



# Capital and growth with oligarchic property rights

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## Abstract

To analyze effects of imperfect property rights on economic growth, we consider economies where some fraction of capital can be owned only by local oligarchs, whose status is subject to political risk. Political risk decreases local capital and wages. Risk-averse oligarchs acquire safe foreign assets for insurance, thus increasing wages in other countries that protect outside investors. We show that for empirically reasonable parameter values, reforms to decrease political risk or to protect more outsiders' investments can decrease local oligarchs' welfare by increasing wages, making such reforms prone to political resistance from the ruling elite. We suggest measures of property rights imperfections derived from empirically observable data, and we test the quantitative predictions of our model using those measures and other parameter values routinely assumed in growth theory.

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## 1. Introduction: a need for new growth models with property rights

The importance of imperfect property rights is widely recognized by observers of developing economies and economies in transition. But this basic insight has been difficult to apply in systematic economic analysis, because most standard economic models still assume perfect en-

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forcement of property rights. This is especially true of standard models of economic growth. Our goal here is to develop a tractable model of economic growth that explicitly incorporates imperfect protection of property rights into a well-defined intertemporal structure with saving and investment decisions in a general equilibrium framework.

In this paper, property rights are imperfect because an individual's ability to get property protected depends on his status in society. More specifically, we assume that protection of valuable property rights is limited to a small privileged subset of society ("the oligarchy"), and each member of this privileged class faces some risk of losing his status. We then show how this assumption can be introduced into the framework of a Ramsey-type growth model, and we develop mathematical results that make such a model analytically tractable. The model yields some stark features of the experience of many developing economies and economies in transition: the flow of capital from poor countries to rich countries, the dissipation of economic rents in unproductive political activity, and the presence of powerful vested interests for maintaining an inefficient status quo. As we calibrate the model using our estimates of the parameters measuring oligarchic property rights, it can approximately fit the cross-country distribution of income when the share of capital in the production function is large enough.

The basic idea here, that property rights are protected only for members of a small privileged elite, is a simplification that does not describe the real situation anywhere in the world. But the standard economic assumption, that all individuals have equally perfect protection of property, is also a simplification that does not apply fully anywhere. Economists often speak of transactions costs, but rarely speak of ownership costs. Even models with imperfect property rights have regularly assumed that all individuals have equal opportunities to own assets and to participate in economic transactions. The assumption that an individual's economic options depend only on his or her wealth, and not any other aspect of social status, has been a pervasive characteristic of most economics analysis.

But economists should recognize that the fundamental dynamics of political competition can create a system where property-rights protection is restricted to a privileged class of politically connected individuals. Protection of property rights is a service provided by political leaders, so it may become a scarce resource to be allocated by those leaders. Under any political system, leaders need active supporters to maintain their position, so contenders for power may rationally offer such scarce protection as a reward to their most active supporters. But both protection and political support require costly efforts that parties may not observe perfectly, limiting the circle of trust to a group of members small enough to actively monitor each other.<sup>1</sup> Moreover, promises to exchange political support for economic protection often cannot be disclosed. Hence, such promises are likely to be credible only among individuals who have reputations for honoring confidential agreements.

Thus, fundamental agency problems in transactions of economic protection and political support can naturally lead to a political-economic equilibrium that is characterized by oligarchic property rights, where certain kinds of property are protected only for a limited group of people who have privileged relationships with local political leaders.<sup>2</sup> Because lack of trust can be a

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<sup>1</sup> Studies of the Sicilian Mafia agree that it could survive only when the chief "tendentiously maintained one-on-one relationships with the other members. . . . The Mafia therefore consists of a network of two-man relationships based on kinship, patronage, and friendship" (Catanzaro, 1988, pp. 42–43). See also Gambetta (1993).

<sup>2</sup> Varese (2001) reports stark evidence of such exclusive protection, in his study of the Russian mafia in Perm. One interviewed businessman, a former colonel in the militia, relied on his connections with the police when he was threatened by an extortion racketeer. The police made no attempt to arrest the racketeer. Instead, they summoned him to the police

self-enforcing equilibrium, an outsider who tried to purchase acceptance of other oligarchs with money would simply find himself cheated.

Other economists have recognized the importance of extending economic analysis to problems of oligarchy. Glaeser et al. (2003) consider a model where people exogenously differ in their ability to punish a judge who violates a corrupt transaction. If most people cannot punish corrupt judges, then the few who can effectively do so would be like our local oligarchs, with an exclusive ability to hold valuable local investments. Acemoglu (2004) has developed a model for comparing the fiscal and regulatory distortions of democratic and oligarchic societies. While we view oligarchic connections as a prerequisite for being able to own capital, Acemoglu assumes that oligarchic status follows from owning capital. But he argues that, when such oligarchs control the government, they will favor public policies that create barriers to entry, so that the oligarchy will effectively become the kind of closed club that we assume in this paper. Oligarchic property rights are perfectly protected in Acemoglu, while capital accumulation and growth may be hindered by the lack of new technology adoption. In contrast, ours is a standard growth model with a fixed technology, and adverse effect on capital accumulation comes from political risk and inability to securely guarantee outsiders' investments.

Polishchuk and Savvateev (2004) and Sonin (2003) have developed other theoretical frameworks to explain how the wealthier elite of a society might prefer imperfect protection of local property rights. In these models, individuals allocate their resources among production activities and private-protection activities, and the rich find a comparative advantage in private protection because the returns to scale in pure production are smaller. Poor public protection increases the benefits of private-protection activities by the rich, but these benefits come from stealing the less-protected property of the poor. In our model, the imperfectly protected property is owned only by oligarchs, and the oligarchs' benefits from imperfect protection are derived instead from its effect on the equilibrium wage. This is similar to factor price manipulation by an oligarchic government in Acemoglu (2005). In particular, we also find that factor-price manipulation by an oligarchy decreases welfare by more than a tax on capital.

Alesina and Tabellini (1989) have analyzed capital flight and low capital accumulation in a model with political risk caused by rivalry between two groups. A right-wing government may be ousted by a left-wing government that would want to expropriate capital owners. Capital flight and external borrowing serve as insurance against such political risk. In our model oligarchs do not face any challenge to their rule as a class, but each individual oligarch faces a risk of losing reputation, so he has to privately insure himself by accumulating assets abroad.

The costs of imperfect property rights have been emphasized in other recent models. Murphy et al. (1991) analyze the impact of political rent-seeking on innovation and growth, while Tornell and Velasco (1992) and Tornell and Lane (1999) analyze imperfect property rights as a common-pool problem, where individuals are discouraged from investing by the prospect of being expropriated by others. Their one-factor model suggests that investors should get positive externalities from each other's investments, but such a conclusion would ignore the wage effects that are central to our equilibrium analysis.

Since property rights may be imperfect in many ways, many different assumptions about the nature of these imperfections need to be explored. Here we consider systems of oligarchic property rights that differ on two parametric dimensions. The first dimension measures the risk that individual oligarchs may lose their good reputation and oligarchic status in the near

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office where he was told in a "civilized" manner that he "had knocked on the wrong door" in approaching a connected businessman. The racketeer acknowledged his mistake and departed amicably (p. 94).

future. To maintain trust among members of the oligarchy, it is essential that anyone who appears to have violated the terms of trust must lose his good status. With imperfect monitoring, appearances of such violations could occur with positive probability, even in an equilibrium where nobody actually chooses to violate any political agreements. The second dimension on which oligarchic systems may differ is the fraction of capital that may be owned or financed by individuals outside of the oligarchy. When property protection depends on personal trust there is strong reason to expect capital-market failure. De Soto (2000) has attributed the failure of capitalism in poor countries to a weak collateral system. Our model allows that oligarchs might create systems for credibly protecting outsiders' claims to some portion of local property.

The analytical framework is developed in Sections 2 through 5. Section 2 characterizes the optimal investment strategies for an individual oligarch, whose ownership of local assets is subject to a given political risk of expropriation. Section 3 develops a growth model of an economy where a given fraction of local capital must be owned by local oligarchs. The profits from distributing expropriated assets accrue to government offices, which are also controlled by local oligarchs. Section 4 analyzes the steady-state equilibrium of such an oligarchic economy. In Section 5, the analysis is extended to a multi-national general equilibrium model, where countries differ according to how well they protect property of oligarchs and of outside investors.

To probe the implications of our general model, we conduct some calibration exercises using parameter values routinely assumed in growth theory. We begin in the second part of Section 5 by analyzing the steady state of a two-country model, and we show how a relatively small political risk in one country may seriously decrease capital and wages there, but may actually increase the wage in another country with better property rights. Section 6 then compares the dynamic equilibria that would follow from various political reforms in one country, starting from a given steady state, changing the degree of political risk or changing the fraction of capital that outsiders can own. The results of this section illustrate how the oligarchs may prefer to maintain a system of imperfect property rights, even though it limits the security of their own holdings and their access to global credit markets.

To simplify exposition, the basic model assumes that the oligarchs who lose their privileged status are expelled and are not replaced. In Section 7, we consider the extension of the model with the recruitment of new individuals into the oligarchy. We show that such recruitment may have only minor effects on the results of our analysis when the oligarchy is a small fraction of the overall population.

Section 8 considers how our model can be taken to data. In the model, well-diversified outside investors must be paid a higher interest rate that compensates for local political risks. We use the data on country risk premia to obtain a proxy for the country-specific political risk. The fraction of capital that may be financed by outside investors can be approximated by the ratio of market capitalization of investable stocks to total stock market capitalization. We obtain the quantitative predictions of our model for cross-country income inequality, and we find that while our simple model fails to fit the magnitude of income inequality, the relative fit turns out to be surprisingly good. Section 9 concludes, while in the "Appendix to Capital and Growth With Oligarchic Property Rights" (Braguinsky and Myerson, 2006) we present some additional derivations and details about data and estimation procedures.

## 2. The investment problem of an insecure oligarch

Our model of economic systems with oligarchic property rights must be founded on an analysis of the individual oligarch's problem of planning his investment and consumption decisions. The distinguishing feature of this problem is that the oligarch's privileged status allows him to buy and own valuable assets in his home country that an outsider could not safely hold. These local assets yield a rate of return that is higher than the interest rate generally available to other investors in world financial markets, but the oligarch then bears a risk of losing these local assets if he loses his oligarchic status. In this section, we formulate a simple model of the oligarch's problem, as a variant of the standard Ramsey-type optimal investment problem.

We consider a simple economy in which there is a single consumption good that serves as numeraire. An investor gets logarithmic utility from his consumption over time, and future utility is discounted at a rate  $\rho$ . Now consider an individual investor who is a member of the oligarchy in a country where valuable local assets can be owned only by such oligarchs. Let  $\pi(t)$  denote the net rate of profit that these assets will pay at any time  $t$ .

The individual oligarch is not perfectly secure in his privileged position. Oligarchs run a risk of losing their oligarchic status that may be caused, for example, by a sudden breaking of personal trust after perceived violation of the political support agreement.<sup>3</sup> Also, if political connections are established through a personal relationship between a political leader and a member of an oligarchic family, events such as the death of the family member or the downfall of the leader can cause the loss of oligarchic privileges by the rest of the family. We capture these political risks in our model by making each oligarch face a small independent probability of losing his status over any short interval of time. When this happens, all his local assets are confiscated.<sup>4</sup> The time  $\tilde{T}$  until such ostracism is assumed to be an independent exponential random variable with mean  $1/\lambda$  for each oligarch. That is, given an individual who has oligarch status at time 0, the probability of his still being an oligarch in good standing at time  $t > 0$  is  $P(\tilde{T} > t) = e^{-\lambda t}$ . For simplicity we assume that this political risk is the only risk that an oligarchic investor faces, and the net profit rate  $\pi(t)$  is perfectly predictable.

The oligarch, like any other investor, can also hold foreign bank accounts which yield a risk-free rate of interest  $r$  that is assumed to be constant over time and less than or equal to the utility-discount rate  $\rho$ .<sup>5</sup> Foreign bank accounts are located in countries where the property-rights system makes them safe against political risk. Thus, if an oligarch were ostracized at a time  $t$  when he holds a safe foreign bank account worth  $x(t)$ , then he (or his family) could move abroad and live off the principal and interest from this account. When political risks are taken into account, the expected profit rate on local assets is  $\pi(t) - \lambda$ , and if this were less than the risk-free rate  $r$  in foreign banks then the risk-averse oligarchs would not hold any local assets. So in equilibrium, we must always have

$$\pi(t) \geq r + \lambda.$$

<sup>3</sup> In 1999 the Russian tycoon Boris Berezovsky played a key role in bringing the previously politically obscure Mr. Vladimir Putin to power. In the next year, Mr. Berezovsky publicly complained about some of Mr. Putin's policies that appeared to violate their political support agreement. Mr. Berezovsky was ostracized, and lives in exile.

<sup>4</sup> Accommodating physical ostracism is straightforward by interpreting the oligarchs' utility functions as dynastic utility functions.

<sup>5</sup> The inequality  $r \leq \rho$  is justified in Section 5.

The oligarch’s problem is to formulate a plan for his future investment and consumption which will depend, at any time  $t$ , on how long he has kept his oligarchic status. He may plan that, if he still has oligarchic status at time  $t$  (that is, if  $t < \tilde{T}$ ), then his wealth will be some amount  $\theta(t)$  of which he will hold some amount  $x(t)$  in safe foreign banks, and he will consume at some rate  $c(t)$ . On the other hand, if he has lost oligarchic status at time  $t$  then his wealth at time  $t$  will be some random variable  $\tilde{\theta}(t)$  that implicitly depends on the actual time  $\tilde{T} \leq t$  when he was expelled from the oligarchy. After losing oligarchic status, all his wealth must be held in foreign banks, but his planned consumption can depend on his wealth according to some function  $\bar{c}(\tilde{\theta}(t))$ . These functions  $(\theta, x, c, \tilde{\theta}, \bar{c})$  are the decision variables in the oligarch’s problem:

$$\begin{aligned} \text{maximize } EU &= E \left( \int_0^{\tilde{T}} e^{-\rho t} LN(c(t)) dt + \int_{\tilde{T}}^{\infty} e^{-\rho t} LN(\bar{c}(\tilde{\theta}(t))) dt \right) \\ \text{subject to } \theta(0) &= \theta_0, \\ \theta'(t) &= \pi(t)[\theta(t) - x(t)] + rx(t) - c(t), \quad \forall t \leq \tilde{T}, \\ 0 \leq x(t) &\leq \theta(t), \quad \forall t \leq \tilde{T}, \\ \tilde{\theta}(\tilde{T}) &= x(\tilde{T}), \\ \tilde{\theta}'(t) &= r\tilde{\theta}(t) - \bar{c}(\tilde{\theta}(t)) \quad \text{and} \quad \tilde{\theta}(t) \geq 0, \quad \forall t \geq \tilde{T}. \end{aligned} \tag{1}$$

The first constraint is the initial condition. By the second constraint, the oligarch accumulates wealth at a rate equal to profits from risky local assets  $\pi(t)[\theta(t) - x(t)]$ , plus interest income from safe bank accounts  $rx(t)$ , minus consumption  $c(t)$ . By the third constraint, the oligarch’s foreign assets  $x(t)$  must be nonnegative and not more than his wealth  $\theta(t)$ , which implicitly bounds his consumption. The fourth constraint says that, when expelled from the oligarchy at  $\tilde{T}$ , he can take only what he was holding in safe foreign assets into exile. By the fifth constraint, after expulsion, the former oligarch will only get interest income  $r\tilde{\theta}(t)$  to counter his consumption expense  $\bar{c}(\tilde{\theta}(t))$ , which will be bounded by the requirement that his wealth cannot become negative. The following lemma characterizes the solution to this optimal planning problem.

**Lemma 1.** *The optimal solution to (1) satisfies, for all  $t \geq 0$ ,*

$$c(t) = \rho\theta(t) \quad \text{and} \quad \bar{c}(\tilde{\theta}(t)) = \rho\tilde{\theta}(t), \tag{2}$$

$$x(t) = \frac{\lambda}{\pi(t) - r} \theta(t), \tag{3}$$

$$\theta'(t) = [\pi(t) - \rho - \lambda] \theta(t). \tag{4}$$

The optimal expected discounted utility for an oligarch with initial wealth  $\theta_0$  is

$$\int_0^{\infty} \left\{ LN(\rho\theta_0 e^{\phi(t)}) + \lambda LN[\rho\theta_0 e^{\phi(t)} \lambda / (\pi(t) - r)] / \rho + \lambda(r - \rho) / \rho^2 \right\} e^{-(\rho+\lambda)t} dt, \tag{5}$$

where  $\phi(t) = \int_0^t (\pi(s) - \lambda - \rho) ds$ .

The proof of Lemma 1 is standard, so we just sketch the essential ideas here (see also Section 1 of Braquinsky and Myerson (2006)). The optimization problem (1) is linearly homogeneous in  $\theta$ ,  $x$ , and  $c$ . So if wealth at any time  $t$  were multiplied by some number  $m$ , then optimal consumption and investments at all future times would be multiplied by the same  $m$ , which would add  $LN(m)$  to utility at any future time and so would add  $LN(m)/\rho$  to the overall present discounted value of future utility. Let  $v(t)$  denote the expected  $t$ -discounted value of future utility at time  $t$  for an oligarch who has wealth 1, and let  $u$  denote the discounted value of future utility for an exiled former oligarch who has wealth 1. So the expected discounted value for an oligarch with wealth  $\theta$  at time  $t$  would be  $v(t) + LN(\theta)/\rho$ , and the expected discounted value for a former oligarch with wealth  $x$  would be  $u + LN(x)/\rho$ . Now consider an oligarch with wealth  $\theta$  at time  $t$  who chooses to consume at rate  $c$  and to hold  $x$  in safe bank accounts over a short time period from  $t$  to  $t + \varepsilon$ . To first-order approximation in  $\varepsilon$ , the probability of ostracism during this period is  $\varepsilon\lambda$ , and so the oligarch’s expected discounted value at time  $t$  is

$$\varepsilon LN(c) + e^{-\rho\varepsilon} \left\{ (1 - \varepsilon\lambda) [v(t + \varepsilon) + LN(\theta + \varepsilon rx + \varepsilon\pi(t)(\theta - x) - \varepsilon c) / \rho] + \varepsilon\lambda [u + LN(x) / \rho] \right\}.$$

The first-order conditions for maximizing this value over  $c$  and  $x$  yield, in the limit as  $\varepsilon \rightarrow 0$ ,  $0 = 1/c - 1/(\rho\theta)$  and  $0 = [r - \pi(t)]/(\rho\theta) + \lambda/(\rho x)$ . So the oligarch should consume at a rate  $c(t) = \rho\theta(t)$  and should hold safe bank accounts worth  $x(t) = \theta(t)\lambda/[\pi(t) - r]$ , as conditions (2) and (3) specify. The optimality of consuming at the rate  $\rho$  times current wealth can be similarly derived for former oligarchs with logarithmic utility. Then (4) and (5) are derived by substituting (2) and (3) into the formulas for  $\theta'$  and  $EU$  in (1).

In welfare analysis, the numerical value of the expected discounted logarithmic utility in (5) may be difficult to interpret. We can more intuitively measure oligarchs’ welfare by their *constant-equivalent consumption*, the guaranteed permanent consumption rate which would yield the same expected discounted utility. Consuming at rate  $\hat{c}$  forever would yield discounted utility  $\int_0^\infty LN(\hat{c})e^{-\rho t} dt = LN(\hat{c})/\rho$ . So for an oligarch with initial wealth  $\theta_0 = 1$ , the expected utility in (5) is as good as getting a guaranteed constant equivalent consumption  $\hat{c}$  such that

$$\frac{LN(\hat{c})}{\rho} = \int_0^\infty \left\{ LN(\rho e^{\phi(t)}) + \frac{\lambda LN[\rho e^{\phi(t)}\lambda/(\pi(t) - r)]}{\rho} + \frac{\lambda(r - \rho)}{\rho^2} \right\} e^{-(\rho+\lambda)t} dt, \tag{6}$$

where  $\phi(t)$  is as in (5). With any other initial wealth  $\theta_0$ , an oligarch’s optimal expected discounted utility is increased by  $LN(\theta_0)/\rho$ , which is as good as getting the constant equivalent consumption  $\hat{c}\theta_0$ .

### 3. Equilibrium in a dynamic economy

We now develop a dynamic equilibrium model of the local region where oligarchs can invest. We assume that there are two kinds of assets in this region: local capital and government offices. Both are subject to the same  $\lambda$  political risk.

In this simple growth model, suppose that the consumption good is produced from capital and labor according to the standard Cobb–Douglas production function:

$$Y = AL^\alpha K^{1-\alpha}, \tag{7}$$

where  $Y$  is the flow of output and  $A > 0$  and  $\alpha \in (0, 1)$  are some given constants. For simplicity, the supply of labor  $L$  is assumed constant and inelastic. The total supply of local capital at any time  $t$  is denoted by  $K(t)$ . Assuming labor mobility within a country, workers must be paid a wage rate  $w(t)$  that is equal to the marginal product of labor

$$w(t) = \partial Y / \partial L = \alpha A (K(t)/L)^{1-\alpha}, \quad (8)$$

and so the gross profit rate  $R(t)$  that can be earned by each unit of capital at time  $t$  is

$$R(t) = [Y(t) - w(t)L] / K(t) = (1 - \alpha)A [L/K(t)]^\alpha. \quad (9)$$

We assume that new capital can be made directly from the consumption good on a unit-per-unit basis, and capital depreciates at some given rate  $\delta$ . Capital is mobile and can be sold abroad, so that its equilibrium price is always 1 in terms of the consumption-good numeraire.

We want to discuss two different dimensions on which imperfect property rights might vary: the degree of political risk faced by oligarchs (the parameter  $\lambda$  that has already been introduced), and the fraction of capital that must be owned and financed by local oligarchs. This second dimension can be introduced by allowing oligarchs to invite outside partners to finance some fraction of their local capital. To be specific, let us suppose that an oligarch may borrow from outside creditors, with his local capital serving as collateral, but only up to a given fraction  $\beta$ . This fraction  $\beta$  represents the portion of local capital to which people outside the local oligarchy can be given some secure rights, at least temporarily, under the local legal system. An oligarch who defaulted on his debts to outside creditors might conceal a fraction  $1 - \beta$  of his local capital from them, but the creditors could take temporary control of the fraction  $\beta$  and sell it to other oligarchs. Equivalently, we could suppose that outsiders can own local capital as long as they have the active protection of a sponsoring partner in the oligarchy, but the norms of the oligarchy would allow such a sponsoring oligarch to take a  $1 - \beta$  fraction of the partnership's capital if he ever ceased protecting it against expropriation by others in the oligarchy.

This enforcement of outsider creditor's claims depends on the oligarch's debts being recognized as legitimate by others in the oligarchy, which might not hold after the debtor has been expelled from the oligarchy. So let us assume that, when an oligarch's assets are expropriated, his outside creditors' or partners' claims to the  $\beta$  fraction of his local capital are also expropriated. With the given risk-free interest rate  $r$  in world financial markets, well-diversified investors should be willing to hold small shares in any oligarch's idiosyncratic political risk provided that he pays the interest rate  $r + \lambda$ , to cover the expected expropriation cost  $\lambda$  per unit time. Since the rate of net profit  $\pi(t)$  on local assets is always greater than  $r + \lambda$  in equilibrium, each local oligarch will always choose to mortgage the maximal  $\beta$  fraction of his local capital investments. That is, every unit of local capital will take an investment  $1 - \beta$  from its owner and will return him the net income stream  $R(t) - \delta - \beta(r + \lambda)$ . Thus, the net profit rate on oligarchs' investments in local capital is

$$\pi(t) = \frac{R(t) - \delta - \beta(r + \lambda)}{1 - \beta} = \frac{(1 - \alpha)A(L/K(t))^\alpha - \delta - \beta(r + \lambda)}{1 - \beta}. \quad (10)$$

Expropriated capital is reallocated through the political sector. We assume that government officials sell the newly expropriated capital to other oligarchs. The income stream from expropriated capital gives a value to government offices, and oligarchs can buy or sell these offices like capital. But also like local capital, government offices would be expropriated from an individual who loses his oligarchic status, and profits from reselling expropriated offices accrue to other government officials.



Let  $G(t)$  denote the total value of all government offices at any time  $t$ . Then the aggregate income for government officials from their offices is  $\lambda[K(t) + G(t)]$ . We think of the number of oligarchs as being a small fraction of the population, but large in numerical terms. Thus, the flow of expropriated wealth to government officials can be considered as a continuous income flow, subject only to the personal political risk of the recipients.

Because an oligarch's investment in a government office involves the same personal expropriation risk as his investment in local capital, these political and economic investments must be perfect substitutes. So the net rate of return from investments in government offices must always be exactly the same as the rate  $\pi(t)$  for investments in local capital. In contrast to capital, however, government offices cannot be sold abroad, and so their value may change over time. Thus, for oligarchs to be indifferent between investing in local capital and government office at any time  $t$ , the following condition must hold:

$$\pi(t)G(t) = \lambda[K(t) + G(t)] + G'(t), \quad (11)$$

where  $G'(t)$  is rate of capital gain in the value of government offices.

At any time  $t$ , let  $X(t)$  denote the total safe foreign bank deposits held by oligarchs from this country. Let  $\Theta(t)$  denote the total wealth of all the oligarchs, so that

$$\Theta(t) = X(t) + (1 - \beta)K(t) + G(t). \quad (12)$$

From Eq. (3) in Lemma 1, we know that each oligarch holds the same fraction of wealth in safe deposits  $x(t)/\theta(t) = \lambda/[\pi(t) - r]$ . Thus, aggregating over all oligarchs, we get

$$X(t) = \lambda\Theta(t)/[\pi(t) - r]. \quad (13)$$

At any time  $t$ , the total oligarchic wealth  $\Theta(t)$  is just the sum of the wealths  $\theta(t)$  of all individual oligarchs. In Eq. (4), we saw that the growth rate of any individual oligarch's wealth is  $[\pi(t) - \rho - \lambda]\theta(t)$  at any time  $t$ , as long as he retains his status in the oligarchy. But individuals are losing oligarchic status over time at the rate  $\lambda$ , and so  $\lambda\Theta(t)$  must be subtracted from each individual's expected contribution to the aggregate  $\Theta'(t)$ .<sup>6</sup> That is, when an oligarch has wealth  $\theta(t)$ , his expected individual contribution to total oligarchic wealth grows at the rate

$$[\pi(t) - \rho - \lambda]\theta(t) - \lambda\theta(t) = [\pi(t) - \rho - 2\lambda]\theta(t).$$

Aggregating the expected contribution of all individuals, the growth of total oligarchic wealth is

$$\Theta'(t) = [\pi(t) - \rho - 2\lambda]\Theta(t). \quad (14)$$

At time 0, the oligarchs have some initial endowment of economic assets  $(1 - \beta)K$  and  $X$ , which have an exogenous value in the global market, but the value of their political assets  $G$  is determined endogenously by transactions within the oligarchy. So our model's initial conditions must specify the aggregate value of the oligarchs' economic holdings, which we denote by  $H_0$

$$H_0 = (1 - \beta)K(0) + X(0). \quad (15)$$

$G(0)$ , the remaining component of  $\Theta(0)$ , is determined in equilibrium from Eq. (11).

To sum up, the dynamic behavior of  $(\Theta, K, X, G, \pi)$  in this economy is characterized by Eqs. (10)–(15), given the parameters  $(L, A, \alpha, \delta, \rho, r, \lambda, \beta, H_0)$ . The authors have provided a

<sup>6</sup> When an oligarch is ostracized, his personal loss is only  $\theta(t) - x(t)$ , but he takes his remaining wealth  $x(t)$  with him out of the aggregate wealth of all oligarchs.

spreadsheet file that numerically solves this dynamic model.<sup>7</sup> A sketch of its computational approach may be instructive.

Given the model's parameters, we can define a function  $\kappa(\Theta, G)$  that solves Eqs. (10), (12), and (13) for  $K$ . This  $\kappa(\Theta, G)$  satisfies

$$\Theta - G = (1 - \beta)\kappa(\Theta, G) + \frac{\lambda(1 - \beta)\Theta}{(1 - \alpha)A(L/\kappa(\Theta, G))^\alpha - \delta - r - \beta\lambda}.$$

With any  $\Theta > G$ , a unique solution  $\kappa(\Theta, G)$  can be found between 0 and  $(\Theta - G)/(1 - \beta)$ .

Our computational algorithm begins with an estimate of  $G(t)$  for all  $t$  (which could initially be  $G(t) = 0$ ). With this estimate,  $\Theta(t)$  can be computed for all  $t$  from 0 to some distant time  $T$  by the differential equation (14), with  $K(t) = \kappa(\Theta(t), G(t))$ , and with  $\pi(t)$  computed from  $K(t)$  by Eq. (10). If  $T$  is large enough, then  $K$  and  $G$  should be approximately constant after  $T$ , in which case Eq. (11) with  $G'(T) = 0$  yields the boundary condition

$$G(T) = \lambda K(T) / [\pi(T) - \lambda].$$

Then we can compute a new estimate of  $G(t)$  for all  $t$  between 0 and  $T$  by solving the differential equation (11) for  $G'$  backwards from time  $T$ . The algorithm can now be repeated using the new estimate of  $G$ . For reasonable parameter values, this algorithm converges quite rapidly.

#### 4. The long-run steady state

In this section, we characterize the steady state of an economy with oligarchic property rights, given the political risk  $\lambda$ , collateralizability  $\beta$ , utility-discounting  $\rho$ , depreciation  $\delta$ , labor supply  $L$ , production parameters  $(A, \alpha)$ , and risk-free interest rate  $r$ .

In a long-run steady state with a constant labor supply, the growth equation (14) implies that the net profit rate for oligarchs' local investments must be<sup>8</sup>

$$\pi^* = 2\lambda + \rho. \quad (16)$$

By Eq. (10), the gross profit rate or rental rate for local capital in the steady state must be

$$R^* = (1 - \beta)\pi^* + \beta(r + \lambda) + \delta = 2\lambda + \rho + \delta - \beta(\lambda + \rho - r). \quad (17)$$

The steady-state supply of local capital can then be determined from Eq. (9)

$$K^* = L[A(1 - \alpha)/R^*]^{1/\alpha}, \quad (18)$$

and the corresponding wage rate is

$$w^* = \alpha A(K^*/L)^{1-\alpha}. \quad (19)$$

From Eq. (11) with  $G' = 0$ , the steady-state value of government offices must be

$$G^* = \lambda K^*/(\pi^* - \lambda) = \lambda K^*/(\lambda + \rho). \quad (20)$$

From Eqs. (12) and (13), the safe foreign bank accounts held by local oligarchs in the steady state must be

$$X^* = \frac{\lambda[(1 - \beta)K^* + G^*]}{(\pi^* - r - \lambda)} = \frac{\lambda(2\lambda + \rho - \beta(\lambda + \rho))K^*}{(\lambda + \rho - r)(\lambda + \rho)}. \quad (21)$$

<sup>7</sup> Available at <http://home.uchicago.edu/~rmyerson/research/oligarch.xls>.

<sup>8</sup> If the labor supply  $L(t)$  grew at some given exponential rate  $n$ , then  $\pi^*$  would be  $2\lambda + \rho + n$ .

Finally, the total wealth of all oligarchs in the steady state is

$$\Theta^* = X^* + (1 - \beta)K^* + G^*, \tag{22}$$

so that substituting into (21), we get  $X^* = \lambda\Theta^*/(2\lambda + \rho - r)$ . Since  $r \leq \rho$ , the oligarchs in steady state will hold up to half of their wealth in safe foreign assets  $X^*$ .

By Eqs. (17)–(19), a decrease in the political risk parameter  $\lambda$  would cause a decrease in the returns to capital  $R^*$ , which in turn will imply an increase in the capital/labor ratio  $K^*/L$  and an increase in the wage rate  $w^*$ . Thus, workers would benefit from better protection of oligarchic property rights. Wealth flows from owners of capital to government officials at the expected rate  $\lambda K$ , so it might seem that the effects of this expropriation are just the same as a tax of rate  $\lambda$  on capital, but that is true only for the extreme case of  $\beta = 1$ , when the expropriation risk is fully diversifiable in financial markets. In general, because the coefficient of  $\lambda$  in the formula (17) for  $R^*$  is  $2 - \beta$ , the adverse impact of  $\lambda$  on steady-state capital and wages is actually comparable to a higher capital tax rate of  $(2 - \beta)\lambda$ . This difference is due to the greater impact of undiversifiable political risks on risk-averse oligarchs’ investment decisions.

Increasing the fraction  $\beta$  of capital that can be financed by outside investors would decrease the steady-state gross profit rate  $R^*$  in proportion to the quantity  $\lambda + \rho - r$ . Since  $\lambda \geq 0$  and  $\rho \geq r$ , a relaxation of the borrowing constraint (increasing  $\beta$ ) causes a decrease in  $R^*$ , which in turn increases the capital/labor ratio  $K^*/L$  and increases the wage rate  $w^*$ . Thus, workers would benefit from increasing the local capitalists’ ability to borrow against their capital. Only in the case where local capital ownership is perfectly secure ( $\lambda = 0$ ) and the global risk-free interest rate is equal to the investors’ personal discount rates ( $r = \rho$ ), would the steady-state returns to local capital  $R^*$  be equal to  $\delta + \rho$  regardless of  $\beta$ , making local capital  $K^*$  and wages  $w^*$  independent of the ability of outside investors to securely finance local capital. This independence result in this special case of  $\lambda = 0$  and  $r = \rho$  should not lead anyone to underestimate the general importance of creating strong corporate governance structures to protect outside investors. These results are summarized in the following proposition.

**Proposition 1.** *The steady-state gross profit rate on capital depends on political risk  $\lambda$  and collateralizability  $\beta$  according to the formula  $R^* = 2\lambda + \rho + \delta - \beta(\lambda + \rho - r)$ . Steady-state capital  $K^*$  and wages  $w^*$  are decreasing functions of  $R^*$ , and so workers would benefit from a decrease of  $\lambda$  or an increase of  $\beta$ .*

We can evaluate the welfare of the oligarchs in the steady state of our model. Substituting  $\pi^* = 2\lambda + \rho$  into Eq. (4), we find that each individual oligarch’s wealth must grow at rate  $\theta' = \lambda\theta$  in the steady state, with his local and foreign assets growing at the same  $\lambda$  rate. So an individual oligarch with the initial wealth  $\theta_0$  would at any time  $t$  consume  $\rho\theta_0e^{\lambda t}$  and hold safe deposits in the amount of  $x_0e^{\lambda t}$ , where

$$x_0 = \lambda\theta_0/(\pi^* - r) = \theta_0\lambda/(2\lambda + \rho - r).$$

From (5)–(6), oligarchs’ constant-equivalent consumption per unit of initial wealth is  $\hat{c}^*$  such that

$$\begin{aligned} LN(\hat{c}^*)/\rho &= \int_0^\infty \{LN(\rho e^{\lambda t}) + \lambda LN(\rho x_0 e^{\lambda t})/\rho + \lambda(r - \rho)/\rho^2\} e^{-(\rho+\lambda)t} dt \\ &= LN(\rho)/\rho + [\lambda + \lambda LN(\lambda/(2\lambda + \rho - r)) + \lambda(r - \rho)/\rho]/[\rho(\rho + \lambda)]. \end{aligned}$$

So in the steady state, an oligarch's constant-equivalent consumption per unit of initial wealth is

$$\hat{c}^* = \rho e^{\left[ \frac{\lambda + \lambda LN(\lambda / (2\lambda + \rho - r)) + \lambda(r - \rho) / \rho}{\rho + \lambda} \right]} = \rho \left( \frac{\lambda e^{r/\rho}}{2\lambda + \rho - r} \right)^{\lambda / (\rho + \lambda)}. \quad (23)$$

Multiplying  $\hat{c}^*$  by the wealth of any group of oligarchs yields the guaranteed permanent constant-equivalent consumption that would be needed to make them as well off as they expect to be in their privileged oligarchic position. In the steady state, the constant-equivalent consumption for the class of all current oligarchs is

$$C^* = \hat{c}^* \Theta^*. \quad (24)$$

This quantity  $C^*$  is our basic measure of aggregate oligarchic welfare in the steady state.

Proposition 1 tells us that Eq. (17) for  $R^*$  is central to the welfare-relevant implications of our model. The effects of changing some assumptions in our model can be evaluated by seeing how this formula for  $R^*$  would change. In other versions of this paper, we have explored the assumption that the  $\beta$ -secured debt of an ostracized oligarch would be protected from expropriation. Under this assumption,  $R^*$  would be  $2\lambda + \rho + \delta - \beta(2\lambda + \rho - r)$ , and so protection of former oligarchs' debt would increase the effect of  $\beta$  on capital and wages.

We may consider how alternative assumptions about the disposal of expropriated property would have changed the nature of this steady state. One alternative assumption would be that the oligarchs compete for expropriated capital by wasteful political activities that could be modeled as equivalent to publicly burning quantities of the consumption good. In an equilibrium of this alternative model there would be no value of government offices. But Eqs. (16)–(19) would not change, and so the steady-state values of  $\pi^*$ ,  $R^*$ ,  $K^*$ , and  $w^*$  would remain the same as in our model.

A second alternative assumption would be that expropriated capital is allocated to oligarchs in proportion to the capital that they control (as if political power in the oligarchy flowed directly from control of capital, rather than from control of government offices). This assumption would change the relationship between  $R$ , the economic rents from capital, and  $\pi$ , the oligarchs' rate of profit from holding capital, by adding the expropriation rate  $\lambda$  in the numerators of Eq. (10). The formula for  $R^*$  in Eq. (17) would become

$$(1 - \beta)\pi^* + \beta(r + \lambda) + \delta - \lambda = \lambda + \rho + \delta - \beta(\lambda + \rho - r).$$

Notice that the 2 coefficient of  $\lambda$  in Eq. (17) has vanished here. Identifying political power with economic capital would add incentives for economic investment, which would decrease  $R^*$  and increase  $K^*$  and  $w^*$  in comparison to our model, where political power is identified with government offices that are a separate form of investment for oligarchs.

Finally, we may compare the adverse effects of an oligarchy to the effects of a local capital monopolist described by Lucas (1990). In Lucas's model, the capital monopolist has the power to supply all local capital  $K$  by borrowing at the world interest rate  $r$ , but the capital is then rented at the rate  $R$  to firms that pay the competitive wage. The steady-state income of such a capital monopolist is then  $(R - r - \delta)K$ , where  $R$  depends on  $K$  according to (9), which implies  $\partial R / \partial K = -\alpha R / K$ . To maximize the capital monopolist's income, he would choose  $K$  so that

$$R = (r + \delta) / (1 - \alpha).$$

Compared to such a capital monopolist, perfect property rights ( $\lambda = 0$ ,  $\beta = 1$ ) would yield lower  $R^*$ . But with  $\beta = 0$ , our oligarchs would have higher  $R^*$  (and so lower capital and wages) when political risk is high enough to satisfy  $\lambda \geq 0.5[(r + \alpha\delta) / (1 - \alpha) - \rho]$ .

## 5. Global general equilibrium with oligarchic property rights: determination and examples

Property rights imperfections that impoverish one country may enrich another. To analyze the redistributive consequences of political risk, let us now consider a multi-national extension, including both the sources and recipients of capital flight.

Let  $J$  denote the set of countries in the world. For simplicity, let us assume that the basic technological and personal-preference parameters of our model ( $\alpha, A, \delta, \rho$ ) are the same in all countries and consider the situation where all  $J$  countries have already reached their steady-state capital stock levels which will be denoted  $K_j$  in each country  $j$ . Let  $L_j$  denote the given fixed labor supply in country  $j$ . The openness and security of property rights in country  $j$  are measured by the parameters  $\beta_j$  and  $\lambda_j$  where  $\beta_j$  is the fraction of local capital that can be owned or financed by outside investors, and  $\lambda_j$  measures the political risk of the privileged insiders who must own the balance of the local capital stock. The risk-free interest rate  $r$  in global capital markets now becomes an endogenous variable and must be determined in equilibrium. For any given  $r$ , however, the steady-state prices and assets in each country  $j$  are easily determined from the results in the previous section.

In each country  $j$ , the net profit rate in steady state from (16) is

$$\pi_j = \rho + 2\lambda_j. \quad (25)$$

Then the gross rate of return to local capital is

$$R_j = (1 - \beta_j)(2\lambda_j + \rho) + \beta_j(r + \lambda_j) + \delta, \quad (26)$$

so that in the steady state, the local capital stock must be given by

$$K_j = L_j(A(1 - \alpha)/R_j)^{1/\alpha}, \quad (27)$$

and the corresponding wage rate is

$$w_j = \alpha A(K_j/L_j)^{1-\alpha}. \quad (28)$$

The steady-state value of government offices in country  $j$  is

$$G_j = (1 - \beta_j)\lambda_j K_j / (\pi_j - \lambda_j). \quad (29)$$

Note that this is equal to zero if either  $\lambda_j = 0$  or  $\beta_j = 1$ . Hence, either a perfect property rights system or a perfect corporate governance system (perfect collateral system) remove economic value from government offices providing valuable protection. As long as oligarchs are insecure and full collateralization of capital is impossible, however, government offices will command value. The privileged insiders of such a country  $j$  with imperfect property rights system will hold positive safe investments in global financial markets that are worth

$$X_j = K_j \lambda_j (2\lambda_j + \rho - \beta_j(\lambda_j + \rho)) / ((\lambda_j + \rho)(\lambda_j + \rho - r)). \quad (30)$$

Let us denote safe assets held in global financial markets by people who are ostracized former oligarchs of country  $j$  by  $\Omega_j$ . Then the global demand for safe financial securities will be given by  $\sum_{j \in J} (X_j + \Omega_j)$ . The global supply, on the other hand, has to be equal to the sum of all collateralized capital stock offered world-wide,  $\sum_{j \in J} \beta_j K_j$ . Hence,

$$\sum_{j \in J} (X_j + \Omega_j) = \sum_{j \in J} \beta_j K_j \quad (31)$$

gives the market-clearing condition for the market of safe financial securities and implicitly determines the global interest rate  $r$ . More specifically, the gross profit rate on local capital in each country  $j$  must be positive  $R_j > 0$ . So the equilibrium real interest rate  $r$  must satisfy

$$r > -[\delta + 2\lambda_j + \rho - \beta_j(\lambda_j + \rho)]/\beta_j \quad (32)$$

for every country  $j$  where  $\beta_j > 0$ . Indeed, as  $r$  approaches this lower bound,  $R_j$  approaches zero, so that the steady-state demand for capital and the steady-state supply of global securities  $\beta_j K_j$  from this country become infinite.

We can also see that, in the steady state, the equilibrium safe world interest rate  $r$  must be less than  $\rho$ . Observe, first, that safe assets held by expatriated oligarchs earn interest at rate  $r$ , but they consume out of their assets at rate  $\rho$ , and so their assets will evolve at the rate  $(r - \rho)\Omega_j$ . At the same time, newly ostracized oligarchs bring their safe holdings into  $\Omega_j$  at the rate  $\lambda_j X_j$ , where  $X_j$  denotes the safe financial assets held by oligarchs of country  $j$ . The market-clearing condition (31) implies that  $\sum_{j \in J} \Omega_j$  must remain constant in the steady state where all capital stocks are constant, so that we must have  $0 = \sum_{j \in J} \Omega'_j = \sum_{j \in J} \lambda_j X_j - (\rho - r) \sum_{j \in J} \Omega_j$ , or

$$\sum_{j \in J} \Omega_j = \sum_{j \in J} \lambda_j X_j / (\rho - r), \quad (33)$$

which only makes sense if  $\rho > r$ . (As  $r$  approaches  $\rho$ , former oligarchs' demand  $\sum_{j \in J} \Omega_j$  for global securities goes to infinity.) To sum up, in the steady state, the global equilibrium interest rate must always lie in-between the bounds given by (32) and  $\rho > r$ , so we have

**Proposition 2.** *In a steady-state global equilibrium where at least one country has positive political risk  $\lambda_j > 0$ , the global risk-free interest rate  $r$  must be strictly less than individuals' rate of time preference  $\rho$ .*

A simple calibration exercise can help better understand how the presence and degree of oligarchic property rights affect the distribution of capital and wages in the global equilibrium. We use the benchmark parameter values for growth models suggested in Barro and Sala-i-Martin (2003, p. 79) to set  $\alpha = 0.7$  for labor's share of income, and  $\delta = 0.05$  for the depreciation rate. Barro and Sala-i-Martin (2003, p. 124) also suggest using the parameter value 0.06 for the world interest rate. In our model, the world interest rate is determined endogenously (Proposition 2), and it would be equal to the subjective discount rate in the steady state where all countries had perfect enforcement of property rights, so we let  $\rho = 0.06$  be the personal discount rate. We normalize  $A = 0.95$  to be the production rate with unit inputs of capital and labor, because this constant together with the other parameters would make the equilibrium wage rate be equal to 1 if all countries had perfect enforcement of property rights. With these parameters, if the world had no political risk anywhere, so that  $\lambda = 0$ , then a steady-state equilibrium would have interest rate  $\bar{r} = \rho = 0.06$ , gross profit rate  $\bar{R} = \rho + \delta = 0.11$ , capital/labor ratio  $\bar{K}/L = (A(1 - \alpha)/\bar{R})^{1/\alpha} = 3.9$ , capital-output ratio  $\bar{K}/\bar{Y} = 2.73$ , and wage rate  $\bar{w} = \alpha A(\bar{K}/L)^{1-\alpha} = 1$ .

Instead of this ideal world, let us now consider a simple world that is divided in two countries with equal population  $L_1 = L_2 = 1$ . In country 1, there is no political risk, and capital ownership can be securely protected as long as politically connected individuals have at least a 40% ownership share, so  $\lambda_1 = 0$  and  $\beta_1 = 0.6$ . Country 2 is run by an oligarchy with positive political risk rate  $\lambda_2 = 0.025$ , and outsiders cannot securely hold any local assets, so  $\beta_2 = 0$ . These parameter values are close to what we estimate in Section 8 for such countries as Egypt, Colombia, and the Philippines, and they, together with other standard values for the basic parameters ( $\alpha, \delta, \rho, A$ )

Table 1

A two-country calibration of the global steady-state equilibrium:  $\alpha = 0.7$ ,  $\delta = 0.05$ ,  $\rho = 0.06$ ,  $A = 0.95$ . The parameter  $\rho = 0.06$  and  $A = 0.95$  make global risk-free interest rate  $r = 0.06$  and steady-state wage  $w = 1$  in ideal case with  $\lambda = 0$ ,  $\beta = 1$

Given parameters				The global risk-free interest rate is $r = 0.0345$					
Country	$L_j$	$\lambda_j$	$\beta_j$	$\pi_j$	$K_j$	$G_j$	$X_j$	$\Omega_j$	$w_j$
$j = 1$	1	0	0.6	0.06	4.83	0	0	0	1.07
$j = 2$	1	0.025	0	0.11	2.28	0.67	1.46	1.43	0.85

Note.  $0.6 \times 4.83 = 1.46 + 1.43$ .

noted above, produce a politically stable parametric case in the sense of Proposition 4 below (Section 6). The expropriation risk should seem small, in that it implies that any oligarch has an expected time until expropriation of  $1/\lambda_2 = 40$  years.

For this two-country world, the global risk-free interest rate in a steady-state equilibrium is  $r = 0.0345$  and other steady state values are as presented in Table 1.

In this example, 68% of the world's capital is in country 1. But 60% of country 1's capital has been financed by the current and former elite of country 2, with  $X_2 = 1.46$  and  $\Omega_2 = 1.42$ . As a result, the capital-output ratio in country 2 is just 1.875. The wage rate in country 1 is 25% higher than in country 2. Furthermore,  $w_1$  is actually 7% higher than the equilibrium wage that workers would get in an ideal world without any political risk ( $\bar{w} = 1$ ) while the capital-output ratio is 16% higher at 3.17. In the on-line spreadsheet we provide the basis for calculating various other global equilibria with different oligarchic property rights: we can add the third, the fourth, and so on countries with different parameters ( $\lambda_j, \beta_j$ ) to obtain essentially the same qualitative results: the political risk in other countries increases the welfare of workers in countries where owners of capital are better protected. More generally, Proposition 2 has the following corollary.

**Proposition 3.** *In a global steady state, if any country has positive political risk  $\lambda_i > 0$ , then any other country that has no political risk and is open to outsiders' investment ( $\lambda_j = 0, \beta_j > 0$ ) will have  $R_j = \rho + \delta - \beta_j(\rho - r) < \rho + \delta$  and so will have capital and wages that are strictly greater than they would be if all countries had perfect property rights.*

The magnitude of these effects is illustrated in Figs. 1 and 2 using the calibrated model for the two-country example in Table 1. Figure 1 shows the steady-state effects of a change in  $\lambda_2$ , the political risk rate in country 2. Greater political risks in country 2 obviously hurt workers in country 2, but it can be seen that the effects on workers in country 1 are ambiguous. As long as  $\lambda_2$  is not too high ( $\lambda_2 < 0.19$  in this example), a small increase in  $\lambda_2$  would increase capital flight from country 2, which would decrease world interest rates (down to  $r = 0.0156$  when  $\lambda_2 = 0.19$ ), and thus would increase steady-state capital and wages in country 1. But when  $\lambda_2$  becomes very high ( $\lambda_2 > 0.19$ ), the principal effect would be to further impoverish country 2, decreasing the funds that its oligarchs invest abroad. This leads to less, not more capital flight (in absolute terms) from country 2 to country 1, increasing world interest rates, and *decreasing* steady-state capital and wages in country 1.

Effects of a change in  $\beta_2$ , the degree of protection for outside investors in country 2 are, on the other hand, unambiguous. Figure 2 shows those effects, given the fixed political risk rate  $\lambda_2 = 0.025$ . Greater protection for outside investors in country 2 would yield higher wages in country 2, but it would also increase world interest rates in the steady state and thus would decrease capital and wages in country 1. As  $\beta_2$  increases to 1, the world interest rate increases

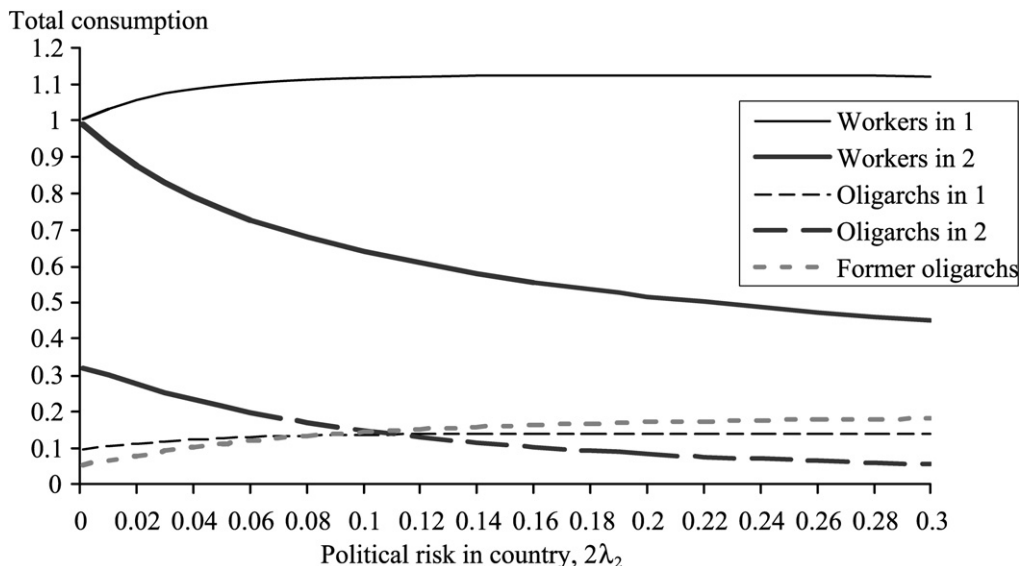


Fig. 1. Aggregate steady-state consumption rates with different political risks in country 2, for two-country model with  $\alpha = 0.7$ ,  $\delta = 0.05$ ,  $\rho = 0.06$ ,  $A = 0.95$ ,  $L_1 = L_2 = 1$ ,  $\lambda_1 = 0$ ,  $\beta_1 = 0.6$ ,  $\beta_2 = 0$ .

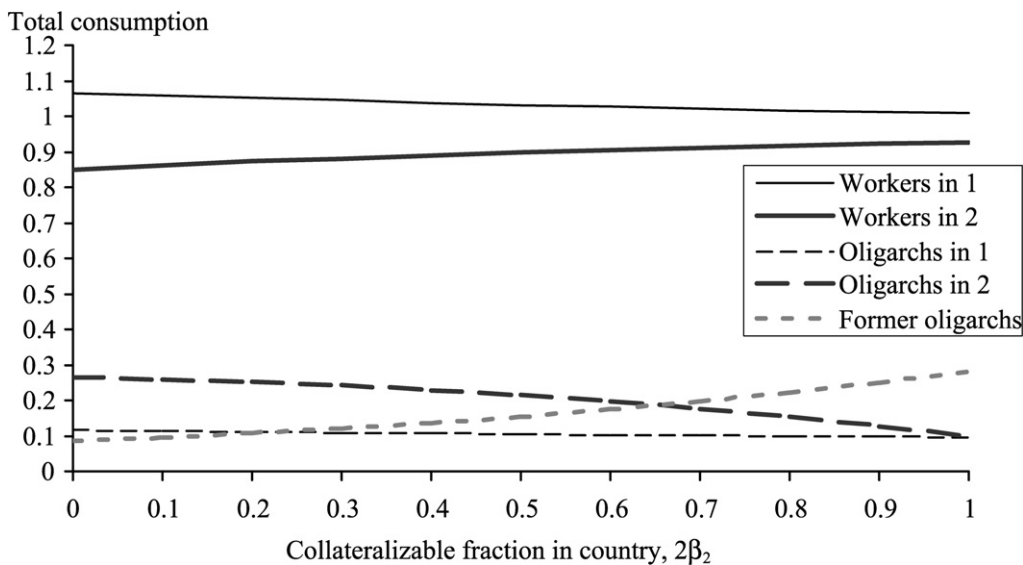


Fig. 2. Aggregate steady-state consumption when outsiders can finance different fractions of local capital in country 2, for two-country model with  $\alpha = 0.7$ ,  $\delta = 0.05$ ,  $\rho = 0.06$ ,  $A = 0.95$ ,  $L_1 = L_2 = 1$ ,  $\lambda_1 = 0$ ,  $\beta_1 = 0.6$ ,  $\lambda_2 = 0.025$ .

to  $r = 0.0559$ , the wage rate in country 1 decreases to  $w_1 = 1.01$ , and the wage rate in country 2 increases to  $w_2 = 0.93$ . Thus, globalization would help workers in the poor country, but it would reduce the steady-state wealth of the oligarchs who dominate the poor country, and it would also be against the interests of workers in the rich country.



## 6. Dynamic effects of unexpected political reforms

Oligarchs' preferences over different systems of property rights are not necessarily fully revealed by aggregate consumption plotted in Figs. 1 and 2. First, aggregate consumption is not a complete measure of welfare for the oligarchs, because it does not take account of their political risks. But for the cases considered in Figs. 1 and 2, the oligarchs' constant-equivalent consumption would differ only slightly from the aggregate consumption rates shown in those figures. A more serious problem comes from the fact that changing the system of property rights would not make the economy jump from one steady state to another, so that the analysis of a change must consider its full dynamic effects.

For example, suppose that the world economy was in the steady state for our two-country example in Table 1, and then a political reform was proposed in country 2 that would decrease the expropriation rate to  $\lambda_2 = 0.01$ . Figure 1 shows that this reform would *eventually* lead to a new steady state in which the oligarchs have higher aggregate consumption. Furthermore, because the oligarchs would have less political risk in this new steady state, their constant-equivalent consumption would be increased even more. But this change would not occur instantly. In the steady state with  $\lambda_2 = 0.01$ , the oligarchs' total economic assets would be  $K_2 + X_2 = 3.07 + 1.50 = 4.57$ , which is 22% larger than their total economic assets in the old steady state with  $\lambda_2 = 0.025$ . To reach the new steady state, the oligarchs would need to save over many years, to accumulate this increased wealth. Once these dynamic effects are taken into account, such a reform can actually make the local oligarchs worse off.

We saw in Section 3 how to analyze such a dynamically evolving economy in the case of a small country whose changing economic aggregates would not affect the global interest rate. To employ this analysis here, we subdivide "country 2" into many small countries, each of which has the same property-rights parameters  $(\lambda, \beta)$ . We can then apply the methods of Section 3 to examine the dynamic effects of a change of the property-rights parameters in one small country.

We continue to use standard parameter values from the previous section,<sup>9</sup>

$$\alpha = 0.7, \quad \delta = 0.05, \quad \rho = 0.06, \quad A = 0.95, \quad L = 1, \quad r = 0.035. \quad (34)$$

Consider an oligarchic country with political risk  $\lambda = 0.025$  and collateralizability  $\beta = 0$ , and suppose that it has converged to the steady state for these parameters. From Eqs. (16)–(24),

$$K^* = 2.28, \quad X^* = 1.48, \quad G^* = 0.67, \quad w^* = 0.85, \quad \pi^* = 0.11,$$

in this steady state, and the aggregate constant-equivalent consumption for all oligarchs is

$$C^* = \hat{c}^*(K^* + X^* + G^*) = 0.0516 \times (2.28 + 1.48 + 0.67) = 0.2283.$$

The oligarchs' total economic holdings are  $H^* = K^* + X^* = 3.76$ .

Figures 3a and 3b illustrate the dynamic adjustment process following an unanticipated political reform that permanently decreases the political risk to  $\lambda = 0.01$  at some time  $t = 0$ , starting from the steady state with the standard parameter values (34) and  $(\lambda^* = 0.025, \beta^* = 0)$ . As soon as they recognize the change to  $\lambda = 0.01$ , the oligarchs will want to invest more in local capital  $K$ . In the dynamic equilibrium, this causes an immediate 28% increase in the local capital stock to  $K(0) = 2.92$ , paid for by an equal decrease in the oligarchs' foreign bank accounts  $X$ . The competitive wage at time 0 jumps by about 7.7%, to  $w(0) = 0.92$ , and the net profit rate on

<sup>9</sup> We let the world interest rate be  $r = 0.035$ , which is close to the equilibrium value in our two-country example.

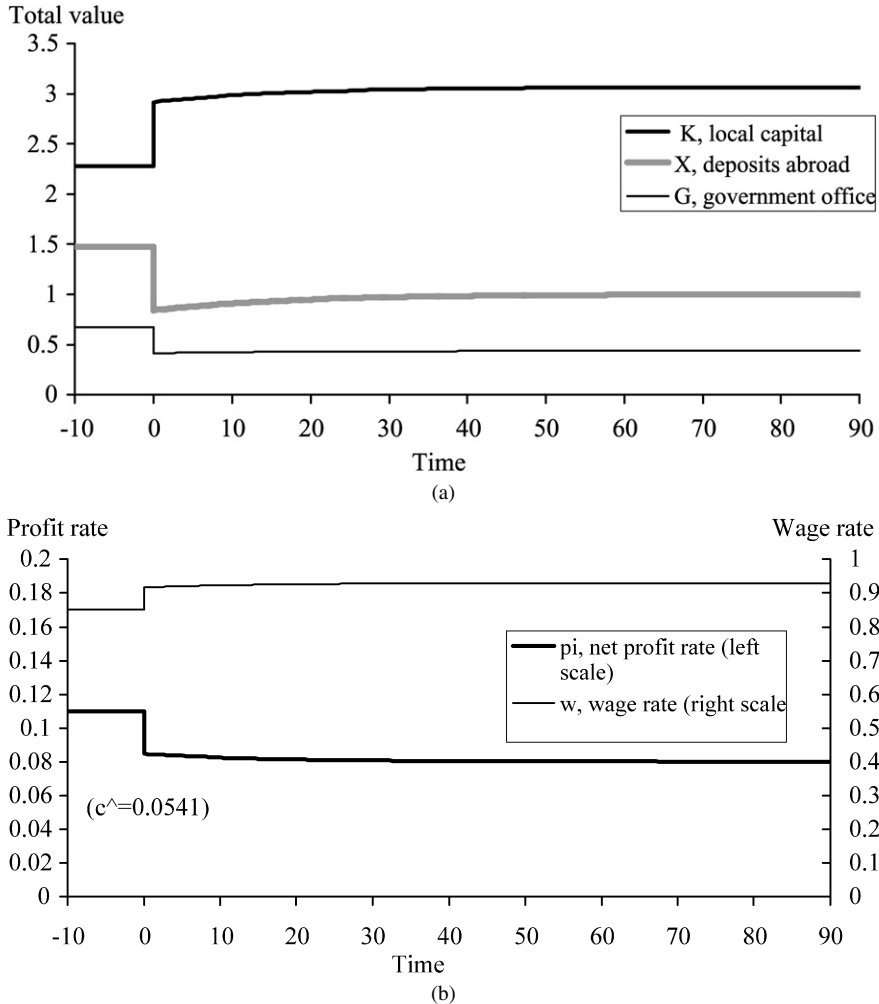


Fig. 3. (a) Asset changes after decreasing political risk to  $\lambda = 0.01$  at  $t = 0$ , starting from the steady state of  $\lambda = 0.025$ , holding fixed  $\alpha = 0.7$ ,  $\delta = 0.05$ ,  $\rho = 0.06$ ,  $A = 0.95$ ,  $r = 0.035$ ,  $L = 1$ ,  $\beta = 0$ . (b) Profits and wages after decreasing political risk to  $\lambda = 0.01$  at  $t = 0$ , starting from the steady state of  $\lambda = 0.025$ , holding fixed  $\alpha = 0.7$ ,  $\delta = 0.05$ ,  $\rho = 0.06$ ,  $A = 0.95$ ,  $r = 0.035$ ,  $L = 1$ ,  $\beta = 0$ .

local investments drops from  $\pi^* = 0.11$  to  $\pi(0) = 0.085$ . Lower expropriation rate also lowers the value of government offices  $G(0)$  by 39%. Then, in the decades after the reform, local capital stock gradually increases towards its new steady-state value of  $K(\infty) = 3.07$ , which yields a competitive wage rate of  $w(\infty) = 0.93$  and a local net profit rate of  $\pi(\infty) = 0.08$ .

When these dynamic effects are taken into account, it turns out that the total constant-equivalent consumption for all oligarchs at time 0 is *lower* than it was in the steady state with *higher* risk of expropriation. Specifically, with the new political risk  $\lambda = 0.01$  and the anticipated net profit rates  $\pi(t)$  for all  $t > 0$  in this dynamic equilibrium, the oligarchs' constant-equivalent consumption per unit wealth at time 0 is  $\hat{c} = 0.0541$  by Eq. (6), which is 4.8% greater than in the old steady state (where  $\hat{c}^*$  was 0.0516). The decline in the value of gov-

ernment offices at time 0, however, has decreased the oligarchs' total wealth by 5.8%, and so the new aggregate constant-equivalent consumption  $C$  at time 0 in this dynamic equilibrium is

$$C = \hat{c}(K(0) + X(0) + G(0)) = 0.0541 \times (2.92 + 0.84 + 0.41) = 0.2255,$$

which is less than the oligarchs'  $C^*$  in the old steady state. Thus, we find that the oligarchs would oppose a political reform that reduces their political risks and increases the security of their property rights. Of course any one oligarch would prefer that his own political risk should be reduced. But the equilibrium with systematically lower political risk for all oligarchs can actually make them worse off.<sup>10</sup>

Similar logic also applies to an increase in the collateralizability parameter  $\beta$ , which measures the fraction of local capital that can be owned or financed by outsiders. Any individual oligarch would generally prefer to extend his own local investments by leverage from global financial markets. But in equilibrium, the credit from an increase of  $\beta$  may cause a growth of the local capital stock that increases wages and decreases local profits, and the oligarchs' total welfare may actually be decreased as a result. For example, consider the effects of an unanticipated political reform that increases the collateralizability of local capital to  $\beta = 0.33$ , starting from the steady state with  $(\lambda^* = 0.025, \beta^* = 0)$ , and other standard parameter values (34) (Figs. 4a and 4b). Right after this reform, the oligarchs borrow massively abroad to finance a 26% increase in local capital, which increases wages by 7% and decreases the local net profit rate to  $\pi(0) = 0.099$ . This decline in the profit rate  $\pi$  occurs even though the financial leverage now allows the oligarchs to profit from 50% more capital per unit of their own investment, because the net expected profit rate  $R - \delta - r - \lambda$  per unit capital is cut to less than half (from 0.05 in the old steady state to 0.0235 immediately after the reform). The reform also causes the total value of government offices to increase substantially (given our assumption here that government officials can also benefit from expropriating capital financed by outsiders). Then, in the decades after the reform, the oligarchs' total wealth and the local capital stock gradually decline, and the oligarchs' net profit rate on their leveraged local investments slowly rises back toward the original steady-state  $\pi^* = 0.11$ . So the post-reform depression of net profit rates is transient, but it changes the oligarchs' total constant-equivalent consumption after the reform to

$$\begin{aligned} C &= \hat{c}[(1 - \beta)K(0) + X(0) + G(0)] = 0.0490 \times [(1 - 0.33) \times 2.88 + 1.83 + 0.89] \\ &= 0.2278, \end{aligned}$$

slightly less than their constant-equivalent consumption in the politically stable steady state.

Of course, reforms that worsen property rights may also be bad for the oligarchs. Starting from the same steady state with  $(\lambda^* = 0.025, \beta^* = 0)$ , and other standard parameter values (34), a regime change that increased political risk to  $\lambda = 0.03$  would reduce aggregate oligarchic welfare to  $C = 0.2282$ . The dynamic effects of this increase of  $\lambda$  would be qualitatively opposite in direction to the effects of decreasing  $\lambda$  that we saw in Figs. 3a and 3b. But it can be shown that, for this increase of  $\lambda$ , the adverse effect of decreased security on  $\hat{c}$  would be quantitatively larger than the wealth-increasing effect on  $G(0)$ .

In fact, the steady state with  $(\lambda^* = 0.025, \beta^* = 0)$  is very close to one that has what may be called "political stability property." Given the other economic parameters of our model, let us

<sup>10</sup> Compare with oligarchs imposing a higher than optimal (revenue-maximizing) tax on other producers to manipulate factor prices in Acemoglu (2005).

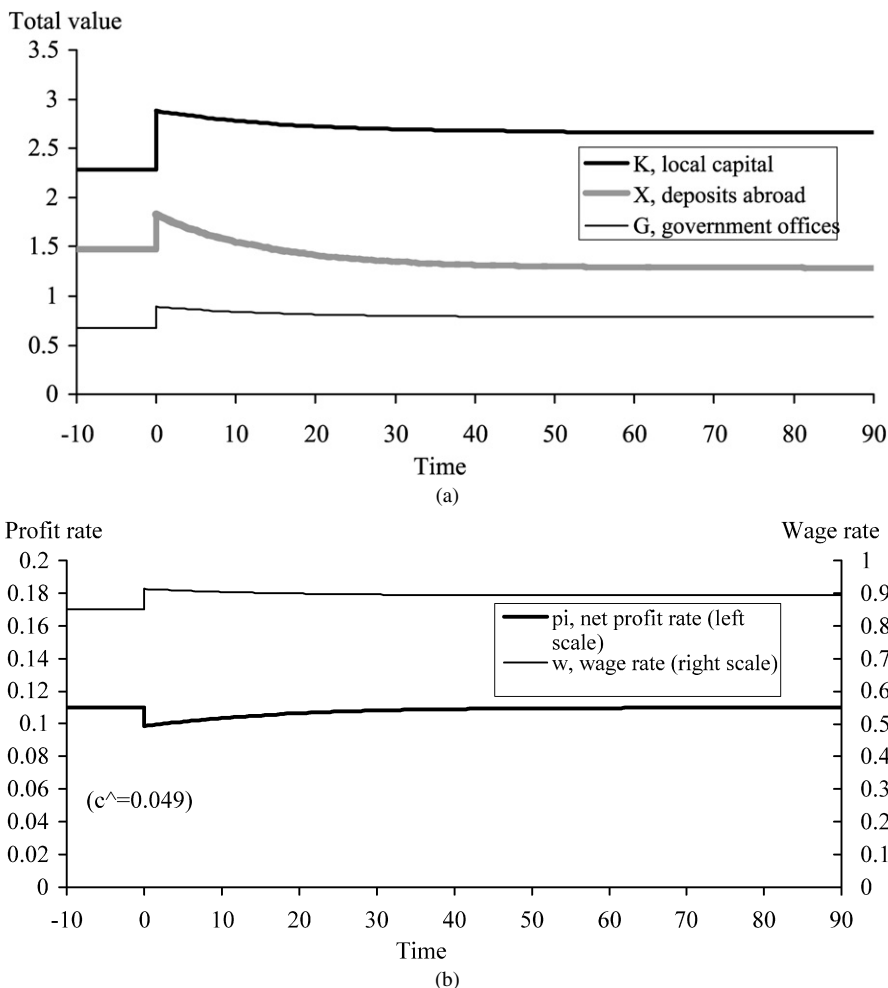


Fig. 4. (a) Asset changes after increasing collateralizability to  $\beta = 0.33$  at  $t = 0$ , starting from the steady state of  $\beta = 0$ , holding fixed  $\alpha = 0.7$ ,  $\delta = 0.05$ ,  $\rho = 0.06$ ,  $A = 0.95$ ,  $r = 0.035$ ,  $L = 1$ ,  $\lambda = 0.025$ . (b) Profits and wages after increasing collateralizability to  $\beta = 0.33$  at  $t = 0$ , starting from steady state of  $\beta = 0$ , with  $\alpha = 0.7$ ,  $\delta = 0.05$ ,  $\rho = 0.06$ ,  $A = 0.95$ ,  $r = 0.035$ ,  $L = 1$ ,  $\lambda = 0.025$  fixed.

say that a regime of oligarchic property rights with expropriation risk  $\lambda^*$  and collateralizability of debt  $\beta^*$  is *politically stable* if, starting from a steady state with any other  $(\lambda, \beta)$  in some neighborhood of  $(\lambda^*, \beta^*)$ , a small change toward  $(\lambda^*, \beta^*)$  would increase the oligarchs' welfare  $C$ . For our standard parameter values in (34), the steady state with  $\lambda^* = 0.025165$  and  $\beta^* = 0$  is politically stable in this sense. This local stability property can be demonstrated by the results of "Appendix to Capital and Growth With Oligarchic Property Rights" (Braguinsky and Myerson, 2006, Section 2), where, by analyzing a local linear approximation to our dynamic economic model, we derive formulas for the welfare effects of small parametric changes from a steady state. With these formulas, it can be shown that  $\partial C / \partial \beta$  is negative and  $\partial C / \partial \lambda$  is 0 and locally decreasing at  $\lambda^* = 0.025165$  and  $\beta^* = 0$  and all other parameters as in (34). These results are summarized by

**Proposition 4.** *In some cases, a parameter change that improves oligarchic property rights by decreasing political risk  $\lambda$  or by increasing collateralizability  $\beta$  can reduce the oligarchs' aggregate welfare  $C$  in the dynamic economic equilibrium. Furthermore, there exist parametric cases where a regime of oligarchic property rights with positive political risk  $\lambda^* > 0$  and no protection for outside investors  $\beta^* = 0$  is politically stable in the sense that, from any steady state where  $\lambda$  and  $\beta$  differ slightly from these politically stable values, a small parameter change toward these stable values would increase the oligarchs' welfare.*

The analysis of oligarchs' welfare here assumed that all oligarchs hold local capital and government office in the same proportions. But in our model, we cannot determine how any individual oligarch should allocate his investments between these two local assets, because they are perfect substitutes as long as the parameters are held fixed. Going beyond the model, there might be some advantage for each individual oligarch to specialize as either an industrialist or a politician, concentrating his local holdings either in local capital or in government offices. Then an increase in political risk  $\lambda$  would be better for the politicians than for the industrialists.

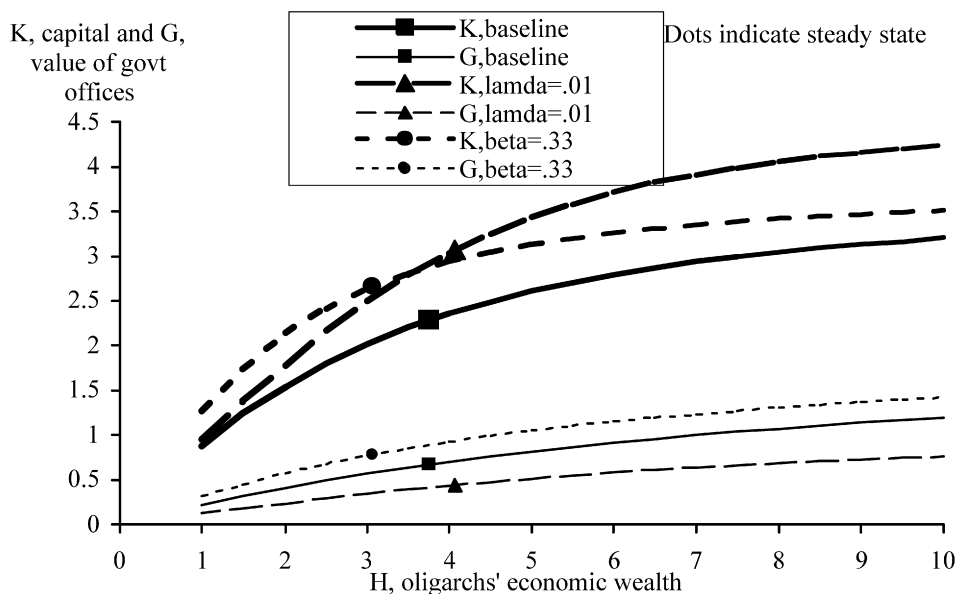
It is worth noting that an increase in collateralizability  $\beta$  also benefits the politicians more than the industrialists, given our assumption that all local capital of an ostracized oligarch, including its collateralized part, is subject to expropriation. It seems that in this framework, politicians in oligarchic countries would have incentives to increase openness to outside investors even for moderate political risk. On the other hand, under the alternative assumption that makes the debt to outside investors secure and not subject to expropriation, it can be shown that an increase in collateralizability  $\beta$  would generally decrease oligarchs' total welfare, as long as the local political risk  $\lambda$  is not too high (details are available upon request).

A lower risk-free interest rate  $r$  in international capital markets would tend to make the oligarchs more favorable to better political security. For example, with lower global interest rate  $r = 0.03$  but all other parameters as in (34), a politically stable steady state can be found with  $\beta^* = 0$  and lower political risk  $\lambda^* = 0.0163$ .

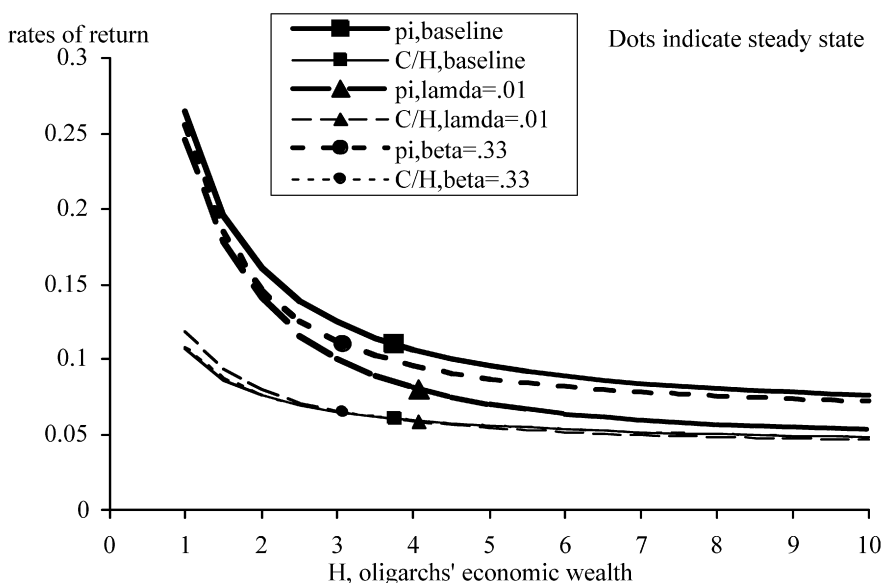
Figures 5a and 5b offer another way of understanding the effects of the parameter changes that we have explored above. Once the parameters  $(\alpha, \delta, \rho, A, r, L, \lambda, \beta)$  have been specified, we can determine the dynamic equilibrium path from the oligarchs' economic holdings  $H(t) = (1 - \beta)K(t) + X(t)$  at any time  $t$ . For our baseline parameter values in (34) with  $\lambda = 0.025$  and  $\beta = 0$ , the solid curves in Fig. 5a shows how the aggregate capital stock  $K$  and the aggregate value of all government offices  $G$  would depend on the oligarchs' economic wealth  $H$ . These curves were computed by solving the dynamic model with these baseline parameter values twice, once starting from  $H_0 = 1$ , and once starting from  $H_0 = 10$ , and then plotting the trajectories  $(H(t), K(t))$  and  $(H(t), G(t))$  for all times  $t$ . The steady-state values on these curves are indicated by the solid squares above  $H^* = 3.76$ . Similarly, the dependence of  $\pi(t)$  on  $H(t)$  with these baseline parameter values is indicated by the solid curve in Fig. 5b.

The dashed curves in Fig. 5a show how the  $(H, K)$  and  $(H, G)$  trajectories would shift when the political-risk parameter is changed to  $\lambda = 0.01$ , with all other parameters held fixed at their baseline values. For any level of the oligarchs' economic holdings  $H$ , the lower political risk  $\lambda$  decreases the value of the oligarchs' government offices  $G$ , and it increases the amount of capital  $K$  that they will hold. Similarly, the dashed curve in Fig. 5b shows that, for any level of the oligarchs' economic wealth  $H$ , the lower political risk decreases the local profit rate  $\pi$ . Notice that each of these effects of decreasing  $\lambda$  tends to be larger at higher levels of  $H$ .

The dotted curves in Figs. 5a and 5b show how these trajectories would shift when the collateralizability parameter is changed to  $\beta = 0.33$ , holding fixed  $\lambda = 0.025$  and all other base-



(a)



(b)

Fig. 5. (a) Relation of  $G$  and  $K$  to oligarchs' economic wealth  $H$  on dynamic equilibrium path, for the baseline example ( $\alpha = 0.7, \delta = 0.05, \rho = 0.06, A = 0.95, r = 0.035, L = 1, \lambda = 0.025, \beta = 0$ ) and two variations: one with  $\lambda = 0.01$ , one with  $\beta = 0.33$ . (b) Relation of  $\pi$  to oligarchs' economic wealth  $H$  on dynamic equilibrium path, for the baseline example ( $\alpha = 0.7, \delta = 0.05, \rho = 0.06, A = 0.95, r = 0.035, L = 1, \lambda = 0.025, \beta = 0$ ) and two variations: one with  $\lambda = 0.01$ , one with  $\beta = 0.33$ .

line parameter values. The improved protection for outside creditors increases the local capital stock  $K$ , increases the value of government offices  $G$ , and decreases the net local profit rate  $\pi$ . In contrast with the decrease of political risk  $\lambda$ , the effects of increasing collateralizability  $\beta$  tend to be relatively larger at lower levels of the oligarchs' economic wealth.

When we start from the baseline steady state at  $H^* = 3.76$ , an unanticipated political reform that changes the  $\lambda$  or  $\beta$  parameter would create a dynamic equilibrium that follows the shifted trajectories shown in Figs. 5a and 5b, starting from a jump onto the new trajectories at given initial value of the oligarchs' economic wealth  $H(0) = 3.76$ . After this initial jump, the economy gradually moves toward the new steady state (indicated in Figs. 5a and 5b by triangles on the dashed  $\lambda = 0.01$  curves, by circles on the dotted  $\beta = 0.33$  curves).

Our model can also be applied to analyzing the economic consequences of the end of Communism. In this context, a communist country is interpreted as an oligarchic country that is closed to both import and export of capital, and the transition to a market economy is modeled as an unexpected political reform that allows local oligarchs to freely invest abroad at the world interest rate. In a companion paper (Braguinsky and Myerson, 2007) we have shown that such a reform can severely reduce local capital and wages, even if there was no change of political risk and the inherited capital stock was at its long-run steady-state value. The depression can be mitigated by increasing  $\beta$  to admit outsiders' investments.

## 7. Extension: recruitment into the oligarchy

We have been considering a model where oligarchs lose their special privileges and become common citizens at random times. In the long run, the flow of people out of the oligarchy should be balanced by an opposite flow of common citizens being recruited into the oligarchy. In this section we consider a simple extension of our model with recruitment into the oligarchic class and show that it leaves the basic results of our analysis intact.

We assume that a person's initial entry into the oligarchic circle of trust requires chance personal connections that cannot be bought or hastened in any way. For simplicity, let any common citizen's waiting time to gain entry into the oligarchy be an exponential random variable with mean  $1/\mu$ , where  $\mu$  is some small number. That is, in any short time interval of length  $\varepsilon$ , a common citizen's probability of gaining admission into the oligarchy is approximately  $\mu\varepsilon$ . With oligarchs exiting at rate  $\lambda$ , the steady-state ratio of common citizens per oligarch in the overall population would be  $\lambda/\mu$ . So we should think of  $\mu$  as being much smaller than  $\lambda$ , and we will be interested in the limit as  $\mu \rightarrow 0$ .

Our characterization of optimal consumption and investment strategies (2)–(4) can be carried over to this more general model. In an investment-consumption strategy that maximizes an individual's expected discounted logarithmic utility of consumption, the optimal consumption rate is always equal to  $\rho\theta(t)$  when  $\theta(t)$  is his current wealth. When the individual has oligarchic status, his optimal investment in the safe asset is  $\lambda\theta(t)/[\pi(t) - r]$ , when  $\pi(t)$  is the local net profit rate. Thus, any individual oligarch's wealth grows at the rate  $\theta'(t) = [\pi(t) - \rho - \lambda]\theta(t)$  as long as he retains his oligarchic status. On the other hand, a common citizen's wealth  $\hat{\theta}(t)$  has negative growth rate  $\hat{\theta}'(t) = (r - \rho)\hat{\theta}(t)$ .

Now consider the dynamics of the aggregates  $(\Theta(t), K(t), G(t), X(t), \Omega(t))$ , where  $\Omega(t)$  is the total wealth of all common citizens in the country, and the other quantities are as defined in Section 3. Equation (14) for the growth of oligarchic wealth must be revised to include the effects

of commoners being randomly recruited into the oligarchy. With such recruitment at rate  $\mu$ , the growth of aggregate oligarchic wealth becomes

$$\Theta'(t) = [\pi(t) - 2\lambda - \rho]\Theta(t) + \mu\Omega(t). \tag{35}$$

The commoners' aggregate wealth  $\Omega(t)$  grows at rate

$$\Omega'(t) = (r - \rho - \mu)\Omega(t) + \lambda X(t) = (r - \rho - \mu)\Omega(t) + \Theta(t)\lambda^2 / (\pi(t) - r). \tag{36}$$

Here  $(r - \rho)\Omega(t)$  is the change of wealth of common citizens whose status stays the same continuously at time  $t$ , while  $\mu\Omega(t)$  is the outflow of wealth taken into the oligarchic class by citizens who get promoted at time  $t$ , and  $\lambda X(t) = \Theta(t)\lambda^2 / (\pi(t) - r)$  is the inflow of wealth that ostracized oligarchs take with them as they become commoners. All other economic variables can be characterized by the same Eqs. (10)–(13) that we found in Section 3. So the dynamic behavior of  $(\Theta, K, X, G, \Omega, \pi)$  in this economy with recruitment at rate  $\mu$  is characterized by Eqs. (35)–(36) together with Eqs. (10)–(13). The initial conditions at time 0 include the commoners' initial wealth  $\Omega(0)$  and the oligarchs' initial economic holdings  $H_0 = (1 - \beta)K(0) + X(0)$ .

To evaluate welfare in this extended model, let the expected  $t$ -discounted future utility of an individual with wealth 1 at time  $t$  be denoted by  $u(t)$  if he is an oligarch and  $v(t)$  if he is a commoner. Because the optimal consumption and investment plan is always proportional to wealth, the expected  $t$ -discounted future utility of an individual with wealth  $\theta(t)$  at time  $t$  is  $u(t) + LN(\theta(t))/\rho$  if he is currently an oligarch,  $v(t) + LN(\theta(t))/\rho$  if he is a commoner. Then  $u(t)$  and  $v(t)$  can be computed by the differential equations

$$\begin{aligned} -u'(t) &= \max_{c,x} LN(c) + [(1-x)\pi(t) + xr - c]/\rho + \lambda[v(t) + LN(x)/\rho - u(t)] - \rho u(t) \\ &= LN(\rho) + [\pi(t) - \lambda - \rho + \lambda LN(\lambda/(\pi(t) - r))]/\rho + \lambda v(t) - (\rho + \lambda)u(t), \tag{37} \\ -v'(t) &= \max_c LN(c) + (r - c)/\rho + \mu(u(t) - v(t)) - \rho v(t) \\ &= LN(\rho) + (r - \rho)/\rho + \mu u(t) - (\mu + \rho)v(t). \tag{38} \end{aligned}$$

In the long-run steady state where  $\pi(t) = \pi^*$ , the constant values of  $u(t)$  and  $v(t)$  are

$$u^* = LN(\rho)/\rho + \{(\mu + \rho)[\pi^* - \lambda - \rho + \lambda LN(\lambda/(\pi^* - r))] + \lambda(r - \rho)\} / [\rho^2(\mu + \rho + \lambda)], \tag{39}$$

$$v^* = LN(\rho)/\rho + \{\mu[\pi^* - \lambda - \rho + \lambda LN(\lambda/(\pi^* - r))] + (\rho + \lambda)(r - \rho)\} / [\rho^2(\mu + \rho + \lambda)]. \tag{40}$$

The oligarchs' constant-equivalent consumption per unit wealth satisfies  $LN(\hat{c}^*)/\rho = u^*$ .

The steady-state condition  $\Omega' = 0$  implies that common citizens' aggregate wealth is

$$\Omega^* = \Theta^*\lambda^2 / [(\pi^* - r)(\mu + \rho - r)]. \tag{41}$$

Then the steady-state condition  $\Theta' = 0$  implies that

$$\pi^* - 2\lambda - \rho + \mu\lambda^2 / [(\pi^* - r)(\mu + \rho - r)] = 0.$$

Thus, with  $\pi^* > \rho + \lambda$ , the local net profit rate in the steady state must be

$$\pi^* = \lambda + (\rho + r)/2 + 0.5\sqrt{(\rho - r)[\rho - r + 4\lambda + 4\lambda^2 / (\mu + \rho - r)]}. \tag{42}$$

The steady-state values of other economic variables ( $R^*, K^*, w^*, G^*, X^*, \Theta^*$ ) can then be computed from this  $\pi^*$  as in Section 4, by Eqs. (17)–(22).



In the steady state, new recruits add to oligarchic wealth at rate

$$\mu\Omega^* = \Theta^* \mu \lambda^2 / [(\pi^* - r)(\mu + \rho - r)] = (2\lambda + \rho - \pi^*)\Theta^*. \quad (43)$$

But if  $\mu/(\rho - r)$  goes to 0 then Eq. (42) becomes

$$\pi^* = \lambda + (\rho + r)/2 + 0.5\sqrt{(\rho - r)^2 + 4\lambda(\rho - r) + 4\lambda^2} = 2\lambda + \rho,$$

which is the steady-state net profit rate that we found in Section 4, and the inflow of wealth from new recruits (43) goes to 0. Thus, when  $\mu$  is much smaller than  $\rho - r$ , the steady-state outcomes in this extended model look like our simpler model without recruitment.

**Proposition 5.** *Consider a sequence of models with recruitment into the oligarchy at different rates  $\mu$  such that  $\mu/(\rho - r) \rightarrow 0$ . Then  $\mu\Omega^* \rightarrow 0$  and  $\pi^* \rightarrow 2\lambda + \rho$ , and so the equilibrium outcomes of these models approach the outcomes of our model without recruitment.*

For example, consider again our baseline example with the standard parameter values (34),  $\lambda = 0.025$ , and  $\beta = 0$ . Now let us consider an extended version of this model with recruitment at rate  $\mu = 0.0005$ , so that there are  $\lambda/\mu = 50$  commoners per oligarch. In the steady state, of this extended model, we get

$$\begin{aligned} K^* &= 2.2845, & X^* &= 1.4837, & G^* &= 0.6732, & w^* &= 0.852, \\ \pi^* &= 0.1098, & \hat{c}^* &= 0.05153. \end{aligned}$$

These quantities are all within 1% of their values in the simpler model without recruitment. The aggregate wealth held by commoners in this steady state is  $\Omega^* = 1.455$ , which may seem substantial, but its effect on the other aggregates is small because the total flow of wealth that new recruits bring into the oligarchy is merely  $\mu\Omega^* = 0.00073$ . The effects of recruitment at this rate  $\mu$  on the dynamic-equilibrium examples that we considered above would be similarly small.

## 8. Measuring oligarchies

In our theoretical model, protection of property rights in different countries can vary in two parameters, political risk  $\lambda$  and openness  $\beta$ , where the case of  $\lambda = 0$  and  $\beta = 0$  represents the traditional economic assumption of perfect property rights. In this section we consider one possible way to estimate these two parameters, and we test the quantitative predictions of the model on a sample of 24 developing countries from around the world.

The political risk parameter  $\lambda$  in our model is closely related to the country risk premium. In the model, if country  $j$  is at least partially open to foreign investment ( $\beta_j > 0$ ), then well-diversified foreign investors should receive the rate of return equal to  $r + \lambda_j$ , where  $r$  is the risk-free world interest rate and  $\lambda_j$  is the country-specific rate of expropriation (see Section 3 above). We can thus measure  $\lambda_j$  by the risk premia carried by foreign bonds issued by oligarchic countries. To estimate country risk premium, we follow Damodaran (2002) and use S&P credit ratings of oligarchic countries' sovereign bonds. These ratings are translated into yield spreads against benchmark US treasury bonds by utilizing the widely available data on US corporate bonds yield spreads. While our model has no sovereign bonds in it, empirical studies have shown close correlation between sovereign risk and dollar-based returns to private investors in both bonds and stock markets in emerging countries (see, e.g., Kelly et al., 1998). "Appendix to Capital and Growth With Oligarchic Property Rights" (Braguinsky and Myerson, 2006, Section 3)

contains the details of our estimating procedure and the discussion of their robustness to using alternative measures.

The second parameter,  $\beta$ , in theory should be equal to the ratio of the total value of debt and equity owed to outside investors (excluding part of it that belongs to insider owners) to the capital stock in a given country. Because of the lack of data distinguishing between debt and equity owned by outsiders and insiders, we estimate beta as the ratio of market capitalization of investable stocks (in the IFC/S&P definition) to total market capitalization of stock markets in emerging countries.<sup>11</sup> It should be noted that this probably represents an overestimate of our parameter  $\beta$ , since the fact that a company is listed in the local stock market means that it is already at least partially open to outside investment.

Table 2 presents the data on GDP per capita as share of the US and our estimates of parameters  $(\lambda, \beta)$  for a sample of 24 emerging markets for which the data allowed to estimate both  $\lambda_j$  and  $\beta_j$  for the five-year interval of 1996–2000 (see Braguinsky and Myerson, 2006, Section 3, and the on-line spreadsheet provided by the authors for details). We then calibrate the model by assuming that all countries have common parameters  $\alpha = 0.7$ ,  $\rho = 0.06$ ,  $r = 0.035$ , and  $\delta = 0.05$ , as in our standard numerical example (34).<sup>12</sup> The last column in Table 2 presents predicted steady-state GDP per capita with those common parameter values and our estimates of  $\lambda$  and  $\beta$ .

Clearly, our model predicts too high levels of GDP per capita in less developed countries. This is not surprising in view of the fact that we are using Cobb–Douglas production function with the same production technology (in particular, the same share of labor) for all countries. What is perhaps surprising, given the super-simple nature of our model, is that the qualitative fit of the model is quite good. An OLS regression of actual GDP per capita on our predicted values of  $Y/L$  for these 24 countries gives

$$Y/L|_{\text{actual}} = \frac{-0.49}{(-2.03)} + \frac{0.91}{(2.94)} \times Y/L|_{\text{predicted}}, \quad R^2 = 0.28, \quad (44)$$

with the coefficient on predicted GDP per capita significant at 1% level (the numbers in brackets under the coefficients are  $t$ -values). In Fig. 6 we present the scatter plot of actual GDP per capita against the affine transformation of the values predicted by our model, using regression coefficients from (44). The GDP per capita predictions generated by our model can be visually seen to be closely related to actual macroeconomic data up to such a transformation.<sup>13</sup>

Our estimates presented in Table 2 suggest that the nature of property-rights imperfections may indeed be quite different in different countries. Among the poorer countries of the world, some seem to have relatively low political risk but to suffer from a low openness to outside investors (such as China, Egypt, and Thailand), whereas others seem to be more open but to suffer from greater political risk (such as Pakistan, Indonesia, Morocco, Peru, and Venezuela). The explanatory power of our model appears to be influenced more by the variations in political risk  $\lambda$  than by variations in collateralizability  $\beta$ . This can be seen, for example, in the following way. The average value of estimated  $\beta$ s across countries in our sample is 0.394. Using this average value of  $\beta$  instead of individual values and keeping only the individual values of  $\lambda$ s does

<sup>11</sup> Investable stocks are defined as stocks in emerging markets that can legally and practically be owned by foreign investors. The International Finance Corporation (and later S&P) had been publishing the data on market capitalization of investable stocks in their annual Emerging Stock Markets Factbooks.

<sup>12</sup> The value of  $A$  is normalized to get  $Y/L = 1$  for the country with perfect protection of property rights (the USA).

<sup>13</sup> It should also be noted that our predicted per capita GDP refer to the steady state, while many countries in the sample might actually be in the process of moving from one steady state to another. This may be part of the reason why the model tends to overpredict per capita GDP in China and India, for example.

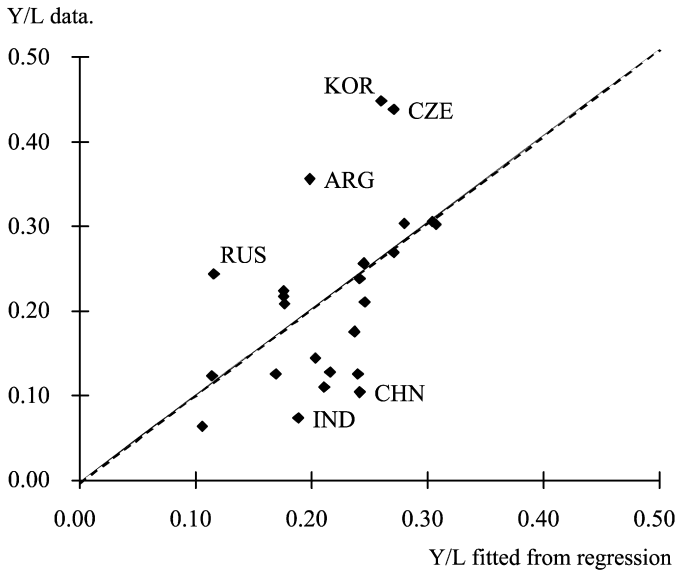


Fig. 6. Values of GDP per capita predicted from the model and transformed using OLS regression coefficients (44) versus actual GDP per capita for 24 countries as a share of the country with perfect protection of property rights (the US). Parameters:  $\alpha = 0.7$ ,  $\rho = 0.06$ ,  $r = 0.035$ ,  $\delta = 0.05$ ,  $A = 0.685$ ,  $(\lambda, \beta)$ s as in Table 2 in Section 8.

not seriously affect the fit of regressions (44). With individual  $\beta$ s replaced by  $\beta = 0.394$ , the coefficient on predicted GDP per capita in regression (44) decreases to 0.78, but is still significant at 5% level. On the other hand, if we replace individual  $\lambda$ s with the sample average value of  $\lambda = 0.036$  while keeping all the individual  $\beta$ s, we cannot reject the null hypothesis for the coefficient on predicted GDP per capita even at the 10% level.

We should stress, however, that this relatively low explanatory power of  $\beta$  refers only to steady-state analysis. Transient effects of a low  $\beta$  can (in a situation like that of a post-soviet transition) be much more important than the long-term steady-state effects.

## 9. Discussion and conclusions

We have studied oligarchic property rights that have two dimensions of imperfection: the degree of exclusion of outside investors, and the insiders' level of political risk. Both imperfections are natural consequences of a system of property protection based on insider trust, and they negatively affect growth, the capital stock, and wages. But in a global general equilibrium where such imperfections differ across countries, a country that has better protection of property rights can become a safe haven for oligarchic investments, and so its workers' welfare could actually be higher than if property were perfectly protected everywhere.

We have shown how imperfect property rights can be politically stable because they benefit the oligarchs. For reasonable economic parameters, we found that oligarchs may prefer not to reduce their political risk below a certain level, and they may prefer to minimize the protection of outside investors. Thus, inefficient oligarchic property rights may persist unless democratic institutions become strong enough to challenge the system of oligarchic privilege.

Table 2

Estimated and fitted values of GDP per capita in 24 oligarchic countries with common parameters  $\alpha = 0.7$ ,  $\rho = 0.06$ ,  $r = 0.035$ ,  $\delta = 0.05$

Sample countries	Estimates from data			Y/L predicted from the model
	Y/L, GDP per capita (share of the US)	$\lambda$	$\beta$	
Pakistan	0.063	0.079	0.38	0.655
India	0.073	0.033	0.13	0.746
China	0.104	0.017	0.06	0.804
Philippines	0.109	0.030	0.25	0.770
Indonesia	0.123	0.075	0.39	0.664
Egypt	0.125	0.022 <sup>a</sup>	0.25 <sup>c</sup>	0.802
Jordan	0.126	0.044	0.26	0.725
Morocco	0.128	0.039 <sup>b</sup>	0.54 <sup>c</sup>	0.776
Peru	0.144	0.042 <sup>a</sup>	0.50	0.762
Colombia	0.176	0.026	0.36	0.799
Venezuela	0.208	0.053	0.52	0.733
Thailand	0.210	0.020	0.24	0.809
Turkey	0.217	0.054	0.53	0.732
Brazil	0.224	0.047	0.39	0.732
South Africa	0.239	0.026	0.40	0.804
Russia	0.244	0.069	0.30 <sup>c</sup>	0.666
Mexico	0.257	0.036	0.69	0.808
Poland	0.269	0.021	0.50	0.836
Chile	0.302	0.014	0.57	0.876
Malaysia	0.304	0.017	0.44	0.846
Hungary	0.305	0.020	0.74	0.873
Argentina	0.356	0.040	0.42	0.757
Czech republic	0.438	0.014	0.23	0.836
Korea	0.448	0.020	0.37	0.824
USA (idealized)	1	0	1	1.000

Notes. All estimates are five-year averages over 1996–2000, unless noted below. GDP per capita as share of the US from Penn World Tables. For estimates of  $\lambda$ s and  $\beta$ s see “Appendix to Capital and Growth With Oligarchic Property Rights” (Braguinsky and Myerson, 2006, Section 3).

<sup>a</sup> Data start at 1997. Since the credit rating remains the same for the period of 1997–2000, the same rating was applied to calculating the 1996 risk premium.

<sup>b</sup> Data start at 1998. Since the credit rating remains the same for the period of 1998–2000, the same rating was applied to calculating the 1996 and 1997 risk premia.

<sup>c</sup> Average for 1997–2000 (no data for 1996).

When we calibrate the model using financial data to estimate the two parameters, political risk and the degree of corporate governance (collateralizability of debt), that characterize property rights imperfections in our model, the predicted relative positions of oligarchic countries in terms of GDP per capita match the real-world data surprisingly well, given how many factors the model leaves out.

The adverse effects of political risk and private protection on investment and capital flight are widely recognized as fundamental forces that affect the wealth and poverty of nations, and yet these effects often seem peripheral in economic analysis. The theoretical model that we have developed here is an attempt to put these effects where they belong, in the center of the economic analysis of growth and development.

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