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The Grand Experiment of Communism: Discovering the Trade-off between Equality and Efficiency

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Abstract

This paper aims to explain the rise and fall of communism by exploring the interplay between economic incentives and social preferences transmitted by ideology. We introduce inequality-averse and inefficiency-averse agents and analyze their conflict through the interaction between leaders with economic power and followers with ideological determination. The socioeconomic dynamics of our model generate a pendulum-like switch from markets to a centrally-planned economy abolishing private ownership, and back to restoring market incentives. The grand experiment of communism is thus characterized to have led to the discovery of a trade-off between equality and efficiency at the scale of alternative economic systems. While our focus is on the long-run transitions from capitalism to communism and back observed in the course of the 20-th century, the model also derives conditions under which each of the systems can remain stable.

Key words: capitalism; communism; inequality; inefficiency; ideological transmission; economic transitions

JEL classification codes: C72, D31, D63, D74, D83, P51

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> February 1848: "The Communists disdain to conceal their views and aims. They openly declare that their ends can be attained only by the forcible overthrow of all existing social conditions. Let the ruling classes tremble at a Communistic revolution. The proletarians have nothing to lose but their chains. They have a world to win." Karl Marx and Frederick Engels, *Manifesto of the Communist Party.*[1]

> September 2010: "There were many odd things about my recent Havana stopover [...] but one of the most unusual was Fidel Castro's level of self-reflection. [...] I asked him if he believed the Cuban model was still something worth exporting. 'The Cuban model doesn't even work for us anymore,' he said." Jeffrey Goldberg, "Fidel: 'Cuban Model Doesn't Even Work for Us Anymore'," *The Atlantic.*[2]

1 Why Another Fable of the Grand Experiment?

Communism was the grand experiment of the 20-th century. It also seems to have been its grand illusion. In terms of utopian vision, radical implementation and socioeconomic impact, communism has left a lasting mark in history. Its rise and fall as a possible alternative to capitalism is a complex and multi-faceted theme, interpreted from different theoretical and methodological perspectives in social sciences. Works from many disciplines, going beyond politics and economics, have tried to portray or, more ambitiously, explain the various manifestations of communism across the map of the world – from nascent and militant through mature and oppressive into stagnating and decaying. So why another attempt to reconsider the key driving mechanisms behind the genesis of the revolutionary communist project and the gradual mass disillusionment with its realities? The novelty of our approach consists in relying on economic theory to examine the interactive dynamics of economic incentives and social preferences in a society experimenting with an economic system that has never been implemented before. We focus on a large region of the world where capitalism was less developed and, perhaps more importantly, any democratization of the society was avoided or much delayed.

In what follows, we build a tractable model to formalize the role of socioeconomic factors in the process that led to the rise of communism via a forced revolution and nationalization of capital, as well as its reversal back to markets. In essence, this grand experiment has led to the discovery of a trade-off between equality and efficiency in terms of productivity and saving at the scale of alternative economic systems.[3] Our theoretical account of the rise and fall of communism, from the revolutionary enthusiasm of Marx and Engels through the disillusionment of Castro we quoted in the beginning, is framed as a stylized game of class struggle involving economic decisions and transmission of ideology across generations. This is along the lines of North (2005), who interprets the experience with communism in Russia as "a story of perceived reality → beliefs

[1] Chapter IV. Position of the Communists in Relation to the Various Existing Opposition Parties, translated by Samuel Moore in cooperation with Frederick Engels, 1888, http://www.marxists.org/archive/marx/works/1848/communist-manifesto/ch04.htm

[2] http://www.theatlantic.com/international/archive/2010/09/fidel-cuban-model-doesnt-even-work-for-us-anymore/62602/

[3] For instance, Stretton (1976) writes: "Equalities can always be ill-designed, or enforced by oppressive methods. When they are, they may reduce productivity, as well as freedom. Some communist countries have flattened their margin for skill or hard work too far, with apparently bad effect on economy efficiency."

→ institutions → policies → altered perceived reality and on and on" (p. 4).[4] The model also shows conditions under which communism remains stable that can explain the persistence and the success of the Chinese social market economy.

On the side of socialization and the transmission of preferences, social norms, and beliefs, a strand of literature starting from Bisin and Verdier (2001) explores the role of intergenerational transmission of attitudes to explain the persistence of socioeconomic status across generations.[5] Only a few of these focus on the interrelation between the intergenerational transmission of ideological preferences and institutional change. The closest to our work is Doepke and Zilibotti (2008), which studies the role of the intergenerational transmission of taste for leisure and patience in the success of institutional changes brought about by the industrial revolution. Also, Saint-Paul (2010) analyzes the impact of the evolution of beliefs about the workings of the market economy on ideological bias in the society and political reform.

In this paper, we combine the above lines of thought and use the transmission and evolution of preferences to shed light on the dynamics of regime switches across economic systems. We devise a non-cooperative game between agent types that takes place in every period of an overlapping-generations (OLG) framework to demonstrate how the equilibrium strategies drive the long-run socioeconomic dynamics and can generate such pendulum-like switch from markets to an egalitarian economy abolishing private ownership, and back to rebuilding market incentives to sustain society. In particular, we model two types of agents, inequality-averse and inefficiency-averse ones, responding to economic incentives and transmitting their values as they are affected by evolving economic outcomes. We first show how capital accumulation by the minority elite and the resulting inequality leads to increasing social discontent over time and, eventually, the overthrow of the system. We then show how a centrally-planned system aimed at equality also fades away due to misalignment of individual and aggregate incentives, lower well-being and the gradual redirection of ideas towards a market system.[6]

The incentive structure under the two economic systems is captured in our model by the *(mis)alignment* of *ownership* and *control*. This is in line with the large literature on the key weaknesses of socialism: one strand dealing with the pervasive problems arising from the 'soft budget constraints' of socialist enterprises (e.g., Kornai, 1980) – what Roemer (2009) labels 'lack of incentives'; another pointing to the overambitious task of central planning, given 'dispersed and local information', to ensure better allocative decisions than markets (e.g., von Hayek, 1940, 1945) – what Roemer (2009) labels 'lack of coordination'. Our approach highlights these two familiar disadvantages of a communist economy at their crucial link, the *intertemporal optimization decision*, at which the (mis)alignment of ownership and control manifests itself. The choice of consumption and accumulation out of one's own wealth given the signals of competitive markets and locally relevant information under capitalism sustains efficiency but generates inequality. Delegating this choice to an egalitarian planner forces equality by revolution but erodes economic efficiency, thus making everyone equal in their poverty.[7] The economic

[4] This view somewhat departs from earlier seminal works on communism versus capitalism, and related studies on the comparative efficiency of the two systems. Among many others, see Lange (1956 [1936]), von Hayek (1940, 1945), Tinbergen (1960), Lancaster (1973), Kornai (1980), Roemer (1980, 1985).

[5] See Bisin and Verdier (2010) for a thorough survey of the literature on cultural transmission and socialization that followed.

[6] Interestingly, recent empirical work in Dohmen et al. (2011) provides evidence on attitudes towards trust being passed over generations and how the inertia can counteract the effect of institutional changes (or improvements) in a country on the willingness to trust.

[7] Note that we ignore neither that inequalities were *de facto* existing in communist countries, nor that they were creating resentment (see, e.g., Joo, 2005, for an account). However, considering explicitly the nomenklatura would only complicate the model without changing the substance of the results (in effect, only accelerating the swing back from plan to market).

literature, and the literature on communism or social evolution more generally, has not provided so far a consistent theory on the institutional change experienced by the Soviet Union and its satellite countries in Eastern Europe throughout the 20-th century accounting for both these transitions. In this consists the contribution of our stylized but history-based formal analysis of the rise and fall of communism and the conditions under which it remains stable.

The paper is organized as follows. In the next section we construct our model, presenting the types of agents, their objectives, constraints, ideological conflict, and the transmission of their beliefs across generations. Section 3 then solves the optimization problems of the agent types and the von Stackelberg game they play every period. Section 4 derives the intergenerational dynamics and highlights the resulting economic outcomes in terms of regime transitions or stability. Section 5 situates our theory in historical context, justifying the key assumptions we employ in our model. The last section concludes by drawing parallels between our propositions and corollaries and corresponding findings in the related formal political-economy literature and summarizing the insights from our model along the lines of the closest discursive interpretations of long-run economic change, in particular in the tradition of the new institutional economics. A brief appendix provides additional derivation details on the within-period von Stackelberg game, itself replayed in each subsequent generation.

2 The Model

2.1 Economic Systems, Agent Types and Conflict

We consider two economic systems under which society can evolve: one is based on the market (capitalist), denoted by M, and the other on an egalitarian planner (communist), denoted by E. True to the historical genesis of communist ideas, our analysis begins with a market-based system founded upon property rights over the means of production and the corresponding private incentives to capital accumulation. Our interest is in a particular region that at some point in time splits apart and experiments with communism. Its total adult population is normalized to 1.

There are two types of agents in the initial capitalist society. The large majority are born without inheriting capital: they are the 'workers'. They are 'unprivileged' in the sense that they can only sell their labor force in the market in order to subsist, as Marx argued. Being the have-nots, they care about inequality in the capitalist society, whose victim they are by birth. We call them *inequality-averse* agents and denote their type as A. A minority of agents are born with inherited capital: they are the 'capitalists'. They extract rents from their private capital, and care about the relative inefficiency between the two systems. We call them *inefficiency-averse* agents and denote their type as B.

Initially, types (A and B) and 'classes' (workers and capital owners) coincide, by definition. In a conventional way, this can be interpreted in terms of the class struggle between capital and labor. However, over time preference types evolve, so that class and preference type may diverge. We consider an OLG model, where agents live for two periods. During childhood (in the first period of life), they are 'socialized' and acquire a particular type just when becoming adult. When mature (in the second period of life), they perform active economic and ideological roles in the society, and die at the end of the period, investing any capital wealth they have accumulated.

Under both systems, M and E, economic power belongs to the preference type who decides upon – and enforces – the intertemporal allocation between capital accumulation and consumption. The other preference type can then only try to change the economic system through ideological influence. We denote the degree of strength of each type

relative to the other by the conflict function $q_t(\cdot)$ and $1-q_t(\cdot)$, respectively for types A and B in any period t, and measure it by an index, $0 < q_t(\cdot) < 1$. More precisely, this index can be defined to be some increasing function of the relative intensity of the preference itself (social resentment or ideological determination), $0 < m_t < 1$, and the relative size (or fraction) of each preference type in the total adult population, $0 < n_t < 1$: $0 < q_t(m_t, n_t) < 1$, with $\frac{\partial q_t(\cdot)}{\partial m_t} > 0$ and $\frac{\partial q_t(\cdot)}{\partial n_t} > 0$. It also captures the probability of a regime shift in any period t.[8] It will be seen that such economic transitions can only occur once the strength of the oppressed type dominates that of the ruling type: $q_t(\cdot) > 0.5$ for A and $1-q_t(\cdot) > 0.5$ for B.

2.2 Preferences

The utility of agent i for $i = A, B$ under each system $j = M, E$ takes the form

$$U^i(c^i_{j,t}, b^i_{j,t+1}, \upsilon_t, \chi_t) = c^i_{j,t} + \beta b^i_{j,t+1} - E^i_t(\upsilon_t, \chi_t) - \frac{\tau^i(\upsilon_t, \chi_t)^2}{2}, \tag{1}$$

with $c^i_{j,t}$ denoting individual consumption levels, $b^i_{j,t+1}$ the private (under M) or social (under E) returns from intergenerational transfers,[9] and $0 < \beta < 1$ the discount factor assumed to be identical for all agents. The third term generally represents the disutility from a change in the system of property rights and control, which also implies that relative status, or reference points, with respect to others matter as well. More precisely, $E^A_t(\upsilon_t)$ and $E^B_t(\chi_t)$ are the expected regime-dependent inequality and inefficiency

$$E^A_t(\upsilon_t) = q_{t+1} \ln \upsilon_{E,t} + (1 - q_{t+1}) \ln \upsilon_{M,t}, \tag{2}$$

$$E^B_t(\chi_t) = q_{t+1} \ln \chi_{E,t} + (1 - q_{t+1}) \ln \chi_{M,t}, \tag{3}$$

where $\upsilon_{j,t}$ measures income of type B relative to A, or inequality within the society as perceived at t, and $\chi_{j,t}$ the relative efficiency, in terms of productivity and potential growth possibilities, of individual optimization under market capitalism over a centrally-planned communist system as perceived at t. Note that communism forcefully proclaims complete equality in the society, $\upsilon_{E,t} = 1$, yielding $\ln \upsilon_E = 0$. Similarly, inefficiency is initially normalized under capitalism, $\chi_{M,t} = 1$, and so $\ln \chi_M = 0$. $\upsilon_{M,t}$ and $\chi_{E,t}$ will be defined further below. The relative strength of the preference types, q_{t+1}, determines the probability of a regime change in period $t+1$. Finally, utility depends on costly socialization effort functions $\tau^A(\upsilon_t)$ and $\tau^B(\chi_t)$, with $0 \leq \tau^i_t(\cdot) \leq 1$, to be discussed in section 2.5.

2.3 Production and Income

We consider a one-sector real model where a single good is produced using a constant-returns-to-scale technology. The output produced at time t in regime j is

$$H(\theta_{j,t}, K_{j,t}, L) = \theta_{j,t} \left\{ (\alpha K_{j,t})^\rho + [(1-\alpha)L]^\rho \right\}^{\frac{1}{\rho}} \tag{4}$$

for $j = M, E$ and depends on two productive factors, capital $K_{j,t}$ depreciating fully during t and labor L supplied inelastically by households. To further simplify matters, we focus on the case of $\rho = 1$, which implies perfect substitutability between capital and labor. Productivity is measured by $\theta_{j,t} \equiv \theta(c_{j,t})$, which can be thought of as a function

[8] Alternatively, Ellis and Fender (2011) show how a revolution can materialize under full rationality in a set-up of Bayesian perfect equilibrium with asymmetric information.

[9] Note that this formulation is equivalent to dynastic OLG models with altruistic preferences à la Barro (1974), where owners of capital leave a stock of wealth to their descendants as a bequest.

of managerial and technical skills developed for improving the production process, determined by the incentives of workers. We approximate incentives by material well-being based on consumption in workers' families. The relative importance of capital and labor in producing output are denoted by α and $1-\alpha$, respectively. Under competitive factor markets, returns to labor and capital can then be written as

$$w_{j,t} = (1-\alpha)\theta_{j,t}$$

and

$$r_{j,t} = \alpha\theta_{j,t}.$$

Both factor returns are j-indexed, because of the potentially different productivity levels under the two systems.

We consider a subsistence consumption level $\bar{c}$, never reached by the A type so that only capital owners can invest. In the market system, income of capital owners and workers in each period is respectively

$$y^B_{M,t} = r_{M,t}s^B_{t-1} = \alpha\theta_{M,t}s^B_{t-1}, \tag{5}$$

where s^B_{t-1} is savings in the previous period, and

$$y^A_{M,t} = w_{M,t} = (1-\alpha)\theta_{M,t}. \tag{6}$$

Under communism, as capital is nationalized and capitalists are deprived of their ownership, investment decisions are no longer individual but made by the egalitarian planner. As a consequence, individual income becomes a centralized allocation of an equal share of output to each member of the society, i.e. wage:

$$y^B_{E,t} = y^A_{E,t} = w_{E,t} = (1-\alpha)\theta_{E,t}. \tag{7}$$

Note that in this case the whole population, including B types, forms the working class ($c^A_{E,t} = c^B_{E,t} = c_{E,t} = w_{E,t}$).

Perceived income inequality arising from saving decisions by capitalists made in period t is denoted by the index

$$\upsilon_{M,t} \equiv \frac{r_{M,t}s^B_t}{w_{M,t}} = \frac{\alpha}{1-\alpha}s^B_t, \tag{8}$$

where imposing the initial condition $y^B_{M,0} > y^A_{M,0}$ prevents a capitalist from switching types and becoming a worker. The index $\upsilon_{M,t}$ is in other words a measure of income from capital versus that from labor as perceived in period t.

2.4 Savings and Efficiency

A capitalist, type B, chooses *individual* savings (which, as mentioned, we denote by lowercase s^B_t, etc.) to maximize utility in (1) given the budget constraint, written in the aggregate for the market economy as

$$c^B_t + s^B_t \leq y^B_{M,t}. \tag{9}$$

The timing of events during the accumulation process is as follows: the savings of the previous period (chosen individually and then aggregated for the economy), s^B_{t-1}, comprise the private capital stock of each type B agent in the present period (again, aggregated for the economy), $k_{M,t}$, which will then be put into production given (4). The private yields from capital ownership $y^B_{M,t} = r_{M,t}s_{t-1}$ generated through the production

process are finally divided between consumption c_t^B and savings s_t^B (forming the future aggregated capital stock, $k_{M,t+1}$).

An egalitarian planner instead maximizes utility (1) in the name of the type A agents under the national budget constraint

$$C_t + S_t \leq H_{E,t}. \tag{10}$$

The savings decision by the planner differs from private ones in that *aggregate* values are considered (which, as mentioned, we denote by uppercase C_t, S_t, etc.). The same timing holds for the accumulation process under the communist regime: S_{t-1} comprises K_t, which is used for national production along with labor and yields $Y_t = r_{E,t}S_{t-1}$. Total output, $H_{E,t}$, is then allocated between further savings, S_t, and aggregate consumption in the society, C_t, divided equally among all agents via identical wages assigned to all workers, $w_{E,t} = c_{E,t}$. Note that under communism there is no market price of capital, therefore $r_{E,t}$ is the shadow price of capital referred to in period t by the planner.

We can now define the (inverse) inefficiency index of the communist system, $\chi_{E,t}$, in terms of perceived relative growth potential of the two regimes by means of savings or capital formation

$$\chi_{E,t} \equiv \frac{r_{M,t}\hat{s}_t^B}{r_{E,t}S_t^*} = \frac{\theta_{M,t}\hat{s}_t^B}{\theta_{E,t}S_t^*}, \tag{11}$$

where S_t^* is the optimal (per-capita) savings chosen by the egalitarian planner, and $\hat{s}_t^B$ a notional value of (per-capita) savings computed by individuals should the market system be operative. Index $\chi_{E,t}$ is in other words a measure of income from capital under markets versus that under communism as perceived in period t.

2.5 Intergenerational Transmission of Beliefs

We assume that type A agents always teach a communist ideology to their children to abolish inequality, while type B agents always teach a pro-market ideology favoring efficiency.[10] This is a first channel of transmitting beliefs that captures the influence on ideology intensity within the family, and corresponds to what is termed 'direct vertical transmission' in the literature (Bisin and Verdier, 2001, 2010). The evolution over time of the relative degree of ideological determination to change the status quo, however, is also affected outside the family. This second channel, known as 'oblique transmission', operates through the influence on ideology intensity by peers and the broader environment (see also Saint-Paul, 2010).

Socialization efforts $\tau_t^i(\cdot)$ affect the determination of the next generation to mobilize in order to change the system. Socialization effort by type A, $\tau^A(\upsilon_t)$, is generated by resentment from inequality υ_t, and for type B, $\tau^B(\chi_t)$, by the inferior efficiency with respect to markets χ_t. The properties of these socialization functions are standard:

$$\tau_t^i(1) = 0,\ \tau_t^{i\,\prime}(\cdot) > 0,\ \tau_t^{i\,\prime\prime}(\cdot) < 0. \tag{12}$$

Property $\tau_t^i(1) = 0$ in (12) states that socialization effort is only activated upon sufferance.[11]

[Figure 1 about here]

[10] Landier et al. (2008) find empirically that ideological priors matter a lot in attitude formation.

[11] This is a special case of Bisin and Verdier (2001) that is based solely on resentment towards the status quo, i.e. only one agent type at a time engages in the transmission of his preferences. The use of this setting allows us to simplify our notation, while maintaining the generality of our results.

Figure 1 presents the socialization process of the agents of each type, A and B. The transition probabilities at time t, $P_t^{i\uparrow}$, that a parent of type i has a child with a *stronger* ($\uparrow$) or *weaker* ($\downarrow$) ideological determination can be written as

$$\begin{aligned} P_t^{A\uparrow} &= \tau^A(\upsilon_t) + [1-\tau^A(\upsilon_t)]q_t; \\ P_t^{A\downarrow} &= [1-\tau^A(\upsilon_t)]\,(1-q_t)\,; \\ P_t^{B\uparrow} &= \tau^B(\chi_t) + [1-\tau^B(\chi_t)]\,(1-q_t)\,; \\ P_t^{B\downarrow} &= [1-\tau^B(\chi_t)]q_t. \end{aligned} \tag{13}$$

Given these transition probabilities, the relative strength of individuals of type A in period $t+1$ is

$$\begin{aligned} q_{t+1} &= q_t P_t^{A\uparrow} + (1-q_t)P_t^{B\downarrow} \\ &= q_t + (q_t - q_t^2)[\tau^A(\upsilon_t) - \tau^B(\chi_t)]. \end{aligned} \tag{14}$$

The dynamics of the probability of a regime shift are endogenous to the present economic situation and depend on the disutility experienced by each type. The properties of the socialization functions imply that $\tau^A(\upsilon_t) = 0$ under communism while $\tau^B(\chi_t) = 0$ under a market economy. Accordingly, the law of motion in (14) simplifies to

$$q_{M,t+1} = q_{M,t} + (q_{M,t} - q_{M,t}^2)\tau^A(\upsilon_t) \tag{15}$$

under markets and to

$$q_{E,t+1} = q_{E,t} - (q_{E,t} - q_{E,t}^2)\tau^B(\chi_t) \tag{16}$$

under communism.

Thus, in the market system the degree of ideological determination of type A to change the status quo, $q_{M,t+1}$, increases with any positive socialization effort by type A, $\tau^A(\upsilon_t) > 0$. Above the critical value $q_{M,t} = 0.5$, the threat to overthrow the capitalist regime becomes credible. Analogously, in the communist system the ideological determination of type B to change the status quo increases, i.e. $1 - q_{E,t+1}$ increases, with any positive socialization effort by type B, $\tau^B(\chi_t) > 0$. Above the critical value $1 - q_{E,t} = 0.5$, the threat to abolish the communist regime as type B agents promote market values becomes credible.

3 Economic Systems and Interaction of Agents

We consider a *sequencing of actions* appropriate for both economic systems, in which the agent type who exercises ownership and control (economic power) to decide on the split between consumption and savings moves first. The agent type who has no ownership and control rights can only have socialization (or ideological) power by instilling beliefs against the regime in force, that is, trying to teach the next generation in favour of his/her own values. The sequence of events at time t is illustrated in Figure 2 parallel to the process of capital accumulation in the same period (see Section 2.4).

[Figure 2 about here]

3.1 Market-Based Economy

In the market system, capitalists both own the capital stock and control the allocation of their income between consumption and savings, to be invested and used to produce in the next period by the next generation. In contrast, workers do not own and control anything apart from their labor force, which they supply inelastically in the model. It is therefore optimal savings and capital accumulation within the capitalist 'dynasties' (where ownership and control rights are *aligned and effective*) that drives the efficiency and sustainability of the market system, but deepens the social inequality.

Type B agents in this case are the first movers in a von Stackelberg leadership game and decide on savings, while taking into consideration in their maximization problem the socialization reaction of type A agents to the inequality caused by their own savings. Starting with type A agents (the working class), they take savings as fixed and maximize their utility using (1):

$$\max_{\tau^A(\upsilon_t)} \quad U^A_{M,t}(\cdot) = c^A_{M,t} - \underbrace{E^A_t(\upsilon_t)}_{(1-q_{t+1})\ln \upsilon_{M,t}} - \frac{\tau^A(\upsilon_t)^2}{2},$$

where we have substituted for $E^A_t(\upsilon_t)$ from (2) after noting that $\ln \upsilon_{E,t} = 0$. Replacing for $\upsilon_{M,t}$ from (8) and for $q_{M,t+1}$ from (15), the optimization problem becomes:

$$\max_{\tau^A(\upsilon_t)} \quad c^A_{M,t} - \left\{1 - \left[q_t + q_t(1-q_t)\tau^A(\upsilon_t)\right]\right\} \ln\left(\frac{\alpha}{1-\alpha} s^B_t\right) - \frac{\tau^A(\upsilon_t)^2}{2}.$$

The first-order condition yields the optimal reaction of type A as follower:

$$\begin{aligned} \frac{\partial U^A_{M,t}(\cdot)}{\partial \tau^A(\upsilon_t)} &= q_t(1-q_t)\tau^{A\,\prime}(\upsilon_t) \ln\left(\frac{\alpha}{1-\alpha} s^B_t\right) - \tau^A(\upsilon_t)\tau^{A\,\prime}(\upsilon_t) = 0 \\ &\Leftrightarrow \quad \tau^A(\upsilon_t)^* = q_t(1-q_t) \ln\left(\frac{\alpha}{1-\alpha} s^B_t\right). \end{aligned} \tag{17}$$

This equation delivers a preliminary insight on the mechanisms that drive the evolution from one system to another. It is easy to see that an increase in private savings (by the capitalists) leads to increased socialization effort by type A agents. The latter can only expect a growing inequality between the two types of agents, which reinforces their determination to instill their values in the next generation, to potentially change the regime. More precisely, the higher the expected inequality, the higher the effort to transmit their preferences towards a more equal society.

Turning to type B agents, they move first by making a decision on the amount of their savings:

$$\begin{aligned} \max_{s^B_t} \quad U^B_{M,t}(\cdot) &= c^B_{M,t} + \beta y^B_{M,t+1} - E^B_t(\chi_t) - \frac{\tau^B(\chi_t)^2}{2} \\ \text{s.t. } c^B_{M,t} + s^B_{M,t} &\leq y^B_{M,t}. \end{aligned}$$

Note that savings by capitalists have no direct negative externality on aggregate productivity because the decision is made at an individual level and consumption by workers $c^A_{M,t}$ is not affected by it. Productivity $\theta_{M,t}$ hence is at that point assumed to be non-decreasing over time as long as markets are in place, or – to sharpen our analysis – to remain at its initial value $\theta_{M,0}$.[12] This enables us to hereafter drop the time subscript to consumption in the productivity function under markets so that $\theta_{M,t} = \theta_{M,0} = \theta_M$.

[12] Allowing $\theta_{M,t}$ to increase over time only strengthens the mechanism at work in our model and results in the same outcomes.

After a series of substitutions (see Appendix A.1) and omitting the M-subscript to savings due to the absence of individual savings under communism in our model, we rewrite

$$\max_{s_t^B} \quad \alpha\theta_M s_{t-1}^B + (\beta\alpha\theta_M - 1)\, s_t^B - \left[q_t + (q_t - q_t^2)\tau^A(\upsilon_t)\right] \ln\left(\chi_{E,t}\right).$$

Replacing for $\tau^A(\upsilon_t)$ with the optimal reaction of type A agents from (17) and taking the first-order condition yields optimal savings by type B as leader:

$$\begin{aligned} \frac{\partial U_{M,t}^B(\cdot)}{\partial s_t^B} &= \beta\alpha\theta_M - 1 - \frac{q_t^2(1-q_t)^2}{s_t^B} \ln\left(\chi_{E,t}\right) = 0 \\ &\Leftrightarrow \quad s_t^{B*} = q_t^2(1-q_t)^2 \frac{\ln\left(\chi_{E,t}\right)}{\beta\alpha\theta_M - 1}, \end{aligned} \tag{18}$$

where $\theta_M > 1/\alpha\beta$ must hold for positive savings by the capital owners. The last equation reveals that increased expected inefficiency under the alternative (communist) system induces higher accumulation by capital owners in an effort to further consolidate the capital stock and, hence, the productive potential of the market economy. In addition, the higher the productivity θ_M the lower the need to save.

Substituting (18) back into (17) to derive the optimal socialization effort of the type A in its final form, we get

$$\tau^A(\upsilon_t)^* = q_t(1-q_t) \ln\left(\frac{\alpha}{1-\alpha} s_t^{B*}\right). \tag{19}$$

Substituting $\tau^A(\upsilon_t)^*$ from (19) into (14), next-period ideological determination of type A to change the status quo becomes

$$\begin{aligned} q_{t+1} &= q_t + (q_t - q_t^2)\tau^A(\upsilon_t)^* \\ &= q_t + q_t^2(1-q_t)^2 \ln\left(\frac{\alpha}{1-\alpha} s_t^{B*}\right). \end{aligned} \tag{20}$$

It is seen from (20) that the evolution of q_t over time under a market system takes a positive value when $\tau^A(\upsilon_t)^* > 0$. This is true as long as

$$\upsilon_{M,t} \equiv \frac{\alpha}{1-\alpha} s_t^{B*} > 1, \tag{21}$$

which given $y_{M,0}^B > y_{M,0}^A$ always holds.

Lemma 1 *Given the initial condition $y_{M,0}^B > y_{M,0}^A$, optimal individual savings by capital owners s_t^{B*} always increase inequality, provoking type-A workers into more intensive transmission of their social discontent and more effort to instigate a regime change.*

Proof. *See equation (21) where $\frac{\partial \upsilon_{M,t}}{\partial s_t^{B*}} > 0$ increases $\tau^A(\upsilon_t)^*$ in (19) and q_{t+1} in (20).* ■

In sum, capital owners allocate their income between consumption and savings, perpetuating inequality; workers then react by choosing their socialization effort, which in turn affects the ideological determination and strength of the next generation to change the status quo.

3.2 Centrally-Planned Economy

Under communism, no one makes economic decisions apart from the egalitarian planner, who is of type A and splits total consumption equally across all members of society.[13] After the nationalization following the communist revolution the society, *de jure* (but not *de facto*) owning the capital, delegates control to the egalitarian planner. Individuals do not control the choice of aggregate consumption and investment out of national income, which is also national output. Thus, under communism, there is *misalignment* of ownership and control rights creating inefficiency. We capture and interpret it in comparing the optimization problems under central planning (aggregate, then disaggregated top-down by equal split) vis-à-vis the market (individual, aggregated bottom-up), as illustrated in great detail in the present section 3.

The egalitarian planner is the first mover and takes into consideration the socialization reaction of type B agents to the relative efficiency of the system caused by his centralized decision. Starting with type B agents (market advocates), they take savings as fixed and maximize:

$$\max_{\tau^B(\chi_t)} \quad U^B_{E,t}(\cdot) = c^B_{E,t} - \underbrace{E^B_t(\chi_t)}_{q_{t+1}\ln\chi_{E,t}} - \frac{\tau^B(\chi_t)^2}{2},$$

where we have substituted for $E^B_t(\chi_t)$ from (3) after noting that $\ln\chi_{M,t}=0$. Replacing for $\chi_{E,t}$ from (11) and for $q_{E,t+1}$ from (16), the optimization problem becomes:

$$\max_{\tau^B(\chi_t)} \quad c^B_{E,t} - \left\{q_t + q_t(1-q_t)[-\tau^B(\chi_t)]\right\}\ln\left(\frac{\theta_M \hat{s}^B_t}{\theta_{E,t}S_t}\right) - \frac{\tau^B(\chi_t)^2}{2}.$$

The first-order condition then yields:

$$\begin{aligned}\frac{\partial U^B_{E,t}(\cdot)}{\partial \tau^B(\chi_t)} &= q_t(1-q_t)\tau^{B\,\prime}(\chi_t)\ln\left(\frac{\theta_M \hat{s}^B_t}{\theta_{E,t}S_t}\right) - \tau^B(\chi_t)\tau^{B\,\prime}(\chi_t) = 0 \\ &\Leftrightarrow \quad \tau^B(\chi_t)^* = q_t(1-q_t)\ln\left(\frac{\theta_M \hat{s}^B_t}{\theta_{E,t}S_t}\right). \end{aligned} \tag{22}$$

Hence, an increase in the planner's aggregate savings directly reduces the socialization effort by type B agents. This is due to the fact that, as seen in (11), such an increase is perceived to give a boost to the efficiency of the communist system. While this effect *per se* could reduce inefficiency, it will be seen below that the command accumulation process has an adverse effect on productivity, leaving the total effect of aggregate savings on the relative efficiency of the communist system and the socialization effort by type B agents who share the values of capital owners ambiguous.[14]

The egalitarian planner as a first mover maximizes utility in the name of the type A agents taking into account aggregate values. Therefore, the egalitarian planner (not individual capitalists, whose capital has been nationalized) optimally chooses the level of aggregate savings, i.e. national investment. This also determines the allocation of output to be distributed equally among the total population for consumption.

[13] This follows our assumption of inequality aversion characterizing type A agents, to conform with the preference for equality among the thinkers and pioneers of communism. Different from maximizing social welfare, it presumes that the central planner himself experiences a disutility from inequality.

[14] This ambiguity resembles historical evidence such as that in Broadberry and Klein (2011), who show Czechoslovakia's comparative productivity position under the central planning regime with respect to the UK to have initially improved before falling back to lower levels.

$$\begin{aligned} \max_{S_t} \quad U^A_{E,t}(\cdot) &= C_t + \beta Y_{t+1} - E^A_t(\upsilon_t) - \frac{\tau^A(\upsilon_t)^2}{2} \\ \text{s.t. } C_t + S_t &\leq H_{E,t}. \end{aligned}$$

Parallel to the market economy, the planner takes βY_{t+1} as the value of the intergenerational transfer in his optimization problem using the *shadow* price of capital $r_{E,t}$ ($Y_{t+1} = r_{E,t}S_t = \alpha\theta_{E,t}S_t$). However, it will be seen below that the social returns to capital realized in $t+1$ turn out to be *lower* than those evaluated by the shadow price ($\alpha\theta_{E,t+1}S_t < \alpha\theta_{E,t}S_t$). This is due to an externality caused by productivity being a function of consumption, which is now changing over time in the new economic system, $\theta(c_{E,t})$.[15] Furthermore, $\theta'(c_{E,t}) > 0$ represents the incentive of the society to engage in technological progress as a function of consumption, and $\theta''(c_{E,t}) < 0$ assures that productivity gains are decreasing.[16]

Aggregate decision making by an egalitarian planner under a communist regime affects total and per capita levels of consumption, therefore changing productivity over time. This is because the national budget constraint implies $C_t + S_t = H_{E,t}$, that is, output in the aggregate has to be equal to the sum of consumption and investment in every period. Therefore, each individual gets an identical consumption level equal to the assigned wage by the planner

$$c_{E,t} = \frac{H_{E,t} - S_t}{1} = C_t. \tag{23}$$

Since allocation between saving and consumption takes place after production in each period, consumption in t determines productivity in the following period $t+1$.

Lemma 2 *The budget constraint of an egalitarian planner in (10), $C_t + S_t = H_{E,t}$, implies that higher aggregate savings cut consumption by the whole population. This results in a negative effect on productivity $\theta_{E,t+1}$ and makes the latter time-dependent.*

Proof. *We can conclude from (23) and the properties of $\theta_{E,t+1}$ that*

$$\frac{\partial\theta_{E,t+1}}{\partial S^*_t} = -\frac{\partial\theta_{E,t+1}}{\partial C_t} = -\frac{\partial\theta_{E,t+1}}{\partial c_{E,t}} = -\theta'_{E,t+1} < 0.$$

■

Substituting further from Appendix A.2, we obtain:

$$\max_{S_t} \quad \theta_{E,t}[\alpha S_{t-1} + (1-\alpha)L] - (1 - \beta\alpha\theta_{E,t})S_t - \left(1 - \left[q_t - (q_t - q_t^2)\tau^B(\chi_t)\right]\right)\ln(\upsilon_{M,t}).$$

Replacing for $\tau^B(\chi_t)$ with the optimal reaction curve by type B agents derived in (22) and taking the first-order condition yields:

$$\begin{aligned} \frac{\partial U^A_{E,t}(\cdot)}{\partial S_t} &= (\beta\alpha\theta_{E,t} - 1) + \frac{q_t^2(1-q_t)^2\ln(\upsilon_{M,t})}{S_t} = 0 \\ &\Leftrightarrow \quad S^*_t = \frac{q_t^2(1-q_t)^2\ln(\upsilon_{M,t})}{1 - \beta\alpha\theta_{E,t}}, \end{aligned} \tag{24}$$

[15] Similar results are obtained when treating utility from the intergenerational transfer as the amount of capital left to produce in the next period, K_{t+1}.

[16] In a somewhat related context, Acemoglu and Robinson (2000) assume productivity to be higher in the market relative to home production.

where $\theta(c_{E,t}) < 1/\alpha\beta$ must hold for positive savings by the planner. The last equation reveals that increased expected inequality under the alternative (market) system induces higher savings by the egalitarian planner in an effort to further consolidate the capital stock and, hence, the productive potential of the communist system.

Lemma 3 *The positive savings constraints under the two systems imply that the lower-bound productivity level under capitalism, $1/\alpha\beta$, is the upper-bound productivity level under communism:*

$$\theta(c_{E,t}) < \frac{1}{\alpha\beta} < \theta_M.$$

Proof. Follows directly from the intertemporal optimization problem of the leader in equations (18) and (24). ■

Substituting (24) back into (22) to derive the optimal socialization effort of type B in its final form, we get

$$\tau^B(\chi_t)^* = q_t(1-q_t)\ln\left(\frac{\theta_M \hat{s}_t^B}{\theta_{E,t} S_t^*}\right). \tag{25}$$

And now substituting $\tau^B(\chi_t)^*$ from (25) into (14), the next-period proportion of the population in favor of a market-based system becomes

$$\begin{aligned} q_{t+1} &= q_t - (q_t - q_t^2)\tau^B(\chi_t)^* \\ &= q_t - q_t^2(1-q_t)^2 \ln\left(\frac{\theta_M \hat{s}_t^B}{\theta_{E,t} S_t^*}\right). \end{aligned} \tag{26}$$

It immediately appears from (26) that the ideological stance of type A's relative to type B's under the communist system weakens when $\tau^B(\chi_t)^* > 0$. This is true as long as

$$\chi_{E,t} \equiv \frac{\theta_M \hat{s}_t^B}{\theta_{E,t} S_t^*} > 1, \tag{27}$$

which will turn out to be the initial condition at the moment of the revolution, T, due to destruction of some fraction of the capital stock (see section 3.3.1). Perceived inefficiency increases when the direct positive effect of aggregate savings S_t^* on efficiency is dominated by its negative effect via productivity in the next period, $\theta_{E,t+1}$. In words, when the egalitarian planner increases aggregate savings S_t^* to trigger an acceleration of the accumulation process and a perceived fall in $\chi_{E,t}$, he must assign a lower consumption level to all workers according to Lemma 2. Since productivity depends positively on consumption in workers' families, next-period worker incentives to upgrade the production process and therefore productivity under communism, $\theta_{E,t+1}$, are reduced. If the latter effect dominates, inefficiency increases and type B agents recruit intertemporally by intensifying their socialization effort.[17]

Lemma 4 *Savings by the egalitarian planner increase inefficiency if the indirect (lagged) negative effect on next period productivity dominates the direct (contemporaneous) positive effect of next-period saving on efficiency ($\frac{\partial \chi_{E,t+1}}{\partial S_{t+1}^*} + \frac{\partial \chi_{E,t+1}}{\partial \theta_{E,t+1}} \frac{\partial \theta_{E,t+1}}{\partial S_t^*} > 0$), leading type B agents into more propaganda to proliferate market ideas and to instigate transition.*

[17] Lindbeck and Nyberg (2006) discuss the disincentive effects on work of welfare-state arrangements, stressing in particular that the "negative effects of the poor incentives for work in former socialist countries in Eastern Europe also seem to have materialized with a time lag".

Proof. *Inefficiency in period $t+1$ increases if the direct positive effect of saving in $t+1$ is dominated by the negative lagged effect of saving in t via a reduction in $\theta_{E,t+1}$:*

$$\underbrace{\frac{\partial \chi_{E,t+1}}{\partial \theta_{E,t+1}}}_{-}\underbrace{\frac{\partial \theta_{E,t+1}}{\partial S_t^*}}_{-} > \left|\underbrace{\frac{\partial \chi_{E,t+1}}{\partial S_{t+1}^*}}_{-}\right|$$

where we know $\frac{\partial \theta_{E,t+1}}{\partial S_t^*} < 0$ from (23). ■

Recalling $S_t^* = K_{t+1}$, it is easy to see that a strong negative externality on productivity in Lemma 4 also prevents production $H_{E,t}$ in (4) from growing over time. This rules out the possibility of investments raising total output over time and creating higher consumption possibilities.[18] Solving out the inequality in Lemma 4 and replacing for optimal savings from (24) shows that in order for the Lemma to hold the condition

$$-\frac{\partial \theta_{E,t+1}}{\partial S_t^*}\frac{S_{t+1}^*}{\theta_{E,t+1}} > 1 \Longrightarrow -\frac{\partial \theta_{E,t+1}}{\partial S_t^*}\frac{q_{t+1}^2(1-q_{t+1})^2\ln\left(\upsilon_{M,t+1}\right)}{\theta_{E,t+1}[1-\beta\alpha\theta_{E,t+1}]} > 1 \tag{28}$$

must be satisfied.

[Figure 3 about here]

Condition (28) is more likely to be satisfied when either S_{t+1}^* or $\frac{\partial \theta_{E,t+1}}{\partial S_t^*}$ is sufficiently large. Savings can be large due to (i) the planner perceiving inequality under an alternative (market) regime $\ln\left(\upsilon_{M,t+1}\right)$ to be high, (ii) productivity $\theta_{E,t+1}$ being large and closer to that under markets ($1/2\alpha\beta < \theta_{E,t+1} < 1/\alpha\beta$ so that $\partial(S_{t+1}^*/\theta_{E,t+1})/\partial\theta_{E,t+1} > 0$), (iii) the strength of the two types is not so different so that $q_{t+1}^2(1-q_{t+1})^2$ is near its maximum. On the other hand, the concave nature of productivity as a function of consumption implies that the lagged negative effect of savings on productivity is large when aggregate consumption availability C_t is limited. This can, for example, be due to a large loss of capital caused by revolution and corresponds to the left region in Figure 3, where $c_{E,t} < c^*$.

The learning embodied in the model essentially captures and explains the discovery of the trade-off between the two alternative economic systems after experimenting with communism. The ambiguity the society faces lies hidden in the productivity function. While everybody understands the negative dependence of productivity on lagged consumption, $\theta_{E,t+1}\left(c_{E,t}\right)$, the *magnitude* of this effect is uncertain. As a consequence, the overall effect on output, $H_{E,t+1}$, is discovered only after the society experiments with communism. This learning or discovery story implies that our agents cannot have perfect foresight although they are rational in the sense of the game they play. That is why they *perceive* inequality and inefficiency the way we have defined these indexes. Current-period saving (per capita) figures in the definition because agents observe it, and understand it perpetuates inequality (under M) and decreases inefficiency (under E, provided Lemma 4 holds).

If the planner and the society observe that the choice of savings in the preceding period has led to a lower efficiency output, everybody discovers the *highly elastic response* of productivity to savings, an analogy to the instability of communism in Lemma 4. We interpret the extent of this elasticity as the sacrifice that the population of the communist region is willing to endure in the name of an egalitarian system, i.e., to what extent their

[18] For an insight on the reduced consumption opportunities delivered by communist regimes, see for example Bergson (1991).

working morale is reduced by lower consumption. This tolerance may have to do with cultural values, social norms, strong ideological conviction or inability to overthrow the communist regime. Thinking along such lines brings in another interesting parallel between Russia and Eastern Europe vs China.

In sum, the egalitarian planner allocates national income between consumption and savings at the aggregate level, and type B agents react by choosing their socialization effort to influence the ideology of the next generation, thus determining the proportion of type B agents in the next period, $(1 - q_{t+1})$. However, if Lemma 4 does not hold, an inelastic negative response of productivity to savings across generations under communism will not undermine it as a sustainable economic system in the long run. Such a scenario, ultimately depending on particular properties and parameters in our model, can then stabilize communism, delaying or avoiding transition to markets.

3.3 Regime Switches and the Shift of Property Rights

3.3.1 The Moment of Revolution

Before analyzing the dynamics of capital accumulation, it is helpful to have a closer look at the first period immediately following the communist revolution, T. Aggregating all capital stock in the hands of the individual capitalists that has been nationalized at the beginning of T and taking into account the costs of the revolution in terms of a destroyed fraction of capital, $0 < 1 - \mu_T < 1$, we write:

$$s^B_{T-1} = k_T \underset{\text{cost (loss)}}{\overset{\text{revolution}}{\Rightarrow}} \mu_T k_T = K_T. \tag{29}$$

The left-hand side of this expression is the capital stock invested by the individual capitalists just before the revolution and aggregated at the national level, s^B_{T-1}; the right-hand side is the same capital stock after accounting for the capital losses during the revolution and the nationalization of all the inherited and surviving capital, $\mu_T k_T$. The latter capital stock, K_T, is what remains for the egalitarian planner to put into production in period T and, obviously, $K_T < k_T$. Note that productivity in T does not change, leaving the planner with unchanged productivity, θ_M, but a lower capital stock, K_T. This results in reduced output in T relative to $T - 1$, inducing the planner to increase savings in his very first intertemporal allocation decision. Such a decision could, of course, be motivated by the need to rebuild the capital base and compensate for the loss from the revolution, or to catch up with the rest of the world.

From then on, in essence, period T has a lagged effect on output in period $T + 1$ via two channels: increasing the capital stock, $K_{T+1} = S_T$, through more savings in the preceding period, (i) increases output, H_{T+1}, but also (ii) decreases wages and consumption that are equally assigned to all workers as from period T; this reduces productivity in the next period $\theta_{E,T+1}\,(c_{E,T})$ resulting in a lower output H_{T+1}. To sum up, if Lemma 4 holds, an elastic negative response of productivity to savings across generations is ensured and communism is not sustainable in the long run.

3.3.2 The Post-Communist Transition Period

By symmetry, it is also important to have a closer look into the first period immediately following the transition of the post-communist society back to a market-based system. We assume that market transition takes place through a process of privatization of the capital stock in the beginning of period $T + N$. The capital stock that has been accumulated by that time, K_{T+N}, is then allocated to the new capital owners, who now have to manage it, by a legal change into property rights. Historically, several ways of ownership transfer have been applied in post-communist transition economies, from

mass privatization, via restitution to the heirs of capitalists with nationalized factories, to communist nomenklatura grabbing. In our context, it suffices to assume without loss of generality that the new capital owners will be the agents most eager to get into this new role. Such agents may be of both types, as type A's will be converting fast to type B's. We assume that at the beginning of period $T+N$, just after privatization, the new capital owners represent a proportion $1-n_{T+N}$ of the adult population. We also assume that there will be certain costs of privatization in terms of the lack of entrepreneurial and managerial skills of the new capital owners or because of inheriting inefficient or outdated enterprises and equipment. We measure these costs by a fraction, $0<1-\mu_{T+N}<1$, of lost capital, and we thus write:

$$S^*_{T+N-1}=K_{T+N}\overset{\text{privatization}}{\underset{\text{cost (loss)}}{\Rightarrow}}\mu_{T+N}K_{T+N}=k^B_{T+N}. \tag{30}$$

The left-hand side of this expression is the optimal savings, S^*_{T+N-1}, invested into capital stock, K_{T+N}, by the egalitarian planner just prior to the transition to markets; it is given directly at its aggregate national level (which also coincides in our model, with a unit mass of adult population, with the per-capita mature-generation capital stock). The right-hand side of (30) is the same capital stock after accounting for the capital losses during the transition to markets and the privatization of all the inherited and surviving capital, $\mu_{T+N}K_{T+N}$. The latter capital stock, k^B_{T+N}, is what remains, in the aggregate, to be allocated to the new capital owners and put into production in period $T+N$, with $k^B_{T+N}<K_{T+N}$. With this lower capital stock and productivity in $T+N$ predetermined by the lagged effect of savings operating via consumption in workers' families, $\theta_{E,T+N}\left(c_{E,T+N-1}\right)$, output in $T+N$ falls relative to $T+N-1$. Once the first period of the return to markets elapses, individual decision-making on the split between consumption and savings by the new capital owners eliminates the negative externality in the intertemporal optimization problem, typical for communism, we highlighted. This allows higher output in the next period and aligns invested savings with individually-consistent decisions of capital owners. It also restores the higher level of consumption characterizing the more efficient market system, yet reintroducing and perpetuating inequality.[19]

4 Intergenerational Dynamics and Economic Outcomes

In this section, we highlight our principal analytical findings derived from the dynamics of q_t and the resulting economic outcomes. That is, having precedingly analyzed the within-period leadership game equilibrium strategies of our two agent types, we are now well equipped to proceed to the analysis of the feedback from ideological strength q_t to strategies across generations. Given that agents only live one period of adulthood, players in the von Stackelberg game change every period. In other words, the same game is played by the next generation, with the level of strength q_t attained by socialization of agents in the previous period as the initial condition. This allows us to observe the law of motion of q_t and potential economic transitions over time.

4.1 Capitalism and the Communist Revolution

We first consider the dynamics underlying the transition from a market-based to a centrally-planned economic system. We can state:

[19] After transition is implemented via privatization and institutional reform, social preferences also change gradually: Alesina and Fuchs-Schuendeln (2007) estimate in a similar context that it would take a generation or two for East German preferences (close to our type A) to converge to West German preferences (close to our type B) after the reunification of Germany.

Proposition 1 (Communist Revolution) *Suppose type A is initially weaker than type B ($q_0 < 0.5$). Given $\tau^A(\upsilon_t)^*$, s_t^{B*}, and the law of motion of q_t, the optimal savings* increase *in q_t ($\frac{\partial s_t^{B*}}{\partial q_t} > 0$). This implies that a higher $q_{M,t+1}$ caused by $\tau^A(\upsilon_t)^*$ will result in more savings by type B's in the next generation von Stackelberg game ($\frac{\partial s_{t+1}^{B*}}{\partial q_{t+1}} > 0$). This trend continues until $q_t > 0.5$ where the threat of a communist revolution becomes credible.*

Proof of Proposition 1. We derive the effect of the relative strength of workers in some period t on the saving behavior of the capital owners in that period:

$$\frac{\partial s_t^{B*}}{\partial q_t} = 2q_t(1-q_t)(1-2q_t)\frac{\ln\left(\chi_{E,t}\right)}{\beta\alpha\theta_M - 1}\begin{cases} > 0 & \text{if } q_t < 0.5 \\ < 0 & \text{if } q_t > 0.5 \end{cases}. \tag{31}$$

Thus, for any low $q_t < 0.5$, we have $\frac{\partial s_t^{B*}}{\partial q_t} > 0$. In words, the optimal reaction functions of the two types in the von Stackelberg game of class struggle under markets lead to a progressive increase of q_t until it surpasses some 'critical mass'. Beyond this threshold type A's become sufficiently strong and ideologically determined to represent a credible threat to overthrow the existing capitalist social order. For $q_t > 0.5$, a communist revolution occurs with probability q_t; if this does not happen, the optimal savings by type B's, s_t^{B*}, become decreasing in q_t potentially stabilizing the capitalist market-economy system. ■

Proposition 1 can be interpreted as follows: a capitalist system is only feasible when type A's are weaker than type B's ($q_0 < 0.5$). The mobilization of the working class caused by inequality increases the ideological motivation of the next generation to overthrow the system. This induces more savings by capital owners, but increases inequality, feeding the resentment of type A agents. The reinforcing effect of social resentment on capital accumulation and inequality could eventually lead the market system towards its fall. Historically, this could be relevant to the case of the uprising of the working class in Russia, on which we focus the analysis.

Corollary 1 (Stable Capitalism) *Should a communist revolution not occur when $q_t > 0.5$, a substantial threat from strong type A's revolting induces the leader to accommodate his strategy in search of a compromise by* decreasing *savings, s_t^{B*}, mitigating inequality and potentially stabilizing the market system.*

Proof. See the proof of Proposition 1. ■

The alternative in Corollary 1 arises because for relatively strong type A's the probability of a regime change is perceived by type B's as credible, thus the latter adapt their behavior. An increase in the probability of a regime change ($q_{t+1} > q_t$) induces a reduction in capital accumulation by type B's. By reducing income inequality and, hence, the ideological determination of type A's to change the status quo, such a reaction by capital owners can avoid slipping towards communism. Historically, this seems to have been the case of social democracies and the welfare state, where democratization of capitalism and redistribution of income have preserved the market system.

4.2 Communism and the Transition to Markets

We turn to the dynamics underlying the transition from a centrally-planned to a market-based economic system in another proposition:

Proposition 2 (Market Transition) *Suppose type B is initially weaker than type A ($q_T > 0.5$) and Lemma 4 holds. Given $\tau^B(\chi_t)^*$, S_t^* and the law of motion of q_t, the*

optimal savings increase *in* $1-q_t$ *(*$\frac{\partial S_t^*}{\partial q_t} < 0$*). This implies that a lower* $q_{E,t+1}$ *caused by* $\tau^B(\chi_t)^*$ *will result in more savings by the egalitarian planner in the next generation von Stackelberg game (*$\frac{\partial S_{t+1}^*}{\partial q_{t+1}} < 0$*). This trend continues until* $q_t < 0.5$ *where the threat of a transition back to a market-based economy becomes credible.*

Proof of Proposition 2. We derive the effect of the relative strength of market advocates in some period t on the saving behavior of the egalitarian planner in that period:

$$\frac{\partial S_t^*}{\partial q_t} = 2q_t(1-q_t)(1-2q_t)\frac{\ln\left(\frac{\alpha}{1-\alpha}s_t^B\right)}{1+\beta\alpha\theta_{E,t+1}\theta'_{E,t+1}}\begin{cases} >0 & \text{if } q_t < 0.5 \\ <0 & \text{if } q_t > 0.5 \end{cases}. \tag{32}$$

Thus, for any high $q_t > 0.5$ (i.e. any low $1-q_t < 0.5$), $\frac{\partial S_t^*}{\partial q_t} < 0$ (i.e. $\frac{\partial S_t^*}{\partial(1-q_t)} > 0$). In words, the optimal reaction functions of the two types in the von Stackelberg game of conflicting beliefs under communism lead to a progressive increase of $1-q_t$, i.e. a progressive decrease of q_t until it drops below certain 'critical mass'. Beyond this threshold type B's become sufficiently strong and ideologically determined to represent a credible threat to bring down communism by pro-market transition reforms. For $q_t < 0.5$, a market transition occurs with probability $1-q_t$; if this does not happen, the optimal aggregate savings, S_t^*, becomes increasing in q_t (that is, decreasing in $1-q_t$) potentially stabilizing the communist system. ■

Proposition 2 can be interpreted as follows: a communist system is only feasible when type B's are weaker than type A's ($1-q_T < 0.5$). Market propaganda that arises from lower relative efficiency under communism results in a shift of ideology in the next generation towards the market-oriented type. This induces more savings by the egalitarian planner as an attempt to restore efficiency through more investment and accumulation. But more savings at the aggregate level creates a negative externality on productivity as it is necessarily accompanied by lower available consumption and wages. Responding to more discontented people by further increasing savings only exacerbates the relative inefficiency of the communist regime making it less and less sustainable.[20] As the convergence of beliefs toward the market ideology continues, the probability of economic transition increases, and the regime may eventually revert to the market system. Historically, this could be relevant to the Soviet and East European case, on which we focus the analysis.

Corollary 2 (Stable Communism) *Should market transition not occur for* $q_t < 0.5$*, a substantial threat from strong type B's to overturn the regime induces the leader to accommodate his strategy in search of a compromise by* decreasing *aggregate savings,* S_t^**, increasing longer-run efficiency (via higher wages and consumption) and potentially stabilizing the communist system.*

Proof. See the proof of Proposition 2. ■

The alternative in Corollary 2 arises because for relatively strong type B's the probability of a regime change is perceived by the egalitarian planner as credible, thus the latter adapts his behavior. An increase in the probability of a regime change ($q_{t+1} < q_t$) induces a reduction in aggregate savings by the egalitarian planner. This increases consumption allocations (material well-being), hence productivity and ultimately the efficiency of the communist system for the range of parameter values where Lemma 4

[20] Essentially, such a set-up resembles the overinvestment experience in communist countries during their period of initial industrialization and subsequent attempts to increase future production (and, in historical context, catch up with the West).

holds. By maintaining efficiency and reducing the ideological determination of type B's to change the status quo, such a reaction by the egalitarian planner can prolong the life of a communist regime and, potentially, avoid surrendering central planning. Historically, this resembles the Chinese social market economy, where pro-market economic reforms were undertaken widely in coexistence with the centralized political system.

[Figure 4 about here]

Figure 4 summarizes the dynamics of the model across generations. To elucidate it, we briefly revisit the events that lead to revolution and back to transition. Under markets, initial (relative) inequality $\upsilon_{M,0} > 1$ in (21) leads to $\ln(\upsilon_{M,0}) > 0$ and $\tau^A(\upsilon_{M,0})^* > 0$ from (19), which itself brings about an increase in the strength of type A's in the next period q_1, via (20). According to equation (18) and Proposition 1 this increases optimal savings by capitalists in the following period, $s_1^{B,*}$, raising inequality. This creates a continuing cycle towards a communist revolution that can be summarized as

$$s_t^{B,*} \rightarrow \upsilon_{M,t} \uparrow\rightarrow \tau^A(\upsilon_{M,t})^* \uparrow\rightarrow q_{t+1} \uparrow\rightarrow s_{t+1}^{B,*} \uparrow\rightarrow \upsilon_{M,t+1} \uparrow\rightarrow \tau^A(\upsilon_{M,t+1})^* \uparrow\rightarrow q_{t+2} \uparrow ...$$

until $q_t > 0.5$, after which either revolution occurs (Proposition 1) or the system stabilizes (Corollary 1). In the case of revolution, initial (relative) inefficiency $\chi_{E,T} > 1$ satisfying condition (27) gives $\ln(\chi_{E,T}) > 0$ and $\tau^B(\chi_{E,T})^* > 0$ from (25), which itself leads to a higher proportion of B type agents in the following period q_{T+1}. According to equation (24) and Proposition 2, this increases optimal aggregate savings by the egalitarian planner in the following period, S_{T+1}^*, raising inefficiency with respect to the market system as long as Lemma 4 holds. This triggers a continuing cycle towards transition back to the market system that can be summarized as

$$S_t^* \uparrow\rightarrow \chi_{E,t} \uparrow\rightarrow \tau^B(\chi_{E,t})^* \uparrow\rightarrow (1-q_{t+1}) \uparrow\rightarrow S_{t+1}^* \uparrow\rightarrow \chi_{E,t+1} \uparrow\rightarrow \tau^B(\chi_{E,t+1})^* \uparrow\rightarrow (1-q_{t+2}) \uparrow ...$$

until $q_t < 0.5$, after which either transition occurs (Proposition 2) or the system stabilizes (Corollary 2).

[Figure 5 about here]

Recall that if regime change occurs when q_t is near 0.5, then optimal saving and hence the probability of a shift back to the previous regime at their highest. On the other hand, when the regime change occurs for lower or higher values of q_t away from 0.5, then optimal saving is relatively lower as stated in the corollaries and stability more likely. But also if transition does occurs when q_t becomes low then the perceived post-transition inequality $\ln(\upsilon_{M,t+1})$ tends to be lower: many people are involved in the regime change as opposed to a sudden transition led by a smaller group of people as in Russia, so capital would be shared among a larger group, higher $1-n_t$. Therefore, there would not be much difference between communism and markets in terms of inequality: only ownership becomes private, but the wealth is in the hands of many and individual savings, s_t^{B*}, will be low. This can be thought of as another example for a successful social market economy that applies to China. The phase diagram in Figure 5 summarizes the overall dynamics of regime switches in propositions 1 and 2, and stability obtained from Lemma 4 and corollaries 1 and 2 in the space of consumption and the balance of power between the two types in the society. The shaded area illustrates the region of instability, where the pendulum restores force and accelerates back to the alternate regime.

5 Historical Evidence

Our model critically relies on the three following assumptions: (i) the use of aggregates in the planner's economic calculus, (ii) the lower productivity delivered by a centralized economy, and (iii) the willingness of the lagging economy to catch-up with the market system. This section shows that these assumptions merely reflect commonly observed facts, grounding our model on historical accounts.

Our first assumption is that the calculus in a centrally-planned economy is not of consent, to paraphrase Buchanan and Tullock's (1962) well-known book title, but of command: economic decisions are taken by higher authorities, which give orders (objectives) to the lower-tier entities such as farms or plants (Ericson, 2008). As such, a command or planned economy does not consider individual (or individual-based) decisions, but nation-wide aggregates. The debate about the virtues of one versus the other has received a lot of attention as early as the well documented debates between Hayek and Lange. Lin (2009) shows how this Soviet-style planning has endured, notably in the developing countries that have been influenced by the ideology or the country (the USSR) that largely sponsored it. Recent studies confirm that what we have referred to as a misalignment of ownership and control is prevalent is such systems. Among others, Brixiová and Bulíř (2003) or Bajona and Locay (2009) show that basing decisions on economic aggregates is prone to deficiencies and lower efforts by private individuals, which results in lower performances. Everywhere, the same ingredients delivered the same recipe, but aggregate planning failed to deliver a consistent dish, in the words, of Li and Yang (2005); probably nowhere else but in China did such economic management result in a (human) disaster as large as the one during the 'Great Leap Forward' (1959–1964), which is an example of communist orthodoxy trying to harness capital to catch-up with the West.

This logically guides the choice of our second main assumption: the lower productivity (relative growth potential) of the planned economy. Although it is very difficult to compare the two systems (if only because the Net Material Product, not the GDP, was used, excluding as a consequence the services), it has been shown that the Soviet-type economies were less productive than their Western counterparts. The USSR, for example, obtained a 2.1 per cent trend annual productivity growth per head after WWII, which compares badly with the West, even after taking into account the losses (and bounce back) due to the war (Harrison, 1998, Bergson, 1992). Broadberry and Klein (2012) confirm that the situation can be generalized to the 'Eastern bloc countries', which they compare to the EEC6 and 9. Wu (2001) considers the productivity of the Chinese industry, comparing it with the US, and finds that China was strongly lagging behind. Even more strikingly, he shows that the average productivity in the nineties (i.e., after the beginning of the reforms) was almost twice larger than what had been reached since 1952. And the lack of performance is commonly attributed to the deficiencies of a command economy (see, for instance, Litwak, 1993), among which the weakening workers' morale, due to low consumption possibilities (Bergson, 1992), as in our own modeling and interpretation.

The last main assumption of our analytical set-up is the willingness to catch-up with the West, an objective which historically led to overinvestment and to a focus on industry as a lever to reach that goal. USSR leaders repeatedly stated that their goal was to bring as much comfort to their population as what existed in the West (Bergson, 1992). Harrison (1985) measures the degree of overinvestment and shows this feature to be even more important in China than in the USSR, while Bergson (1992) draws the link between the insistence on industry (and especially heavy industries) and the lower consumption possibilities delivered by the Soviet economy. Easterly and Fischer (1995)

go as far as attributing the decline of the Soviet economy to such overinvestment bursts.

The challenge here is, thus, to consider how China fits in this landscape, given that its savings rate has been high for the last decades, since the start of the reforms, and stand at levels that are higher than either in the other developing countries or in the developed ones (Yang et al., 2012). Although it may not have reached the productivity level of the Western economies, China has at least been able to follow a reform path that has permitted maintaining such a high level of savings without creating too much resentment, or 'reform without losers' as referred to in Lau et al. (2000). The reform has compensated the expected decay of the old industries by aligning incentives in the collective farms and state-owned firms (hence soothing the impact of the changes on people) and by liberalizing the more promising industrial sectors, thus promoting the country's growth along a dual-track approach (Lin, 2009, Lau et al., 2000). Such accounts explain why China may be a good case in point with regard to Corollary 2, with the Communist Party making concessions in unleashing entrepreneurial spirits and accommodating the strive for economic profit and higher consumption, or when Lemma 4 is not satisfied.

6 Discussion and Concluding Remarks

Our theoretical analysis above summarized the rise and fall of communism as a process of experimenting with a new economic system that failed in most world regions, while reaching stability in few others. It also showed how the same general mechanism we emphasized as driving social evolution could generate, under certain conditions and under minor regime-dependent specificity, not just the advent of communism but also its demise, or prolonged stability. That is, we proposed a model of long-run economic dynamics as one possible explanation for a principal insight from the history and the turn of events during the last century and a half.

Our work is in line with the few related formal accounts of political economy nature regarding the processes leading to succesful democratization or to dictatorships succeeding democracy and democracy succeeding dictatorships in unstable societies, in particular the book by Acemoglu and Robinson (2006). Our approach is close to their framework in that we employ all of their three 'fundamental building blocks', namely:

1. "economic-based approach", emphasizing "individual economic incentives as determining political attitudes" and that "people behave strategically in the sense of game theory" (p. xii);

2. "the fundamental importance of conflict", where "different groups, sometimes social classes, have opposing interests over political outcomes" (p. xii);

3. "political institutions" that "play a central role in solving problems of commitment by affecting the future distribution of *de jure* political power".

It is interesting to note as well that their example of stable democracy, Britain, corresponds to our stable capitalism under Corollary 1 and the hypothesis in Acemoglu and Robinson (2000) that the extended franchise in the West prevented communism to happen. Their case of repeated cycles of democratization and dictatorship, Argentina, relates to our more general metaphor, in propositions 1 and 2, of the pendulum of economic systems. Their example of a stable nondemocratic regime, Singapore, parallels our Corollary 2, and its likely relevance to China.

Moreover, our work is also in line with North's (2005) arguments on the process of long-run economic change, where institutions are, according to Aoki (2011), "social artifacts that cognitively mediate agents' strategic interactions and their individual beliefs

in societal games". North characterizes succinctly the nature of this social evolutionary process as follows:

> "In contrast to Darwinian evolutionary theory, the key to human evolutionary change is the intentionality of the players. (...) Economic change, therefore, is for the most part a deliberate process shaped by the perceptions of the actors about the consequences of their actions. The perceptions come from the beliefs of the players – the theories they have about the consequences of their actions – beliefs that are typically blended with their preferences." (North, 2005, p. viii)

While the book by North is framed along purely descriptive argumentation, in the tradition of the new institutional economics, the chain of logic in the last quote is certainly compatible with a learning perspective formalized in recent works such as Buera et al. (2011). Our goal with this paper was to capture the 'perceived reality → beliefs → institutions → policies → altered perceived reality' chain North (2005) emphasized in words into a coherent and general theoretical construct capable to highlight the social pendulum across economic systems using the specific case of communism.

Indeed, our model begins with a perceived reality that is unjust for our type A agents, as they are born unequal and poorer. Their beliefs are thus shaped out by the ideal of achieving equality, and are propagated by socialization and the spread of ideology across society in our model. At this initial point, however, the world has never operated a communist economic system, to which the A types strive. In other words, the society faces huge (aggregate) ambiguity if it decides to attempt a change in the status quo. The experimentation with communism can, in this light, be seen as the 'necessary evil' to pass through in order to learn (more) about (the properties of) an unknown form of socioeconomic organization. The experiment accordingly creates its own institutions and policies, forcing equality in incomes and a central planning system to replace the role of capitalists and markets. But after repeating a few generation-spans of production and consumption, the social realities imposed by the revolution and nationalization turn out simply not to work. When our Lemma 4 holds, all members of the communist region suffer lower and lower material well-being due to misaligned incentives resulting from a distorted ownership and control structure. This will be, in fact, the side effect of abolishing private property and market signals: all agents will discover that communism forces equality of ownership through a centralized allocation that comes at the cost of lower productivity and poor coordination. While observing as a reference point the rest of the world that has remained market-based and is performing better, a drive to pro-market reforms – the altered perceived reality – reverts the society back to sustainability. Although we conclude modeling the chain of social evolution at this point, the pendulum certainly does not stop here and can continue to swing back and forth.

Sometimes – if not often – in history, the society faces the unavoidable challenge to experiment with its own existence and future under huge ambiguity. With heterogenous agents, information sets, expectations and interests, it is not always easy to converge to a commonly shared plan, or at least hope for such a plan to possibly end up successfully. Doubts, conflicts and ideologies emerge naturally, values and institutions evolve, responding to evolving realities, experiences, learning. At times, the experiment discovers a positive outcome. And then society finds and settles into a new (again, temporary) equilibrium, until the next unprecedented vital change of the environment. However, when the outcome of such a social experiment is negative, the pendulum of history swings back, or possibly along a spiral, whose circles constitute a gradation of hard-to-acquire knowledge.

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A Derivation of the Model Solutions

A.1 The von Stackelberg Game under Market Capitalism

Type B agents move first by making a decision on the amount of their savings:

$$\begin{aligned} \max_{s^B_{M,t}} \; U^B(\cdot) &= c^B_{M,t} + \beta y^B_{M,t+1} - E^B_t(\chi_t) - \frac{\tau^B(\chi_t)^2}{2} \\ \text{s.t. } c^B_{M,t} + s^B_{M,t} &\leq y^B_{M,t}. \end{aligned}$$

We first substitute out: consumption $c^B_{M,t}$ from the budget constraint; income $y^B_{M,t+1}$ from the production function, after taking into account the marginal return to capital; the expected regime-dependent inefficiency $E^B_t(\chi_t)$ from its definition after noting that $\ln \chi_{M,t} = 0$; under a market economy $\tau^B(\chi_{M,t}) = \tau^B(1) = 0$ (since $\chi_{M,t} = \chi_M = 1$). Below we omit the M-subscript to savings because under communism individual savings are absent:

$$\max_{s^B_t} \left(y^B_{M,t} - s^B_t\right) + \beta r_M s^B_t - q_{t+1} \ln(\chi_{E,t}).$$

Next, we substitute: $y^B_{M,t} = r_M s^B_{t-1}$ and $r_M = \alpha\theta_M$ (from the production function, after taking into account the marginal return to capital); q_{t+1} (from its law of motion):

$$\begin{aligned} &\max_{s^B_t} \; r_M s^B_{t-1} - s^B_t + \beta\alpha\theta_M s^B_t - \left[q_t + (q_t - q_t^2)\tau^A(\upsilon_t)\right] \ln\left(\chi_{E,t}\right), \\ &\max_{s^B_t} \; \alpha\theta_M s^B_{t-1} + (\beta\alpha\theta_M - 1)\, s^B_t - \left[q_t + (q_t - q_t^2)\tau^A(\upsilon_t)\right] \ln\left(\chi_{E,t}\right). \end{aligned}$$

A.2 The von Stackelberg Game under the Communist Plan

The egalitarian planner as a first mover maximizes utility in the name of type A agents taking into account aggregate values:

$$\begin{aligned} \max_{S_t} \; U^A_{E,t}(\cdot) &= C_t + \beta Y_{t+1} - E^A_t(\upsilon_t) - \frac{\tau^A(\upsilon_t)^2}{2} \\ \text{s.t. } C_t + S_t &\leq H_{E,t}. \end{aligned}$$

Substituting out consumption and savings from (23); the expected regime-dependent inequality $E^A_t(\upsilon_t)$ from its definition after noting that $\ln \upsilon_{E,t} = 0$; q_{t+1} (from its law of motion); $\upsilon_{M,t} = \frac{\alpha}{1-\alpha} s^B_t$ from (8); and $\tau^A(\upsilon_{E,t}) = \tau^A_t(1) = 0$ under a centralized economy (since $\upsilon_{E,t} = \upsilon_E = 1$):

$$\max_{S_t} \; H_{E,t} - S_t + \beta Y_{t+1} - (1 - q_{t+1}) \ln(\upsilon_{M,t}).$$

Next we substitute: $Y_{t+1} = r_{E,t} S_t$ and $r_{E,t} = \alpha\theta_{E,t}$ (the current-period shadow price of capital in a communist system); q_{t+1} (from its law of motion):

$$\begin{aligned} &\max_{S_t} \; \theta_{E,t}[\alpha K_t + (1-\alpha)L] - (1 - \beta\alpha\theta_{E,t}) S_t - (1 - q_{t+1}) \ln\left(\upsilon_{M,t}\right), \\ &\max_{S_t} \; \theta_{E,t}[\alpha S_{t-1} + (1-\alpha)L] - (1 - \beta\alpha\theta_{E,t}) S_t - \left(1 - \left[q_t - (q_t - q_t^2)\tau^B(\chi_t)\right]\right) \ln\left(\upsilon_{M,t}\right). \end{aligned}$$

B Figures

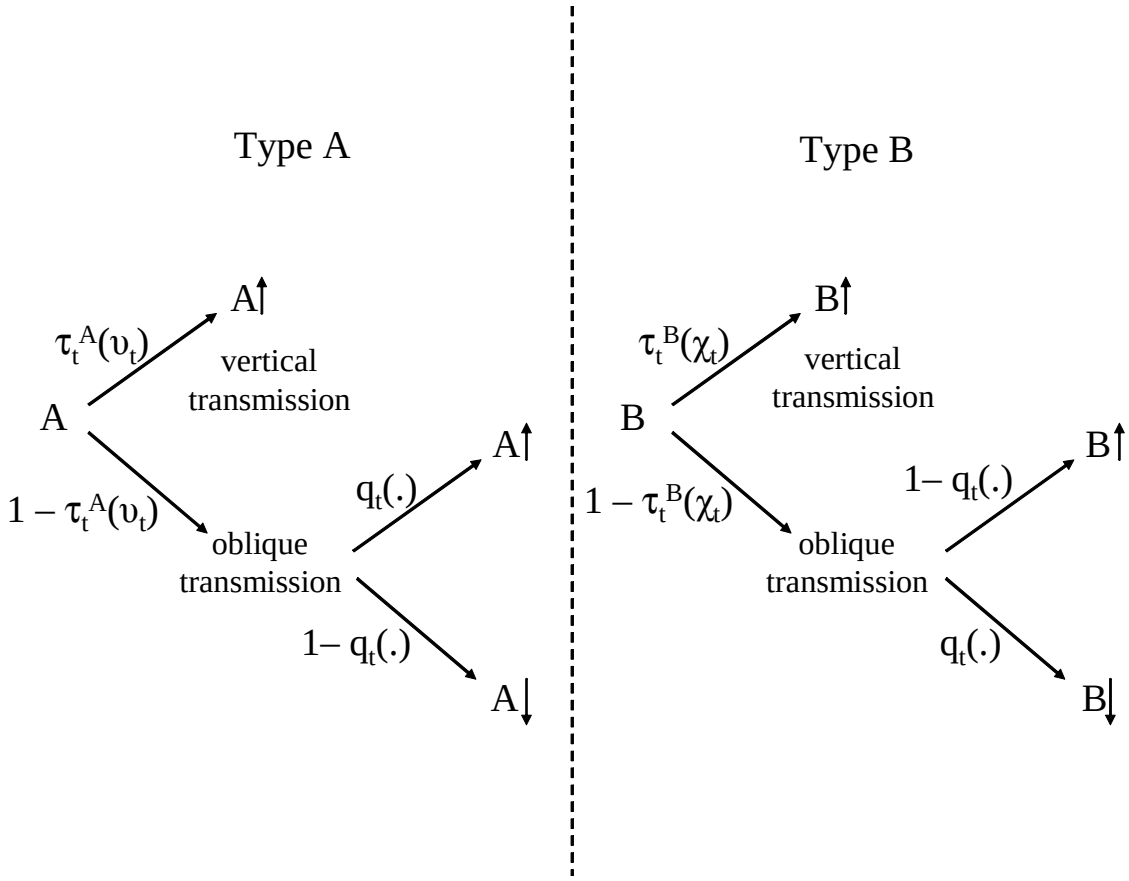

Figure 1: Types of Agents and Socialization

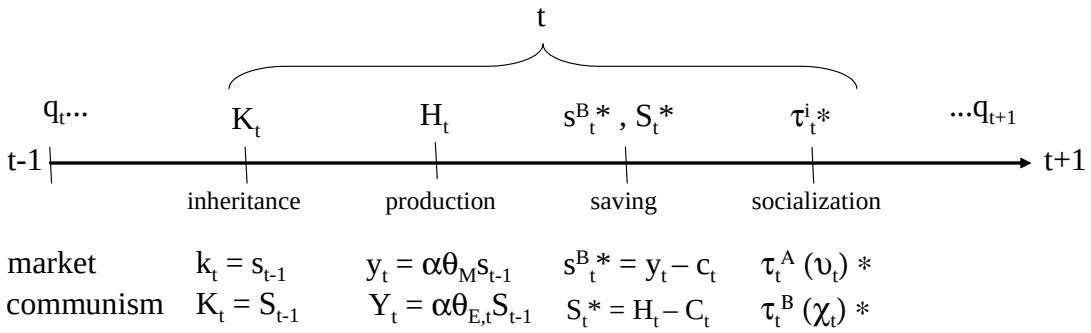

Figure 2: Sequence of Events in Period t

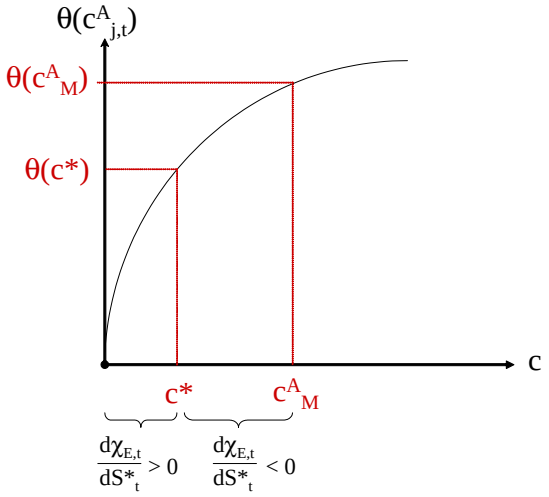

Figure 3: The Impact of Centralized Savings on Inefficiency

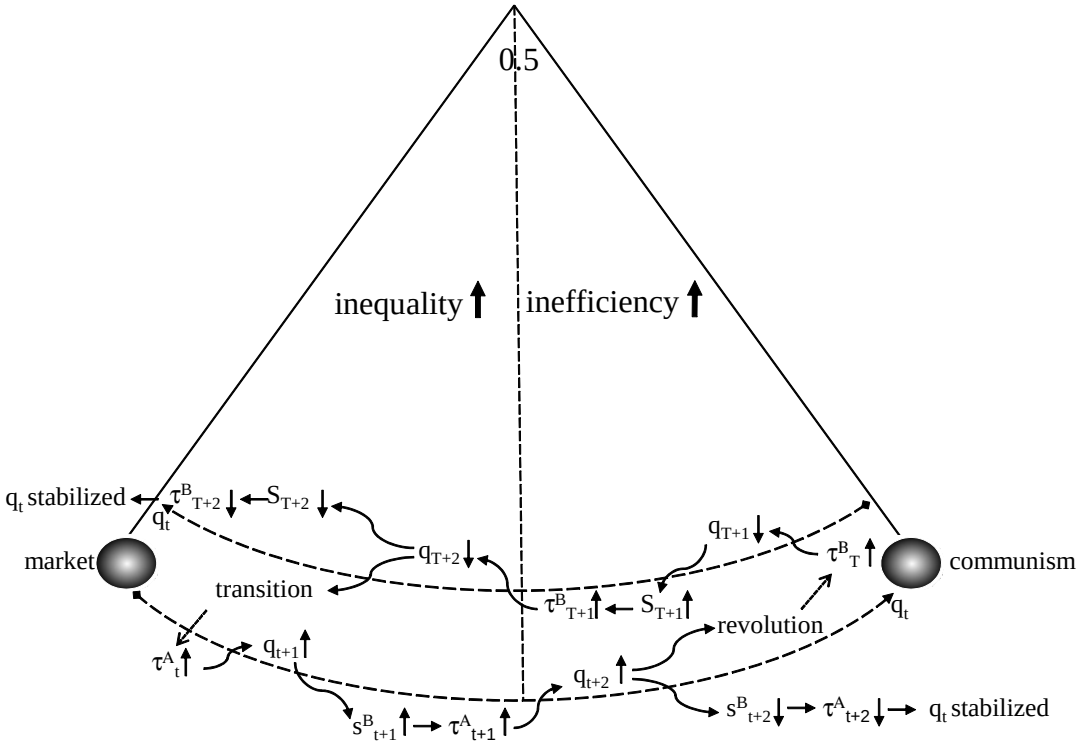

Figure 4: Dynamics of Ideology Across Generations

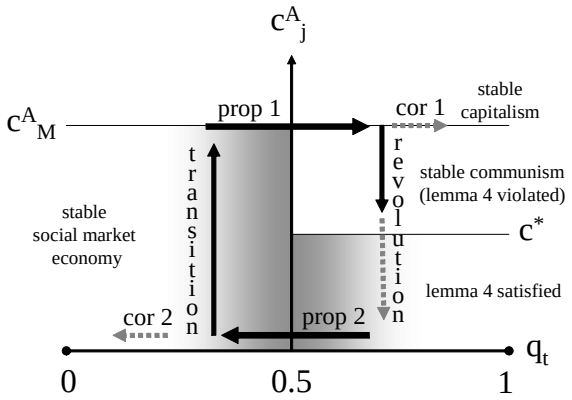

Figure 5: Dynamics of Regime Switches and Stability