

Violence, Coercion and Settler Colonialism*

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Abstract

Previous game-theoretic analyses of the settlement of the United States assume that Indigenous peoples and settler colonizers either engaged in free exchange or total war for land. We reframe the model to consider that violence, including coercion, was present in most of their interactions; that is, we allow for the settler colonizer to engage in coercion to strategically lower their appropriation costs for Indigenous peoples' lands. We find that the settler strategically uses violence to pay less in exchanges for Indigenous peoples' lands. In addition, we examine how uncertainty, about whether an agreement can ensure the avoidance of all-out conflict, affects initial violence and resistance. We find that the likelihood of all out-conflict affects settler violence and it critically depends on whether the Indigenous people can seek compensation.

Keywords: Settler colonialism, coercion, violence, game theory

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1 Introduction

The settler-colonial project in the United States (US) has perpetrated violence against Indigenous peoples from its origin.¹ In economic assessments of the interactions between Indigenous peoples and settler colonizers, the structural violence of settler colonialism remains formally under-addressed. Moreover, the connections between the manifestations of the structural violence in that time and its manifestations today are under-studied in the discipline. There exist no formal game-theoretic analyses considering that structural power imbalances subvert equitable economic interactions between Indigenous peoples and the US settler state.

In our paper, we utilize game theory to address the following question: How does coercion influence initial settler-colonial violence, Indigenous resistance, and compensation in land exchanges? Similar to Anderson and Mc Chesney (1994), we focus upon the strategic behavior of settlers and Indigenous peoples during the settlement of what is now known as the US. However, we incorporate, with a formal theoretic approach, what Kades (2000) discusses: that a range of strategic coercive tactics were employed by colonizers belonging to “the regime of efficient expropriation” of Indigenous peoples’ lands in what became the US. He argues further that these tactics were employed to undermine free exchange. To our knowledge, this study is the first game-theoretic analysis of US settlement to formally consider that the settler-colonizers’ actions before land exchanges strategically undermine consent.

The economic literature that our paper relates to is the theoretic conflict literature including, for example, analyses such as Hirshleifer (1988), Powell (2002), and Acemoglu et al. (2012).² However, the most closely related economic analysis to our own is Anderson and

¹The US government’s relations with Indigenous peoples are dominantly exploitative, extractive and coercive (see Grande (2015, pp.30)). As, Benson (2020) discusses, “coercion is a form of violence.” Even when interactions avoided outright war, they are often characterized by inherent structural violence.

²See Kimbrough et al. (2017) for a review of these and other conflict models in economics.

Mc Chesney (1994); they employ game theory to demonstrate that the evolution of the level of violence between US settlers and Indigenous peoples can be exclusively explained by economic incentives. Aside from Anderson and Mc Chesney (1994), our paper is the only formal game-theoretic analysis to examine the levels of violence between the US settler state and Indigenous peoples. In contrast to Anderson and Mc Chesney (1994), however, we are not primarily concerned with determining whether economic costs and benefits can predict when land exchanges will devolve into outright battles for the land. Instead, we are concerned with the violence and coercive tactics preceding negotiation for the land. Similar to Hirshleifer (1988), though using a different approach in a unique context, we allow for coercion to be present even when all-out conflict or war is avoided. Hirshleifer (1988) and many of the analyses that followed in the conflict literature in economics use the “guns versus butter” type models, but we instead focus on the appropriative efforts exclusively. We incorporate a similar concept of coercion to that described by Powell (2013) and modify its manifestation in our model to adapt it to our question. We also provide some understanding of the “trigger of conflict,” in the context of exchanges between a settler-colonial regime and Indigenous people, that Kimbrough et al. (2017) discuss is an avenue for contribution in models of conflict.

We draw from a multitude of disciplines³ by infusing our economic analysis of the interactions between the US settler-colonial institution and Indigenous peoples with terms and considerations for coercion and power. A specific and critical understanding that we maintain is that settler colonialism is a persisting societal structure.⁴ Dunbar-Ortiz (2014a)

³These include Indigenous studies, critical ethnic studies, anthropology, sociology, history, critical geography and settler-colonial studies, to name some. We do so in recognition of the understanding that leaving systemic discrimination unacknowledged in economic theory, and so the policies it informs, at best undermines any efforts to eliminate structural inequality and often contributes to policies that enact further harm.

⁴Settler colonialism is, according to Rowe and Tuck (2017) “The specific formation of colonialism in which people come to a land inhabited by (Indigenous) people and declare that land to be their new home...[it] is about the pursuit of land, not just labor or resources...[and] is a persistent societal structure, not just a historical event or origin story for a nation-state.” A key feature of settler colonialism, as Wolfe (2006) identifies it, is its, “logic of elimination.” As Wolfe (2006) states, “Settler colonialism destroys to replace...[it] is

provides historical analysis and concludes that, “the history of the US is a history of settler colonialism.” By directly addressing that the formation and maintenance of the US settler state is characterized by coercion, we address a critical and formally unconsidered dynamic in game-theoretic analyses of US settlement. In doing so, we follow Arruda (2016)’s prescription for economics to directly name and address axes of oppression.

Economics is well-suited to examining certain components of settler colonialism. This is in part due to settler colonialism centrally concerning the strategic acquisition of land. Even where it is not the primary focus of economic analysis, it is critical that settler colonialism, and its persisting inequitable consequences, be acknowledged in the discipline. Kendi (2016) demonstrates in his analysis of US history, that self-interest, including economic self-interest, begets racially discriminatory policies that lead to the formation of racist ideas. McCoy (2014) provides a land education analysis of settler colonialism that describes how in Jamestown, Virginia, US, economic self-interest lead to a policy of removal of Indigenous peoples and ultimately to correspondingly problematic ideology. Anderson and Mc Chesney (1994) conclude that economic incentives can explain why battles occurred during US settlement. Similar to all of these analyses, we find that economic self-interest can be a sufficient catalyst for violence against Indigenous peoples, even when land is exchanged without resorting to all-out war. Our paper is the only game-theoretic analysis to incorporate understandings of settler colonialism and to consider that violence was employed even in the interactions between the settler state and Indigenous peoples that avoided outright seizure of the land. K-Sue Park (2015) traces the legacy of conquest in the US, including settler colonialism, and describes how it endures in US legal institutions. Using a game-theoretic

an inclusive, land-centred project that coordinates a comprehensive range of agencies, from the metropolitan centre to the frontier encampment, with a view to eliminating Indigenous societies.” The importance of the logic of elimination to settler colonialism is perhaps most intuitive when one considers its most simplified form; namely, “settler society required the practical elimination of the natives in order to establish itself on their territory” (Wolfe, 2006). For additional details, other helpful sources include: Allen (2019), Arruda (2016), Benson (2020), Brown-Perez (2017), Dunbar-Ortiz (2014a), Kendi (2016), McLaren (2015), K-Sue Park (2015), and Rowe and Tuck (2017).

approach, we similarly consider that the system of settler colonialism continues to influence interactions today.

We examine a complete-information sequential-move game of a representative interaction between a settler-colonial regime and Indigenous people wherein the settlers seek to acquire the Indigenous people group's land. We include a structural power imbalance in the model and allowances for the US settler-colonial state to coerce the Indigenous people group with whom they interact. The structure of the game consists of four main stages: first, the settlers arrive upon the land of the Indigenous people and engage in some level of violence against them; second, the Indigenous people group resists that violence; third, the settler government proposes a compensation offer for the land; and fourth, the Indigenous people group decides whether to accept or reject the offer. If they reject the offer, the interaction escalates to all-out conflict over the land whereby there exists a probability that either side will succeed. In a benchmark case we analyze the context in which there is no coercion or resistance (e.g., the first and second stage are removed). We also examine what occurs when the stages for compensation are eliminated. Lastly, we include an extension of the game that incorporates uncertainty that accepting the terms of exchange prevents all-out conflict. This extension permits the examination of the effect that uncertainty may have on initial settler-colonial violence against Indigenous peoples.

Our results indicate that the settler colonizers utilize violence to reduce the amount that they have to compensate Indigenous peoples in land exchanges. This aligns with Kades (2000)'s argument that the US strategically undermined voluntary exchange to facilitate least-cost expropriation of Indigenous peoples' land; specifically, it is in accord with the assertion in Kades (2000) that the colonial regime primarily engaged in threats and weakening of Indigenous peoples by systematic settlement (resulting in among other things, thinning of game and spreading of disease) in order to acquire their lands in a cost-effective manner.⁵

⁵Kades (2000) provides as examples several legal policies and "discounting policies" that encouraged this strategic settlement (e.g., the policies of "compact settlement," "the rectangular survey system," and the

As Veracini (2011) explains, “Colonialism is primarily defined by exogenous domination. It thus has two fundamental and necessary components: an original displacement and unequal relations.” Our paper reflects that it is essential in a game-theoretic analysis of US settlement to discuss the implications of the unequal distribution of power between players and to acknowledge, like Banner (2007) emphasizes, that even when land is exchanged without outright battle, it is critical to consider coercion and power. By expanding the choices of the settler state to allow for coercion, our findings call into question whether consent was possible surrounding many of the land exchanges between Indigenous peoples and settlers. This result further provides a lens with which to view current structural violence maintained in interactions between the US government and Indigenous peoples in, for example, legal settlements (K-Sue Park, 2015). We discuss several historical examples in order to contextualize the comparative statics that correspond with our equilibrium outcomes. For example, we provide discussion of historical events that correspond with the results indicating that settler violence is decreasing in the marginal cost of settler violence and increasing in the marginal cost of Indigenous resistance.

Another main result of this analysis is that a land exchange between a settler colonizer and Indigenous people is more likely to avoid all-out conflict if the benefit from the land for the Indigenous people is lower. This is also true if the monetary benefit of the land for the settler, the economic dependence of the Indigenous people on settler society, the costs of all-out conflict, and initial settler violence are higher (all else equal in each respective case). This provides an additional perspective to consider when speculating about the factors contributing to the increase in all-out conflicts as US settlement reached further west. While Anderson and Mc Chesney (1994) consider that it is likely that differing institutional

Homestead Acts) that “enhanced the spread of endemic diseases and thinned game rapidly.” Additionally, Kades (2000) discusses the devastating effects of game-thinning at the frontier and particularly refers to multiple Indigenous people groups for whom the depletion of game was an explicit strategy employed by the colonizers and/or mentioned by the Indigenous people as harmful. Those Indigenous peoples specifically referred to include: the Mohegan, the Cherokee, the Choctaws, and the Piankashaws.

structures between Indigenous peoples living in the east versus the west (e.g., purportedly poorly defined property rights of certain Indigenous peoples) drove the increase in formal battles between settlers and Indigenous peoples, our finding offers additional points of consideration. For example, we find that if an Indigenous people is linked more closely with the land, then this triggers more initial settler violence which could partially explain the increase in explicit conflicts. Another possible driver could be that the settlers may have had a relatively lower capacity to make the Indigenous peoples more economically dependent upon settler institutions in those exchanges where conflict escalated.

We also find that in the presence of uncertainty concerning whether agreement prevents all-out conflict, the effect on settler's violence depends on the presence of compensation. For instance, if settler violence is low enough that the Indigenous people receives compensation, settler violence is decreasing in the likelihood of all-out conflict. This is explained by the fact that when the interaction descends into all-out conflict, then the Indigenous people will not receive the agreed upon compensation.

Section 2 contains the descriptions of the basic structure of the game and the two specific versions of the game (with and without coercion), along with a brief reporting of their respective results. In Section 3, we extend the coercion game to incorporate that a representative for an Indigenous people accepting settler compensation does not guarantee the avoidance of all-out conflict over the land. Finally, Section 4, consists of a summative conclusion for the entire analysis.

2 Model

We examine a complete-information sequential-move game with representative players for an Indigenous people and a settler-colonizing group.^{6,7} The foundational model is a simplified representation of the interaction between these two groups in the context of the formation of the settler colonial state of the US; specifically, our analysis focuses upon the engagement between the two groups immediately preceding a settler colonial regime’s attempt at land acquisition. The model, in addition to providing insights for that particular context, can also be understood to represent a structural game between a settler-colonial agent and Indigenous people in more general contexts. This section focuses on the engagement between the two wherein the settler colonizer attempts to facilitate appropriation of an Indigenous people’s land (either by exchange or attempted forced removal). In this section, we assume that neither group contains individuals who deviate from the representatives’ strategies; however, in Section 3 we consider the setting where even when the representatives for each group agree to exchange land without all-out conflict, the interaction might descend to it anyways.⁸

Upon arrival to the land of the Indigenous people, the settler colonizer has incurred travel costs, T , where $T \in (0, \infty)$, and chooses the level of initial violence, denoted by $\lambda \in [1, \infty)$, to enact against them. In addition to physical violence, this variable is composed of other documented methods of coercion⁹ enacted against Indigenous peoples such as threats and

⁶Though for simplicity we often refer to the settler-colonizing power with whom the Indigenous people group interacts as the settler colonizer or simply the settler, this is shorthand for the entirety of the US settler-colonial project (including the government, militias, and individual settlers, etc.) To emphasize that this unified settler-colonizing coalition is composed of many actors pursuing a common goal, we assign the coalition “they/them” pronouns. This understanding of a collusive project rather than just a government is important for our analysis as it emphasizes the structural nature of settler colonialism.

⁷To begin to address the questions central to our paper, we consider that individuals within the settler coalition and Indigenous people group, respectively, were unified in their actions and decision-making (allowing for us to consider a representative for each group). This allows for us to focus on the conflict between the two groups primarily without yet adding the complexity of within-group discrepancies.

⁸We include this extension to acknowledge that the settler government did not often control individual settlers well, and sometimes depended on their disobedience with official policy in order to maintain the appearance of innocence while still acquiring land in a low-cost manner.

⁹Settler-colonial violence both includes physical violence and is also more than that. Dunbar-Ortiz (2014b, p. 8) explains, “Settler colonialism, as an institution or system, requires violence or the threat of violence to

strategically disruptive settlement to prevent access to food and spread disease (for more details see Kades (2000) and Dunbar-Ortiz (2014a)). If the settler colonizer intends to take the land for themselves, then their level of initial violence¹⁰ falls anywhere between passive disruption (e.g., $\lambda = 1$) and the most explicitly violent expression of expropriation of the Indigenous people group’s land that they are capable of (e.g., $\lambda \rightarrow \infty$). The Indigenous people then chooses the level of resistance, $R \in [0, \infty)$, to mount in response to the violence. Similar to the scope of actions belonging to settler initial violence, the Indigenous people’s resistance includes more than physical retaliation; for the Indigenous people, it encompasses a myriad of actions that not only ensure their physical but also cultural survival.

We consider that the settler offers compensation, $M \in [0, \infty)$, to the Indigenous people group from whom they wish to take the land.¹¹ Finally, the Indigenous people group chooses to either accept or reject the compensation offer, M , in light of the initial levels of settler-colonial violence,¹² λ . If the Indigenous people accepts the offer, then the land is exchanged and the game ends.¹³ Given that the Indigenous people accepted the terms of the exchange, they leave and no longer receive the benefit, denoted by B , of living with the land¹⁴ from

attain its goals...In employing the force necessary to accomplish its goals, a colonizing regime institutionalizes violence.”

¹⁰We extend upon the work done by Anderson and Mc Chesney (1994) by considering that settlers can choose from a continuum of violence, rather than a binary choice of “raid or trade.” We refrain from characterizing settler-colonial violence as a dichotomous variable to align with the consensus that it would be an oversimplification that erases meaningful aspects of the interactions between the settler-colonial state and Indigenous peoples (Rider, 1993; Kades, 2000; Banner, 2007).

¹¹Primarily, the US held monopsonistic power to purchase Indigenous lands. This was generally true across two dimensions; namely, the US through “Johnson v. M’intosh” and preemption, successfully precluded individual settlers and European powers, respectively, from presenting competing offers for Indigenous lands. See Wolfe (2006) and Kades (2000) for more detailed discussions. Note that this game similarly assumes that a single Indigenous people group was the sole seller, or monopoly, for the land in consideration. Thus, as suggested by Kades (2000), the game is reduced to a bilateral monopoly.

¹²To reflect the documented fact that the mere presence of settlers was harmful to Indigenous peoples, the only way that the settler colonizer can avoid causing harm in this game is if they leave before trespassing upon the land and make no compensation offer, M and λ are completely removed; if they were to do this, then the game ends and the settler colonizer has for their payoffs only accrued the cost of traveling, T .

¹³Though bargaining could in fact across occur multiple stages, we limit our analysis to a one-shot ultimatum negotiation to maintain the focus of the analysis upon the strategic initial violence and resistance before exchange.

¹⁴We use the word “with” to honor that for Indigenous peoples land is more than a resource to be exploited (see, for example, Rowe and Tuck (2017)). We acknowledge that we are all in relation with the land, though

which they are now removed, where $B \in (0, \infty)$.¹⁵ Meanwhile, the settler colonizer receives the monetary value V , where $V \in (0, \infty)$. If the Indigenous people rejects the offer, then the interaction immediately escalates to all-out conflict, or war, over the land between the two groups. As a result of the all-out conflict, they face additional costs; the Indigenous people and the settler face costs Q and L , respectively, where $Q, L \in (0, \infty)$. Though our analysis is primarily concerned with the behavior of the Indigenous people and settler coalition leading up to exchange, along with the terms of that exchange (or rejection of it), we include these fixed costs to reflect that all players recognize that all-out conflict involves costs even beyond the risk it involves.¹⁶

If the Indigenous people rejects the compensation offer and the interaction escalates to all-out conflict, then the probability that the settler colonizer succeeds in forced removal of the Indigenous people from their land is p ; correspondingly, the probability of failure is $1 - p$, where $p \in [0, 1]$. Beyond the likelihood of succeeding in explicit forced removal of the Indigenous people, we include several other parameters that influence the Indigenous people group’s decision to accept or reject the settler colonizer’s offer. For instance, γ represents the economic dependence of the Indigenous people on the settler society; it reflects how much the Indigenous people values settler compensation, where $\gamma \in [0, 1]$. If the Indigenous people considers settler compensation to be completely without value, then $\gamma = 0$. Conversely, if they are wholly economically dependent on settler institutions, then $\gamma = 1$. Furthermore, c_S and c_I represent the marginal costs of engaging in violence and resistance for the settler and Indigenous people, respectively. In addition to it being costly for the settler colonizer to

for some (e.g., the settler colonizer) that relationship is restricted “to the relationship of the owner to his property” (Tuck and Yang, 2012).

¹⁵By creating this parameter for the Indigenous people group, we again aim to draw attention to the distinction between the settler colonial view of land as something to be exploited for profit and Indigenous peoples’ relationships with the land. Namely, that settlers viewed land as real estate and Indigenous peoples view land as sacred (Dunbar-Ortiz, 2014a, p. 54).

¹⁶The levels of violence and resistance associated with the actual attempted explicitly forced removal of the Indigenous people (strategic choices during an all-out conflict between the two groups) are outside the scope of our paper. The focus in our paper are the actions immediately preceding the negotiation that could collapse into such an event.

be violent, it becomes more costly when the Indigenous people group resists their violence. Another important parameter that we include is that which accounts for the intrinsic ability of the Indigenous people group to resist, β , where $\beta \in (0, \infty)$ and will for the remainder of the analysis be referred to as resilience.¹⁷ Relatedly, the environmental damage, denoted by D where $D \in (0, \infty)$, is an additional factor that the Indigenous people must face; this parameter represents existing and exogenous environmental damage not generated by the settler coalition's violence in this interaction. We include this to emphasize that harm is increasing in the existing environmental damage (e.g., generated by other, or previous, settler groups excluded from this interaction).¹⁸

The payoff for the Indigenous people group, if they lose their land and accept the settler colonizer's compensation, is expressed as follows

$$\pi_I^{accept} = \gamma M - H(\lambda, R) - C_I(R). \quad (1)$$

The first term represents the effective value of settler compensation, the second term is the harm they endure, and the third term is the cost of resisting settler violence. Notice that the benefit from the land for the Indigenous people, B , is missing from this function. Its absence reflects the loss of the benefit of living with the land for the Indigenous people when they accept compensation and are removed. The harm borne by the Indigenous people group is specified as

¹⁷We include this parameter to capture factors that make an Indigenous people more or less able to resist settler-colonial violence. Among many others, these include factors such as how reliant an Indigenous people is on game for sustenance, their degree of reliance upon Indigenous trade roots, which were commonly seized by settlers (for more details see Dunbar-Ortiz (2014a, p. 41)), the structure of their society, fighting tactics, ability to maintain alliances with other Indigenous nations, and geographical attributes.

¹⁸This parameter also emphasizes the importance of the land, environment, for the Indigenous people; given their relationship with the land, their wellbeing is interwoven with its own. In addition, we acknowledge that other settler coalitions generated conditions that amplified violence, without adding them as separate actors in our model.

$$H(\lambda, R) = \frac{D}{\beta} \times \frac{\lambda}{R}. \quad (2)$$

This function represents an addition cost for Indigenous people through their loss of their ability to subsist and persist into the future as a people. Note that the harm function is increasing in the level of the harmful actions taken by the settler colonizer, $H_\lambda > 0$, and environmental damage, $H_D > 0$.¹⁹ In addition, the harm to the Indigenous people group is decreasing in their resilience, $H_\beta < 0$ and their chosen level of resistance, $H_R < 0$. The cost function for the Indigenous people is

$$C_I(R) = \frac{c_I}{\beta} \times R, \quad (3)$$

which is increasing in the level of Indigenous resistance and decreasing in resilience. If instead the Indigenous people group rejects the settler colonizer's offer, then the Indigenous people's expected payoff is given by

$$\pi_I^{reject} = p[-H(\lambda, R) - C_I(R) - Q] + [1 - p][B - H(\lambda, R) - C_I(R) - Q]. \quad (4)$$

Equation 4 represents the expected payoff that the Indigenous people receives if they reject the settler's compensation offer. The first term represents the expected payoff the Indigenous people receive if they lose their land and the second term is the expected payoff from winning the conflict and remaining on the land. When the Indigenous people rejects, there exists probability $1 - p$ that they prevail in all-out conflict and so continue to receive the benefit, B , of living with the land. The settler's payoff, if their offer is accepted, is

$$\pi_S^{accept} = V - M - C_S(\lambda, R) - T, \quad (5)$$

¹⁹Where H_x denotes the first derivative of the harm function with respect to x .

which represents the valuation of the land by the settler, less compensation and costs.²⁰ If instead the Indigenous people group rejects the settler colonizer’s compensation offer, then their expected payoff is

$$\pi_S^{reject} = p[V - C_S(\lambda, R) - T - L] + [1 - p][-C_S(\lambda, R) - T - L], \quad (6)$$

where the first term is the probability that the settler prevails in all-out conflict over the land multiplied by the valuation of the land less the costs of their attempt to seize it. The second term is the product of the probability that the settler loses in war over the land and the costs they face. The settler coalition faces the following costs associated with their initial violence and Indigenous resistance

$$C_S(\lambda, R) = c_S \times \left(\frac{\lambda}{D} + \beta \times R^2 \right). \quad (7)$$

Note that a higher environmental damage reduces the settler’s cost, however, their cost increases in effective Indigenous resistance.

In summary, the structure of the game is as follows: (1) the settler colonizer chooses how much to harm the Indigenous people group, λ , then (2) the Indigenous people group chooses how much to resist, R , that violence. Next, (3) the settler determines how much to offer for compensation, M , and then (4) the Indigenous people group chooses to accept or reject the offer. If they accept, then the exchange occurs. If they reject, then the two groups engage in all-out conflict over the land (see graphical representation in Appendix A.12). Finally, we incorporate a structural power imbalance by allowing for the probability that the settler colonizer succeeds in open conflict over the land to be affected by the settler colonizer’s

²⁰Note that the settler colonizer does not internalize the consequences of their actions for Indigenous peoples, as Kades (2000) discusses, “Instead of facilitating free trade that would have maximized the joint product of both societies, European settlers adopted rules that maximized their own utility, regardless of Indian welfare.”

initial violence level;²¹ that is, $p \equiv 1 - \frac{1}{\lambda}$. Recall from the previous discussion that this violence, λ , is a composite term in the sense that it is made up of all of the documented ways that settler colonizers diminish Indigenous peoples' ability to engage in truly voluntary exchange. Consequently, if settler violence leading up to the offer of compensation is extremely high, $\lambda \rightarrow \infty$, then the probability that the settler wins in outright conflict over the land is one. We next obtain the subgame perfect Nash equilibria (SPNE) using backward induction.

Stage 4: The Indigenous people accepts or rejects settler compensation.

We begin by analyzing the circumstances wherein the Indigenous people group accepts the settler's compensation offer and forfeits their land.

LEMMA 1. *The conditions that induce the Indigenous people to accept exchange are the following:*

(i) when $\lambda < \frac{B}{Q}$ (Case 1):

$$M \geq \frac{B - Q\lambda}{\gamma\lambda}; \quad (8)$$

(ii) when $\lambda \geq \frac{B}{Q}$ (Case 2):

$$M \geq 0. \quad (9)$$

In our analysis, we consider that the benefit provided by the land for the Indigenous people is strictly greater than their cost of all-out conflict ($B > Q$) to focus upon those cases wherein the Indigenous people might have incentives to reject settler compensation. In the scenario where initial settler violence, λ , is sufficiently low (Case 1), an acceptable offer for the Indigenous people increases in the benefit they receive from the land. They accept less,

²¹Skaperdas (1992) also uses the win probability to reflect agents' respective power. The simplification we maintain for this analysis is that only the settler-colonial regime may directly influence the probability of winning in all-out conflict. We include the structural power imbalance to incorporate the discussions in, for example, Anderson and Mc Chesney (1994) and Banner (2007); they discuss that the settler colonial power possessed certain structural advantages in comparison to Indigenous peoples (e.g., military might). We do so in this way in lieu of further complicating the model.

however, if they value settler currency more (e.g., the economic dependence parameter, γ , is higher), or if the initial violence, λ , enacted by the settler increases (all other variables held constant). This relationship, taken in conjunction with the fact that settler payoffs are strictly decreasing in M , lends additional insight into why the settler strategically increases initial violence even when they seek to avoid direct seizure of Indigenous land; namely, they are violent to reduce the value of the offer that an Indigenous people would be willing to accept.

When settler initial violence exceeds the ratio of the benefit of living with the land to the cost of all-out conflict for the Indigenous people (Case 2), the Indigenous people will accept an offer with zero value; that is, the cost of all-out conflict or initial settler violence is so high that the Indigenous people chooses to leave for no compensation rather than resort to all-out conflict. This again shows the strategic benefit to the settler of being initially violent in order to obtain the land.

Stage 3: The settler colonizer offers compensation.

The settler colonizer must determine whether it is optimal to induce acceptance, and will do so if and only if the following holds:

$$\pi_S^{accept} \geq \pi_S^{reject}. \quad (10)$$

That is, the condition that the settler's profits must be greater under acceptance than under rejection must hold to motivate the settler colonizer to provide an acceptance-inducing offer, which we discuss below (considering cases 1 and 2 from Lemma 1).

LEMMA 2. *The settler colonizer induces acceptance if:*

(i) *Case 1:*

$$V \geq \frac{B - \lambda(\gamma L + Q)}{\gamma}; \quad (11)$$

(ii) *Case 2 : the settler induces acceptance for all admissible parameter values.*

In Case 1, a higher settler valuation of the land is required for the settler to make an acceptable offer if the Indigenous people is deeply connected to the land (e.g., higher value for B). However, the condition for the settler to induce acceptance is less restrictive if either group's cost of all-out conflict (L and/or Q) increases. Similarly, the condition is less restrictive if the Indigenous people is more dependent upon settler compensation (e.g., when the Indigenous people is more dependent upon the settler's economic system). Furthermore, when the settler is more initially violent toward the Indigenous people, the land needs to be less valuable for exchange of the land to be profitable to the settler. If, however, the settler enacts initial violence in the range indicated in Case 2, the Indigenous people will forfeit the land to avoid all-out conflict. That is, with sufficiently high levels of initial violence, the settler can force the Indigenous people to need to avoid all-out conflict so desperately that they require no payment to leave the land for the settler (refer also to Lemma 1). In this scenario, any positive settler valuation of the Indigenous people's land would be sufficient incentive to induce "acceptance".

Stage 2: The Indigenous people chooses a resistance level.

Upon experiencing the violence enacted by the settler colonizer, the Indigenous people chooses a resistance level.

LEMMA 3. *For all admissible parameter values, the Indigenous people's best-response resistance function is:*

$$R(\lambda) = \left(\frac{D}{c_I} \times \lambda \right)^{\frac{1}{2}}. \quad (12)$$

Intuitively, the Indigenous people's best-response resistance is increasing in settler violence, environmental damage and decreasing in their cost of resisting. In addition, regardless of the state of the world and whether the settler colonizer induces acceptance (in Case 1 or

Case 2) or rejection, the Indigenous people maintains the same best-response function. Next, we examine the first stage of the game in which the settler chooses a level of violence.

Stage 1: The settler colonizer chooses a violence level.

Internalizing the aforementioned conditions and best-response resistance, the settler colonizer determines the optimal level of violence to engage in. The following proposition presents the SPNE of the game..

PROPOSITION 1. *The equilibrium actions taken by the settler colonizer and Indigenous people group are:*

(i) *under acceptance Case 1:*

$$\hat{\lambda}^* = \left[\frac{BDc_I}{\gamma X} \right]^{\frac{1}{2}}, \hat{R}^* = \left[\frac{BD^3}{\gamma c_I X} \right]^{\frac{1}{4}}, \text{ and } \hat{M}^* = \gamma^{-1} \left[\sqrt{\frac{\gamma BX}{c_I D}} - Q \right],$$

where

$$X \equiv c_S(c_I + \beta D^2) \text{ and } Q < \sqrt{\frac{\gamma BX}{c_I D}};$$

(ii) *under acceptance Case 2:*

$$\tilde{\lambda}^* = \frac{B}{Q}, \tilde{R}^* = \sqrt{\frac{BD}{c_I Q}}, \text{ and } \tilde{M}^* = 0;$$

(iii) *under rejection:*

$$\bar{\lambda}^* = \left[\frac{VDc_I}{X} \right]^{\frac{1}{2}}, \bar{R}^* = \left[\frac{VD^3}{c_I X} \right]^{\frac{1}{4}}, \bar{M}^* = 0.$$

We discuss some of the implications of these results in the remainder of our analysis. The strategic benefit that the settler colonizer obtains when they harm the Indigenous people before making the offer comes from two avenues: (1) as shown in Lemma 1, the Indigenous people is willing to accept a lower compensation when they are confronted with higher settler

violence before the offer is made and (2) their initial violence conveys a higher probability of success to the settler in the event that the Indigenous people rejects and the interaction escalates to all-out conflict. That is, settler violence makes it cheaper to acquire the land by compensation and conveys more favorable odds if they engage in all-out conflict. The structural advantages that the settler enjoys in this game inherently contribute to the widespread use of violence against the Indigenous people. Consider also that in two of the three equilibria the settler offers no compensation to the Indigenous people for their land, which is historically precedented. Finally, the settler chooses to settle rather than leave if the cost of all-out conflict for the Indigenous people is sufficiently high and the cost of all-out conflict for the settler is sufficiently low (see the Proof of Proposition 1 in the Appendix for more details).

For comparison, we make simplifications to the general structure of the game to outline a benchmark game wherein it is impossible for the settler to extort the Indigenous people. Specifically, we remove the capacity for the settler colonizer to harm the Indigenous people (Stage 1) and the ability of the Indigenous people to resist (Stage 2); the settler colonizer can only offer compensation, M , for the land and must allow the Indigenous people group to freely choose to accept or reject the offer. It is valuable for interpretation of the main game to understand what the exchange may look like under the aforementioned structurally different circumstances. The conclusions of this benchmark game are presented in the following corollary.

COROLLARY 1. If we remove the possibility of violence and resistance, then the settler will offer the acceptable compensation level, $M^ = \frac{B}{\gamma}$, to the Indigenous people if and only if $V \geq \frac{B}{\gamma}$.*

Therefore, the settler only makes an offer in this benchmark game if its valuation, V , of the land is greater than the benefit received by the Indigenous people group for that land, B , divided by the weight, γ , that the Indigenous people assigns to the settler's compensation

offer, M . The more the Indigenous people depends economically upon the settler-colonizer's compensation, the lower the valuation that the settler needs in order to justify making an acceptable offer. Conversely, if the land is more important to the Indigenous people, the settler's valuation of the land must be higher for it to be worthwhile to the settler to make an acceptable compensation offer. The next related question we address is whether the settler compensates the Indigenous people more under acceptance²² in the game without coercion.

LEMMA 4. *The Indigenous people is compensated weakly more without coercion ($M^* \geq \hat{M}^*$) if*

$$Q \geq \sqrt{\frac{B\gamma X}{c_I D}} - B.$$

The settler compensates the Indigenous people more in the game without coercion when the cost of all-out conflict for the Indigenous people is as high as indicated in Lemma 4.²³ In addition to evaluating the game without coercion, we examine the game without the stages containing the proposal and acceptance or rejection of the compensation offer. We do this to acknowledge that the settler may do away with all pretense of seeking the consent of the Indigenous people before trying to take their land. In this setting, the interaction always goes to all-out conflict.

COROLLARY 2. *The setting without the compensation offer results in the equilibrium associated with rejection in the full game.*

In this complete information setting wherein the settler has the intention of stealing the land from the beginning, then the Indigenous people and settler choose resistance and violence levels that correspond with the central game's rejection equilibrium.

²²We consider only acceptance Case 1 for this comparison given that it is the only acceptance equilibrium in the central game with strictly positive compensation. This implies that the condition will be the most demanding.

²³When the marginal cost of settler violence is sufficiently low, $c_S \leq \frac{Bc_I D}{\gamma(c_I + D^2\beta)}$, then the Indigenous people always receives better compensation when coercion is prohibited.

2.1 Comparative Statics

To begin, we briefly discuss the comparative statics for acceptance Case 2. Immediately following this discussion, we focus upon the comparative statics associated with the Case 1 and rejection equilibrium levels of settler violence, Indigenous resistance, and acceptable compensation.²⁴

In acceptance Case 2, initial settler violence increases in the benefit of the land to the Indigenous people and decreases in their cost of all-out conflict. The same relationships are maintained in this equilibrium's resistance level. In addition to these, Indigenous resistance is decreasing in the marginal cost of resisting and increasing in environmental damage. Lemma 5 contains the comparative statics for Case 1 acceptance and rejection.

LEMMA 5. *The equilibrium levels of violence and resistance (under acceptance and rejection), and acceptable compensation respond in the following ways:*

- (i) *the settler colonizer's violence increases (decreases) in the cost of resistance for the Indigenous people group and, if $D < \sqrt{\frac{c_I}{\beta}}$, in environmental damage (cost of violence for the settler colonizer, Indigenous resilience, and economic dependence, respectively);*
- (ii) *Indigenous resistance decreases in the cost of resistance, the settler colonizer's cost of violence, Indigenous resilience, and economic dependence, but increases in environmental damage;*
- (iii) *compensation increases (decreases) in the cost of violence and Indigenous resilience (cost of resistance, in economic dependence if $Q < \frac{1}{2}\sqrt{\frac{\gamma BX}{c_I D}}$, and, if $D < \sqrt{\frac{c_I}{\beta}}$, environmental damage, respectively).*

In Table 1, we summarize the results described in Lemma 5. The comparative statics for settler violence and Indigenous resistance hold if the settler induces acceptance or rejection

²⁴Settler profits evaluated in equilibrium Case 1 are strictly greater than those in Case 2.

Table 1: Comparative Statics

	Settler Violence	Indigenous Resistance	Acceptable Compensation
Marginal Cost of Indigenous Resistance, c_I	+	-	-
Marginal Cost of Settler Violence, c_S	-	-	+
Indigenous Resilience, β	-	-	+
Environmental Damage, D	+*	+	-*
Economic Dependence, γ	-	-	-**

* if $D < \sqrt{\frac{c_I}{\beta}}$

** if $Q < \frac{1}{2}\sqrt{\frac{\gamma BX}{c_I D}}$

(regardless of which equilibrium prevails). In addition, the results for compensation only pertain to acceptance given that if the settler wishes to induce rejection they offer no compensation. In order to connect our findings to documented events, we provide Table 2, which contains a sample of the examples included in our discussion that follows.

Table 2: Connections to Comparative Statics

Comparative Statics	Examples
Settler Violence Increasing in the Marginal Cost of Indigenous Resistance	Sand Creek Massacre
Resistance Decreasing in the Marginal Cost of Indigenous Resistance	Sand Creek Massacre, The Seminole Nation
Indigenous Resistance is Decreasing in Indigenous Resilience	Iroquois Confederacy and the Continental Army
Settler Violence Decreasing in the Marginal Cost of Violence	James Carleton's treatment of Navajo

We next discuss the comparative statics for which we include examples in Table 2 in the order that they appear in the table. Therefore, we begin with the finding indicating that settler violence is increasing in the marginal cost of resistance. A horrific example²⁵

²⁵Despite the fact that the specific examples provided throughout our paper are not exact replicas of the central model we consider, they are indicative of the structural objective of the settler-colonial regime, which does correspond generally with the model. That is, these historical examples fit within a structural game

of extreme unprovoked violence being exacted upon Indigenous peoples who had already endured sustained violence and could no longer resist enough (e.g., increased marginal cost of resistance), given the conditions that they were subjected to, is the Sand Creek Massacre. Dunbar-Ortiz (2014a, p. 137) explains that:

[D]isplaced and captive Cheyennes and Arapahos...incarcerated in a US military reservation called Sand Creek...camped under a white flag of truce...[were] on November 29, 1864...[w]ithout provocation or warning...attacked [by seven hundred Colorado Volunteers], leaving dead 105 women and children and 28 men.

The circumstances that the Cheyenne and Arapaho peoples were subjected to not only harmed them, but also forced them into a uniquely bad situation for defending themselves. The marginal cost of resistance is very high, for example, in the face of hunger and exhaustion. They were isolated, not prepared for attack, and their group consisted of mostly women and children. The Sand Creek Massacre highlights the dangerous equilibrium effects of an increase in the marginal cost of Indigenous resistance. In this circumstance, an increased marginal cost of resistance was related with settler violence escalating and Indigenous resistance diminishing to a devastating level.

In addition to providing insight into the circumstances that made the Sand Creek Massacre so devastating, the comparative static indicating that an Indigenous people's resistance is decreasing in the marginal cost of resisting could also lend insight to Indigenous peoples who have historically resisted settlement more successfully. An example of such a people is the Seminole Nation,²⁶ who, as described by Dunbar-Ortiz (2014a, pp. 101–102):

was born of resistance...never sued for peace, were never conquered...never signed a treaty with the United States, and although some were rounded up and sent in 1832 to Oklahoma, where they were given a land base, the Seminole Nation has never ceased to exist in the Everglades.

Their resistance is especially distinctive given that the US waged three wars against the

that the settler-colonial regime is playing with Indigenous peoples wherein the objective is to acquire land at the lowest cost possible.

²⁶The Seminole Nation in the US, contained both self-liberated Africans and survivors of previously destroyed Indigenous communities (Dunbar-Ortiz, 2014a, pp. 101).

Seminole Nation, the second of which, “was the longest foreign war waged by the United States up to the Vietnam War” (Dunbar-Ortiz, 2014a, p. 101). Part of their relative success is attributed to the guerrilla tactics they employed that increased their effectiveness at resisting (e.g., decreased marginal cost of resisting) settler violence (for more details see Dunbar-Ortiz (2014a, p. 101)). That is, perhaps they were able to provide relatively more resistance given their increased effectiveness at resisting settlers.

Another result contained in Lemma 5 is that resistance is decreasing in the Indigenous people’s resilience; that is, as their resilience increases, the optimal level of resistance decreases given that they would need less to achieve the same goals. This is not to say that they do not resist, but rather that the less vulnerable they are, the lower levels of additional resistance they need to engage in to limit harm. An example demonstrating the importance of including resilience in the model is the stark difference in the resistance success between the Cherokee Nation and the Haudenosaunee (Six Nations Iroquois) surrounding the time of the Revolutionary War. In this example, unity seems to be a primary contributor to resilience. The British and separatist settlers sought alliances with these Indigenous nations to aid in their own conflicts. Dunbar-Ortiz (2014a, p. 74) describes, “Despite constant attacks on its villages and crops, and with refugees and disease, the enormous Cherokee Nation remained intact with a well-functioning government.” Settlers’ extreme violence and cruelty, “caused them to be despised and spurred some Cherokees to take sides against them...separatists quickly announced their determination to destroy the Cherokee Nation.” Despite settlers’ total war campaign against the Cherokee Nation, they were unsuccessful in removing them from their land until close to 50 years after the US won their independence (Dunbar-Ortiz, 2014a, p. 76). In contrast, the Haudenosaunee were split in the alliances they forged (some forged alliances with the British, some remained neutral, and one made an alliance with the settlers), and so, “With the Iroquois confederacy disunited regarding the war, the Continental Army forces were practically unimpeded in their triumphal and deadly march...[and]

civil war erupted within the Iroquois Confederacy itself' (Dunbar-Ortiz, 2014a, p. 77).

Our result that the equilibrium level of settler violence is decreasing in the marginal cost of enacting the violence is reflected in the following scenario. Dunbar-Ortiz (2014a, pp. 138–139) describes the acts of then US Army brigadier general James Carleton, who:

With unlimited authority and answering to no one...spent the entire Civil War in the Southwest engaged [leading the Colorado Volunteers] in a series of search-and-destroy missions against the Navajos...and in 1864 in a three-hundred mile forced march of eight thousand Navajo civilians to a military concentration camp...At least a fourth of the incarcerated died of starvation. Not until 1868 were the Navajos released and allowed to return to their homeland...This permission was not based on the deadly conditions of the camp, rather that Congress determined that the incarceration was too expensive to maintain.

In contrast to the Sand Creek Massacre, where violence increased to its most extreme expression and did not abate, in this example the very high violence levels were lowered and so a complete massacre was avoided; this eventual reduction, despite the devastatingly weakened state of the Navajos who had endured the march and incarceration, occurred explicitly because the settler regime determined that those additional levels of violence were too costly (e.g., increased marginal cost of violence).

Now we provide additional examples for the results observed in Lemma 5. Though they are not included in Table 2 specifically, there are connections that we can draw to those examples and that we can understand more intuitively. For instance, the comparative static indicating that resistance is decreasing in the marginal cost of settler violence. In a sense, equilibrium resistance is more necessary if the costs to the settlers of enacting violence are relatively low, which is demonstrated by the example above. This, along with the comparative static that indicates settler violence is decreasing in the cost of enacting violence, reflects the necessity that Indigenous peoples faced when confronted with a settler colonizer that found it relatively cheap to be violent.

Resistance is similarly decreasing in economic dependence upon settler institutions; this implies that if the Indigenous people necessarily values settler compensation relatively more,

then they will lower their resistance levels. This could lend some insight into the strategic benefit of a favored settler-colonial practice of disrupting game patterns and Indigenous trade routes, as Dunbar-Ortiz (2014a, p. 41) summarizes anthropologist Henry Dobyns, “the ensuing acute shortages, including food products, weakened populations and forced them into dependency on the colonizers, with European manufactured goods replacing Indigenous ones.” In the context of this analysis, these behaviors directly reduce the compensation that the settler state must offer Indigenous peoples.

In regard to the changes in optimal acceptable compensation, we find that it increases in the cost of violence and decreases in the cost of resistance. Therefore, the need for Indigenous resistance is integrally related to both their harm reduction and reception of better compensation in exchanges. The comparative statics also indicate that the optimal levels of violence, resistance, and compensation when the settler colonizer induces acceptance are all increasing in the benefit that the Indigenous people group receives from living with the land. If the settler colonizer induces rejection, then the optimal values of violence and resistance are both increasing in the settler valuation of the land. In the following section, we extend the model to allow for uncertainty that agreeing to the terms of exchange prevents all-out conflict.

3 Uncertainty of All-Out Conflict Avoidance

In this extension, we allow for uncertainty that accepting the terms of exchange unfailingly prevents all-out conflict over the land. Sources of this uncertainty include dissenting individuals belonging to the Indigenous people, violent settler squatters, and overt failure of the settler coalition to honor their agreements.²⁷ For example, in the late 18th century, even

²⁷The United States employed a version of “divide and conquer” within tribes as well as among them’ (Kades, 2000) by creating and exploiting intra-group disunity (Kades, 2000; Dunbar-Ortiz, 2014a); therefore disagreements within the Indigenous people could certainly lead to all-out conflict, especially if certain members refused settler removal (as, for example, described in Dunbar-Ortiz (2014a, p. 91), was the case

after the settler government negotiated an agreement with the Muskogee Nation, squatters violently undermined it (Dunbar-Ortiz, 2014a, p. 90). The settler government did very little to remove settlers squatting on Indigenous lands; in fact, despite the squatters extremely violent practices, the government set a precedent of protecting them, seeking ultimately to preserve their reputation with settlers in order to continue to acquire Indigenous land (Kades, 2000).

Therefore, squatters belonging to the settler colonial coalition contributed to the uncertainty that an agreement to exchange would avoid all-out conflict. In addition to the problem of squatters, earlier agreements were often blatantly disregarded and undermined by the settler government. For example, President Andrew Jackson did not honor previous treaties with Indigenous peoples and instead violently forced them from their land. Therefore, in this extension, we acknowledge that officially unsanctioned violence from squatters and violent settler refusal to honor treaties can lead to all-out conflict even if the Indigenous people agrees to an exchange; given the ostensibly unplanned (on the part of the negotiators) source of this uncertainty, we incorporate it not as an endogenous strategy, but rather as exogenous probability, $\theta \in (0, 1)$, that all-out conflict might occur even if representatives of each group reach an exchange agreement. Given that we maintain the complete information setting, this probability is known by both the settler coalition and Indigenous people. In order to reflect this extension, the acceptance payoffs for both the settler and Indigenous people incorporate the probability. The expected payoff for the Indigenous people associated with acceptance is

$$\tilde{\pi}_I^{accept} = (1 - \theta) \pi_I^{accept} + \theta \pi_I^{reject}. \quad (13)$$

The first term represents the expected payoff of the Indigenous people when the settler coalition for the Muskogee and the Choctaw nations (Kades, 2000)). Therefore, for simplicity and to acknowledge that settler strategy was the central driver of such uncertainty, in this section we interpret the possibility of violence after agreement to stem from the settler coalition.

tion honors the agreement and refrains from all-out conflict; the second term is the expected payoff associated with a breakdown of the agreement and hence contains the Indigenous people's expected payoff of rejection. Relatedly, the expected profit of acceptance for the settler is

$$\tilde{\pi}_S^{accept} = (1 - \theta) \pi_S^{accept} + \theta \pi_S^{reject}. \quad (14)$$

We consider that both groups face the same uncertainty. That is, even if an agreement is reached, their representatives do not know if that agreement will be respected. The settler coalition is uncertain that the agreement will be honored by their own people. Stages 4 and 3 lead to the same conditions as they did in the previous section, so we will next only discuss Stages 2 and 1, respectively.

Stage 2: The Indigenous people group chooses a resistance level.

Upon experiencing the violence enacted by the settler colonizer, the Indigenous people resists. However, in this version of the game the Indigenous people also understands that all-out conflict might occur even if they accept the terms of exchange.

LEMMA 6. *The Indigenous people's best-response resistance function is:*

(i) *Acceptance Case 1 and Rejection*

$$R(\lambda) = \left(\frac{D}{c_I} \times \lambda \right)^{\frac{1}{2}}; \quad (15)$$

(ii) *Acceptance Case 2*

$$\tilde{R}(\lambda) = \frac{D\sqrt{3\lambda^3}}{\beta\sqrt{B\theta + \lambda(D\lambda - \theta Q)}}. \quad (16)$$

As before, the Indigenous people's best-response resistance (for rejection and acceptance Case 1) is increasing in the initial violence they endure and decreasing in their cost of resisting. In Case 2, their best-response resistance is increasing in settler violence depending

upon the range of initial violence and existing level of environmental damage.

Stage 1: The settler colonizer chooses a violence level.

The settler chooses the optimal level of violence to engage in. In the following proposition, we present the results of this modified game.

PROPOSITION 2. *The equilibrium actions taken by the settler colonizer and Indigenous people group are:*

(i) *under acceptance Case 1*

$$\lambda_{A1}^* = \left[\frac{c_I D ([1 - \theta] B + \gamma \theta V)}{\gamma X} \right]^{\frac{1}{2}}, \quad R_{A1}^* = \left[\frac{D^3 ([1 - \theta] B + \gamma \theta V)}{c_I \gamma X} \right]^{\frac{1}{4}}, \quad \text{and}$$

$$M_{A1}^* = \left[\frac{B^2 X}{c_I \gamma D ([1 - \theta] B + \gamma \theta V)} \right]^{\frac{1}{2}} - \frac{Q}{\gamma}$$

(ii) *under acceptance Case 2*

$$\lambda_{A2}^* = \underset{\lambda}{\operatorname{argmax}} \left\{ \frac{1}{\beta} \left[\frac{3\theta c_s (BD\lambda + B\theta Q - \theta\lambda Q^2)}{B\theta + \lambda(D\lambda - \theta Q)} - \frac{\lambda c_s (\beta + 3D^2)}{D} - \theta(\beta L + 3Qc_s) \right] \right.$$

$$\left. - T - V \left[1 - \frac{\theta}{\lambda} \right] \right\},$$

$$R_{A2}^* = \frac{\sqrt{3} D \lambda_{A2}^{*3/2}}{\beta \sqrt{B\theta + \lambda_{A2}^* (D\lambda_{A2}^* - \theta Q)}}, \quad \text{and } M_{A2}^* = 0$$

(iii) *under rejection*

$$\lambda_R^* = \left[\frac{V D c_I}{X} \right]^{\frac{1}{2}}, \quad R_R^* = \left[\frac{V D^3}{c_I X} \right]^{\frac{1}{4}}, \quad M_R^* = 0.$$

To illustrate how initial violence and Indigenous resistance in acceptance cases 1 and 2 change as the probability that all-out conflict occurs despite acceptance increases, we include

Figure 1 below.²⁸ Acceptance Case 1 violence and resistance are decreasing in the likelihood that agreement does not prevent all-out conflict. In Case 2, however, the more likely it is that acceptance fails to prevent all-out conflict, the settler is more initially violent, and in response the Indigenous people resists more. A primary difference between acceptance in Case 1 and Case 2 is that the settler must pay compensation (if the agreement is maintained and all-out conflict is avoided) in the former while the settler does not pay compensation in the latter. It is only in Case 1 that an increase in the likelihood that all-out conflict occurs after agreement makes it less likely that the settler will have to compensate the Indigenous people. Recall that compensation in Case 1 is strictly decreasing in settler violence; therefore, as it becomes more likely that the settler will not need to provide any compensation (as θ increases), the strategic value of initial violence diminishes. This is likely the driver for the negative relationship between violence and the probability of unplanned all-out conflict in Case 1.

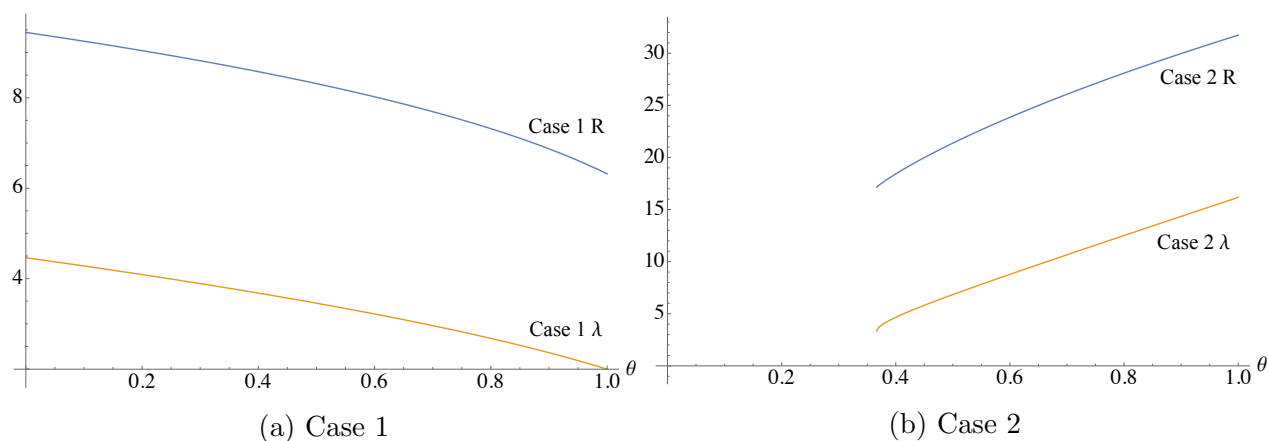


Figure 1: Violence and Resistance

To consider whether uncertainty about an agreement's ability to prevent all-out conflict leads to higher levels of initial settler violence and lower levels of compensation, we compare the related results under acceptance Case 1 between this extension and the central game.²⁹

²⁸We consider the following case for Figure 1: $B = 100, Q = 90, D = 10, \beta = 1, V = 40, c_s = \frac{1}{2}, \gamma = \frac{1}{2}, c_I = \frac{1}{2}$.

²⁹The rejection equilibrium in the game with the probability of all-out conflict under acceptance remains

The results are presented in the following lemma.

LEMMA 7. *In acceptance Case 1, initial settler violence (compensation) is higher (lower) in the game where there exists some possibility of all-out conflict under acceptance if $V \geq \frac{B}{\gamma}$.*

This condition implies that as the settler assigns a greater value to Indigenous land, it becomes increasingly likely that they offer lower compensation and are more initially violent towards the Indigenous people in the setting with uncertainty of all-out conflict.

4 Conclusion

In this paper, we consider a context characterized by a structural power imbalance and the violence of settler colonialism. We do so by developing a model that directly addresses a central component of settler colonialism, the strategic and violent dispossession of Indigenous peoples of their land so that the settler society can establish itself. We consider that the settler-colonial methods of appropriation involved a continuum of coercion, rather than applying a framework where free exchange or all-out conflict are the only possible equilibria. By allowing for coercion in the interaction between an Indigenous people and settler-colonial regime, we critically examine whether authentic consent is possible in exchanges where these dynamics are maintained. We further extend the model to allow for uncertainty that agreement prevents all-out conflict. In doing so, we gain insights into the strategic interactions central to both the founding of the US settler-colonial state and to ongoing exchanges between Indigenous peoples and the US settler-colonial state.

We find that the settler-colonial coalition uses violence before exchanges with Indigenous peoples to appropriate their land at a lower cost. Additionally, we demonstrate that reducing the marginal cost of an Indigenous people's resistance can both bolster their resistance and

the same as the one without. This is because the probability of all-out conflict affects only the acceptance equilibria. For acceptance Case 2, we consider sets of possible parameter values and discuss them later in the analysis.

result in reductions to equilibrium settler violence. Lastly, we find that settler violence, when initial settler violence is so high that the Indigenous people leaves their land without compensation, increases in the likelihood of all-out conflict despite agreement.

There are a number of extensions of our paper that can continue characterizing the interactions between Indigenous peoples and settlers. For example, it would be beneficial to consider a setting in which Indigenous peoples do not have full understanding of the settler's capacity for violence (information asymmetry) or a context in which these two groups engage in several rounds of negotiation (repeated-game setting). Understanding these historical interactions helps to identify an inequitable negotiation process that Indigenous peoples still endure. This critical analysis, in conjunction with others, can help to alert economists and other policy shapers to the manifestations and consequences of settler colonialism. From this awareness, acknowledgement of and healing changes to systems and policies in the US can grow.

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A Appendix

A.1 Proof of Lemma 1

The Indigenous people group chooses to accept the settler colonizer's offer if the value of accepting the offer is greater than the expected value of rejecting the offer and allowing negotiations to break down. That is, they accept the offer, M , if and only if $\pi_I^{accept} \geq \pi_I^{reject}$.

This implies:

$$\gamma M - \frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R \geq (1-p) \left(B - \frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R - Q \right) + p \left(-\frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R - Q \right). \quad (17)$$

Upon rearranging (and substituting in the equation for p), it follows that:

$$\gamma M - \frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R \geq \left(1 - 1 + \frac{1}{\lambda} \right) B - \frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R - Q. \quad (18)$$

which yields

(i) If $\lambda < \frac{B}{Q}$

$$M \geq \frac{B - Q\lambda}{\gamma\lambda}; \quad (19)$$

(ii) If $\lambda \geq \frac{B}{Q}$

$$M \geq 0. \quad (20)$$

To consider both of these cases, for the remainder of the analysis we consider that $B > Q$.

A.2 Proof of Lemma 2

The settler colonizer induces acceptance (given that $B > Q$) if

$$\pi_S^{accept} \geq \pi_S^{reject}, \quad (21)$$

which implies

$$V - M - c_S \times \left(\frac{\lambda}{D} + \beta \times R^2 \right) - T \geq pV - c_S \times \left(\frac{\lambda}{D} + \beta \times R^2 \right) - L - T. \quad (22)$$

Rearranging and substituting in the expression for acceptable M and p , it follows that:

(i) If $\lambda < \frac{B}{Q}$

when $0 < L < \frac{B - \lambda Q}{\gamma \lambda}$

$$V \geq \frac{B - \gamma \lambda L - \lambda Q}{\gamma}; \quad (23)$$

when $L \geq \frac{B - \lambda Q}{\gamma \lambda}$ then all admissible values lead the settler to induce acceptance.

(ii) If $\lambda \geq \frac{B}{Q}$, then the settler induces acceptance for all admissible parameter values.

A.3 Proof of Lemma 3

The Indigenous people group chooses how much to resist, R , the settler colonizer's initial violence, λ . There are two cases to consider.

Acceptance

Case 1

If $\lambda < \frac{B}{Q}$, and acceptance is induced ($M = \frac{B - \lambda Q}{\gamma \lambda}$), it implies that the Indigenous people faces this scenario:

$$\max_R \left[\gamma \times \frac{B - \lambda Q}{\gamma \lambda} - \frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R \right] \quad (24)$$

Simplifying, it becomes:

$$\max_R \left[\frac{B}{\lambda} - \frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R - Q \right] \quad (25)$$

Finding the first-order condition with respect to R yields

$$\frac{\partial \pi_I^{accept}}{\partial R} = \frac{D\lambda}{\beta R^2} - \frac{c_I}{\beta} = 0, \quad (26)$$

and solving for R we obtain

$$R(\lambda) = \sqrt{\frac{D}{c_I} \times \lambda}. \quad (27)$$

Case 2

If $\lambda \geq \frac{B}{Q}$, and acceptance is induced ($M = 0$), it implies that the Indigenous people faces this scenario:

$$\max_R \left[-\frac{c_I}{\beta} \times R - \frac{D\lambda}{\beta R} \right] \quad (28)$$

Finding the first-order condition with respect to R yields

$$\frac{\partial \pi_I^{accept}}{\partial R} = \frac{c_I R^2 + D\lambda}{\beta R^2} - \frac{2c_I}{\beta} = 0, \quad (29)$$

and solving for R we obtain

$$R(\lambda) = \sqrt{\frac{D}{c_I} \times \lambda}. \quad (30)$$

Rejection

When rejection is induced ($M = 0$), the Indigenous people is confronted with this choice:

$$\max_R \left[(1-p)B - \frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R - Q \right] \quad (31)$$

Upon substitution and simplification, it becomes:

$$\max_R \left[\frac{B}{\lambda} - \frac{D\lambda}{\beta R} - \frac{c_I}{\beta} \times R - Q \right] \quad (32)$$

Finding the first-order condition with respect to R yields

$$\frac{\partial \pi_I^{reject}}{\partial R} = \frac{D\lambda}{\beta R^2} - \frac{c_I}{\beta} = 0, \quad (33)$$

and solving for R we obtain:

$$R(\lambda) = \sqrt{\frac{D}{c_I}} \times \lambda. \quad (34)$$

Therefore, in all scenarios, the Indigenous people group maintains the same best response function.

A.4 Proof of Proposition 1

The settler colonizer chooses the level of initial violence to enact against the Indigenous people group, internalizing their resistance best-response functions. There are two cases to consider.

Acceptance

Case 1

If $\lambda < \frac{B}{Q}$, then the settler colonizer solves the following maximization problem:

$$\max_{\lambda} \left[V - M - c_S \times \left(\frac{\lambda}{D} + \beta \times R(\lambda)^2 \right) - T \right]. \quad (35)$$

Recall that in acceptance Case 1 the settler sets $M = \frac{B - \lambda Q}{\gamma \lambda}$ (see Lemma 1), which implies:

$$\max_{\lambda} \left[V - \frac{B - \lambda Q}{\gamma \lambda} - c_S \times \left(\frac{\lambda}{D} + \beta \times R(\lambda)^2 \right) - T \right]. \quad (36)$$

Substituting in the Indigenous people group's best-response function for R (see Lemma 3)

further implies:

$$\max_{\lambda} \left[V - \frac{B - \lambda Q}{\gamma \lambda} - c_S \times \left(\frac{\lambda}{D} + \beta \times \left[\sqrt{\frac{D}{c_I} \times \lambda} \right]^2 \right) - T \right]. \quad (37)$$

Simplifying the above expression yields

$$\max_{\lambda} \left[V - \frac{B - \lambda Q}{\gamma \lambda} - c_S \lambda \left(\frac{1}{D} + \frac{D\beta}{c_I} \right) - T \right], \quad (38)$$

and finding the first-order condition with respect to λ we obtain

$$\frac{\partial \pi_S^{accept}}{\partial \lambda} = \frac{B}{\gamma \lambda^2} - c_S \left(\frac{D\beta}{c_I} + \frac{1}{D} \right) = 0. \quad (39)$$

Solving for λ , we obtain

$$\hat{\lambda}^* = \left[\frac{BDc_I}{\gamma X} \right]^{\frac{1}{2}}, \text{ where} \quad (40)$$

$$X \equiv c_S(c_I + \beta D^2) \text{ and } Q < \sqrt{\frac{\gamma BX}{c_I D}};$$

Substituting (40) into (27) and (19), respectively, yields

$$\hat{R}^* = \left[\frac{BD^3}{\gamma c_I X} \right]^{\frac{1}{4}} \text{ and} \quad (41)$$

$$\hat{M}^* = \gamma^{-1} \left[\sqrt{\frac{\gamma BX}{c_I D}} - Q \right]. \quad (42)$$

Where $M > 0$ when $Q < \sqrt{\frac{\gamma BX}{c_I D}}$.

Case 2

From Lemma 3 we have that $\tilde{M}^* = 0$ and the settler chooses the least costly violence level that induces acceptance, i.e., $\tilde{\lambda}^* = \frac{B}{Q}$. Using (30) we obtain that $\tilde{R}^* = \sqrt{\frac{BD}{c_I Q}}$. Therefore

the Case 2 equilibrium values are:

$$\tilde{\lambda}^* = \frac{B}{Q}, \tilde{R}^* = \sqrt{\frac{BD}{c_I Q}}, \text{ and } \tilde{M}^* = 0.$$

Rejection

In the case of rejection, if $\lambda < \frac{B}{Q}$ and the settler chooses $\overline{M}^* = 0$ given that in this SPNE they induce rejection, then the settler colonizer solves the following maximization problem:

$$\max_{\lambda} \left[pV - c_S \times \left(\frac{\lambda}{D} + \beta \times R(\lambda)^2 \right) - L - T \right]. \quad (43)$$

Substituting in the Indigenous people group's best response function implies:

$$\max_{\lambda} \left[\left(1 - \frac{1}{\lambda} \right) V - c_S \times \left(\frac{\lambda}{D} + \beta \left[\sqrt{\frac{D}{c_I} \times \lambda} \right]^2 \right) - L - T \right]. \quad (44)$$

Finding the first-order condition with respect to λ , we obtain

$$\frac{\partial \pi_S^{reject}}{\partial \lambda} = \frac{V}{\lambda^2} - c_S \times \left(\frac{1}{D} + \frac{\beta D}{c_I} \right) = 0. \quad (45)$$

Solving for λ , we obtain

$$\bar{\lambda}^* = \left[\frac{VDc_I}{X} \right]^{\frac{1}{2}}. \quad (46)$$

Using (34) and (46), we obtain

$$\bar{R}^* = \left[\frac{VD^3}{c_I X} \right]^{\frac{1}{4}} \quad (47)$$

Next, we show that equilibrium settler profits in acceptance Case 1 are strictly greater than those in acceptance Case 2 for all parameter values. This is true if and only if:

$$V - \hat{M}^* - c_S \left(\frac{\hat{\lambda}^*}{D} + \beta \hat{R}^{*2} \right) - T \geq V - c_S \left(\frac{\tilde{\lambda}^*}{D} + \beta \tilde{R}^{*2} \right) - T,$$

which holds for all admissible parameter values. We make a similar comparison to determine when equilibrium settler profits of acceptance Case 1 are greater than those in rejection. This requires:

$$V - \hat{M}^* - c_S \left(\frac{\hat{\lambda}^*}{D} + \beta \hat{R}^{*2} \right) - T \geq \left(1 - \frac{1}{\bar{\lambda}^*} \right) V - c_S \left(\frac{\bar{\lambda}^*}{D} + \beta \bar{R}^{*2} \right) - L - T.$$

For this condition to hold, it must be true that

$$L \geq \frac{2V \left(\sqrt{\frac{B\gamma c_i^5 D c_S}{\beta D^2 + c_I}} + \beta^2 \sqrt{\frac{B\gamma c_I D^9 c_S}{\beta D^2 + c_I}} + 2\beta \sqrt{\frac{B\gamma c_I^3 D^5 c_S}{\beta D^2 + c_I}} \right) - 2\gamma \left(\beta \sqrt{c_I D^5 V^3 X} + \sqrt{c_I^3 D V^3 X} \right)}{\gamma(\beta c_I D^3 V + c_I^2 D V)} - \frac{Q}{\gamma}.$$

That is, the cost of all-out conflict for the settler must be sufficiently high for their equilibrium profits under acceptance Case 1 to be greater than those under rejection. Next, we will determine when the equilibrium settler profits are greater under settlement than leaving without attempting settlement. In order to do this, we compare equilibrium settler profits associated first with acceptance Case 1 with those of leaving without trying to settle and then make a similar comparison with rejection settler profits and those of leaving (notice that given the settler always obtains higher profits in acceptance Case 1 than in Case 2, we only make the two aforementioned comparisons). For the acceptance Case 1 comparison, we require:

$$V - \hat{M}^* - c_S \left(\frac{\hat{\lambda}^*}{D} + \beta \hat{R}^{*2} \right) - T \geq -T,$$

which, combined with the condition on Q for this equilibrium, implies

$$\frac{2 \left(\sqrt{\frac{B\gamma c_I D c_S}{\beta D^2 + c_I}} + \beta \sqrt{\frac{B\gamma D^5 c_S}{\beta c_I D^2 + c_I^2}} \right)}{D} - \gamma V \leq Q < \sqrt{\frac{B\gamma X}{c_I D}}.$$

The rejection equilibrium settler profits are greater than those from leaving without settlement if

$$\left(1 - \frac{1}{\bar{\lambda}^*}\right) V - c_S \left(\frac{\bar{\lambda}^*}{D} + \beta \bar{R}^{*2}\right) - L - T \geq -T.$$

This requires that

$$L \leq V - \frac{2 \left(\beta \sqrt{c_I D^5 V^3 X} + \sqrt{c_I^3 D V^3 X} \right)}{\beta c_I D^3 V + c_I^2 D V}.$$

Therefore, the equilibrium rejection settler profits are greater than those from leaving if the settler cost of all-out conflict is sufficiently low.

A.5 Proof of Lemma 4

The Indigenous people is compensated weakly more without coercion ($M^* \geq \hat{M}^*$) if and only if:

$$\frac{B}{\gamma} \geq \gamma^{-1} \left[\sqrt{\frac{B\gamma c_S (c_I + \beta D^2)}{c_I D}} - Q \right] \quad (48)$$

Which further implies that

$$B \geq \sqrt{\frac{B\gamma c_S (c_I + \beta D^2)}{c_I D}} - Q, \quad (49)$$

which yields

$$Q \geq \sqrt{\frac{B\gamma c_S (c_I + \beta D^2)}{c_I D}} - B. \quad (50)$$

Additionally, note that the condition is more easily satisfied when the cost of resisting in-

creases for the Indigenous people because

$$\frac{\partial}{\partial c_I} \left(\sqrt{\frac{B\gamma c_S (c_I + \beta D^2)}{c_I D}} - B \right) = -\frac{\beta B \gamma D c_S}{2c_I^2 \sqrt{\frac{B\gamma c_S (c_I + \beta D^2)}{c_I D}}}. \quad (51)$$

A.6 Proof of Corollary 2

When the settler does not, and never intends to enter into negotiation with the Indigenous people, the interaction is most closely represented by immediate all-out conflict (i.e., the case of rejection). Therefore, the equilibrium results coincide with those of the rejection case in Proposition 1.

A.7 Proof of Lemma 5

The expressions for the comparative statics are below. As there were before, there are two cases to consider.

Acceptance

Case 1

The derivative of $\hat{\lambda}^*$ with respect to the cost of violence is negative by assumption since

$$\frac{\partial \hat{\lambda}^*}{\partial c_S} = -\frac{1}{2} \left(\frac{BDc_I}{c_S^2 \gamma X} \right)^{\frac{1}{2}} < 0. \quad (52)$$

The derivative of $\hat{\lambda}^*$ with respect to the cost of resistance is positive by assumption since

$$\frac{\partial \hat{\lambda}^*}{\partial c_I} = \frac{1}{2} \left(\frac{BD^5 \beta^2}{c_I c_S \gamma [c_I + D^2 \beta]^3} \right)^{\frac{1}{2}} > 0. \quad (53)$$

The derivative of $\hat{\lambda}^*$, violence under acceptance, with respect to β is negative by assumption

since

$$\frac{\partial \hat{\lambda}^*}{\partial \beta} = -\frac{1}{2} \left(\frac{BD^5 c_I}{c_S \gamma [c_I + D^2 \beta]^3} \right)^{\frac{1}{2}} < 0. \quad (54)$$

The derivative of $\hat{\lambda}^*$ with respect to environmental damage is positive

$$\frac{\partial \hat{\lambda}^*}{\partial D} = \frac{1}{2} \left(\frac{B c_I}{D c_S \gamma [c_I + D^2 \beta]^3} \right)^{\frac{1}{2}} \times (c_I - D^2 \beta) > 0 \quad (55)$$

if $c_I > D^2 \beta$ or $D < \sqrt{\frac{c_I}{\beta}}$.

The derivative of $\hat{\lambda}^*$ with respect to economic dependence upon settler institutions is negative by assumption since

$$\frac{\partial \hat{\lambda}^*}{\partial \gamma} = -\frac{1}{2} \left(\frac{BD c_I}{\gamma^3 X} \right)^{\frac{1}{2}} < 0. \quad (56)$$

The derivative of \hat{R}^* with respect to the cost of settler violence is negative by assumption since

$$\frac{\partial \hat{R}^*}{\partial c_S} = -\frac{1}{4} \left(\frac{BD^3}{c_S^4 c_I \gamma X} \right)^{\frac{1}{4}} < 0. \quad (57)$$

The derivative of \hat{R}^* with respect to the cost of resisting is negative by assumption since

$$\frac{\partial \hat{R}^*}{\partial c_I} = -\frac{2c_I + D^2 \beta}{4} \left(\frac{BD^3}{c_S c_I^5 \gamma [c_I + D^2 \beta]^5} \right)^{\frac{1}{4}} < 0. \quad (58)$$

The derivative of \hat{R}^* with respect to Indigenous resilience is negative by assumption since

$$\frac{\partial \hat{R}^*}{\partial \beta} = -\frac{1}{4} \left(\frac{BD^{11}}{c_S c_I \gamma [c_I + D^2 \beta]^5} \right)^{\frac{1}{4}} < 0. \quad (59)$$

The derivative of \hat{R}^* with respect to environmental damage is positive by assumption since

$$\frac{\partial \hat{R}^*}{\partial D} = \frac{1}{4} \left(\frac{3c_I + D^2 \beta}{D [c_I + D^2 \beta]} \right) \times \left(\frac{BD^3}{c_I \gamma X} \right)^{\frac{1}{4}} > 0. \quad (60)$$

The derivative of \hat{R}^* with respect to economic dependence upon settler institutions is negative

by assumption since

$$\frac{\partial \hat{R}^*}{\partial \gamma} = -\frac{1}{4} \left(\frac{BD^3}{c_I \gamma^5 X} \right)^{\frac{1}{4}} < 0. \quad (61)$$

The derivative of \hat{M}^* with respect to the cost of settler violence is below positive by assumption since

$$\frac{\partial \hat{M}^*}{\partial c_S} = \frac{1}{2\gamma c_S} \sqrt{\frac{B\gamma X}{c_I D}} > 0. \quad (62)$$

The derivative of \hat{M}^* with respect to the cost of Indigenous resistance is negative by assumption given that

$$\frac{\partial \hat{M}^*}{\partial c_I} = -\frac{\beta B D c_S}{2c_I^2 \sqrt{\frac{B\gamma X}{c_I D}}} < 0. \quad (63)$$

The derivative of \hat{M}^* , acceptable compensation, with respect to Indigenous resilience is positive by assumption since

$$\frac{\partial \hat{M}^*}{\partial \beta} = \frac{B D c_S}{2c_I \sqrt{\frac{B\gamma X}{c_I D}}} > 0. \quad (64)$$

The derivative of \hat{M}^* with respect to environmental damage is negative

$$\frac{\partial \hat{M}^*}{\partial D} = -\frac{B c_S (c_I - \beta D^2)}{2c_I D^2 \sqrt{\frac{B\gamma X}{c_I D}}} < 0 \quad (65)$$

if $c_I > D^2 \beta$ or $D < \sqrt{\frac{c_I}{\beta}}$.

The derivative of \hat{M}^* with respect to economic dependence upon settler institutions is negative by assumption since

$$\frac{\partial \hat{M}^*}{\partial \gamma} = -\frac{\sqrt{\frac{B\gamma X}{c_I D}} - 2Q}{2\gamma^2} < 0 \quad (66)$$

if $Q < \frac{1}{2} \sqrt{\frac{B\gamma X}{c_I D}}$.

The derivative of \hat{M}^* with respect to Q is negative by assumption since

$$\frac{\partial \hat{M}^*}{\partial Q} = -\frac{1}{\gamma} < 0. \quad (67)$$

Case 2

The derivative of $\tilde{\lambda}^*$ with respect to Q is negative by assumption since

$$\frac{\partial \tilde{\lambda}^*}{\partial Q} = -\frac{B}{Q^2} < 0. \quad (68)$$

The derivative of $\tilde{\lambda}^*$ with respect to B is positive by assumption since

$$\frac{\partial \tilde{\lambda}^*}{\partial B} = \frac{1}{Q} > 0. \quad (69)$$

The derivative of \tilde{R}^* with respect to Q is negative by assumption since

$$\frac{\partial \tilde{R}^*}{\partial Q} = -\frac{BD}{2\sqrt{Bc_I DQ^3}} < 0. \quad (70)$$

The derivative of \tilde{R}^* with respect to B is positive by assumption since

$$\frac{\partial \tilde{R}^*}{\partial B} = \frac{D}{2\sqrt{Bc_I DQ}} > 0. \quad (71)$$

Rejection

The derivative of $\bar{\lambda}^*$, with respect to the cost of violence is negative by assumption given

$$\frac{\partial \bar{\lambda}^*}{\partial c_S} = -\frac{1}{2} \left(\frac{VDc_I}{c_S^2 X} \right)^{\frac{1}{2}} < 0. \quad (72)$$

The derivative of $\bar{\lambda}^*$ with respect to the cost of resistance is positive by assumption since

$$\frac{\partial \bar{\lambda}^*}{\partial c_I} = \frac{1}{2} \left(\frac{VD^5\beta^2}{c_S c_I [c_I + D^2\beta]^3} \right)^{\frac{1}{2}} > 0. \quad (73)$$

The derivative of $\bar{\lambda}^*$ with respect to β is negative by assumption since

$$\frac{\partial \bar{\lambda}^*}{\partial \beta} = -\frac{1}{2} \left(\frac{VD^5 c_I}{c_S [c_I + D^2\beta]^3} \right)^{\frac{1}{2}} < 0. \quad (74)$$

The derivative of $\bar{\lambda}^*$ given a change in environmental damage is positive

$$\frac{\partial \bar{\lambda}^*}{\partial D} = \frac{1}{2} \left(\frac{V c_I}{D c_S [c_I + D^2\beta]^3} \right)^{\frac{1}{2}} \times (c_I - D^2\beta) > 0 \quad (75)$$

if $c_I > D^2\beta$ or $D < \sqrt{\frac{c_I}{\beta}}$.

The derivative of \bar{R}^* with respect to the cost of settler violence is negative by assumption since

$$\frac{\partial \bar{R}^*}{\partial c_S} = -\frac{1}{4} \left(\frac{VD^3}{c_S^4 c_I X} \right)^{\frac{1}{4}} < 0 \quad (76)$$

The derivative of \bar{R}^* with respect to the cost of resistance is negative by assumption since

$$\frac{\partial \bar{R}^*}{\partial c_I} = -\frac{2c_I + D^2\beta}{4} \left(\frac{VD^3}{c_S c_I^5 [c_I + D^2\beta]^5} \right)^{\frac{1}{4}} < 0. \quad (77)$$

The derivative of \bar{R}^* with respect to β is negative by assumption since

$$\frac{\partial \bar{R}^*}{\partial \beta} = -\frac{1}{4} \left(\frac{VD^{11}}{c_S c_I [c_I + D^2\beta]^5} \right)^{\frac{1}{4}} < 0. \quad (78)$$

The derivative of \bar{R}^* with respect to environmental damage is positive by assumption since

$$\frac{\partial \bar{R}^*}{\partial D} = \frac{1}{4} \left(\frac{3c_I + D^2\beta}{D [c_I + D^2\beta]} \right) \times \left(\frac{VD^3}{c_I X} \right)^{\frac{1}{4}} > 0. \quad (79)$$

A.8 Proof of Lemma 6

First note that Stages 4 and 3 result in the same conclusions as those in Lemma 1 and Lemma 2. The following proof concerns Stage 2 of the extension game, wherein there are two acceptance cases and one rejection under consideration.

The Indigenous people group chooses how much to resist, R , the settler colonizer's initial violence, λ . There are two cases to consider.

Acceptance

Case 1

If $\lambda < \frac{B}{Q}$, and acceptance is induced ($M = \frac{B-\lambda Q}{\gamma\lambda}$), it implies that the Indigenous people faces this scenario (where $p = 1 - \frac{1}{\lambda}$ is substituted in and the rejection expression is simplified):

$$\max_R \left[\theta \left(\frac{B}{\lambda} - \frac{c_I R}{\beta} - \frac{D\lambda}{\beta R} - Q \right) + (1 - \theta) \left(\gamma M - \frac{c_I R}{\beta} - \frac{D\lambda}{\beta R} \right) \right] \quad (80)$$

Further simplifying, it can be written:

$$\max_R \left[\frac{B}{\lambda} - \frac{c_I R}{\beta} - \frac{D\lambda}{\beta R} - Q \right] \quad (81)$$

solving for R , we see

$$R(\lambda) = \sqrt{\frac{D\lambda}{c_I}}. \quad (82)$$

Note that the above simplified maximization is now the same that yielded the previous game's rejection SPNE. Therefore, the best-response resistance function in acceptance Case 1 is the same as that associated with the previous game. Please refer to the proof of Lemma 3 for further details.

Case 2

If $\lambda \geq \frac{B}{Q}$, and acceptance is induced ($M = 0$), it implies that the Indigenous people faces this scenario:

$$\max_R \left[\frac{B\theta}{\lambda} - \frac{c_I R}{\beta} - \frac{D\lambda}{\beta R} - \theta Q \right] \quad (83)$$

The first-order condition with respect to R is

$$\frac{\partial \pi_I^{accept}}{\partial R} = \frac{\beta^2 B \theta R^2 + \lambda (D \lambda (\beta^2 R^2 - 3 D \lambda) - \beta^2 \theta Q R^2)}{\beta^3 \lambda R^4} = 0, \quad (84)$$

solving for R , we find

$$R(\lambda) = \frac{\sqrt{3} D \lambda^{3/2}}{\sqrt{\beta^2 B \theta + \beta^2 D \lambda^2 - \beta^2 \theta \lambda Q}}. \quad (85)$$

Rejection

This maximization is the same as that found for rejection in the previous case. Therefore, the best-response resistance function is the same as both acceptance Case 1 in the extension game, and the best-response resistance function for all cases in the previous game. Please refer to Lemma 3 for the details.

A.9 Proof of Proposition 2

The settler chooses the level of violence to enact against the Indigenous people group, internalizing their resistance best-response functions. Now, however, there is a probability that all-out conflict ensues despite an agreement between the settler and Indigenous people.

Acceptance

Case 1

If $\lambda < \frac{B}{Q}$, then the settler colonizer solves the following maximization problem.

$$\max_{\lambda} \left[(1 - \theta) \pi_S^{accept} + \theta \pi_S^{reject} \right]. \quad (86)$$

Substituting in the best-response resistance functions, the probability equation, and the

equation for compensation associated with this case implies:

$$\max_{\lambda} \left[\frac{\frac{B(\theta-1)}{\gamma} + \lambda \left(-\frac{\lambda X}{c_I D} + \frac{Q - \theta(\gamma L + Q)}{\gamma} - T \right) + V(\lambda - \theta)}{\lambda} \right]. \quad (87)$$

and finding the first-order condition with respect to λ we obtain

$$\frac{\partial(\cdot)}{\partial \lambda} = \frac{B(-\theta) + B + \gamma\theta V}{\gamma\lambda^2} - \frac{\beta D c_S}{c_I} - \frac{c_S}{D} = 0. \quad (88)$$

Solving for λ , we obtain

$$\lambda_{A1}^* = \left[\frac{c_I D ([1 - \theta] B + \gamma\theta V)}{\gamma X} \right]^{\frac{1}{2}}. \quad (89)$$

Substituting this result into the Indigenous people's best-response function and acceptable compensation level, respectively, implies

$$R_{A1}^* = \left[\frac{D^3 ([1 - \theta] B + \gamma\theta V)}{c_I \gamma X} \right]^{\frac{1}{4}} \text{ and} \quad (90)$$

$$M_{A1}^* = \left[\frac{B^2 X}{c_I \gamma D ([1 - \theta] B + \gamma\theta V)} \right]^{\frac{1}{2}} - \frac{Q}{\gamma}. \quad (91)$$

Case 2

If $\lambda \geq \frac{B}{Q}$, and the settler seeks to induce acceptance, then the settler colonizer solves the following maximization problem.

$$\max_{\lambda} \left[(1 - \theta) \pi_S^{accept} + \theta \pi_S^{reject} \right]. \quad (92)$$

Consider that they offer no compensation in acceptance Case 2, however, so we substitute the corresponding best-response resistance function from the Proof of Lemma 6 into the

maximization. Therefore, the maximization can be written:

$$\max_{\lambda} \left[\frac{\frac{3\theta c_S(BD\lambda + B\theta Q - \theta\lambda Q^2)}{B\theta + \lambda(D\lambda - \theta Q)} - \frac{\lambda c_S(\beta + 3D^2)}{D}}{\beta} - \frac{\theta(\beta L + 3Qc_S)}{\beta} + T - \frac{\theta V}{\lambda} + V \right]. \quad (93)$$

where the first-order condition with respect to λ is

$$\begin{aligned} \frac{\partial(\cdot)}{\partial\lambda} &= \frac{\theta V}{\lambda^2} - \frac{c_S(\beta B^2\theta^2 + B\theta\lambda(9D^3\lambda + 2\beta D\lambda - 2\beta\theta Q))}{\beta D(B\theta + \lambda(D\lambda - \theta Q))^2} \\ &- \frac{\lambda^2(D^2\lambda^2(\beta + 3D^2) - 2D\theta\lambda Q(\beta + 3D^2) + \beta\theta^2 Q^2)}{\beta D(B\theta + \lambda(D\lambda - \theta Q))^2} = 0. \end{aligned} \quad (94)$$

To illustrate the change in settler violence and Indigenous resistance with respect to the probability that agreement fails to prevent all-out conflict, we include Figure 1 (assuming $B = 100, Q = 90, D = 10, \beta = 1, V = 40, c_s = \frac{1}{2}, \gamma = \frac{1}{2}, c_I = \frac{1}{2}$).

Rejection

The rejection SPNE in this extension is the same as that in the previous game. Please refer to the Proof of Proposition 1 for more details.

A.10 Proof of Lemma 7

If equilibrium violence is higher with a possibility that agreement fails to prevent all-out conflict (in agreement Case 1), it must be true that

$$\hat{\lambda}^* \geq \lambda_A^* \quad (95)$$

Substituting the results from Propositions 1 and 2 into the above condition implies that

$$\left[\frac{BDc_I}{\gamma X} \right]^{\frac{1}{2}} \geq \left[\frac{c_I D([1 - \theta]B + \gamma\theta V)}{\gamma X} \right]^{\frac{1}{2}} \quad (96)$$

which is true if $V \geq \frac{B}{\gamma}$.

A.11 Proof of Lemma 8

The Indigenous people is compensated less with the inclusion of a probability of failure to prevent all-out conflict after agreement ($\hat{M}^* \geq M_A^*$) in acceptance Case 1 if and only if:

$$\gamma^{-1} \left[\sqrt{\frac{B\gamma X}{c_I D}} - Q \right] \geq \left[\frac{B^2 X}{c_I \gamma D ([1 - \theta] B + \gamma \theta V)} \right]^{\frac{1}{2}} - \frac{Q}{\gamma}, \quad (97)$$

which is true if $V \geq \frac{B}{\gamma}$.

A.12 Game Figure

