Learning Traps

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Abstract

Under policy uncertainty, policy choices generate a tradeoff between payoffs and information. Incumbent leaders who set policies can implement their preferred policy, but if the outcome is bad, constituents learn this and threaten office removal. I study a model of how this threat of information revelation constrains leaders' policies. I show that, in equilibrium, leaders implement uninformative "learning trap" policies that halt learning, even when more preferable policies are available. I argue that the codification of the commune in Imperial Russia can be viewed as a learning trap that distorted peasants' economic incentives to obfuscate the benefits of liberal reform.

JEL Codes: D72, D73, D78, D83, N33, N40, N43, N53

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1 Introduction

The policies of incumbent leaders — autocrats, CEOs, or elected officials — are often constrained by threats of being ousted by their constituents — elites, boards of directors, or the electorate. When the optimal policy for constituents is certain, a leader simply implements her most preferred policy that avoids *immediate overthrow*. However, when there is uncertainty about the effects of different policies, policy choices generate both payoffs and information about policy efficacy. If a leader implements her preferred policy today and the outcome is good, she can continue to remain in office because constituents will have no incentive to oust her. But if the resulting outcome is bad, constituents may take this as a sign that their preferences are misaligned with the leader's and threaten overthrow, forcing a leader to implement policies she desires less in the future. Uncertainty generates an additional *threat of information revelation* that constrains leaders' willingness to implement certain policies.

This paper develops a dynamic model with two agents — a "leader" in charge of policy and a representative agent for the "people" who threatens overthrow — to argue that leaders facing such informational threats will pursue muddied, intermediate "learning trap" policies. Learning trap policies are identified by the feature that, when implemented, they generate no information on policy efficacy. Hence, they allow leaders to sustain uncertainty about policy alignment with the people, preventing revelation of information that could constrain their actions or result in future overthrow. Our prediction generates an equilibrium nonmonotonicity in experimentation. When the effects of a leader's preferred policy are beneficial in expectation, leaders pursue their most preferred policy. When they are non-beneficial in expectation, they are forced to implement the most extreme policy preventing overthrow. It is precisely when the effects of policies are ambiguous that leaders can implement learning traps, balancing informational considerations with what the people allow.

I apply this model to study a prominent feature of the 1861 reforms ending serfdom in Russia — the codification of the peasant commune — providing a novel lens for viewing why Europe's largest land reform failed to develop fully private property or a mobile labor force. Russia's defeat in the 1850s Crimean War caused its government to seriously reconsider the structure of its economy. Many in the Tsar's government believed liberal economic reform — implementing private property and freeing up labor to move to the cities — could stimulate growth and, crucially, expand fiscal capacity. However, in the eventual reforms resulting from the War, the government mixed elements of private and communal property and restricted labor mobility, potentially stunting manufacturing growth and sacrificing the fiscal revenues it so desired. While the historical literature emphasizes demands from the elite and consistently low state capacity as drivers of this middle-ground, these explanations do not fully explain many puzzling features of the reform. I interpret the Tsar's policies as a "learning trap," arguing that the government feared overthrow if liberal policies ended up being ineffective. Distortions of peasants' labor and production decisions minimized learning about the effects of liberal institutions, thereby minimizing chances of revolt or severe fiscal straits.

In my model, a leader would like to maximize a policy $x \in [0,1]$, while a representative agent for the people want to maximize an outcome $y \in \mathbb{R}$. There are two states of the world: one where the relationship between x and y is positive (or single peaked) and one where it is negative. The leader and people share a common prior. As different policies are implemented, information is revealed. Agents use histories of policy-outcome data (y, x) to infer the state. The key feature is that data on policy efficacy are generated endogenously: by setting x, the leader also has flexibility in controlling inference. Although the people can overthrow the leader at any point, the threat of overthrow binds more heavily upon resolution of uncertainty.

In equilibrium, I show that if leaders are patient or exhibit sufficient distaste for low policies, they prefer to implement a "learning trap policy" x_{LT} below a certain belief threshold. A learning trap policy is a spatially intermediate policy x_{LT} which, upon implementation, keeps beliefs about policy efficacy invariant. Such policies exist if the people's maximal policy payoffs in each state are roughly symmetric. Information can help or hurt a leader, but it is more likely to hurt below a certain belief. Implementing x_{LT} is then preferable in expectation to an informative $x > x_{LT}$ that might force the leader to implement some $x < x_{LT}$ from tomorrow onwards. Indeed, at very low beliefs, a leader would like to implement x_{LT}, but the people force her to implement another policy which will lead to greater expected utility for them. Hence, x_{LT} is only implemented in equilibrium for an intermediate range of beliefs. This range of beliefs expands as patience increases, policies become more informative, or the utility loss from the leader's unfavorable policies grows.

In the baseline setting, learning is endogenous; leader's policy decisions are the only sources of inference. I extend the model with anticipated and unanticipated *external information revelation*. Unanticipated information — such as wars or disasters that "throw back the veil" on policy efficacy — reveals asymmetry in policy variation. Leaders desire experimentation only when larger informational shocks favor their preferred policy, and otherwise prefer learning trap policies. When exogenous information is *anticipated*, leaders pursue learning trap policies less often. Since learning can no longer be completely shut down, leaders experiment with their preferred policy and hope information will favor them. Anticipated shocks can be viewed through the lens of political "contagion," as groups of countries with similar historical institutions may learn from each other. I show that these results can explain how political fragmentation in early 19th century Europe generated a turbulent period of experimentation with indirect political rule, while politically unified China experienced little policy variation during the same period.

Reforms in Imperial Russia I apply the model's insights to the emancipation reforms of late-19th century Imperial Russia. Prior to 1861, Russian peasants worked state or noble-owned land as members of communes; their production and labor choices were managed by seigneurs (Nafziger, 2010). Russia's defeat in the 1856 Crimean War revealed a need to modernize its economy (Starr, 2015). The Tsar's government seemed to prefer liberal institutions to reduce the power of the nobility (Moon, 2014) jumpstart Russia's industrial revolution (Pereira, 1980), and increase fiscal revenue (Dennison

(2020), Dennison (2023)). However, the regime worried a liberal system might instead lead to unemployment, exploitation, abandonment of peasant land, dire fiscal straits, and — were the outcome particularly bad — overthrow (Dennison (2014), Polunov, Owen, and Zakharova (2015)).

The model predicts that policy uncertainty and fears from a reform backfiring should have led the Russian government to inhibit learning about the efficacy of liberal policies. Indeed, the government pursued a policy mixing key elements of serfdom with Western European institutions like private property. While seigneurs no longer oversaw peasants, communes themselves remained, and many household production, property, and labor allocation decisions required communal consent. Agricultural land — and incentives to invest and work it — were mostly held communally instead of privately (Dennison, 2020). The government used the commune to enforce mobility restrictions, inhibiting urban migration and stifling industrial growth (Nafziger, 2010). I argue that the regime believed the negative consequences associated with either allowing serfdom to remain or proceeding with fully liberal reform could have revealed information that constrained it in the future, but that a mixture of the two minimized learning and the chances of such constraints.

Traditional explanations of the government's unwillingness to pursue more radical reform have included ideological pressures from the nobility (Khristoforov & Gilley, 2016) and state capacity (Dennison, 2020). While both explanations undoubtedly influenced the reforms, the former seems to not have been a strong enough force to overcome the Tsar's decisions; the latter does not explain a persistent unwillingness to even gradually reform until the 1900s, especially compared to other countries. I argue that, in tandem with existing theories, threats of information revelation viewed through the lens of a learning trap provides a more complete picture of the reform's intermediacy.

I introduce the model in section two and solve it with comparative statics in section three. Section four applies the findings of the model to the codification of the Russian commune. Section five incorporates exogenous information revelation into the model with applications to political fragmentation in Europe and China. I conclude in section six. The remainder of the section addresses the relevant theoretical literature; literature on Russia is contained in section four and on political fragmentation in section five.

Literature This paper contributes to theoretical research on the use of policy-outcome data to make inferences, which often argues agents do not fully learn or converge on false models (Eliaz & Spiegler, 2020; Levy & Razin, 2021a; Montiel Olea, Ortoleva, Pai, & Prat, 2022; Schwartzstein & Sunderam, 2021; Spiegler, 2016). Policy-outcome histories may hamper learning about policies or politician ability. Callander (2011) shows that voters learning from spatial platforms may converge on inefficient policies. Frequentist inference or bounded memory can cause polarization (Izzo, Martin, & Callander, 2021; Levy & Razin, 2021b). Less information about policies can be better for voters (Prat, 2005) or politicians (Kartik, Squintani, Tinn, et al., 2015). Substitutability between politician effort and ability (Ashworth, De Mesquita, & Friedenberg, 2017) can hamper learning about ability. Empirical work also documents inferences about policy efficacy, including government reliability in China's Great Famine (Chen & Yang, 2019), external validity of policy experiments (Wang & Yang, 2021), and policy contagion (Buera, Monge-Naranjo, & Primiceri, 2011; Mukand & Rodrik, 2005).

This paper closely relates to reputation literature where leaders take inefficient actions to obfuscate ability. Political reputation papers (Dewan & Hortala-Vallve, 2019; Dur, 2001; Fu & Li, 2014; Izzo, 2024; Prendergast & Stole, 1996; Tomasi, 2023) establish a "gambling for resurrection" result: experimentation decreases with reputation. Most of these papers study uncertainty over leader ability in two period models, where politicians implement their preferred policy in the last period. This paper's primary contribution is to study a *repeated* model with policy uncertainty, showing that experimentation is in fact *nonmonotonic* with reputation. To illustrate this difference, consider the closest model to the present — that of Izzo (2024) — which studies how voters resolve policy uncertainty from an incumbent's choices. Quadratic voter utility means moderate policies, like in this paper, halt learning. However, due to the model's two period structure, constituents only retain high-reputation incumbents, meaning low-reputation incumbents experiment to "gamble for resurrection" and high-reputation incumbents implement safe policies to maintain reputation. Models with uncertainty over ability, such as that of Majumdar and Mukand (2004), also establish threshold retention rules since low ability incumbents can be replaced by outside options even in repeated settings. Such retention rules may not hold under repeated *policy* uncertainty since replacement does not resolve uncertainty and low reputation incumbents may not implement their preferred policies, unlike in this paper. This paper further suggests that when voters use observed utilities to make inferences and there is state-wise payoff symmetry, uninformative policies are spatially intermediate.

The present paper's insights contribute to broader theoretical studies of reputation and non-learning in repeated environments. Holmström (1999) shows that managers oversupply effort when firms set future wages based on inferences about their ability. However, ability's additive effect means agents eventually learn ability. [1] Non-learning then requires asymmetries in costs (Manso, 2011), information (Ely & Välimäki, 2003), or ability to interpret signals (Aghion & Jackson, 2016). In the latter, constituents threaten to replace incumbents until a high-ability leader emerges, generating learning in equilibrium. This cannot be replicated under policy uncertainty, since replacement does not change beliefs.[2] This paper finds more patient leaders prefer to slow learning since *future* policy constraints become more salient, the opposite of Besley and Case (1995) and Banks and Sundaram (1998).

A large political economy literature argue that regimes implement the most extreme policies keeping constituents indifferent to overthrow in dictator-game-like environments. (Acemoglu & Robinson, 2000, 2001; De Mesquita & Smith, 2010; Dower, Finkel, Gehlbach, & Nafziger, 2018; Li, Gilli, et al., 2014[3]). This paper argues that leaders instead *moderate* their actions when

[1]Non-learning in their paper is driven by an evolving state.

[2]The learning trap policy in this paper delivers the same utility in all states of the world. If constituents prefer a learning trap to a (constant) outside option at one belief, they prefer it at all beliefs, meaning this paper's result hence could not hold with an outside option.

[3]This paper looks at authority given to peasant communes given the frequency of dis-

policies generate information. It also relates to gradualism in "divide-the-dollar" settings like land reform[4], as discussed in Roland (2002) and Acemoglu and Robinson (2008), showing that under uncertainty about the optimal form of land ownership, "partial reforms" mixing different regimes obfuscate which reform is better.

2 Model

Policies Consider an infinite-horizon model beginning at $t = 1$. Each period, a policy $x_t \in X = [0, 1]$ is implemented which determines an outcome $y_t \in \mathbb{R}$ realized later that period. For example, y can represent profits, income, or the value of a public good.

Agents The first agent in the model is the "leader" — an entrenched incumbent, autocrat, or CEO. The second agent — "the people" — constrains the leader's power and can be interpreted as a representative agent for an electorate, board of directors, or elite group. Both agents are infinitely lived.

The leader discounts the future at rate δ. Her flow utility is $(1 - \delta)u_\ell(x_t)$ for $u_\ell(\cdot)$ strictly increasing, differentiable, and weakly concave.[5] Preference for higher x_t could reflect an ideological bent; reputational concerns; or the size of rents the government is able to extract in a setting like land reform[6].

The people's flow utility is y_t. They discount the future at rate 0. We make this assumption to highlight how policy moderation gives the people a strict incentive to retain the leader. The qualitative insights are identical with nonmyopia and other frictions, which we study in the analysis section.

ruptions in 1860s Russia, the period of this paper's case study.

[4]These considerations are important in the context of the Russian case study application, and a microfoundation addressing their specific role is constructed in the appendix.

[5]We assume concavity for tractability; all results go through with $u_\ell(\cdot)$ strictly increasing using a piecewise concavification of $u(\cdot)$.

[6]The "Additional Results" appendix explores a fiscal microfoundation in the setting of the paper's Russian case study. Specifically, x represents both the degree of involvement of the gentry in intermediating taxation and access to private property. Increasing x reduces the degree of gentry intermediation in revenue collection, improving the share the government can keep for itself.

Actions At $t = 1$, the leader holds power. At the beginning of each period the leader is in power, the people decide whether to incur a one-time cost $c > 0$ to overthrow the leader, following the literature on political transitions. If they overthrow, the people set x_t from t onwards. Overthrow succeeds with probability 1; the leader receives a loss $-L < u_\ell(0)$ and no further flow utility. If the leader is not overthrown, she sets x_t for that period and t moves to $t+1$.

States Agents possess uncertainty over two states of the world governing the relationship between x and y. In the "pro-leader" state, increases in x cause increases in y up to a single-peak $\tilde{x} > 0$. In the "anti-leader" state, increases in x cause decreases in y:

$$\begin{aligned} y_t &= -(x_t - \tilde{x})^2 + \epsilon_t \equiv f_g(x_t) + \epsilon_t && \text{Pro-Leader} \\ y_t &= -x_t^2 + \epsilon_t \equiv f_b(x_t) + \epsilon_t && \text{Anti-Leader} \end{aligned}$$

$\epsilon_t \sim \mathcal{U}[-\sigma, \sigma]$ is i.i.d. every period, making inference potentially imperfect. f_g and f_b are graphed in Figure 1. [7] In particular this means that $f_g(x) - f_b(x)$ is single crossing at some $x_{LT} \in (0,1)$ with $y_{LT} \equiv f_g(x_{LT})$. The expected value of y conditional on $x = \tilde{x}$ is in the pro-leader than the anti-leader state, and $x = 0$ to be better in the anti-leader than the pro-leader state.

Inference Both agents follow Bayes' Rule and use histories $\{y_\tau, x_\tau\}_{\tau \le t}$ to update a common belief over the two states. Denote q_{t-1} the belief in the pro-leader state at the beginning of time t. During period t, agents observe a policy-outcome pair (y_t, x_t) and use it to update q_{t-1} to q_t, to be carried into $t+1$. Denote $\Delta(x) = \min\{|f_g(x) - f_b(x)|, 2\sigma\}$ the *effective difference* between the expectation of y conditional on x in each state. Bayes' Rule implies that

[7] All results hold if f_g and f_b are linear with positive and negative slope, respectively; as well as under moderate asymmetry, which we analyze later.

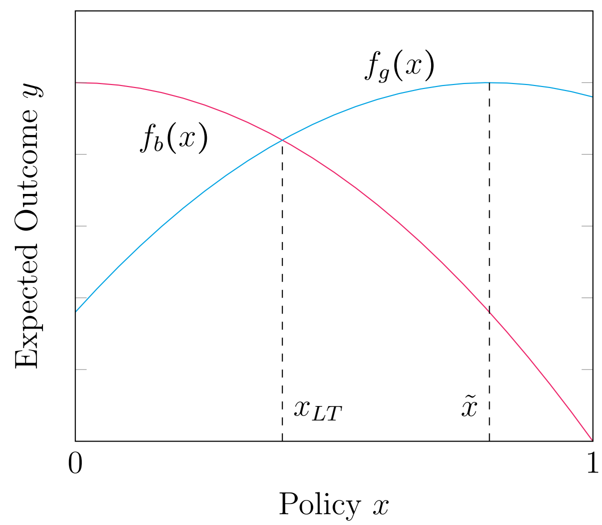

Figure 1: $f_g(x)$ and $f_b(x)$ graphed

the distribution of posteriors conditional on x_t and q_{t-1} is:

$$q_t | q_{t-1}, x_t = \begin{cases} 1 & \text{with prob. } \frac{\Delta(x_t)}{2\sigma} q_{t-1} \\ q_{t-1} & \text{with prob. } 1 - \frac{\Delta(x_t)}{2\sigma} \\ 0 & \text{with prob. } \frac{\Delta(x_t)}{2\sigma}(1 - q_{t-1}) \end{cases}$$

When $x_t = x_{LT}$, $f_g = f_b$, meaning $\Delta(x_{LT}) = 0$. x_{LT} shuts down information revelation ($q_{t-1} = q_t$ with probability 1) and we refer to it as the **learning trap policy**. [8] While extreme policies reveal more information and are preferable when uncertainty is resolved, x_{LT} is a "muddied policy" that mixes elements of these opposing extremes to hamper inference. Finally, we assume $c < x_{LT}^2$ so that the overthrow threat binds in equilibrium.

[8] The existence of x_{LT} only depends on the single-crossing property, and generalizes beyond uniform noise. If $\epsilon_t \sim p(\epsilon_t)$ for some continuous density p :

$$q_t = \frac{p(y_t - f_g(x_{LT}))q_{t-1}}{p(y_t - f_g(x_{LT}))q_{t-1} + p(y_t - f_b(x_{LT}))(1 - q_{t-1})} = \frac{p(y_t - f_g(x_{LT}))q_{t-1}}{p(y_t - f_g(x_{LT}))q_{t-1} + p(y_t - f_g(x_{LT}))(1 - q_{t-1})}$$
$$= \frac{p(y_t - f_g(x_{LT}))q_{t-1}}{p(y_t - f_g(x_{LT}))} = q_{t-1}$$

Sequential Game We describe the game recursively.

1. At time t, the people decide whether to overthrow the leader.
   (a) If the people decide to overthrow the leader:
      i. The people incur the cost of overthrow c. The leader loses power, receives $-L$, and receives no further flow utility.
      ii. The people set x_t, y_t realizes, and they receive utility y_t.
      iii. The people update q_{t-1} to q_t. Return to step 1(a)ii at $t+1$.
   (b) If the people decide not to overthrow the leader:
      i. The leader sets x_t, y_t realizes, and the people receive utility y_t. The leader in power receives $(1-\delta)u_\ell(x_t)$.
      ii. Agents update their belief q_{t-1} to q_t. Returns to step 1 at $t+1$.

We focus on pure-strategy Markov Perfect Equilibria with respect to the belief q_{t-1}. $x_\ell(q) \in [0,1]$ indicates the leader's policy plan. The people's strategy is given by $\{p(q), x_p(q)\}$. $p(q) \in \{\text{overthrow}, \text{nooverthrow}\}$ denotes the overthrow decision. $x_p(q) \in [0,1]$ indicates their policy plan once in power. $x_\ell(q)$ and $\{p(q), x_p(q)\}$ must best respond to each other in equilibrium.

3 Analysis

We begin by analyzing the baseline model to highlight the central features of the model. We then relax the people's myopia and introduce costly experimentation to illustrate how the model's insights extend to a non-myopic people. Full proofs for this section are provided in the Appendix.

3.1 Analysis of Baseline Model

People The people have an incentive to overthrow if and only if

$$\max_x \mathbb{E}[y|x] - c \geq \mathbb{E}[y|x_\ell(q)],$$

i.e. if the best policy they can achieve is, in expectation, better than what the leader would implement less the cost of overthrow. $x_p(q) = \arg\max_x \mathbb{E}[y|x]$. For each q, we can then define $\text{NR}(q)$ as the set of policies that weakly prevents overthrow: $\text{NR}(q) = \{x \in [0,1] : \max_x \mathbb{E}[y|x] - c \geq \mathbb{E}[y|x_\ell(q)]\}$. $\text{NR}(q)$ is closed with nonempty interior. Because x_{LT} delivers the same utility in both states of the world, there exist a range of interior beliefs where x_{LT} is contained in the interior of $\text{NR}(q)$. Finally, $\text{NR}(q)$ is monotone in q, in the sense that its minimal and maximal elements are increasing in q. Its graph as a function of q is shaded below.

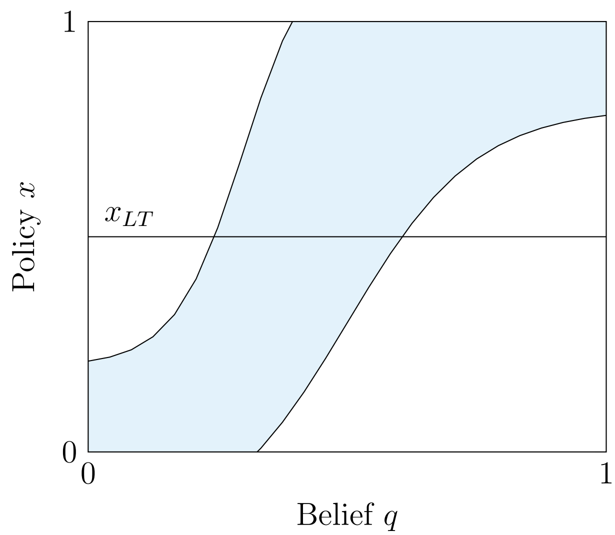

Figure 2: No-Overthrow Constraint $\text{NR}(q)$

Leader's Solution Let $\overline{x}(q) \equiv \max\{\text{NR}(q)\}$. Suppose $q = 0$ or 1. Policies have no information externalities, so the leader plays the most extreme policy preventing overthrow, as in a dictator game. $x_\ell(1)$ is then $\overline{x}(1)$ and $x_\ell(0) = \overline{x}(0)$. Denote $u_\ell(x_\ell(0)) = \underline{u}$ and $u_\ell(x_\ell(1)) = \overline{u}$. Denote $u_\ell(x_{LT}) = u_{LT}$ and note that, by the assumptions on c, $\underline{u} < u_{LT} < \overline{u}$. Since $u_\ell(q) > -L$ for all q, the leader will always want to avoid overthrow on the equilibrium path. Using this, for interior q, the Bellman describing $x_\ell(q)$ is:

$$V(q) = \max_{x_\ell(q)\in \mathrm{NR}(q)} (1-\delta)u_\ell(x) + \frac{\delta\Delta(x)}{2\sigma}\Psi(q) + \delta(1-\frac{\delta\Delta(x)}{2\sigma})V(q),$$

where $\Psi(q,x') = q\overline{u}+(1-q)\underline{u}$. Ψ is the expected value from the revelation of the truth. Suppose the leader implements policy x. With probability $q\Delta(x)/2\sigma$, $q \to 1$ and she receives $\overline{u}$ from tomorrow onwards. With probability $(1-q)\Delta(x)/2\sigma$, $q \to 0$ and she is highly constrained by the threat of overthrow, receiving $\underline{u}$. Otherwise, q is invariant.

The following proposition characterizes $x_\ell(q)$ for patient leaders.

Proposition 1. *Suppose $\sigma(1-\delta)$ is small and/or $\underline{u}$ is sufficiently low. There exists a threshold $\underline{q} \in (0,1)$ such that:*

1. *If $q \leq \underline{q}$, $x_\ell(q) = \min\{x_{LT}, \overline{x}(q)\}$. The leader plays the learning trap or the policy closest to it.*

2. *If $q > \overline{q}$, $x_\ell(q) = \overline{x}(q)$. The leader plays the maximal policy preventing overthrow.*

Proof. Normalize $\overline{u} = 1$, $u_{LT} = x_{LT}$, and allow $\underline{u}$ to vary. A lower or negative $\underline{u}$ can represent the unwillingness of the leader to concede lower x to the people or the increased salience of external overthrow sources. Consider a problem where the leader is constrained at $q = 0$ or 1 but can otherwise implement any policy in $[\underline{x}(0), \overline{x}(1)]$, written as:

$$\max_{x\in[\underline{x}(0),\overline{x}(1)]} \frac{2\sigma(1-\delta)}{2\sigma(1-\delta)+\delta\Delta(x)}u_\ell(x) + \frac{\delta\Delta(x)}{2\sigma(1-\delta)+\delta\Delta(x)}\Psi(q)$$

This expression is a convex combination of policy utility $u_\ell(x)$ and the value $\Psi(q)$ of the truth. As x departs from x_{LT}, weight shifts from $u_\ell(x)$ to $\Psi(q)$. A strategy $x_\ell(q) = x_{LT}$ delivers value x_{LT}. When are deviations from x_{LT} profitable?

1. Suppose $\Psi(q) < x_{LT}$. $x < x_{LT}$ decreases flow utility relative to x_{LT} and increases the probability with which the truth is revealed. Because $\Psi(q)$ is $< x_{LT}$, this is not profitable. On the other hand:

- $x > x_{LT}$ generates a positive effect by increasing flow utility;
- $x > x_{LT}$ shifts weight onto $\Psi(q) < x_{LT}$, generating a negative effect;

If $\Psi(q) < x_{LT}$ and $\sigma(1-\delta)$ is small, the negative effect dominates the positive, and x_{LT} is preferred to $x > x_{LT}$. Otherwise, implementing $x > x_{LT}$ is preferable. The point of indifference defines $\underline{q}$.

2. Suppose $\Psi(q) > x_{LT}$. An increase in x increases information revelation, but since $\Psi(q) > x_{LT}$, revelation of information goes in the leader's favor. The leader is attracted to higher policies on grounds of both flow utility and information revelation[9].

The *unconstrained* solution is shown in the left panel of Figure 3 in red, along with thresholds $\underline{q}$ and $\overline{q}$ that indicating the sign of the derivative in the unconstrained problem. Finally, we use $\mathrm{NR}(q)$ to trace out $x_\ell(q)$ in the constrained problem. $\mathrm{NR}(q)$ is shaded on the right below, and the bold lines indicate $x_\ell(q)$.

[9]Lower policies may dominate x_{LT} because of informational considerations. The threshold above which this occurs is given by $\overline{q}$. since they generate the same information as higher policies but less flow utility. This switch is indicated by $\overline{q}$ in Figure 2. While this consideration is irrelevant for the baseline model, it may hold in the general model.

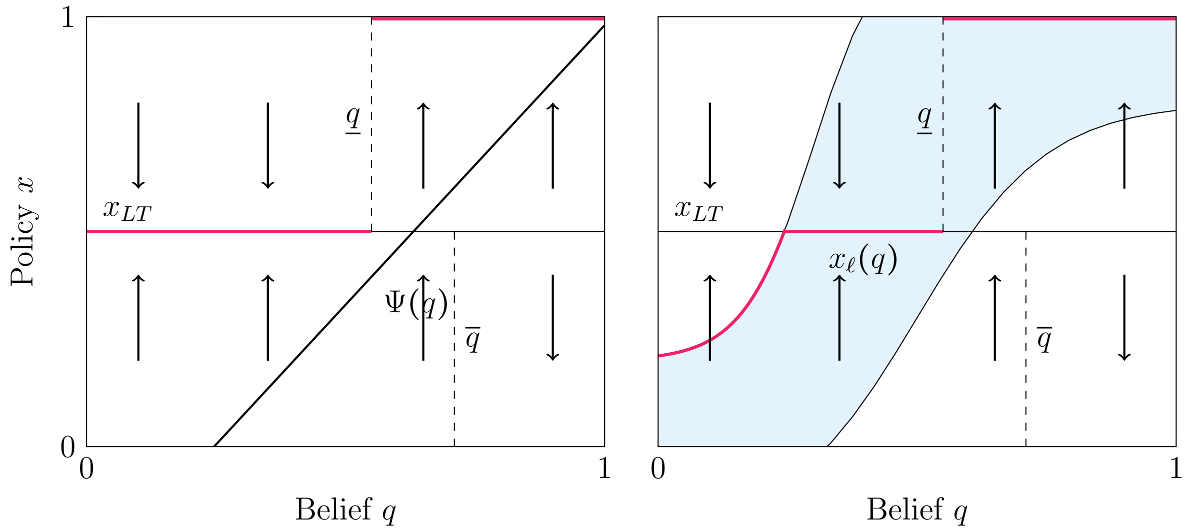

Figure 3: Sign of Derivative in Unconstrained Leader's Problem (Left) vs. NR(q) and $x_\ell(q)$ (Right)

□

The result also yields the following comparative statics.

Proposition 2. *Suppose σ decreases, δ increases for the leader, or $\underline{u}$ decreases. Then $\underline{q}$ increases.*

As σ decreases, for each x, the probability of information revelation increases. As δ increases, the leader deemphasizes flow utility; one interpretation is that $(1 - \delta)$ represents the length of the leader's office tenure and the frequency of evaluations. In both cases, the leader is worried more about how her actions may reveal the truth, increasing attraction to learning traps. Finally, as $\underline{u}$ decreases, constraints on the leader's policies from threats of overthrow are more undesirable in the future. The expected utility of revealing the truth strictly decreases for all $q < 1$, generating stronger commitment to nonlearning.

Comments Learning traps will be present in settings where there is policy uncertainty and a leader fears unfavorable information revelation will constrain her future actions or ability to remain in office. They will be more salient when costs of overthrow or policy adjustment increase, the leader stands to lose more when the truth unfavorably affects her; the leader is more patient; or the informativeness of policies increases.

A repeated setting is crucial for the result. In a two period model, a leader would always implement her preferred policy in the second period. The people would overthrow in the first period if q fell below a threshold. This would generate the opposite effect: leaders with q above the threshold would implement x_{LT} so as not to "rock the boat," while leaders below the threshold would implement $x = 1$ to "gamble for resurrection."

Our model instead generates an effective nonmonotonicity in experimentation. Leaders experiment for low q because they are forced to. Leaders do not experiment for intermediate q and, crucially, give the people a *strict* incentive to keep them in power, contrasting with the dictator game-like arrangements in the literature on political transitions. Leaders experiment for high q because the truth is likely to favor them and is preferred in expectation to perpetually moderating their policies to obfuscate information.

Finally, the result would not hold if the people received a constant outside option upon overthrow. Suppose y_{LT} were preferred to the outside option at $q = 1/2$. At $q = 0$, y_{LT} would still be preferred to the outside option. The leader could then achieve utility at least x_{LT} at $q = 0$ by repeatedly implementing x_{LT}, eroding the need to implement x_{LT} at any higher beliefs.

3.2 Model with Nonmyopia

We now allow the people in our model to be infinitely lived and discount the future at rate δ. The leader discounts the future at rate δ^{ℓ}. The people's utility is now also a function of x_{t-1}, as they bear adjustment costs $\kappa(x_t, x_{t-1}) = \kappa|x_t - x_{t-1}|$, capturing frictions from institutional reform and costly experimentation.[10] Their utility is $u_p(y_t, x_t, x_{t-1}) = (1-\delta)y_t - (1-\delta)\kappa|x_t - x_{t-1}|$.

[10] A model where a cost of policy adjustment does not depend on the size of an adjustment will deliver identical results. Myopia, risk aversion, or replacing the leader with one who wants to minimize x_t could be used as alternative frictions. Forcing the leader to bear the adjustment costs as well strengthens the result.

We denote $k \equiv (1-\delta)\kappa$.

Additionally, we allow for asymmetry in the value of y_t between states as follows:

$$\begin{aligned} y_t &= \beta_g - (x_t - \tilde{x})^2 + \epsilon_t \equiv f_g(x_t) + \epsilon_t \qquad \text{Pro-Leader} \\ y_t &= \beta_b - x_t^2 + \epsilon_t \equiv f_b(x_t) + \epsilon_t \qquad \text{Anti-Leader} \end{aligned}$$

We assume that:

1. $2k > |f_g'(x_{LT})|, |f_b'(x_{LT})| > k$;
2. $|(\beta_g - \beta_b)/2\tilde{x}| < k$;
3. $\tilde{x}^2/4 > 3|\beta_b - \beta_g| + 3(\beta_b - \beta_g)^2/\tilde{x}^2$;
4. $k \in \left(\frac{2\tilde{x} - \sqrt{\tilde{x}^2/4 - 3|\beta_b - \beta_g| - 3(\beta_b - \beta_g)^2/\tilde{x}^2}}{3}, \frac{2\tilde{x} + \sqrt{\tilde{x}^2/4 - 3|\beta_b - \beta_g| - 3(\beta_b - \beta_g)^2/\tilde{x}^2}}{3} \right)$.

This assumption bounds the degree of payoff symmetry between the two states, and suggests policy adjustment should not be *so* costly that policy never moves, but not *so* cheap that experimentation is almost free; this assumption shuts down excessive preferences for experimentation. When $\beta_b = \beta_g$, our assumption reduces to $2k > \tilde{x} > 5\tilde{x}/6 > k$.

Our Markov Perfect Equilibrium is now calculated with respect to the prior belief q and the previous period's status quo policy x'. We write $x_p(q, x')$ to the people's optimal policy conditional on overthrow.

Solution to People's Problem We first solve for $x_p(q, x')$. We then use this to characterize the overthrow decision and $x_\ell(q, x')$. Let q be the initial belief and x' yesterday's policy. $x_p(q, x')$ is the policy function of the following

Bellman equation:

$$W(q,x') = \max_{x\in[0,1]} \underbrace{(1-\delta)\mathbb{E}[y|x] - k|x-x'|}_{\text{Flow utility}}$$
$$+\,\delta\Bigg(\underbrace{\frac{\Delta(x)}{2\sigma}\big(qW(1,x)+(1-q)W(0,x)\big)}_{\text{Truth revealed}} + \underbrace{\Big(1-\frac{\Delta(x)}{2\sigma}\Big)W(q,x)}_{\text{Truth not revealed}}\Bigg)$$

Expectations are taken with respect to q. The first term represents expected flow utility $qf_g(x)+(1-q)f_b(x)$ less costs $k|x-x'|$. The next terms represent continuation utility. With probability $\frac{\Delta(x)}{2\sigma}$, the truth is revealed. Conditional on this, the belief moves to 1 with probability q and 0 with probability $1-q$. With probability $1-\frac{\Delta(x)}{2\sigma}$, the truth isn't revealed, the belief remains at q. Today's x becomes tomorrow's status quo policy.

The following proposition describes the value function associated with $x_p(q,x')$, which captures a tradeoff between information and policy flexibility. It suggests that for intermediate values of c, there exists an open set $LT \subseteq [0,1]\times X$ such that for all $(q,x')\in LT$ the people will not overthrow a leader continually implementing x_{LT}.

Proposition 3. *$x_p(q,x')$ is the solution to the following Bellman equation:*

$$W(q,x') = \max_{x\in[0,1]} \frac{2\sigma(1-\delta)\mathbb{E}[y|x]+\delta\Delta(x)\Phi(q,x)}{2\sigma(1-\delta)+\delta\Delta(x)} - k|x-x'|$$

where $\Phi(q,x) = qW(1,x)+(1-q)W(0,x)$. For intermediate values of c, there exists a nonempty open set $LT \subseteq [0,1]\times X$ with $LT \ni (1/2, x_{LT})$ such that for all $(q,x')\in LT$, $W(q,x') \le y_{LT}+c \le W(0,x'), W(1,x')$.

Proof. Suppose $\beta_b = \beta_g$ and $\tilde{x}=1$ so that $x_{LT}=1/2$. The problem's gives an objective for the value function, graphed on the left panel below for $q=1/2$ and the right one for $q=0$.

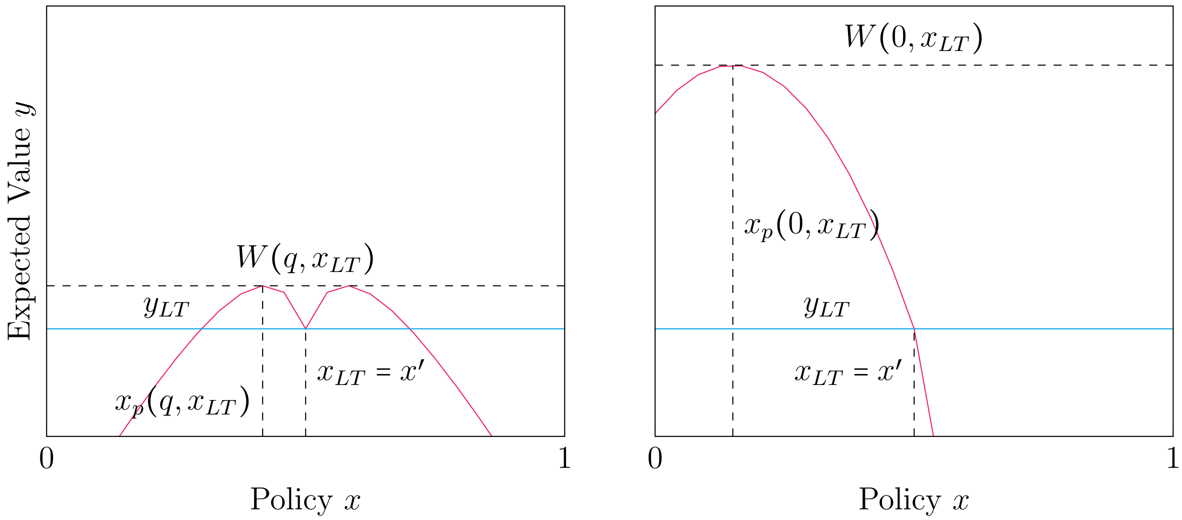

Figure 4: Objectives Associated with $W(q, x')$ for $q = 1/2$ (Left), $q = 0$ (Right)

At $q = 1/2$ and $x' = x_{LT}$, the people face a tradeoff. Experimentation near $x = 0$ or $x = 1$ generates information but is costly. Uncertainty exacerbates costs; if experimentation with a high x generates evidence that $x = 0$ is optimal, the people incur future costs to "backtrack" to lower x. Experimenting near x_{LT} is less costly but generates little information. Hence, at $q = 1/2$ and $x' = x_{LT}$, the people trade off the value of gathering information — pushing them towards extreme policies — with current and expected future costs — pushing them towards x_{LT}. Contrast this with the right panel, where $q = 0$. Policy certainty drives the people to lower policies since there are no more future "backtrack" costs.

The last part of the proposition establishes bounds for c which we assume for the remainder of the paper. The utility y_{LT} from implementing x_{LT} is given by the solid horizontal line, while the maximal utilities $W(q, x_{LT})$ are given by dashed horizontal lines. The proposition states that c should be larger than the difference between the horizontal lines on the left but smaller than the difference on the right. This means the leader can implement x_{LT} without being overthrown only under uncertainty. $\square$

This result suggests intuitive comparative statics: increasing policy adjustment or overthrow costs expands the set of beliefs and status quo policies at which it is not credible to overthrow a leader continually implementing x_{LT}.

Proposition 4. *Let $LT(c,k)$ parametrize the set of values which the learning trap is permissible. Fixing all other parameters, suppose either c or k increases to c' or k'. Then, $LT(c,k) \subsetneq LT(c',k)$ and $\subsetneq LT(c,k')$.*

Overthrow Decision Define $\tilde{W}_{x_\ell(q,x')}$ recursively as follows:

$$\begin{aligned}\tilde{W}_{x_\ell(q,x')}(q,x') &= (1-\delta)\mathbb{E}[y|x_\ell(q,x')] - k|x_\ell(q,x') - x'| + \frac{\delta\Delta(x)}{2\sigma}\tilde{\Phi}_{x_\ell(q,x')}(q,x_\ell(q,x')) \\ &\quad + \delta(1-\frac{\Delta(x)}{2\sigma})\tilde{W}_{x_\ell(q,x')}(q,x_\ell(q,x')) \\ \tilde{\Phi}_{x_\ell(q,x')}(q,x) &= q\tilde{W}(1,x_\ell(1,x)) + (1-q)\tilde{W}(1,x_\ell(0,x))\end{aligned}$$

This represents the *people*'s value from accepting a leader's policy plan $x_\ell(q,x')$. Lemmata 7 and 8 in the appendix provides a closed form for this expression and show that, in equilibrium $x_\ell(q,x) = x_\ell(q,x_\ell(q,x))$. If the leader's strategy is only to implement x_{LT} for all time, the value of this objective is $y_{LT} - k|x_{LT} - x'|$.

Let $\mathrm{NR}(q,x')$ be the set of policies that weakly prevents credible overthrow:

$$\mathrm{NR}(q,x') = \left\{x \in [0,1] : \tilde{W}_x(q,x') \geq W(q,x') - c\right\}$$

The people overthrow the leader if and only if $x_\ell(q,x') \notin \mathrm{NR}(q,x')$.

Leader's Problem Define $\underline{x}_{LT}(q,x')$, $\overline{x}_{LT}(q,x')$, $\underline{x}(q,x')$, and $\overline{x}(q,x')$ as follows:

$$\underline{x}_{LT}(q,x') = \max\{x \in \mathrm{NR}(q,x') : x \leq x_{LT}\} \qquad \overline{x}_{LT}(q,x') = \min\{x \in \mathrm{NR}(q,x') : x \geq x_{LT}\}$$
$$\underline{x}(q,x') = \min\{x \in \mathrm{NR}(q,x')\} \qquad \overline{x}(q,x') = \max\{x \in \mathrm{NR}(q,x')\}$$

$\underline{x}_{LT}$ and $\overline{x}_{LT}$ correspond to the *closest* policies to the learning trap preventing overthrow. $\overline{x}$ and $\underline{x}$ are the lowest and highest policies preventing overthrow altogether.

Suppose $q = 0$ or $q = 1$. Then, $x_\ell(q, x')$ will be the highest policy possible that keeps the people indifferent to overthrow. Denote $u_\ell(x_\ell(0, x')) = \underline{u}(x')$ and $u_\ell(x_\ell(1, x')) = \overline{u}(x')$. Finally, denote $u_\ell(x_{LT}) = u_{LT}$ and note that, by the assumptions on c, $\underline{u}(x') < u_{LT} < \overline{u}(x')$.

Finally, since $u_\ell(0) > -L$, the leader will always want to avoid overthrow on the equilibrium path. The Bellman describing $x_\ell(q, x')$ is:

$$V(q, x') = \max_{x_\ell(q,x') \in \mathrm{NR}(q,x')} (1 - \delta) u_\ell(x) + \frac{\delta \Delta(x)}{2\sigma} \Psi(q, x) + \delta(1 - \frac{\delta \Delta(x)}{2\sigma}) V(q, x)$$

where $\Psi(q, x') = q\overline{u}(x') + (1 - q)\underline{u}(x')$. Suppose the leader implements policy x. With probability $q\Delta(x)/2\sigma$, $q \to 1$ and she receives $\overline{u}(x)$. With probability $(1-q)\Delta(x)/2\sigma$, $q \to 0$ and she is highly constrained by the threat of overthrow, receiving $\underline{u}(x)$. Otherwise, q is invariant. The following theorem characterizes $x_\ell(q, x)$ for patient leaders: the leader is either attracted to policies as close to x_{LT} as possible — minimizing information revelation — or an experimental policy that reveals information.

Theorem 1. *Suppose $\sigma(1-\delta)$ is small and/or $\underline{u}(x')$ is sufficiently low. Then, there exist thresholds $\underline{q} < \overline{q} \in [0, 1]$ such that the following hold:*

1. *If $q \leq \underline{q}$, then $x_\ell(q, x') = \underline{x}_{LT}(q, x')$ or $\overline{x}_{LT}(q, x')$. The leader plays the* closest policy *to the learning trap.*

2. *If $q \in [\underline{q}, \overline{q}]$, then $x_\ell(q, x') = \underline{x}_{LT}(q, x')$ or $\overline{x}(q, x')$. The leader plays either the lowest policy below the learning trap*

3. *If $q > \overline{q}$, $=$ then $x_\ell(q, x') = \overline{x}(q, x')$ or $\underline{x}(q, x')$ (and it is necessary that $\Delta(\underline{x}(q, x')) > \Delta(\overline{x}(q, x'))$). The leader either plays her highest feasible policy or policies maximizing information revelation.*

The comparative statics with respect to σ, δ, and $\underline{u}(x')$ follow identicially as in the baseline model. A version of Theorem 1 can be proven for more arbitrary forms of ϵ if $\mathrm{NR}(q, x')$ is increasing in q and its graph convex fixing x'. However, $\mathrm{NR}(q, x')$ may not be convex or connected, meaning standard dynamic programming results cannot be used to analyze the problem.

4 Application: The 1861 Reforms as a Learning Trap in Imperial Russia

In this section, I examine the institutionalization of the peasant commune in Imperial Russia to show how large-scale economic reform may be viewed through the lens of a learning trap. Faced with a need to modernize its economy in the 1860s, the Russian government preferred and potentially had capacity for liberal, Western European style economic reform that gave peasants access to private property and opened up opportunities for wage labor, especially in manufacturing. However, it worried reform could backfire, fiscally damage the Empire and, unchecked, lead to regime overthrow.

I argue that the Russian government may have codified a system mixing private and communal economic institutions to distort individual labor and production decisions, obfuscate information about the efficacy of liberal institutions on the aggregate economy, and suppress risks of future overthrow. Liberal reform would have shifted production and labor decisions from nobles to individual peasant households while also allowing the government to collect revenue *directly* from these households. As part of this reform, the State would have to compensate landlords for expropriation of their properties. If liberal reform generated significant economic gains, the government could grow fiscal revenue while placating elites and improving peasant outcomes. However, if liberal institutions did not work in Russia, the government could face dire fiscal straits — constraining compensation of the gentry, restricting state capacity, and paving the way for political chaos.

Prior to 1861, most Russians peasants provided services or payments to the state or a noble in exchange for use of arable land (peasants working noble land were "serfs").[11] Officials oversaw a "commune" of households in charge of repartitioning land, solving disputes, and managing resources.[12] Many types

[11] Peasants rarely owned land, but both before and after 1861 owned small pieces of private property. There was also heterogeneity in this arrangement; Nafziger (2012) shows how State peasants possessed some more individual property rights than serfs.

[12] Additionally, a failure of one commune member to pay taxes could result in punishment for others; or, the purchase of new land for the commune would make everyone collectively

of peasants possessed limited control over production decisions, had few rights, and could be tied to their land in the event of sale[13] (Vasudevan (1988, 209), Nafziger (2010, 382), Nafziger (2016, 775-776) Dennison (2014, 252-257)). Although Russia's defeat in the 1856 Crimean War crystallized a need for reform that would modernize Russia's economy, there was uncertainty about whether a liberal system would be better than serfdom.

To use our model to understand Imperial Russia, we first identify players and policies. One extreme policy in X represents a communal land tenure system controlled by a seigneur — corresponding also to the status quo x_0. The other extreme policy represents a liberal private property system where peasants control individual labor and production decisions. The "people" are a combination of the Russian peasantry and elites — whose respective salience in constraining the government's power depends on the state of the world. Outcomes y represent taxable aggregate economic outcomes — e.g. measurable peasant income. The "leader" is the Tsar's government and, for fiscal reasons, prefers liberal policies; the "Additional Results" appendix explores a microfoundation for these preferences within the specific context of the case study. As in the model, experimentation with liberal reform is costly, requiring institutions like land cadastres to protect property rights.

In one state of the world, liberal reform would ideally lead to much greater output than serfdom. This involved taking the Russian nobility out of the picture — requiring transfers to compensate their loss of power — but allowing peasants freedom of movement and production decisions. In the event liberal economic reform generated substantively greater economic surplus, this would increase the fiscal revenue the government could extract from the peasantry, some of which would be transferred to the elites and the rest used for State endeavors. The state's utility in this ideal world would be better.

If reform did not do *enough* to increase aggregate outcomes, however, the government would be spread thin trying to both compensate the gentry and

liable for paying mortgages on this land.

[13]For example, if noble A sold land to noble B, the serfs working that land would then be under the tutelage of noble B.

funding state capacity, constraining the regime by attracting the ire of the elites, if not also the peasantry . In this other state of the world, liberal reform may not have been appropriate to Russia's historical and cultural institutions, meaning the government would be relatively better off maintaining serfdom. The government would concentrate administrative power with elites and limit peasants' economic freedoms. Since elites could siphon revenue and peasants themselves would be worse off, the government under serfdom would give up more resources keeping the people (especially the peasantry) indifferent to revolt, constraining fiscal capacity. The government's utility — measured as fiscal revenue — would be worse under serfdom in this state.

To show how the predictions of the model match the Russian case, I first establish the existence of policy uncertainty over the efficacy of liberal institutions in Russia. Next, I show that the Tsar's government preferred liberal economic policies — particularly in the context of increasing fiscal capacity vis-a-vis the salience of pressures from the peasantry and elites — but that it was concerned that information revelation could lead to its overthrow were these reforms unsuccessful, and that the intermediacy of policies post-1861 reforms were conceived as responses to these informational threats. I then use these mappings to describe how policies mixing communal and liberal institutions post-1861 created an equilibrium that obfuscated inference about the efficacy of liberal institutions. I conclude by addressing the relevance of two prominent alternative explanations for the commune's persistence — elite power and state capacity.

4.1 Mapping the Model Assumptions to Russia

Policy Uncertainty Extensive debates following Russia's embarrassing defeat in the Crimean War belied a general uncertainty about whether liberal economic reforms could enhance Russian growth and prevent such disasters from occurring again. Many educated Russians believed private economic activity was superior to the commune and could imitate Western growth patterns (Starr, 2015, 53-63). Some nobles who may not have been in favor of granting peasants land vehemently opposed the commune, favoring a Manchesterian arrangement where individual peasants would rent and work nobles' land "on the basis of free competition" (Khristoforov, 2009, 65). "Leading Russian economist" Ivan Vernadskii derided views that communal property was superior to private property due to Russian exceptionalism (Kingston-Mann, 1991, 23-24), a view echoed by statesmen in later decades.

Other intellectuals opposed liberal movement. Slavophilic ideologues romanticized the peasant as a self-sufficient "bearer of his own culture, worldview, and legal consciousness" (Khristoforov, 2009, 62) and argued that the commune should be left untouched to respect custom. Some bureaucrats believed private property could lead to a countryside marred with disorder; state or seigneurial intervention would prevent exploitation, particularly of common spaces (Pravilova, 2014). Some contended that peasants were not keenly aware of outstanding issues with the pre-1861 system (Field, 1976, 53), and one study went as far as to argue that peasants preferred the security of communal land to private property (Kingston-Mann, 1991, 34). Members of these different camps — spread throughout the intelligentsia, nobility, and government — sat on the Tsar's Editing Commissions charged with designing the eventual emancipation reforms.

Regime's Preferences The Russian regime, headed by Tsar Alexander II, likely preferred a liberal path to economic modernization. One prominent view after Russia's defeat in the Crimean War was that the Crowninability to quickly draw up army reserves from the peasant population. Severing the ties between serfs and landowners would give the Tsar more power to draw up reserves (Moon, 2014, 53-54). A widening military gap with its neighbors was attributed to the stifled emergence of an Industrial Revolution in Russia due to the incentive structure of serfdom (Zenkovsky (1961, 284), Emmons (1966, 48-50)). Abolishing serfdom could increase worker mobility and productivity, generating industrial growth that could fuel military prowess (Pereira, 1980, 108).

A liberal system could also increase fiscal revenues, accelerating the development of state institutions and the economy; "state financing was of central concern to Tsarist reforms" (Dennison, 2023, 642). Tax collection was outsourced to nobles under serfdom, and the government was previously unwilling to pressure them for a greater share of rents (Dennison, 2020). On the eve of 1861, Dennison (2023) argues that landlords' ability to siphon surpluses as well as informational asymmetries about land values exacerbated serfdom's contribution to inefficient revenue collection (639). A liberal reform would eliminate the nobility's hold on the peasantry, weakening their political bite and increasing revenue returned to the State; it would shift from a regime where the gentry were happy but the peasantry faced immense extraction to one where the peasantry possessed greater freedom but the government worried about compensating the gentry[14] (Moon, 2014, 33). If liberal reform could *substantially* increase economic surpluses, the government would be in a better place even if it had to compensate elites. Prior Tsars had been reluctant to reform because serfdom was profitable for the nobility, but doubts about its sustainability after the war increased policy flexibility (Dower et al., 2018). Finally, the government's reformers hoped to increase state capacity to imitate the expansion of Western European capital markets, setting up banks and corporate forms in the 1850s to provide additional sources of financing for domestic and military ventures; revenue from emancipated peasants could, beyond serving as a direct revenue source, fund the expansion of these institutions (Dennison, 2023, 642).

Fears of Information Revelation Despite a preference — in the ideal world — for granting peasants economic freedom for economic, military, and even ideological purposes, Alexander II's government simultaneously worried liberal policies could fail to *sufficiently* grow the Russian economy, and instead viewed "communal land tenure and mobility restrictions [as] necessary precautions during a time of increased urbanization and marketization" (Dennison, 2014, 62). Foremost were external validity arguments claiming Westernization was inappropriate for Russia. Fears of "the rise of an industrial proletariat,

[14] Section 4.3 more carefully examines the nobility's impact on the reform process.

ruthless competition, unemployment, and other evils of industrial capitalism" (Polunov et al., 2015, 61) colored the government's attitude towards reform.

The government also faced uncertainty over the potential fiscal consequences. If reform was successful, the government's coffers, state capacity, economy, and military could grow. If it were not, the government would need to backtrack on certain elements of the reform to keep its constituents pleased. Economic freedom could allow peasants to depart the countryside for jobs in, for example, manufacturing. While this could increase peasant income and hence tax revenue, the government was concerned that alienation of rural land could, in addition to shrinking agricultural output, limit the government's ability to collect the revenue necessary to compensate the nobility for land. If this indeed happened, the government would need to find new (costly) mechanisms for restoring order to the countryside. By tightening finances, unsuccessful reform could severely stress state capacity (Dennison, 2023, 644). Alexander II was known for "repeated appeals for caution and discretion," and indeed one of his committees concluded early on that "the Order of the State might be shaken" by an emancipation that did *not* tie peasants to land (Field, 1976, 75). The institutionalization of the commune was then seen as an explicit solution to the uncertain effects that more radical liberal reform would have on the greater economy and, consequently, the government's fiscal position.

Simultaneously, it was clear that the Tsar believed allowing serfdom to remain unadulterated would still generate information that could result in overthrow; Alexander II stated that the government should "begin eliminating serfdom from above [rather] than to wait until it begins to eliminate itself from below" (Pereira, 1980, 104), remarking that "serfdom had almost outlived its time" (Field, 1976, 96). This was despite the fact that the Russian countryside was not beset by an endemic economic crisis (Moon, 2014, 19-22). The government's tentativeness towards more radical reform reflected a concern that blindly going through with Westernization could tie the government's (fiscal) hands in the future and generate political chaos were the reform to backfire.

In the setting of our model, a necessary condition for an *intermediate* policy to be a “learning trap” is that it mixes two opposing, information-generating policies. Because the Tsar believed that both liberal reform and the status quo of serfdom generated information, it stands to reason that some mixture of these two systems was uninformative. The next section argues that the Tsar’s mixture of communal and liberal institutions in the Emancipation reforms indeed possessed this feature by sustaining uncertainty about policy efficacy.

4.2 The Post-1861 System as a Learning Trap

This section details the emancipation reforms and how codification of the commune distorted economic decisions. Distorted economic incentives meant that observers could distinguish neither the advantages nor disadvantages of a liberal economic system in the *aggregate* economy — even if some benefits or drawbacks could be observed in localized contexts — minimizing information revelation and sustaining general uncertainty about its efficacy.

Terms of Emancipation The Tsar’s emancipation reforms beginning in 1861 ended serfdom and freed peasants from the coercive status-quo of seigneur-peasant agriculture. The reform impacted serfs working private lands more than state peasants, whose institutional constraints arguably changed less post-1861 (Nafziger, 2012). While broadening civil rights (Dennison, 2014), the reform did *not* remove the peasant commune and used it to constrain household labor mobility and capacity to acquire private property.

Nobles were forced to relinquish most land, but were compensated by the State. Expropriated properties were redistributed between members of peasant communes. Ex-serfs made mortgage-like redemption payments to the State Bank of Russia over 49 years to finance nobles’ compensation. After all payments were made, ex-serfs would formally own land allotted to them by the commune, but were otherwise collectively responsible for redemption and tax payments. Households could not legally sell, lease, transfer, alienate, or use land as collateral *until* redemption payments were complete, restricting their ability to abandon agricultural production (Dower and Markevich (2019, 234), Nafziger (2012, 5-6), Nafziger (2016, 776), (Dennison, 2014, 259)).

Mixing Private and Communal Property A feature of the 1861 reforms is that they mixed the communal status quo with private property, An external seigneur no longer regulated economic decisions. Peasants could theoretically privatize their communal allotment land by paying off redemption obligations (Nafziger, 2010, 383). Peasants owned houses, gardens, and rights to output (Kingston-Mann, 1991, 35). Communes (and sometimes households) even engaged in market land transactions with or without formal credit backing (Nafziger, 2010, 384). However, the persistence of the commune — and its recognition as a formal institution by the State — clashed with private economic incentives. Land allotments, repartitions, and redemption obligations were enacted communally and sometimes against households' will. Peasants owned small, scattered strips of land in communes, at best allowing for geographic diversification, at worst increasing travel times and disincentivizing technological experimentation, arguably slowing productivity growth in the agriculture sector relative to what it could have been in a more radical liberal system (Williams (2013, 52-53, 65-66), Dower and Markevich (2019, 243)).

Mobility Restrictions Instead of allowing for labor mobility associated with fully liberal reform, the commune directly restricted labor mobility by controlling the issuance of documents to pursue outside work (Nafziger, 2012, 7). Because households were communally responsible for payments to authorities, those with disproportionately larger obligations would have an incentive to enforce mobility restrictions to free-ride on others. Nafziger (2010) notes: "Income-maximizing peasant households may have been unable to freely allocate resources between agricultural production and non-agricultural activities if they were subject to collective decision-making. . . By potentially inhibiting land transfers (inside or outside the community) and restricting the allocation of labor outside the village, the communal system may have introduced wedges between the shadow and market values for these factors of production" (384). Weakened labor mobility also prevented labor from moving to cities, arguably dampening the emergence of the industrial sector which, ironically, was a goal of the reforms. Indeed, Nafziger (2010) argues that weaker communal structures around Moscow allowed this area to develop a stronger industrial sector than other parts of Russia.

Sustaining Uncertainty The fact that elites and the State could often not discern whether the commune was "good" or "bad" suggests that the institutional arrangement generated by the Tsar's reforms sustained policy uncertainty at-large. Even for the peasants — who were likely better off than under serfdom either way — the *size* of gains from dissolving the commune was uncertain. Despite the commune's apparent discouragement of technological adoption in agriculture, Kingston-Mann (1991) documents that when innovation did occur, it *spread* more quickly in districts with greater communal intensity. While many in the government still believed in the pursuit of a liberal, Western path, one sources cites the case of "a district secretary for the Moscow Agricultural Society, an enthusiastic critic of the commune" (Kingston-Mann, 1991, 49), who conceded that introducing private property could prove unrealistic due to the commune's ability to provide mutual aid during emergencies or incidents requiring collective action. Decades later under Alexander III, limited cases where peasants were allowed to sell land on the market allegedly caused exploitation of peasant decision making (Wcislo, 2014, 89), further casting doubt on private property as an alternative to communal property. Even the 1906 Stolypin Reform introducing private property to the countryside was viewed as an "experiment" attempting to resolve uncertainty about whether liberal policies could work (Yaney, 1964, 275-276). These conflicting realities — allowing some to argue in favor of the commune and others in favor of liberal reform — suggest a general lack of consensus endemic of muddied inference generated by the State's policies.

The enforcement and strength of the commune did vary across regions and property regimes. Heterogeneity in the enforcement of communal institutions allowed some households to observe the power of private incentives — or accumulate wealth — by participating in land rental markets or full-time non-agricultural labor (Nafziger, 2010, 385). However, the contemporary remarks above bely a general, sustained uncertainty — at the aggregate level

— about the benefits of a more radical liberal reform[15]. Crucially, the *general equilibrium* effects of a fuller reform on the aggregate economy may have been quite different from the partial-equilibrium experience of an individual village toying with more robust private incentives.

4.3 Implications and Alternative Interpretations

Many contemporaries felt the Tsar's reforms did not go far enough. Finkel, Gehlbach, and Olsen (2015), for example, show a marked increase in peasant disturbances after 1861 in large part due to the tepidness (relative to expectation) of the reform. More puzzlingly, in practice,"[f]ew surpluses could be wrung from peasants who were already obligated to repay the nobility for their freedom and their land and who continued to face obstacles to the most efficient allocation of their resources" (Dennison, 2023, 644-5). These realities make the choice to let the commune remain seems odd; if liberal reform could certainly result in large economic gains, the State would have been in a much better fiscally than with the inefficient middle ground of the commune, where both peasant surplus and the ability to pay the nobility seemed constrained. But under policy uncertainty, fears that information revelation could strain the government's coffers and reputation were it to backfire give an informational explanation for this middle-ground.

The Tsar's government — from the early drafts of the reform — explicitly believed that a system that ended many of serfdom's abuses but still tied peasants to agricultural land could mitigate the informational threats posed by more liberal reform. By sustaining uncertainty, a learning trap minimizes information revelation that could lead to overthrow. Not only did the Tsar's government hold power for decades, but except for the spike in disturbances following the Emancipation reform, reported peasant disturbances remained low in the following years (Finkel et al., 2015, 1000). In this sense, an "intermediate" policy, despite being inefficient in the interim, was successful in tiding threats of future overthrow from either radical liberal reform or allowing

[15]As addressed in the next section, a learning trap does not even need to shut down information revelation but only minimize it — allowing some learning in practice

serfdom to remain.

However, this arrangement may have led to persistent and negative side-effects. Beyond stifling Russia's industrial sector and potentially slowing agricultural adoption in the medium term, Markevich and Zhuravskaya (2018) go as far as to argue that the allocation of property rights to communes instead of households dampened Russian economic growth into the 20th century. [16]

The literature discusses two main non-informational arguments for why the Tsar's government may have mixed communal and liberal policies. First, this mixture may have balanced the desires of elites with those of the state. Second, Russia's lack of state capacity may have prevented more radical reform. I contend that although these factors undoubtedly affected the shape of the Tsar's reform, the threat of informational revelation from radical reform still affected the Emancipation reforms.

Elite Power The landed nobility's commitment to serfdom constrained previous attempts to abolish serfdom. Could the post-1861 reforms have simply been an outcome of bargaining between a liberal State and pro-serfdom nobles?

It is true that the commune may have been logistically preferable for landlords (and the government) to deal with in civil and property disputes (Khristoforov & Gilley, 2016, 12). Labor allocation and rental payments may have been easier for landlords to organize when serfs were held collectively responsible (Dennison, 2014, 257). Landlords often disapproved of arrangements that would have forced them to give up land to peasants, and extensively bargained over the size of government compensation for their land during the years of the reform, although they were compensated quite well after the reforms (Moon, 2014, chaps. 7-8). However, the constraint binding the government *to the commune* was far weaker in the late 1850s than the decades prior, suggesting capacity for liberal reform was much greater than in the past.

[16] Some historians point to redemption payments as the first order inefficiency impeding livelihood in post-1861 ex-serf communities. Interestingly, Gerschenkron (1962) suggests that the commune *worsened* the bite of redemption payments. Households with particularly large debt obligations would have an incentive to free-ride on other members of the commune, affecting commune enforcement of labor mobility and production incentives which undoubtedly affected households' very ability to make payments.

Moreover, nobles, especially in the 1850s, were ideologically diverse. It was not necessarily the case that nobles as a class overwhelmingly wanted to keep the commune. In fact, many nobles' preferences aligned with the liberal aspirations of the Tsar. Most educated Russians believed that "the sanctity of private property was the basis of the political and social order" (Field, 1976, 58). Some liberals supported abolishing serfdom and endowing peasants with land. Even some conservative nobles wanted peasants to rent and work noble land in a competitive market. Many critics of the post-1861 system — at times more critical of serfdom than the government's own reformers — contrasted Russia's system of land tenure with the more desirable British case, "where large-scale land tenure and local self-government controlled by the aristocracy allegedly guaranteed economic prosperity and political stability" (Khristoforov, 2009, 58, 63-65). Khristoforov (2022) goes as far as to argue that some form of "private property individualism" was in the interest of both landlords and the government.[17]

Finally, a sufficiently large bloc of the nobility may not have been interested, much less able, to challenge the Tsar's decisions. Many nobles ultimately "did not want political change. . . They wanted the tsar's favor. . . At each stage in the development of the government's program, the nobility swallowed its objections or stated them obliquely" (Field, 1976, 362).

State Capacity State capacity undoubtedly constrained the Tsar's policies in the reform era. The process of emancipating and endowing peasants with property, compensating nobles, demarcating property and setting up a cadastre, building legislative systems to secure property rights, and levying taxes was expensive. Depressed stock prices and banking crises in the late 1850s drained coffers and limited ambitious plans of reform (Dennison, 2020, 197), meaning the government had to look to the nobility for help. Landlords had previously overseen communal proceedings as agents with "skin in the game," and they did end up playing a disproportionate role in commune politics (Dennison, 2020). By outsourcing dispute resolution to the commune and levying

[17] One reason was that a liberal system could ideologically oppose socialist currents.

taxes collectively, the government had less work on its hands than were it to protect the rights of individual households (Khristoforov (2022, S163), Dennison (2011)). Since the nobility collected fiscal revenue prior to 1861, liberal reform could eliminate the nobility from this equation, enable greater surplus extraction, and allow the State to pursue even more liberal reform. However, in the off-chance a sufficient mass of the nobility could oppose liberalization, the Tsar's government could never raise revenue and hence pursue liberal reform to begin with.

Puzzles still arise from ascribing the intermediacy of the reform solely to weak administration. First, before and after the 1850s, the government may have been able to relax the commune's power on State lands (where it was not nearly as constrained by elite activity). Nafziger (2012) suggests instead that the institutional experience of the State peasantry faced few changes before and after 1861, and that outcomes of ex-Serf and State peasants converged by 1900. Second, the State made few attempts to deal with demarcation of peasant land boundaries. Officials wanted to tie peasants to their land, and knew private property was easier to abandon through sale or mortgage. The State refused to separate the tax liabilities of a handful of peasants who had paid off their redemption obligations ahead of time and were now theoretically private landowners (Khristoforov, 2007, 30). Dennison (2006) shows the system of serfdom gave rise to an informal economy built on social networks and patronage which continued to hamper economic development post-1861, even though the state had power to (at least slowly) introduce "universal enforcement of contracts and property rights" (89). Third, the state's nebulous attitude towards property demarcation emanated at least in part from an informational desire to limit market activity. For example, the government had in fact experimented with developing a land cadastre prior to 1861 under Kiselev. The experiment's results were never clearly revealed or publicly accessible, likely because the results may not have favored rationalization of property (Khristoforov & Gilley, 2016, 9, 11). Fourth, the development of an administrative center was not a problem unique to Russian development; Western European countries dealt with similar issues in the preceding centuries. Fifth, the Tsar's Editing Commissions "recognized [the commune] as a temporary fact" (Khristoforov, 2007, 30), but until his death, Alexander II did not pursue more radical reform, and his son's government infamously strengthened the institution's enforcement power[18] (Wortman, 1989, 21). Finally, as suggested above, a primary goal of the reforms was to *increase* fiscal revenue and expand state capacity itself. To this end, maintaining the commune seems surprising — peasant surplus was potentially lower than it could have been had the government permitted more liberal reform. However, instituting private property and labor mobility on the one hand could have increased taxable peasant income but on the other could have shrunk agricultural output and caused land alienation, resulting in the cautious fiscal outlook the government possessed towards further reform.

The power of a critical mass of the nobility, idiosyncratic financial issues, and administrative costs bound the ambitiousness of Russia's 1861 reforms. However, the first constraint was certainly relaxed in the late 1850s. The second does not explain the uniformity of the State peasant experience. The third is built into this paper's model (via costly policy adjustment) and does not explain why Russia experienced little liberal movement for decades after 1861, especially if the very purpose of reform was fiscal expansion. These limitations can be addressed with the interpretation that another goal of these reforms was to minimize information revelation about policy efficacy.

5 Exogenous Information Revelation

This section returns to the baseline model to study the effect of exogenous informational shocks on attraction to the learning trap and equilibrium policy variation. I first show that *unanticipated* external information revelation generates minimal policy variation in equilibrium, but potentially large jumps if evidence suddenly swings in the leader's favor. Unanticipated shocks should

[18]For example, "[a]dditional legislation in 1893 explicitly forbade all sales of allotment land to non-peasants" and required a two-thirds majority of communal assembly votes to redeem or release landholdings and increased the portion of communal assembly votes (to two- thirds) required for a household to obtain release from their share or to redeem their land individually (Nafziger, 2010, 393).

be thought of as economic shocks that force leaders to vastly restructure organizations — such as work at home policies during pandemics; or sudden wars or disasters that test production infrastructure.

Next, I show that when external information revelation is *anticipated*, the leader is less attracted to the learning trap since she focuses more on obtaining flow utility, generating more equilibrium policy variation. This leads to more learning from both a direct channel (exogenous information) and an indirect channel (the leader herself is more likely to depart from the learning trap, increasing learning). This suggests that politically fragmented regions of the world with a large degree of policy contagion should possess a greater deal of state-led policy experimentation and, insofar as this experimentation fails, shorter office tenure for incumbent leaders. Interpreting 19th century Europe as a region where the probability of external information revelation was high and China as a region where it was low, I show how this insight can explain why European nations experimented with indirect rule and experienced high political turnover in the process, while China did not. Proofs of this section as well as an additional extension showing the robustness of the model to multiple states of the world, are provided in the Additional Results Appendix.

5.1 Unanticipated Information Shocks

Unanticipated shocks represent situations like sudden earthquakes, health emergencies, or war mobilization efforts that can be neither easily predicted nor planned for until they occur. I model these changes by considering exogenous shifts to the belief q in policy efficacy at the end of every period. Figure 4 and Theorem 1 provide an insight of how shocks to q affect policy when the status quo is $x' = x_{LT}$, shown below in Figure 5 as q_0 moves either to q_1, q_2, or q_3. With a slight abuse of notation, we write $x(q) = x_\ell(q, x_{LT})$.

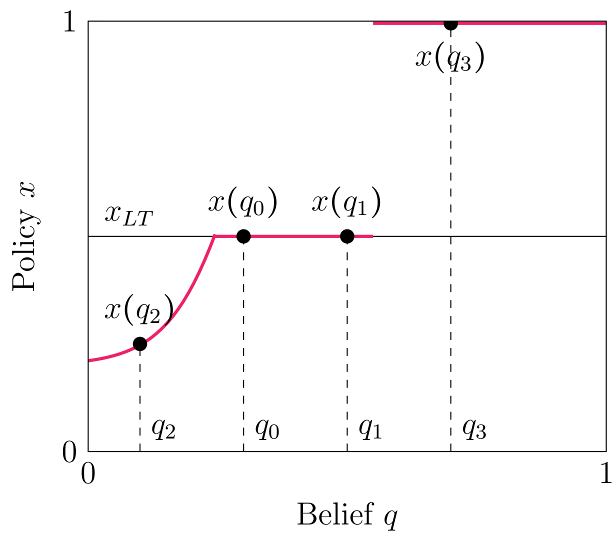

Figure 5: Effect of Unanticipated Shock to q on Policy

If q_0 moves slightly to the right to q_1, there is no policy change even though this information favors the leader. If q_0 drops to q_2, the leader is still attracted to x_{LT}, but must play a lower policy to obey the people's no-revolt constraint. Finally, if q_0 jumps up to q_3, policy experiences a discontinuous jump from x_{LT} to 1, since information revelation would now swing in the leader's favor.

Ultimately, the leader faces two constraints: a threat of immediate overthrow *and* a threat of information revelation from policy. The dynamics of unanticipated information revelation can be summarized by these two constraints:

1. If shocks to beliefs in policy efficacy are small, there will be no policy variation since the threat of information revelation still dominates.

2. If shocks to beliefs do not favor the leader, there will be minimal policy variation since both the threat of information revelation and immediate overthrow are in effect.

3. If shocks to beliefs are sufficiently large and favor the leader, there will be large, discontinuous policy shifts that experiment with the leader's preferred policy since the threat of information revelation is relaxed.

The threat of information revelation binds more strongly for more patient leaders that are highly averse to being constrained by a threat of overthrow. Learning is *greater* when leaders are more short-sighted. Learning is also more common if leaders have more to lose when $q = 0$. For example, leaders' who stand to lose more rents at low x will be less willing to commit to any form of experimentation. On the flipside, we should observe more policy variation among leaders who collect fewer office rents, or those who are relatively myopic. These leaders are more willing to implement extreme policies, increasing policy variation due to exogenous informational shocks and thereby increasing information revelation.

5.2 Anticipated Information Shocks

Information revelation may be *anticipated* when leaders are consciously aware of external sources of inference. Officials in regions plagued by earthquakes or hurricanes may foresee that these disasters will eventually occur and reveal information about disaster relief policies. Another application is political contagion, where a group of countries with similar institutions can learn from their policy experiences. Suppose that all these countries are stuck in a learning trap except for one, which commits to implement informative policies. Neighboring countries use these informative policies as an additional source of policy inference, meaning their leaders now face an additional threat of information revelation from external sources.

I model anticipated information shocks as follows. Let $\eta \in (0, 1)$ be small. With probability η at the end of every period, the true state of the world is exogenously revealed. An unconstrained version of the leader's problem, anticipating the exogenous revelation of information, can be written as:

$$\max_{x \in [0,1]} \frac{2\sigma(1-\delta)u_\ell(x) + \delta((1-\eta)\Delta(x) + 2\sigma\eta)\Psi(q)}{2\sigma(1-\delta) + \delta((1-\eta)\Delta(x) + 2\sigma\eta)}$$

Note that when $x = x_{LT}$, the leader's value is now

$$\frac{(1-\delta)u_{LT} + \delta\eta\Psi(q)}{(1-\delta) + \delta\eta}$$

Implementing x_{LT} is no longer a "safe option" for the leader that shuts down learning. Anticipating that she can no longer *fully* control information, she may take extreme actions to enjoy more flow utility. This intuition is reflected in the following proposition.

Proposition 5. *Suppose η increases. Then, $\underline{q}$ decreases and $\overline{q}$ increases. Fixing x', the leader plays the learning trap for fewer values of q.*

Anticipated information revelation improves policy learning compared to the unanticipated or baseline model. While there is mechanically more information revelation due to the realization of shocks, because $\underline{q}$ decreases, the leader's commits to experimental policies for a larger set of values, meaning learning also increases through an *endogenous* channel. As learning increases, q is more likely to move to 0. This means that fragmented regions plagued by political contagion will see more governments conceding to their people — e.g. movements from absolute to constitutional monarchy — or, insofar as lower x is also a shorthand for increased external threats of overthrow, leaders' terms will be shorter, corresponding to more frequent political turnover.

5.3 Political Fragmentation in Europe and China

Our model's prediction — that politically fragmented regions of the world exhibit larger policy variation, more policy experimentation, and more frequent political turnover — is consistent with stylized historical facts differentiating Western Europe and China. It explains how the spread of constitutional monarchies and representative democracies in fragmented Western Europe constrasted with the consistent stability of consolidated Imperial China. Because systems of indirect rule were not widely experimented with by Eurasian states until the 1700s, we can view our "uncertain policy" as the optimal degree of democracy or autocracy. Our policy space corresponds to direct rule (e.g. monarchy) on one end and indirect rule (e.g. republican democracy) on the other end. Constitutional monarchies can be thought of as situations where autocrats begrudgingly cede power to the people but remain in office.

European countries around 1800 had a high η; Europe was populated by dozens of sovereign states — on average 85 between the years 1000 and 1799 (Dincecco & Wang, 2018)) — and thus possessed rich sources of policy information. England's "Glorious Revolution" at the end of the 17th century marked Europe's first constitutional monarchy (Kurian, 2011) and one of the first sources of data on indirect rule. After the French Revolution, rulers began to actively worry about citizens' desires for indirect rule (Evans & Von Strandmann, 2002, 10) as demands for freedom of speech, press, and disposal of private property became more prominent (Sperber, 2005, 66-67). By the first half of the 19th century, both Britain (constitutional monarchy) and America (representative democracy) were providing information on the efficacy of indirect rule. As these informational pressures strengthened, most European states shifted to some form of indirect rule by 1850, where the government was partially controlled by an elected legislature (Tilly, 1989). In some cases, governments peacefully ceded power; in others, power was wrested as part of the dozens of uprisings characterizing the "Age of Revolutions." A salient threat of external information revelation forced European governments to engage in more experimentation with indirect rule, increased policy learning via convergence to indirect rule, and led to a great degree of political upheaval.

In contrast, China was ruled by a single, unified State nearly uninterrupted for almost a millennium. No states shared China's scale or political structure, suggesting it had low η in 1800. China possessed relatively integrated economic institutions that allowed its central government to oversee trade and a tightly-managed bureaucracy composed of strong elite networks (Rosenthal & Wong, 2011). The state's Confucian ideology centered political continuity and stability as tenets of efficient government, in contrast to the "disruptive progress" of Western Europe, authenticating the emperor's direct rule over the people. The entrenched power of the emperor coupled with a shared ideology of "stability" among the state and elites arguably prevented the emergence of ideologies promoting indirect rule which was only strengthened by the lack of external informational sources (Mokyr, 2016, ch. 16). China's high (although stagnant) economic standards in the late 1700s evidence a degree of policy *moderation* that was not seen in Western Europe (Pomeranz, 2021). Threats of overthrow came from mostly regional elites — rather than from informational sources — and seemingly strengthened — rather than eroded — the collective power of the emperor and elite class (Dincecco & Wang, 2018).

The fragmented "high η" environment of Western Europe in the 18th and 19th centuries was accompanied by significantly more policy variation, policy concessions to liberal demands, and political transitions than the consolidated "low η" environment of Imperial China, which experienced little policy variation and minimal political turnover. This prediction of the model is consistent with Mokyr (2016), who argues that "there were repressive and reactionary regimes galore in Europe, but the interstate competitiveness constrained their ability to enforce a specific orthodoxy" (317). This prediction also complements a large literature arguing that Europe's "political fragmentation" drove the Great Divergence, such as by fostering state competition over technology adoption (Diamond, 2005), intellectual networks (Mokyr, 2016), and institutional innovation (Cox, 2017)

6 Conclusion

This paper develops a model that studies how leaders set policy in the face of uncertainty. Because agents can only discover whether policies work after their implementation, leaders' policies are in-and-of-themselves informative. When leaders face threats of office removal if their preferred policy fails, their actions are constrained by a threat of information revelation. I show that leaders solve this problem by implementing middling "learning trap policies" that shut down inference about policy efficacy. Leaders concerned with maintaining power will then implement less preferable policies that shut down information revelation; sustaining uncertainty prevents overthrow. Attraction to learning trap policies increases when policies are more informative, leaders stand to lose more upon policy failure, and leaders grow more patient.

I use the model to study how the peasant commune of Imperial Russia may have been codified post-1861 to prevent learning about the efficacy of liberal institutions. Despite the Tsar's fiscal preference for liberal policies in the wake of Russia's defeat in the Crimean War, both the government and elites worried liberal institutions could fail and lead to political disaster. Hence, instead of pursuing an ambitious liberal reform upon the end of serfdom, the Tsar's government used the commune to distort household production and labor decisions, forcing collective decision making on many rural households and tying peasant labor to agricultural land. This hampered experimentation on farms and restricted peasant movement to pursue urban labor, dampening agricultural and industrial growth but also obfuscating peasants' ability to learn about whether liberal institutions were actually effective. Although pro-commune elements within the nobility and a lack of state capacity also pushed Russia towards adopting the commune, these informational configurations still affected the Tsar's policies.

The model's findings are robust to settings with exogenous information revelation. Unexpected information revelation generates minimal policy variation unless a large amount of information swings in the leader's favor. Anticipated information revelation generates greater policy variation because leaders cannot fully control information revelation, which also generates more concessions to the people and turnover. By interpreting exogenous information as the result of policy experimentation in an externally valid country, the latter insight explains why Europe experienced a great deal of political upheaval and convergence to systems of indirect rule at the turn of the 19th century, while China did not, complementing "fragmentation" hypotheses of the Great Divergence.

The lens of a learning trap can also be applied to other historical cases. For example, Brezhnev's failure to continue Khrushchev's ambitious communist reforms can be viewed as a response to worries that "full communism" might have caused total collapse of the Soviet economy and lead to overthrow (Bacon & Sandle, 2002, 57-58, 165-166). Future work will continue to explore the implications of learning trap policies in such historical settings from both empirical and qualitative standpoints, as well as the salience of learning traps under alternative theoretical assumptions.

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Appendix

Proof of Solution to People's Problem

Proposition 3. *$x_p(q,x')$ is the solution to the following Bellman equation:*

$$W(q,x') = \max_{x\in[0,1]} \frac{2\sigma(1-\delta)\mathbb{E}[y|x] + \delta\Delta(x)\Phi(q,x)}{2\sigma(1-\delta)+\delta\Delta(x)} - k|x-x'|$$

where $\Phi(q,x) = qW(1,x) + (1-q)W(0,x)$. For intermediate values of c, there exists a nonempty open set $LT \subseteq [0,1]\times X$ with $LT \ni (1/2, x_{LT})$ such that for all $(q,x') \in LT$, $W(q,x') \leq y_{LT} + c \leq W(0,x'), W(1,x')$.

Lemma 1. *Suppose x^* is a solution to the functional equation defining $W(q,x')$. Then, x^* is also a solution to the functional equation defining $W(q,x^*(q,x'))$.*

Proof. This proof utilizes the linearity of adjustment costs. Suppose by contradiction that x^{**} solves the functional equation associated with $W(q,x^*)$ but not $W(q,x')$. Since both x^* and x^{**} are always feasible, this implies

$$(1-\delta)\mathbb{E}[y|x^{**}] - k|x^{**}-x^*| + \frac{\delta\Delta(x^{**})}{2\sigma}(qW(1,x^{**}) + (1-q)W(0,x^{**})) + \delta(1-\frac{\Delta(x^{**})}{2\sigma}W(q,x^{**})$$
$$> (1-\delta)\mathbb{E}[y|x^*] + \frac{\delta\Delta(x^*)}{2\sigma}(qW(1,x^*) + (1-q)W(0,x^*)) + \delta(1-\frac{\Delta(x^*)}{2\sigma})W(q,x^*)$$

which also implies

$$(1-\delta)\mathbb{E}[y|x^{**}] - k|x^{**}-x^*| - k|x^*-x'| + \frac{\delta\Delta(x^{**})}{2\sigma}(qW(1,x^{**}) + (1-q)W(0,x^{**}))$$
$$+\delta(1-\frac{\Delta(x^{**})}{2\sigma})W(q,x^{**})$$
$$> (1-\delta)\mathbb{E}[y|x^*] - k|x^*-x'| + \frac{\delta\Delta(x^*)}{2\sigma}(qW(1,x^*) + (1-q)W(0,x^*)) + \delta(1-\frac{\Delta(x^*)}{2\sigma})W(q,x^*)$$

However, since $k|x^{**} - x'| \le k|x^{**} - x^*| + k|x^* - x'|$, this implies

$$(1-\delta)\mathbb{E}[y|x^{**}] - k|x^{**} - x'| + \frac{\delta\Delta(x^{**})}{2\sigma}(qW(1,x^{**}) + (1-q)W(0,x^{**})) + \delta(1 - \frac{\Delta(x^{**})}{2\sigma})W(q,x^{**})$$
$$\ge (1-\delta)\mathbb{E}[y|x^{**}] - k|x^{**} - x^*| - k|x^* - x'| + \frac{\delta\Delta(x^{**})}{2\sigma}(qW(1,x^{**}) + (1-q)W(0,x^{**}))$$
$$+ \delta(1 - \frac{\Delta(x^{**})}{2\sigma})W(q,x^{**})$$
$$> (1-\delta)\mathbb{E}[y|x^*] - k|x^* - x'| + \frac{\delta\Delta(x^*)}{2\sigma}(qW(1,x^*) + (1-q)W(0,x^*)) + \delta(1 - \frac{\Delta(x^*)}{2\sigma})W(q,x^*)$$

contradicting that x^* solved the functional equation associated with $W(q,x')$.

□

Lemma 2. *There exist* $0 \le \underline{x} < x_{LT} < \overline{x} < \tilde{x} \le \overline{\overline{x}} \le 1$ *such that*

$$W(1,x') = \begin{cases} f_g(\overline{x}) - k(\overline{x} - x') & x' \notin (\overline{x}, \overline{\overline{x}}) \\ f_g(x') & x' \in (\overline{x}, \overline{\overline{x}}) \end{cases}$$
$$W(0,x') = \begin{cases} f_b(\underline{x}) - k(x' - \underline{x}) & x' \ge \underline{x} \\ f_b(x') & x' < \underline{x} \end{cases}$$

Proof. Suppose $q = 1$ and $x' \le \tilde{x}$. $W(1,x') = \max_{x\in[0,1]}(1-\delta)f_g(x) + \delta W(1,x) - k|x - x'|$ The previous lemma allows us to simplify this to $\max_{x\in[0,1]} f_g(x) - k|x - x'|$, which is solved by $\overline{x} = \tilde{x} - k/2$. A reverse argument shows $\overline{\overline{x}} = \tilde{x} + k/2$. That these points are to the right of x_{LT} follows from $f_g'(x_{LT}) > k$. □

Lemma 3. *Suppose x^* is a solution to the functional equation defining $W(q,x')$ and $q \in (0,1)$ Then:*

$$W(q,x^*) = \frac{2\sigma(1-\delta)\mathbb{E}[y|x^*] + \delta\Delta(x^*)\Phi(q,x^*)}{2\sigma(1-\delta) + \delta\Delta(x^*)}$$

where $\Phi(q,x) = qW(1,x) + (1-q)W(0,x)$.

Moreover, $W(q,x') = \max_x \frac{2\sigma(1-\delta)\mathbb{E}[y|x] + \delta\Delta(x^*)\Phi(q,x)}{2\sigma(1-\delta)+\delta\Delta(x)} - k|x - x'|$.

Proof. Since x^* solves the functional equation associated with $W(q,x')$, by the previous lemmata it also solves the one associated with $W(q,x^*)$. Hence:

$$\begin{aligned}
W(q,x^*) &= (1-\delta)\mathbb{E}[y|x^*] + \frac{\delta\Delta(x^*)}{2\sigma}\Phi(q,x^*) + \delta(1-\frac{\Delta(x^*)}{2\sigma})W(q,x^*) \\
&= \frac{(1-\delta)\mathbb{E}[y|x^*] + \frac{\delta\Delta(x^*)}{2\sigma}\Phi(q,x^*)}{1-\delta(1-\frac{\Delta(x^*)}{2\sigma})} = \frac{2\sigma(1-\delta)\mathbb{E}[y|x^*] + \delta\Delta(x^*)\Phi(q,x^*)}{2\sigma(1-\delta)+\delta\Delta(x^*)}
\end{aligned}$$

$W(q,x')$ can then be written as:

$$\begin{aligned}
W(q,x') &= \max_{x^*}(1-\delta)\mathbb{E}[y|x^*] + \frac{\delta\Delta(x^*)}{2\sigma}\Phi(q,x) \\
&\quad + \delta(1-\frac{\Delta(x^*)}{2\sigma})\frac{2\sigma(1-\delta)\mathbb{E}[y|x^*] + \delta\Delta(x^*)\Phi(q,x)}{2\sigma(1-\delta)+\delta\Delta(x)} - k|x^*-x'| \\
&= \max_x \mathbb{E}[y|x]\Big((1-\delta) + \delta(1-\frac{\Delta(x)}{2\sigma})\frac{2\sigma(1-\delta)}{2\sigma(1-\delta)+\delta\Delta(x)}\Big) \\
&\quad + \delta\Phi(q,x)\Big(\frac{\Delta(x)}{2\sigma} + (1-\frac{\Delta(x)}{2\sigma})\frac{\delta\Delta(x)}{2\sigma(1-\delta)+\delta\Delta(x)}\Big) - k|x-x'| \\
&= \max_x \mathbb{E}[y|x]\Big((1-\delta)\Big(1+\frac{2\sigma\delta-\delta\Delta(x)}{2\sigma(1-\delta)+\delta\Delta(x)}\Big)\Big) \\
&\quad + \delta\frac{\Delta(x)}{2\sigma}\Phi(q,x)\Big(1+\frac{2\sigma\delta-\delta\Delta(x)}{2\sigma(1-\delta)+\delta\Delta(x)}\Big) - k|x-x'| \\
&= \max_x \frac{2\sigma(1-\delta)\mathbb{E}[y|x] + \delta\Delta(x)\Phi(q,x)}{2\sigma(1-\delta)+\delta\Delta(x)} - k|x-x'|
\end{aligned}$$

□

Lemma 4. *Suppose $x' \in [\underline{x}, \overline{x}]$. Then $x_p(q,x') \in [\underline{x}, \overline{x}]$.*

Proof. Note that our problem can be written as:

$$\begin{aligned}
W(q,x') = \max_{x\in[0,1]} &\frac{2\sigma(1-\delta)}{2\sigma(1-\delta)+\delta\Delta(x)}\big(\mathbb{E}[y|x] - k|x-x'|\big) \\
&+ \frac{\delta\Delta(x)}{2\sigma(1-\delta)+\delta\Delta(x)}\big(\Phi(q,x) - k|x-x'|\big)
\end{aligned}$$

First, since $\frac{\partial^2}{\partial q\partial x}\mathbb{E}[y|x] = f_g'(x) - f_b'(x) > 0$, since $\arg\max f_g(x) - k|x-x'| = \overline{x}$, and since $\arg\max f_b(x) - k|x-x'| = \underline{x}$, we have: $\arg\max_{\hat{x}\in[0,1]} \mathbb{E}[y|\hat{x}] - k|\hat{x}-x'| \in [\underline{x}, \overline{x}]$. All $x < \underline{x}$ are dominated by $\underline{x}$ and all $x > \overline{x}$ are dominated by $\overline{x}$.

Next, I claim $\arg\max_{\tilde{x}\in[0,1]} W(q,\tilde{x}) - k|\tilde{x} - x'| \in [\underline{x}, \overline{x}]$. Suppose $x < \underline{x}$, meaning $f_b(x)$ is concave and $f_b'(x) > -k$ for $x < \underline{x}$. Then, the derivative with respect to x here is: $qk + (1-q)f_b'(x) + k = (1-q)(f_b'(x) + k) > 0$, meaning $\underline{x}$ dominates all options to its left. Similarly, for $x \in (\overline{x}, \overline{\overline{x}})$, $|f'(x)|$ is necessarily $< k$ and the derivative is $qf'(x) - (1-q)k - k < 0$. Finally, for $x \geq \overline{\overline{x}}$, the derivative is $-k - k < 0$ meaning $\overline{\overline{x}}$ dominates in this range, but since the left and right derivatives at $\overline{\overline{x}}$ are then both negative, we have that $\overline{x}$ dominates all options to its right.

Finally, suppose by contradiction that $[\underline{x}, \overline{x}] \not\ni \hat{x}$, where $\hat{x}$ is the maximizer associated with $W(q, x')$. If $\hat{x} < \underline{x}$, we know that $\mathbb{E}[y|\hat{x}] - k|\hat{x} - x'| < \mathbb{E}[y|\underline{x}] - k|\underline{x} - x'|$ and $\Phi(q,\hat{x}) - k|\hat{x} - x'| < \Phi(q,\underline{x}) - k|\underline{x} - x'|$ Any convex combination of $\mathbb{E}[y|\underline{x}] - k|\underline{x} - x'|$ and $\Phi(q,\underline{x}) - k|\underline{x} - x'|$ is strictly larger than any convex combination of $\mathbb{E}[y|\hat{x}] - k|\hat{x} - x'|$ and $\Phi(q,\hat{x}) - k|\hat{x} - x'|$, meaning playing $\overline{x}$ dominates $\hat{x}$ in the original program. A symmetric argument shows that playing any $\hat{x} > \overline{x}$ is always strictly worse than $\overline{x}$. □

Lemma 5. *Under Assumptions 1 and 2', there exists $c > 0$ such that: $f_g(\overline{x}) - k(\overline{x} - x_{LT}) \geq y_{LT}$, $f_b(\underline{x}) - k(x_{LT} - \underline{x}) + c > y_{LT}$ and $W(1/2, x_{LT}) < y_{LT} + c$. Hence, the set $LT = \{(q,x') : W(q,x') < y_{LT} - c\}$ has nonempty interior.*

Proof. We constructing an upper bound for $W(1/2, x_{LT})$. First, I claim:

$$\frac{1}{2}\big(f_g(\overline{x}) - k(\overline{x} - x_{LT})\big) + \frac{1}{2}\big(f_b(\underline{x}) - k(x_{LT} - \underline{x})\big) - k(\overline{x} - x_{LT}) < y_{LT}$$
$$\frac{1}{2}\big(f_g(\overline{x}) - k(\overline{x} - x_{LT})\big) + \frac{1}{2}\big(f_b(\underline{x}) - k(x_{LT} - \underline{x})\big) - k(x_{LT} - \underline{x}) < y_{LT}.$$

Sufficient conditions for the first equation are: $f_g(\overline{x}) - 2k(\overline{x} - x_{LT}) < y_{LT}$ and $f_b(\underline{x}) - k(\overline{x} - \underline{x}) < y_{LT}$. The first inequality follows immediately from the fact that $f_g'(x_{LT}) < 2k$, contained in Assumption 2. Next, note that $x_{LT} = \frac{\beta_b - \beta_g + \tilde{x}^2}{2\tilde{x}}$. Then, using the fact that $\underline{x} = k/2$ and $\overline{x} = \tilde{x} - k/2$, $f_b(\overline{x}) - k(\overline{x} - \underline{x}) < y_{LT}$ if and only if:

$$\beta_b - \frac{k^2}{4} - k(\tilde{x} - k) < \beta_b - \left(\frac{\beta_b - \beta_g + \tilde{x}^2}{2\tilde{x}}\right)^2 \iff \frac{3}{4}k^2 - \tilde{x}k + \left(\frac{\tilde{x}^2}{4} + (\beta_b - \beta_g) + \frac{(\beta_b - \beta_g)^2}{4\tilde{x}^2}\right) < 0$$

This holds if $k \in \left[\frac{2\tilde{x}-\sqrt{\tilde{x}^2-3\tilde{x}^2/4-3(\beta_b-\beta_g)-3(\beta_b-\beta_g)^2/\tilde{x}^2}}{3}, \frac{2\tilde{x}+\sqrt{\tilde{x}^2-3\tilde{x}^2/4-3(\beta_b-\beta_g)-3(\beta_b-\beta_g)^2/\tilde{x}^2}}{3}\right]$ and $k \in \left[\frac{2\tilde{x}-\sqrt{\tilde{x}^2/4-3(\beta_b-\beta_g)-3(\beta_b-\beta_g)^2/\tilde{x}^2}}{3}, \frac{2\tilde{x}+\sqrt{\tilde{x}^2/4-3(\beta_b-\beta_g)-3(\beta_b-\beta_g)^2/\tilde{x}^2}}{3}\right]$. This is satisfied by Assumptions 2 and 2', which also subsume a similar condition with the second inequality: $k \in \left[\frac{2\tilde{x}-\sqrt{\tilde{x}^2/4+3(\beta_b-\beta_g)-3(\beta_b-\beta_g)^2/\tilde{x}^2}}{3}, \frac{2\tilde{x}+\sqrt{\tilde{x}^2/4+3(\beta_b-\beta_g)-3(\beta_b-\beta_g)^2/\tilde{x}^2}}{3}\right]$.

We now construct our upper bound for $W(1/2, x_{LT})$. $W(1/2, x_{LT}) =$

$$
\begin{aligned}
&\max_{x\in[\underline{x},\overline{x}]} \frac{2\sigma(1-\delta)\mathbb{E}[y|x] + \delta\Delta(x)\Phi(1/2,x)}{2\sigma(1-\delta)+\delta\Delta(x)} - k|x - x_{LT}| \\
&= \max_{x\in[\underline{x},\overline{x}]} \frac{2\sigma(1-\delta)}{2\sigma(1-\delta)+\delta\Delta(x)}\big(\mathbb{E}[y|x] - k|x-x_{LT}|\big) + \frac{\delta\Delta(x)}{2\sigma(1-\delta)+\delta\Delta(x)}\big(\Phi(1/2,x) - k|x-x'|\big) \\
&\le \max_{x\in[\underline{x},\overline{x}]} \frac{2\sigma(1-\delta)}{2\sigma(1-\delta)+\delta\Delta(x)}\big(\max_{\breve{x}} \mathbb{E}[y|\breve{x}] - k|\breve{x}-x_{LT}|\big) + \frac{\delta\Delta(x)}{2\sigma(1-\delta)+\delta\Delta(x)}\big(\Phi(1/2,x) - k|x-x'|\big) \\
&= \max_{x\in[\underline{x},\overline{x}]} \frac{2\sigma(1-\delta)}{2\sigma(1-\delta)+\delta\Delta(x)} y_{LT} + \frac{\delta\Delta(x)}{2\sigma(1-\delta)+\delta\Delta(x)}\big(\Phi(1/2,x) - k|x-x_{LT}|\big) \equiv \max_{x\in[\underline{x},\overline{x}]} U(x)
\end{aligned}
$$

$U(x)$ will be the objective associated with the upper bound. The third line holds since

$$
\partial/\partial x\Big|_{x=x_{LT}} \mathbb{E}[y|x] = \frac{1}{2}2(\tilde{x} - x_{LT}) - \frac{1}{2}2x_{LT} = \tilde{x} - 2x_{LT} = \tilde{x} - 2\frac{\tilde{x}^2 + (\beta_b - \beta_g)}{2\tilde{x}} = \frac{\beta_b - \beta_g}{2\tilde{x}}
$$

and by Assumption 2', $|\frac{\beta_b-\beta_g}{2\tilde{x}}||\frac{\beta_b-\beta_g}{\tilde{x}}| < |\frac{\beta_b-\beta_g}{\tilde{x}-k}| < k$.

Note that Φ does not depend on x at $q = 1/2$: $1/2(f_g(\overline{x}) - k(\overline{x} - x)) + 1/2(f_b(\underline{x}) - k(x - \underline{x})) = 1/2(f_g(\overline{x}) + f_b(\underline{x}) - k(\overline{x} - \underline{x}))$. Hence:

$$
\begin{aligned}
\Phi(1/2, x_{LT}) =& 1/2(f_g(\overline{x}) - k(\overline{x} - x_{LT})) + 1/2(f_b(\underline{x}) - k(x_{LT} - \underline{x})) > y_{LT} \\
>& 1/2(f_g(\overline{x}) - k(\overline{x} - x_{LT})) + 1/2(f_b(\underline{x}) - k(x_{LT} - \underline{x})) - k(\overline{x} - x_{LT}), \\
& 1/2(f_g(\overline{x} - k(\overline{x} - x_{LT})) + 1/2(f_b(\underline{x}) - k(x_{LT} - \underline{x})) - k(\underline{x} - x_{LT})
\end{aligned}
$$

Let $\hat{x}_1$ and $\hat{x}_2$ be defined by the following:

$$
\begin{aligned}
y_{LT} &= 1/2(f_g(\overline{x} - k(\overline{x} - x_{LT})) + 1/2(f_b(\underline{x}) - k(x_{LT} - \underline{x})) - k(\hat{x}_1 - x_{LT}) \qquad \hat{x}_1 \in (x_{LT}, \overline{x}) \\
y_{LT} &= 1/2(f_g(\overline{x} - k(\overline{x} - x_{LT})) + 1/2(f_b(\underline{x}) - k(x_{LT} - \underline{x})) - k(\hat{x}_2 - x_{LT}) \qquad \hat{x}_2 \in (\underline{x}, x_{LT})
\end{aligned}
$$

which exist and are unique by continuity, strict monotonicity, and the Intermediate Value Theorem. Because we are taking convex combinations of y_{LT} and $\Phi - k|x - x_{LT}|$, where the weights depend on x as well, we will only want to place less weight on y_{LT} if $\Phi - k|x - x_{LT}| > y_{LT}$ (precisely on $[\hat{x}_2, x_{LT}]$ and $[x_{LT}, \hat{x}_1]$).

The derivative of $U(x)$ for $x > x_{LT}$ is:

$$\frac{2\sigma(1-\delta)\delta\Delta'(x)(\Phi - k(x - x_{LT}) - y_{LT}) - 2\sigma(1-\delta)\delta\Delta(x)k - \delta^2\Delta(x)^2 k}{(2\sigma(1-\delta) + \delta\Delta(x))^2}$$

A nearly identical derivative for $x < x_{LT}$ is omitted. At $x = x_{LT}$, the right derivative is $\frac{\delta\Delta'(x)(\Phi - y_{LT})}{2\sigma(1-\delta)} > 0$. At $\hat{x}_1$, when $\Phi - k(\hat{x}_1 - x_{LT}) - y_{LT} = 0$, the derivative is $-\frac{\delta\Delta(x)k}{2\sigma(1-\delta)+\delta\Delta(x)} < 0$. The derivative is ≥ 0 when:

$$\begin{aligned}
2\sigma(1-\delta)\delta\Delta'(x)(\Phi - k(x - x_{LT}) - y_{LT}) &\geq \delta\Delta(x)(2\sigma(1-\delta) + \delta\Delta(x))k \\
\Phi - k(x - x_{LT}) - y_{LT} &\geq \frac{\delta\Delta(x)(2\sigma(1-\delta) + \delta\Delta(x))k}{2\sigma(1-\delta)\delta\Delta'(x)} \\
\Phi - k(x - x_{LT}) &\geq y_{LT} + \frac{\Delta(x)(2\sigma(1-\delta) + \delta\Delta(x))}{2\sigma(1-\delta)\Delta'(x)}k \\
&= y_{LT} + k(x - x_{LT})\left(1 + \frac{\delta\Delta(x)}{2\sigma(1-\delta)}\right)
\end{aligned}$$

The final line is strictly increasing in x with a zero at $x_{LT} < \hat{x_1}$. $\Phi - k(x - x_{LT})$ is strictly decreasing in x with a zero at $\hat{x_1}$. Hence there is a *unique* maximizer $\overline{x}^\star$ to this problem in $(x_{LT}, \hat{x}_1)$. Define c implicitly as $\Phi - k(\overline{x}^\star - x_{LT}) = y_{LT} + c$. Defining c using the derivative to the left of x_{LT} gives the same c, since Φ, $\Delta(x)$, and $k|x - x_{LT}|$ are symmetric about x_{LT}. Then:

$$\begin{aligned}
W(1/2, x_{LT}) \leq \max_x U(x) &= y_{LT} + \frac{\delta\Delta(\overline{x}^\star)}{2\sigma(1-\delta) + \delta\Delta(\overline{x}^\star)}\left(k(\overline{x}^\star - x_{LT})\left(1 + \frac{\delta\Delta(\overline{x}^\star)}{2\sigma(1-\delta)}\right)\right) \\
&= y_{LT} + \frac{\delta\Delta(\overline{x}^\star)}{2\sigma(1-\delta) + \delta\Delta(\overline{x}^\star)}c < y_{LT} + c.
\end{aligned}$$

Since $x^\star > x_{LT}$, we also have $\Phi(1/2, x_{LT}) - k(x^\star - x_{LT}) = y_{LT} + c \implies \Phi(1/2, x_{LT}) > y_{LT} + c$. That c is not *so* large that the people are discouraged from overthrowing at $q = 0, 1$ follows from the fact that $\Phi(1/2, x_{LT}) = \frac{1}{2}W(1, x_{LT}) + \frac{1}{2}W(0, x_{LT})$ and that $|\beta_g - \beta_b|$ is small. Since $W(q, x')$ is continuous, the inequality $W(1/2, x_{LT}) < y_{LT} + c$ also holds in a *neighborhood* of $(1/2, x_{LT})$. This means that $LT : \{(q, x') : W(q, x') \leq y_{LT} + c\}$ has nonempty interior. □

Proof of Solution to Leader's Problem

Theorem 1. *Suppose $\sigma(1-\delta)$ is small and/or $\underline{u}(x')$ is sufficiently low. Then, there exist thresholds $\underline{q} < \overline{q} \in [0, 1]$ such that the following hold:*

1. *If $q \leq \underline{q}$, then $x_\ell(q, x') = \underline{x}_{LT}(q, x')$ or $\overline{x}_{LT}(q, x')$. The leader plays the* closest policy *to the learning trap.*

2. *If $q \in [\underline{q}, \overline{q}]$, then $x_\ell(q, x') = \underline{x}_{LT}(q, x')$ or $\overline{x}(q, x')$. The leader plays either the lowest policy below the learning trap*

3. *If $q > \overline{q}$, = then $x_\ell(q, x') = \overline{x}(q, x')$ or $\underline{x}(q, x')$ (and it is necessary that $\Delta(\underline{x}(q, x')) > \Delta(\overline{x}(q, x'))$). The leader either plays her highest feasible policy or policies maximizing information revelation.*

Lemma 6. *Suppose that the leader can implement any $x \in [x_\ell(0, x'), x_\ell(1, x')]$. Then, there exist thresholds $\underline{q} < \overline{q}$ such that: for $q \leq \underline{q}$, the derivative of the objective in the maximization problem is positive for $x < x_{LT}$ and negative for $x > x_{LT}$; for $q \in [\underline{q}, \overline{q}]$, the derivative of the objective is positive for $x < x_{LT}$ and positive for $x > x_{LT}$; and for $q \geq \overline{q}$, the derivative of the objective is negative for $x < x_{LT}$ and positive for $x > x_{LT}$.*

Proof. Let $X_{unc} = [x_\ell(0, x'), x_\ell(1, x')]$. The leader's Bellman in the unconstrained case can be written as:

$$\tilde{V}(q) = \max_{x \in X_{unc}} (1-\delta)u_\ell(x) + \delta\frac{\Delta(x)}{2\sigma}(q\overline{u}(x') + (1-q)\underline{u}(x')) + \delta\left(1 - \frac{\Delta(x)}{2\sigma}\right)\tilde{V}(q)$$

Let $\Psi(q) = q\overline{u}(x') + (1-q)\underline{u}(x')$. Replicating an earlier argument implies

$$\tilde{V}(q) = \max_{x \in X_{unc}} \frac{2\sigma(1-\delta)u_\ell(x) + \delta\Delta(x)\Psi(q)}{2\sigma(1-\delta) + \delta\Delta(x)}.$$

The numerator of the derivative with respect to x for $x \neq x_{LT}$ is:

$$= 4\sigma^2(1-\delta)^2 u'_\ell(x) + 2\sigma\delta(1-\delta)(\Delta(x)u'_\ell(x) + \Delta'(x)\Psi(q) - \Delta'(x)u_\ell(x)).$$

Observe that $\Delta(x)$ is the absolute value of a linear function with zero at x_{LT}.

$$\Delta(x) = |\beta_g - (x-\tilde{x})^2 - (\beta_b - x^2)| = |\beta_g - \beta_b - \tilde{x}^2 + 2\tilde{x}x| \equiv \xi|x - x_{LT}|$$

This means that for $x > x_{LT}$, the derivative of the objective is negative if and only if

$$\begin{aligned} 2\sigma(1-\delta)u'_\ell(x) &\leq \delta\big(\Delta'(x)u_\ell(x) - \Delta(x)u'_\ell(x) - \Delta'(x)\Psi(q)\big) \\ 2\sigma(1-\delta)u'_\ell(x) &\leq \delta\xi\big(u_\ell(x) - u'_\ell(x)(x - x_{LT}) - \Psi(q)\big) \end{aligned}$$

$u_\ell(x) - u'_\ell(x)(x - x_{LT})$ is equal to u_{LT} at $x = x_{LT}$ and is weakly increasing for $x > x_{LT}$.[19] By weak concavity, the LHS below is decreasing and the RHS increasing:

$$2\sigma(1-\delta)u'_\ell(x) \leq \delta\xi\big(u_\ell(x) - u'_\ell(x)(x - x_{LT}) - \Psi(q)\big) \tag{1}$$

If $\sigma(1-\delta)$ is small, since $\underline{u}(x') < u_{LT} \leq u_\ell(x) - u'_\ell(x)(x - x_{LT}) < \overline{u}(x')$, there is a threshold $\underline{q}$ such that the inequality satisfies strictly if and only if $q < \underline{q}$. Moreover, for any $\sigma(1-\delta)$, as $\underline{u}(x')$ grows more negative, $-\Psi(q)$ grows large, which can also allow the inequality to satisfy. A similar argument shows that for $x < x_{LT}$, the derivative is positive when:

$$2\sigma(1-\delta)u'_\ell(x) \geq \delta\xi\big(\Psi(q) - \big(u_\ell(x) - u'_\ell(x)(x - x_{LT})\big)\big) \tag{2}$$

[19]To see this, note that the derivative of this expression with respect to x is $u'_\ell(x) - u''_\ell(x)(x - x_{LT}) - u'_\ell(x) = -u''_\ell(x)(x - x_{LT}) \geq 0$.

When (1) holds with equality, its RHS is strictly positive, meaning the RHS of (2) is strictly negative, showing $\underline{q} < \overline{q}$. Hence: for $x > x_{LT}$, the derivative of the objective is strictly negative when $q < \underline{q}$ and strictly positive when $q > \underline{q}$, with equality at $q = \underline{q}$; for $x < x_{LT}$, the derivative of the objective is strictly positive when $q < \overline{q}$ and strictly negative when $q > \overline{q}$, with equality at $q = \overline{q}$. This completes the lemma. $\square$

Lemma 7. *Let $x_\ell(q, x')$ denote a policy for the leader such that $x_\ell(q, x_\ell(q, x')) = x_\ell(q, x')$. Then, the people overthrow if and only if $\tilde{W}(x_\ell, q, x') \geq W(q, x') - c$, where*

$$\tilde{W}(x_\ell, q, x') = \frac{2\sigma(1-\delta)\mathbb{E}[y|x_\ell(q, x')] + \delta\Delta(x_\ell(q, x'))\tilde{\Phi}(q, x_\ell(q, x'))}{2\sigma(1-\delta) + \delta\Delta(x)} - k|x_\ell(q, x') - x'|$$

where $\tilde{\Phi}(q, x) = q\big(f_g(x_\ell(1, x) - k|x_\ell(1, x) - x'|\big) + (1-q)\big(f_b(x_\ell(0, x) - k|x_\ell(0, x) - x|\big)$.

Proof. Let $\tilde{W}(x_\ell, q, x')$ be the value for the people of accepting for all time a policy $x_\ell(q, x')$ satisfying the hypothesis. Let

$$\tilde{\Phi}(q, x) = q\tilde{W}(x_\ell, 1, x_\ell(1, x_\ell(1, x'))) + (1-q)\tilde{W}(x_\ell, 1, x_\ell(0, x_\ell(0, x')))$$
$$\tilde{W}(x_\ell, 1, x') = \Big(\sum_{t=0}^{\infty}(1-\delta)f_g(x_\ell(1, x'))\Big) - k|x_\ell(1, x') - x'| = f_g(x_\ell(1, x') - k|x_\ell(1, x') - x'|$$
$$\tilde{W}(x_\ell, 0, x') = \Big(\sum_{t=0}^{\infty}(1-\delta)f_b(x_\ell(0, x'))\Big) - k|x_\ell(0, x') - x'| = f_b(x_\ell(0, x') - k|x_\ell(0, x') - x'|.$$

Then:

$$\begin{aligned}
\tilde{W}(x_\ell, q, x_\ell(q, x')) &= (1-\delta)\mathbb{E}[y|x_\ell(q, x')] + \delta\frac{\Delta(x_\ell(q, x'))}{2\sigma}\Phi(q, x_\ell(q, x')) \\
&\quad + \delta\big(1 - \frac{\Delta(x)}{2\sigma}\big)\tilde{W}(q, x_\ell(q, x')) \\
&= \frac{2\sigma(1-\delta)\mathbb{E}[y|x_\ell(q, x')] + \delta\Delta(x_\ell(q, x'))\Phi(q, x_\ell(q, x'))}{2\sigma(1-\delta) + \delta\Delta(x)}
\end{aligned}$$

Replicating arguments from earlier lemmata gives the result:

$$\tilde{W}(x_\ell, q, x') = \frac{2\sigma(1-\delta)\mathbb{E}[y|x_\ell(q,x')] + \delta\Delta(x_\ell(q,x'))\Phi(q, x_\ell(q,x'))}{2\sigma(1-\delta) + \delta\Delta(x)} - k|x_\ell(q,x') - x'|$$

□

Lemma 8. $x_\ell(q,x') = x_\ell\big(q, x_\ell(q,x')\big)$, *meaning the previous lemma characterizes the equilibrium overthrow decision.*

Proof. If $\mathrm{NR}(q,x')$ does not bind, the leader implements her preferred policy by the previous lemma, which satisfies the property. So, suppose $\mathrm{NR}(q,x')$ binds and that by contradiction there exists x' such that $x_1 \equiv x_\ell(q,x') \neq x_\ell\big(x_\ell(q,x')\big) \equiv x_2$. Let $h(x) = (1-\delta)\mathbb{E}[y|x] + \frac{\delta\Delta(x)}{2\sigma}\tilde{\Phi}(q,x)$. Then, we must have

$$\begin{aligned} W(q,x') - c &= h(x_1) - k|x_1 - x'| \\ &\quad + \delta\Big(1 - \frac{\Delta(x_1)}{2\sigma}\Big)\Big(h(x_2) + \delta\Big(1 - \frac{\Delta(x_2)}{2\sigma}\Big)\tilde{W}_{x_\ell}(x_2) - k|x_2 - x_1|\Big) \\ W(q,x_1) - c &= h(x_2) + \delta\Big(1 - \frac{\Delta(x_2)}{2\sigma}\Big)\tilde{W}_{x_\ell}(x_2) - k|x_2 - x_1| \end{aligned}$$

Let $x^* = x_p(q,x')$. Since $\mathrm{NR}(q,x')$ is binding, it must be that:

$$\begin{aligned} &\frac{2\sigma(1-\delta)\mathbb{E}[y|x^*] + \delta\Delta(x^*)\Phi(q,x^*)}{2\sigma(1-\delta) + \delta\Delta(x^*)} - k|x^* - x'| - c > \\ &\qquad h(x_2) + \delta\Big(1 - \frac{\Delta(x_2)}{2\sigma}\Big)\tilde{W}_{x_\ell}(x_2) - k|x_2 - x'| \end{aligned}$$

where the RHS is equal to $W(q,x')$. Since either $x^* < x_1 < x_2$ or $x^* > x_1 > x_2$ by a previous lemma (policy is attracted in a single direction; implementing x^* and then x_2 is dominated by a policy between x^* and x_2), as $x' \to x_1$, both sides increase/decrease by the same amount or the right side increases by more, meaning:

$$\frac{2\sigma(1-\delta)\mathbb{E}[y|x^*] + \delta\Delta(x^*)\Phi(q,x^*)}{2\sigma(1-\delta) + \delta\Delta(x^*)} - k|x^* - x_1| > h(x_2) + \delta\Big(1 - \frac{\Delta(x_2)}{2\sigma}\Big)\tilde{W}_{x_\ell}(x_2) - k|x_2 - x_1|$$

But then:

$$
\begin{aligned}
W(q, x_1) = \max_{x \in [0,1]} & \frac{2\sigma(1-\delta)\mathbb{E}[y|x] + \delta\Delta(x)\Phi(q,x)}{2\sigma(1-\delta) + \delta\Delta(x)} - k|x - x_1| \\
\geq & \frac{2\sigma(1-\delta)\mathbb{E}[y|x^*] + \delta\Delta(x^*)\Phi(q,x^*)}{2\sigma(1-\delta) + \delta\Delta(x^*)} - k|x^* - x_1|
\end{aligned}
$$

a contradiction.

□

Proof. We use the lemmata above to prove the original theorem; the solution can be written as:

$$
V(q, x') = \max_{x \in \mathrm{NR}(q,x')} \frac{2\sigma(1-\delta)u)\ell(x) + \delta\Delta(x)\Psi(q)}{2\sigma(1-\delta) + \delta\Delta(x)}
$$

where, replicating the previous lemma's argument, we have $\Psi(q) = q\overline{u}(x') - (1-q)\underline{u}(x')$. If $q \leq \underline{q}$, the derivative for $x > x_{LT}$ is negative and the derivative for $x < x_{LT}$ is positive, meaning the leader is attracted to the learning trap. Hence, $x_\ell(q, x') = \underline{x}_{LT}(q, x')$ or $\overline{x}_{LT}(q, x')$. If $q \in [\underline{q}, \overline{q}]$, the solution is either $\underline{x}_{LT}(q, x')$ or some $x \geq x_{LT}$. If $q \geq \overline{q}$. the derivative for $x > x_{LT}$ is positive and the derivative for $x < x_{LT}$ is negative. Hence the optimal solution is either $\overline{x}(q, x')$ or $\underline{x}(q, x')$. □

Additional Results

Preference Microfoundation: Land Reform

Overview This subsection provides a microfoundation for the preferences of the "people" and "leader" with an eye to the fiscal setting of Russian land reform. Peasants produce output, which is extracted by the leader via taxation that is siphoned away by elites. We represent the people's utility as the sum of post-tax surplus for the gentry and peasantry. The main mechanism driving the leader's preference for disempowering the gentry — beyond effects on aggregate output by changing peasant production incentives — is that disenfranchising the gentry (high x in the main model) allows them to siphon less tax revenue.

We allow the preference of the leader, in this case, to depend on the state of the world, and relax the assumption of strict monotonicity; however, this does not radically alter the proofs in the previous section.

Setup Consider an economy made up of peasants, gentry, and leader. The union of the peasants and gentry compose the "people." Each period, peasants produce surplus $i(x) \geq 0$, depending on $x \in [0,1]$ and the state of the world (pro or anti-leader). $x = 0$ represents a system of overseen serf labor. $x = 1$ represents a system where peasant households are given private property and labor mobility. x_{LT} represents an arrangement where the commune remains and the peasantry have some economic freedom.

The leader collects revenue from the peasantry in a process intermediated by the gentry by setting a tax $t \in [0,1]$ on $i(x)$. Assume there is some maximal-level of taxation $\bar{t} < 1$ that the peasantry will permit (reflecting e.g. subsistence or overthrow threats) so that the leader set $t = \bar{t}$ in equilibrium.

Since x reflects not only peasants' economic incentives but also gentry involvement, suppose that when the government taxes at t, the gentry siphons away a share $s(x) \in [0,1]$ of revenue. We assume s is strictly decreasing for $x < x_{LT}$ and constant for $x \geq x_{LT}$. For $x < x_{LT}$, the leader gradually expropriates gentry land, meaning they can siphon less-and-less. For $x \geq x_{LT}$, the leader only has to worry about compensating the gentry for their land (so $s(x)$ is constant but is likely > 0).

Writing y as Post-Tax Surplus Let $u_p(x)$ denote the sum of both peasants' and gentry utility:

$$u_p(x) = (1 - \bar{t} + \bar{t}s(x))i(x)$$

Suppose that for each state of the world, $i(x) =:$

$$\begin{array}{ll} \dfrac{f_g(x)}{1 - \bar{t} + \bar{t}s(x)} & \text{Pro-Leader} \\ \dfrac{f_b(x)}{1 - \bar{t} + \bar{t}s(x)} & \text{Anti-Leader} \end{array}$$

Assume that $f_g(x), f_b(x) \geq 0$ on $[0,1]$ since $i(x)$ represents output. With this interpretation, y_t in each stage of the main game represent the *post-tax* output left to the "people" (gentry plus peasantry) —substituting these expressions for $i(x)$ back into $u_p(x)$ gives $u_p(x) = f_g(x)$ in the pro-leader state and $f_b(x)$ in the anti-leader state of the world. Note that since $f_g(x_{LT}) = f_b(x_{LT})$, $i(x_{LT})$ is the same in both states of the world; hence, both aggregate output and post-tax output are the same in each state of the world, and inference made with either quantity yields similar results. Next, since $1 - \bar{t} + \bar{t}s(x)$ is weakly decreasing in x and positive, $i(x)$ is strictly increasing in x in the pro-leader state of the world, just as $f_g(x)$. The derivative with respect to x in the anti-leader state is

$$\frac{f_b'(x)}{1 - \bar{t} + \bar{t}s(x)} - \bar{t}s'(x)\frac{f_b(x)}{\left(1 - \bar{t} + \bar{t}s(x)\right)^2}$$

which is strictly decreasing for $x > x_{LT}$ and for some region of $x < x_{LT}$ as well. This means that *aggregate* output may not be higher under full-serfdom, but that departing from x_{LT} results in some gains, and that *post-tax surplus* for the sum of the elite and peasant surpluses is higher in this state of the world.

Establishing Leaders' Preferences The leader's revenue is given by $\bar{t}(1-s(x))i(x)$. Using the mapping above, utility $u_\ell(x)$ in each state of the world is

$$\begin{aligned} &\bar{t}(1-s(x))\frac{f_g(x)}{1-\bar{t}+\bar{t}s(x)} &&\text{Pro-Leader} \\ &\bar{t}(1-s(x))\frac{f_b(x)}{1-\bar{t}+\bar{t}s(x)} &&\text{Anti-Leader} \end{aligned}$$

In the pro-leader state of the world, $u_\ell(x)$ is clearly strictly increasing in x. In the anti-leader state of the world, for the main results of the main model to go through, we simply require that

$$\bar{t}(1-s(x_\ell(0,x')))\frac{f_b(x_\ell(0,x'))}{1-\bar{t}+\bar{t}s(x_\ell(0,x'))} < \bar{t}(1-s(x_{LT}))\frac{y_{LT}}{1-\bar{t}+\bar{t}s(x_{LT})}$$

recalling that $x_\ell(0,x')$ is the solution to the leader's problem in the main model when the anti-leader state of the world. This holds, for example, if $s(x_\ell(0,x'))$ is large relative to $s(x_{LT})$, and would seem to hold in the Russian case, where the gentry have a strong hold in the peasantry during serfdom but have their property expropriated after the reforms (at x_{LT}).

These pieces exemplify precisely how a "divide-the-dollar" land-reform arrangement can serve as a foundation for the preferences of the leader in the model and how these preferences align with features of the 1861 Russian reforms.

External Information Revelation

Proposition 5. *Suppose η increases. Then, $\underline{q}$ decreases and $\overline{q}$ increases. Fixing x', the leader plays the learning trap for fewer values of q.*

Proof. The objective of an unconstrained problem here here can be written as:

$$\max_{x\in[0,1]} \frac{2\sigma(1-\delta)u_\ell(x)+\delta((1-\eta)\Delta(x)+2\sigma\eta)\Psi(q)}{2\sigma(1-\delta)+\delta((1-\eta)\Delta(x)+2\sigma\eta)}$$

The numerator of the derivative can be expressed as:

$$
\begin{aligned}
=&\big(2\sigma(1-\delta)+\delta(1-\eta)\Delta(x)+2\sigma\delta\eta\big)\big(2\sigma(1-\delta)u_\ell'(x)+\delta(1-\eta)\Delta'(x)\Psi(q)\big)\\
&-\delta(1-\eta)\Delta'(x)\big(2\sigma(1-\delta)u_\ell(x)+\delta\big((1-\eta)\Delta(x)+2\sigma\eta\big)\Psi(q)\big)\\
=&4\sigma^2(1-\delta)^2u_\ell'(x)+2\sigma\delta(1-\delta)(1-\eta)\big(\Delta(x)u_\ell'(x)+\Delta'(x)\Psi(q)-\Delta'(x)u_\ell(x))\big)\\
&+2\sigma\delta\eta\big(2\sigma(1-\delta)u_\ell'(x)+\delta(1-\eta)\Delta'(x)\Psi(q)-(1-\eta)\Delta'(x)\Psi(q)\big)\\
=&4\sigma^2(1-\delta)^2u_\ell'(x)+2\sigma\delta(1-\delta)(1-\eta)\big(\Delta(x)u_\ell'(x)+\Delta'(x)\Psi(q)-\Delta'(x)u_\ell(x))\big)\\
&+4\sigma\delta(1-\delta)\eta u_\ell'(x)
\end{aligned}
$$

For $x > x_{LT}$, the derivative is negative, replicating a previous lemma, if:

$$2\sigma(1-\delta)u_\ell'(x)+2\sigma\delta\eta u_\ell'(x) \le \delta(1-\eta)\xi\big(u_\ell(x)-u_\ell'(x)(x-x_{LT})-\Psi(q)\big)$$

where $\underline{q}$ is the unique point that solves this equation with equality. For each x, the LHS is increasing in η and the RHS is decreasing in η. This means that as η increases from 0, $\underline{q}$ shifts to the left. The equation defining $\overline{q}$ can be written as:

$$2\sigma(1-\delta)u_\ell'(x)+2\sigma\delta\eta u_\ell'(x) = \delta(1-\eta)\xi\big(\Psi(\overline{q})-\big(u_\ell(x)-u_\ell'(x)(x-x_{LT})\big)\big)$$

An increase in η likewise causes the LHS to increase and RHS to decrease, causing $\overline{q}$ to increase. $\square$

Three States of the World

This section shows robustness of this paper's fundamental insight on leaders' policies to three states of the world by establishing a version of Lemma 6. Analogues of Proposition 1 or Theorem 1 are difficult to work with because $\text{NR}(q, x')$ is hard to pin down.

The three states of the world are described as follows

$$\begin{aligned} f_g(x) &\qquad y_t = \beta_g - (x_t - \tilde{x}_g)^2 + \epsilon_t \\ f_m(x) &\qquad y_t = \beta_m - (x_t - \tilde{x}_m)^2 + \epsilon_t \\ f_b(x) &\qquad y_t = \beta_b - x_t^2 + \epsilon_t \end{aligned}$$

for $\tilde{x}_g > \tilde{x}_m \in (0,1]$ and $\epsilon_t \sim \mathcal{U}[-\sigma,\sigma]$ in all cases, as earlier. We assume $f_i(x) - f_j(x)$ each single-cross at some x_{LT}^{ij} for all $i \neq j$. Examples are graphed below.

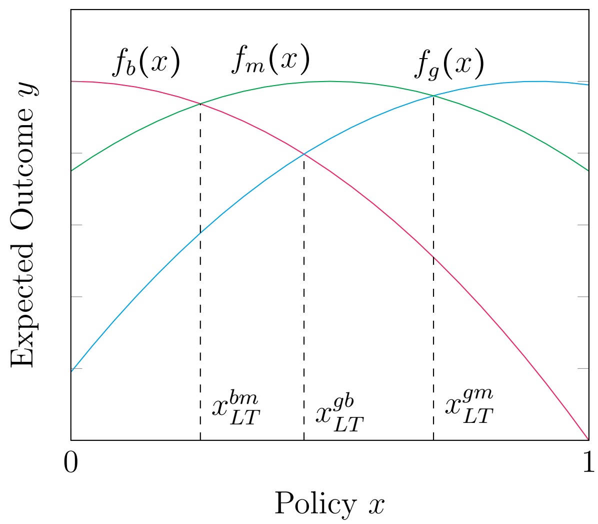

Figure 6: $f_g(x)$, $f_m(x)$, and $f_b(x)$ graphed

Our state variables are q_g (belief that g holds) and q_m (belief that m holds) and we fix $q_g, q_m > 0$ and $q_g + q_m < 1$ for the remainder of the analysis. Beginning at a vector of states (q_g, q_m), we can write the following expected values of the problem, as well as the probabilities with which they occur (which are all functions of x).

- V^{gmb}: initial value of the problem at (q_g, q_m).
- V^g: value of problem if g is true; $(q_g, q_m) \to (1, 0)$; occurs with prob. p_g. Solution is denoted x_ℓ^g.

- V^m: value of problem if m is true; $(q_g, q_m) \to (0,1)$; occurs with prob. p_m Solution is denoted x_ℓ^m.

- V^b value of problem if b is true; $(q_g, q_m) \to (0,0)$; occurs with prob. p_b. Solution is denoted x_ℓ^b.

- V^{gb} value of problem if only m is not true; $(q_g, q_m) \to (\frac{q_g}{1-q_m}, 0)$; occurs with prob. p_{gb}

- V^{gm} value of problem if only b is not true; $(q_g, q_m) \to (\frac{q_g}{q_g+q_m}, \frac{q_m}{q_g+q_m})$; occurs with prob. p_{gm}

- V^{mb} value of problem if only g is not true; $(q_g, q_m) \to (0, \frac{q_m}{1-q_g})$; occurs with prob. p_{mb}

Each of these probabilities can be computed explicitly in terms of the beliefs and x; for example, $p_g(x)$ is given by $q_g \cdot \frac{|f_g(x)-f_b(x)|}{2\sigma} \cdot \frac{|f_g(x)-f_m(x)|}{2\sigma}$.

We assume that $x_\ell^b < x_{LT}^{gb} < x_\ell^g$ and $x_\ell^b < x_{LT}^{mb} < x_\ell^m$. Fixing $1 - q_m - q_b$, suppose the difference between $V^b = u_\ell(x_\ell^b)$ and $V^m = u_\ell(x_\ell^m)$ is sufficiently large. Applying Lemma 6 shows:

- $V^{gb} = x_{LT}^{gb}$: suppressing the risk of information revelation that could reveal b as true, the leader will choose a "pairwise" learning trap x_{LT}^{gb}

- $V^{mb} = x_{LT}^{mb}$: suppressing the risk of information revelation that could reveal b as true, the leader will choose a "pairwise" learning trap x_{LT}^{mb}

This gives us the following result:

Proposition 6. *Suppose the following: $q_g, q_m > 0$ and $q_g + q_m < 1$; the leader's policies are constrained if g, m, or b are revealed as true but can otherwise play any policy in x_ℓ^b, x_ℓ^g; and V^b is sufficiently small. Then, the leader either implements a learning trap policy x_{LT}^{gb} or x_{LT}^{mb}.*

Proof. The proof for this result is intuitive. Replicating earlier arguments, the leader's problem can be written as a convex combination of flow and continuation values:

$$V^{gmb} = \max_x \frac{(1-\delta)u_\ell(x) + \delta\big(p_g V^g + p_m V^m + p_b V^b + p_{gb} V^{gb} + p_{gm} V^{gm} + p_{mb} V^{mb}\big)}{(1-\delta) + \delta\big(p_g + p_m + p_b + p_{gb} + p_{gm} + p_{mb}\big)}$$

$$V^{gmb} = \max_x \frac{(1-\delta)u_\ell(x) + \delta\big(p_g V^g + p_m V^m + p_b V^b + p_{gb} x_{LT}^{gb} + p_{gm} V^{gm} + p_{mb} x_{LT}^{mb}\big)}{(1-\delta) + \delta\big(p_g + p_m + p_b + p_{gb} + p_{gm} + p_{mb}\big)}$$

Since we assume V^b is sufficiently small, the leader will do anything in its power to suppress revealing that b is true, i.e. will try its best to set $p_b = 0$. p_b is expressed as:

$$p_b = (1 - q_g - q_m)\frac{|f_g(x) - f_b(x)|}{2\sigma} \cdot \frac{|f_m(x) - f_b(x)|}{2\sigma}$$

With probability $1 - q_g - q_m$, b is true. Then, with probability $\frac{|f_g(x)-f_b(x)|}{2\sigma}$, state b is separable from state g and with probability $\frac{|f_g(x)-f_b(x)|}{2\sigma}$ it is separable from state m. Because the left and right derivatives of p_b are always nonzero, the only way to set p_b equal to zero is either to set $f_g(x) = f_b(x)$ by playing x_{LT}^{gb}, or to set $f_m(x) = f_b(x)$ by implementing x_{LT}^{mb}. The option that is chosen will depend on the parameters of the model (precise beliefs and values of x_{LT}^{gb} and V^m). $\square$

The fundamental insight is that a leader, when faced with a threat of future overthrow, will *always* be attracted to a moderate policy that shuts down information revelation about b.

More subtly, the terminal history of the model always reduces to one or two states of the world . Suppose the leader implements x_{LT}^{gb}, allowing information revelation only about whether $\{g, b\}$ or $\{m\}$ is true. In the former case, we arrive at the baseline two-state model. On the equilibrium path, uncertainty is resolved only when upon revelation of states to which the leader is not highly averse.