Investment in the Shadow of Conflict: Globalization, Capital Control, and State Repression*

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Abstract

In conflict-prone societies, the fear of expropriation that accompanies a regime change reduces capital investment. These reductions in investments, in turn, harm the economy, amplifying the likelihood of regime change. This paper studies the implications of these feedback channels for the interactions between globalization, capital control, state repression, and regime change. I show that processes that facilitate capital movements (e.g., globalization, economic modernization, technologies that reduce transportation costs) amplify the likelihood of regime change in conflict-prone societies, and strengthen the elite's demand for a strong coercive state. In particular, to limit their collective action problem and manage the political risk of regime change, capitalists support a state that imposes capital control. We identify two conflicting forces, the Boix Effect and the Marx Effect, which determine when capital control and state repression become complements (Nazi Germany) or substitutes (Latin American military regimes) in right-wing regimes.

Keywords: Regime Change, Political Risk, Globalization, Capital Control, Capital Mobility, Repression, General Equilibrium, Global Games

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Introduction

Political instability is a leading empirical explanation for capital flight and for why capital doesn't flow from rich to poor countries (Collier et al. 2001; Le and Zak 2006; Alfaro et al. 2008; Papaioannou 2009).[1] Conversely, a weak economy gives rise to political instability (Blattman and Miguel 2010; Besley and Persson 2011). These empirical observations show a feedback between the economy and politics akin to self-fulfilling expectations: the risk of expropriation that accompanies regime change reduces investment and encourages capital flight, thereby harming the economy. This, in turn, heightens the risk of political instability, further damaging the economy, and so on. This paper develops a tractable framework that captures these interlinkages by integrating a general equilibrium model of economy into a model of collective action to study the interactions between globalization, capital control, state repression, and regime change.

The key logic of this paper is that the decisions of a multitude of small economic players to withhold investment in a country in anticipation of political instability work through the levers of the economy to reduce economic opportunities (e.g., lower wages). In turn, this endogenous reduction in the opportunity costs of political actions raises the incentives of potential activists to switch their efforts from economic to political activities, increasing the likelihood of regime change. The feedback channels between the economy and politics, as well as the players' expectations of each other's behavior, tend to create a self-fulfilling strategic environment with multiple equilibria. Our first result is that, by introducing a small strategic uncertainty, we obtain a unique equilibrium with a simple closed-form solution that identifies when regime change happens. In conflict-prone societies,[2] the equilibrium likelihood of regime change rises with foreign capital returns and with capital mobility, and hence with globalization, which facilitates capital movements at lower costs. This destabilizing effect is stronger where ideological convictions for regime change are lower, or where the

[1]For example, in the months preceding the Iranian Revolution, "$50 million was leaving the country every day" (Parsa 2000, p. 201), and capital flew out of the Philippines in response to heightened anti-Marcos protests (Boyce 1993). Empirical estimates suggest an increase in capital flight in both Egypt and Tunisia in 2010 just before the Arab Spring (Ndikumana and Boyce 2012). Using quarterly panel data, Burger et al. (2016) show that FDI dropped dramatically in countries that experienced the Arab Spring.

[2]By conflict-prone societies, we refer to societies in which a portion of the population have some underlying economic, cultural, or social grievances severe enough that they would like to overturn the regime.

workers' share of income is higher. Second, we show that the rich (capital owners) support capital control to reduce their collective action problem, which amplifies the likelihood of regime change. This generates an inertia against market integration in its early stages when capital movements are relatively costly. Third, we show how the rich support a combination of economic coercion (capital control) on themselves and political coercion (repression) of workers, and study when these forms of coercion are complements (e.g., Nazi Germany) or substitutes (e.g., Latin American military regimes). These results imply that in conflict-prone societies, processes that facilitate capital movements can generate strategic responses that tend to strengthen the alliance between the rich and the state and raise support for a centralized authority with strong coercive power.

In our model, there is a continuum of citizens distinguished by whether they own capital (capitalists) or labor (workers). Capitalists decide how to allocate their mobile capital into domestic or foreign markets. Workers decide whether to allocate their labor into economic production or into revolutionary activities aimed at regime change. Revolution succeeds if the mass of workers who revolt exceeds a threshold of regime strength (regime change). This threshold is uncertain, and capitalists and workers have noisy private signals about it. A subset of workers would like to revolt, but when they divert efforts from economic production to revolt, they lose their wages. Capitalists do not like revolution because if it succeeds, their domestic capital is confiscated. In anticipation of this political risk, they can move their mobile capital to foreign markets. Investments in foreign markets yield a safe expected return. However, absent a revolution, foreign returns are lower than endogenously determined domestic returns. These capital allocations influence the workers' wages through market mechanisms. In particular, wages and domestic capital returns are determined endogenously in a competitive market with Cobb-Douglas production technology.

Capitalists face a coordination problem. The *strategic uncertainty* arising from their private information about the regime's strength impairs their ability to coordinate on their investments. For example, when the regime is strong enough that it survives if all capitalists invest domestically, strategic uncertainty about others' behavior causes some capitalists to move their capital abroad. This reduction in domestic capital reduces economic opportunities (wages), raising workers' incentives to revolt and tipping the balance toward regime change.

Thus, when other capitalists are more likely to invest abroad, the political risks of domestic investment increase, raising a capitalist's incentives to do the same. This underlies the *political source of strategic complementarities* among the capitalists. Markets generate their own strategic forces. The first reinforces this political force: when more capitalists move their capital abroad, and consequently more workers withdraw their labor, capital returns in domestic markets fall due to complementarities between capital and labor in production technology. This raises a capitalist's incentive to move his capital abroad, and underlies the *economic source of strategic complementarities* among the capitalists. The second market-induced strategic force goes in the opposite direction. When the domestic supply of capital falls, capital returns increase, raising a capitalist's incentive to keep his capital in domestic markets. This underlies the economic *strategic substitutes* force in the capitalists' interactions.

Similar strategic considerations arise for workers: strategic complementarities arise because enough workers must revolt for the revolution to succeed; strategic substitutes arise because reductions in labor supply raise wages (congestion externalities). These conflicting forces arise from the couplings between the coordination problems of capitalists and workers through the market. Despite these interlinked strategic considerations, we show that (under mild conditions and) when the noise in private signals is vanishingly small, there is a unique equilibrium in cutoff strategies. In equilibrium, the regime collapses when its strength is below a threshold (*equilibrium regime change threshold*).

The equilibrium regime change threshold is proportional to an *effective wage*, stemming from an effective labor supply and an effective capital supply, which arises from strategic interactions and markets. This effective wage (and hence the ex-ante likelihood of regime change) is decreasing in foreign returns and in capital mobility: higher foreign returns increase the capitalists' incentives to move their capital abroad, and higher degrees of capital mobility mean that the capitalists can move a larger fraction of their capital abroad. Moreover, these effects are higher where the capital share of income or ideological convictions for regime change are lower, i.e., in societies that are more stable. These results have implications for processes of modernization and globalization, as well as for technological changes that reduce transportation costs. Economic modernization often involves a reallocation of capital from relatively immobile to more mobile sectors—e.g., from the agricultural sector to services and finance. Similarly, globalization and market integration facilitate international capital movements, increasing effective foreign returns. It is well-known that these processes can create significant value by improving efficiency and productivity (Donaldson 2015). Our results highlight that these processes also generate opposing strategic forces that undermine political stability.

When a capitalist decides to move capital abroad, he does not internalize that reductions in domestic capital reduce wages and increase the likelihood of revolution, thereby hurting those who invest domestically. To curb these negative externalities, the capitalists can support a central authority with strong coercive power to impose capital control. Capital control features a tradeoff for capitalists: it reduces the ex-ante likelihood of revolution, but it also destroys the value of their subsequent private information by preventing those with pessimistic beliefs from moving their capital abroad and escaping confiscation. We identify conditions under which capitalists want to impose capital control on themselves. Thus, in contrast with the literature where capital control is imposed by those who own less capital (Alesina and Tabellini 1989; Schulze 2000; Eichengreen 2003), we show that capitalists themselves may want to impose capital control to limit their collective action problem. This result suggests that in the early stages of globalization, when effective foreign returns are low, capitalists will try to prevent the integration of the country's capital markets into global markets by supporting capital control.

Capital control is a form of economic coercion. Generally, the state's coercive measures can be divided into economic coercion and political coercion. Thus, we study how a state that represents the capitalists' interests combines capital control and repression. In particular, are capital control and repression complements or substitutes? With capital control, a revolution imposes higher costs on capitalists, who now cannot move their capital abroad in anticipation of the revolution. Thus, when there is capital control, the capitalists' incentives to use repression increase. We call this the *Boix Effect*, capturing the idea that capital mobility reduces the elite's resistance to regime change by alleviating its confiscatory consequences (Boix 2003). But capital control also reduces the likelihood of revolution, mitigating the capitalists' incentives to use repression. We call this the *Marx Effect*, reflecting the Marxist idea that freer global movement of capital can result in labor repression.

Colloquially, the Boix effect reflects that when there is little at stake (i.e., when little capital remains in the country), there is little need to repress; while the Marx effect reflects that when there is little risk (i.e., when revolution is unlikely), there is little need to repress. Critically, there is a tension between these two forces: capital control reduces the risk by reducing the likelihood of regime change, but raises the stakes because more capital remains in the country. When the Boix effect dominates, the state tends to combine capital control and repression, as in the pre-war Nazi regime. When the Marx effect dominates, a state that uses high levels of repression tends to impose low degrees of capital control, as in Latin American right-wing regimes between 1965 and 1985. These results link the two theories for why the rich support dictators with strong coercive power. They do so either (a) to protect their wealth and status from the poor—a Rousseauian approach; or (b) to protect themselves from their own attrition—a Hobbesian approach (Greif and Laitin 2004; Guriev and Sonin 2009). Our analysis combines these channels and shows the nature of their relationship.

The methodological contribution of this paper is to develop a tractable framework that integrates a model of regime change, which features coordination and information frictions, with a general equilibrium model of the economy where wages and capital returns are determined in competitive markets with production. This framework can be extended to address questions regarding the interactions between production technology, market structure, growth, and the political risk of regime change. The analysis is complex because two groups interact, and because, due to market forces, within-group strategic interactions feature forces for both strategic complements and substitutes. Strategic complementarities generate multiple equilibria, but the market forces that underlie strategic substitutes preclude the application of the standard global games approach to obtain uniqueness (Carlsson and van Damme 1993; Frankel et al. 2003; Morris and Shin 1998, 2003). In particular, the game is not super-modular, best responses are non-monotone, and critically, monotone equilibria will not generally exist. We identify conditions that deliver the existence of monotone equilibria by generating single-crossing properties (Athey 2001), so that a best response to a monotone strategy is also monotone. Moreover, even though players must estimate wages and capital returns based on production technology and others' behavior, we show that when the noise is small, the equilibrium is unique and takes a simple closed form.[3]

[3]Technically, our analysis essentially shows that, despite the coupling of interactions through markets,

This paper also contributes to the literature that examines revolutions. This literature typically abstracts from interactions between the economy and the citizens' decisions, focusing instead on the coordination problem among the citizens who seek regime change, and on the state's decisions to prevent it.[4] In the literature that studies the interactions between the economy and regime change, either the key aspects of the economy (e.g., wages and capital returns) are exogenous, or coordination and information frictions are absent, or both (Acemoglu and Robinson 2001, 2006a; Persson and Tabellini 2009). This paper is also related to the literature that examines the origins and nature of state coercion as well as the dictator-capitalist nexus (Acemoglu and Robinson 2006a; Boix 2003; Besley and Persson 2011; Egorov and Sonin 2017). In this literature, the state uses coercion against those seeking regime change. We show that those favoring the status quo may demand a strong state that uses economic coercion against them, and explore conditions under which economic and political coercion complement or substitute each other.

Our paper also contributes to the literature on capital control. In Alesina and Tabellini (1989), capital flight occurs due to exogenous uncertainty about whether the future government will expropriate capital, and capital control is imposed by a government that represents workers in order to limit this capital flight. Chang (2010) endogenizes the likelihood of a pro-business victory in a democratic setting based on a probabilistic voting model, showing that multiple equilibria can arise. In Bartolini and Drazen (1997), capital control directly raises the government's ability to tax capital, but has an indirect, strategic effect of reducing capital inflows. Governments' preferences for capital tax is their private information, and relaxing capital control signals their types and hence their future favorable behavior toward capital, thereby increasing capital inflows. These theories imply that right-wing regimes

under (basically) limit dominance conditions and when the workers' noise vanishes sufficiently fast, the games between the capitalists and workers sufficiently disentangle, and then each game satisfies the "Action Single Crossing" and "Strict Laplacian State Monotonicity" properties described in Morris and Shin (2003). It is remarkable that these properties hold in this setting. Further, these conditions are tight in the sense that without them, even monotone equilibria do not generally exist. Angeletos and Lian (2016) provide a detailed review of the application of global games in macroeconomic models.

[4] Topics studied in this literature include: coordination (Bueno de Mesquita 2010; Shadmehr and Bernhardt 2011; Chen et al. 2016; Tyson and Smith 2018), leaders and their tactics (Bueno de Mesquita 2013; Loeper et al. 2014; Morris and Shadmehr 2017; Lipnowski and Sadler 2019; Shadmehr and Bernhardt 2019), the role of media (Egorov et al. 2009; Edmond 2013; Guriev and Treisman 2015; Shadmehr and Bernhardt 2015; Barbera and Jackson 2016), the effect of elections (Little 2012; Egorov and Sonin 2017; Lou and Rozenas 2018), and contagion (Chen and Suen 2016).

tend to remove capital control, and that capital control always reduces foreign investment. In contrast to this literature, we show that right-wing regimes may maintain capital control to limit the capitalists' collective action problem and manage the political risk of regime change. Such capital controls protect capital investments by reducing the political risk of regime change, and may attract foreign capital which otherwise may not enter.

The next three sections present the model, discuss two benchmarks, and characterize the equilibrium, respectively. Then, we discuss capital control and its relationship with repression. An online appendix contains the proofs.

Model

Players and Actions. There is a continuum 1 of workers, indexed by $i \in [0, 1]$, and a continuum 1 of capitalists, indexed by $j \in [0, 1]$. Each worker is endowed with 1 unit of labor. Each capitalist is endowed with $\overline{K}$ units of capital, $\underline{K} \in (0, \overline{K})$ units of which are immobile and must be invested in domestic market, while the remaining $\overline{K} - \underline{K}$ units can be invested in domestic or foreign markets. The game proceeds in two stages. In stage one, each capitalist decides how to divide his mobile capital between domestic and foreign investments. Let $k_j \in [0, \overline{K} - \underline{K}]$ be capitalist j's domestic investment of his mobile capital, and $K = \int k_j dj \in [0, \overline{K} - \underline{K}]$ be the aggregate domestic mobile capital. In stage two, each worker observes the total capital investment, and decides whether to work or to revolt. If a worker decides to work, he contributes $l_i = 1$ unit of labor.

Payoffs. Payoffs are realized after the success or failure of the revolution. All players are risk-neutral, and maximize their expected payoffs. If the revolution fails, the capitalists receive their returns from domestic and foreign capital; the workers who worked receive their wages, and those who revolted get 0. If the revolution succeeds, domestic capital is confiscated from the capitalists, and is distributed evenly among all workers, and the workers who worked receive their wages. Moreover, a fraction $1 - \underline{L} \in (0, 1)$ of workers are potential revolutionaries, and derive warm-glow payoffs $s > 0$ from participating in a successful revolution.[5] Let $L = \int l_i di \in [0, 1 - \underline{L}]$ be the aggregate labor input of these potential

[5]As Morris and Shadmehr (2017) discuss in detail, this "warm glow" benefit is identical to the notion of "pleasure in agency" in revolutions and civil wars formulated by Wood (2003) based on extensive

revolutionary workers. The remaining workers do not gain from participating in a successful revolution, and hence always work in equilibrium. In the rest of the paper, when we say workers, we mean potential revolutionary workers who receive warm-glow payoffs $s > 0$ from participating in a successful revolution.

Markets and Production Technology. Domestic markets are competitive, so that the wage and the return to capital are their marginal revenue products. The production technology is Cobb-Douglas $(\underline{K}+K)^{\alpha}(\underline{L}+L)^{1-\alpha}$, with $\alpha \in (0,1)$, and $\underline{K},\ \underline{L} > 0$ as described above. Let r_d be the domestic return to capital and w be the wage. Because domestic markets are competitive, $r_d = \alpha\left(\frac{\underline{L}+L}{\underline{K}+K}\right)^{1-\alpha}$ and $w = (1-\alpha)\left(\frac{\underline{K}+K}{\underline{L}+L}\right)^{\alpha}$, where we normalize the output price to 1. Alternatively, mobile capital can be invested in foreign markets, e.g., treasury bonds or stocks. The rate of return to capital in foreign markets is r_f, which is a random variable with support $[0, \overline{f}]$.[6]

Revolution Technology and Information Structure. The revolution succeeds whenever the measure of revolters exceeds the uncertain regime strength $\theta \in \mathbb{R}$. Capitalists and workers share a prior that $\theta \sim G(\cdot)$, and they receive noisy private signals about θ. Let y_j be a capitalist j's private signal, and x_i a worker i's private signal. $x_i = \theta + \sigma_w\ \epsilon_i$, where $\epsilon_i \sim\ iid\ F_{\epsilon}(\cdot)$, and $y_j = \theta + \sigma_c\ \eta_j$, where $\eta_j \sim\ iid\ F_{\eta}(\cdot)$. We assume that signals and the fundamental θ satisfy the monotone likelihood ratio property.[7] The capitalists observe r_f, but workers receive a noisy public signal $\tilde{r}_f = r_f + \epsilon_f$ about it, with $\epsilon_f \sim H(\cdot)$, so that they cannot infer the exact value of θ from aggregate domestic capital investment K. All the noises $\epsilon_i,\ \eta_j,\ \epsilon_f$, and the fundamental θ are independent of each other, and distributed accordingly to twice continuously differentiable distributions with full support on $\mathbb{R}$.

Timing. Capitalists observe the return to foreign investment r_f and their signals y_js about the regime's strength θ, and decide how to divide their capital between domestic and foreign

qualitative works and the sociological and historical literature on conflict. Such "warm glow" benefits are a common feature of models of political regime change, e.g., Persson and Tabellini (2009) and Bueno de Mesquita (2010). When we use the term "conflict-prone societies," we refer to societies that feature this $s > 0$, capturing some underlying economic, cultural, or social grievances. A society is more conflict-prone whenever its associated s is higher.

[6]Our goal is to maintain the sequential timing of decisions while preventing the revelation of θ to the workers. Uncertainty about r_f achieves this in the simplest manner. If the workers observe r_f and K, they can perfectly infer θ, which would generate equilibrium multiplicity as we describe in Benchmark 1.

[7]In particular, we assume that the pdfs $f_{\epsilon}(\cdot)$ and $f_{\eta}(\cdot)$ are log-concave.

markets. Workers observe aggregate domestic capital, a public signal of foreign returns $\tilde{r}_f$, and their signals x_is about the regime's strength θ, and then decide whether or not to revolt. The success or failure of revolution is determined, payoffs are realized, and the game ends.

We maintain the following assumptions throughout the paper.

Assumption 1 *If a worker is sure that the revolution will succeed, then he has a dominant strategy to revolt:* $s > (1-\alpha)\left(\frac{\overline{K}}{\underline{L}}\right)^{\alpha}$.

Assumption 2 *If a capitalist is sure that no one will revolt, he has a dominant strategy to invest domestically:* $\overline{f} < \alpha(1/\overline{K})^{1-\alpha}$.

Assumption 1 ensures that when the regime is very weak, the workers have a dominant strategy to revolt. That is, the payoff from participating in a successful revolution s is larger than the upper bound on wages, which is obtained if the supply of capital is at its maximum $\overline{K}$ and the supply of labor is at its minimum $\underline{L}$. Assumption 2 ensures that when the regime is very strong, then even if all the mobile capital is invested domestically (thereby reducing domestic capital returns), a capitalist wants to invest domestically. It also implies that the reason for capitalists to invest in foreign markets is to avoid the political risk of regime change. Assumption 1 implies that workers prefer regime change over regime stability, while Assumption 2 implies that capitalists prefer regime stability to regime change. These Assumptions generate a lower dominance region in $\theta < 0$ for the interactions among the workers, and a higher dominance region in $\theta > 1$ for the interactions among the capitalists.

A pure strategy for a capitalist $j \in [0,1]$ is a mapping $\rho_j : \mathbb{R} \times [0, \overline{f}] \to [0, \overline{K} - \underline{K}]$ from his private signal y_j and the foreign rate of return r_f to a decision of how much capital $k_j \in [0, \overline{K} - \underline{K}]$ to invest domestically. A pure strategy for a worker $i \in [0,1]$ is a mapping $\sigma_i : \mathbb{R}^2 \times \mathbb{R}_+ \to \{0,1\}$ from his signals x_i and $\tilde{r}_f$ and the aggregate domestic capital $\underline{K} + K$ to a decision whether to work or revolt, where $\sigma_i(x_i, \tilde{r}_f, K) = 0$ indicates that he works, and $\sigma_i(x_i, \tilde{r}_f, K) = 1$ indicates that he revolts. We focus on symmetric strategies, so that $\rho_j(\cdot,\cdot) = \rho(\cdot,\cdot)$ for all j and $\sigma_i(\cdot,\cdot,\cdot) = \sigma(\cdot,\cdot,\cdot)$ for all i. The equilibrium concept is Perfect Bayesian. Adapting a global games approach to equilibrium selection, we characterize the equilibrium in the limit when first the noise in the workers' private signals becomes vanishingly small and then the noise in the capitalists' private signals becomes vanishingly small.

Before we proceed, we highlight two limitations of the model. One concerns the order of limits: we characterize the equilibrium when first the noise in the workers' signals goes to zero, and then the noise in the capitalists' signals goes to zero. A more general solution would characterize the equilibrium for all manners in which the noise goes to zero. The question of how to characterize the equilibria in this more general case remains open. However, three observations are worth highlighting. (1) If the workers move first, before the capitalists, then one can mirror our approach and obtain a solution with the reverse order of limits. (2) That the workers' information about the regime's strength is far more precise than the capitalists' can reflect, for example, that workers have better information about the attitudes and sentiments of security forces as well as rank-and-file government employees, which play a key role in determining the regime's strength. This is more so if the capitalists are foreign investors. (3) Given this order of limits, the model makes reasonable predictions. The second issue concerns the workers' information about their wages. An implication of the model is that, when workers decide whether to revolt or work, they estimate their future wages, reflecting the strategic uncertainty about other workers' behavior, which will determine labor supply. That workers do not observe their wage before deciding to work reflects the simplifying choice of collapsing repeated decisions over a time period into a single decision of whether to work or revolt.[8] Abstracting from these more dynamic considerations, the model focuses on how strategic uncertainty affects the workers' beliefs about their economic opportunities—a worker recognizes that other workers' behaviors influence his economic opportunity.

Benchmarks

We begin with two benchmark models. The first maintains our model of economy, but modifies the model of collective action by removing uncertainty, assuming that the regime's strength is known. The second maintains our collective action model, but assumes wages and capital returns are exogenous, effectively removing our model of the economy.

Benchmark 1: Complete Information. Suppose the regime's strength θ is known. In

[8] Another interpretation of this modeling choice is a form of stickiness in the decision to revolt, so that a worker believes that once he decides to divert his efforts into politics, he cannot switch back to economic production. Such a worker then would have to estimate his future earnings, which depend on other workers' behavior.

this complete information setting, if $\theta \geq 1 - \underline{L}$, then even if all potential revolutionaries revolt, the regime survives. Anticipating this, all capitalists invest all their capital domestically, and no worker revolts. In contrast, if $\theta < 0$, the regime collapses for exogenous reasons, even absent any significant active revolters.[9] Anticipating this, all capitalists move all their mobile capital abroad, leaving only the immobile capital $\underline{K}$ in the country. However, due to market congestion externalities, workers' decisions depend on each other. A worker's decision to revolt depends on the difference between his forgone wages and the rewards s that he gets from participating in a successful revolution. But the wage varies depending on how many workers revolt, going from $(1 - \alpha)\ (\underline{K}/1)^{\alpha}$ if almost no one revolts to $(1 - \alpha)\ (\underline{K}/\underline{L})^{\alpha}$ if almost all potential revolutionaries revolt. Assumption 1 implies that when $\theta < 0$, so that a worker is sure that the regime collapses, then he has a dominant strategy to revolt. For intermediate values of regime strength, both these equilibria exist. In sum:

Proposition 1 *Consider the complete information setting where the regime's strength θ is known. There are multiple equilibria:*

- *If $\theta \geq 1 - \underline{L}$, there is a unique equilibrium in which capitalists invest all their capital domestically, no worker revolts, and there is no regime change.*
- *If $\theta < 0$, there is a unique equilibrium in which capitalists move all their mobile capital abroad, all potential revolutionaries revolt, and there is a regime change.*
- *If $\theta \in [0, 1 - \underline{L})$, then both equilibria coexist.*

The model with complete information has three shortcomings: the multiplicity of equilibria hinders empirical predictions; it is unreasonable to assume that the regime's strength is known; and there are no useful comparative statics. In fact, the capitalists play a passive role. That is, the political risk of regime change affects the economy by influencing the capitalists' investment decisions; but the capitalists' decisions do not influence the workers' decisions or the political risk.

[9] An interpretation of this feature is that when the regime is extremely weak, every worker who has some grievance (who has $s > 0$) will protest, regardless of whether he believes that others will join. For example, dissidents may demonstrate in streets after the defeat and collapse of a regime in a war. Absent this limit dominance region, there will always be an equilibrium in which citizens never revolt even with asymmetric information—see Bueno de Mesquita (2010) for a discussion.

Benchmark 2: Incomplete Information with an Exogenous Economy. Now, suppose domestic capital returns r_d and wages w are exogenous, but the regime's strength is uncertain as described in the model. We assume $s > w$ and $r_d > r_f$ to avoid trivial cases where no worker ever revolts, or no capitalist ever invests domestically. To simplify exposition, we focus on symmetric cutoff strategies. Suppose a potential revolutionary worker revolts whenever his signal about the regime's strength is below a threshold, $x_i < x_e$. Then, for any given regime strength θ, the measure of revolters is $Pr(x_i < x_e|\theta)\ (1-\underline{L})$. This measure is decreasing in θ, crossing the 45 degree line at a unique point. Calling that point θ_e, the measure of revolters exceeds the regime's strength for all $\theta < \theta_e$, causing a regime change. Otherwise, the regime survives. That is, the equilibrium regime change threshold θ_e is exactly the measure of revolters at $\theta = \theta_e$, which we will show to be $(1-\underline{L})(1-w/s)$. Let $p(x_i) \in [0,1]$ be citizen i's belief that the regime collapses, so that $p(x_i) = Pr(\theta < \theta_e|x_i)$. Different regime strengths θ induce difference signal distributions among the workers, and hence difference distributions of beliefs $p(x_i)$. If we knew the distribution of these beliefs in an equilibrium, because those with $p(x_i) > w/s$ will revolt, we could calculate the equilibrium regime change thresholds.

$$\theta_e = (1-\underline{L})\ Pr(p(x_i) > w/s|\theta_e). \tag{1}$$

A key statistical property simplifies the analysis (Morris and Shin 2003; Guimaraes and Morris 2007; Loeper et al. 2014):

Lemma 1 *Recall that $x_i = \theta + \sigma_w\ \epsilon_i$. Fix $\hat{\theta}$, and for all $\hat{x}$, define $p(\hat{x}) = Pr(\theta < \hat{\theta}|x_i = \hat{x})$. Let $H(p|\theta)$ be the cdf of $p(x_i)$ conditional on θ. Then, when the noise is vanishingly small ($\sigma_w \to 0$), $H(p|\theta = \hat{\theta}) = p$. That is, p is distributed uniformly at $\theta = \hat{\theta}$.*

Applying Lemma 1 to the equilibrium conditions (1) yields a unique equilibrium regime change threshold.

Proposition 2 *Consider the setting with exogenous wage and capital returns. When the noise in private signals becomes vanishingly small, there is a unique symmetric monotone equilibrium in which the regime collapses if and only if $\theta < \theta_e$, where*

$$\theta_e = (1-\underline{L})\ (1-w/s).$$

Critically, neither foreign returns r_f nor the magnitude of capital mobility $\overline{K} - \underline{K}$ affect the likelihood of regime change. The political risk of revolt affects the capitalists' behavior: when θ_e is higher, more capital moves abroad. However, with no model of economy to determine wages and capital returns endogenously, capital allocations have no influence on political risk, and there is no coordination problem among the capitalists. In fact, the capitalists' problem is barely strategic: given θ_e that comes from the anticipated behavior of the workers, each capitalist simply estimates the likelihood of regime change and his expected returns, and decides how to allocate his capital.

Equilibrium

We now begin our main analysis. Each worker observes his private signal x_i about the regime's strength, a public signal $\tilde{r}_f$ about foreign returns, and the aggregate domestic capital investment. For any given $\tilde{r}_f$ and K, a lower private signal suggests a weaker regime—and indicates that others, too, are more likely to believe that the regime is weaker. Thus, we focus on the natural class of symmetric monotone strategies, so that given $\tilde{r}_f$ and K, a worker i's strategy is to revolt if and only if his signal is below a threshold, $x_i < x^*$. This has two implications. First, as we saw in our second benchmark, for a given θ, the measure of revolters is $m(\theta) = Pr(x_i < x^*|\theta)\ (1 - \underline{L})$. As θ traverses from $-\infty$ to ∞, the measure of revolters falls from $1 - \underline{L}$ to zero. Therefore, there exists a θ^{**} at which $m(\theta^{**}) = \theta^{**}$, so that the revolution succeeds if and only if $\theta < \theta^{**}$. Second, for a given θ, the aggregate labor of potential revolutionary workers is $L(\theta) = Pr(x_i \geq x^*|\theta)\ (1 - \underline{L})$, which is increasing in θ. When the regime is stronger, more workers will dedicate their efforts to economic production rather than revolution, thereby raising labor supply and suppressing wages.

Given his signals x_i and $\tilde{r}_f$, and the aggregate capital level K, a worker i revolts if and only if:

$$Pr(\theta < \theta^{**}|x_i, \tilde{r}_f, K) \times s > E[w|x_i, \tilde{r}_f, K]. \tag{2}$$

The left hand side is the expected gains from revolt, and the right hand side is the expected opportunity costs of revolt. A worker with signal x_i assigns a probability $Pr(\theta < \theta^{**}|x_i, \tilde{r}_f, K)$ that the revolution succeeds, in which case he receives s from participating in the revolution. However, by participating in revolutionary activities, he forgoes the wages he could earn from economic activities. These wages depend on the behavior both of other workers and of the capitalists, which determines the aggregate supply of labor and capital in the economy, $w = (1-\alpha)\left(\frac{\underline{K}+K}{\underline{L}+L}\right)^{\alpha}$. A worker observes the aggregate supply of capital, but he has to estimate the aggregate supply of labor by anticipating other workers' equilibrium strategies. If the worker knew θ, he could anticipate the aggregate supply of labor $\underline{L} + L(\theta) = \underline{L} + Pr(x_i \geq x^*|\theta)\ (1-\underline{L})$. But he does not observe θ, and hence uses all information available to him to estimate his expected wage:

$$Pr(\theta < \theta^{**}|x_i, \tilde{r}_f, K)\ s > (1-\alpha)\ E\left[\left(\frac{\underline{K}+K}{\underline{L}+Pr(x_j \geq x^*|\theta)\ (1-\underline{L})}\right)^{\alpha}\middle| x_i, \tilde{r}_f, K\right]. \tag{3}$$

The interactions between the workers feature two conflicting strategic forces. When other workers are more likely to revolt, the revolution is more likely to succeed, increasing a worker's incentive to revolt. This corresponds to an increase in θ^{**}, and hence in the left-hand side of equation (2). This generates a force for strategic complements. However, when other workers are more likely to revolt, the reduction in labor supply raises the wage, which reduces a worker's incentives to revolt. This corresponds to an increase in $w = (1-\alpha)\left(\frac{\underline{K}+K}{\underline{L}+L}\right)^{\alpha}$, and hence in the right-hand side of equation (2). This generates a force for strategic substitutes.

These conflicting forces have another related implication: net expected payoffs from revolting are non-monotone in general, and hence the best response to a cutoff strategy need not be a cutoff strategy. When a worker's signal increases, he believes that the regime is stronger, reducing his incentives to revolt. But he also believes that others, too, receive higher signals and become more inclined to work, raising labor supply and suppressing wages. This increases his incentives to revolt. We show that Assumption 1, rather surprisingly, implies that the net expected payoff from revolting (versus not revolting) has the single-crossing property, and hence the best response to a monotone strategy is a monotone strategy.

Lemma 2 *Suppose all workers $j \neq i$ use a cutoff strategy in which they revolt whenever their private signals are below a finite threshold x^*. Then, worker i's best response is also a cutoff strategy in which he revolts whenever his signal is below a finite threshold.*

To convey the key idea of the proof, let $\Delta(x_i)$ be the net expected payoff from revolting versus not revolting for worker i with signal x_i. If he knew θ, his net expected payoff from

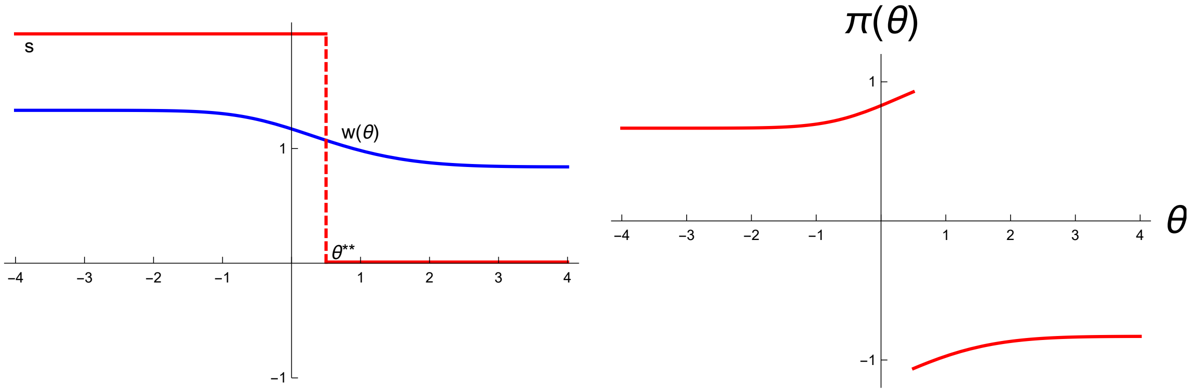

Figure 1: A worker's net payoff $\pi(\theta)$ from revolting versus not revolting conditional on θ, given an aggregate level of domestic capital and a monotone strategy of other workers.

revolting would be:

$$\pi(\theta) = \mathbf{1}_{\{\theta<\theta^{**}\}}\ s - w(\theta) = \mathbf{1}_{\{\theta<\theta^{**}\}}\ s - (1-\alpha)\ \left(\frac{\underline{K}+K}{\underline{L}+Pr(x_j \geq x^*|\theta)(1-\underline{L})}\right)^{\alpha}.$$

But worker i does not know θ, and has to use his information to estimate his net expected payoff:

$$\Delta(x_i) = \int_{\theta=-\infty}^{\infty} \pi(\theta)\ pdf(\theta|x_i, \tilde{r}_f, K)\ d\theta.$$

We then invoke Karlin's Theorem that links the number of sign changes in $\pi(\theta)$ to the number of sign changes in $\Delta(x_i)$. The theorem implies that when x_i and θ satisfy monotone likelihood ratio property, if $\pi(\theta)$ has one sign change, then $\Delta(x_i)$ has at most one sign change. Assumption 1 implies that $\Delta(x_i)$ has at least one sign change. Thus, it suffices to show that $\pi(\theta)$ has one sign change. Now, $\pi(\theta)$ consists of a decreasing step function ($\mathbf{1}_{\{\theta<\theta^{**}\}}\ s$) and a continuous, strictly positive and decreasing function ($w(\theta)$). The first term is the payoff from participating in a successful revolution, and the second term is wage conditional on θ, K, and other workers' strategy x^*. As Figure 1 illustrates, this implies that if $\lim_{\theta\to-\infty} w(\theta) < s$, then even though $\pi(\theta)$ may be non-monotone, it will have exactly one sign change. That is, if the workers who believe that the revolution surely succeeds prefer to revolt even when the wage is at its highest given K (Assumption 1), the best response to a monotone strategy will be a monotone strategy.

Another contrast with the benchmark models is that each worker now uses his information to estimate how other workers' decisions affect the aggregate labor supply and wages.

Critically, if $E[w(\theta)|x_i = x^*, \tilde{r}_f, K]$ depended on x^*, this would create additional complexity, and possibly multiple equilibria. A key observation is that in the limit when noise in workers' signals becomes vanishingly small, the marginal worker's (with the threshold signal x^*) estimate of the expected wage is independent of his signal. With very precise private signals, workers discard their noisy public information $\tilde{r}_f$ and K (Hellwig 2002).[10] Moreover,

Lemma 3 *When the noise in private signals is vanishingly small ($\sigma_w \to 0$), the marginal worker with signal $x_i = x^*$ believes that labor supply is distributed uniformly in its range:*

$$\underline{L} + L(\theta)|x_i = x^* \sim U[\underline{L}, 1].$$

To see the intuition, suppose a potential revolutionary worker i with signal x_i wants to know the rank of his signal in the population of potential revolutionary workers. In particular, he wants to know what percentage of these workers have higher signals than him. If worker i knew θ, then he would know the answer is $1-F_\epsilon(x_i-\theta)$. But he does not know θ, and using his signal, he believes that the probability that less than A per cent of the population have higher signals than him is $Pr(1-F_\epsilon(x_i-\theta) \leq A|x_i)$. In particular, the marginal worker with signal $x_i = x^*$ believes that the probability that less than A per cent of the potential revolutionaries have higher signals than him is $Pr(1 - F_\epsilon(x^* - \theta) \leq A|x_i = x^*)$, i.e., $Pr(L(\theta)/(1 - \underline{L}) \leq A|x_i = x^*)$. But he does not have any information about his ranking in a realization of signals. Thus, his belief is uniform. That is, $Pr(1 - F_\epsilon(x^* - \theta) \leq A|x_i = x^*) = A$, and hence $Pr(L(\theta)/(1 - \underline{L}) \leq A|x_i = x^*) = A$, implying that $L(\theta)|x_i = x^* \sim U[0, 1 - \underline{L}]$. A key step in this intuition is that worker i has no information about his ranking. If workers had no common prior information about θ, this was obvious. When workers have prior information about θ, then in the limit when their private signals become very precise, they effectively ignore their imprecise common prior, acting as if they have no prior information about θ.

[10] More specifically, $\tilde{r}_f$ and K together are a public signal of θ. To see this, suppose capitalists' strategies take a cutoff form so that each capitalist keeps his capital in the country whenever his signal is above a threshold that depends on the foreign return on capital: $y_j \geq y^*(r_f)$, where $y^*(r_f)$ is increasing in r_f. Then, $K(\theta) = Pr(y_j \geq y^*(r_f)|\theta)\ (\overline{K} - \underline{K})$. If r_f was known to the workers, they could infer θ from $K(\theta)$. However, they only observe a noisy signal $\tilde{r}_f$ about r_f. They can use Bayes rule to calculate $pdf(\theta|K,\ \tilde{r}_f)$. That requires calculating $pdf(K|\theta,\ \tilde{r}_f) \propto pdf(Pr(y_j \geq y^*(r_f)|\theta)|\tilde{r}_f) = pdf(1 - F_\eta([y^*(r_f) - \theta]/\sigma_c)|\tilde{r}_f)$, which amounts to calculating the distribution of a monotone function of the random variable r_f given $\tilde{r}_f$.

Thus, in the limit:

$$E[w(\theta)|x_i = x^*] = \int_{u=\underline{L}}^{1} (1-\alpha) \left(\frac{\underline{K}+K}{u}\right)^{\alpha} \frac{du}{1-\underline{L}} = (\underline{K}+K)^{\alpha} \frac{1-\underline{L}^{1-\alpha}}{1-\underline{L}} \tag{4}$$

We established that, given Assumption 1, the best response to a monotone strategy is also a monotone strategy, and that from the perspective of a marginal worker with the threshold signal $x_i = x^*$, the opportunity cost of revolt does not vary with x^*. Thus, we have effectively isolated the marginal workers' problem: for a given domestic capital supply, the workers' problem is *as if* we are in our second benchmark, with an exogenous wage given in equation (4).

Proposition 3 *Fix a level of aggregate domestic capital* $\underline{K}+K$*. When the noise in the workers' signals becomes vanishingly small, there is a unique symmetric monotone equilibrium. In that equilibrium, the revolution succeeds whenever* $\theta < \theta^{**}(K) \in (0,1)$*, where*

$$\theta^{**}(K) = (1-\underline{L})\ (1 - w^{**}(K)/s),\ \textit{with}\ w^{**}(K) = (\underline{K}+K)^{\alpha}\ (1-\underline{L}^{1-\alpha})/(1-\underline{L}). \tag{5}$$

The wage term, $w^{**}(K)$, is the expected wage of the marginal worker with signal x^* when the aggregate domestic capital is K. This expected wage is increasing in domestic capital $\underline{K}+K$, and decreasing in the fraction of workers who never revolt $\underline{L}$. This latter effect reflects the fact that increases in the fraction of these workers raise the aggregate labor supply both directly and by changing the strategic behavior of other workers.

Capitalists' Problem. The capitalists' equilibrium behavior determines the aggregate domestic capital. A capitalist i with signal y_i invests a fraction $\rho(y_i, r_f)$ of his mobile capital abroad. We focus on monotone strategies, so that $\rho(y_i, r_f)$ is increasing in y_i for a given r_f. Given a level of regime strength θ, the aggregate domestic mobile capital is $K(\theta) = \int \rho(y_i, r_f) f(y_i|\theta) dy_i$. When the regime is stronger, aggregate capital is higher:[11] $K(\theta)$ is increasing in θ, rising from $\lim_{\theta\to-\infty} K(\theta) = 0$ to $\lim_{\theta\to\infty} K(\theta) = \overline{K} - \underline{K} > 0$. Thus, as θ traverses the real line, $\theta^{**}(K)$ from Proposition 3 falls from $\theta^{**}(0)$ to $\theta^{**}(\overline{K}-\underline{K})$. This implies that there exists a unique $\theta^* \in (0,1)$ such that the regime collapses if and only if $\theta < \theta^*$, where

$$\theta^* = (1-\underline{L})\ (1 - w^{**}(K(\theta^*))/s). \tag{6}$$

[11] Because $\rho(y_i, r_f)$ is increasing in y_i, and y_i and θ have monotone likelihood ratio property.

The capitalists' strategic interactions feature forces for both strategic complements and substitutes. When other capitalists are more likely to move their capital abroad, the workers' productivity and hence their wages fall, increasing the likelihood of revolution, and raising a capitalist's incentives to move his capital abroad. However, the smaller supply of domestic capital raises its returns, increasing a capitalist's incentives to invest domestically.

Given the strategy of other capitalists and the workers, a capitalist i with signal y_i maximizes his expected payoff:

$$\max_{k_i \in [0, \overline{K} - \underline{K}]} r_f \ (\overline{K} - \underline{K} - k_i) + Pr(\theta \geq \theta^* | y_i) \times E[r_d(\theta) | \theta \geq \theta^*, y_i] \times (\underline{K} + k_i),$$

where $k_i = \rho(y_i, r_f)$ is the fraction of i's mobile capital that he invests domestically. The capitalist's problem can be written as:

$$\max_{k_i \in [0, \overline{K} - \underline{K}]} \{Pr(\theta \geq \theta^* | y_i) \ E[r_d(\theta) | \theta \geq \theta^*, y_i] - r_f\} \times k_i$$

$$\text{with} \ \ r_d(\theta) = \alpha \left(\frac{\underline{L} + L(\theta)}{\underline{K} + K(\theta)} \right)^{1-\alpha}.$$

When a capitalist's signal increases, he believes that the regime is stronger, raising his incentives to invest domestically: $Pr(\theta \geq \theta^* | y_i)$ increases. But he also believes that both workers and other capitalists also receive higher signals, and hence workers become more inclined to work, and the capitalists become more inclined to invest domestically. However, this increase in capital supply has another effect: it suppresses capital returns, thereby reducing incentives to invest domestically. Of course, in calculating domestic returns, capitalists must also condition on the fact that they only receive domestic returns if the regime survives, i.e., $\theta \geq \theta^*$. In sum, the net expected payoff from moving a unit of capital abroad need not be monotone. However, we show that Assumption 2 delivers that this net expected payoff has the single-crossing property, and the best response to a monotone strategy is a finite-cutoff strategy.

Lemma 4 *Suppose all capitalists $j \neq i$ use a cutoff strategy in which they invest their mobile capital domestically whenever their private signals are above a finite threshold y^*. There exists a threshold $\bar{\sigma} > 0$ such that if $\sigma_w < \bar{\sigma}$, then capitalist i's best response also takes a cutoff form, in which he invests all his mobile capital domestically if and only if his signal is above a finite threshold.*

The idea of the proof is similar to that of Lemma 2, but it is complicated by the facts that capitalists have to anticipate the worker's behavior and that they receive their domestic returns only if the regime survives. Let $\Gamma(y_i)$ be the net expected payoff from investing one unit of capital in domestic versus foreign markets versus for capitalist i with signal y_i. If a capitalist knew θ, his net expected payoff would be:

$$\Pi(\theta) = \mathbf{1}_{\{\theta \geq \theta^*\}}\ \alpha \left(\frac{\underline{L} + Pr(x_k \geq x^*|\theta)\ (1-\underline{L})}{\underline{K} + Pr(y_j \geq y^*|\theta)\ (\overline{K} - \underline{K})} \right)^{1-\alpha} - r_f. \tag{7}$$

But capitalist i does not know θ, and has to use his information to estimate his net expected payoff:

$$\Gamma(y_i) = \int_{-\infty}^{\infty} \Pi(\theta)\ pdf(\theta|y_i) d\theta.$$

Now, when the regime is very weak, $\Pi(\theta) = -r_f < 0$. Assumption 2 implies that when the regime is very strong,

$$\lim_{\theta \to \infty} \Pi(\theta) \geq \alpha \left(1/\overline{K}\right)^{1-\alpha} - r_f > 0.$$

Thus, $\Pi(\theta)$ and $\Gamma(y_i)$ both have at least one sign change. A stronger version of Assumption 2 that $\alpha \left(\underline{L}/\overline{K}\right)^{1-\alpha} > \overline{f}$ would immediately imply that $\Pi(\theta)$ has exactly one sign change: if $\theta < \theta^*$, then $\Pi(\theta) = -r_f < 0$; if $\theta \geq \theta^*$, then $\Pi(\theta) > \alpha \left(\underline{L}/\overline{K}\right)^{1-\alpha} > \overline{f}$. With the current Assumption 2, however, domestic return is generally non-monotone in θ (see the ration in equation (7)). Still, the proof shows that $\Pi(\theta)$ switches sign only once when the noise in the workers' signals is sufficiently small. Here, the idea is to use $\lim_{\sigma_w \to 0} x^*(\sigma_w) = \theta^*$. Then, one can show that for any $\theta > \theta^*$, labor supply (the numerator in equation (7)) approaches 1, allowing one to invoke Assumption 2. But this approach needs to be modified to prove uniform convergence, so that one can find a threshold $\overline{\sigma} > 0$ such that if $\sigma_w < \overline{\sigma}$, then $\Pi(\theta)$ has one sign change—as opposed to the easier task of proving a separate threshold ($\overline{\sigma}_\theta$) for each θ.

Lemma 4 implies that the marginal capitalist whose signal is at the equilibrium threshold y^* must be indifferent between investing in the country or abroad. Thus, symmetric monotone equilibria are characterized by cutoffs (x^*, y^*, θ^*):

$$Pr(\theta \geq \theta^*|y_j = y^*)\ E[r_d(\theta)|\theta \geq \theta^*, y_j = y^*] = r_f. \tag{8}$$

$$r_d(\theta) = \alpha \left(\frac{\underline{L} + L(\theta)}{\underline{K} + K(\theta)} \right)^{1-\alpha}. \tag{9}$$

$$\theta^* = (1-\underline{L}) \left(1 - \frac{w^{**}(K(\theta^*))}{s}\right), \text{with } w^{**}(K(\theta)) = \frac{(\underline{K}+K(\theta))^\alpha\ (1-\underline{L}^{1-\alpha})}{(1-\underline{L})}, \tag{10}$$

where aggregate supply of capital and labor (conditional on θ) are:

$$K(\theta) = Pr(y_j \geq y^*|\theta)\ (\overline{K}-\underline{K}) \ \text{ and } \ L(\theta) = Pr(x_i \geq x^*(K(\theta))|\theta)\ (1-\underline{L}),$$

and $x^*(K)$ is the workers' equilibrium strategy from the second stage, in which the workers observe the aggregate domestic capital.

These conditions reflect both within-group and between-group interactions among capitalists and workers. For example, the very shape of the equation (10) reflects the interactions among the workers, which capitalists anticipate, and the appearance of $K(\theta)$ in it reflects that each capitalist recognizes the effect of other capitalists on the likelihood of regime change. Using an approach similar to what we discussed in our characterization of the workers' behavior, we show that when the noise is vanishingly small, in equilibrium, the marginal capitalist believes that domestic supply of capital is uniformly distributed: $\underline{K}+K(\theta)|y_i = y^* \sim U[\underline{K},\overline{K}]$. Although the capitalists' problem is more complex than the workers' (e.g., the workers' behavior must be taken into account, and domestic capital returns must be conditioned on the regime's survival), we show that the equilibrium is unique and the equilibrium regime change threshold θ^* takes a simple closed form.

Proposition 4 *When the noise in private signals becomes vanishingly small (where we first let $\sigma_w \to 0$ and then let $\sigma_c \to 0$), there is a unique symmetric monotone equilibrium in which the regime collapses if and only if $\theta < \theta^*$, where*

$$\theta^* = (1-\underline{L})\ (1-w^*/s), \text{ with } w^* = (\overline{K}^\alpha - (\overline{K}-\underline{K})\ r_f)\ (1-\underline{L}^{1-\alpha})/(1-\underline{L}). \tag{11}$$

By analogy with Proposition 2, Proposition 4 shows that we can treat our model *as if* we are in our second benchmark, with an exogenous wage given in equation (11). Calling w^* the "effective wage," we can define effective supply of labor and capital that would generate this wage in a competitive market with Cobb-Douglas production technology. To do so, we can use Proposition 3 to derive an effective labor supply, and then use it together with w^* in Proposition 4 to calculate an effective capital supply. From Proposition 3,

$$(1-\alpha)\ \left(\frac{\underline{K}+K}{\text{effective labor supply}}\right)^\alpha = (\underline{K}+K)^\alpha\ \frac{1-\underline{L}^{1-\alpha}}{1-\underline{L}}, \tag{12}$$

and hence

$$\text{effective labor supply} = (1-\alpha)^{1/\alpha} \left(\frac{1-\underline{L}}{1-\underline{L}^{1-\alpha}}\right)^{1/\alpha}.$$

Now, using w^* from Proposition 4, we have

$$(1-\alpha) \left(\frac{\text{effective capital supply}}{\underline{L}+L}\right)^{\alpha} = \left(\overline{K}^{\alpha} - (\overline{K} - \underline{K})\ r_f\right) \frac{1-\underline{L}^{1-\alpha}}{1-\underline{L}}.$$

Finally, substituting the effective labor supply from equation (12) for $\underline{L}+L$ yields

$$\text{effective capital supply} = \left(\overline{K}^{\alpha} - (\overline{K} - \underline{K})\ r_f\right)^{1/\alpha}.$$

If changes in $\underline{L}$ did not have a strategic effect due to the workers' within-group interactions, then the effective labor supply would be linear: $\underline{L} + q_w^*\ (1-\underline{L})$ for some equilibrium value q_w^* that would not depend on $\underline{L}$. Similarly, if changes in $\underline{K}$ did not have a strategic effect, then the effective capital supply would be linear: $\underline{K}+q_c^*\ (\overline{K}-\underline{K})$ for some equilibrium value q_c^* that would not depend on $\underline{K}$. These non-linearities in effective supply of labor and capital stem from the players' strategic interactions.

Corollary 1 *Increases in immobile capital $\underline{K}$ or total capital $\overline{K}$ both decrease the likelihood of regime change. In contrast, increases in the foreign returns to capital r_f, the warm-glow from participating in a successful revolution s, or the fraction of potential revolutionary workers $1-\underline{L}$ all raise the likelihood of regime change.*

$$\frac{\partial \theta^*}{\partial \underline{K}},\ \frac{\partial \theta^*}{\partial \overline{K}},\ \frac{\partial \theta^*}{\partial \underline{L}} < 0 < \frac{\partial \theta^*}{\partial r_f},\ \frac{\partial \theta^*}{\partial s}. \tag{13}$$

The effects of global economy r_f and capital mobility $\underline{K}$ are of particular interest. Improvements in global markets that increase foreign returns r_f raise the capitalists' incentives to move their capital abroad, and increases in capital mobility (smaller $\underline{K}$) enable them to do so. Both these changes raise the likelihood of regime change domestically. Thus, globalization and market integration, as well as improvements in transportation technology that reduce the costs of moving capital, or economic modernization that changes the focus of the economy from relatively immobile sectors to more mobile ones (e.g., from the agricultural sector to service/finance sectors), can amplify the likelihood of social conflict and revolution.[12] When are these destabilizing effects stronger? We focus on the marginal effect of increases in foreign return—the effect of capital mobility is similar.

Corollary 2 *The marginal effect of foreign returns to capital r_f is higher when either the warm-glow from participating in a successful revolution s or the capital share α is lower.*

$$\frac{\partial^2\theta^*}{\partial\alpha\partial r_f},\ \frac{\partial^2\theta^*}{\partial s\partial r_f} < 0.$$

Corollary 2 implies that the destabilizing effect of globalization (marginal increases in r_f) is higher where ideological convictions for regime change (captured by s) or the capitalists' share of income (captured by α) are lower. Labor share $1-\alpha$ is considered as a measure of inequality (Acemoglu et al. 2008; Piketty 2014), and there is a theme in the literature that associates inequality with conflict. We can capture this effect of inequality by positing that s is an increasing function of α. Then, increases in capital share α increase the likelihood of regime change by raising the workers' motivation to revolt (Corollary 1). But increases in α also affect the likelihood of regime change by changing the technology, $(\underline{K}+K)^{\alpha}(\underline{L}+L)^{(1-\alpha)}$. Thus, for example, when total capital $\overline{K}$ is sufficiently high, increases in capital share can raise the effective wage, thereby reducing the likelihood of regime change. These conflicting effects are consistent with inconclusive empirical findings on the relationship between inequality and conflict (Blattman and Miguel 2010, p. 26-7). Corollary 2 adds to this debate by highlighting the mediating effect of capital share on the destabilizing effect of globalization in conflict-prone societies. Now, the effect is unambiguous, as both effects move in the same direction:

$$\frac{d}{d\alpha}\frac{\partial\theta^*}{\partial r_f} = \frac{\partial^2\theta^*}{\partial\alpha\partial r_f} + \frac{\partial^2\theta^*}{\partial s\partial r_f}\ \frac{\partial s(\alpha)}{\partial\alpha} < 0.$$

Higher labor share always exacerbates the destabilizing effect of increases in foreign returns (or capital mobility), which can stem from globalization, modernization of the economy, or improvements in technologies that reduce international transportation costs.

We end this section by highlighting two additional observations. First, one may wonder what would happen if, instead of a continuum of capitalists, there was only one capitalist.

[12] Garfinkel et al. (2008) also link globalization to conflict. In their model, when free trade raises the price of a commodity whose property rights are contested, it increases the contestants' incentives to switch from economic to military production to win the contest.

Then, in the limit when the capitalist's noise goes to zero, he prevents revolution whenever possible. That is, if the regime survives when all the capital is invested domestically, then the capitalist invests all his capital domestically; otherwise, he invests all his mobile capital abroad. In particular, the equilibrium regime change threshold does not depend on foreign returns or capital mobility. The reason is that the workers' decisions, which determine the regime change threshold, depend on foreign returns and capital mobility only through the capitalist's decisions. When the capitalist has a very precise estimate of the regime's strength, absent strategic risk, he knows whether or not he can stop the regime change, and does so if he can, independent of foreign returns and capital mobility.

Second, our analysis so far applies as much to decisions of foreign investors to invest in a country as to decisions of domestic capitalists to send their capital abroad. In the following section, we focus on the latter interpretation (capital flight), and investigate the capitalists' decisions to give the state authority over their decisions in order to remedy their collective action problem.

Capital Control

When a capitalist decides whether to invest domestically or to move his capital abroad, he does not take into account the effect of his decision on other capitalists. In particular, a capitalist does not internalize that reductions in domestic capital reduce wages and increase the likelihood of revolution, thereby potentially hurting the capitalists who invest domestically. To remedy this, the capitalists, before they receive their private information, may ex-ante decide to give the state the authority to impose capital control.

To investigate whether and when the capitalists want to impose capital control on themselves, we extend the game to include an earlier stage in which the capitalists, before observing their private information, decide whether to impose capital control. At this stage, the capitalists are identical, and maximize their expected payoff using their prior information about the regime's strength, anticipating the equilibrium behavior that follows. If capital control is imposed, the state will not allow capital to move abroad, and hence all the capital will be invested domestically. Otherwise, the capitalists are free to move their capital abroad. After the capitalists decide whether to impose capital control on themselves, all players receive their signals. If capital control has been imposed, all capital is invested domestically, and the workers observe the level of capital and decide whether to work or to revolt. If capital control has not been imposed, the subgame that follows is identical to our original game.

Let $\gamma \in \{0, 1\}$ capture capital control, where $\gamma = 0$ means that capitalists can move their capital with no restrictions, and $\gamma = 1$ means that capital is not allowed to move abroad. Capital control determines the effective mobility of intrinsically mobile capital: without capital control, mobile capital is $\overline{K} - \underline{K}$, while with capital control, mobile capital becomes $(\overline{K} - \underline{K})\ (1 - \gamma)$. This logic allows us to adjust Proposition 4 to account for capital control by multiplying $(\overline{K} - \underline{K})$ by $(1 - \gamma)$:

$$\theta^*_\gamma = (1 - \underline{L})\ (1 - w^*_\gamma/s),\ \text{with}\ w^*_\gamma = (\overline{K}^\alpha - (\overline{K} - \underline{K})\ (1 - \gamma)\ r_f)\ (1 - \underline{L}^{1-\alpha})/(1 - \underline{L}), \quad (14)$$

where θ^*_γ and w^*_γ capture the dependence of the regime change threshold and effective wage on capital control. Capital control reduces the likelihood of regime change: $\theta^*_1 < \theta^*_0$. This is the benefit of capital control for the capitalists. However, capital control also prevents capitalists from moving their capital abroad if, based on their subsequent private information, they believe that revolution is likely. That is, capital control destroys the value of the capitalists' subsequent information. This is the cost of capital control for the capitalists.

To analyze when capitalists favor capital control, let U_1 be a capitalist's expected payoff with capital control, and U_0 be a capitalist's expected payoff without capital control. To ease exposition, let $r_d \geq r_f$ be the exogenous domestic capital returns—propositions and proofs are with endogenous returns. Then,

$$U_1 = [Pr(\theta \geq \theta^*_1)\ r_d]\ \overline{K}, \quad (15)$$

and

$$U_0 = Pr(\theta \geq \theta^*_0, y_i \geq y^*)\ r_d\ \overline{K} + Pr(y_i < y^*)\ R_f, \quad (16)$$

where $R_f = (\overline{K} - \underline{K})r_f \in [0, (\overline{K} - \underline{K})r_d]$.[13] When either the foreign return is zero, $r_f = 0$, or there is no capital mobility, $\underline{K} = \overline{K}$, so that $R_f = 0$, capitalists do not have any incentive to move their capital abroad, and hence capital control does not make a difference:

$$U_1 = U_0(R_f = 0), \quad (17)$$

[13]In equation (16), U_0 has an additional term, $Pr(\theta \geq \theta^*_0, y_i < y^*)\ r_d\ \underline{K}$, which goes to zero in the limit when $\sigma_c \to 0$.

where we recognize that the expected payoff with capital control (U_1) does not depend on R_f because the capital cannot move abroad. In the other extreme, when all the capital is mobile, $\underline{K} = 0$, and moving capital abroad has no costs, $r_f = r_d$, so that $R_f = (\overline{K} - \underline{K})r_d$, then capital control hurts the capitalists:

$$U_1 < U_0(R_f = (\overline{K} - \underline{K})r_d). \tag{18}$$

Combining (17) and (18) implies that unless $U_0(R_f)$ is very volatile, either (i) $U_1 < U_0(R_f)$ for all R_f, or (ii) $U_1 > U_0(R_f)$ *if and only if* R_f is small. Proposition 5 shows that the log-concavity of the prior beliefs about the regime strength tames the volatility of $U_0(R_f)$ enough to get these results. Which pattern emerges depends on the strength of the strategic effect of R_f. Higher R_f means that effective foreign returns are higher or more capital can move abroad. Thus, the direct, non-strategic effect of increases in R_f goes against capital control. However, higher R_f also increases the likelihood of regime change by affecting the capitalists' strategic decisions, and through them, the workers'. This strategic effect favors capital control. In the limit when the noise in the capitalists' private signals is vanishingly small ($\sigma_c \to 0$), the equilibrium cutoff y^* approaches the regime change threshold θ_0^* and the distribution of y approaches that of θ (see equation (39) in the proof of Proposition 5), so that (16) becomes:

$$U_0(R_f) = (1 - G(\theta_0^*(R_f)))\; r_d\; \overline{K} + G(\theta_0^*(R_f))\; R_f.$$

Differentiating (for a fixed level of capital $\overline{K}$) teases out these direct and strategic effects:

$$\begin{aligned} \frac{dU_0(R_f, \theta_0^*)}{dR_f} &= \frac{\partial U_0(R_f, \theta_0^*)}{\partial R_f} + \frac{\partial U_0(R_f, \theta_0^*)}{\partial \theta_0^*} \frac{\partial \theta_0^*(R_f)}{\partial R_f} \\ &= G(\theta_0^*(R_f)) - \frac{\partial \theta_0^*(R_f)}{\partial R_f}\; g(\theta_0^*(R_f))\; (r_d\; \overline{K} - R_f). \end{aligned}$$

The first term captures the direct, non-strategic effect of increases in R_f, which tends to raise U_0 and goes against imposing capital control. In contrast, the second terms captures the strategic effects of increases in R_f, which tend to reduce U_0 and favor capital control. The ratio $g(\theta_0^*)/G(\theta_0^*)$ controls the relative strength of strategic and direct effects. Thus, if this ratio is large enough at $R_f = 0$, so that the strategic effect dominates, capitalists opt for capital control when R_f is small. As R_f increases, so that the revolution becomes more likely, this ratio falls due to log-concavity, reducing the relative strength of the strategic effect. As we saw in (18), when R_f is sufficiently large, the direct effect dominates, and the capitalists go against capital control.

Proposition 5 *Fix a level of aggregate capital $\overline{K}$, and suppose $G(\theta)$ is log-concave. Let $\sigma_w \to 0$ and then let $\sigma_c \to 0$. In equilibrium, there is a threshold $\hat{R}_f \in (0, \alpha\overline{K}^\alpha)$ such that capitalists want the state to impose capital control if and only if*

$$R_f < \hat{R}_f \quad \textit{and} \quad \alpha \, \frac{g(\theta^*_{0,m})}{G(\theta^*_{0,m})} > \frac{1}{(1-\underline{L}) - \theta^*_{0,m}}, \quad \textit{where} \quad \theta^*_{0,m} = \theta^*_0(R_f = 0).$$

This result highlights a force that acts as a political barrier to globalization (Grossman and Helpman 1994; Acemoglu and Robinson 2006b): as long as the combination of effective foreign return and capital mobility remains low ($(\overline{K} - \underline{K})r_f < \hat{R}_f$), capitalists favor capital control because they recognize that their collective action problem can amplify political instability, and this effect may swamp the benefits of market integration.

Economic and Political Coercion in Right-wing Regimes

Capital control is a form of economic coercion that can be exercised by a central authority (the state). More generally, one can divide coercive measures into economic coercion and political coercion. Economic coercion aims to limit economic decisions, while political coercion aims to limit political decisions. For example, capital control limits the movement of capital, and state repression limits protest activities by raising their expected costs. To prevent regime change, the capitalists can support a combination of these two coercive measures: economic coercion of themselves and political coercion of the workers. In this section, we analyze whether and when the support for one kind of coercion increases or decreases the support for another. In particular, do capitalists support higher or lower levels of repression when there is capital control?

We model the degree of state repression by an expected direct cost of revolt c that a worker incurs if he revolts. Now, in addition to choosing capital control, the capitalists ex-ante decide the state's repression level c at a cost of $R(c)$, with $R(0) = R'(0) = 0$, and $R'(c),\ R''(c) > 0$ for $c > 0$. The cost of revolt raises its opportunity costs, and is the same as raising wages by the same amount. In particular, in (2), the left hand side will have an additional term of $-c$, which can be moved to the right hand side and be added to $w(\theta)$. Thus:

$$\theta^*_\gamma(c) = (1 - \underline{L}) \left(1 - \frac{w^*_\gamma + c}{s}\right),$$

where we recall that $\gamma = 1$ corresponds to capital control and $\gamma = 0$ corresponds to no capital control. As expected, raising repression reduces the likelihood of revolution:

$$\frac{\partial \theta^*_\gamma(c)}{\partial c} = -\frac{1 - \underline{L}}{s} < 0. \tag{19}$$

Next, we investigate the optimal level of repression from the capitalists' perspective with and without capital control. Incorporating repression into (15) yields:

$$U_1(c) = [1 - G(\theta^*_1(c))]\ r_d\ \overline{K} - R(c),$$

where $\theta^*_1(c)$ highlights the dependence of the equilibrium regime change threshold on the level of repression c. In the limit when the noise becomes vanishingly small, (16) becomes:

$$U_0(c) = (1 - G(\theta^*_0(c)))\ r_d\ \overline{K} + G(\theta^*_0(c))\ r_f\ \Delta K - R(c).$$

Differentiating with respect to c yields:

$$\frac{\partial U_0(c)}{\partial c} = g(\theta^*_0)\ \frac{\partial \theta^*_0(c)}{\partial c}\ (r_f\ \Delta K - r_d\ \overline{K}) - R'(c) \quad \text{and} \quad \frac{\partial U_1(c)}{\partial c} = -\ g(\theta^*_1)\ \frac{\partial \theta^*_1(c)}{\partial c}\ r_d\ \overline{K} - R'(c).$$

The marginal cost of repression $R'(c)$ is increasing, and from (19), the marginal effect of repression on the equilibrium regime change threshold ($\partial \theta^*_\gamma(c)/\partial c$) is constant. Therefore, letting c^*_1 and c^*_0 be interior optimal repression levels with and without capital control, we have:[14]

$$c^*_0 > c^*_1 \quad \Leftrightarrow \quad g(\theta^*_0)\ r_f\ \Delta K < [g(\theta^*_0) - g(\theta^*_1)]\ r_d\ \overline{K}. \tag{20}$$

The term $g(\theta^*_0)\ r_f\ \Delta K$ captures that, absent capital control, less capital remains in the country, reducing the marginal value of raising repression to prevent revolution. We call this the *Boix Effect* (Boix 2003). In the extreme case where r_f is at its maximum and all the capital is mobile $\Delta K = \overline{K}$, all the capital moves abroad and repression will have no value to the

[14]Endogenizing capital returns changes r_d in (20) to $\alpha \overline{K}^{\alpha-1}$, and alters the values of equilibrium thresholds θ^*_0 and θ^*_1, and hence optimal repressions. However, the basic tradeoffs on which we focus remain similar.

capitalists. However, absent capital control, the equilibrium likelihood of regime change is also higher $G(\theta_0^*) > G(\theta_1^*)$. When higher likelihood of revolution ($G(\theta_0^*) > G(\theta_1^*)$) translates into higher *margins* of reducing the equilibrium thresholds, $g(\theta_0^*) > g(\theta_1^*)$, it means that the marginal value of repression is higher without capital control. We call this the *Marx Effect*, capturing the idea that freer movement of capital causes higher repression of labor. When this substitution effect dominates, the state uses higher levels of repression absent capital control. To see when this happens, consider a case where $g(\theta)$ is strictly unimodal with low variance, and a mode slightly to the right of θ_0^*. Then, $g(\theta)$ rises sharply from $g(\theta_1^*)$ to $g(\theta_0^*)$, so that the Marx effect dominates. In contrast, when there is little prior knowledge about the regime's strength (θ is distributed almost uniformly, so that $g(\theta_0^*) \approx g(\theta_1^*)$), the Boix Effect dominates, so that repression is higher under regimes that impose capital control. The reason is that when the capitalists' prior belief about the regime's strength is very diffuse, the marginal change in the likelihood of revolution from raising repression becomes independent from capital control decisions, rendering the Marx effect negligible.

When the Marx effect dominates, capital control and labor repression become substitutes, consistent with the policies of Latin American right-wing regimes between 1960s and 1980s. Alesina and Tabellini (1989) document the low degree of capital control under these regimes (e.g., Argentina and Chile), which also severely repressed the protest activities of workers.[15] When the Boix effect dominates, economic and political coercion become complements, resonating with the Nazi regime's policies in the 1930s that combined capital control and harsh repression of labor. The capitalists' support of the Nazis to contain the revolutionary threat of the left, and the Nazis' harsh repression of labor unions and the left, are well-known (Shirer 1960). We also highlight that as part of the economic recovery and social stabilization "New Plan" of 1934 under the Nazis, "comprehensive controls over foreign transactions were established." In particular, "capital could not be moved freely abroad" (Overy 1996, p. 26).

[15]The "dependent development" literature also shows the alliance between the state and capital in Latin America, and the state's facilitation of capital movements (Evans 1979).

Conclusion

We developed a tractable general equilibrium model of regime change, which combined key aspects of the economy and politics—production, markets, and coordination and information frictions. Multiple equilibria could arise, and the presence of conflicting strategic forces could make the analysis intractable. We showed that, with reasonable assumptions, these difficulties can be overcome to obtain a simple characterization of a unique equilibrium. We focused on three sets of substantive results. The first set studies how processes that facilitate capital movements (e.g., globalization) affect political stability. The other two investigate the origins and functioning of capital control, and the relationship between economic and political coercion in right-wing authoritarian regimes—regimes that represent the capitalists' interests. From a broader perspective, the logic put forth in this paper points to a natural alliance between the capitalists and strong authoritarian states, even when such states involve corrupt officials who hinder productivity. Disruptions that accompany major reforms can temporarily weaken the state's coercive power both in realm of the economy (capital control) and in politics (state repression). This in turn can invoke the strategic complementarities involved in capital flight and revolution that can unravel into a regime change. That is, a form of "politics of fear" (Padro i Miquel 2007) underlies the "capitalist-dictator" alliance well-documented in Latin America, the Philippines, modern Russia, and other former Soviet countries.

Because it is tractable, this framework can be adapted to study the interactions between political stability and economic growth or technological change. For example, one could integrate our framework with Acemoglu and Restrepo's (2018a, 2018b) task-based framework of technological change. In such a framework, automation reduces wages or labor share, thereby increasing the political risk of regime change in autocracies or anti-business populist challengers in democracies. Thus, capitalists may collectively decide to support a central authority to arrest the spread of automation.[16] In our model, the state is subservient to the

[16] Historically, producers have occasionally appealed to the state to restrict production. When agricultural prices plummeted in the Great Depression, farmers responded by producing more, thereby dampening prices even further. The crop control policies of the early 1930s in the United States were a response to curb this collective action problem. When the voluntary provisions of the Agricultural Adjustment Act failed to sufficiently reduce production, some farmers turned to vigilante intimidation to enforce quotas, which soon gave way to the Bankhead Cotton Control Act and Kerr-Smith Tobacco Control Act, "compulsory, statutory measures, requested by the majority of producers themselves" (Kennedy 1999, p. 207; see p. 202-7).

interests of the capitalists as a whole. Although some regimes may heavily cater to capitalists in their early years, centralized states with coercive powers eventually develop interests that are not fully aligned with the capitalists'. To improve the stability of their regimes, dictators may nationalize industries, implement wage controls, and enlarge the public sector to shield the workers from market fluctuations, including capital flight. Thus, one can contemplate a more general model that takes the state as an independent player with separate interests from those of the capitalists and the workers. These directions are left for future work.

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Online Appendix: Proofs

Proof of Lemma 1: First, observe that in the limit when the noise goes to zero, we have (Morris and Shin 2003):

$$Pr(x_i < \hat{x}|\theta = \hat{\theta}) = 1 - Pr(\theta < \hat{\theta}|x_i = \hat{x}), \quad \text{for all } \; \hat{x} \text{ and } \hat{\theta}. \tag{21}$$

To show this, we mirror the steps in Morris and Shin (2003):

$$\begin{aligned}
Pr(\theta < \hat{\theta}|x_i = \hat{x}) &= \int_{\theta=-\infty}^{\hat{\theta}} pdf(\theta|\hat{x})d\theta \\
&= \int_{\theta=-\infty}^{\hat{\theta}} \frac{pdf(\hat{x}|\theta)\ g(\theta)}{\int_{-\infty}^{\infty} pdf(\hat{x}|\theta)\ g(\theta)\ d\theta}\ d\theta \\
&= \int_{\theta=-\infty}^{\hat{\theta}} \frac{f_\epsilon(\frac{\hat{x}-\theta}{\sigma_w})\ g(\theta)}{\int_{-\infty}^{\infty} f_\epsilon(\frac{\hat{x}-\theta}{\sigma_w})\ g(\theta)\ d\theta}\ d\theta \\
&= \int_{z(\hat{\theta})}^{z=\infty} \frac{f_\epsilon(z)\ g(\hat{x}-\sigma_w\ z)}{\int_{-\infty}^{\infty} f_\epsilon(z) g(\hat{x}-\sigma_w\ z)\ dz}\ dz \\
&= 1 - F_\epsilon(z(\hat{\theta})) \;\; \text{(in the limit when } \sigma_w \to 0) \\
&= 1 - F_\epsilon\left(\frac{\hat{x}-\hat{\theta}}{\sigma_w}\right) \\
&= 1 - Pr(x_i < \hat{x}|\theta = \hat{\theta}).
\end{aligned}$$

We now use equation (21) to prove the lemma:

$$\begin{aligned}
H(p|\theta = \hat{\theta}) &= Pr(Pr(\theta < \hat{\theta}|x_i = \hat{x}) < p|\theta = \hat{\theta}) && \text{(definition of } H) \\
&= Pr(1 - Pr(x_i < \hat{x}|\theta = \hat{\theta}) < p|\theta = \hat{\theta}) && \text{(from (21))} \\
&= Pr(\ 1 - F_\epsilon((\hat{x}-\hat{\theta})/\sigma_w) < p\ |\theta = \hat{\theta}\ ) \\
&= Pr(\ \hat{\theta} + \sigma_w\ F^{-1}(1-p) < \hat{x}\ |\theta = \hat{\theta}\ ) \\
&= 1 - F_\epsilon(F_\epsilon^{-1}(1-p)) \\
&= p.
\end{aligned}$$

□

Proof of Lemma 2: Let $\Delta(x_i; x^*)$ be worker i's net expected payoff from revolting versus not revolting. We show that as x_i traverses the real line from $-\infty$ to ∞, $\Delta(x_i; x^*)$ changes sign at a unique point.

$$\begin{aligned}\Delta(x_i;x^*) &= Pr(\theta<\theta^{**}|x_i,\tilde{r}_f,K)\times s-(1-\alpha)\ E\left[\left(\frac{\underline{K}+K}{\underline{L}+Pr(x_j\geq x^*|\theta)(1-\underline{L})}\right)^{\alpha}\Bigg|x_i,\tilde{r}_f,K\right]\\ &= \int_{\theta=-\infty}^{\infty}\left(\mathbf{1}_{\{\theta<\theta^{**}\}}\ s-(1-\alpha)\ \left(\frac{\underline{K}+K}{\underline{L}+Pr(x_j\geq x^*|\theta)(1-\underline{L})}\right)^{\alpha}\right)f(\theta|x_i,\tilde{r}_f,K)\ d\theta\\ &= \int_{\theta=-\infty}^{\infty}\pi(\theta)\ f(\theta|x_i,\tilde{r}_f,K)\ d\theta,\end{aligned}$$

where $\mathbf{1}_{\{\cdot\}}$ is the indicator function, and $\pi(\theta)\equiv\mathbf{1}_{\{\theta<\theta^{**}\}}\ s-(1-\alpha)\ \left(\frac{\underline{K}+K}{\underline{L}+Pr(x_j\geq x^*|\theta)(1-\underline{L})}\right)^{\alpha}$. Observe that

$$\begin{aligned}\lim_{\theta\to-\infty}\pi(\theta) &= s-(1-\alpha)\ \left(\frac{\underline{K}+K}{\underline{L}}\right)^{\alpha}>s-(1-\alpha)\ \left(\frac{\overline{K}}{\underline{L}}\right)^{\alpha}>0.\ \text{(Assumption 1)}\\ \lim_{\theta\to\infty}\pi(\theta) &= -(1-\alpha)\ \left(\frac{\underline{K}+K}{1}\right)^{\alpha}<0.\end{aligned}$$

Moreover, inspection of $\pi(\theta)$ reveals that $\pi(\theta)$ changes sign from positive to negative at a unique point $\theta=\theta^{**}$.

Next, because $f(\theta|x_i,\tilde{r}_f,K)$ is TP_2 (i.e., has MLRP between θ and x_i), by Karlin's theorem (Karlin 1968, Ch. 1, Theorem 3.1), $\Delta(x_i;x^*)$ has, at most one sign change. Finally, the inspection of $\Delta(x_i;x^*)$ reveals that $\lim_{x_i\to-\infty}\Delta(x_i;x^*)>0>\lim_{x_i\to\infty}\Delta(x_i;x^*)$. Thus, $\Delta(x_i;x^*)$, indeed, has one sign change from positive to negative. □

Proof of Lemma 3: Recalling that

$$L(\theta)=Pr(x_i\geq x^*|\theta)\ (1-\underline{L})=\left(1-F_{\epsilon}\left(\frac{x^*-\theta}{\sigma_w}\right)\right)\ (1-\underline{L}), \tag{22}$$

we have:

$$\begin{aligned}Pr(L(\theta)/(1-\underline{L})<A|x_i=x^*) &= Pr(1-F_{\epsilon}((x^*-\theta)/\sigma_w)<A|x_i=x^*) \qquad \text{(from (22))}\\ &= Pr(\theta<x^*-\sigma_wF_{\epsilon}^{-1}(1-A)|x_i=x^*)\\ &= 1-Pr(x_i<x^*|\theta=x^*-\sigma_wF_{\epsilon}^{-1}(1-A)) \quad \text{(from (21))}\\ &= 1-F_{\epsilon}\left(\frac{x^*-x^*+\sigma_wF_{\epsilon}^{-1}(1-A)}{\sigma_w}\right)\\ &= 1-F_{\epsilon}(F_{\epsilon}^{-1}(1-A))\\ &= A.\end{aligned}$$

Hence, the marginal worker with signal $x_i = x^*$ believes that $Pr(x_i \geq x^*|\theta)$ is distributed uniformly on $[0,1]$, and hence $L(\theta)|x_i = x^* \sim U[0, 1-\underline{L}]$. □

Proof of Proposition 3: Given a level of aggregate domestic capital $\underline{K}+K$, the equilibrium is characterized by a pair (x^*, θ^*) such that:

$$Pr(\theta < \theta^{**}|x_i = x^*, \tilde{r}_f, K) \times s = E[w(\theta)|x_i = x^*, \tilde{r}_f, K]. \tag{23}$$

$$w(\theta) = (1-\alpha)\left(\frac{\underline{K}+K}{\underline{L}+Pr(x_i \geq x^*|\theta)(1-\underline{L})}\right)^{\alpha}. \tag{24}$$

$$Pr(x_i < x^*|\theta^{**}, \tilde{r}_f, K)\ (1-\underline{L}) = \theta^{**}. \tag{25}$$

First, observe that in the limit where the noise in the workers' private signals approaches zero, $pdf(\theta|x_i, \tilde{r}_f, K)$ approaches $pdf(\theta|x_i)$.[17] Now,

$$\begin{aligned}
E[w(\theta)|x_i = x^*] &= (1-\alpha)\ (\underline{K}+K)^{\alpha} \int_{-\infty}^{\infty} \frac{1}{[\underline{L}+(1-Pr(x_i<x^*|\theta))(1-\underline{L})]^{\alpha}}\ pdf(\theta|x_i = x^*)\ d\theta \\
&= (1-\alpha)\ (\underline{K}+K)^{\alpha} \int_{0}^{1} \frac{dz}{(\underline{L}+z(1-\underline{L}))^{\alpha}} \quad \text{(from Lemma 3)} \\
&= (1-\alpha)\ \frac{(\underline{K}+K)^{\alpha}}{1-\underline{L}} \left[\frac{(\underline{L}+z(1-\underline{L}))^{1-\alpha}}{1-\alpha}\right]_0^1 \\
&= (\underline{K}+K)^{\alpha}\ \frac{1-\underline{L}^{1-\alpha}}{1-\underline{L}}.
\end{aligned}$$

Thus, in the limit, equations (23) and (25) simplify to:

$$Pr(\theta < \theta^{**}|x_i = x^*) \times s = (\underline{K}+K)^{\alpha}\ \frac{1-\underline{L}^{1-\alpha}}{1-\underline{L}}. \tag{26}$$

$$Pr(x_i < x^*|\theta^{**})\ (1-\underline{L}) = \theta^{**}. \tag{27}$$

Because $Pr(\theta < \theta^{**}|x^*) = 1 - Pr(x_i < x^*|\theta^{**})$ in the limit, the result for $\theta^{**}(K)$ follows. Given this $\theta^{**}(K)$, equation (27) implies a unique x^*.

Moreover, $\theta^{**}(K)$ is decreasing in K and clearly $\theta^{**}(K) < 1$. To see that $\theta^{**}(K) > 0$, note that $\frac{1-\underline{L}^{1-\alpha}}{1-\underline{L}} < \frac{1-\alpha}{\underline{L}^{\alpha}}$, and hence $\frac{(\underline{K}+K)^{\alpha}\ (1-\underline{L})^{1-\alpha}}{1-\underline{L}} < (1-\alpha)\left(\frac{\overline{K}}{\underline{L}}\right)^{\alpha} < s$, where the last inequality follows from Assumption 1. □

Proof of Lemma 4: Let $\Gamma(y_i;\rho)$ be a capitalist's net expected payoff from investing one unit of capital in the country versus abroad, given his private signal y_i and given the strategies

[17] As we discussed in footnote 10, $\tilde{r}_f$ and K constitute a noisy public signal of θ, which becomes irrelevant for calculating the posterior when the noise in private signals becomes sufficiently accurate.

of other capitalists (ρ) and workers (x^*). We show that $\Gamma(y_i;\rho)$ has single-crossing property.

$$\begin{aligned}
\Gamma(y_i;\rho) &= Pr(\theta \geq \theta^*|y_i)\ E[r_d(\theta)|\theta \geq \theta^*, y_i] - r_f \\
&= \int_{-\infty}^{\infty} \left[\mathbf{1}_{\{\theta\geq\theta^*\}}\ \alpha \left(\frac{\underline{L} + Pr(x_k \geq x^*|\theta)\ (1-\underline{L})}{\underline{K} + K(\theta)} \right)^{1-\alpha} - r_f \right] pdf(\theta|y_i)\ d\theta \\
&= \int_{-\infty}^{\infty} \Pi(\theta)\ pdf(\theta|y_i) d\theta, \qquad (28)
\end{aligned}$$

where $\Pi(\theta) \equiv \mathbf{1}_{\{\theta\geq\theta^*\}}\ \alpha \left(\frac{\underline{L}+Pr(x_k\geq x^*|\theta)\ (1-\underline{L})}{\underline{K}+K(\theta)} \right)^{1-\alpha} - r_f$. Observe that:

$$\lim_{\theta\to-\infty} \Pi(\theta) = -r_f < 0 \text{ and } \lim_{\theta\to\infty} \Pi(\theta) \geq \alpha \left(\frac{1}{\overline{K}}\right)^{1-\alpha} - r_f > 0, \qquad (29)$$

where the last inequality follows from Assumption 2 that $\overline{f} < \alpha(1/\overline{K})^{1-\alpha}$, where we recall that $r_f \in [0, \overline{f}]$. From (28) and (29), $\lim_{y_i\to-\infty} \Gamma(y_i;\rho) < 0 < \lim_{y_i\to\infty} \Gamma(y_i;\rho)$. Thus, $\Gamma(y_i;\rho)$ has at least one sign change.

We will show that there exists a $\overline{\sigma} > 0$ such that if $\sigma_w < \overline{\sigma}$, then $\Pi(\theta;\sigma_w)$ has exactly one sign change as θ traverses the real line from $-\infty$ to ∞, where we have made the dependence of Π on σ_w explicit.[18] Then, because $pdf(\theta|y_i)$ is TP_2 (i.e., has MLRP between θ and y_i), by Karlin's theorem, $\Gamma(y_i;\rho,\sigma_w)$ has at most one sign change for $\sigma_w < \overline{\sigma}$.

Now, we show that there exists a $\overline{\sigma} > 0$ such that if $\sigma_w < \overline{\sigma}$, then $\Pi(\theta;\sigma_w)$ has exactly one sign change as a function of θ. Clearly, $\Pi(\theta;\sigma_w) = -r_f < 0$ for $\theta < \theta^*$. Let $\widehat{\Pi}(\theta;\sigma_w)$ be the restriction of $\Pi(\theta;\sigma_w)$ to $[\theta^*, \infty)$, so that

$$\widehat{\Pi}(\theta;\sigma_w) \equiv \alpha \left(\frac{1 - F_\epsilon\left(\frac{x^*(\sigma_w)-\theta}{\sigma_w}\right)(1-\underline{L})}{\overline{K} - F_\eta\left(\frac{y^*-\theta}{\sigma_c}\right)\Delta K} \right)^{1-\alpha} - r_f, \quad \text{for} \quad \theta \in [\theta^*, \infty),$$

where $\Delta K \equiv \overline{K} - \underline{K} < \overline{K}$, and we used the cdf of the noise in the signals of workers (F_ϵ) and capitalists (F_η). By continuity, for every $\gamma > 0$, there exists a $\delta > 0$ such that if $\theta \in [\theta^*, \theta^*+\delta]$, then $\overline{K} - F_\eta\left(\frac{y^*-\theta}{\sigma_c}\right)\Delta K \in [\overline{K} - F_\eta\left(\frac{y^*-\theta^*}{\sigma_c}\right)\Delta K, \overline{K} - F_\eta\left(\frac{y^*-\theta^*}{\sigma_c}\right)\Delta K + \gamma]$. Moreover, because $\lim_{\sigma_w\to0} x^*(\sigma_w) = \theta^*$, for sufficiently small σ_w, we have $x^*(\sigma_w) - (\theta^*+\delta) < 0$. Thus, for every

[18] A stronger assumption, $\overline{f} < \alpha(\underline{L}/\overline{K})^{1-\alpha}$, immediately implies that, for any $\sigma_w > 0$, $\Pi(\theta)$ switches sign from negative to positive at the unique point θ^*. Then, because $pdf(\theta|y_i)$ is TP_2 (i.e., has MLRP between θ and y_i), by Karlin's theorem, $\Gamma(y_i;y^*)$ has at most one sign change.

$\beta > 0$, there exists a $\sigma_\beta > 0$ such that if $\sigma_w < \sigma_\beta$, then $1 - F_\epsilon\left(\frac{x^*(\sigma_w)-\theta}{\sigma_w}\right)(1-\underline{L}) > 1 - \beta$, for all $\theta \geq \theta^* + \delta$. Now, choose a $\hat{\beta} > 0$ such that $\alpha\ \left(\frac{1-\hat{\beta}}{\overline{K}}\right)^{1-\alpha} > r_f$ (by Assumption 2, such a $\hat{\beta}$ exists). Thus, there exists a $\sigma_{\hat{\beta}} > 0$ such that if $\sigma_w < \sigma_{\hat{\beta}}$, then for $\theta \geq \theta^* + \delta$, we have:

$$\begin{aligned}
\widehat{\Pi}(\theta;\sigma_w) &> \alpha\ \left(\frac{1 - F_\epsilon\left(\frac{x^*(\sigma_w)-\theta}{\sigma_w}\right)(1-\underline{L})}{\overline{K}}\right)^{1-\alpha} - r_f \\
&\geq \alpha\ \left(\frac{1 - F_\epsilon\left(\frac{x^*(\sigma_w)-(\theta^*+\delta)}{\sigma_w}\right)(1-\underline{L})}{\overline{K}}\right)^{1-\alpha} - r_f \\
&> \alpha\ \left(\frac{1-\hat{\beta}}{\overline{K}}\right)^{1-\alpha} - r_f \\
&> 0 \qquad\qquad (\text{for } \theta \geq \theta^* + \delta). \qquad (30)
\end{aligned}$$

Next, we show that there is at most one sign change in $\theta \in [\theta^*, \theta^* + \delta]$. By continuity, at any $\theta_0 \in (\theta^*, \theta^* + \delta]$ at which there is a sign change, we must have $\widehat{\Pi}(\theta = \theta_0; \sigma_w) = 0$:

$$1 - F_\epsilon\left(\frac{x^*(\sigma_w) - \theta_0}{\sigma_w}\right)(1-\underline{L}) = \left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\ \left(\overline{K} - F_\eta\left(\frac{y^* - \theta_0}{\sigma_c}\right)\Delta K\right). \qquad (31)$$

By Assumption 2, $\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\ \left(\overline{K} - F_\eta\left(\frac{y^*-\theta^*}{\sigma_c}\right)\Delta K\right) < 1$. If $\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\ \left(\overline{K} - F_\eta\left(\frac{y^*-\theta^*}{\sigma_c}\right)\Delta K\right) < \underline{L}$, then choose γ (and the corresponding δ) such that, for all $\theta \in [\theta^*, \theta^* + \delta]$,

$$\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\ \left(\overline{K} - F_\eta\left(\frac{y^* - \theta}{\sigma_c}\right)\Delta K\right) \leq \left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\ \left(\overline{K} - F_\eta\left(\frac{y^* - \theta^*}{\sigma_c}\right)\Delta K + \gamma\right) < \underline{L}.$$

Thus, $\widehat{\Pi}(\theta;\sigma_w) > 0$ for all $\theta \in [\theta^*, \theta^* + \delta]$.

Next, consider the case where $\underline{L} < \left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\ \left(\overline{K} - F_\eta\left(\frac{y^*-\theta^*}{\sigma_c}\right)\Delta K\right) < 1$. Then, choose γ (and the corresponding δ) such that $\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\ \left(\overline{K} - F_\eta\left(\frac{y^*-\theta^*}{\sigma_c}\right)\Delta K + \gamma\right) < 1$. This implies that, for all $\theta \in [\theta^*, \theta^* + \delta]$, $\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\ \left(\overline{K} - F_\eta\left(\frac{y^*-\theta}{\sigma_c}\right)\Delta K\right) \in [I_1, I_2] \subset (\underline{L}, 1)$, for some $I_1 < I_2$. Thus, from equation (31), at any $\theta_0 \in (\theta^*, \theta^* + \delta]$ at which there is a crossing, we must have $\frac{y^*-\theta_0}{\sigma_c} \in [k_1, k_2]$ and $\frac{x^*(\sigma_w)-\theta_0}{\sigma_w} \in [l_1, l_2]$, for some $k_1 < k_2$ and $l_1 < l_2$. Define

$$f_\eta^M \equiv \max_{x \in [k_1,k_2]} f_\eta(x) \quad \text{and} \quad f_\epsilon^m \equiv \min_{x \in [l_1,l_2]} f_\epsilon(x) > 0. \qquad (32)$$

Differentiating $\widehat{\Pi}(\theta;\sigma_w)$ with respect to θ yields:

$$\frac{d\widehat{\Pi}(\theta;\sigma_w)}{d\theta} > 0 \quad \Leftrightarrow \quad \frac{\frac{1}{\sigma_w} f_\epsilon\left(\frac{x^*(\sigma_w)-\theta}{\sigma_w}\right)(1-\underline{L})}{1 - F_\epsilon\left(\frac{x^*(\sigma_w)-\theta}{\sigma_w}\right)(1-\underline{L})} > \frac{\frac{1}{\sigma_c} f_\eta\left(\frac{y^*-\theta}{\sigma_c}\right)\Delta K}{\overline{K} - F_\eta\left(\frac{y^*-\theta}{\sigma_c}\right)\Delta K}. \qquad (33)$$

Thus, at any θ_0 at which $\widehat{\Pi}(\theta = \theta_0; \sigma_w) = 0$, we have:

$$\left.\frac{d\widehat{\Pi}(\theta;\sigma)}{d\theta}\right|_{\theta=\theta_0} > 0 \quad \Leftrightarrow \quad \frac{1}{\sigma_w} f_\epsilon\left(\frac{x^*(\sigma_w)-\theta_0}{\sigma_w}\right) > \frac{1}{\sigma_c} f_\eta\left(\frac{y^*-\theta_0}{\sigma_c}\right)\frac{\Delta K}{1-\underline{L}}\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}, \tag{34}$$

where we used equation (31). Moreover, from (32),

$$\frac{1}{\sigma_w} f_\epsilon\left(\frac{x^*(\sigma_w)-\theta_0}{\sigma_w}\right) \geq \frac{1}{\sigma_w} f_\epsilon^m \text{ and } \frac{1}{\sigma_c}\frac{\Delta K}{1-\underline{L}}\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}} f_\eta^M \geq \frac{1}{\sigma_c}\frac{\Delta K}{1-\underline{L}}\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}} f_\eta\left(\frac{y^*-\theta_0}{\sigma_c}\right). \tag{35}$$

Thus, from (34) and (35), if $\sigma_w < \frac{f_\epsilon^m}{f_\eta^M}\left(\frac{1}{\sigma_c}\frac{\Delta K}{1-\underline{L}}\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\right)^{-1} \in (0,\infty)$, then $\frac{d\widehat{\Pi}(\theta;\sigma_w)}{d\theta}\Big|_{\theta=\theta_0} > 0$. That is, for sufficiently small σ_w, at any point $\theta_0 \in (\theta^*, \theta^*+\delta]$ at which $\widehat{\Pi}(\theta)$ crosses 0, the derivative is strictly positively. Thus, there is at most one such crossing. In particular, either $\Pi(\theta)$ switches sign only at θ^*, or it switches sign only at some $\theta_0 \in (\theta^*, \theta^*+\delta)$.

Finally, consider the special case, where $\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\left(\overline{K} - F_\eta\left(\frac{y^*-\theta^*}{\sigma_c}\right)\Delta K\right) = \underline{L}$. Then, $\widehat{\Pi}(\theta^*;\sigma_w) > 0$ for all $\sigma_w > 0$. If $x^*(\sigma_w)$ goes to θ^* from below, for sufficiently small σ_w, there exists a $\delta > 0$ such that $\widehat{\Pi}(\theta;\sigma_w) > 0$ for all $\theta \in [\theta^*, \theta^*+\delta)$. To see this, observe that

$$1 - F_\epsilon\left(\frac{x^*(\sigma_w)-\theta}{\sigma_w}\right)(1-\underline{L}) \geq \underline{L} + (1-F_\epsilon(0))(1-\underline{L}) > \underline{L},\ \forall\theta \geq \theta^*.$$

Thus, we can pick a $\gamma > 0$ (with the corresponding δ) small enough, so that for $\theta \in [\theta^*, \theta^*+\delta)$ we have:

$$\left(\frac{r_f}{\alpha}\right)^{\frac{1}{1-\alpha}}\left(\overline{K} - F_\eta\left(\frac{y^*-\theta}{\sigma_c}\right)\Delta K\right) < \underline{L} + (1-F_\epsilon(0))(1-\underline{L}) \leq 1 - F_\epsilon\left(\frac{x^*(\sigma_w)-\theta}{\sigma_w}\right)(1-\underline{L}),$$

and hence $\widehat{\Pi}(\theta;\sigma_w) > 0$ for all $\theta \in [\theta^*, \theta^*+\delta)$. Next, suppose $x^*(\sigma_w)$ approaches θ^* from above. From (33), for sufficiently small σ_w, $\frac{d\widehat{\Pi}(\theta;\sigma_w)}{d\theta}|_{\theta=x^*(\sigma_w)} > 0$, and it can be made arbitrarily large. Further, by log-concavity, the left hand side of the second inequality in (33) is decreasing in θ. Thus, for sufficiently small σ_w, when $\theta \in (\theta^*, x^*(\sigma_w)]$, we have $\frac{d\widehat{\Pi}(\theta;\sigma_w)}{d\theta} > 0$, and hence $\widehat{\Pi}(\theta;\sigma_w) > 0$ for all $\theta \in [\theta^*, x^*(\sigma_w)]$. Thus, any crossing must happen at some $\theta_0(\sigma_w) > x^*(\sigma_w)$, and hence $\frac{x^*(\sigma_w)-\theta_0(\sigma_w)}{\sigma_w} < 0$, where we made explicit the possible dependence of θ_0 on σ_w. Now, if $\frac{x^*(\sigma_w)-\theta_0(\sigma_w)}{\sigma_w}$ is finite for all sufficiently small σ_w, then the logic of equations (32)-(35) goes through because we can find some $f_\epsilon^m > 0$. That is, there exists a $\overline{\sigma}_a > 0$ such that if $\sigma_w < \overline{\sigma}_a$, then $\Pi(\theta;\sigma)$ has one sign change as a function of θ. Otherwise, $\frac{x^*(\sigma_w)-\theta_0(\sigma_w)}{\sigma_w}$ must become unboundedly negative. But then $F\left(\frac{x^*(\sigma_w)-\theta_0(\sigma_w)}{\sigma_w}\right)$ approaches 0, and the logic of (30) applies. That is, there exists a $\overline{\sigma}_b > 0$ such that if $\sigma_w < \overline{\sigma}_b$, then $\Pi(\theta;\sigma)$ has one sign change as a function of θ. If $x^*(\sigma_w)$ approaches θ^* from both above and below, then set $\overline{\sigma} = \min\{\overline{\sigma}_b, \overline{\sigma}_a\}$. □

Proof of Proposition 4: First, we calculate the expected payoff from domestic investment for a capitalist whose signal is at the equilibrium threshold $y_j = y^*$. The left hand side of equation (8) is:

$$\begin{aligned}
& Pr(\theta \geq \theta^*|y_j = y^*)\ E[r_d(\theta)|\theta \geq \theta^*, y_j = y^*] \\
= \quad & Pr(\theta \geq \theta^*|y_j = y^*)\ \alpha\ \int_{-\infty}^{\infty} \left(\frac{\underline{L}+L(\theta)}{\underline{K}+K(\theta)}\right)^{1-\alpha}\ pdf(\theta|\theta \geq \theta^*, y_j = y^*)\ d\theta \\
= \quad & Pr(\theta \geq \theta^*|y_j = y^*)\ \alpha\ \int_{\theta^*}^{\infty} \left(\frac{\underline{L}+L(\theta)}{\underline{K}+K(\theta)}\right)^{1-\alpha}\ \frac{pdf(\theta|y_j = y^*)}{Pr(\theta \geq \theta^*|y_j = y^*)}\ d\theta \\
= \quad & \alpha \int_{\theta^*}^{\infty} \frac{[\underline{L} + Pr(x_i \geq x^*|\theta)\ (1-\underline{L})]^{1-\alpha}}{[\underline{K} + Pr(y_l \geq y^*|\theta)\ (\overline{K}-\underline{K})]^{1-\alpha}}\ pdf(\theta|y_j = y^*)\ d\theta \\
= \quad & \alpha \int_{\theta^*}^{\infty} \frac{1}{[\underline{K} + Pr(y_l \geq y^*|\theta)\ (\overline{K}-\underline{K})]^{1-\alpha}}\ pdf(\theta|y_j = y^*)\ d\theta, \quad \text{(because } \lim_{\sigma_w \to 0} Pr(x_i \geq x^*|\theta > \theta^*) = 1) \\
= \quad & \alpha \int_{z(\theta^*)}^{1} \frac{1}{[\underline{K} + (\overline{K}-\underline{K})\ z]^{1-\alpha}}\ dz, \quad \text{(change of variable from } \theta \text{ to } z = Pr(y_l \geq y^*|\theta)) \qquad (36) \\
= \quad & \alpha\ \frac{1}{\overline{K}-\underline{K}} \left[\frac{[\underline{K} + (\overline{K}-\underline{K})\ z]^{\alpha}}{\alpha}\right]_{z=z(\theta^*)}^{1} \\
= \quad & \frac{1}{\overline{K}-\underline{K}}\ \{\overline{K}^{\alpha} - [\underline{K} + (\overline{K}-\underline{K})\ z(\theta^*)]^{\alpha}\} \\
= \quad & \frac{\overline{K}^{\alpha} - [\underline{K} + K(\theta^*)]^{\alpha}}{\overline{K}-\underline{K}}. \qquad (37)
\end{aligned}$$

Substituting from equation (37) into equation (8) yields:

$$[\underline{K} + K(\theta^*)]^{\alpha} = \overline{K}^{\alpha} - (\overline{K}-\underline{K})\ r_f. \qquad (38)$$

Substituting from equation (38) into equation (10) yields the unique θ^* in equation (11). Finally, given a unique θ^*, we show that a unique y^* solves equation (38), and hence y^* exists and is unique. Recall that $K(\theta^*) = Pr(y_j \geq y^*|\theta^*)\ (\overline{K}-\underline{K})$. From equation (38), for a given θ^*, as y^* traverses the real line from $-\infty$ to ∞, the left hand side (strictly) falls from $\overline{K}^{\alpha}$ to $\underline{K}^{\alpha}$. Clearly, $\overline{K}^{\alpha} > \overline{K}^{\alpha} - (\overline{K} - \underline{K})\ r_f$. Next, we show $\underline{K}^{\alpha} < \overline{K}^{\alpha} - (\overline{K} - \underline{K})\ r_f$, i.e., $\frac{\overline{K}^{\alpha} - \underline{K}^{\alpha}}{\overline{K} - \underline{K}} > r_f$. Observe that from (36) and (37) we have:

$$\begin{aligned}
\frac{\overline{K}^{\alpha} - \underline{K}^{\alpha}}{\overline{K} - \underline{K}} &= \lim_{y^* \to \infty} \frac{\overline{K}^{\alpha} - [\underline{K} + K(\theta^*)]^{\alpha}}{\overline{K} - \underline{K}} \\
&= \lim_{y^* \to \infty} \alpha \int_{z(\theta^*)}^{1} \frac{1}{[\underline{K} + (\overline{K} - \underline{K})\ z]^{1-\alpha}}\ dz \\
&= \alpha \int_0^1 \frac{1}{[\underline{K} + (\overline{K} - \underline{K})\ z]^{1-\alpha}}\ dz \geq \alpha\ \frac{1}{\overline{K}^{1-\alpha}} > \overline{f} \geq r_f,
\end{aligned}$$

where second to last inequality is true by Assumption 2. Thus, there is a unique y^* that satisfies equation (38) and hence equation (8). □

Proof of Corollary 1: From Proposition 4,

$$\frac{\partial \theta^*}{\partial \underline{L}} = -1 + \frac{1}{s}\ (1-\alpha)\ \underline{L}^{-\alpha}\ [\overline{K}^{\alpha} - (\overline{K} - \underline{K})\ r_f] \leq -1 + \frac{1}{s}\ (1-\alpha)\ \left(\frac{\overline{K}}{\underline{L}}\right)^{\alpha} < 0,$$

where the last inequality follows from Assumption 1. $\frac{\partial \theta^*}{\partial \overline{K}} > 0$ follows from Assumption 2. Other results are immediate. □

Proof of Proposition 5: With capital control, a capitalist's expected payoff is:

$$U_1 = (1 - G(\theta_1^*))\ \alpha\ \overline{K}^{\alpha},$$

where we used $\lim_{\sigma_w \to 0} Pr(x_i \geq x^* | \theta \geq \theta_1^*) = 1$. Without capital control, a capitalist's expected payoff is:

$$\begin{aligned}
U_0 &= Pr(\theta \geq \theta_0^*, y_i \geq y^*)\ \alpha\ E\left[\left(\frac{1}{\underline{K} + Pr(y_j \geq y^* | \theta)\ (\overline{K} - \underline{K})}\right)^{1-\alpha} \middle| \theta \geq \theta_0^*, y_i \geq y^*\right]\ \overline{K} \\
&\quad + Pr(y_i < y^*) r_f\ \Delta K \\
&= Pr(\theta \geq \theta_0^*, y_i \geq y^*)\ \alpha\ \left(\frac{1}{\overline{K}}\right)^{1-\alpha}\ \overline{K} + Pr(y_i < y^*)\ r_f\ \Delta K \\
&= (1 - G(\theta_0^*))\ \alpha\ \overline{K}^{\alpha} + G(\theta_0^*)\ r_f\ \Delta K, \qquad (39)
\end{aligned}$$

where we used the facts that $\lim_{\sigma_c \to 0} y^* = \theta_0^*$, and the distribution of y_j approaches that of θ.

Lemma 5 *Fix $\overline{K}$, and suppose $\sigma_c \to 0$ and $g(\theta)$ is log-concave. For $R_f \in \left[0, \alpha\ \overline{K}^{\alpha}\right]$, either $U_0(R_f)$ is monotone, or it has a unique extremum, which is minimum.*

Proof of Lemma 5: Differentiating $U_0(r_f)$ from (39) with respect to r_f yields:[19]

$$\frac{dU_0(R_f)}{dR_f} = G(\theta_0^*) \ - \frac{\partial \theta_0^*}{\partial R_f} \, g(\theta_0^*) \left(\alpha \, \overline{K}^{\alpha} - R_f \right). \tag{40}$$

Moreover, from equation (14),

$$\frac{\partial \theta_0^*}{\partial R_f} = \frac{1 - \underline{L}^{1-\alpha}}{s}. \tag{41}$$

Substituting from (41) into (40) yields:

$$\frac{dU_0(R_f)}{dR_f} = G(\theta_0^*) - g(\theta_0^*) \, \frac{1 - \underline{L}^{1-\alpha}}{s} \, \left(\alpha \, \overline{K}^{\alpha} - R_f \right).$$

Thus,

$$\frac{dU_0(R_f)}{dR_f} > 0 \quad \Leftrightarrow \quad \frac{g(\theta_0^*)}{G(\theta_0^*)} < \left[\, \frac{1 - \underline{L}^{1-\alpha}}{s} \, \left(\alpha \, \overline{K}^{\alpha} - R_f \right) \, \right]^{-1}. \tag{42}$$

As R_f increases from 0 to $\alpha \overline{K}^{\alpha}$, (i) the right hand side rises, and (ii), from equation (41), θ_0^* increases, and hence the left hand side falls by log-concavity of $g(\theta)$. Thus, $U_0(r_f)$ is either monotone, or it has a unique extremum, which is a minimum. $\square$

From (42),

$$\left. \frac{dU_0(R_f)}{dR_f} \right|_{R_f=0} < 0 \quad \Leftrightarrow \quad \frac{g(\theta_{0,m}^*)}{G(\theta_{0,m}^*)} > \left[\, \frac{1 - \underline{L}^{1-\alpha}}{s} \, \alpha \, \overline{K}^{\alpha} \, \right]^{-1} = \frac{1}{\alpha[(1 - \underline{L}) - \theta_{0,m}^*]}.$$

The result follows because $U_0(R_f = 0) = U_1$ and $U_0(R_f = \alpha \overline{K}^{\alpha}) > U_1$. $\square$

[19] Results are the same if one differentiates first, and then takes the limits.

Online Appendix: Karlin's Theorem

For completeness we state Karlin's Theorem. We first provide the definitions of the objects used in the theorem. All the material is quoted from Chapter 1 of Karlin's (1968) book, *Total Positivity, Vol. I.*

Definition 1 *A real function (frequently called kernel) $K(x, y)$ of two variables ranging over linearly ordered sets X and Y, respectively, is said to be totally positive of order r (abbreviated TP_r) if for all*

$$x_1 < x_2 < \cdots < x_m, y_1 < y_2 < \cdots < y_m \qquad x_i \in X, y_j \in Y; 1 \leq m \leq r \tag{43}$$

we have the inequalities

$$K\begin{pmatrix} x_1, x_2, \cdots, x_m \\ y_1, y_2, \cdots, y_m \end{pmatrix} = \begin{vmatrix} K(x_1, y_1) & K(x_1, y_2) & \cdots & K(x_1, y_m) \\ K(x_2, y_1) & K(x_2, y_2) & \cdots & K(x_2, y_m) \\ \vdots & \vdots & & \vdots \\ K(x_m, y_1) & K(x_m, y_2) & \cdots & K(x_m, y_m) \end{vmatrix} \geq 0$$

A concept more general than total positivity is that of sign regularity.

Definition 2 *A function $K(x, y)$ is sign-regular of order r (abbreviated SR_r) if there exists a sequence of numbers ϵ_m each either $+1$ or -1 such that where conditions (43) apply, we have*

$$\epsilon_m\, K\begin{pmatrix} x_1, x_2, \cdots, x_m \\ y_1, y_2, \cdots, y_m \end{pmatrix} \geq 0$$

Definition 3 *Let $f(t)$ be defined in I, where I is an ordered set of the real line. Let*

$$S^-(f) = S^-[f(t)] = sup\ S^-[f(t_1), f(t_2), \cdots, f(t_m)]$$

where the supremum is extended over all sets $t_1 < t_2 < \cdots < t_m$ $(t_i \in I)$, m is arbitrary but finite, and $S^-(x_1, x_2, \cdots, x_m)$ is the number of sign changes of the indicated sequence, zero terms being discarded.

Let $K(x, y)$ defined on $X \times Y$ be Borel-measurable, and assume for simplicity that the integral $\int_Y K(x, y) d\mu(y)$ exists for every x in X. Here μ represents a fixed sigma-finite regular measure defined on Y such that $\mu(U) > 0$ for each open set U for which $U \cap Y$ is nonempty. Let f be bounded and Borel-measurable on Y, and consider the transformation

$$g(x) = (Tf)(x) = \int_Y K(x, y) f(y) d\mu(y)$$

Theorem 1 *If K is SR_r and satisfies the integrability requirements stated above, then*

$$S^-(g) = S^-(Tf) \leq S^-(f) \quad \textit{provided } S^-(f) \leq r - 1$$

In the case in which K is TP_r and f is piecewise-continuous, if $S^-(f) = S^-(g) \leq r - 1$, we further assert that the values of the functions f and g exhibit the same sequence of signs when their respective arguments traverse the domain of definition from left to right.