowly as there are many economic risks. But it grows more quickly if a rare case of a state j in active private sectors occurs, or it develops quickly due to a low political risk as the government always protects the economy, either in expectation of future predation gains or aiming to build up public trust. Historical evidences show that emperors in the early years of a dynasty usually execute a series of policies to restore and develop the economy, such as the first emperor of a typical Chinese dynasty or Henry IV of the House of Bourbon.

Second, there exist a virtuous circle when capital stock is large and trust is not too low, and a vicious circle when the level of capital is relatively low. These circles generate the economic and political gaps across countries and over time.

In a virtuous circle, citizens' investment in intermediate sectors and the opportunistic government's strategy σ both increase with the capital stock of the economy. Economic development facilitates informational efficiency of a bad signal thus political accountability and discourages predation, which in turn promotes economic development. Therefore, economic prosperity goes hand in hand with good governance. In most democratized countries with high output and stable public trust, this is what we observe of the consolidated democracy.

In a vicious circle, similarly, capital stock is not low but insufficient for full diversification of economic risks, thus informational efficiency and political accountability is low. An opportunistic government tends to extract resources of the economy, which further worsens the situation of a developing economy. With a certain level of economic risks and a high level of political risk, our model predicts a turning point of middle income trap joined by corruption on some developmental trajectories.

[18] In our paper, it is determined by how we set q_H and $q_L(n)$.

Third, extreme political optimism or pessimism breeds corruption. This can capture the downturn and overthrow of some of the ancient dynasties at their peak and at the end.

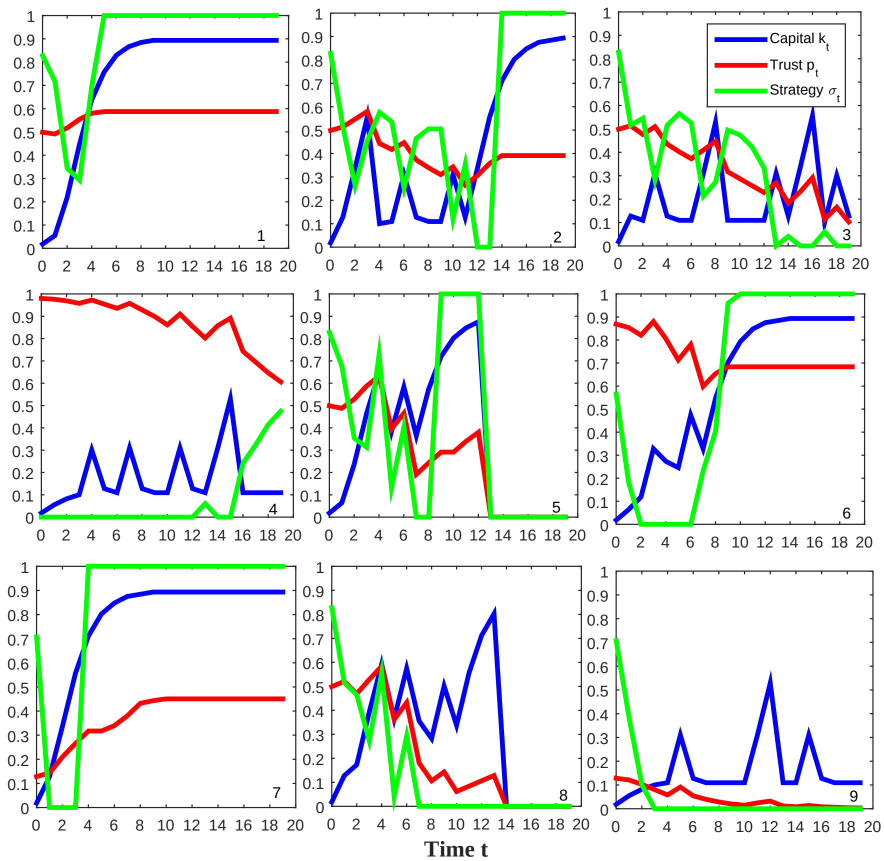


Figure 10: Nations' Developmental Trajectories

We simulate the developmental trajectories by introducing endogenous political and economic risks. Several of them are displayed in Figure 10. The features discussed above can be found in them. We start from a low k_0 to coarsely replicate the entire economic development process. We see that capital always accumulates in the early stage and the government always chooses protection with a high probability if public trust is not too low or high. If capital accumulates to a level high enough, then together with the economic development, the government also starts to mimick and choose protection with a high probability, economic and political risks are thus both low for the economy (graphs (1), (2), (6) and (7)) and virtuous circle can arise. However, if economic is underdeveloped then the government chooses predation more often, together with a medium level of bad luck, the country can fall into the middle income trap as is shown in (3), (4) and (9). Moreover, if there is a bad luck or the opportunistic government does not mimick with probability one due to a low public trust, while capital accumulation has reached the threshold of $\bar{k}$, then the government will be overthrown and democracy cannot be consolidated as shown in graphs (5) and (8). Finally, extreme (dis)trust in (4) (6) and (9) induces a pure strategy of predation.

5 Self-fulfilling Political Transition

In Acemoglu and Robinson (2001) where they introduce a theory of political transitions, the interaction between citizens' investment and governments' taxation decision as a possible source of multiple equilibria in political transition is discussed. They argue that "if agents believe that democracy will persist, they will invest more, and this will in turn increase the durability of democracy". The same self-fulling political transition (democracy consolidation) mechanism can be realized in our model, apparently in the stage where area π is approached and government starts to commit to pure strategy of protection. Similarly, we incorporate this mechanism via the interaction between citizens' investment decision and governments' strategy.

We generalize citizens' utility functions and rewrite their maximization problem[19] so that the saving decision is affected by citizens' estimation of both political and economic risks:

$$\begin{aligned}\max_{s_t} \quad & u_1(c_t) + \Big[(n_t + (p_t + (1-p_t)\sigma_t)\gamma)u_2(q_H s_t) + (1 - n_t - (p_t + (1-p_t)\sigma_t)\gamma)u_3(q_L(n_t)s_t)\Big] \\ s.t. \quad & c_t \leq (1-\tau)w_t + (1+r_t)k_t - s_t,\end{aligned}$$

where u_1, u_2 and u_3 are standard concave utility functions strictly increasing in its argument. We have the following proposition:

Proposition 12. *If $u_2'(q_H s)q_H > u_3'(q_L s)q_L$, citizens' optimal saving s_t is an increasing function of capital and government's reputation, i.e., it increases in k_t, p_t and $\sigma(k_t, p_t)$.*

Proof. See Appendix B.

This proposition establishes that as long as the marginal utility from an additional unit of saving is large enough, a higher public trust and a higher belief that an opportunistic government will take an action of protection will lead to more investment into the private sectors, which is intuitive. k'^H and k'^L thus increase in μ_t as well.

As long as η is high enough, π still exists where an opportunistic government consistently chooses protection. We then study the government's strategy when (k,p) approaches π.[20]

We compare σ's effects separately on the net predation gain $(\phi(k)+\beta\{\gamma[\phi(k'^L)-\phi(k'^H)] + [n'^L\phi(k'^L) - n'^H\phi(k'^H)]\})$ and the opportunity distrust cost $(\beta[\psi(p'^H) -$

[19]We can introduce a portfolio decision of citizens into our original setting and make some minor adjustments so that it resembles Acemoglu and Zilibotti (1997)'s setting. This modification will not affect our results since the same mechanism applies then through the portfolio decision. See Appendix E for more details.

[20]Given that self-fulling multiple equilibria exist, when a path develops to approach area π, arbitrary changes in citizens' expectations will influence the outcome. Therefore, dynamically, we need to introduce sunspot equilibrium concept. However, when $(k,p) \to \pi$, the continuation value is certain as $k'^L = 0$ and $k'^H \in \pi$. Therefore, we still can discuss self-fulling political transition without extrinsic fluctuations.

$\psi(p'^L)]$) to discuss opportunistic governments' strategy in the current setting. Since k'^H increases more than k'^L when $\sigma(k,p)$ increases, net predation gain decreases when the opportunistic government mimicks more often. The effects of strategy $\sigma(k_t,p_t)$ on p'^H and p'^L feature additional channels compared with the case of unique equilibrium. Because through its additional impact on capital accumulation, it now also affects the informational efficiency and thus Bayesian updating:

$$p'^H(k,p) = \frac{p(n(k,p,\sigma(k,p))+\gamma)}{p(n(k,p,\sigma(k,p))+\gamma)+(1-p)(n(k,p)+\gamma\sigma(k,p))},$$
$$p'^L(k,p) = \frac{p_t(1-n(k,p,\sigma(k,p))-\gamma)}{p_t(1-n(k,p,\sigma(k,p))-\gamma)+(1-p)(1-n(k,p,\sigma(k,p))-\gamma\sigma(k,p))}.$$

There are two counteracting effects of $\sigma(k,p)$ on p'^H and p'^L. The first effect works through signal jamming. If $\sigma(k,p)$ increases, it is harder for citizens to detect the government's type. They update their trust at smaller steps and the divergence between p'^H and p'^L is smaller. The second effect operates through informational efficiency. When $\sigma(k,p)$ is larger, there is more investment in the private sectors and an economic risk is less likely to take place. p'^L falls faster when precision of a bad signal is improved in revealing an opportunistic government, hence the gap between p'^H and p'^L is larger. When $\sigma(k,p)$ is relatively small, the first effect dominates; when $\sigma(k,p)$ increases and π is quickly approached, the second effect dominates. Figure 11 shows the forces of these effects and the two cases when there exist three equilibria.

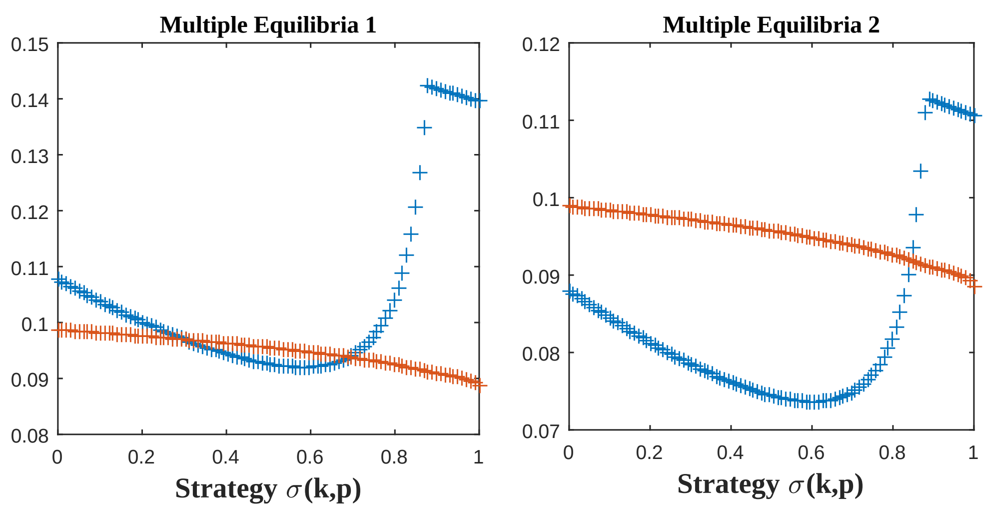


Figure 11: Self-fulfilling Multiple Equilibria

Note: The red line is the net predation gain which decreases as $\sigma(k_t,p_t)$ increases. The blue line is the opportunity distrust cost which decreases when $\sigma(k_t,p_t)$ is relatively small and increases when $\sigma(k_t,p_t)$ is relatively large. In the left panel, there exist two mixed strategies and one pure strategy of protection. In the right panel, there exist one pure strategy of predation, one mixed strategy and one pure strategy of protection.

If the government's reputation is low with a small $\sigma(k_t,p_t)$, which implies a high political risk, citizens will save and invest less. Fewer sectors are opened and the signal precision is lower. It remains relatively difficult to hold the government accountable in case of a low return. Aware of citizens' response, an opportunistic government confiscates more often as political accountability is relatively low. The expectation is self-fulfilling. Similarly, if the government's reputation is high with a large $\sigma(k_t, p_t)$, citizens are optimistic and active in saving and investment. As an economy expands, informational efficiency is improved and political accountability is higher. Predation is thus discouraged and citizens' optimism is justified.

6 Conclusion

In this paper we endogenize political accountability in a dynamic game with hidden information and action. Political accountability is determined by the levels of informational efficiency and public trust.

Regarding informational efficiency, the quality of the signals which convey information about the quality of the government to the public, hinges on the the level of economic development. Economic development reduces risks. Therefore a good outcome in an underdeveloped economy is more precise in signalling a benevolent government than in a developed economy, while a bad signal is more precise in revealing an opportunistic government in a more developed economy if the government does not show restraint.

Opportunistic governments employ adaptation strategy as the tradeoffs they face vary with the economic development. They opt more for mimicking to build trust and postpone predation in the early stage, engage in predation more often in the expansion stage and again choose to mimick more in the maturity stage due to the increase in political accountability. Extreme political optimism and pessimism also breed predation.

Good or poor governance in turn has dramatic economic and political consequences, creating either virtuous circle of "good governance–economic growth–high political accountability–good governance" or vicious circle of "poor governance–economic underdevelopment–low political accountability –poor governance".

Nations' developmental trajectories are determined by even more factors all endogenous in our model. Luck, public trust and economic development as well as their interactions all impact on the formation of political and economic stages and development paths.

While countries today or dynasties in history may very coarsely fit into one of the stages or trajectories, further empirical work can be done to examine our theory based on political inference and our predictions about the co-evolution of political and economic development.

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Appendices

A Proof of Theorem 1

We impose an additional condition of the MPE for proof and programming: citizens update their belief with $\hat{\sigma}(k,p)$ and in equilibrium, $\hat{\sigma}(k,p) = \sigma(k,p)$. Therefore:

$$\begin{aligned}
V_{pb}(k,p) &= \max_{a\in\{NI,I\}}\{v_{pb}(k,p,a) + \beta\int V_{\omega'_j}(k'(k,a), p'(k,p,\hat{\sigma}(k,p),a))f(\omega'_j|k'(k,a))dj\},\\
V_{pr1}(k,p) &= v_{pr1}(k,p) + \beta\int V_{\omega'_j}(k'^L(k), p'^L(k,p,\sigma(k,p)))f(\omega'_j|k'^L(k))dj,\\
V_{pr0}(k,p) &= v_{pr0}(k,p) + \beta\int V_{\omega'_j}(k'^L(k), p'^L(k,p,\sigma(k,p)))f(\omega'_j|k'^L(k))dj,\\
\hat{\sigma}(k,p) &= \sigma(k,p).
\end{aligned}$$

The steps involved in establishing existence and uniqueness of the MPE and uniqueness of Markov strategy $\sigma(k,p)$ are as follows:

1. We prove that given any $\sigma(k,p)$, $(T_1V_{pb})(k,p)$ is a contraction mapping.

2. We show that for the equilibrium conditions to hold, $V_{pb}(k,p)$ must be continuous and monotonically increasing in p.

3. Given monotonicity of $V_{pb}(k,p)$ in p, we show that the equilibrium definition is equivalent to finding $\min_{\sigma(k,p)}|V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)|$.

4. We prove that $(T_2L)(k,p) = \min|V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)|$ is a contraction mapping, and the minimizer $\sigma(k,p)^*$ is unique.

The stochastic variable $\omega_{j_t} \in \Omega = \{pr1, pr0, pb\}$, which is finite and compact. We denote $x_t = (k_t, p_t) \in \mathbf{X} \subset \mathbb{R}^2$ as the state vector, to be specific, $\mathbf{X}(k_t \in [0,k^*], p_t \in [0,1])$. $y_t = (a_t \in \{NI, I\}, \sigma(k_t,p_t)|\omega_{j_t} = pb) \in \mathbf{Y} \subset \mathbb{A}\times\mathbb{R}^1$ is the control vector. Capital's law of motion is determined by either ω_{j_t} or a_t. Bayesian updating is determined by a_t and $\sigma(k_t,p_t)$. The density of transition probability $f(\omega_{j_{t+1}}|k_{t+1})$ is continuous in x_{t+1}. We assume $x_{t+1} \in M(x_t, \omega_{j_t})$, and $M : \mathbf{X}\times\Omega \rightrightarrows \mathbf{X}$ specifies the constraint correspondence. $\mathbf{X}$ is compact, M is nonemtpy-valued, compact-valued and continuous. ϕ and ψ are continuous and increasing functions.

Step 1. Given $\sigma(k,p), \forall k,p$, $V_{pb}(k,p)$ is a contraction mapping.

This will not give us any equilibrium because the equilibrium conditions may well be violated. However, if we solve $\sigma(k,p)^*$, this step ensures that important properties of $V_{pb}(k,p)$ will not be affected.

Let $\mathbf{B}(k,p)$ be the set of bounded functions defined on $\mathbf{X}$, endowed with the sup norm $\|f\| = \sup_{x\in\mathbf{X}}|f(x)|$. (Metric spaces of all bounded real functions is complete anyway.) For $V(k,p) \in \mathbf{B}(k,p)$, define the operator T_1 as

$$\begin{aligned}
(T_1V_{pb})(k,p) &= \max_{a\in\{NI,I\}}\{u_{pb}^{gov}(k,p,a) + \beta\mathbb{E}V(k',p')\},\\
\mathbb{E}V(k',p') &= \int V_{\omega'_j}(k'(k,a), p'(k,p,\hat{\sigma}(k,p),a))f(\omega'_j|k'(k,a))dj.
\end{aligned}$$

By boundedness, the maximum exists. Therefore, T_1 is well defined and bounded, so T_1 maps $\mathbf{B}(k,p)$ into itself. Blackwell's sufficient conditions for contraction are satisfied for this operator.

Step 2. We show that for the equilibrium conditions to hold, $V_{pb}(k,p)$ must be continuous and monotonically increasing in p.

Norets (2010) establishes the continuity and differentiability of value functions of dynamic discrete choice under fairly general conditions. The continuity of our value functions relies on the continuity of transition probability function of all state variables. (There is a discontinuity of $V_{pr0}(k,p)$ and $V_{pb}^{NI}(k,p)$ at $\bar{k}$ when $p'^L = 0$ but that does not affect the continuity of $V_{pb}(k,p)$.) $f(\omega_{j_{t+1}}|k_{t+1})$ is only for ω_{j_t} and k_t. To ensure continuity of $f(\omega_{j_{t+1}}, k_{t+1}, p_{t+1}|k_{t+1}, \sigma(k_t,p_t))$, we require continuity of $\sigma(k_t,p_t)$ which cannot be obtained from contraction mapping of operator T_1.

Moreover, monotonicity in p is not direct since $\frac{\partial p'}{\partial p}$ is also affected by $\sigma(k,p)$, we need to impose conditions on $\sigma(k,p)$ so that this property can be established. However, we can prove both properties by assuming that the equilibrium exists first. If the MPE exists, then $V_{pb}(k,p)$ is continuous and strictly increasing in p. The equilibrium definition and the boundaries' (π, $p=0$, $p=1$) properties ensure the continuity and monotonicity of $V_{pb}(k,p)$.

In π, $V_{pb} = V_{pb}^I = \frac{\psi(p)}{1-\beta}$ which is continuously increasing in p. Moreover, Proposition 1 establishes that when $p \to 0$ & $k > \underline{k}$ or $p \to 1$ & $k < \bar{k}$, $\frac{\partial p'}{\partial \sigma(k,p)} \to 0$. Therefore, $V_{pb} = V_{pb}^{NI}$ in these cases. And it is easy to show that $V_{pb}(k,0) \ll V_{pb}(k,1)$ and $V_{pb}(k,0) < V_{pb}(k,p)$, $p > 0$.

We consider discontinuity first. It is trivial to show that there must be a mixed strategy area in the equilibrium if MPE exists as long as strategies in π and $p=0$ are constructed under assumption like $\eta > \underline{\eta}$ (Proposition 5). Discontinuity in them is impossible. In other areas, discussion in case of pure strategy is the same as mixed strategy. So we focus on equilibrium definitions of mixed strategy. For all types of discontinuity, we consider the following setting:

Given two points (k,p_1), (k,p_2), $p_1 > p_2$. The discontinuity point is (k,p_1) and we assume $V_{pb}(k,p_1) > V_{pb}(k,p_2)$ and leave the discussion of non-increasing cases till later. We assume as $p_2 \to p_1$, $\exists\ \delta > 0$ such that $V_{pb}(k,p_1) - V_{pb}(k,p_2) > \delta$. Therefore, $\exists\ \epsilon > 0$, $|\sigma(k,p_1) - \sigma(k,p_2)| > \epsilon > 0$.

If $\sigma(k,p_1) - \sigma(k,p_2) > \epsilon$, (k,p_2) is updated to $(k'^H, p_2'^H)$, (k,p_1) is updated to $(k'^H, p_1'^H)$, $\exists\ \epsilon_1 > 0$, $p_2'^H > p_1'^H > \epsilon_1$ while $p_2 \to p_1$ and $p_1 > p_2$. By assumption, this is an equilibrium point, therefore, if continuity and monotonicity are kept at k'^L, then there is $V_{pb}(k'^H, p_1'^H) > V_{pb}(k'^H, p_2'^H)$ although $p_1'^H < p_2'^H$. If $\sigma(k,p_2) - \sigma(k,p_1) > \epsilon$, (k,p_2) is updated to $(k'^L, p_2'^L)$, (k,p_1) is updated to $(k'^L, p_1'^L)$, and we will have $V_{pb}(k'^L, p_1'^L) > V_{pb}(k'^L, p_2'^L)$ although $p_1'^L < p_2'^L$. Both are equivalent to the case of non-increasing value functions.

Now we discuss this case: $p_1 > p_2$, $V_{pb}(k,p_1) < V_{pb}(k,p_2)$. First, if there is continuity of σ, then we will gradually update to π or $p=0$ area with decreasing V_{pb}

in some p, which is a contradiction. If σ is discontinuous, and monotonicity is kept at k'^H or k'^L, then for equilibrium to hold, $\sigma(k,p_2) < \sigma(k,p_1)$ and this will cause $V_{pb}(k,p'_1)$ to be even smaller than $V_{pb}(k,p'_2)$ while $p'_1 > p'_2$ at k'^L or k'^H. We again get the same contradiction if we let on the process.

There is another case where we should not always control continuity and monotonicity in one direction at k'^H or k'^H so that area π and $p = 0$ will not be approached, then we will have larger and larger $V_{pb}(k,p'^{\cdots}_2) - V_{pb}(k,p'^{\cdots}_1)$, while $p'^{\cdots}_1 \to 1$ and $p'^{\cdots}_2 \to 0$, given that $V_{pb}(k,0) \ll V_{pb}(k,1)$, this is a contradiction again.

Therefore, we have used the equilibrium definition and the boundary settings to prove the continuity and monotonicity of $V_{pb}(k,p)$ and thus continuity of $\sigma(k,p)$ if MPE exists. We can check that the property of continuity and monotonicity are validated with the contraction mapping of T_1.

Step 3. Given monotonicity of $V_{pb}(k,p)$ in p, we show that the equilibrium definition is equivalent to finding $\min_{\sigma(k,p)} |V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)|$.

We have proved that $\frac{\partial p'^H}{\partial \sigma} < 0$, $\frac{\partial p'^L}{\partial \sigma} > 0$, $\frac{\partial V_{pb}(k,p)}{\partial p} > 0$, therefore denote $d_1 = V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)$, then $\frac{\partial d_1}{\partial \sigma} > 0$. However, if we denote $d_2 = |V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)|$, then d_2 is V-shaped along $\sigma \in [0,1]$ if $d_2 = 0$ at some $\sigma \in (0,1)$.

Therefore, if $V_{pb}^{NI} \leq V_{pb}^{I}$ when $\sigma = 1$, then $V_{pb}^{NI} < V_{pb}^{I}$ when $\sigma \in [0,1)$ and d_2 is the smallest at $\sigma = 1$. Likewise, if $V_{pb}^{NI} \geq V_{pb}^{I}$ when $\sigma = 0$, then $V_{pb}^{NI} > V_{pb}^{I}$ when $\sigma \in (0,1]$ and d_2 is the smallest at $\sigma = 0$. Therefore, finding the minimum of d_2 is the necessary condition of the equilibrium definition.

It is also a sufficient condition. If the minimum of d_2 is larger than 0, then given the monotonicity property, $\sigma = 1$ or 0 depends on the sign of d_1. If $d_2 = 0$, then it is a mixed strategy, satisfying the conditions of the equilibrium.

Step 4. We prove that $T_2L(k,p) = \min_{\sigma(k,p)} |V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)|$ is a contraction mapping, and the minimizer $\sigma(k,p)^*$ is unique. (We only need compactness of M and boundedness of $V_{pb}(k,p)$).

We have established the equivalence between the equilibrium definition and finding minimum of d_2. $\sigma(k,p)$ is the policy function (correspondence) of a new operation to solve the minimum of all d_2: $T_2L(k,p) = \min_{\sigma(k,p)} |V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)|$. As long as we can prove that the new operator is also a contraction with some modulus, the existence and uniqueness of the MPE are established.

Let $\mathbf{C}(p)$ be the set of continuous functions defined on $p \in [0,1]$ endowed with the sup norm. d_2 is a bounded continuous function over a compact set, and by Weierstrass's Theorem, $L(k,p)$ has a solution at every (k,p). Therefore, operator

$$(T_2L)(k,p) \quad = \quad \min_{\sigma(k,p)} \left| V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p) \right|$$

is well defined. Moreover, $T_2L \in \mathbf{B}(p)$, and T_2 maps $\mathbf{B}(p)$ into itself.

We can simplify $L(k,p)$ by equating $V_{pr0}(k,p)$ and $V_{pb}^{NI}(k,p) - \phi^{NI}(k)$, and by equating $V_{pr1}(k,p)$ and $V_{pb}^{I}(k,p)$. Depending on $V_{pb}^{NI}(k'^{NI}, p'^{NI}) \lesseqgtr V_{pb}^{I}(k'^{NI}, p'^{NI})$ and

$V_{pb}^{NI}(k'^I, p'^I) \lesseqgtr V_{pb}^{I}(k'^I, p'^I)$, we have four cases. We show one of them, $V_{pb}^{NI}(k'^L, p'^L) \geq V_{pb}^{I}(k'^L, p'^L)$ and $V_{pb}^{NI}(k'^I, p'^I) \geq V_{pb}^{I}(k'^I, p'^I)$:

$$
\begin{aligned}
V_{pb}^{NI}(k,p) &= h^{NI}(k,p,k'^L) + \beta\Big[n'^L V_{pb}^{I}(k'^L, p'^L) + (1-n'^L)V_{pb}^{NI}(k'^L, p'^L)\Big], \\
V_{pb}^{I}(k,p) &= h^{I}(k,p,k'^H) + \beta\Big[n'^H V_{pb}^{I}(k'^H, p'^H) + (1-n'^H)V_{pb}^{NI}(k'^H, p'^H)\Big].
\end{aligned}
$$

So we get rid of the max and the other two value functions.

We study the properties of the operator assuming $V_{pb}^{NI}(k'^L, p'^L) \geq V_{pb}^{I}(k'^L, p'^L)$ and $V_{pb}^{NI}(k'^I, p'^I) \geq V_{pb}^{I}(k'^I, p'^I)$ (the other three cases follow similarly). We consider $V_{pb}^{NI}(k,p)$ and $V_{pb}^{I}(k,p)$ generated by two different $\sigma(k,p)$s, and we get two distance functions $L(k,p)$ and $G(k,p)$, supposedly $L(k,p) > G(k,p)$. We can find that the difference between $L(G)(k'^H, p'^H)$ and $L(G)(k'^L, p'^L)$ is of second order in the operator T_2:

$$
\begin{aligned}
(T_2 L)(k,p) &= \min_{\sigma(k,p)} \Big|V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)\Big| = \min_{\sigma(k,p)} \Big|h(k) + \beta\Big[n'^L V_{pb}^{I}(k'^L, p'^L) \\
&+ (1-n'^L)V_{pb}^{NI}(k'^L, p'^L) - (n'^H V_{pb}^{I}(k'^H, p'^H) + (1-n'^H)V_{pb}^{NI}(k'^H, p'^H))\Big]\Big|.
\end{aligned}
$$

We know that

$$
\begin{aligned}
V_{pb}^{I}(k'^L, p'^L) \leq n'^L V_{pb}^{I}(k'^L, p'^L) + (1-n'^L)V_{pb}^{NI}(k'^L, p'^L) \leq V_{pb}^{NI}(k'^L, p'^L), \\
V_{pb}^{I}(k'^H, p'^H) \leq n'^H V_{pb}^{I}(k'^H, p'^H) + (1-n'^H)V_{pb}^{NI}(k'^H, p'^H) \leq V_{pb}^{NI}(k'^H, p'^H).
\end{aligned}
$$

Therefore depending on the value of $h(k)$, we can pick V_{pb}^{I} or V_{pb}^{NI} at (k'^L, p'^L) and (k'^H, p'^H), so that the minimum is reached between the smallest possible value of one and largest possible value of the other if they do not overlap and equal to zero if they do, and $L(k'^L, p'^L)$ and $L(k'^H, p'^H)$ only add to the minimum.

Suppose $h(k) + V_{pb}^{NI}(k'^L, p'^L) \geq V_{pb}^{NI}(k'^H, p'^H)$(the other case can be discussed similarly), we can further have:

$$
\begin{aligned}
& (T_2 L)(k,p) \\
= \; & \min_{\sigma(k,p)} \Big|h(k) + \beta\Big[V_{pb}^{I}(k'^L, p'^L) - V_{pb}^{NI}(k'^H, p'^H) + n'^L[V_{pb}^{NI}(k'^L, p'^L) - V_{pb}^{I}(k'^L, p'^L)] \\
& + n'^H[V_{pb}^{NI}(k'^H, p'^H) - V_{pb}^{I}(k'^H, p'^H)]\Big]\Big| \\
= \; & \min_{\sigma(k,p)} \Big|h(k) + \beta\Big[V_{pb}^{NI}(k'^L, p'^L) - V_{pb}^{NI}(k'^H, p'^H) + n'^L L(k'^L, p'^L) + n'^H L(k'^H, p'^H)\Big]\Big|.
\end{aligned}
$$

k'^H and k'^L are functions of k alone. We can see that difference of the value functions is of first order. The difference between the difference of the value functions is of second order. Therefore the operator is actually:

$$
\begin{aligned}
& (T_2 L)(k,p) \\
= \;& \min_{\sigma(k,p)} \left| h(k) + \beta \Big[V^{I}_{pb}(k'^L, p'^L) - V^{NI}_{pb}(k'^H, p'^H) \Big] \right| + \beta n'^L L(k'^L, p'^L) + \beta n'^H L(k'^H, p'^H) \\
\geq \;& \min_{\sigma(k,p)} \left| h(k) + \beta \Big[V^{I}_{pb}(k'^L, p'^L) - V^{NI}_{pb}(k'^H, p'^H) \Big] \right| + \beta n'^L G(k'^L, p'^L) + \beta n'^H G(k'^H, p'^H) \\
= \;& \min_{\sigma(k,p)} \left| h(k) + \beta \Big[V^{NI}_{pb}(k'^L, p'^L) - V^{NI}_{pb}(k'^H, p'^H) + n'^L G(k'^L, p'^L) + n'^H G(k'^H, p'^H) \Big] \right| \\
= \;& (T_2 G)(k,p).
\end{aligned}
$$

Discounting:

$$
\begin{aligned}
(T_2(L+a))(k,p) \;&=\; \min_{\sigma(k,p)} \Big| h(k) + \beta \Big[V^{I}_{pb}(k'^L, p'^L) - V^{NI}_{pb}(k'^H, p'^H) \\
&\qquad + n'^L (L(k'^L, p'^L) + a) + n'^H (L(k'^H, p'^H) + a) \Big] \Big| \\
&\leq\; (T_2 L)(k,p) + \beta \Big| n'^H + n'^L \Big| a.
\end{aligned}
$$

With q_L or β small enough, the discounting condition is also met. As is established in step 3, with monotonicity of $V_{pb}(k,p)$ in p, we know that the minimizer $\sigma(k,p)^*$ is unique.

B Proofs of Propositions

Proof of Proposition 2. Except for the set $A = \{(k,p) : k = 0 \text{ or } p = 0 \text{ or } p = 1\}$, there exists no absorbing set if $k < \bar{k}$. We have made the assumption to exclude initial state in set A. And for any $k_0 > 0, 0 < p_0 < 1$, $k_{t+1} > k_t, p_{t+1} > p_t$ with probability $n_t + (p_t + (1-p_t)\sigma_t)\gamma$ which is positive if $k_t > 0$ and $p_t > 0$. Conditional on a sequence of high return, $k_t \to k^*$, $k^* > \bar{k}$ and this sequences occurs with positive probability. □

Proof of Proposition 3. We rewrite the alternative-specific value functions in a simple way:

$$
\begin{cases}
V^{NI}_{pb}(k,p) = \phi(k) + \psi(p) + \beta[n'^L V'^L_{pr1} + (1 - n'^L - \gamma) V'^L_{pr0} + \gamma V'^L_{pb})] \\[2ex]
V^{I}_{pb}(k,p) = \psi(p) + \beta[n'^H V'^H_{pr1} + (1 - n'^H - \gamma) V'^H_{pr0} + \gamma V'^H_{pb})]
\end{cases}
$$

If we expand $m = V^{NI}_{pb}(k,p)$ in mixed strategy: we get $m^{mix} = \phi(k) + \psi(p) + \beta[(n'^L + \gamma)\phi(k'^L) + \psi(p'^L)] + ...$ at (k'^L, p'^L). (Expansion at (k'^H, p'^H) is similar.) If we expand it with pure strategy of NI and I at (k'^L, p'^L), then $\phi(k) + \psi(p) + \beta[\gamma\phi(k'^L) + \psi(p'^L)] + ... < m^{NI} < m^{mix} < m^I < \phi(k) + \psi(p) + \beta[\phi(k'^L) + \psi(p'^L)] + ...$, the same for $m = V^I_{pb}(k,p)$.

Therefore, the tradeoffs are not affected qualitatively if we focus on m^{mix}. The expansion of $d \equiv V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)$ is thus:

$$\begin{aligned} d &= \phi(k) + \beta\Big\{[(n'^L+\gamma)\phi(k'^L) - (n'^H+\gamma)\phi(k'^H)] + [\psi(p'^L) - \psi(p'^H)]\Big\} \\ &\quad +\beta^2\Big\{[(n''^{FF}+\gamma)\phi(k''^{FF}) - (n''^{SF}+\gamma)\phi(k''^{SF})] + [\psi(p''^{FF}) - \psi(p''^{SF})] + ...\Big\} \\ &\approx \phi(k) + \beta\Big\{[(n'^L+\gamma)\phi(k'^L) - (n'^H+\gamma)\phi(k'^H)] + [\psi(p'^L) - \psi(p'^H)]\Big\}, \end{aligned}$$

as $k^{FF\cdots} \to k^{SF\cdots}$ and $p^{FF\cdots} \to p^{SF\cdots} \to 0$. Since picking $d = \phi(k) + \beta\{[(\gamma+n'^L)\phi(k'^L) - (\gamma+n'^H)\phi(k'^H)] + [\psi(p'^L) - \psi(p'^H)]\}$ does not qualitatively affect the results, we use it for analysis. When there is the need to extend analysis into infinite periods, we make the adjustment. □

Proof of Proposition 4. $\psi = -\eta(1-p)^2, \eta > 0$. If predation is chosen, then $p'^L = 0$; if protection is chosen, then $p'^H = p$, $\psi(0) = -\eta < -\eta(1-p'^H)^2 = \psi(p'^H)$. Since $k'^H > k > \bar{k}$, $p'^H = p$, the same strategy $\sigma = 1$ is employed at (k'^H, p'^H).

Since $p = 0$ and π are absorbing stages, we expand $d \equiv V_{pb}^{NI}(k,p) - V_{pb}^{I}(k,p)$ completely. Since it is a pure strategy of no predation at (k'^H, p'^H) and a pure strategy of predation at (k'^L, p'^L), we get:

$$\begin{aligned} d &= \phi(k) + \beta[\gamma\mathbb{E}\frac{\phi(k'^L)}{1-\beta} + \frac{\psi(0)}{1-\beta} - \frac{\psi(p'^H)}{1-\beta}] < 0, \\ &(1-\beta)\phi(k) + \beta\gamma\mathbb{E}\phi(k'^L) < \eta - \eta(1-p'^H)^2. \end{aligned}$$

Note that $p'^H \in (0,1)$, therefore $\exists \xi \in (0,1)$ such that $\xi\eta \leq \eta - \eta(1-p'^H)^2 < \eta$; besides, $0 < k'^L \leq \frac{q_L(k^*)k^*}{1-\gamma}$. Thus as long as η is large enough and p'^H is large enough, the equilibrium condition is satisfied and π exists: let $\eta > \underline{\eta}$, where $\underline{\eta} = \inf\{\eta | \xi\eta > (1-\beta)\phi(k^*) + \beta\gamma\phi(\frac{q_L(k^*)k^*}{1-\gamma})\}$. □

Proof of Proposition 5. If $\sigma = 1$ at (k,p), then $p'^L = p'^H$, which means predation benefit comes at no cost, then:

$$d = \phi(k) + \beta\{\gamma[\phi(k'^L) - \phi(k'^H)] + [n'^L\phi(k'^L) - n'^H\phi(k'^H)]\} < 0$$

is impossible if $(k,p) \to \pi$, given the discussion in proof of Proposition 6.

If $\sigma = 0$ at a point A, where $k_A < \bar{k}$ and $A \to B$, $B \in \pi$. $p_A'^L \to 0$ given our endogenous Bayesian updating equation. We know from Proposition 4 that if $\eta > \underline{\eta}$, $V_{pb}^{NI}(k,p) < V_{pb}^{I}(k,p)$ in π, and in Appendix A we have established the continuity of $V_{pb}^{NI}(k,p)$ at $p = 0$ and $V_{pb}^{I}(k,p)$ at π. Suppose the distance at point B is $d_B > \delta > 0$, we can always find an $\epsilon > 0$ such that when $\|A - B\| < \epsilon$, $V_{pb}^{I}(A) - V_{pb}^{NI}(A) > \delta > 0$, a contradiction of $\sigma = 0$. □

Proof of Proposition 6. Given that we have $p'^L = p'^H$, the constraint on the distance function is

$$d = \phi(k) + \beta\{\gamma[\phi(k'^L) - \phi(k'^H)] + [n'^L\phi(k'^L) - n'^H\phi(k'^H)]\} < 0.$$

Note that both capital accumulation and the production function is concave. $\phi(k) = \tau(1-\alpha)zk^\alpha$, $k'^H = q_H s(k)$, $k'^L = q_L s(k)$. We ignore the second term $n'^L\phi(k'^L) - n'^H\phi(k'^H)$ since $n'^L < n'^H$, $k'^L < k'^H$, and prove $\phi(k) + \beta\gamma[\phi(k'^L) - \phi(k'^H)] < 0$. After some calculation, we need to prove $k^\alpha < C[(k'^H)^\alpha - (k'^L)^\alpha]$, $C > 0$. Dividing by k^α, it is trivial to show that $\exists \underline{k}$, if $k < \underline{k}$, $d < 0$. Note that if $k'^H < \underline{k}$ then we will have to consider

$$\phi(k) + \beta\{\gamma[\phi(k'^L) + n'^L\phi(k'^L)]\} < 0,$$

which is impossible. However, since $k'^H - k'^L < k''^{SS} - k''^{FS}$ when $k \to 0$, we need to consider second order difference. Taking this into consideration, we still have $d < 0$. $\square$

Proof of Proposition 7. Given k, $\lim_{p \to 0/1|\sigma} \psi(p'^H) - \psi(p'^L) \to 0$. And we have found the area $k > \underline{k}$ such that $\phi(k) + \beta\{[(\gamma + n'^L)\phi(k'^L) - (\gamma + n'^H)\phi(k'^H)]\} > 0$. Therefore:

$$d = \underbrace{\phi(k) + \beta\{[(\gamma + n'^L)\phi(k'^L) - (\gamma + n'^H)\phi(k'^H)]}_{>0} + [\psi(p'^L) - \psi(p'^H)]\}.$$

$\forall k$, we can find a $\bar{p_k}$ and a $\underline{p_k}$ so that the bracketed term is larger than $\psi(p'^H) - \psi(p'^L)$ if $p > \bar{p_k}$ or $p < \underline{p_k}$ and we have $d > 0$, satisfying the equilibrium condition for $\sigma = 0$.

Note that, it also means even if $k > \bar{k}$ and $p'^L = 0$, as long as $p'^H < \underline{p_k}$, $\sigma = 0$. $\square$

Proof of Proposition 8. This result is direct after we have established Proposition 2–Proposition 7. $\square$

Proof of Proposition 9.

$$d = \phi(k) + \beta\{[(\gamma + n'^L)\phi(k'^L) - (\gamma + n'^H)\phi(k'^H)] + [\psi(p'^L) - \psi(p'^H)]\}$$

In the mixed strategy area, $\underline{p_k} < p < \bar{p_k}$. Given the concavity of the production function and capital's law of motion, it can be verified that $\phi(k) + \beta[(\gamma + n'^L)\phi(k'^L) - (\gamma + n'^H)\phi(k'^H)]$ is increasing in k, but the second order is negative. Given the results of Proposition 1, it is trivial to show $\frac{\partial(\psi(p'^L) - \psi(p'^H))}{\partial\sigma} > 0$. However, if $\sigma = 0$, $\exists \hat{n_p}$ such that $\frac{\partial(\psi(p'^L) - \psi(p'^H))}{\partial n} < 0$ when $0 < n < \hat{n_p}$ and $\frac{\partial(\psi(p'^L) - \psi(p'^H))}{\partial n} > 0$ when $\hat{n_p} < n < 1 - \gamma$ given the first and second order conditions in Proposition 1. Since $\eta > \underline{\eta}$, n's effect on the second term is strong enough. Therefore, by the mapping from k to n, we can find $\hat{k_p}$. And to make $d = 0$ when $\underline{p_k} < p < \bar{p_k}$, σ is first decreasing if $\underline{k} < k < \hat{k_p}$ then increasing if $\hat{k_p} < k < \bar{k}$. $\square$

Proof of Proposition 10. Given $\underline{k} < k < \bar{k}$, $\phi(k) + \beta\{[(\gamma + n'^L)\phi(k'^L) - (\gamma + n'^H)\phi(k'^H)]\}$ is fixed value. It is easy to verify that if $\sigma = 0$, $\frac{\partial(p'^H - p)}{\partial p} > 0$ if $p \in [\underline{p_k}, \hat{p_k}]$ and $\frac{\partial(p'^H - p)}{\partial p} < 0$ if $p \in [\hat{p_k}, \bar{p_k}]$:

$$p'^H - p = \frac{p(1-p)\gamma(1-\delta)}{n + (p + (1-p)\sigma)\gamma}$$

so is the case with p'^L, thus to make $d = 0$, σ is increasing in $[\underline{p_k}, \hat{p_k}]$ and decreasing in $[\hat{p_k}, \bar{p_k}]$. □

Proof of Proposition 11.

$$\begin{aligned} & d = \phi(k) + \beta[\gamma\mathbb{E}\frac{\phi(k'^L)}{1-\beta} + \frac{\psi(0)}{1-\beta} - \frac{\psi(p'^H)}{1-\beta}] \\ & d(k, \underline{p_k}|\sigma = 0) = 0 \\ & d(k, \bar{p_k}|\sigma = 1) = 0 \end{aligned}$$

We can fix $\bar{k} < k < k^*$. If $\sigma < 1$, p'^H increases in p, thus to make $d = 0$, σ must also increase in $p \in [\underline{p_k}, \bar{p_k}]$. We can fix $p \in [\underline{p_k}, \bar{p_k}]$, since $\phi(k) + \beta\gamma\phi(k'^L)$ is an increasing function of k, to make $d = 0$, σ must decrease in k so p'^H is higher for a cost to balance d. □

Proof of Proposition 12. Taking first order condition and applying Implicit Function Theorem, we can easily obtain that $\frac{\partial s_t}{\partial \mu_t} > 0$ if $u_2'(q_H s)q_H > u_3'(q_L s)q_L$. □

C Numerical Procedure

There are two approaches we can employ to solve the equilibrium strategy numerically. The first is a fast one which employs orthogonal polynomial approximation of the value functions and solves a nonlinear system of $F(k, p) = 0$ using the nonlinear programming solver fminsearch. The second is an accurate one which is based on theoretical foundation of contraction mapping and uses policy function iteration in the outer loop. We use the second one to precisely depict the equilibrium strategy.

Based on the contraction mapping theorem, we employ a value function iteration in the inner loop of $(T_1 V_{pb})(k, p)$. For the outer loop, we employ the policy function iteration to solve the unique minimizer $\sigma(k, p)^*$ of $(T_2 L)(k, p) = \min |V_{pb}^{NI}(k, p) - V_{pb}^{I}(k, p)|$. The idea is to guess an optimal policy function $\sigma(k, p)^*$ (assuming it's stationary) and evaluate the future alternative-specific value functions given this policy function. Then we determine the policy function that would minimize the distance between $V_{pb}^{NI}(k, p)$ and $V_{pb}^{I}(k, p)$, which then generates a new policy improvement. We continue iterating on the policy evaluation and improvement until the difference in the value functions $\|\epsilon\|$ meets two requirements. The first requirement is that the relative error $\frac{\|\epsilon\|}{\|V\|}$ is small enough, which is standard. The average relative error is

$9*10^{-4}$ if we exclude the pure strategy areas and $3.13*10^{-4}$ if we include them. The second requirement is that the maximal error $\|\epsilon\|$ should be smaller than the distances between the corresponding two grid points of each value function. The reason is that as we are minimizing the difference between the value functions, there should be no more space for improvement once the grids are set.

D Pareto Improvment

Without a government and the division into public and private sectors, citizens invest in all active sectors with the same amount, including the sectors with zero minimum size requirement. The competitive equilibrium is then inefficient as citizens ignore the impact of their investment on others' diversification opportunities (Acemoglu and Zilibotti (1997)). They invest equally thus over-invest in the sectors with zero minimum size requirement. Pareto improvement is achieved if they reduce investment in those sectors and activate more sectors for risk diversification when $q_L(n)$ is sufficiently low.

We compare citizens' welfare in decentralized equilibrium W^{CE} with the welfare W^{Gov} which they can achieve under the reign of a benevolent government who taxes their wage at τ. Regarding W^{Gov}, we therefore make the assumption that there is complete information and the government is benevolent. Moreover, to get rid of the multiplier effect (see Section §2.3) so that all welfare gain comes from restructuring citizens' investment, we assume citizens acquire return q_H only on the investment in public sectors which is τw_t instead of on their private investment s_t when a state of nature j_t occurs in the public sectors. Note that $q_H \gg q_L(n)$ is necessary for the achievement of Pareto improvement as economic recessions should be sufficiently bad for risk diversification to be vital. With this assumption, restructuring balanced investment into unbalanced investment leads to activation of more sectors and more risk diversification opportunities so that a higher welfare can be achieved.

For simplicity, we assume the citizens' maximization problems are respectively:

$$\begin{cases} CE: \quad \max_{s_t} \quad \log(y_t - s_t) + \delta\Big[n_t \log(q_H s_t) + (1-n_t)\log(q_L(n_t)s_t)\Big] \\ s_t^{CE} = \frac{\delta}{(1+\delta)} y_t \\ \\ Gov: \quad \max_{s_t} \quad \log(y_t - \tau w_t - s_t) + \delta\Big[n_t \log(q_H s_t) + (1-n_t-\gamma)\log(q_L(n_t)s_t) + \gamma \log(q_H \tau w_t)\Big] \\ s_t^{Gov} = \frac{\delta(1-\gamma)}{(1+\delta(1-\gamma))}(y_t - \tau w_t) \end{cases}$$

An unbalanced investment therefore features less investment in the sectors with zero minimum size requirement, i.e. the public sectors in our setting. We have:

$$s_t^{Gov} > \tau w_t, \quad \tau < \bar{\tau} = \frac{\Gamma}{(1+\Gamma)(1-\alpha)},$$

where $\Gamma = \frac{\delta(1-\gamma)}{(1+\delta(1-\gamma))}$. If τ is small, marginal utility of an additional unit of public sector investment is very high, therefore there exists a $\underline{\tau}$ to ensure $W^{CE} < W^{Gov}$. We show in Figure 12 an exogenous tax rate τ that achieves Pareto improvement with a benevolent government compared with the competitive equilibrium.

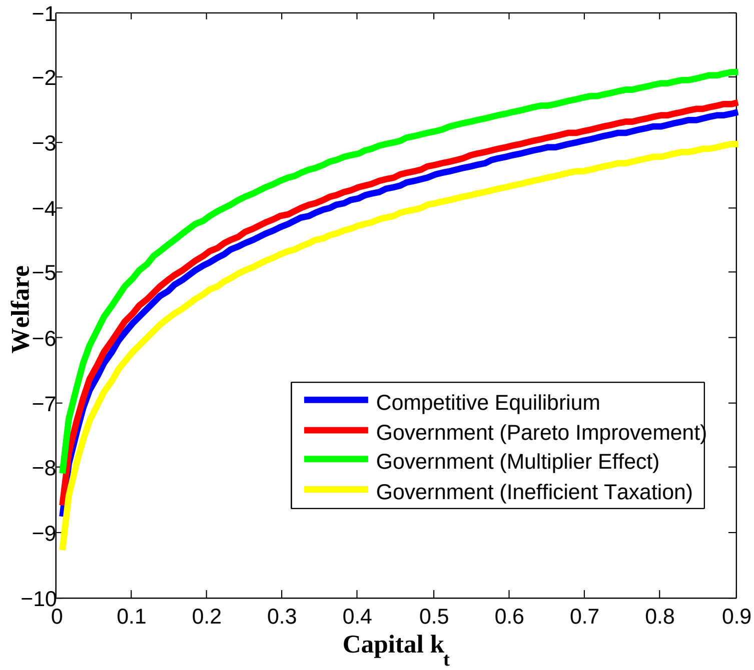

Figure 12: Welfare Comparisons

E Self-fulfilling Multiple Equilibria: A Portfolio Decision

We introduce an additional portfolio decision for citizens and show that it generates similar results. Besides investing in private risky sectors, citizens can choose to invest in an insurance policy which has a rate of return q_L on the investment in case of low return. Therefore, the new assumption justifies the low return in our previous setting.[21] We assume citizens are risk averse while the government is not allowed to make an investment in the insurance policy.

The a priori distribution of the government's type and of its policy choices determine the citizens' assessment of political risk and thus their portfolio decisions, which will further affect capital accumulation of the economy. Let α_t denote the proportion of savings that is invested into the private sectors, then the formulation

[21] In Acemoglu and Zilibotti (1997), a riskless asset providing some return in any state is assumed. We replace such asset with an insurance policy to simplify the calculation of equilibrium number of private sectors that are opened. The nature of risk diversification and the main mechanism we are after are not affected by this modification.

of the citizens' problem and its solution are:

$$\max_{s_t,\alpha_t} \quad u(c_t) + \Big[(n_t + (p_t + (1-p_t)\sigma_t)\gamma)\log(q_H\frac{\alpha_t s_t}{n_t}) + (1 - n_t - (p_t + (1-p_t)\sigma_t)\gamma)\log(q_L(1-\alpha_t))s_t\Big]$$

$$s_t = s(k_t) \quad \alpha_t = \frac{n_t}{1-(p_t+(1-p_t)\sigma_t)\gamma}$$

$$k^H_{t+1} = q_H\frac{s_t}{1-(p_t+(1-p_t)\sigma_t)\gamma} \quad k^L_{t+1} = q_L(1-\frac{s_t}{D(1-(p_t+(1-p_t)\sigma_t)\gamma)})s_t$$

Citizens' investment in the private sectors are determined by government's reputation $\mu_t = (p_t + (1-p_t)\sigma_t)\gamma$ other than the level of capital. α_t is an increasing function of both p_t and σ_t, which is intuitive. Citizens invest more in the risky assets when they have a higher trust or they believe an opportunistic government chooses protection more often. As a result, a high level of capital will be achieved.

With a positive probability of political risk ($\sigma(k_t, p_t) < 1$), the optimal value of α_t remains strictly lower than 1. When there is no risk of predation ($\sigma(k_t, p_t) = 1$), citizens invest their saving entirely into risky sectors.

Given (k, p), $k'^H = q_H\frac{s}{1-(p+(1-p)\sigma)\gamma}$ and increases in σ. $k'^L = q_L(1-\frac{s}{D(1-(p+(1-p)\sigma)\gamma)})s$ and decreases in σ. Because citizens purchase less insurance when they are optimistic.

Therefore, this setting generates similar results like we have in Section §5.