# Economic Systems and Economic Growth

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Abstract

In a planned economy, state monopoly ensures that economies of scale are exploited. However, state monopoly could not commit to reward its workers. Anticipating this, individuals will exert less effort. In a market economy, competition among firms ensures that higher effort from workers will be rewarded. However, competition means that economies of scale are not fully exploited. Per capita output growth is generated by continuous adoption of new technologies substituting labor for capital. Growth rate in a market economy is higher than that in a planned economy when the incentive to exert effort is relatively more important.

**Keywords:** Market economy, Planned economy, Economic growth, Competition, Monopoly

**JEL Classification Numbers:** O40, P50

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## 1. Introduction

The debate of the relative merits of a market economy and a planned economy has a long tradition. On the one hand, Lange (1937) argues that with the growth of large-scale industry and the concentration of financial control, the pursuit of maximum profit destroys free competition. A planned economy can mimic the price system and does a better job in avoiding a cumulative reduction of purchasing power. On the other hand, Hayek (1944) argues that the concentration in production is not inevitable and he predicts that a planned economy will stifle individual incentives and is inconsistent with the rule of law.[1]

The planned system was for a time thought to offer an economic challenge to the market system. One of the most significant things in the 20th century is the rise and fall of the planned economic system. Surprisingly, there are limited formal models demonstrating the relationship between economic systems and economic growth.[2] This type of research is interesting not only for intellectual curiosity, but also for practical purposes. First, understanding the relative merits of different economic systems is relevant to those countries experiencing transition. As competition is important for the performance of a market economy, policies ensuring competition such as the entry of new firms can be very helpful for the success of countries in

[1] Kornai (1980) and Olson (2000) provide more detailed illustrations of features of different economic systems.

[2] Duranton and Haniotis (2004) compare economic performance for different economic systems. They study the tradeoff between the loss associated with risk-taking in a market economy and the informational problems in a planned economy. Different from this paper, economic growth is not studied in their model.

transition. Second, a key feature of a planned economy is the high degree of monopoly power in production. As various industries such as the electricity industry in developed countries usually have high degrees of monopoly power, understanding the impact of monopoly power on economic performance can also be relevant to the understanding of economic performance of highly concentrated industries in developed countries.

There are many differences between a market economy and a planned economy, such as asset ownership and the degree of hardness of budget constraint of firms. In this paper, we focus on one important difference between a planned economy and a market economy: a planned economy has one huge organization and a market economy has many organizations competing with each other. This difference in market structure is related to other differences between a market economy and a planned economy. In a market economy, capital is owned by diverse private owners and thus competition is possible, and competition hardens budget constraint. With the diverse ownership in a market economy, economic activities may not be sufficiently coordinated. This may lead to overinvestment in production capacity and overproduction and recession, as highlighted by the Great Depression. In a planned economy, capital is mainly owned by the government and this single ownership makes monopoly possible and monopoly makes soft budget constraint more likely. The high degree of monopoly power in planned economies is well known (Qian and Xu, 1993, and Olson, 2000). It was hoped that the state monopoly of productive resources in a planned economy would lead to better coordination of economic activities and thus a higher level of social welfare.

This paper contributes to the literature by providing a formal model to compare economic growth under different economic systems. We emphasize the role of competition in affecting the performance of different economic systems. In this model, output is produced by capital and labor. Economic growth is generated by continuous adoption of technologies substituting capital for labor. In a planned economy capital is owned by the state and thus monopoly is the norm. In a market economy, capital is privately owned by individuals and thus competition is the norm.

In a planned economy, with the existence of fixed cost of production and each good is produced by only one firm, economies of scale are fully exploited. However, with the state monopoly of productive resources, the state could not commit to reward workers. Anticipating that investment will not be fully rewarded, individuals will exert less effort and the effective supply of labor is low. In a market economy, there are multiple firms producing the same good.

Competition among firms ensures that higher effort level will be rewarded.[3] However, as multiple firms incur fixed costs to produce the same good, economies of scale are not fully exploited.[4] A market economy does relatively better than a planned economy in industries in which incentives to exert effort matter significantly.

Our model about the importance of competition can be used to illustrate the performance of China and some Eastern European countries in the 1990s. In the case of China, to implement the development strategy, monopolies in production, in the financial sector, and in foreign trade were established after 1949 (Lin et al., 2003, chap. 2). China's reform after 1978 was associated with the practice of dual-track price liberalization, the rise of township and village enterprises, and the opening of international trade. The dual-track price liberalization differs from the standard recipe of price liberalization and the rise of township and village enterprises differs from the standard recipe of privatization (Lin et al., 2003). However, the dual-track price liberalization and the rise of town-village enterprises led to increased competition faced by state owned enterprises. The opening of international trade also increased the degree of competition faced by domestic firms. Thus competition provides a factor that may be used to unify different types of practices in China's reform: with a higher degree of competition after reform, China grows rapidly. In the case of Eastern Europe, Blanchard and Kremer (1997) study the decrease of output for some Eastern European countries in the 1990s. Before reform, many firms relied on a single supplier for inputs. During transition, with incomplete contract or/and asymmetric information, bargaining may break down and output can decrease significantly. If there were higher degree of competition among firms before transition, holdup problems identified in Blanchard and Kremer (1997) could be avoided. Overall, increased degree of competition helped China to grow while lack of competition at the early stage of transition led to a decrease of output in some Eastern European countries in the 1990s.

[3] One well-known phenomenon in a planned economy is the "soft-budget constraint" problem (Dewatripont and Maskin, 1995). Our emphasis of the role of competition in ensuring that workers are sufficiently compensated is similar to their argument that decentralization makes the liquidation of a bad project credible. The role of competition in the process of industrialization is discussed in Zhou (2009).

[4] Our framework is highly stylized. In a market economy, imperfect competition is quite common. This will not change our result as long as the degree of monopoly in a planned economy is higher than that in a market economy. In a planned economy, monopoly pricing and rents would decrease the benefit of monopoly. This aspect does not contradict our model because this model accommodates the aspect that monopoly is costly. If we combine the cost from monopoly pricing with cost from low effort in this model, the analysis of this model still goes through.

The paper is organized as follows. First, we specify the model. Then we study the growth rate in a first-best economy, in a market economy, in a planned economy, and compare the growth rates. Finally, we conclude.

## 2. Specification of the Model

Time is discrete. If there is no confusion, the time indices of variables are frequently suppressed. A representative individual lives infinitely. The population is constant over time and the size of the population is normalized to one. To eliminate a firm's market power in the labor market in a market economy, we assume there is a continuum of final goods with a total mass of one indexed by a number $\varpi \in [0,1]$. All final goods are symmetric in the sense that they enter a consumer's utility function in the same way and they have the same marginal and fixed costs of production. In a general equilibrium model, only the relative price level can be determined. We choose the price of a final good as the numeraire: $p \equiv 1$.

A consumer's consumption of good $\varpi$ in period $t$ is $c_t(\varpi)$. For $\rho$ denoting the subjective discount rate, a consumer's discounted utility is specified as

$$\sum_{t=0}^{\infty} (1+\rho)^{-t} U_t, \tag{1}$$

$$U_t = \int_0^1 \left( \frac{c_t(\varpi)^{1-\theta} - 1}{1-\theta} \right) d\varpi . \tag{2}$$

For this type of utility function, the absolute value of a consumer's elasticity of demand is $1/\theta$. We assume that $\theta > 1$. Later on, we show that the number of firms producing the same good in a market economy is $2\theta$. Thus the assumption that $\theta$ is larger than one ensures that there are at least two firms producing the same good in a market economy.

A consumer's quantity of consumption of a final good in a first-best economy, in a market economy, and in a planned economy is denoted by $c_f$, $c_m$, and $c_p$ separately. For each type of the three economies, the growth rate of consumption is defined as

$$g_t = (c_{t+1} - c_t)/c_t . \tag{3}$$

Capital and labor are the two factors of production. The amount of capital is $K_t$. Capital depreciates at a rate of $\delta$. In a market economy, capital is diversely and privately owned. In a

planned economy, the state monopolizes the ownership of capital. Regardless of the type of economy, we assume that labor is always owned by individuals.

Final goods can be used either for consumption, or for capital accumulation. Similar to Zhou (2004, 2009), to produce each final good, there is a continuum of technologies indexed by a number $n$.[5] The initial level of technology is normalized to one. The level of technology in a first-best economy, in a market economy, and in a planned economy is denoted by $n_f$, $n_m$, and $n_p$ separately. A higher number indicates a more advanced technology. For technology $n$, the fixed cost in terms of capital is $f(n)$ and the marginal cost in terms of labor is $\beta(n)$. Capital is the fixed cost and labor is the marginal cost of production. To capture the substitution between capital and labor in production, a technology with a higher number of $n$ needs a higher level of capital and a lower level of labor: $f'(n) > 0$ and $\beta'(n) < 0$.

For an example of the choice of technology, before the introduction of containers, cargos were handled by longshoremen and were labor intensive. The adoption of containers led to a sharp increase of fixed costs in the transportation sector because containerships and container ports are costly (Levinson, 2006). With containerization, the marginal cost of loading and unloading decreased sharply. If the volume of transportation is high, containerization will be profitable because the high fixed costs of containerization can be distributed to a high level of output and the average cost decreases.

Let $\tau$ and $\psi$ denote positive constants. For convenience, we specify the fixed and marginal costs as

$$f(n) = \tau n, \tag{4a}$$

$$\beta(n) = \psi / n. \tag{4b}$$

At the beginning of each period, a decision about the level of human capital and skill needs to be made. Each individual is endowed with one unit of time. This amount of time may be allocated either in the acquisition of human capital and skill or working. For $s \in [0,1]$, if an individual spends $s$ units of time in the acquisition of human capital and skill, the level of

[5] This paper does not address the development of new technologies. We have also studied a model in which new technologies are developed by the R&D sector. The essential tradeoff between a market economy and a planned economy remains because which economy has a higher growth rate still depends on which economy has a higher supply of effective labor. However, there will be no closed-form solutions for the growth rates. Since incorporating a R&D sector complicates the presentation significantly without adding important insights, it is not pursued.

realized human capital and skill is $h(s)$. As a result, this individual is able to supply $(1-s)h(s)$ units of effective labor in each period.[6] We assume that $h'(s)>0$ and $h''(s)<0$. That is, spending more time on the acquisition of human capital and skill leads to a higher level of human capital and skill. However, the rate of the increase of human capital and skill decreases when more time is spent on human capital and skill acquisition. The amount of time spent on skill acquisition in a first-best economy, in a market economy, and in a planned economy is denoted by $s_f$, $s_m$, and $s_p$ separately.

Here $(1-s)h(s)$ is a worker's supply of effective labor and it is generated by human capital acquisition. The main idea of this paper does not depend on this specific mechanism leading to different levels of effective labor. What matters is that different economic systems may lead to different levels of supply of effective labor. For example, if different economic systems lead to different monitoring and thus different effective supply of labor, the main idea still goes through.

After the decision on human capital has been made and the amount of time on skill acquisition becomes sunk, the wage rate will be determined. Following the incomplete contract approach, a contract between a worker and its employer based on the effective level of labor is not available. In the following, we study the growth rates under different regimes.

## 3. Economic Growth in a First-best Economy

In a first-best economy, the social planner is able to choose the level of human capital, technology, the number of firms producing each good, and the level of output to maximize a consumer's welfare. The growth rate in a first-best economy is used as a benchmark for comparison with growth rates in a market economy and in a planned economy.

As $s_f$ is the amount of time spent on human capital and skill acquisition in a first-best economy, it will be chosen to maximize $(1-s_f)h(s_f)-s_f$. The optimal choice of the time on human capital acquisition requires

[6] Here we assume that human capital does not accumulate over time. Introducing human capital accumulation will not change the essence of this model if the growth rate of human capital in a market economy is similar to that in a planned economy. One interpretation of the assumption of no human capital accumulation is that individuals of different periods are just different generations of a family. Different generations are linked as an individual cares about the utility of his offspring while human capital does not transfer between different generations.

$$(1-s_f)h'(s_f)-h(s_f)-1=0\,. \tag{5}$$

A higher level of skill increases the effective supply of labor by $(1-s_f)h'(s_f)$ but decreases the amount of working time by $h(s_f)$, thus the marginal benefit of more skill is $(1-s_f)h'(s_f)-h(s_f)$. Equation (5) states that marginal benefit $(1-s_f)h'(s_f)-h(s_f)$ equals marginal cost 1. For $s_f$ determined in equation (5), define $e_f=(1-s_f)h(s_f)$. That is, $e_f$ is the effective supply of labor by a worker in a first-best economy. With the existence of fixed costs of production, only one firm will be allowed to produce each final good. The level of output in a first-best economy is $x_f$.

In a first-best economy, labor demand $\beta x_f$ equals labor supply $e_f$:

$$\beta(n_f)x_f=e_f\,. \tag{6}$$

Since each good is produced by only one firm and the total mass of firms is one, supply and demand for capital is equalized in a given period:

$$f(n_f)=K_t\,. \tag{7}$$

The evolution of capital stock in a first-best economy is given by

$$K_{t+1}-K_t=x_f-c_f-\delta K_t\,. \tag{8}$$

The social planner maximizes (1) subject to the constraint (4a), (4b), and (6)-(8). For the growth rate in a first-best economy to be positive, we assume $e_f/(\psi\tau)>\rho+\delta$. This inequality can be interpreted as follows. Normalized by the marginal cost ($\psi$) and fixed cost($\tau$), the effective supply of labor should be larger than the sum of the discount rate($\rho$) and the depreciation rate ($\delta$) to make growth possible. The following proposition studies growth rate in a first-best economy.

**Proposition 1** *The growth rate in a first-best economy is given by*

$$g_f=(\frac{e_f}{\psi\tau}+1-\delta)^{1/\theta}/(1+\rho)^{1/\theta}-1. \tag{9}$$

**Proof** Plugging the value of $x_f$ from (6) and the value of $K$ from (7) into equation (8) and using (4a) and (4b) to replace $f(n_f)$ and $\beta(n_f)$ yield the following equation between consumption and the evolution of technology in a first-best economy

$$\left(\frac{e_f}{\psi}+\tau-\delta\tau\right)n_{f,t}-c_f-\tau n_{f,t+1}=0\,. \tag{10}$$

In equation (10), $n_{f,t+1}$ denotes the level of technology in a first-best economy in period $t+1$. Maximization of (1) subject to the constraint (10) leads to (9).

Proposition 1 shows that the growth rate in a first-best economy decreases with the discount rate and the depreciation rate. This is natural. A higher discount rate means that an individual is less concerned with the future and lower amounts of final goods should be allocated for capital accumulation. A higher depreciation rate decreases the capital stock at a faster rate. These factors thus decrease the growth rate. As $\theta$ is larger than one, Proposition 1 also shows that the growth rate decreases with $\theta$.

**4. Economic Growth in a Market Economy**

In a market economy, suppose each final good is produced by $m$ identical firms. With free entry and exit, each firm earns a profit of zero. Thus, $m$ is determined by the zero profit condition. In a market economy, competition among firms means that an individual gets fully compensated for the investment on human capital and skill.[7] The assumption that competition increases rewards to workers is consistent with empirical evidence. For example, Rodrik (1999, p. 727) argues that a democracy increases the relative bargaining strength and outside options of workers, and decreases the value of outside options for employers. He finds that authoritarian regimes transfer income from labor to employers. After controlling for productivity differences, workers in a democratic country have higher wages rates than their counterpart in a less democratic country.

The wage rate in a market economy is $w_m$. As $s_m$ denotes the amount of time on human capital acquisition in a market economy, a worker's labor income is equal to $(1-s_m)h(s_m)w_m$. A worker chooses the time spent on human capital and skill acquisition to maximize $[(1-s_m)h(s_m)-s_m]w_m$. For a positive wage rate, the optimal choice of human capital and skill requires

[7] Here a worker gets all surplus generated by him if there are two or more firms producing the same good. Alternatively, a worker's share of the surplus can be specified to increase with the number of firms producing the same good. The tradeoff between a market and a planned economy will be similar under the alternative setup.

$$(1-s_m)h'(s_m)-h(s_m)-1=0. \tag{11}$$

The interpretation of (11) is similar to that of (5). For $s_m$ determined in equation (11), define $e_m=(1-s_m)h(s_m)$. That is, $e_m$ is the equilibrium level of effective labor supplied by a worker in a period in a market economy. The total value of assets held by all individuals is equal to the capital stock in the economy. Let $r_t$ denote the interest rate. The evolution of a consumer's asset $a_t$ is given by

$$a_{t+1}-a_t=r_t a_t+w_m e_m-pc_m. \tag{12}$$

A consumer maximizes utility (1) subject to the constraint (12). Let $\lambda_t$ denote the Lagrange multiplier in period $t$. A consumer's utility maximization leads to

$$(1+\rho)c_m^{-\theta}=\lambda_t p, \tag{13}$$

$$\lambda_t(1+r_t)-\lambda_{t-1}=0. \tag{14}$$

A firm in a market economy with output level $x_m$ has a total revenue of $p\,x_m$. This firm's cost of purchasing capital service is $f(n_m)R_t$, where $R_t$ is the rental price of a unit of capital service. Labor cost is $\beta(n_m)x_m\,w_m$. Thus, its total cost is $f(n_m)R_t+\beta(n_m)x_m\,w_m$. As a result, its profit in period $t$ is $\pi=p\,x_m-f\,R_t-\beta\,x_m w_m$.

Firms producing the same good engage in Cournot competition. Since there is a continuum of final goods, even if a firm has market power in the market for the good it produces, it does not have market power in the labor market. In each period, a firm takes the wage rate as given and chooses its level of technology and it level of output optimally to maximize its profit. When a firm chooses a more advanced technology, the marginal benefit comes from saving of marginal cost $-x_m\,w_m\beta'(n_m)$ and the marginal cost is the additional fixed cost $R_t f'(n_m)$. A firm's optimal choice of technology requires marginal benefit equals marginal cost:

$$-x_m\,w_m\beta'(n_m)-R_t f'(n_m)=0. \tag{15}$$

A firm's optimal choice of output requires $p+x_m\partial p/\partial x_m-w_m\beta(n_m)=0$. From (2), the elasticity of demand faced by a firm is $\dfrac{\partial x_m}{\partial p}\dfrac{p}{x_m}=-m/\theta$. Combination of this elasticity with the condition for a firm's optimal choice of output leads to

$$p = \frac{m w_m \beta(n_m)}{m - \theta}. \tag{16}$$

Zero profit for a firm producing a final good leads to[8]

$$p x_m - R_t f(n_m) - x_m w_m \beta(n_m) = 0. \tag{17}$$

Each firm demands $x_m \beta(n_m)$ units of labor and there are $m_t$ firms. Thus, the total demand for labor is $m x_m \beta(n_m)$. The supply of labor is $e_m$. The clearance of the labor market requires that demand equals supply:

$$m x_m \beta(n_m) = e_m. \tag{18}$$

Each of the $m$ firms demands $f(n_m)$ units of capital. The supply of capital is $K_t$. The clearance of capital market requires that demand equals supply:

$$m f(n_m) = K_t. \tag{19}$$

As capital depreciates at a rate of $\delta$, the net real return to capital is $R_t - \delta$. As a consumer can loan its money to another consumer or invest, the return in the two cases should be equal:

$$R_t = r_t + \delta. \tag{20}$$

The amount of goods available for investment is $m x_m - c_m$. The amount of depreciated capital is $\delta K_t$. Thus, the evolution of capital is given by

$$K_{t+1} - K_t = m x_m - c_m - \delta K_t. \tag{21}$$

We focus on the symmetric equilibrium in which equal amount of each final good is produced and a consumer purchases equal amount of each of the final goods. An equilibrium in a market economy is a set of prices $(p_t, r_t, R_t, w_m)_{t=0}^{\infty}$, optimal choices $(n_m, x_m)_{t=0}^{\infty}$ for a firm, and optimal choices $(s_m, c_m)_{t=0}^{\infty}$ for a worker, such that the evolution of $\lambda_t$ is given by (14) and the evolution of $K_t$ is given by (21). Also, in each period, $(n_m, x_m)$ solves (15) and (16) at the stated prices; $(s_m, c_m)$ solves (11) and (19) at the stated prices; and markets clear: (17)-(20) are valid.

For the growth rate in a market economy to be positive, we assume $e_m / (4\theta\psi\tau) > \rho + \delta$. Compared with the inequality for the growth rate in a first-best economy to be positive, here the effective supply of labor should be higher to accommodate the fact that more than one firm

[8] For an example of oligopolistic competition with free entry, see Lahiri and Ono (2004).

producing the same good in a market economy (the number of firms is $2\theta$). The following proposition studies the steady state growth rate in a market economy. It shows that the growth rate in a market economy also decreases with the discount rate and the depreciation rate.

**Proposition 2** *The steady state growth rate in a market economy is*

$$g_m = \left( \frac{e_m}{4\theta\psi\tau} + 1 - \delta \right)^{1/\theta} / (1+\rho)^{1/\theta} - 1. \tag{22}$$

**Proof** Plugging the value of $f(n)$ and $\beta(n)$ from (4a) and (4b) into (15) leads to $R_t f(n_m) = x_m w_m \beta(n_m)$. Plugging this equation and the value of $p_t$ from (16) into (17) leads to $m/(m-\theta) - 2 = 0$, or $m = 2\theta$. Plugging $m = 2\theta$ into (17) yields $R_t = e_m/(4\theta\psi\tau)$. From (13) and (14), $\frac{c_{m,t+1}}{c_{m,t}} = \left( \frac{1+r_{t+1}}{1+\rho} \right)^{1/\theta}$. In this equation, $c_{m,t+1}$ denote a consumer's consumption of a final good in a market economy in period $t+1$. Combination of this equation with (20) and $R_t = e_m/(4\theta\psi\tau)$ leads to (22).

## 5. Economic Growth in a Planned Economy

In a planned economy, we assume that the state can choose the number of firms producing each good and the level of output for a firm. However, the state could not control an individual's skill acquisition directly. We focus on the friction on the incentive to exert effort while all other (informational, coordination, and control) costs of central planning are ignored.

In a planned economy, the link between an individual's contribution to output and return is weak. This is a result of various factors. First, in planned economies, rewarding workers is not a priority (Gorbachev, 1987, p. 6, Olson, 2000, chap. 7). Second, even if the government wants to reward workers, it could not commit to this. In a planned economy, the state is the only employer. As a monopsony, the state could not commit to reward the workers.[9] The weak link between an individual's contribution to output and income in a planned economy is reflected in the writing of politicians, such as Gorbachev (1987, p. 71).

[9] Here it is assumed that in an infinite horizon, the government in a planned economy could not establish a reputation that investment in human capital will be rewarded.

In a planned economy, the objective of the state may be to maximize the planner's benefit (Li, 1999). Here we assume that the objective of the state is to maximize a representative consumer's discounted utility. This assumption is useful in demonstrating the potential of a planned economy. This assumption is not essential since if the planner tries to maximize personal benefit, the planner will try to lower the wage rate. This is likely to decrease the incentives for workers to exert effort. Regardless of the objective in a planned economy is to maximize a representative consumer's welfare or personal benefits of the planner, a robust feature is that the link between the effort and the reward in a planned economy is low.

With the state monopolizes the ownership of capital, an individual may not be able to enjoy the surplus created by his higher level of supply of effective labor. We assume that the surplus is allocated through the bargaining between the state and an individual worker (Rodrik, 1999). A worker's bargaining power is $\alpha$, and $\alpha \in (0,1)$. We assume that each side's outside option has a value of zero. The wage rate in a planned economy is $w_p$. As $s_p$ is the amount of time spent on human capital acquisition in a planned economy, a worker's income in a planned economy is $\alpha(1-s_p)h(s_p)w_p$. A worker chooses the time spent on human capital and skill acquisition to maximize $\left(\alpha(1-s_p)h(s_p)-s_p\right)w_p$. For a positive wage rate, a worker's optimal choice of acquisition of human capital and skill requires

$$\alpha(1-s_p)h'(s_p)-\alpha h(s_p)-1=0. \tag{23}$$

One difference between (23) and (5) is that an individual only gets $\alpha$ percent of the benefit. From (23), incentive for an individual to invest in human capital and skill is positively related to an individual's bargaining power. In a planned economy, with the state controlling capital stock and the judicial system, an individual's bargaining power is likely to be low. This leads to a low incentive to exert effort and thus a low level of supply of effective labor. As discussed in Gorbachev (1987), this lack of incentives in planned economies is severe.

For $s_p$ determined in equation (23), define $e_p=(1-s_p)h(s_p)$. That is, $e_p$ is the equilibrium amount of effective units of labor supplied by one worker each period in a planned economy. With fixed costs of production, only one firm will produce each final good.[10]

[10] In a planned economy, the number of firms producing a good may be higher than one. This does not necessarily mean there is competition among these firms. The reason is that all firms may follow orders from the same government agency.

For a planned economy, in each period, labor demand $x_p \beta(n_p)$ equals labor supply $e_p$:

$$x_p \beta(n_p) = e_p . \tag{24}$$

As the price of a final good is normalized to one, the wage rate is equal to the quantity of per capita consumption. Since the size of the population is one, the amount available for capital accumulation is $x_p - c_p$. The evolution of capital in a planned economy is given by

$$K_{t+1} - K_t = x_p - c_p - \delta K_t . \tag{25}$$

In a planned economy, the state maximizes (1) subject to the constraint (4a), (4b), (7), (24), and (25). For the growth rate in a planned economy to be positive, we assume $e_p /(\psi\tau) > \rho + \delta$. The interpretation of this inequality is similar to that in a first-best economy. The following proposition studies the steady state growth rate in a planned economy.

**Proposition 3** *The growth rate in a planned economy is given by*

$$g_p = \left( \frac{e_p}{\psi\tau} + 1 - \delta \right)^{1/\theta} /(1+\rho)^{1/\theta} - 1. \tag{26}$$

**Proof** Plugging the value of $x_p$ from (24) and the value of $K$ from (7) into (25) and using (4a) and (4b) to replace $f(n_f)$ and $\beta(n_f)$ yield the following equation between consumption and the evolution of technology in a planned economy

$$\left( \frac{e_p}{\psi} + \tau - \delta\tau \right) n_{p,t} - c_p - \tau n_{p,t+1} = 0 . \tag{27}$$

In equation (27), $n_{f,t+1}$ denotes the level of technology in a planned economy in period $t+1$. Maximization of (1) subject to the constraint (27) leads to (26).

## 6. Comparison of Growth Rates

From (9), (22), and (26), the growth rates in a market economy and in a planned economy are lower than that in a first-best economy. From (5) and (11), the level of acquisition of human capital and skill in a market economy is optimal. However, there are too many firms producing the same good in a market economy. In a planned economy, the number of firms producing a good is optimal. However, the effective supply of labor is lower than social optimum.

Suppose there are two economies with the same initial conditions. One economy adopts the planned system and the other adopts the market system. Which economy will grow faster?

**Proposition 4** *The steady-state growth rate in a market economy is higher than that in a planned economy if and only if*

$$\frac{(1-s_m)h(s_m)}{(1-s_p)h(s_p)} > 4\theta. \tag{28}$$

**Proof** From equations (22) and (26), $g_m > g_p$ if and only if $e_m / e_p > 4\theta$.

Equations (11) and (23) define $s_m$ and $s_p$ respectively. To understand Proposition 4, from (11) and (23), the effective supply of labor in a market economy is higher than that in a planned economy. The left-hand side of (28) shows the advantage and the right-hand side of (28) shows the disadvantage of a market economy. A market economy performs better when the ratio of the effective supply of labor between a market economy and a planned economy is large. Also, if the elasticity of demand is low, a market economy will perform better. From $m = 2\theta$, a higher elasticity increases the number of firms producing the same good in a market economy, and this duplication of fixed costs decreases the growth rate in a market economy.

If the growth rate in a planned economy is lower than that in a market economy, the speed of adopting new technologies in a planned economy will also be lower. The difference of the growth rate can be understood as follows. If a market economy has a higher supply of effective labor in the first period, output will be higher and capital stock in the next period will be higher. A higher capital stock in the second period decreases the price of capital and makes the adoption of more advanced technology profitable in a market economy. The adoption of more advanced technology leads to a lower average cost and higher level of output in the second period. Thus, a higher level of supply turns into a higher growth rate.

One implication of Proposition 4 is that a planned economy will perform relatively better in simple industries in which incentives of workers are less important. A market economy will do in industries producing complex goods in which incentives of workers are important. As economic growth relies more and more on innovation and innovation relies on incentives to invest in the acquisition of human capital and skill, a market economy is likely to perform better in the long run. Thus, it is natural that Gorbachev (1987, p. 5) was concerned with that the gap in

the production of advanced technologies and the use of advanced techniques between the former Soviet Union and the West was widening.

## 7. Conclusion

In this paper, we focus on one prominent difference between a market economy and a planned economy: the degree of competition is higher in a market economy than that in a planned economy. In a planned economy, economies of scale are fully exploited but the effective supply of labor is low. In a market economy, firm competition ensures higher effective labor supply but economies of scale are less exploited. A market economy does better than a planned economy in industries in which incentives matter significantly. As growth relies more on the incentives to acquire human capital, a market economy will have a higher growth rate in the long run.

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