

Sleeping with the enemy: A dynamic model of declining political commitment in state socialism¹

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In recent decades communist elites in virtually every socialist state embarked on strategies of reform that progressively weakened their authority. In Eastern Europe, the reform policy of the Hungarian state during the 1970s reflected official acceptance of the market-like informal economy. Rather than suppressing the shadow second economy, Kadar initiated reforms that sought to make official and legal the market activities of households. In China, economic reforms launched by post-Mao party leaders led to the emergence of markets both within and outside the boundaries of the state socialist redistributive economy. The state attempted to specify a new structure of property rights, institute legal and regulatory reforms, and create new economic institutions required for a hybrid mixed economy. As in Hungary, however, the spread of market transactions was broadly speaking corrosive of the legitimacy of the communist party. After more than a decade of reform, today the Chinese communist elite fitfully await the consequences of what they sense is a deepening crisis in the party's legitimacy. Both in Eastern Europe and in China, the combined effects of myriad market-like transactions highlighted the failures of central planning and contributed to the erosion of party legitimacy; in Eastern Europe they paved the way for regime change.² Although *perestroika* accomplished little in reforming the Soviet economy, Soviet citizens too came to rely increasingly on the market-like informal second economy as their source of consumer goods and services.³ Although little progress was achieved under Gorbachev in instituting a market economy, high-level talks and public airing of plans for a rapid transition to a market economy contributed to the collapse of the Soviet planned economy. The failed coup of August 1991 reflected the extent of defection and the erosion of commitment to the party's cause within the Soviet elite. It was not so much the breadth of popular resistance as the failure of will on the part of conspirators that caused the coup's speedy collapse.

Whether in Eastern Europe, China, or the Soviet Union, communist elites pursued strategies of reform that worked to erode the institutional foundation of their legitimacy and power. Why did communist elites initiate these reforms in the first place? And once they initiated reform, why did communist elites come to love the market despite the obvious institutional and symbolic threats it posed to the legitimacy of communist power? Why do communists sleep with the enemy if doing so leads to their defeat?

Although economic reforms are not new to the communist world, the recent reform initiatives in China, Eastern Europe, and the Soviet Union differed from earlier reforms.⁴ Rather than arising from confidence in the future of communism, the recent reform movements were launched in a context of deep misgivings about the adequacy of the planned economy.⁵ To understand the decision to initiate the recent reforms, we need to focus our attention not so much on internal factors, such as the relationship between ruler and governed, but on the changing calculus of power in inter-state competition during the Cold War. Here North's proposition that changes in the relative strength of competitive states impose pressure for change in the structure of property rights within stagnant states provides the theoretical framework.⁶

Then, to understand why communist elites pursue reform when by doing so they erode the basis of their authority, we examine the dynamics of choice between unwavering commitment to the cause and defection through opportunism within the communist elite. Here the theory of market transition⁷ is extended to explain why the expansion of markets under conditions of partial reform increases the payoff for opportunism. Lastly, we develop a dynamic model of declining political commitment that demonstrates the effect of rising opportunism on the deterioration of the communist party as an effective political organization.

This article extends new institutionalist theory to explain the initiation of economic reform and the ensuing decline of political commitment in state socialist regimes. Our explanation turns on an analysis of the institutional dynamics of change following the shift to markets. The core assumption of our approach is the idea that institutions establish the parameters of choice and thereby guide action. Defined as the rules of the game, institutions shape the structure of incentives and provide the framework in which actors identify and pursue their interests. Institutionalists differ from neoclassical economics in insisting that interests

or preferences are embedded in institutional arrangements, change in which result in the articulation of new interests and parameters of choice.

Our strategy of explanation is first to specify the causal mechanism that brings about macroscopic change – why communist rulers initiated reform. A growing gap in the economic performance of lagging state socialist economies and technologically dynamic market economies upset the institutionalized balance of power that underpinned Cold War global politics. In the next section we analyze the effect of resulting institutional change on communist elites. The penetration of market institutions – both informal and formal, domestic and international – increases the incentive for opportunism at the same time that accompanying institutional change weakens the monitoring and enforcement capacity of the party. Importantly, increasing market opportunities reduces agents' dependence on the party. Lastly, we specify how individual-level behavior can change the macrosocietal outcome in a dynamic setting, showing why there is a waning of commitment leading to the collapse of the party as an effective political organization. The theoretical logic of the first section derives from a systems-level argument, while the following two sections focus more on the effect of institutional change on the choice-set of individual actors and the macrosocietal consequence. Although the story involves different levels of analysis, together they serve to establish the causal mechanisms involved in the macro \Rightarrow micro \Rightarrow macro sequences of change.

Why communist rulers initiate economic reform

North's theory of the state points to the central role played by the state in defining the institutional foundations of an economy by specifying and enforcing property rights.⁸ North emphasizes the state's role in devising the structure of property rights so as to maximize revenue in exchange for its services, and within this framework, in reducing transaction costs to maximize society's output and hence tax revenue. North further emphasizes the constraints imposed on rulers by competitor states when more efficient neighbors threaten the survival of a state and force "the choice of extinction or of modifying the fundamental ownership structure to enable the society to reduce transaction costs and raise the rate of growth."⁹ In his view, changes in the relative strength of competitor states imposes pressure for institutional change on stagnant states. Like North, Skocpol places causal priority on the

interaction between inter-state competition and institutional arrangements that constrain economic performance and limit the state's capacity to extend power and influence.¹⁰ Whereas North contends that pressure from inter-state competition compels a ruler to initiate institutional change, Skocpol shows how failure in inter-state competition – military defeat – results in a collapse of state control, which in France, Russia, and China triggered the outbreak of social revolution. In any case, throughout history inter-state competition has involved military rivalry,¹¹ and changes in the relative strength of competitor states impose pressure for change in the structure of property rights on lagging states.

The institutional environment of communist economic reform was shaped by the world system that emerged after World War II, composed of competing states organized around the advanced market and state socialist economies. Cold War politics pitted the United States and the Soviet Union against each other in a global competition for power and influence.¹² One manifestation of this was the arms race and the militarization of the American and Soviet economies.¹³ Virtually every foreign policy crisis in the post-War years centered on the institutionalized competition between the United States and the Soviet Union. The rules of the game of great power competition were often implied rather than explicitly stated.¹⁴ Game theorists have skillfully modeled the confrontation between the United States and the Soviet Union, demonstrating the dynamics of international politics in the Cold War as games of Chicken, Deadlock, Prisoner's Dilemma, and Assurance,¹⁵ and recursive games.¹⁶ A revealing description of the rules of superpower competition is recorded in the *White House Years*, the memoirs of Henry Kissinger, a consummate theorist and practitioner of the Cold War.¹⁷ More systematic elaborations of the principles of international politics during the Cold War can be found in Kissinger's *Nuclear Weapons and Foreign Policy* and *The Necessity for Choice: Prospects of American Foreign Policy*.¹⁸

In a world divided by hostile economic and military blocs, economic performance fundamentally affects the security of states and their capacity to project power and influence in international politics. A central dilemma facing communist rulers after their seizure of state power was the economic backwardness of their countries and the lack of access to the capital and technological resources of the West. "Socialism in one country" enshrined Stalin's strategy of reliance on internally generated capital to finance rapid economic growth and military

preparedness. It was foremost a reactive strategy aimed at overcoming the policy of containment and isolation of the advanced capitalist states while simultaneously expanding Soviet power and influence in the arena of international politics.¹⁹ Hence the Stalinist growth model responded more to the challenges and demands imposed by international politics than to the goal of improving domestic consumption. Communist rulers' ambition for international prestige and power was evident in the high rate of investment, the high priority placed on heavy and capital industries, and the low priority given to developing light industries, consumer-goods industries, and services.

Stalinist central planning offered communist elites a feasible growth model by providing an autonomous mechanism for capital accumulation and a strategy for rapid economic growth independent of the market economies.²⁰ From 1950 to 1965 the adjusted catch-up growth performance of state socialist economies was virtually the same as the growth rate of advanced market economies of Western Europe and the United States, as demonstrated by Murrell and Olson. Despite problems of incentive and the high cost of information, in the 1940s and 1950s Soviet-type economies achieved their goal of economic growth,²¹ but at the cost of prodigious waste of resources and lasting economic distortions, as well as untold misery. From 1965 to 1985, however, there was a marked slowdown of the adjusted catch-up annual growth rate of the socialist economies, while the advanced market economies continued to sustain their post-war growth. Murrell and Olson conclude, "it is plausible that many people were persuaded in the 1940s and 1950s that the centrally planned economies would ultimately surpass the market economies, but that in more recent years the observation of these economies naturally generated a sense that they were flawed or decadent."²² Listing the symptoms of the deteriorating economic performance in Eastern Europe by the 1970s, the Hungarian economist Nagy pointed to the problems of "low efficiency, a lack of competitiveness, slow adaptability, slowdown of growth or stagnation, deterioration of living conditions, especially of the environment, shortages of all kinds in parallel with wastefulness and squandering, a strong decline in work morale, etc."²³

According to Szelenyi, the deteriorating performance of Eastern Europe economies in the 1960s stemmed from the end of extensive growth (arising from the shift of labor from agriculture to industry) and the difficulties of transition to intensive growth.²⁴ Although this view is plausible, the problem with it is that neither China nor the Soviet

Union had exhausted their extensive growth potential by the 1960s; yet like the Eastern European economies, China and the Soviet Union also experienced economic decline and stagnation by the mid-1960s. An alternative explanation provided by Murrell and Olson is that whereas communist rulers were able to achieve rapid economic growth in the earlier years, as the regime aged collusion among economic bureaucrats and enterprise managers, reflected in burgeoning elite privileges and corruption, resulted in decline and stagnation.²⁵ This explanation extends Olson's analysis of the crippling effect of collusion on economic performance to Soviet-type economies, which they argue are even more vulnerable to special-interest groups than a stable market democracy.²⁶ Though plausible, this theory is unable to explain why communist regimes of disparate ages experienced declining performance at about the same time, and initiated far-reaching institutional change in the late 1970s and the 1980s. Neither of these competing explanations is entirely satisfactory in light of inconsistencies that emerge from even a cursory comparative analysis. However, they concur on the point that the superior performance of the advanced market economies was an important factor in both the Eastern European and the Soviet decisions to initiate reforms.

Despite cyclical patterns of growth and recession, overall the 1970s and 1980s were a period of remarkable technological progress and substantial expansion of the world capitalist economy. A pivotal technological change experienced by the advanced market economies in the 1970s and 1980s was the increasing reliance on microprocessors to achieve gains in economic performance. Symbolizing the transition was the decline of smokestack industries and the shift to progressive application of numerical-control technology in manufacturing and the development of "intelligent" products. The leading advanced market economies accepted the export of older manufacturing industries to less-developed market economies, and encouraged the shift of human and financial resources to develop new technologies useful for revitalizing established industries and to create new product lines. The export of older manufacturing industrial capacity to less-developed market economies in turn stimulated in these countries rapid economic growth fueled by consumer demand in the advanced market economies.

The perception of a rapidly growing technological and economic gap between state socialist economies and the advanced market economies was critical to the initiation of economic reform. State socialist economies were struggling to make mass production more efficient just as the

advanced market economies were turning away from this paradigm. Piore and Sabel argue that what made this a watershed period was a deepening crisis of the mass production factory system and the institutional arrangements – i.e., industrial unions, collective bargaining, the welfare state – which provided mass production its stabilizing regulatory mechanism.²⁷ In their view, the political and economic crises of the 1970s exacerbated long-term trends leading to the breakdown of the mass market for general goods (standardized commodities). The resulting changes inaugurated a new era during which the leading edges of innovation and growth came to reside in countries and regions that foster flexible specialization and craft production. This has rendered obsolete the factory system built around mass production involving large fixed capital investments and slow product turnover. With the advent of easily programmed general-purpose computer-numerical-control machines, smaller firms could acquire advanced production tools that enable them to innovate continuously their product line to meet changing demand and competition. The advantages of scale diminish with the shift to flexible specialization; size becomes a disadvantage insofar as it corresponds to structural inertia manifested in an inability to respond flexibly to changing markets. Like the rusting hulks of smoke-stack factories in the West, the industrial plants of Eastern Europe and the Soviet Union encompassed large fixed-capital investments in specialized machines that produced general goods for which there was no market in the world economy.

Let us briefly review the events leading to the initiation of reform movements in China and the Soviet Union. In the final years of the Cultural Revolution, China's ping-pong diplomacy opened the way for high-level delegations to travel to the West and Japan. As the accounts of technological and economic progress in the advanced market economies filtered through elite networks, they sparked high-level debates about the efficacy of China's development model under Mao. Particularly distressing to the Chinese communist elite was their perception of Japan's extraordinary progress. Whereas the Chinese and Japanese GNP were roughly similar in 1950, by the 1970s many despaired that China could ever narrow the rapidly growing technological and economic gap between the two countries. Comparisons of the mid-nineteenth century crisis of the Qing dynasty and the situation China faced in the early 1970s underscored the urgent need for drastic measures. National surveys revealed extensive rural hunger and poverty, while the search for the causes of backwardness highlighted the failures of planning.²⁸ China's reform movement was launched in 1978, two years after the death of Mao.²⁹

In the case of the U.S.S.R. a crucial factor, within the larger context of detente, was the Soviet response to the Strategic Defense Initiative (SDI) or "Star Wars" program, which sought to utilize an array of new technological breakthroughs in developing a sophisticated anti-ballistic defense system with the capacity of destroying Soviet missiles shortly after blast-off. Although the scientific community pointed to the unreliability of Star Wars technology,³¹ in subsequent strategic meetings involving the U.S.S.R. and the United States, Soviet representatives vociferously protested the Star Wars program as a paramount threat to Soviet security. An American commitment to Star Wars came to symbolize possession of a formidable array of exotic "smart" weapons beyond Soviet reach,³² fundamentally changing the calculus of Cold War competition.³³ The Star Wars program represented a qualitative escalation of the arms race, one that could not be matched by the Soviet Union. If the arms race could no longer be sustained in light of the superior technological and economic progress of the advanced market economies and the declining performance of the Soviet economy, then the decision to reform could not be avoided. Detente had facilitated the flow of information between the Soviet Union and the West, allowing Soviet intelligence greater ease in monitoring the rapid technological and economic progress of the West during this period. In his first programmatic speech in December 1984, Gorbachev highlighted the importance of improved economic performance for the security of the Soviet Union.³⁴

Thus, knowledge of the growing technological and economic gap between East and West contributed to eroding confidence in the efficacy of central planning while inspiring belief in the superiority of markets, thereby paving the way for reform.³⁵ Our intention is not to make light of internal trends contributing to stagnation and structural inertia in centrally planned economies,³⁶ and motivating under state socialism repeated efforts at economic and administrative reforms.³⁷ The internal causes of economic stagnation explain why the Soviet-type economies began to lag behind the market economies in annual per capita growth rate. In the absence of competitive pressure from rival states, however, national economies have stagnated for long periods without undergoing fundamental institutional change.

Thus far we have provided a post hoc explanation for the decision to initiate market reform in China, and the Soviet Union. Does our explanation, which focuses causal attention on the changing calculus of inter-state competition, have predictive power? As it happens there are

still a few socialist states that have not inaugurated major economic reforms as of our writing this article in 1991. One of the last remaining state socialist countries with an orthodox planned economy is North Korea. With a 5.1 percent real per capita growth in GNP in the 1960s and 1970s, the North Korean economy maintained among the highest growth rates of the state socialist economies, and only began to experience decline and stagnation in the 1980s. Not until 1983 did North Korea's economy enter into a trajectory of negative growth, where it remains today. The Soviet Union no longer subsidized the North Korean economy with concessionary prices and credit, and China was unwilling to provide help. Table 1 provides a cross-sectional comparison between the performances of the North and South Korean economies in 1990. Whereas the GNP growth of the South Korean economy (9.0%) remained among the highest in the world, the North Korean economy contracted to -3.7% in 1990. South Korean military expenditure was nearly double that of North Korea, but it absorbed only 4.1% of the South Korean GNP compared with 21.5% required to maintain military preparedness in the North. With its long-standing isolationist policy, thus far the North Korean state remains intransigent in its refusal to initiate fundamental reform. The growing gap in economic performance between North and South, however, exerts enormous pressure on North Korea's rulers. Repressive state policy might succeed in suppressing popular protest over deteriorating economic conditions. However, North Korea is experiencing a rapid decline in power relative to its arch-rival in the South. The rulers' interest in maximizing revenue, coupled with the proximity of a rival government,³⁸ furnish powerful incentive for North Korea's rulers to initiate economic reform; either that or contemplate war, which is why South Korea

Table 1. Comparative economic performance in North and South Korea, 1990

	North Korea	South Korea
Population (in million)	21.7	42.8
Annual population growth	1.60%	0.97%
GNP (in billions of dollars)	\$23.1	\$237.9
GNP (per capita, in dollars)	\$1,064	\$5,569
GNP growth	-3.7%	9.0%
Government budget (as a percentage of GNP)	71.9%	15.3%
Military expenditure (in billions of dollars)	5	9.7
Military expenditure (as a percentage of GNP)	21.5%	4.1%
Total trade (in billions of dollars)	\$4.6	\$134.9

Source: *The Wall Street Journal*, 17 September 1991: A12.

worries that North Korea may be intensifying efforts to develop nuclear weapons.

Communist reformers took a calculated risk in initiating economic reform by gambling that the gains in revenue would outweigh the costs of shifting to markets. Their belief in ultimate success had its historical roots. Lenin succeeded in the 1920s through the NEP in stabilizing Soviet power by relying temporarily on rural markets to stimulate production following the excesses of War Communism. Similarly, Mao experienced success in recovering from the disasters of the Great Leap Forward by a tactical retreat allowing peasants to engage in rural markets. Communist reformers could sleep with the enemy without trepidation because past experience provided them with the self-confidence that they could play the part of a Blackbeard or Henry VIII and emerge after the shift to markets still in command of an intact party-state with the capacity to maintain economic growth and extend power and influence in international politics.

Why communists come to love the market

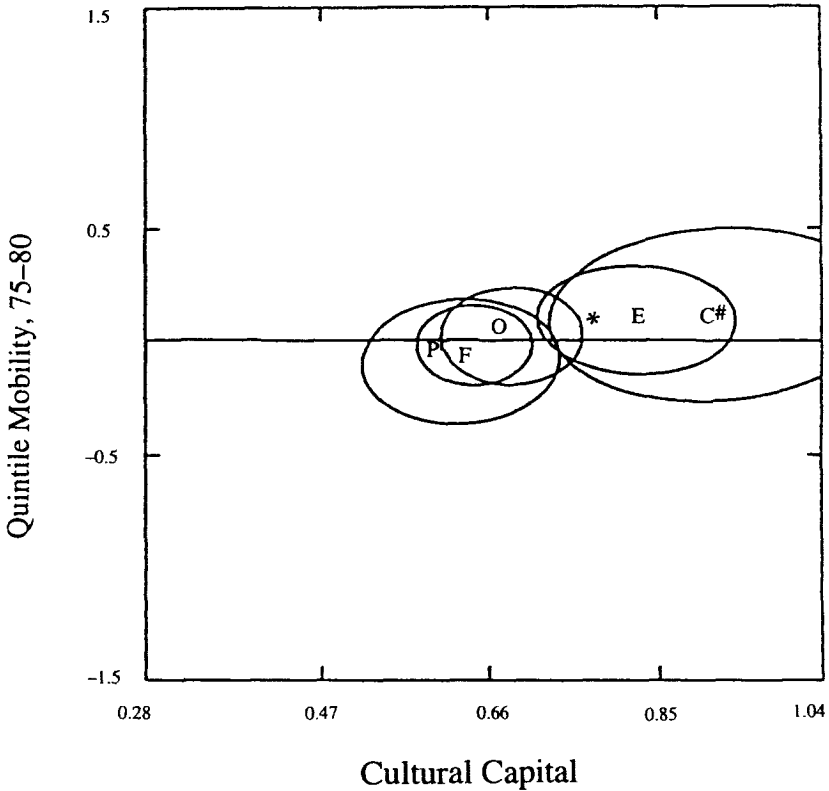
Once reform is underway, what is the effect of incremental marketization on the communist party and economic bureaucracy? Market transition theory maintains that the expansion of markets in a socialist economy – whether in the informal or formal economy – opens up alternative sources of power and privileges to those controlled by the redistributive bureaucracy.³⁹ The theory turns on the causal claim that the expansion of markets reduces the proportion of goods and services that are allocated by administrative fiat, and as a result the power of redistributors declines, as does the dependence of citizens on the socialist redistributive economy. Rather than opportunities for advancement and profit being contained within the boundaries of the redistributive economy, markets expand the extent of opportunities beyond the control of the state, resulting in changes in the structure of incentives and the rise of entrepreneurship. When new economic niches open up and expand outside the boundaries of the redistributive economy, not only are citizens freer to pursue interests beyond the reach of the state, but so are the agents of the state. As a result, the shift to markets – domestic or international – increases the extent of opportunism among agents of the state. Here we define opportunism as market-oriented entrepreneurship and rent-seeking activity by party officials and economic bureaucrats.

Ever since Oscar Lange formulated his model for socialism, the idea of combining the plan with the market has inspired economic bureaucrats in centrally planned economies.⁴⁰ Like alchemists bewitched with the challenge of turning lead into gold, these reformers dreamt of harnessing the power of the market to remedy the failures of the plan. The goal of all reformers has been to stimulate economic growth by combining plan and market, and above all, to safeguard the institutional foundation of state socialism even while introducing markets. To accomplish this task, communist rulers must rely on party officials and economic bureaucrats to implement the reform program, monitor the market activities of citizens, and enforce regulations.

The institutional logic of the plan is to allocate goods and services through central decisions by administrative fiat, while that of the market is characteristically to allocate resources through a myriad of negotiated transactions between buyer and seller. Because the plan and the market do not readily combine, in the absence of accompanying institutional changes, the result of partial reform is a rapid escalation in the cost of transacting. This is what Kornai has labeled the “dilemma of reform.”⁴¹ The difficulty of combining the plan and the market inexorably leads reformers to change the institutional framework that specifies, monitors, and enforces the underlying rules of competition and cooperation that provide a structure of property rights. For example, when private firms negotiate marketing arrangements with state agencies or seek to establish reliable sources of raw material, the monitoring and enforcement of agreements often involve substantially higher transaction costs than in advanced market economies. Some foreign firms in Shanghai wait up to eight months to get a three-year license renewed for a representative office. In the absence of private property rights and routinely enforced contract law, parties to the agreement must seek official backing to insure that the terms of the agreement are met. Reliance on personal ties to local officials may provide an effective informal means to lower the cost of transacting under partial reform; however, such arrangements are susceptible to arbitrariness, and render private and hybrid marketized firms vulnerable to unofficial taxes and rent-seeking by government agents. To the extent reformers seek improved performance of the economy as a whole, they must reduce the cost of transacting across the borders of the redistributive and marketized sectors. To reduce transaction costs, communist reformers must promulgate new contract laws that are binding on both state and non-state enterprises; thereby changing incrementally the institutional framework.

Institutional changes introduced by economic reform create an often confusing and contradictory set of instructions for officials and involve higher levels of uncertainty in monitoring and enforcement. In addition, monitoring the activities of officials becomes more difficult because the norms of acceptable performance and the criteria of evaluation are often contradictory. Lacking clearly specified and legitimized rules of the game, economic actors must negotiate transactions that involve ad hoc institutional arrangements, the legal status of which are ambiguous at best and which often are in violation of extant state regulations. Whereas in market economies, rent seeking results from government restrictions over economic activity,⁴² in state-socialist redistributive economies it stems from bureaucratic control over the allocation of resources.⁴³ When parties in economic exchanges have an interest in working out informal solutions to reduce transaction costs and when the cost of malfeasance for agents approaches zero due to difficulties in monitoring and enforcement, opportunism will become rampant in the bureaucracy. Thus public officials are even more likely to engage in rent-seeking activities under the conditions of uncertainty in the transition regime.

Another dilemma posed by partial reform is that the spread of markets increases the payoff for opportunism for party officials and economic bureaucrats. The expansion of markets opens up new opportunity structures or niches, giving rise to entrepreneurship. Under partial reform, however, investment capital is largely governed by state-owned banks reluctant to extend credit to private citizens,⁴⁴ access to regional and international markets is often controlled by state trading companies;⁴⁵ and control over many critical resources is retained by state agencies compelling managers to cultivate ties with economic bureaucrats.⁴⁶ In other words, redistributive institutions of the state still dominate the economy. As a result, entrepreneurs who combine resources across the borders of the state and marketized sectors enjoy clear advantages over those whose activities are limited to the subordinated private economy. Whereas in the pre-reform regime, rent seeking typically involved forms of petty corruption that arose out of the bargaining process, after the start of economic reform, there is a progressive "commodification of bureaucratic privileges."⁴⁷ Insofar as officials combine resources from both the redistributive and marketized sectors to maximize profit in the marketplace for themselves and their families they become entrepreneurs. Hence expanding markets give rise to a hybrid stratum of cadre-entrepreneurs who use positional power – political capital – to gain advantages in the marketplace.



E = Entrepreneur

C = Current cadre

F = Former cadre

O = Off farm worker

= Cadre entrepreneur

* = Former-cadre entrepreneur

Horizontal = Regression line

Oblong = 95 percent confidence interval

Fig. 1. Household economic mobility by social group and cultural capital, 1975-1979.

Market transition theory claims that, under conditions of partial reform, officials who forgo the temptation of exploiting opportunities in the marketplace derive declining relative advantage to positional power. It also asserts that entrepreneurs from cadre backgrounds are advantaged relative to noncadre entrepreneurs because cadre-entrepreneurs enjoy lower transaction costs in trade across the borders of the redistributive and marketized sectors of the economy. Figures 1 and 2 substantiate these claims, using evidence from rural China.⁴⁸ Cultural capital is a composite variable comprising the level of educational attainment of husband and wife and the cultural practices of the head of the household measured by the frequency of reading newspapers and magazines, listening to the radio and watching television.

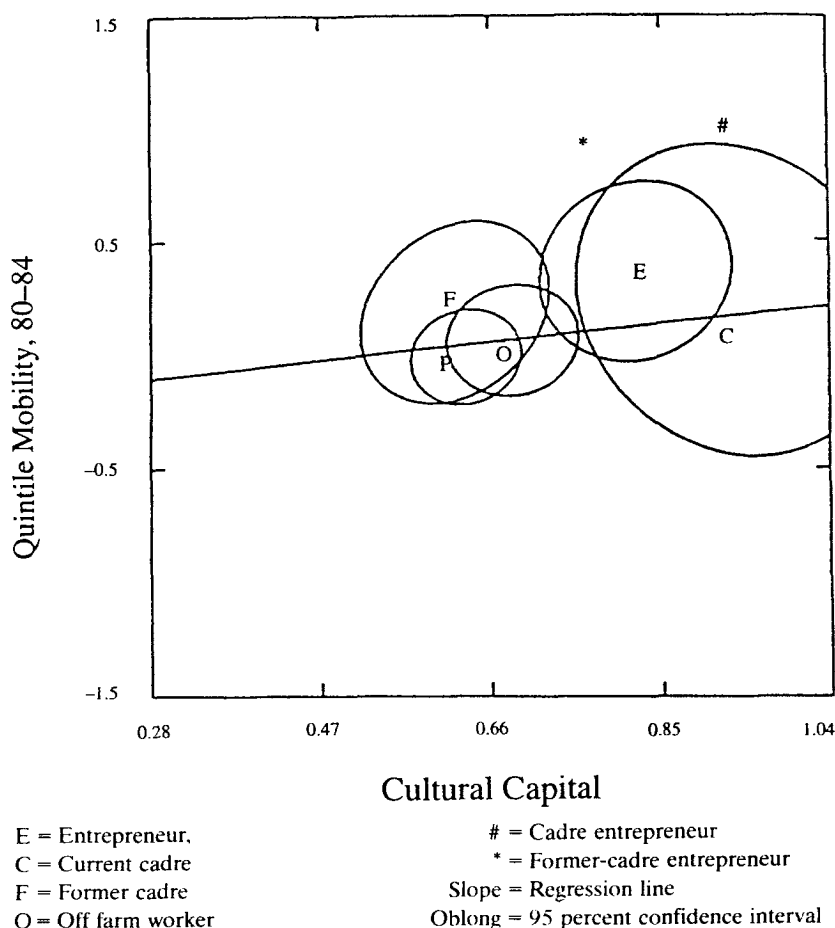


Fig. 2. Household economic mobility by social group and cultural capital, 1980-1984.

Quintile mobility reflects the upward movement from one income quintile to another from 1975 to 1980 and from 1980 to 1984. In Figure 1 notice that households of current cadres and cadre-entrepreneurs have the most cultural capital and ordinary peasant households the least. Cadre and entrepreneurial households experience slightly greater economic mobility than other households, but the near horizontal regression line and distribution of social groups within close proximity of it indicates that overall there was little economic mobility from 1975 to 1980. Figure 2 reveals a substantial increase in economic mobility following market reform. Notice that village cadres who are not entrepreneurs are unable to translate their positional power to attain a higher rate of economic mobility after the shift to markets.

Entrepreneurial households with members who are currently and formerly local cadres experience the greatest economic mobility, followed by entrepreneurs from noncadre backgrounds, who constitute 73 percent ($N = 98$) of the sample of entrepreneurs.

These findings indicate that the shift to markets has resulted in changing sources of power and privilege, with market power increasing in significance relative to redistributive power. But under partial reform the socialist redistributive economy remains dominant, while the institutional foundations of a market economy (e.g., private property rights) are still embryonic. In the transition regime, the capacity to combine resources across the redistributive and marketized sectors of the economy yields the most lucrative strategies for profit. This is why many communists come to love the market, whether formal or informal, domestic or international.

Some might argue that this explanation best fits the Chinese and Hungarian cases, but might not apply as well to the Soviet Union and other Eastern European states where economic reform made little headway.⁴⁹ However, although under Gorbachev the Soviet Union made only modest progress in instituting markets, the market-like informal economy and formal private economy incrementally replaced the centrally planned economy as it collapsed.⁵⁰ According to Grossman, economic difficulties in the late 1970s and early 1980s intensified the growth of the Soviet informal economy, which exacerbated "corruption of the society at large and particularly of the governing *apparatus*, reportedly reaching high up."⁵¹ More importantly, party officials positioned themselves to benefit from impending economic reforms even while they opposed free markets. During this same period, socialist states (Poland, Yugoslavia, Romania, and the Soviet Union) experienced intensifying Western market penetration in the wake of massive foreign debts. We note here that international markets may provide even more seductive incentives for opportunism than domestic markets because they offer the additional enticement of foreign social connections and travel. It was not coincidental that the Solidarity movement began the Gdansk Shipyard where workers could monitor the flow of Western consumer goods to party officials.

Having explained why the shift to markets increases the payoff for opportunism, we now turn to modeling how changes in the dynamics of choice precipitate waning commitment to the party, leading progressively to its collapse as an effective political organization. Increasing

opportunism within the elite, we contend, contributes to undermining morale within the party and economic bureaucracy, diminishes organizational discipline, and erodes the legitimacy of the party.

Why commitment to the party declines

We develop in this section a dynamic model of declining commitment to the party. The setup is as follows. First, a dynamic model is established. Second, we provide our basic results and show how changes in individual behavior result in a macrosocietal outcome – the deterioration of the communist party – that triggers the politics of regime change. Third, we discuss how our results are generally valid when ideology plays a role. Fourth, we answer the following puzzle: if the collapse of state socialism has something to do with markets, why did communist parties collapse in socialist states where markets were less developed? Fifth, a computer simulation is undertaken, which indicates that increasing opportunism among party members and economic bureaucrats is positively related to market temptation and negatively related to improving economic performance, centralization of power in the party, and the punishment of opportunism. Last, we briefly list implications and limitations of the model. All proofs are given in the Appendix (see p. 291).

Model

Let us model party members and economic bureaucrats as agents in a multi-agent repeated game, where agents face binary choices, commitment to the party's cause or defection to opportunism in each period t ($t = 1, 2, \dots$). Here we define opportunism as market-oriented entrepreneurship and rent-seeking. The shift to markets in state socialism results in increasing payoffs for opportunism outside the boundaries of the redistributive economy.

Suppose each agent i is characterized by a probability b_i of being a successful opportunist, where $b_i \in [\underline{b}, \bar{b}]$, $0 \leq \underline{b} < \bar{b} \leq 1$, and b_i has a continuous density⁵² $f(b_i) > 0$ for all i and a cumulative distribution function $F(\cdot)$. Since $F(b_i)$ is the cumulative distribution function of being successful opportunists, $1 - F(b_i)$ can be interpreted as the monitoring capacity of the party.

Regarding payoffs,⁵³ let us assume c to be the average payoff to agents; for simplicity, we also assume that there are not any opportunists so that c is the payoff to each agent at $t = 0$ prior to the initiation of market reform.⁵⁴ Assume further h to be the payoff for successful opportunism;⁵⁵ l the payoff for unsuccessful opportunism; m_t the payoff of commitment in period t . Since m_t is the same across all committors, it equals the total payoff for party commitment minus the payoff to opportunists divided by the number of committors. That is,

$$m_t = \frac{\text{total payoff} - \text{payoff to opportunists}}{\text{number of committors}}. \quad (1)$$

The above payoffs can be interpreted as follows: c , the average payoff, is a parameter of economic performance; h indicates how high the market temptation is; and l shows the punishment payoff for opportunism.

At the outset of the reform movement, commitment to the cause of reforming communism is the dominant strategy for most party members. The party and economic bureaucracy provide the primary source of rewards for party members through career advancement and selective incentives. There may be problems of endemic opportunism, but these constitute, in most cases, petty forms of rent-seeking. Because malfeasance involves small numbers, it is routinely dealt with through the normal monitoring and enforcement procedures, both formal and informal, of the party and economic bureaucracy.⁵⁶ In cases of serious malfeasance the official involved is, upon discovery, likely to be suspended or expelled from the party and even sentenced to a prison term. Thus at the outset of reform the requirements for solidarity among party members are more than adequate in that there is no real alternative to the party for advancement and the party's control capacity is effective in reducing free riding.

Following a turn to markets – whether formal or informal, domestic or international – the payoff for opportunism increases rapidly relative to the payoff for commitment to the party. It is evident that

$$h > c > l.$$

Let us assume c , h and l are all constant and commonly known among party members. We assume the distribution of b , i.e., the monitoring capacity is not common knowledge, and *agents can only observe m_t with one period delay*; that is, at time t , agents only know the history of payoffs for commitment, $m_0 = c$, m_1, \dots, m_{t-1} . The assumption of

incomplete information about b is extremely crucial in deriving our conclusions.

Let us assume that at time t each agent i ($i = 1, 2, \dots$) is an expected payoff maximizer and chooses to be an opportunist if and only if his or her expected payoff for opportunism is larger than that for commitment. Because an agent can only observe commitment payoff m_t with one period delay, we assume he or she maximizes his or her expected payoff based on m_{t-1} . That is, at time t , an agent simply updates his or her belief of payoff for commitment by using the latest payoff for commitment he or she observes, i.e., the payoff for commitment at time $t - 1$.⁵⁷ We formulate this assumption as follows:

Assumption 1: Each agent i uses the following dominant strategy at time t , i.e., to be an opportunist if and only if

$$b_i h + (1 - b_i) l > m_{t-1}. \quad (2)$$

We adopt a fact-like definition of the collapse of a communist party as follows:

Definition 1: The party collapses when all agents choose to be opportunists at the same time.

The timing of our model is as follows.

Period 1: Before period 1, each agent i observes $\{m_0 = c\} \times \{h, l\}$; then he or she decides whether to remain committed by using the dominant strategy stated in Assumption 1. Everyone gets his or her corresponding payoff. Specifically, a successful opportunist gets h , an unsuccessful agent gets l and a committor gets m_1 , which is decided according to equation (1).

Period 2: Before period 2, each agent i observes $\{m_1, c, h, l\}$; then he or she chooses whether to commit by using the dominant strategy stated in Assumption 1. Everyone gets his or her corresponding payoff, which can be similarly determined.

The process goes on indefinitely or ends when all agents become opportunists and the communist party collapses.

Our model is similar to that of Granovetter since both models study how individual preferences interact and aggregate.⁵⁸ Granovetter

requires that the decision be one where the costs and benefits to an agent of making one or the other choice depend in part on how many others make which choice.⁵⁹ This requirement is difficult to realize because when the population is large, it is difficult for an agent to observe how many agents remain committed and no opportunist would like truly to reveal his or her choice to the public voluntarily. However, it is more realistic to assume that an agent makes his or her choice by using the latest payoff for commitment (which is observable) to undertake a cost/benefit analysis. Thus our article is more robust in explaining the declining commitment to a communist party. In addition, by explicitly modeling payoff to commitment, payoff for opportunism, and punishment for opportunism, we can study the effect of changes of different payoffs on the declining commitment to a communist party, simulate outcomes, and make predictions on whether a communist party will collapse and how long the collapse will take under different situations.

The real deterioration process of a communist party is certainly much more complicated than that in our model. However, because the model here is simple and intuitive, and needs no fancy assumptions, our results can be instructive and helpful in understanding the collapse of communist parties in Eastern Europe and the Soviet Union and communism's resilience in China.

Results

In this part of the article we demonstrate: first, opportunism will become more and more widespread after market temptation induces the first opportunist. Second, although opportunism becomes commonplace, a communist party may still survive; however, a sufficiently high market temptation can undermine the party. Third, a communist party is more vulnerable when the monitoring capacity of the party is weaker. The following proposition shows the deterioration of commitment to a communist party after the initiation of market reform.

Proposition 1: *Assume b_t^* to be the pivotal b at time t such that any agent i will choose to be an opportunist if and only if his or her b^i is greater than b_t^* , then as long as some agents become opportunists, the payoff to committors becomes smaller and smaller, and more and more agents will become opportunists as time passes. That is,*

$$c = m_0 > m_1 > \dots > m_t > \dots$$

$$b_1^* > \dots > b_t^* > \dots$$

Proposition 1 provides a dynamic explanation of the collapse of the communist party. If the market provides strong enough incentives for some agents to become opportunists at $t = 1$, then committors will be worse off ($m_1 < m_0 = c$). Moreover, because at time $t = 2$, each agent chooses an action based on m_1 , the pivotal b beyond which agents become opportunists gets smaller, thus more agents choose to be opportunists. This will further diminish the payoff for a committor (smaller m_2) and decrease the pivotal b . When there is a period T in which the pivotal m is smaller than l (the cost of unsuccessful opportunism), all agents will become opportunists and the party collapses.

In every transition regime, vivid accounts of officials gaining windfall profits from private-sector entrepreneurship and of growing corruption have become commonplace. As the student protest leading to the 1989 Tiananmen massacre indicated, unbridled opportunism of party officials and economic bureaucrats becomes a focal point of citizens' anger. Their discontent diminishes the legitimacy of the party. Whether manifested in increasing numbers quitting the party, or declining attendance at party meetings, or widespread problems of low morale among remaining party members, a progressive waning of commitment to the party follows in the wake of the unbridling of opportunism. Defection from the party, which began first as a small stream and grew into a virtual flood of members turning in their party membership, preceded the collapse of communist regimes in Eastern Europe and the Soviet Union.

Although opportunism becomes more and more widespread, the deterioration of commitment to the party does not necessarily lead to the collapse of the party. The following proposition suggests a formal proof.

Proposition 2: If deterioration starts, a communist party can survive if and only if the monotonically decreasing sequence

$$\{b_1^*, b_2^*, \dots, b_T^*, \dots\}$$

converges to a limit $b^* \geq \underline{b}$.

The viability of state socialism is contingent, we maintain, on the survival of the communist party as a dominant political organization. In

explaining the collapse of state socialism in Eastern Europe and the Soviet Union and its resilience in China, analysts need to pay attention to the organizational health of the communist party. Its demise makes possible the breakdown of control that Skocpol contends is crucial to the dynamics of regime change.⁶⁰ On this point we agree with Deng Xiaoping, who once said, without the communist party, state socialism will collapse in China.

Although a communist party may survive under certain circumstances, its survival is impossible when market temptation is sufficiently high. The following Proposition 3 shows that if h (the payoff to a successful opportunist) is sufficiently high, then as deterioration progresses, the payoff to committors decreases dramatically until it is less than l (the payoff of an unsuccessful opportunist) and everybody becomes an opportunist and abandons the party. Without loss of generality, we only consider the support of b over $[0, 1]$.⁶¹

Proposition 3: If h is sufficiently large such that $h - c/h - l > \int_0^1 F(b)db$, the party will collapse as an effective political organization.

Under what context is a communist party more vulnerable to market temptation given other conditions? Corollaries 1 and 2 provide the answer.

Corollary 1: A communist party is super stable if its monitoring capacity is very strong.

Corollary 2: When the monitoring capacity is very weak in a communist party, any h that is greater than c is sufficient to undermine the party.

The monitoring capacity of a communist party determines its stability in the face of increasing market temptations. If the monitoring capacity is very strong, a communist party is super stable (Figure 3); on the contrary, if the monitoring capacity is very weak, a communist party is in chaos, a situation in which almost everyone can be a successful opportunist (Figure 4). If the monitoring capacity is moderate, a communist party will collapse when the payoff to opportunism is high enough (Proposition 3).

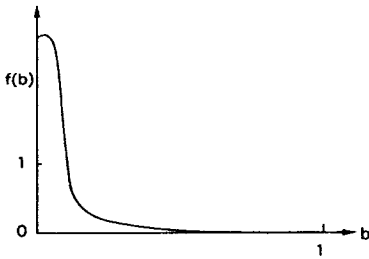


Fig. 3(a). Density with 0 almost everywhere.

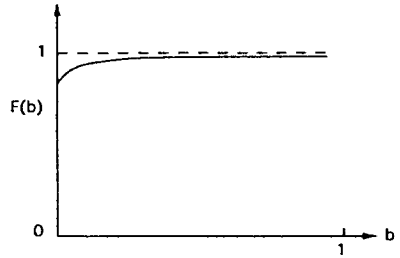


Fig. 3(b). Cumulative distribution function with 1 almost everywhere.

Ideology and declining commitment to the party

In mature state socialism, party members who join the party for personal gain can be expected to be among the first to succumb to the temptations of opportunities offered up by market demand, especially if institutional uncertainty leads to a weakening of monitoring and enforcement procedures in the party. But is the increased payoff for opportunism sufficient in itself to induce universal decline in commitment to the party? Some party officials joined the party not only for personal gain but because they believed in the cause of communism. For these officials ideological conviction, as well as calculation of interest, governs commitment. For them, the increasing payoff for opportunism poses no real dilemma because their framework of choice is not altogether represented by the logic of our model. Rather than responding only to the payoff to opportunism, these true believers respond to values that stem from an all-encompassing commitment to the party's cause. Especially in the case of the communist party, which like the Jesuits recruits members on the basis of fundamental belief, a model that includes only the increasing payoff from opportunities outside the party-controlled state and economy can account for only part of the story, albeit an important part.

For the purpose of broadening our model, let us assume that the communist party is composed of three groups: true believers, opportunists, and middle-of-the-roaders. True believers are the zealous party members with unwavering commitment to the party's cause. They are accustomed to exercising leadership through their ideological authority and by means of the formal control capacity of the party organization. Hence among the true believers are rational actors who seek to maximize power within the party-state. For them, the only payoff that matters derives from an all-encompassing commitment to the party's

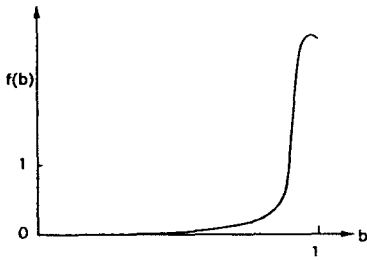


Fig. 4(a). Density with 0 almost everywhere.

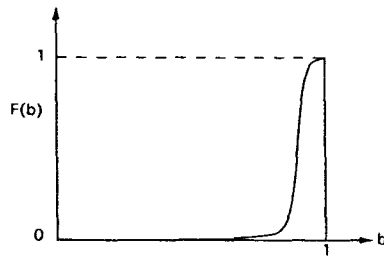


Fig. 4(b). Cumulative distribution function with 0 almost everywhere.

cause. Opportunists, by contrast, mouth the party line but their commitment stems not from ideological conviction but from the calculation of material interest. If the payoff from opportunities outside the party-controlled system is greater than what they might derive from the redistributive economy, opportunists will be among the first to engage in market-oriented entrepreneurial activity or rent-seeking.

While communist parties in mature state socialism attract both true believers and opportunists, the third category of middle-of-the-roaders, who combine qualities of both, probably represents the modal group. Among the middle-of-the-roaders are political entrepreneurs who inspire trust through their sensitivity to members' interests and whose leadership style creates mutually reinforcing expectations that the party will prevail as an effective political organization.⁶² Middle-of-the-roaders may not be the first to accept bribes, nor the first to seek shares in a newly privatized enterprise, but they are nonetheless sensitive to the gap between the payoff for opportunism and that for commitment. As the payoff for opportunism increases, middle-of-the-roaders begin to consider the option of opportunism more carefully. If the commitment to the party becomes too costly, middle-of-the-roaders will abandon the party. In particular, we may assume that if the payoff for commitment is lower than l , the payoff for an unsuccessful opportunist, then all middle-of-the-roaders will become opportunists. This permits us to define the timing of party collapse.

Definition 2: A communist party collapses if and only if all opportunists remain so and middle-of-the-roaders become opportunists.

The turning point in reform probably comes when middle-of-the-roaders start to defect in large numbers. Far more than the behavior of either the true believers or the opportunists, the behavior of the

middle-of-the-road group is decisive to the political fortune of the reforming communist party. If the middle-of-the-roaders defect, the party will surely collapse as an effective political party; however, if they remain committed to the party, true believers still have the organizational resources to forge a new political coalition and strive through political entrepreneurship to survive the disorderly transition from central planning to a market-coordinated economy.

When the monitoring and enforcement capacity is not very strong, then a sufficiently high market temptation will undermine a socialist state. A sufficiently high market temptation will eventually attract all opportunists away from commitment to the party, as shown in Proposition 3. This will decrease the suckers' payoff to a level lower than l , which is the bottom line of commitment of the middle-of-the-roaders. Then all middle-of-the-roaders will abandon the party and cause the collapse of a communist party.

Proposition 4: Suppose the cumulative distribution functions of b for opportunists and middle-of-the-roaders are not 1 almost everywhere, i.e., $\int_0^1 F(b)db < 1$, then if h is sufficiently large such that $h - c/h - 1 > \int_0^1 F(b)db$, a communist party will collapse.

Because middle-of-the-roaders combine principle with practicality, the payoff to opportunism may not be what pushes them to their threshold point. Instead the declining legitimacy and prestige of the party may be the prerequisite factors contributing to decline in their commitment. If individuals believe that their actions contribute to the success of a larger cause that they regard as worthwhile, they are more apt to stay the course.⁶³ However, if the party is despised by citizens, if its ideology is discredited by failing economic performance and the shift to markets, and its claim to the moral high ground shattered, commitment can be expected to ebb, rendering the sucker's payoff even less tenable. As North⁶⁴ points out, ideology is more than an economizing device that simplifies the task of decision-making by providing individuals with a world view.⁶⁵ The characteristic feature of a successful ideology is its ability to overcome the free-rider problem so as to "energize groups to behave contrary to a simple, hedonistic, individual calculus of costs and benefits."⁶⁶ By providing people with a theory of justice, ideology serves as a moral and ethical cement of society. To the extent individuals believe the system of production and distribution is fair, they believe it is legitimate. The less legitimate the social order, the more unbridled the problem of free riding, the higher the costs of monitoring

and enforcement, and hence of governance. In effect, commitment to the party becomes too costly, while the social and political rewards of membership are greatly diminished. Defection reaches a critical mass when it begins to assume the characteristics of collective action.⁶⁷ When the party is perceived as a lost cause or sinking ship, the party member faces a situation similar to that of a bank panic in which the only rational action is to abandon the party. At this stage it becomes virtually impossible to restore commitment to the party. The morale of the remaining true believers plunges as they despair of their ability to remain in control of events, which include mounting popular protests and other forms of extra-party collective action.⁶⁸ Because the party organization embodies the control capacity of the communist polity, its diminished power unleashes the contending social and political forces that vie to lead the transition to the post-communist political order. The communist polity is destabilized, and it is only a matter of time and happenstance before it eventually collapses. As with a car careening out of control, whether it is a sudden turn in the road or an oncoming car that precipitates the crash, the causal mechanism is not these precipitating factors, they are instead what explains why the driver lost control of the car.

Why did communist parties collapse in socialist states where markets were less developed?

The above analysis presents a pessimistic picture for communist parties after the introduction of market-oriented economic reforms. However, one might ask: Why did communist parties collapse in socialist states where markets were less developed? Why does the communist party survive as a monopolist party in China, where markets are more developed than in some of the Eastern European countries and the former Soviet Union?

As seen in Propositions 3 and 4, the difference between $\int_0^1 F(b)db$ and $h - c/h - l$ characterizes the stability of a communist party under increasing market temptation. As discussed before, c , the average payoff, is a parameter of economic performance; h indicates how high the market temptation is; and l shows the punishment payoff for opportunism, which is equivalent to Hechter's sanctioning capacity.⁶⁹

Proposition 5: The stability of a communist party is positively related to economic performance, the sanctioning capacity of the party, and negatively related to market temptation.

It is intuitive that the higher the payoff (i.e., h is higher) and the less the punishment (i.e., l is greater) for opportunism, the more frequently agents will be opportunists. The reason why agents are more likely to be opportunists when economic conditions are worse is that, given h and l , (and $h - l$), when the economic pie is smaller (i.e., c is smaller), relatively speaking, $h - c$ gives greater incentive for opportunism.

Among those factors discussed above, changes in the parameters other than l are largely determined by forces outside the party's control. First, h is exogenously determined by the market. Second, c , the parameter of economic performance, depends mainly on the success of market-oriented reform. Third, administrative and political reforms concomitant with economic reform, and increased levels of institutional uncertainty result inevitably in weakening of the monitoring capacity of the party. Although l is the only factor that can be fully controlled by a communist party, it is extremely difficult for the party to control l , the punishment for opportunism. On the one hand, opportunism always takes place first among high-level party officials and economic bureaucrats; on the other hand, these are the very people who are supposed to set l and punish opportunists. This paradox cannot be solved without an exogenous player setting the rules. Therefore opportunism in a communist party is inevitable politically and economically. The inevitable opportunism among high-level party officials and economic bureaucrats sets a "demonstration effect" that only induces others to become opportunists.

Why did communist parties in socialist states where markets were less developed collapse? In our view, there are two main factors that explain the collapse of communist parties in the Soviet Union and Eastern European countries. First, Soviet political reform proceeded too quickly, so that the monitoring capacity weakened greatly, rendering the party hyper-vulnerable to market temptation, especially in the informal economy. Second, there was no real improvement in economic performance in the Soviet Union and most Eastern European countries.

By contrast in China, three factors discussed above account for the survival there of the communist party. First, China did not carry out democratic reform in any meaningful way, so that the party's monitoring capacity was not substantially weakened. Weingast argues that a central although underemphasized factor of China's reform is that decentralization of power led to the emergence of a market-preserving

federalism.⁷⁰ We maintain that such institutional reform might actually enhance the party's monitoring capacity over agents, since power decentralization provides stronger incentive for local governments to supervise their agents more directly. Second, economic reform has resulted in substantial improvements in the living standard of people. Third, the Chinese government launched several anti-corruption campaigns and punished thousands of lower and middle level party officials and economic bureaucrats. Despite such measures, opportunism remains incorrigible because the highest-ranking party officials are virtually immune from punishment, hence the "demonstration effect" always exists. So when an anti-corruption campaign ends and the distribution of power shifts to the right, defection becomes more widespread and serious. In other words, an anti-corruption campaign serves as a signal to party officials and economic bureaucrats that their real power indices are substantially lower than they thought.

Computer simulation

In this section, we present computer simulations to demonstrate the effect of the payoff for opportunism, the average payoff, the punishment against opportunism, and the distribution of power on the declining commitment to a communist party. The numerical examples are to help readers better understand our dynamic model. Without loss of generality, we choose the following parameters as our baseline: $h = 6.02$, $c = 3.00$, and $l = 0$ when the density of monitoring capacity is uniform over $[0, 1]$. By varying a factor each time, we can see in what direction and by how much this change affects the declining commitment to the party. All mathematical accounts are given in Appendix B.

Case 1: The relationship between market temptation, h , and the number of periods that a communist party can survive, given $c = 3, l = 0$, and the uniform density of monitoring capacity. The result of computer simulation is given in Table 2. For instance, when h is larger than 7.24264, the party can only survive for one period (row 1); when h is lower than 6, the party can survive indefinitely (row 8). *There is a negative relationship between market temptation and the number of periods that the party can survive* (see Figure 5). Given other factors, the final outcome (whether the party will collapse, and if so, how long it will take) is sensitive to market temptation. For example, when market temptation increases by 20.7 percent from 6.02000 to 7.24264, the process of declining commitment to the party speeds up and the party can survive

Table 2. Market temptation and the number of party survival periods when $c = 3$, $l = 0$, and $f(b)$ is uniform

h	t
(7.24264, $+\infty$)	1
(6.24718, 7.24264)	2
(6.05877, 6.24718)	3
(6.01452, 6.05877)	4
(6.00362, 6.01452)	5
(6.00090, 6.00362)	6
.....
($-\infty$, 6.00000)	$+\infty$

- h: The payoff for successful opportunism, or market temptation.
 c: The average payoff, or the parameter of economic performance.
 l: The payoff for unsuccessful opportunism, or the punishment payoff for opportunism.
 b: The probability of being a successful opportunist.
 t: The number of periods that a communist party can survive.

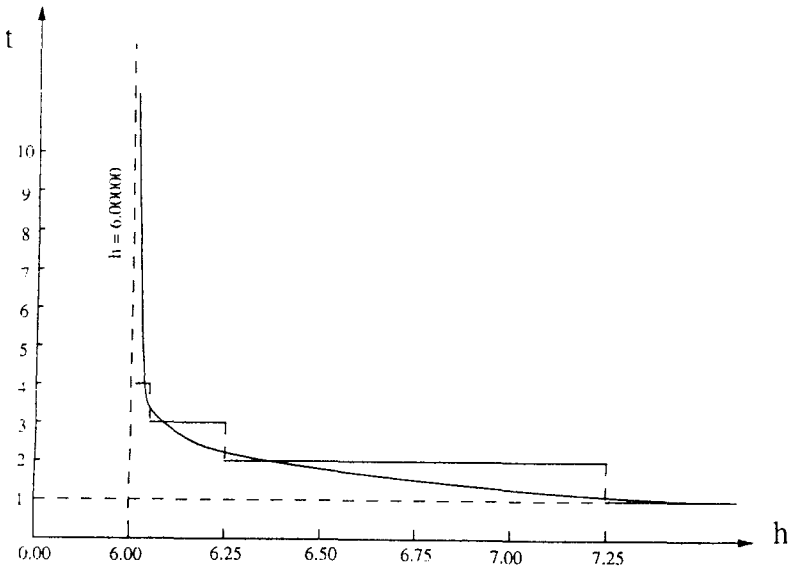


Fig. 5. The relationship between h and t when $c = 3$, $l = 0$ and $f(b)$ is uniform.

for only one period instead of four as before. This confirms the conclusion that a sufficiently high market temptation will undermine a communist regime (Proposition 3). When market temptation decreases only by 0.34 percent from 6.02000 to 6.00000, the party can survive indefinitely!

Case 2: The relationship between the average payoff, c , and the number of periods that a communist party can survive, given $h = 6.02$ and $l = 0$, and the uniform density of monitoring capacity. The result of computer simulation is given in Table 3. For instance, when c is less than 0.00000, which is equal to the punishment for opportunism, the party will collapse instantaneously (row 1); when c is higher than 3.01000, the party can survive indefinitely (row 9). *There is a positive relationship between the average payoff and the number of periods that the party can survive* (see Figure 6). Given other factors, the final outcome is sensitive to the average payoff. For example, when the average payoff increases only by 0.33 percent from 3.00000 to 3.01000, the party will survive indefinitely rather than only four periods!

Case 3: The relationship between punishment payoff for opportunism, l , and the number of periods that a communist party can survive, given $h = 6.02$, and $c = 3.00$, and the uniform density of monitoring capacity. As shown in Table 4, when l is higher than 3, the average payoff, the party will collapse instantaneously (row 1); when l is lower than -0.02000 , the party can survive indefinitely. *There is a negative relationship between punishment payoff and the number of periods that the party can survive* (see Figure 7). In other words, the more serious the punishment (i.e., the lower l), the longer the party can survive.

Implications and limitations of the model

Our dynamic model has the following additional implications. First, any political reform that weakens the party's monitoring capacity severely and goes far ahead of economic reform will topple a communist party. Shrewdly, leaders of the Chinese communist regime have drawn the same conclusion. Second, the decline of commitment to the party does not necessarily imply the collapse of the party; however, there is always a danger of collapse of the party due to the demonstration effect of those agents with greater power. Third, different communist parties can experience different paths of collapse because they may have different h , l , c , and monitoring capacities.

Table 3. Average payoff and the number of party survival periods when $h = 6.02$, $l = 0$, and $f(b)$ is uniform

c	t
$(-\infty, 0.00000)$	0
$(0.00000, 2.49357)$	1
$(2.49357, 2.89091)$	2
$(2.89091, 2.98080)$	3
$(2.98080, 3.00274)$	4
$(3.00274, 3.00820)$	5
$(3.00820, 3.00955)$	6
.....
$(3.01000, +\infty)$	$+\infty$

h : The payoff for successful opportunism, or market temptation.

c : The average payoff, or the parameter of economic performance.

l : The payoff for unsuccessful opportunism, or the punishment payoff for opportunism.

b : The probability of being a successful opportunist.

t : The number of periods that a communist party can survive.

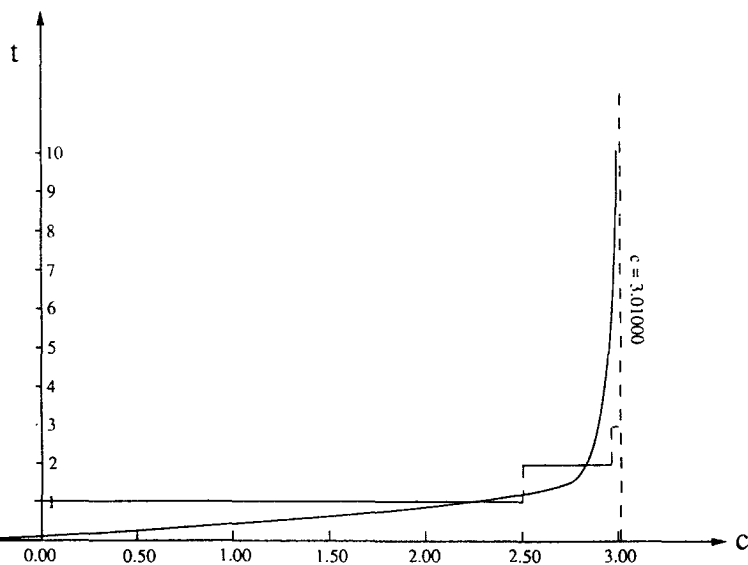


Fig. 6. The relationship between c and t when $h = 6.02$, $l = 0$ and $f(b)$ is uniform.

Table 4. Punishment payoff and the number of party survival periods when $h = 6.02$, $c = 3$, and $f(b)$ is uniform

l	t
(3.00000, $+\infty$)	0
(0.86454, 3.00000)	1
(0.20988, 0.86454)	2
(0.03803, 0.20988)	3
(-0.00546, 0.03803)	4
(-0.01637, -0.00546)	5
(-0.01909, -0.01637)	6
.....
($-\infty$, -0.02000)	$+\infty$

- h: The payoff for successful opportunism, or market temptation.
 c: The average payoff, or the parameter of economic performance.
 l: The payoff for unsuccessful opportunism, or the punishment payoff for opportunism.
 b: The probability of being a successful opportunist.
 t: The number of periods that a communist party can survive.

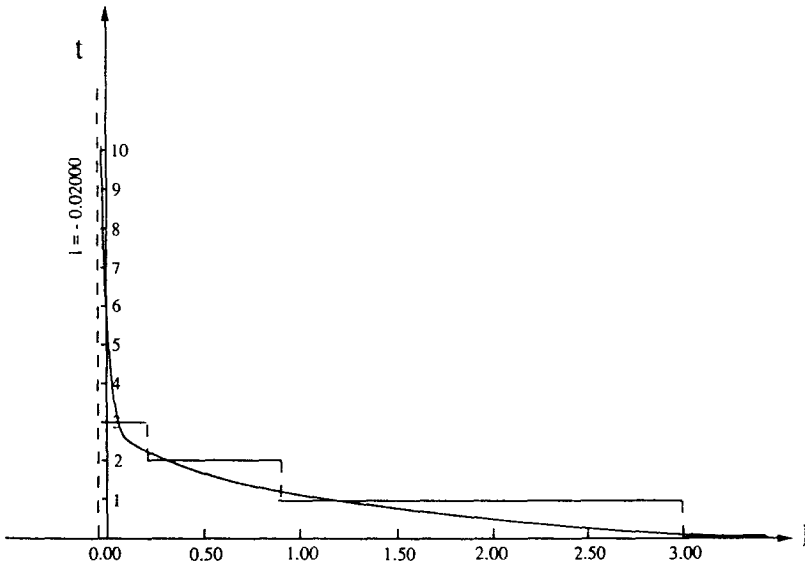


Fig. 7. The relationship between l and t when $h = 6.02$, $c = 3$ and $f(b)$ is uniform.

There are several limitations of our model that point to future research. First, agents are not forward-looking; they do not take their future expectations into account. Generally speaking, when a communist party opens its door to the outside world, people there immediately recognize the large gap of living standard between western countries and the socialist state. Future expectation might speed up the decline of commitment to the party.

Second, in reality, b and l are positively related to the number of opportunists, i.e., the more the opportunists, the easier it is to be a successful opportunist and the lower the cost of unsuccessful opportunism.⁷¹ However, taking this factor into account does not change our results; instead we expect the collapse of a communist party to accelerate under the new circumstance.

Third, future work should also consider endogenizing payoffs (h , l , and c) in a more dynamic setting because as economic reform goes on those payoffs may change and take into account the learning behavior of agents because agents may update their beliefs about commitment payoffs in a repeated game.

Last, but not least, future work should distinguish the productive function of market-oriented entrepreneurship from rent-seeking in opportunism. While the former might in fact increase the total economic welfare, the latter only engages in a zero-sum game. At the outset of economic reform, both market-oriented entrepreneurship and rent-seeking lacked legitimacy, however, in China market-oriented entrepreneurship is now approved by the party for its members.

Conclusion

Several arguments in combination explain why communist elites pursued economic reform despite the corrosive effect – both institutional and symbolic – of markets on state socialist redistributive power. North's proposition that changes in the relative strength of competitor states impose pressure for change in the structure of property rights on stagnant states explains why communist rulers in China and the Soviet Union initiated economic reform (section 1). Once reforms are underway, market transition theory explains why communist elites come to love the market (section 2). The penetration of markets increases the payoff for opportunism among party officials and economic bureau-

crats. Increasing opportunism in turn results in declining commitment to the party and its deterioration as an effective political organization (section 3). Widespread opportunism among party officials and economic bureaucrats makes the sucker's payoff for commitment to the party less tenable for those who combine principle with practicality. When middle-of-the-roaders begin to abandon the party, the crescendo effect of their collective action has a demoralizing influence on true believers, paving the way for the collapse of the party as an effective political organization. Overall, we argue that the market as an institution and symbol set the stage for regime change in reforming state socialism.

In China, even while local officials rebuild local redistributive power through control over rural industries, the economic institutions of state socialism are being replaced incrementally by market institutions. As a result, the main integrative mechanism of a state socialist redistributive economy – the capacity to redistribute goods and services on a national basis by administrative fiat – has been irreparably weakened. Paradoxically, the local communist officials who strive so hard to reconsolidate redistributive power are, by virtue of their success, undermining the main integrative mechanism of state socialism. They thereby hurry the transition to an economy mainly coordinated by the market. By 1993 the central state controls the allocation of only 7 percent of the national budget. Dengist China promises itself a 50-year period to catch up with the contemporary middle-developed market economies. A 50-year “tactical retreat” from non-market coordination of the economy is likely to end communism in China, incrementally through political deterioration rather than by revolution, whether or not the party survives, and sooner rather than later. The dilemma confronting the few remaining communist rulers is that to survive in a world of competing states, they are compelled to initiate and sustain market reform. Yet the spread of markets erodes commitment to the party and paves the way for regime change.

Notes

1. Earlier drafts of this article were first presented at the Annual Meeting of the Social Science History Association in 1991 and the 87th Annual Meeting of the American Sociological Association. We received helpful criticism on earlier drafts from James Alt, Roger Friedland, Michael Hechter, Peter Katzenstein, Bill Keech, M. P. Rouse, Andrew Rutten, David Stark, David Strang, Henry Walker, Henry Wan Jr., Barry Weingast, and Xueguang Zhou. Partial funding for this project was provided

- by the College of Arts & Sciences at Cornell University. Peng Lian gratefully acknowledges financial support from the National Science Foundation through the Harvard/MIT RTG program in Positive Political Economy.
2. For a comparative overview of reform in China and Eastern Europe, see V. Nee and D. Stark, editors, *Remaking the Economic Institutions of Socialism: China and Eastern Europe* (Stanford: Stanford University Press, 1989).
 3. G. Grossman, "The 'shadow economy' in the USSR," *Problems of Communism* 26 (1977): 25–40; and G. Grossman, "The 'shadow economy' in the socialist sector of the USSR," *The CMEA Five-Year Plans (1981–85) in a New Perspective: Planned and Non-Planned Economies* (Brussels: NATO Economics and Information Directorate, 1982), 99–115.
 4. Despite communist ideological portrayal of the evils of the marketplace, as long as the plan guided the market, communist reformers could embrace market institutions. The economic reforms in Poland (1956), Czechoslovakia (1964–1968), Yugoslavia (1965), Hungary in 1957 through the 1960s, and the Soviet Union (1953) reflected such hopes. In China, the central planner, Chen Yun, argued as early as 1956 that markets for consumer products and local free markets were entirely compatible with central planning. See N. Lardy and K. Lieberthal, editors, *Chen Yun's Strategy for China's Development: A Non-Maoist Alternative* (Armonk, N.Y.: M. E. Sharpe, 1982); and R. Hsu, "Conceptions of the market in post-Mao China," *Modern China* 11 (1986): 436–460. A model of central planning with regulated markets is outlined in W. Brus, *The Market in a Socialist Economy* (London: Routledge, 1972).
 5. D. Stark and V. Nee, "Towards an institutional analysis of state socialism," in V. Nee and D. Stark, editors, *Remaking the Economic Institutions of Socialism: China and Eastern Europe* (Stanford: Stanford University Press, 1989), 208–232; and A. Nagy, "Social choice' in Eastern Europe," *Journal of Comparative Economics* 15 (1991): 266–283.
 6. D. North, *Structure and Change in Economic History* (New York: Norton, 1981).
 7. V. Nee, "A theory of market transition: From redistribution to markets in state socialism," *American Sociological Review* 54 (1989): 663–681.
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 9. North, 29. We employ in this article North's definition of transaction cost, which comprises the cost of measurement of the valuable attributes being exchanged and the cost of protecting rights and of monitoring and enforcing agreements. See D. North, *Institutions, Institutional Change and Economic Performance* (Cambridge: Cambridge University Press, 1990). See also S. Cheung, "A theory of price control," *Journal of Law and Economics* 12 (1974): 23–45 and "The contractual nature of the firm," *Journal of Law and Economics* 17 (1983): 53–71. This approach differs somewhat from that used in O. Williamson, *The Economic Institutions of Capitalism* (New York: Free Press, 1985). A recent article by Williamson reconciles his approach with North's, see "Comparative economic organization: The analysis of discrete structural alternatives," *Administrative Science Quarterly* 36 (1991): 269–296.
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48. Data for Figures 1 and 2 come from the Fujian Market Transition Project conducted in 1985, in which a cluster sampling procedure drew a probability sample of 30 villages, involving 624 completed household interviews.
49. In Eastern Europe, with the exception of Yugoslavia, Soviet-type regimes were imposed from above with the help of the Soviet Army. If the U.S.S.R. had at any time weakened its resolve, the Eastern European empire would have defected decades earlier. For this reason there are really only two cases, China and the Soviet Union, to be explained. Soviet commitment to Eastern Europe ebbed when these client states became an economic liability. See V. Bunce, "The empire strikes back: The evolution of the Eastern Bloc from a Soviet asset to a Soviet liability," *International Organization* 39 (1985): 1–46. Once Gorbachev signaled that Soviet troops would no longer intervene militarily, he removed the main force propping up the Eastern European party regimes.
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52. We provide an example in Appendix A to show that our results can hold for the case of discrete density functions.
53. First, we do not consider a concave utility function because the current setting is easier for computer simulation, which will be discussed later. Second, our results are also valid when all payoffs are expressed in relative terms.
54. In fact, our results hold when there are some agents who choose to be opportunists at time $t = 0$.
55. It is very likely for a successful opportunist to encounter cost as well, so h can be thought of as the net payoff after subtracting implicit cost.
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57. Although there are some complicated updating rules for the belief of commitment payoff, we maintain that our simple updating rule is not unrealistic. For a study of strategic learning in experimental implementations of the centipede game, see M. El-Gamal, R. McKelvey, and T. Palfrey, "Myopic and strategic learning in a sequential experimental study of the centipede game," mimeo, California Institute of Technology, 1990. They solve the model for the full sequential Nash equilibrium where the players update their beliefs within and between games and take into consideration that their opponents do the same. The challenging model is a myopic version where the players do not learn at all. They simply keep their initial priors about the proportion of irrationals and play both games as if they are being played simultaneously. They find the sequential Nash model failed to defeat the simple myopic straw-man, and the myopic model is just as good as the sequential one.
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Appendix A

Proof of Proposition 1: (i) $t = 1$, $m_1 < c = m_0$. Because there are some agents become opportunists, there must exist some b_i such that $b_i h + (1 - b_i)l > c$. In other words, those who choose to be opportunists must have

$$b_i > b_1^* = \frac{c - l}{h - l}. \quad (3)$$

Clearly if each agent follows the dominant strategy stated in Assumption 1, then b_1^* is the pivotal b such that all agents with b larger than b_1^* become opportunists and all agents with b smaller than b_1^* remain committed. Therefore

$$\begin{aligned} \int_{b_1^*}^{\bar{b}} [bh + (1 - b)l] f(b) db + \int_{\underline{b}}^{b_1^*} m_1 f(b) db &= c. \\ \int_{\underline{b}}^{b_1^*} m_1 f(b) db &= \int_{\underline{b}}^{\bar{b}} cf(b) db - \int_{b_1^*}^{\bar{b}} [bh + (1 - b)l] f(b) db \\ &< \int_{\underline{b}}^{\bar{b}} cf(b) db - \int_{b_1^*}^{\bar{b}} cf(b) db \\ &= \int_{\underline{b}}^{b_1^*} cf(b) db. \end{aligned}$$

I.e., $m_1 < c = m_0$.

(ii) When $t = 2$, following (2), an agent i becomes an opportunist if and only if

$$b_i h + (1 - b_i)l > m_1, \text{ i.e.,}$$

$$b_i > b_2^* = \frac{m_1 - l}{h - l}.$$

However, $b_2^* < b_1^*$ because $m_1 < c$. Using continuity of f and $f(b) > 0$, we have

$$1 - F(b_2^*) > 1 - F(b_1^*),$$

that is, there are more opportunists now than in the first period. Moreover

$$\begin{aligned} c &= \int_{b_1^*}^{\bar{b}} [bh + (1 - b)l] f(b) db + \int_{\underline{b}}^{b_1^*} m_2 f(b) db \\ &= \int_{b_1^*}^{\bar{b}} [bh + (1 - b)l] f(b) db + \int_{\underline{b}}^{b_1^*} m_1 f(b) db, \text{ i.e.,} \\ \int_{\underline{b}}^{b_2^*} m_2 f(b) db &= \left(\int_{b_1^*}^{b_2^*} + \int_{\underline{b}}^{b_1^*} \right) m_1 f(b) db \\ &\quad - \int_{b_1^*}^{b_2^*} [bh + (1 - b)l] f(b) db \\ &= \int_{\underline{b}}^{b_2^*} m_1 f(b) db. \end{aligned}$$

I.e., $m_2 < m_1 < c = m_0$.

(iii) It is easy to check sequence $\{c = m_0, m_1, m_2, \dots, m_t, \dots\}$ is strictly decreasing by induction. Using $b^t = m_{t-1} - l/h - l$, sequence $\{b_1^*, b_2^*, \dots, b_t^*, \dots\}$ is strictly decreasing too. \square

Proof of Proposition 2: (Necessity) By contradiction. If a communist party survives and at the same time the sequence of b does not converge to a limit $b^* \in \geq \underline{b}$, then there are two possible cases. One is the sequence is not bounded below at all, i.e., the sequence diverges, then clearly $\exists T$ such that $b_{T-1}^* \geq \underline{b}$ and $b_T^* < \underline{b}$, that is, at time T , all agents become opportunists and the party collapses. Another case is the sequence has a lower bound, thus the sequence has a limit (for any monotone and bounded sequence has a limit) b^* which is smaller than \underline{b} , then clearly there exists a T such that $b_t^* < \underline{b}$ for all $t \geq T$ with

$$\lim_{t \rightarrow \infty} b_t^* = b^* < \underline{b}$$

and the party collapses at time T . Clearly both cases contradict with the assumption that the party survives.

(Sufficiency) If the sequence does approach a limit $b^* \geq \underline{b}$, then $\forall T (T = 1, 2, \dots)$, $b^T > \underline{b} \geq \underline{b}$, there are agents with b lower than b^T since all densities inside $[\underline{b}, b^T]$ are positive. These agents will commit according to the dominant strategy in Assumption 1, thus the party survives. \square

Proof of Proposition 3: Since the support of b is $[0, 1]$, it is obvious opportunism always happens for $h > c$ since agents with $b = 1$ are always opportunists. By Proposition 1, there exists two monotonically decreasing sequences, i.e.,

$$\{m_0, m_1, \dots\} \text{ and } \{b_1^*, b_2^*, \dots\}.$$

By contradiction. As known from Proposition 2, if the party does not collapse, $\{b_1^*, b_2^*, \dots\}$ converges to a limit $b^* \geq 0$. It is easy to prove that at the same time $\{m_0, m_1, \dots\}$ converges to a limit m^* too. Therefore in limit, we have

$$\begin{aligned} c &= \int_{b^*}^1 [bh + (1-b)l] f(b) db + \int_0^{b^*} m^* f(b) db \\ &= \int_{b^*}^1 (h-l)bf(b) db + \int_{b^*}^1 lf(b) db + \int_0^{b^*} m^* f(b) db \\ &= (h-l)[bF(b)\Big|_{b^*}^1 - \int_{b^*}^1 F(b) db] + l[1 - F(b^*)] + m^* F(b^*) \\ &= (h-l)[1 - b^*F(b^*)] + m^* F(b^*) + l[1 - F(b^*)] - \\ &\quad - (h-l) \int_{b^*}^1 F(b) db \\ &= h - (h-l) \int_{b^*}^1 F(b) db. \end{aligned}$$

The last equality holds because $b^* = m^* - l/h - l$. Therefore, $\int_{b^*}^1 F(b)db = h - c/h - l$. However, $b^* \geq 0$, thus

$$\int_0^1 F(b)db \geq \int_{b^*}^1 F(b)db = \frac{h-c}{h-l}, \quad (4)$$

which is a contradiction to $h - c/h - l > \int_0^1 F(b)db$. \square

Proof of Corollary 1: By Proposition 3, a communist party facing very high market temptations will not collapse when $\int_0^1 F(b)db \rightarrow 1$ such that there is no h satisfies $h - c/h - l > \int_0^1 F(b)db$. This corresponds to the case when the density function is extremely biased to the left, i.e., there is a sufficiently small $\delta > 0$ such that all points larger than δ have densities close to zero. Then the cumulative distribution function is 1 almost everywhere (see Figure 3). In reality, this case refers to a socialist state where the monitoring capacity is very strong. \square

Proof of corollary 2: Step 1, given $f(b) = a_k b^k (k = 0, 1, \dots)$, $b \in [0, 1]$, and payoffs c and l , the pivotal market temptation to undermine a communist party is

$$h^* = \frac{(k+2)c-l}{k+1}. \quad (5)$$

$$F(b) = \int_0^b f(b)db = \int_0^b a_k b^k db = a_k \frac{b^{k+1}}{k+1}.$$

and $F(1) = 1$ imply $a_k = k+1$, thus $f(b) = (k+1)b^k$ and $F(b) = b^{k+1}$.

As known from the proves of Propositions 2 and 3, if a communist party can survive, there exists a $b^* \geq 0$, such that (4) holds, i.e.,

$$\int_{b^*}^1 b^{k+1} db = \frac{h-c}{h-l}, \text{ i.e.,}$$

$$\frac{b^{k+2}}{k+2} \Big|_{b^*}^1 = \frac{h-c}{h-l}, \text{ i.e.,}$$

$$1 - \frac{h-c}{h-l} (k+2) = (b^*)^{k+2}.$$

Because $b^* \geq 0$, if the left-hand-side of the above equation is less than zero, then a communist party cannot survive anymore. So the pivotal h^* should satisfy

$$\frac{h^* - c}{h^* - l} = \frac{1}{k+2}.$$

Solving the above equation, we get

$$h^* = \frac{(k+2)c-l}{k+1}.$$

Step2, as $k \rightarrow +\infty$, $h^* = c$.

Take limit in (5), we have $h^* = c$.

Step 3, when the monitoring capacity is extremely weak, almost all agents have b close

to 1, i.e., there is a sufficiently small $\delta > 0$ such that all points less than $1 - \delta$ have densities close to zeros, i.e., the density function is extremely biased to the right, and the cumulative distribution function is 0 almost everywhere (Figure 4). The result in step 2 is generically true for any distribution function that is 0 almost everywhere by using Weierstrass Approximation Theorem which states any continuous function f on a closed interval $[a, b]$ can be approached by a sequence of polynomials which converges uniformly to f on $[a, b]$. \square

Proof of Proposition 5: Let $\alpha = h - c/h - l$, then the higher α , the less stable a communist party. By taking derivatives of α with respect to h , c and l , we have

$$\frac{\partial \alpha}{\partial h} > 0$$

$$\frac{\partial \alpha}{\partial c} < 0$$

$$\frac{\partial \alpha}{\partial l} > 0. \quad \square$$

Discrete density function: Let us consider the decline of commitment to a communist party when the density function of monitoring capacity is discrete. It is intuitive that if all different densities are distributed in such a way that the distance of any two nearby densities is sufficiently small, then all our results for continuous density are valid. The requirement that positive densities are distributed almost everywhere is not unrealistic when the population is large enough. We are not able to show and formulate at this point the exact condition of "positive densities almost everywhere." However, the following example shows that in fact this condition is not very strict as it might sound at first glance.

Example: Assume $c = 3$, $h = 4$, $l = 0$ and everyone gets -2 when the party collapses, except now we have the following discrete density distribution, which is not common knowledge.

$$p(b_1 = 0.9) = 1/3; p(b_2 = 0.7) = 1/3; p(b_3 = 0.66) = 1/3.$$

We index an agent's type by subscripts of b .

At $t = 1$, type-1 agents will become opportunists because their expected payoff then is greater than the payoff of a committor at $t = 0$, i.e.,

$$0.9 \times 4 + 0.1 \times 0 = 3.6 > 3.$$

Thus the payoff to a committor at $t = 1$ is

$$m_1 = \frac{3 - 3.6 \times 1/3}{2/3} = 2.7.$$

At $t = 2$, type-2 agents as well as type-1 agents will become opportunists too because their expected payoff then is greater than the payoff of a committor at $t = 1$, i.e., m_1 , that is,

$$0.7 \times 4 + 0.3 \times 0 = 2.8 > 2.7 = m_1.$$

Thus the payoff to a committor at $t = 2$ is

$$m_2 = \frac{3 - 3.6 \times 1/3 - 2.8 \times 1/3}{1/3} = 2.6.$$

At $t = 3$, type-3 agents together with type-1 and type-2 agents will choose to become opportunists, because their expected payoff then is greater than the payoff of a committor at $t = 2$, i.e., m_2 , that is,

$$0.66 \times 4 + 0.34 \times 0 = 2.64 > 2.6 = m_2.$$

Unfortunately because the party collapses due to the fact that all agents choose not to commit, each agent can only get $d = -2$ instead of 3.6 (type-1), 2.8 (type-2) and 2.64 (type-3).

Appendix B

Case 1: Relationship between h and t when the density function of monitoring capacity is uniform, and $c = 3$ and $l = 0$. Suppose the party collapses in period t ($t = 2, 3, \dots$), then it must be the case that at time $t - 1$, commitment payoff is zero so that all agents will defect to opportunism at time t , i.e., $m_{t-1} = 0$. Since the average payoff is always 3, we have in period $t - 1$

$$\int_{b_{t-1}}^1 bhdb + b_{t-1}m_{t-1} = 3, \text{ i.e.,}$$

$$\frac{h}{2} (1 - b_{t-1}^2) + b_{t-1}m_{t-1} = 3.$$

Because agents use the dominant strategy stated in (2) in period $t - 1$, we have

$$b_{t-1}h = m_{t-2}.$$

Similarly we have

$$\frac{h}{2} (1 - b_{t-2}^2) + b_{t-2}m_{t-2} = 3.$$

A similar process can be gone through until at period 1

$$b_1h = 3.$$

In general for any given t ($t = 2, 3, \dots$), we can solve $h, b_1, m_1, \dots, b_{t-1}, m_{t-1}$ from the following $2t - 1$ simultaneous equations.

$$m_{t-1} = 0,$$

$$\frac{h}{2} (1 - b_{t-2}^2) + b_{t-1}m_{t-1} = 3,$$

$$b_{t-1}h = m_{t-2},$$

$$\frac{h}{2} (1 - b_{t-2}^2) + b_{t-2}m_{t-2} = 3,$$

...

$$b_2h = m_1,$$

$$\frac{h}{2}(1 - b_1^2) + b_1 m_1 = 3,$$

$$b_1 h = 3.$$

Case 2: Relationship between c and t when the density function of monitoring capacity is uniform, and $h = 6.02$ and $l = 0$. The logic above follows except now we use c instead of 3 and 6.02 instead of h . In general for any given t ($t = 1, 2, \dots$), we can solve $c, b_1, m_1, \dots, b_{t-1}, m_{t-1}$ from the following $2t - 1$ simultaneous equations.

$$m_{t-1} = 0,$$

$$3.01(1 - b_{t-1}^2) + b_{t-1} m_{t-1} = c,$$

$$6.02 b_{t-1} = m_{t-2},$$

$$3.01(1 - b_{t-2}^2) + b_{t-2} m_{t-2} = c,$$

...

$$6.02 b_2 = m_1,$$

$$3.01(1 - b_1^2) + b_1 m_1 = c,$$

$$6.02 b_1 = c.$$

Case 3: Relationship between l and t when the density of monitoring capacity is uniform, and $h = 6.02$ and $c = 3$. The logic in case 1 follows except now we use l instead of 0 and 6.02 instead of h . Moreover, in period t , the equation which states that the periodic average payoff is 3 becomes

$$\int_b^1 [6.02b + l(1 - b)] db + b_t m_t = 3, \text{ i.e.,}$$

$$(3.01 + 0.5l) - lb_t - (3.01 - 0.5l)b_t^2 + b_t m_t = 3.$$

The dominant strategy equation at time t becomes

$$l + (6.02 - l)b_t = m_{t-1}.$$

In general for any given t ($t = 1, 2, \dots$), we can solve $l, b_1, m_1, \dots, b_{t-1}, m_{t-1}$ from the following $2t - 1$ simultaneous equations.

$$m_{t-1} = l,$$

$$(3.01 + 0.5l) - lb_{t-1} - (3.01 - 0.5l)b_{t-1}^2 + b_{t-1} m_{t-1} = 3,$$

$$l + (6.02 - l)b_{t-1} = m_{t-2},$$

$$(3.01 + 0.5l) - lb_{t-2} - (3.01 - 0.5l)b_{t-2}^2 + b_{t-2} m_{t-2} = 3,$$

...

$$l + (6.02 - l)b_2 = m_1,$$

$$(3.01 + 0.5l) - lb_1 - (3.01 - 0.5l)b_1^2 + b_1 m_1 = 3,$$

$$l + (6.02 - l)b_1 = 3.$$
