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Three Models of Border Stability and Integrity

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by

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ABSTRACT OF THE DISSERTATION

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Border policies have gained a surge of interest from politicians, policymakers, citizens and voters in all corners of the globe in the current millennium. In turn, academia too has turned its interest into systematically studying this increasingly salient political phenomenon. At this stage, however, this topic of study remains theoretically under-founded. The primary objective of this dissertation then is to make several theoretical contributions towards the study of border politics. To this end, my dissertation studies the causes and consequences of state decisions (or non-decisions) to secure their borders from social, political and economic perspectives. I approach this problem primarily through the use of game theory and offer a rich variety of models that isolate different factors of interest within border politics. The different components of the dissertation specifically study (1) the economic relationship between neigbouring states and between states and their borderland citizens, (2) the economic relationship between states and trans-border illicit actors, and (3) the social consequences of stricter versus more open border policies on borderland citizens.

1 Introduction: Rationalising Borders

Article 13 of the Universal Declaration of Human Rights outlines what can perhaps be understood as the prevailing view towards freedom of movement. It states that

> (1) Everyone has the right to freedom of movement and residence within the borders of each State.
>
> (2) Everyone has the right to leave any country, including his own, and to return to his country.

The two points of this article delineates that freedom of movement works differently within state borders as opposed to across state borders. Whilst individuals are given the right to roam freely within their state, this freedom is not extended across them (unless to return home). Inter-state borders therefore remain an area where international norms typically say that freedom of movement can be justifiably obstructed.

Borders are political institutions. They are strategically constructed by political actors and determine the nature of interactions between citizens that straddle the crafted boundary. Their effect is stronger with greater integrity and enforcement but, even as merely lines-in-the-sand, borders will often delineate societies that are more likely to play within the boundaries as opposed to across it. This applies for both sub-national and trans-national borders, for natural and artificial borders, and for both present and past borders.

Normatively speaking, borders are an important object of study as they are the most overt obstacle we encounter to our freedom of movement. Freedom of movement is a largely under-emphasised political right and is one that can often be restricted by governments without drawing too much scrutiny. The very discussion explored in this dissertation, where I dryly weigh the merits and demerits of stronger border controls, and related literatures support this.

In broader reality, the suppression of movement across borders is ubiquitous. Very few in everyday discourse question the legitimacy of passport regimes and customs checkpoints. The only significant occasion when freedom of movement across inter-state borders is scrutinised is when refugees and asylum seekers enter the conversation, and even then their legitimacy is under constant and continuous attack (Esses, Medianu and Lawson, 2013; Findor et al., 2021). Beyond this exception, the acceptance of current international norms on borders—the states as political units with the authority to stop anything at their borders should they wish to do so—is near complete.

The normative status of borders is not directly the subject of this proposed dissertation. However, I hope to have demonstrated that the combination of their pervasiveness and their oppressive nature makes borders an important object of study. As aforementioned, I consider borders to be a form of political institution. As such, it forms part of the many imperfect institutions that together characterise our societies. My objective here is to give borders as a political institution the same treatment that political science has given to many other institutions: to rationalise them through the use of formal models in order to better understand their relationship to various political actors. While borders in general has received reasonable attention from formal theorists already (for example, Acharya and Lee (2018); Alesina and Spolaore (2005)), I believe I have more to contribute this discussion.

This dissertation studies the causes and consequences of border policy from political, social and economic perspectives. These introductory passages will briefly review some of the most relevant existing literature on border politics and sketch some common threads across the different dissertation components. The focus of the selection of reviewed literature here is to establish border politics as a subject of political economy. In particular, I aim to highlight works that describe borders and border policy as a consequence of economic factors. After establishing the lay of the land, I turn to describing and summarising the three chapters of the dissertation.

1.1 The Formal Study of Borders

The most prominent formal-theoretical studies of borders are largely inseparable from studies of statehood and territory more broadly. For a border to exist, there must be more than one political unit in play. How do these political units divide territory between themselves? The answer to this question will determine the location and nature of borders between these political units. Unsurprisingly, formal theorists typically have the same answer to this question: economic efficiency. The economic mechanisms that facilitate this efficiency however has varied from study to study.

Friedman (1977) provides one of the earlier answers to the above question. Friedman assumes that political units hold territory in order to extract taxes. More territory typically means more tax revenue; however, various inefficiencies may lead to diminishing returns on this revenue. This efficiency varies depending on the factor that is being taxed. Friedman argues that taxes on trade activity grows more efficient when there are fewer political units. When there are multiple political units in play, each tax regime will be incentivised to under-charge in order to compete for trade activity. Fewer political units thus means less competition and more efficient tax collection due to the ability to set higher taxes. By contrast, taxes on land do not have this feature. As a result, Friedman argues that political units focused on trade will be large in territory and more agrarian polities will be smaller.

More importantly perhaps for my interests here is that Friedman (1977) argues that taxes on labour have a similar status to that of trade. If labour is over-taxed, then labourers may have an incentive to emigrate in search of better conditions. Thus, political units will in turn have an incentive to under-tax labour in the presence of competition from other political units. Labour-based economies will thus also encourage larger political units to avoid competition in setting tax rates. Labour-intensive economies will also have an incentive to coercively restrict emigration by securing the border and imposing stricter border policies. Thus, the economic factors in play will influence both the location of borders and the nature of border policies.

Advancements in this line of thought are provided Alesina and Spolaore (1997, 2005), whose central idea is instead focused on diversity. Larger political units will inevitably contain a more heterogeneous population. The greater this heterogeneity, the more difficult it becomes for the political unit to efficiently provide governance and services to its subjects. Combined with the economies of scale discussed earlier, Alesina and Spolaore thus argue that there is an optimal distribution of territory between political units when accounting for these various push-and-pull factors.

Further variations of this story exist (e.g Abramson, 2017; Tam, 2004), but the punchline of this literature with regards to borders remains constant. Political units may find themselves in conflict in order to capture territory. However, once an optimal distribution of territories has been achieved, political units now have an incentive to mutually respect each other's territories in order to make the most of the achieved efficiency (based on the assumption that conflict is costly). This conclusion for border politics is made plain by Acharya and Lee (2018) who argue that a cartel of mutual non-interference will develop between states in order to maximise the aforementioned economic efficiencies. What results then are stable and peaceful borders, and this may explain the general respect for territorial boundaries that exists both practically and normatively today.

1.2 Border Fortifications, Security and Stability

A challenge for the above conclusion is that there are occasions where mutual non-interference appears to not be respected at certain borders. Putting aside outright territorial conflicts (where it might be argued that an optimal division of territory is yet to be achieved), one remaining puzzle is the pursuit of fortifications at various trans-national borders across the world. Carter and Poast (2017) find that there have been twenty-eight borders newly fortified since the year 2000. This represents over forty percent of the sixty-two borders fortified since the year 1800. The puzzle here is why states feel compelled to take on the costs of shoring up their frontiers when there should be already be a rational incentive for their neighbouring states to respect established boundaries.

The first obvious response is that there are more than economic factors at play here. States may be fortifying their borders for security purposes. Indeed, state borders remain permeable to the spill-overs from conflicts in their neighbouring states (Bara, 2018) and fortifications have been shown to be effective in mitigating this spill-over (Avdan and Gelpi, 2017; Linebarger and Braithwaite, 2020). However, security seems to be generally unappealing as a broad explanation for border fortifications. The most obvious counter-argument is that, as the data in Carter and Poast (2017) show, the rate of border fortifications is accelerating over time. Yet, as time has progressed, (1) the world has generally grown more peaceful, mitigating the need to fortify for security reasons, and (2) the capability of military armaments has also grown, rendering border fortifications less and less effective as a defensive investment.

Thus, economic explanations still seem important to explain the puzzle of border fortifications. Whilst advances in technology and globalisation may have rendered physical borders less relevant in certain ways, border regions are still economically important to states. A range of scholarship has demonstrated that "stable" borders are generally economically beneficial to states (e.g. Gavrilis, 2008; Schultz, 2010; Simmons, 2005). Border stability here is in reference to the state's ability to regulate and control what enters and exits its borders (Rudolph, 2003). The associated literature discusses various benefits of stability, but for my purposes here, each dissertation chapter will focus on a different economic benefit of stable borders: the ability to (1) set prices without the threat of outside competition, (2) avoid the leakage of wealth to illicit actors, and (3) facilitate successful coordination for economic activities.

States have a variety of tools to achieve greater border stability. Border fortifications are but one of the policies states can take to strengthen the stability of their borders. This dissertation focuses on fortifications as the intervention of choice that states can make to stabilise their borders. This greatly simplifies the design of the formal models that follow as it allows me to assume that fortification are (1) permanent and (2) primarily incur only up-front costs.

These simplifications are, of course, not strictly reflective of reality but seem appropriate given that fortifying the border represents a significant commitment with significant start-up costs.

That said, I do argue that the lessons from the various models in this dissertation are generically applicable to a variety of interventions states can make to secure their borders. Such interventions may include intensifying patrols or further tightening customs and immigration regimes. So long as the intervention involves an overt commitment that is either politically or economically costly, then the lessons from my models should still be applicable to such border policies. Fortifications are simply the most extreme end of such interventions—being the most permanent and most immediately expensive method of securing the border—but are otherwise merely another tool on the same spectrum.

1.3 Economic Determinants of Border Fortifications

Explaining border fortifications through economic factors is a small but growing literature, and I hope to add significantly to the theoretical side of this discussion. The starting point for this conversation may be Rosière and Jones (2012), where a typology of "hardening"—the different ways states may fortify their borders— is presented. The authors go on to descriptively show that this hardening typically occurs at social and economic discontinuities and argue that border fortifications are therefore a tool for the more privileged to defend their wealth against the less privileged. This sets down the basic building block of the story: border fortifications emerge where there is economic inequality.

This general theory is empirically interrogated by Carter and Poast (2017). Carter and Poast demonstrate that border fortifications can be predicted by increasing income inequality between the two states in question. The mechanisms for this are various, but can best be summarised by the stability discussed earlier. When there is significant disparity in wealth between two states, there is greater incentive for labour to move in search of greater wages and for goods to move in search of better markets. States may then have incentive to fortify their borders to ensure stability in the face of this greater incentive people and goods have to cross the frontier.

One of the objectives of this dissertation is to more rigorously interrogate and describe this theoretical process. This will involve distilling the various economic capabilities and motivations of the different stakeholders in border politics. The two neighbouring states, of course, remain central to the story, but equally important are the economic incentives of other actors in the border region. What falls out of this interrogation is an analysis of the overall suitability of fortifying or otherwise securing the border as a tool for the state to improve economic outcomes. A general lesson from my models in this dissertation is that border fortifications appear to have significant inefficiencies as an economic tool due to collective action problems and information asymmetries.

Finally, the most attractive facet of an economic explanation of border fortifications is how such the components of such a theory appears to temporally trend together in the right direction. As civilisation advances, more and more land becomes economically relevant due to the spread of populations and advancements in technology. This might turn areas at the frontier that were previously unimportant for the state into significant sources of wealth. States may then look to secure their borders to protect these assets and thus the recent boom in fortifications trends together with the general spread in economic development.

1.4 Consequences of Border Fortifications

Given that the argument that borders are secured for economic motives, it follows that fortifying the border will have economic impacts. Such impacts are difficult to empirically demonstrate due to the lack of good counter-factuals in the study of borders, but empirical work has indeed shown some economic consequences. Carter and Poast (2020) show that fortifications disrupt formal trade, whilst Getmansky, Grossman and Wright (2019) show their ability to displace illegal economic activity. These impacts might be considered an extension of the "border effect" (Anderson and van Wincoop, 2003) where borders, even without significant enforcement, naturally impede cross-border economic activity due to the legal and logistical obstacles they create. The choice of states to fortify their border can be considered an attempt to magnify this effect.

Broadly speaking however, the burden of proof has rarely fallen onto showing that borders matter. Scholars tend to presume that borders matter from the outset; they are an overtly intuitive point where things are presumed to change. The unfortunate consequence of this mindset is that there are strands of scholarship that rely on borders, or geographic separation more generally, as treatment in a study whilst remaining largely atheoretical about the mechanisms at play. One culprit of such an approach is the branch of social science known as "legacy studies" (see Nunn 2009; Simpser, Slater and Wittenberg 2018 for reviews). Legacy studies argue that historical divergences can have long-term social, political and economic consequences. Legacy studies will use borders or other geographic variables to delineate the limits of their treatment (the historical divergence) in their attempt to empirically test the effects of legacy.

Do borders really have the powers of containment ascribed to them by scholars? Whilst the border effects somewhat alludes to such capabilities, they were never meant to argue that borders be airtight. Thus, another objective of my dissertation is to interrogate whether borders are capable of separating societies across the march of time.

1.5 Dissertation Roadmap

This dissertation studies the causes and consequences of border policy from political, social and economic perspectives. It consists of three separate chapters, each focusing on a different formal model of border politics.

The first of these chapters, titled "Economic Origins of Border Fortifications", focuses on how the economic relationship between neighbouring states, and between these states and their citizens, influence decisions over border policy. Whilst existing work has already begun to highlight the importance of the economy as a determinant of fortifications (Carter and Poast, 2017; Rosière and Jones, 2012), my objective here is to provide more rigorous theoretical backing to this theory. Using a model of borderland governance inspired by Acharya and Lee (2018), I demonstrate that border fortifications are most likely to be built by high economic capacity states that border a low economic capacity state.

My second proposed chapter moves away from states and citizens in discussing the economics and politics of borders. There are many other relevant political actors at the borders and one of such, illicit actors, is the focus of "How to Smuggle Contraband and Influence Border Policy". The objective of the second chapter is to continue the discussion of the first chapter by pivoting to consider a key actor in border politics that has not yet been significantly studied in the literature on economic factors and border fortifications. A key argument made by this second component is that illicit actors are strategic in their choices and are not easily corralled by state action. I thus offer a game of incomplete information to illustrate the subtleties of the relationship between states and trans-border illicit actors, revealing the many inefficiencies states must confront in deciding border policy.

The third and final chapter pivots somewhat to consider the social consequences of borders of greater and lesser degrees of integrity. In "Persistent and Self-Perpetuating Political Differences between Neighbouring Communities", I look to formally demonstrate the conditions under which neighbouring communities, separated by a border of variable integrity, can remain socially or politically distinct from each other. The mechanism of interest here is the integrity of the border that separates the two communities, or equivalently the degree to which the two neighbouring communities are integrated and regularly interact with each other. Using evolutionary game theory, I demonstrate the relative ease through which neighbouring communities can maintain significant political differences even when they are relatively well-integrated with each other.

2 Economic Origins of Border Fortifications

Why do modern states fortify their borders? Border fortifications refer to artificial physical obstruction between the territories of two states, such as walls and heavy fencing. Globalisation scholars are skeptical of the relevance of borders and their walls in the contemporary world (see for example Jacobson, 1966; Ohmae, 1990). Border fortifications have also been deemed obsolete for security purposes due to the advancement of military technology. Yet, according to data collected by Carter and Poast (2017), twenty-eight borders have been newly fortified since the year 2000. This represents over forty per cent of the sixty-two borders fortified since the year 1800. This recent growth in fortification rates is therefore counter-intuitive and presents a puzzle: why are fortifications still being built?

While empirical approaches have begun to study why states choose to fortify their borders, there are still gaps in the literature's theoretical basis. I offer a theoretical foundation by arguing that states use border fortifications to achieve border stability—the ability to regulate what enters and exits the state—which in turn secures the economic fruits of the border regions. This theory builds on existing work on economic motivations for fortifications (Carter and Poast, 2017; Rosière and Jones, 2012). Such works were in turn built upon the idea that stable border regions are more economically productive than unstable border regions (Gavrilis, 2008; Schultz, 2010; Simmons, 2005). Whilst border regions can be stable through mutual non-interference (Acharya and Lee, 2018), the persistence of contentious borderlands across the world suggests that such an outcome cannot be guaranteed. This paper demonstrates that border fortifications offer states an opportunity for recourse when stability fails to emerge by other means.

Recognising that fortifications form part of the broader processes of border management (Gavrilis, 2008), I present a game that embeds states' choices of border fortifications within the broader context of border politics. The border region between two states is represented on a single-dimension continuum. Along this space lives a mass of potential citizens. The states must compete with each other in providing services to this population and the state that offers such services at the lower price (i.e., lower tax rates and more lax regulations) creates greater advantages for the economic enterprises of their citizens. This results in competition between the two states and competitive pricing inevitably drives down the long-term economic profits of both states. This foundational framework of the model takes inspiration from the work of Acharya and Lee (2018); the model then diverges significantly by allowing the states to fortify their borders. The construction of fortifications restricts the movements of persons and goods. As a result, citizens become unable to benefit from conditions offered by the government across the wall, preventing wealth from escaping across the border. States now have a monopoly over the citizens on their side of the fortifications and are able to maximally extract taxes and productivity from local enterprises for long-term economic gain. In other words, fortifications enforce border stability and this stability is profitable for the states. The trade-off however is that the construction of border fortifications has significant upfront costs and states face the strategic choice of spending significant immediate investment on fortification construction to secure long-term profits.

Altogether, the results of the model allow us to form expectations over the economic conditions that produce border fortifications. States of equal economic capacities are unlikely to fortify their borders. This is because two low capacity states have no reason to fortify as they cannot significantly profit from a more stable market, and two high capacity states are dissuaded either by existing cooperation—which is more likely to emerge between wealthy neighbours—or by a free rider problem—as both states have the capacity to shoulder construction costs. By contrast, borders between two states of varying capacities are more likely to see fortifications. The wealthier state in this scenario is incentivised to act as they know their poorer neighbour will never do so for them. This implies that border fortifications are more common where there is economic inequality between the two territories and capacity disparities between the two governments.

Such a theoretical contribution aligns with the empirical findings of Carter and Poast (2017), the key preceding work. They argue that "the economic incentives of the populations on both sides of the border are key to understanding border stability" (Carter and Poast, 2017, p.244) yet were only able to tests these patterns in the aggregate. Thus, I advance existing theories by showing how nuanced economic incentives, built endogenously into a formal model of border stability and fortification, gives the appropriate empirical expectations. A formal approach is perfectly suited for such an enterprise as it allows for stripping away other complications to thoroughly interrogate particular mechanisms in a complex political phenomenon (Ashworth, Berry and Bueno de Mesquita, 2021; Paine and Tyson, 2020). Such depth of inquiry into the mechanisms behind economic factors in border policy choice provides this theory with greater sophistication than what has come before (Carter and Poast, 2017; Hassner and Wittenberg, 2015; Rosière and Jones, 2012).

2.1 Economic Motivations for Fortifications

2.1.1 Governance in the Borderlands

Skeptics are likely correct that developments in technology have diminished the relevance of land borders. They are now much less significant for defence and travel, but borderlands themselves remain economically important. In this paper, I focus on the economic significance of borders for states and their citizens. I borrow the framework for this from Acharya and Lee (2018), where "governance" is used as shorthand for the economic relationship between state and citizens. This relationship is characterised as extractive: the state extorts rents from citizens in exchange for an escape from the state of nature. This characterisation follows from a long tradition in political thought that considers states as "stationary bandits" that attempt to maximise revenue (Levi, 1988; Olson, 2000).

As I do not intend to make an explicitly historical argument nor appeal to the state of nature in this paper, it is necessary to affirm that this framework remains similar to the substantive reality in contemporary borderlands. The modern state governs by offering citizens some combination of welfare, security and infrastructure. In return for governance, the state extracts a "price" (later p) from citizens for these services. Such a price should primarily be considered to be the direct contributions that citizens make to the state as part of their continued enfranchisement. This includes the payment of taxes on income or tariffs on formal trade. More broadly, this price also involves the contribution that citizens make to the state through the passive economic endowments of a productive population.

For states with land borders, a complicating factor in this economic relationship is the inescapable physical presence of the neighbouring state. Exposure to markets, employment opportunities and services across the border is a unique aspect of borderland life that many average citizens may use to their economic advantage. Should a citizen choose to purchase goods, sell produce or find employment across the border, then they are effectively channelling their economic productivity to the neighbouring state and not their home state. Examples of this behaviour include Mexican farmers smuggling agricultural products to sell in Guatemala to avoid competition form US imports in local markets (Galemba, 2012, 2018), Indian ranchers smuggling livestock to sell in Bangladeshi markets where there are fewer restrictions (Sur, 2020, 2021), and Yemeni labourers—especially prior to 1990—looking for higher-income employment in Saudi Arabia (Thiollet, 2011). To prevent these economic losses to the neighbouring state, the home state gains an interest in securing their borders.

The model in this paper assumes that states provide governance of the same quality or value (later v) towards anyone that accepts them. It instead allows for states to tailor specific prices p for each citizen who then evaluate these offers based price. The assumption of equal quality governance is a significant simplifying assumption; however, the ability for states to compete on price compensates for this. From the perspective of the citizen, the price and value of governance services are additive and allowing for variance in price captures any effect that allowing for variance in quality provides.

Providing governance is costly to states. This cost (later c) becomes greater the further away a population is from the state capital. This reflects both logistics, where it is more difficult to service subjects the further away they are, and politics, where the wants of those further away from the interior tend to be more dissonant and difficult to provide for from the perspective of the capital. These costs limit the range of the population that a state can offer its services to. Beyond cost, states have an incentive to secure as many contributions as possible. This is achieved in two ways: by charging a higher price for their services or by increasing the proportion of the border region populace that accepts their services. The citizens in the border region, as a function of their location, will often be exposed to offers set up by either state. It is then up to the states to present the more attractive offer in order to win economic contributions.

2.1.2 Border Stability and Fortifications

This competition for providing governance is how my models endogenously capture border instability. There are several ways in which border stability can be understood. The more typical approach by Simmons (2005), Carter (2010) and others focus on clarity of territorial jurisdictions. Such an approach emphasises "disputes over location" as the source of border instability. For the purposes of this paper, I prefer to follow the definition used by authors such as Rudolph (2003) or Carter and Poast (2017) where border instability is instead defined as persistence of significant movement of persons and goods across the border unwanted by the states. Such a definition appeals more to concerns over the function of the border and is more appropriate given this paper's focus on economic factors.

The competition for governance perfectly captures the latter form of instability. A porous border is clearly unwanted as the competition for governance forces the home state to offer its services at a cheaper price, reducing their profits. Approaching border instability as the failure rate of filtration reflects how, in reality, a porous border exposes a state to labour and goods originating from the neighbouring state. If the citizens of the state employ labour or purchase goods from the other side, then wealth leaks out of the state as the economic contribution of these enterprises flow across the border. This can be exacerbated by how payments in exchange for labour or goods can more easily avoid taxes, tariffs and other regulations when borders are unstable.

To avoid these losses, the home state must ensure that local labour and goods remain attractive. Welfare arrangements that reduce wages for locals or subsidies for domestic production are examples options. Such policies, in the formal construction of my model, means that the state must price their governance competitively and this results in a loss of profit. States thus prefer the border to be stable to avoid these losses and this endogenously captured preference for border stability is one of the strengths of the presented approach.

I will note here that, in the model, economic losses from border instability directly result from the loss of contributions from citizens in the border region specifically. Whilst labourers, migrants and traders that successfully cross the border may not necessarily stay in border regions, I argue that for modelling purposes it is still appropriate to consider that the bulk of their impact is on the borderland. Consider, for example, how Hispanic communities of Mexican origin in the United States tend to be concentrated in states closer to the border. I therefore hope the reader considers this an acceptable simplification.

One option that states have to enforce border stability is by constructing fortifications. Fortifications enforce stability because they make accessing alternative options difficult. In practical terms, fortifications reduce the leakage of state wealth by filtering the people and goods that can flow across the border. The extensive fortifications built on the Saudi-Yemen border, for example, make it more difficult for Yemeni labourers to find employment across the border (Al-Awlaqi, Al-Hada and Al-Shawthabi, 2019; Thiollet, 2011). When citizens can no longer easily access labour and goods from the other state, they are forced to commit their contributions to the home state. The games in this paper model the equivalent of this phenomenon: fortifications stop states from offering services across the border. This is captured by an increase in costs to provide services beyond the wall. Through this mechanism, a state can thus choose to fortify in order to unilaterally stop the competition for governance and enforce border stability. This choice comes with a cost (later k) and states must weigh the long-term benefits of fortifications against this immediate expense.

2.1.3 Objectives, Limitations and Scope Conditions

The objective of my models is to isolate the possibility that states may be solidifying their borders in response to leakages of wealth. These incentives thus focus on the economic choices of the two neighbouring states and their citizenry. Borders and the economy interact in numerous other ways and it is neither feasible nor illustrative to attempt a model of all relevant economic processes. Other prominent economic actors in border regions such as arms smugglers and drug cartels are not represented in my models.

Less direct economic consequences of border policies may also not be appropriately captured at this stage. For example, Peters (2015, 2020) argues that the loss of foreign labour can lead corporations to move their factories overseas. Such a relationship is a potential downstream effect that states might also weigh when deciding border policy. I leave these more advanced complications for further research and reiterate my focus on the basic relationship between states and citizens.

The primary case of interest for my models then are states that are capable of extracting significant economic value from their borderland populations. The models in Acharya and Lee (2018), where my models begins and departs from, explicitly focuses on the experience of a modernising Europe. They argue that economic expansion in Europe proliferated lands that were profitable to govern, in turn creating competition between states over territory. I believe that similar circumstances can be applied to ever increasing parts of the world. As global populations proliferate, more and more land is now occupied by civilisation. This in turn can create territory that is profitable to govern beyond the traditional interiors of the state towards the periphery to create the tensions over border politics described in this paper. This increase in economically valuable territory over time, through the processes in my model, may then provide some of the explanation for the growth in fortified borders noted in the opening passages. Whilst I am unaware of direct empirical results of this pattern in populations, I do formally demonstrate in an extension that the assumptions of my model are congruent with this expectation that borderland areas will become increasingly occupied.

Finally, as the states captured in my games are funded by the contributions of their citizens, the model is not suitable to be applied to states that have a significant amount of other forms of income that would be throttled by fortifications. Smaller European states whose economies are significantly dependent on cross-border tourism are prominent examples of such exceptions. States heavily reliant on trades across land borders may also be outside of the models' scope given that Carter and Poast (2020) find that border walls have a depressive effect on formal trade, though notably other research does find that secure borders instead helps facilitate legitimate cross-border flows (see Schultz 2015 for a review) and renders the significance of this complication muddy.

Importantly, I note that states with other forms of income that would not be affected by fortifications (such as the oil reserves of Saudi Arabia) are still captured by my models even if they are not explicitly included. This is because such exogenous economic endowments should largely be constants regardless of border policy choices and can thus be largely excluded from the model design without affecting key patterns.

2.2 The Fortification Game

2.2.1 Basic Structure of the Game

Consider two neighbouring states, $i \in \{A, B\}$, that share a-not-yet-clearly-delineated border with each other. There is a game space $L = [0, 1]$, where point 0 can be considered State A's capital and point 1 can be considered State B's capital. The game space is populated by a continuum of individuals $l \in L$ that are distributed uniformly throughout the interval. The states and the individuals play an infinitely repeated game of border region politics where periods are indexed by t and discount factor $\delta \in [0, 1]$ is applied to pay-offs of future periods. Pay-offs are realised at the end of every period.

When there have never been any fortifications constructed, one of the two states is activated and given the choice of **Fortify** or **Not Fortify** at the start of the period. States alternate this activation, with State A activated in odd periods and State B in even periods, until one of the states chooses to Fortify. This alternating design over fortification choice is intended to side-step the question of what happens should both States simultaneously fortifies the same border, a scenario that seems unlikely in reality.

Following the decision on fortifications, both states simultaneously have the opportunity to offer governance to as many individuals l as they wish for specific prices $p_i(l)$. The individuals value governance at some set $v > 0$ that is the same for all l. They may choose to accept the price of services from a particular state or not to accept any services at all; that is, they choose from $p \in \{p_A, p_B, \text{no service}\}$. The pay-off for individuals l are

$$u_l(p) = \begin{cases} v - p_A(l) & \text{if } p = p_A \\ v - p_B(l) & \text{if } p = p_B \\ 0 & \text{if no service} \end{cases}$$

After services are accepted, pay-offs are realised for every player and the game repeats. The infinite repetition reflects the reality of border management as a perpetual and continuous process where decisions made may have long-term consequences. From a formal standpoint, the repeated play design allows for randomising mixed strategy equilibria that form an important part of the results.

2.2.2 Consequences of Fortification

Once a state has ever chosen Fortify in the history of play, the resulting sub-game is referred to as **Fortified**. The sub-game is referred to as **Unfortified** otherwise. When the game is Unfortified, the cost to provide governance $c_i(l)$ to a particular individual l for a particular state i is increasing in distance to l from their capital. That is, $c_A(l)$ is weakly increasing in l and $c_B(l)$ is weakly decreasing in l (or weakly increasing as $l \to 0$). This means that the cost of providing services to individuals further away from the capital becomes (weakly) more expensive. These cost functions are illustrated in figure 1. The states only pay the cost if their governance services are accepted by a particular l. States look to maximise their profit from providing services: $u_i = \sum (p_i(l) - c_i(l))$ for all l that accept their services.

To help define the remaining portions of the game, I first partition the game space L. The value of governance to any individual is v and as a result they never accept any price for services higher than v. As the costs of providing service increases, it may be that $c_i(l) > v$ for some range of l. For such regions, State i is not able to profit from providing services. This is because they must charge a price $p_i(l) > c_i(l) > v$ to turn a profit, and the individual at l would never accept this offer. Let the area for which State i can profit from providing services (that is all l such that $c_i(l) \leq v$) as State i's **market**. Wherever both states can profit from offering services, it is an **overlapping market**. The overlapping market, or some subset of it, can substantively be interpreted as the border region. Let the areas beyond the overlapping market be each state's **monopoly market**. There is also the possibility that there exists an interval on L where neither of these markets apply; that is, an interval where $c_i(l) > v$ for both states. Such a region, which if it exists would be in between the the markets of the states courtesy of the monotonically increasing costs functions, would become **ungovernable space** between the territories of the two states. These terms (and others) are adapted from Acharya and Lee (2018).

The state that is activated to fortify can choose any location in L as the construction point and the chosen location is defined as $l^\dagger$. When the game is Fortified, the following cost function for providing services to a subject is used instead:

$$c_A^\dagger(l) = \begin{cases} c_A(l) + (v - c_A(l^\dagger)) & \forall \quad l \in [l^\dagger, 1] \\ c_A(l) & \text{otherwise} \end{cases}$$

and

$$c_B^\dagger(l) = \begin{cases} c_B(l) + (v - c_B(l^\dagger)) & \forall \quad l \in [0, l^\dagger] \\ c_B(l) & \text{otherwise} \end{cases}$$

The altered cost functions $c_i^\dagger(l)$ are illustrated in figure 2. These functions make it so that the cost of providing services on the opposite side of $l^\dagger$ is higher than v and is thus non-profitable. Substantively, this formulation is meant to capture how the introduction of fortifications makes it difficult for either state to offer services across the fortifications. As the introduction of fortifications in this model is designed specifically as a tool to cement a monopoly market for governance and extract the subsequent economic benefits, it follows that whatever fortifications are constructed should be sufficiently obstructive to movements that it makes governance on the other side non-profitable.

Fortifications once built are permanent. The permanence is an important substantive element of the model and differentiates fortifications from more temporary forms of border enforcement activities. Formally, the game captures this by only allowing the activation to fortify in the Unfortified sub-game and not the Fortified sub-game.

Choosing to fortify incurs the fortifying state a one-time immediate cost of $k_i(l^\dagger)$. The cost $k_i(l^\dagger)$ is weakly monotonically increasing the further away the location is from the state capital. The construction costs are defined as

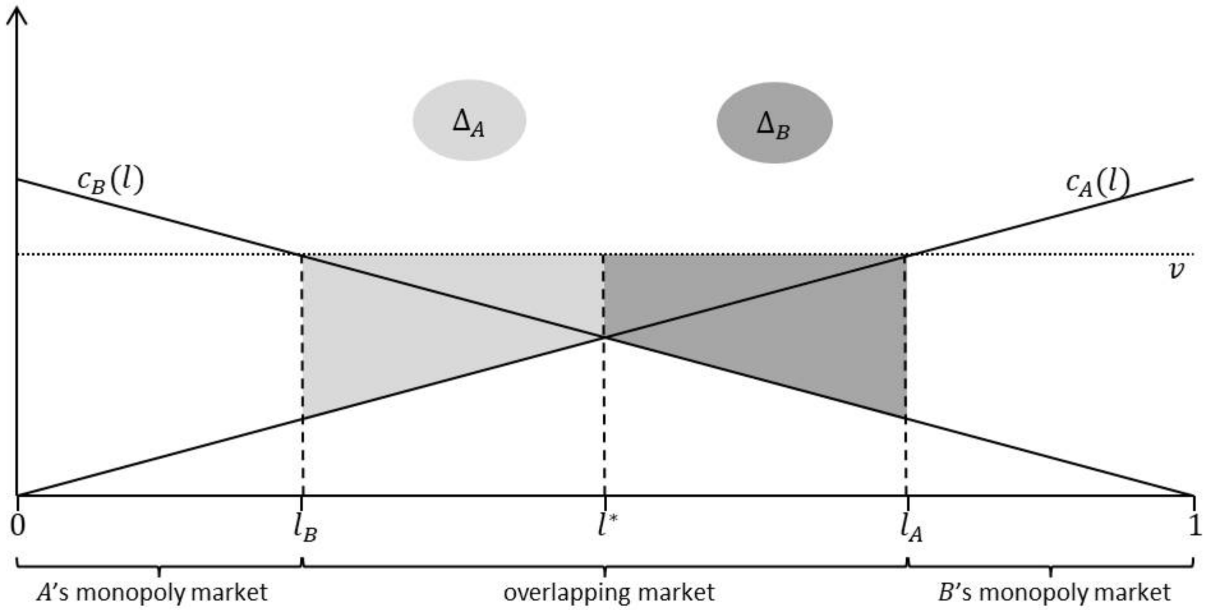

Figure 1: Parameters in the Unfortified Sub-Game

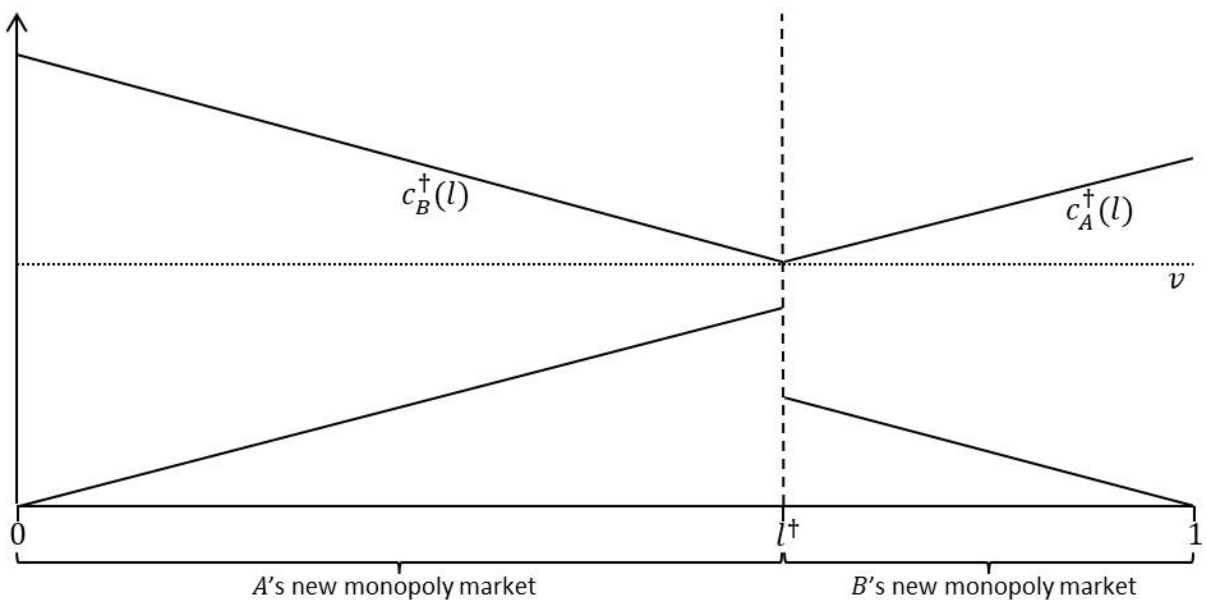

Figure 2: Parameters in the Fortified Sub-Game

$$k_i(l^\dagger) = \begin{cases} k_1 & \text{in State } i\text{'s monopoly market} \\ k_2 & \text{in the overlapping market where } c_i \leq c_{-i} \\ k_3 & \text{in ungovernable space} \\ k_3 & \text{in the overlapping market where } c_i > c_{-i} \\ k_4 & \text{in State } -i\text{'s monopoly market} \end{cases}$$

where $k_4 > k_3 > k_2 > k_1 > v$. This completes the description of the game.

2.2.3 Summary and Simplifications

In summary, the order of play is

1. Set $t = 0$.
2. Increase t by 1. If t is odd, State A is activated. If t is even, State B is activated. The activated state chooses Fortify or Not Fortify, and chooses a location $l^\dagger \in L$ if Fortify is chosen.
3. States simultaneously offer prices $p_i(l)$ to as many individuals l as they wish.
4. Individuals l choose whether and from which state to accept services.
5. Pay-offs are realised. If Not Fortify was chosen, the game repeats from Step 1. If Fortify was chosen, the game advances to Step 6.
6. States simultaneously offer prices $p_i(l)$ to as many individuals l as they wish.
7. Individuals l choose whether and which state to accept services from.
8. Pay-offs are realised. The game repeats from Step 6.

This streamlined description of the game clarifies the two sub-games: Steps 2 through 5 represent the Unfortified sub-game while Steps 6 through 8 is the Fortified sub-game. Each sub-game results in a stage game that is then infinitely repeated with the additional possibility of moving from Unfortified to Fortified sub-games at most once in the entire history. When the game is in motion, as made clearer in later results, the choices in Steps 3 and 4 (and 6 and 7) become largely mechanical and depend only on whether the game is Fortified or Unfortified. Thus, the main strategic choice of the game occurs in Step 2: where State i may choose to fortify their borders.

To focus results, some simplifications are made. (1) Define on L the following points and let them be of zero measure: $l^\star$ as where c_A and c_B intersect, l_A as where c_A and v intersect and l_B as where c_B and v intersect. Such points are illustrated on figure 1. (2) Let c_A be strictly increasing in the neighbourhoods of l_A and $l^\star$ and c_B be strictly decreasing in the neighbourhoods of l_B and $l^\star$. This ensures that the relevant intersections are points and not intervals. (3) Assume individuals accept services when indifferent and accept services from the **nearest** state when indifferent. Define the nearest state as State A if $l < l^\star$ and State B if $l > l^\star$. (4) Assume that states choose to Not Fortify when indifferent.

An index of symbols is provided in the online appendix for ease of reference.

2.3 Strategies in Equilibrium

2.3.1 Monopoly Market Strategies

Consider first the monopoly markets. Here, states are able to charge the highest price $p_i(l) = v$ and individuals under the monopoly accept this offer as the neighbouring state cannot offer any meaningful competition. For simplicity, the equilibria studied specify that states make no offers into their neighbour's monopoly market. In actuality, it is possible for the neighbouring state to make such offers in equilibrium, but they will never attempt a winning offer as winning gives them negative utility. Such possibilities are ignored in equilibrium specification.

2.3.2 Overlapping Market Strategies

It is in the overlapping market that the behaviour of states become interesting. To distinguish between different behaviours, this section formally defines stable and unstable borders. From existing definitions in the literature (Carter and Poast, 2017; Rudolph, 2003), stable borders are those without significant unwanted flows of goods and persons. If offers of governance are interpreted to involve such unwanted flows, then stable borders in this game would be an outcome where states do not offer governance services (or at least not viable offers) into the territory of their neighbour. As a result, when borders are stable, the game space L can be exhaustively partitioned into an interval where individuals l only receive offers from State A, an interval with only offers from State B and (if it exists) ungovernable space. More formally

Definition 1. *Let $\underline{l}$ and $\bar{l}$ be specific points in L. In the* ***Stable Borders Strategy Profile*** *(SBSP),*

- *State A offers price v to all $l < \underline{l}$ and State B offers price v to all $l > \bar{l}$,*
- *State A does not offer services to all $l > \bar{l}$ and State B does not offer services to all $l < \underline{l}$, and*
- *Individuals accept the offer they receive (if any).*

Should $\underline{l} = \bar{l}$, then there is no ungovernable space between the two state's territories.

Complementarily, unstable borders are those where states do make governance offers into the territory of other states. That is, states compete over the governance of territory by attempting to under price each other. Both states offer $p_i(l) \in \max\{c_A(l), c_b(l)\}$ (the higher of the two states' cost of providing services to the specific l) and the nearer state wins the governance of l by the tie-breaking rule. (Without the tie-breaker, the nearer state would simply offer $c_{-i}(l) - \varepsilon$ to win the sale, giving substantively the same conclusion.)

Definition 2. *In the* ***Unstable Borders Strategy Profile*** *(UBSP),*

- *Both states offer price v to their respective monopoly markets,*
- *Both states offer price $p_i(l) = \max\{c_A(l), c_B(l)\}$ in the overlapping market,*
- *Both states do not offer services to each other's monopoly market, and*
- *Individuals accept the services of the nearest state.*

The result of unstable borders is that governance changes hands at $l^\star$. Beyond $l^\star$, the farther state can no longer win the competition of underpricing their services and loses out. However, their presence as a competitor forces the nearer state to offer their services at a cheaper price to retain governance.

With these definitions established, I quickly resolve a niche and straightforward case. When two territories are separated by ungovernable space, fortifications are never built. This is because there already exists two separate monopoly markets with no overlapping markets for fortifications to resolve. Thus,

Proposition 1. *If $c_i(l^\star) > v$, then there exists a sub-game perfect Nash Equilibrium to the Fortification Game such that*

- *All players always play the Stable Borders Strategy Profile where $\underline{l} = l_A$ and $\bar{l} = l_B$.*
- *When activated to fortify, states always choose to Not Fortify.*

Proof for all main propositions are in the appendices.

All remaining results in this paper focus on cases where proposition 1 does not apply and stability is not guaranteed by ungoverned space. Formally, this is when $c_i(l^\star) < v$ and all subsequent equilibria studied requires this condition to be true. Under this condition, there are several different ways in which Stable Borders may emerge. One such way is by mutual restraint and this is the main result of Acharya and Lee (2018). This paper focuses on advancing the possibility of a second way to achieve stability: by fortifying the border. The construction of fortifications forces the game into Stable Borders by eliminating the overlapping market and the inefficient competition attached to it.

2.3.3 Where to Fortify

Having deduced the strategies in Steps 2 and 3, consider now the choice in Step 1: whether or not the activated state fortifies. There are two separate components of this choice, whether or not to Fortify and the specific location of the fortification $l^\dagger$. Focusing on the latter component, recall that the construction costs vary by location and are given by a step function that increases at specific points in l. It follows that the most profitable fortification locations are before each step. At such points, fortifying secures the largest possible market for that particular cost. For State A, these points are $l^\star$ for paying k_2 and l_A for paying k_3; and for State B, $l^\star$ for k_2 and l_B for k_3. Never will the states want to pay the most expensive price k_4 as it is strictly dominated by paying k_3: paying k_4 does not grant a larger market as it only allows State i to expand into State $-i$'s monopoly market where State i cannot profit. They also never want to pay the lowest price k_1 as this only makes their market smaller. Thus, in Step 1, the activated state has at most three plausible choices–to fortify at $l^\star$, l_i or not at all—and the state chooses the best of these options.

The post-fortification profits of each choice is straightforward. Following fortification, both states have a monopoly and can charge price v in their entire market. That is, the players must follow the Stable Borders Strategy Profile, where $\underline{l} = \bar{l} = l^\dagger$ as it is the sub-game perfect Nash Equilibrium in the Fortified sub-game. Thus following fortifications, the one period pay-offs for that state can only be $u_A(\text{SBSP}) = vl^\dagger$ and $u_B(\text{SBSP}) = v(1 - l^\dagger)$.

The ultimate decision on fortifications of course requires a comparison between these post-fortification utilities and the appropriate equilibrium utilities of not fortifying. Let $\Delta_A = \int_{l_B}^{l^\star} v - c_A(l)dl$ and $\Delta_B = \int_{l^\star}^{l_A} v - c_B(l)dl$. This Δ_i, adapted from Acharya and Lee (2018), is a useful shorthand to describe economic gains when moving from instability to stability and is illustrated in figure 1. When players play the Unstable Borders Strategy Profile, the one period pay-offs of the states are $u_A(\text{UBSP}) = vl^\star - \Delta_A$ and $u_B(\text{UBSP}) = v(1 - l^\star) - \Delta_B$

respectively.

2.4 Fortifying to Achieve Stability

2.4.1 When (and When Not) to Fortify

In the Unfortified sub-game, the stage game equilibrium is for each state to price their services competitively. My main results focus on equilibria where this stage game equilibrium is also the equilibrium choice in the repeated game. That is, players always play the Unstable Borders Strategy Profile in the Unfortified sub-game. In this subsection, the optimal pure strategy choice of fortifications is determined, given (1) the stated assumption over Unfortified sub-game strategies, and (2) that all players play stationary strategies.

Fortifications serve as an opportunity to escape the inefficiency of border instability. However, when making this choice, the appropriate utility comparison is not simply between existing instability and potential stability. The activated state must also consider that, if they let the opportunity slip, what potential futures await when the other state is activated.

Consider the following scenario: should State $-i$ be activated in period $t+1$, then State $-i$ will choose to Fortify at $l^{\star}$. In turn, when State i is activated to fortify in period t, the only rationalisable choices are to Fortify at l_i or to Never Fortify. This choice is essentially between paying to secure a more advantageous fortification location versus going along with the less advantageous stability that State $-i$ chooses to enforce. They would not choose to Fortify at $l^{\star}$ as they would prefer to wait for State $-i$ to do so instead and free-ride on the construction cost. (The possibility that State i would Fortify at $l^{\star}$ to take advantage of increased profits from immediate stability is ruled out by the prohibitively high cost.) Similar logic can be followed when State $-i$ in period $t+1$ prefers to Fortify at l_{-i} or Never Fortify. The exception is that should State i be unsatisfied with the choice that State $-i$ intends to implement, they have two locations—and two prices they might pay—to enforce a different stability arrangement.

Whether or not State i chooses to Fortify depends on their valuation of future profits. States with a higher discount factor δ will find fortifications more profitable as they provide stability for greater future economic extraction. Thus, states Fortify given that δ is sufficiently high and Never Fortify otherwise. The specific threshold varies depending on State $-i$'s strategy and the fortification location under consideration.

Optimising across different tiers of fortifications is straightforward. A state prefers paying for more expensive fortifications when the increase in profits from the larger monopoly market outweighs the increase in construction costs. For example, State i prefers paying k_3 to fortify at l_i over paying k_2 to fortify at $l^\star$ when $\frac{v(l_i-l^\star)}{1-\delta} > k_3 - k_2$ and so on. Repeatedly applying the comparison yields the following definition, where $l^\dagger, l^{\dagger\prime} \in L' \subset L$

Definition 3. *State i **prefers** to Fortify at $l^\dagger$ over Fortify at $l^{\dagger\prime}$ when $\frac{v(l^\dagger-l^{\dagger\prime})}{1-\delta} > k_i(l^\dagger)-k_i(l^{\dagger\prime})$, where $l^\dagger, l^{\dagger\prime} \in L'$. A fortification location $l^\dagger$ is **most preferred** by State i when it is preferred over all $l^{\dagger\prime} \in L' \setminus l^\dagger$.*

Note that, by the nature of infinitely repeated games, should it not be rational for a state to Fortify for a particular price in a particular period t, it would also not be rational for them to do so in any future period so long as they face the exact same strategic problem in that future period. The latter statement applies in this paper as the results studied are largely stationary: players always respond to particular scenarios with the same strategy regardless of t. This principle similarly applies to subsequent equilibria studied in this paper.

The following strategy thus represents the optimal choice of fortifications in reaction to the other state's choices given that states play the Unstable Borders Strategy Profile in the Unfortified sub-game:

Definition 4. *Define the **Counter-Fortification Strategy** for State i as playing Fortify* *at their most preferred $l^\dagger$ where*

$$L' = \begin{cases} \{l_i\} & \textit{if State } -i \textit{ plays Fortify at } l^\star \textit{ when activated} \\ \{l_i, l^\star\} & \textit{otherwise} \end{cases}$$

The strategies defined above come together in an equilibrium where one state plays their most preferred fortification choice and the other state reacts to this choice with a contingency-based strategy, as follows

Proposition 2. *Given $c_i(l^\star) < v$ and sufficiently large δ, there exists a sub-game perfect Nash equilibrium to the Fortification Game where*

- *In the Fortified sub-game, players play the Stable Border Strategy Profile where $\underline{l} = \bar{l} = l^\dagger$,*
- *In the Unfortified sub-game, players play the Unstable Border Strategy Profile,*
- *State $-i$ plays Fortify at their most preferred location when activated, and*
- *State i plays the Counter-Fortification Strategy when activated.*

In the above equilibrium, one of the states, State $-i$, looks to Fortify so long as at least one fortification option is profitable. The remaining state, State i, in response only plays Fortify if they are unhappy with State $-i$'s prospective choice.

2.5 Empirical Implications

What does the above result to the fortification game reveal about expectations over border fortifications? There are two particular aspects that I have discussed: what makes a border more likely to be fortified and, if such fortifications were to be built, what types of states are more likely to fortify. To best unravel these expectations, I scrutinise the condition that determines whether or not fortifications are constructed at all. This being the decision of State i to Fortify given that State $-i$ will never choose to do so. Such a threshold is

$$\delta > 1 - \frac{\Delta_i + v\left(|l^\dagger - l^\star|\right)}{k_i(l^\dagger)}$$

Proposition 3. *The choice to Fortify at $l^\dagger$ becomes more profitable for State i as the profits of stability Δ_i and the size of the market gains $|l^\dagger - l^\star|$ increase, and the cost of construction $k_i(l^\dagger)$ decreases.*

From these comparative statics, we should expect to see fortification projects where they bring greater economic benefits, relative to the cost of investment, for at least one of the two neighbouring states. Applying this condition to both states suggests that we should not expect to see fortifications at a border where neither state are able to significantly benefit from added stability. Substantively, this might suggest that the border region on both sides is relatively undeveloped and therefore would not be able to produce significant wealth for the state even with monopoly extraction. Alternatively, if the cost for providing governance $c_i(l)$ is interpreted as economic capacity, it can be concluded that states of low economic capacity are unable to take advantage of a stronger market (as Δ_i is a function of $c_i(l)$) and therefore would not seek it through fortifications. Borders between two poor states are therefore likely to remain unfortified.

By contrast, we should expect fortifications between a wealthy State i and a poor State $-i$. When only State i has the capacity to significantly profit from border stability, they have the incentive to simply unilaterally impose fortifications for their own benefit. There will be no hesitation from the wealthier state to do so as they know that fortifications will never be built by the poorer state. Thus fortifications are more likely between states of unequal wealth and this expectation is at the very least consistent with existing empirical results. Carter and Poast (2017) find that income inequality across populations is strongly correlated with border fortifications, and although income inequality is indeed different from disparities in state capacity, the two concepts should be strongly correlated. Furthermore, Carter and Poast (2017) also find that the wealthier state is also more likely to initiate construction and this is also consistent with the model's predictions.

In summary, the main equilibrium analysed here provides expectations for two scenarios. When both states are of low economic capacity, we should not expect fortifications. When the two states are of varying economic capacity, then the state of higher capacity should be expected to construct fortifications. What remains is to study the expectations over fortifications between two states of high economic capacity. Currently, the equilibrium in Proposition 2 allows for either state to be the builder in such a scenario and it remains unclear what expectations should be. To find a clearer answer, I turn in the next section to a mixed strategy free-riding outcome.

2.6 Fortifications between Wealthy States

2.6.1 Free-Riding on Fortifications

I here study two states of relatively equal but significant wealth and focus on a mixed strategy equilibrium. Such an equilibrium indicates free-riding: both states want the benefits of stability brought by fortifications but would prefer that the other state pay the cost of construction. Thus, although fortifications are wanted by both states, they may not actually be built as each state awaits the other to build the fortifications instead. Allowing for this mixed strategy equilibrium is the main reason the game is designed to be infinitely repeated.

To solve for a mixed strategy equilibrium, we must assume that the two states most prefer the same fortification location $l^\star$. In such an equilibrium, every time they are activated, states with probability q_i choose to Fortify at $l^\star$ and with probability $1 - q_i$ choose Not Fortify, where $0 < q_i < 1$. The value of q_i is found at the indifference point between choosing to Fortify at $l^\star$ and Not Fortify, given that the other state is playing the mixed strategy. This yields the following equilibrium

Proposition 4. *Given $c_i(l^\star) < v$ and that both states most prefer fortification location $l^\star$, there exists a sub-game perfect Nash equilibrium where*

- *In the Fortified sub-game, players play the Stable Border Strategy Profile where* $\underline{l} = \bar{l} = l^\dagger$,
- *In the Unfortified sub-game, players play the Unstable Border Strategy Profile, and*
- *When activated, both states play Fortify at* $l^\star$ *with probability* q_i *and Never Fortify with probability* $1 - q_i$.

2.6.2 Empirical Implications

Studying the mixed strategy equilibrium gives expectations over fortifications between two states of high economic capacity. The possibility of a free-riding outcome suggests that states of equally high capacity are less likely to be separated by fortifications. This is further supplemented by analysing the equilibrium choice of q_i, the probability the states play Fortify at $l^\star$, which are the following probabilities

$$q_A = 1 - \frac{(1-3\delta)k_2 + (1-\delta)(\Delta_B)}{\frac{\delta^2 v(1-l^\star)}{1-\delta} - \delta k_2}, \quad q_B = 1 - \frac{(1-3\delta)k_2 + (1-\delta)(\Delta_A)}{\frac{\delta^2 v l^\star}{1-\delta} - \delta k_2}$$

Although the expressions above are unwieldy, the effect of most parameters are clear, especially under the restriction $\delta > \frac{1}{3}$.

Proposition 5. *Fortifications become more likely as the profits of stability* Δ_i *decreases, and the cost of construction* k_2 *increases.*

The q_i demonstrates the characteristics expected of a free-rider problem. The probability of fortifications increases with the cost of fortifications k_2. As fortifying becomes more expensive, states are less likely to expect that the other state will take up that burden and in turn are more willing to erect fortifications themselves. Conversely, the probability of fortifications decreases as the benefits of cooperation Δ_i increase. As stability becomes more appealing, the states become more likely to free-ride on the possibility that the other state takes initiative in erecting fortifications. These rather backwards results are typical of single-provider free-rider problems.

These comparative statics suggests that the wealthier the states, the less likely fortifications become. When state capacity grows, their ability to extract wealth from a larger market Δ_i increases and the costs to fortify k_2 decreases. Both of these changes result in a smaller probability to Fortify according to proposition 5. The probability of fortifications therefore becomes increasingly small as both states become of increasingly high economic capacity.

While such an expectation is congruent with patterns in reality—fortifications are rare between two highly developed states—the model provides an unintuitive motivation for this outcome. We would not normally presume that two wealthy states are waiting on each other to build fortifications. This may be because many wealthy neighbouring states, such as Canada and the United States or various members of the European Union, have a history of cooperation and thus pursuing a policy of more stringent border controls runs counter to their established relationship. The following section studies cooperative agreements between neighbouring states and finds that when such cooperation is accounted for, fortifications are indeed less likely to emerge between amicable neighbours.

2.6.3 Returning to Mutual Restraint

Acharya and Lee (2018) have described how border stability can be achieved without fortifications. They show how a cartel-like agreement where the states choose mutual non-interference allows both states to cooperatively exploit the population for economic gain. I expand on these results by demonstrating how stability by mutual restraint is still possible in the Fortification Game, with the caveat that it is now vulnerable to aggressive fortification. This aggressive fortification is in reference to the use of fortifications to unilaterally acquire territory that was previously under the monopoly extraction of the other state. That is, states may choose to pay price k_3 to capture the overlapping market controlled by the other state. States never choose to pay k_1 or k_2 to fortify as such projects would not yield a monopoly market any larger than that which is already provided by mutual restraint.

Stability by mutual restraint takes after a Grim Trigger-style solution, where the fruits of cooperation (border stability and Δ_i) is achieved in the face of permanent punishment for defecting (border instability and the loss of Δ_i). For both states to commit to mutual restraint, there must be a sufficiently high δ such that both states would prefer the long-term benefits of cooperating by restraint over the short-term gain of defecting by pilfering. However, a high δ also suggests that a state has a lot to gain by aggressively fortifying to secure a larger monopoly market, leading to the following equilibrium

Proposition 6. *Given $c_i(l^\star) < v$ and sufficiently large δ, there exists a sub-game perfect Nash equilibrium to the Fortification Game where*

- *In the Fortified sub-game, players play the Stable Border Strategy Profile where $\underline{l} = \bar{l} = l^\dagger$,*
- *In the Unfortified sub-game, so long as the history has always been the Stable Borders Strategy Profile, players play the Stable Border Strategy Profile and, when activated, both states play Fortify at $l^\star$ at l_i when $\delta > 1 - \frac{v(|l_i - l^\star|)}{k_3}$ and Never Fortify otherwise, and*
- *In the Unfortified sub-game, if the history has ever departed from the Stable Borders Strategy Profile, players play as described in Proposition 2.*

This result demonstrates that even existing stability is not necessarily a deterrent to fortifications. Even if two efficient monopolies of extraction exist without the need for fortifications, states may still be tempted to use fortifications to secure an even larger monopoly.

However, pre-existing stability does indeed make fortifications less profitable. The threshold for temptation to manifest into construction in proposition 6 is more difficult to achieve than the threshold in proposition 2. As a result, we should indeed expect fortifications to be less common between states that can form the cartel of extraction described by Acharya and Lee (2018, 2023). As such cartels require both states to find mutual restraint to be profitable, they are exclusively available to states with high and reasonably equal wealth. This is because the Grim Trigger-style enforcement is only credible between wealthy neighbours; if one state is significantly more capable, then they may find it worth their while to renege for a large short term profit and enduring a smaller long-term punishment. See proposition 2 of Acharya and Lee (2018) for further discussion.

Proposition 6 is therefore further support to suggest that states of equally high economic capacity are less likely to fortify their shared border. Collectively, the analysis of the Fortification Game produces the following conclusions. Border fortifications are most likely between two states of unequal economies. This is because the state of a higher capacity has no reason to restrain themselves from pressing their advantage and constructing fortifications. Conversely, we are less likely to see fortifications between two states of more equal economies. This is because two low capacity states do not greatly benefit from fortifications and two high capacity states may be either paralysed by a free-rider problem or be discouraged by existing cooperation. Overall, this provides us with the expectation that border fortifications become more likely as inter-state inequality grows.

2.7 Robustness to Migration

In this extension, I consider whether the Fortification Game is robust to a more nuanced incorporation of migration and human mobility. In the main model, the citizen may nominally be a player in the game but they are largely mechanical in their interaction with the states. Their choices in the main model are simply summarised as (1) choosing the cheapest offer of governance services and (2) choosing the services of the nearest state when indifferent.

Taking an abstraction of the Fortification Games, (one of) the citizens now has the choice of moving to a different location on L. Such an exercise tests if the Fortification Game is robust to the possibility of migration in its concept of border stability. Such robustness is substantively important as the definition of border stability employed (from Rudolph 2003 and Carter and Poast 2017) requires that cross-border movements of people unwanted by the states be limited. The formal conceptualisation of border stability, which is what fortifications enforce, in the main game must then be able to capture this restriction on migration to support the broader project.

Let citizens now have the opportunity to choose a 2-tuple (l, p); that is, the citizen can choose a location $l \in L$ to reside in and choose one of any services in $p \in \{p_A, p_B, \text{no service}\}$ offered (or none of the services) to that location l. The citizen's utility is slightly modified as follows

$$u_C(l,p) = \begin{cases} v - p_A(l) & \text{if } p = p_A \\ v - p_B(l) & \text{if } p = p_B \\ 0 & \text{if no service} \end{cases}$$

In addition to this, maintain the tie-breaking assumption that, when indifferent, the citizen chooses the services of the nearest state. Assume also that the citizen chooses not to migrate if indifferent between all locations and services. This latter assumption is intuitive of course as a cost of migration can easily be motivated as an argument for staying put when no strictly better economic options are available.

With this new specification the citizen is slightly more nuanced. In addition to choosing the cheapest service, they also choose the location with the cheapest service. Such a choice allows us to study if a citizen would choose to strategically relocate in search of better economic circumstances (some anecdotal accounts of such behaviours can be seen in Sahlins (1989)). Consider the perspective of a single citizen in L who has the opportunity to make the above choice after the outcome of the Fortification Game has established, loosely speaking. The results from this construction are fairly straightforward and support the earlier conceptualisation of stable and unstable border equilibria.

Take the Stable Borders Strategy Profile that develops from either the construction of fortifications or the adoption of mutual restraint. Under the presumed stable borders, each and every single location $l \in L$ only has one offer of services at price v. As there are no better economic opportunities anywhere for the citizens, they will choose to stay where they are. Thus, the stable borders equilibrium sees no migration which is in line with the definition of stable borders as one where the movement of persons unwanted by the states is minimised.

Finally, consider the Unstable Borders Strategy Profile. In this equilibrium, states compete over providing services to citizens. Both states offer a price of service equal to the higher of the two costs of providing services to a particular $l \in L$ and the citizen at this l chooses the offer of the nearer state. Unlike the stable borders outcome, here there is indeed a variance in economic circumstances at different locations in L. The cheapest services are exactly around $l^\star$ where the *de facto* border between States A and B are established. Recall the simplification that $l^\star$ is of zero measure; this means that some particular l (of which there can be multiple) just inside one side of the border would become the most profitable location for the citizen. This location becomes the destination for economic migration and, as this location is on the other side of $l^\star$ for at least some citizens in L, the prospect of cross-border migration is certainly attractive when borders are unstable.

This demonstrates how the unstable borders captured in the Fortification Games indeed conforms to the earlier definition. Some citizens will be enticed to migrate across the border and such migration is unwanted by one of the states as they lead to a loss in their governance market. This extension thus suggests an empirical expectation where border regions that are unstable will attract significant migration. This provides some support for my earlier assertion that borderlands are becoming increasingly relevant for state economies that motivated the main model of this paper, though this is of course no substitute for an empirical description of this phenomenon that can be the object of further research.

2.8 Conclusion

This paper further develops our understanding of why contemporary states choose to fortify borders. It relies on economic explanations for this phenomenon, specifically highlighting that fortifications serve as an instrument to maximise the economic value (from taxes and market productivity) that a state can extract from its border region citizenry. Fortifications satisfy this purpose through their ability to act as a filter and limit the flow of goods and persons across the border. When such flows are stopped, the populace has no choice but to turn to the local authorities for various governance services which they exchange for taxes and engaging in local markets. Thus, the extraction of this economic value can, at the very least, form part of why contemporary states fortify their borders.

The models above provide some further implications on when we should expect the construction of fortifications. Two important factors are instability and inequality. While there are ways states may achieve border stability by methods such as mutual restraint and non-interference (Acharya and Lee, 2018, 2023), pilfering is tempting and thus mutual restraint is not always possible. Fortifications serve as a costly tool for recourse to establish border stability where it fails to emerge without enforcement. Furthermore, we should also expect fortifications to be more likely across borders that separate regions of unequal prosperity. This is because pairs of border regions that are more economically equal are more likely to achieve stability through mutual restraint (as the temptation to pilfer is reduced). Furthermore, even when borders are initially unstable, economically equal border regions may be less likely to fortify due to the possibility of a free-rider problem where neither state wishes to unilaterally take on the costs of a fortification project in the hopes that the other state does so instead. This relationship between economic inequality and the likeliness of fortifications tangentially echoes the empirical findings of Carter and Poast (2017).

Invoking an economic story provides a satisfying explanation for the correlation between the advancement of time and the uptick in fortifications. One way in which contemporary states diverge from earlier entities is by their bilateral economic relationships with their neighbours over their land borders. The global proliferation in population means that more and more land is now occupied by civilisation. Populated areas are valuable to states due to their economic productivity, consumption and taxability. For many states, this now means that their border regions become ever more relevant to their economic interests as potential sources of revenue now extend all the way to the frontier. States must engage with their neighbours in managing the populace in their shared border regions in order to claim their share of spoils from such economic activity. Thus as the economic value of securing border regions increases, so too does the attractiveness of constructing fortifications to clearly separate one's territory from the neighbours.

Understanding these economic motivations is important as the political discourse around borders and their integrity across the world continues to be xenophobic and exclusionary. We must recognise that such rhetoric may be, at least partially, hiding an attempt to extract wealth from the population for profit. From this perspective, the pursuit of border fortifications may actually be an economic policy that occasionally wears a populist mask. The outcome of such a thought process may be a re-orientation of how we think about borders and their integrity. The modern state may be securing their borders, not in an attempt to curb any outside threats, but rather in the pursuit of keeping their own wealth fenced inside.

3 How to Smuggle Contraband and Influence Border Policy

> "If the fence and we weren't here, all our cattle would flow into Bangladesh. Even now, every night that it rains, these smugglers try all kinds of ways to send the cattle floating down this stream and then get them across the fence."
>
> "*Hum BSF nahin, CSF hain!* We are not the BSF, we are the CSF! Cattle—Security—Force!"
>
> —Indian Border Security Force (BSF) officers, as quoted by Ghosh (2019).

Cattle raised in India fetch a much higher price in neighbouring Muslim-majority Bangladesh than they do in the local markets in Hindu-majority India. This imbalance creates a lucrative market for cattle smuggling that forms part of the headaches for Indian border policy. Whilst some form of fencing has existed between India and Bangladesh since the 1980s, a surge in the construction of outposts on this border in the past few years may be related to the proliferation of cattle smuggling in recent decades. See Sur (2020, 2021) for more on cattle smuggling at the India-Bangladesh border.

Beyond cattle, borders across the world are increasingly permeated by informal and illegal flows of goods (Naím, 2005). Invoking economic factors to explain state motivations for fortifying their borders has found growing traction in the literature (Carter and Poast, 2017; Rosière and Jones, 2012). However, this literature largely focuses on economic factors with respect to the citizenry, and everyday citizens are far from the only economic actors in border politics. Shady corporate ventures, armed militias, illicit traders, smuggling rings and other such actors that can carve out an advantage from an unsecured border are still largely unaccounted for. Any advantage taken by these other actors that hold a stake in border security generally comes at the disadvantage of the state. It follows then that states may fortify their borders to deter such actors and this dynamic is currently under-theorised in the literature.

I present a model where states use border fortifications as a potential response to the activities of these illicit actors or "bandits". Bandits have the opportunity to decide on the extent of their enterprise in the border region. These activities "extract wealth" out of the local economy and are therefore detrimental to state interests. In response, states can choose to fortify their borders and limit the extractive capabilities of the bandits. However, the effectiveness of such fortifications varies depending on the capacity of the illicit actors at the state border. Some bandits are "low-types" that would be severely hampered by fortifications, whilst other bandits can be "high-types" that have the capacity to continue operating significantly despite increased security. By the inherent nature of illicit activity, states cannot be sure of the true capacities of the bandits that trouble them and instead would need to infer types from the extent of wealth extraction these bandits engage in. These activity levels can reveal bandit type and the state responds to this through their decision over border fortifications. However, as fortifications are detrimental to the bandits, they may have the incentive to obfuscate their activities to discourage the state from pursuing fortifications.

My model reveals that border fortifications are more appropriately predicted by perceived threat rather than observed economic impact. This is because bandits are strategic actors and will temper their activities in an attempt to influence state policy-making. Bandits will moderate the extraction of wealth, such as by deliberately limiting the volume of smuggled goods, just enough to make investing in fortifications not worth the cost relative to the benefit. Thus, when fortifications are pursued by states, it is likely driven by the state's beliefs over unrealised threats rather than actual realised consequences of banditry as a strategic bandit would act to avoid such an outcome. Such a result has important implications for our understanding of a state's pursuit of border security policies.

This self-moderation by bandits however is not to the state's benefit as the dynamics of incomplete information significantly hamper the state's ability to properly respond to bandit threat. While bandit self-restraint does reduce the economic losses of states in the short-term, it is also a strategic choice to dissuade the state from strengthening their borders and allows for greater long-term exploitation. Due to this, in a large number of scenarios, states only employ border fortifications sub-optimally and are unable to significantly reduce illicit activity through such policies.

This paper contributes to the literature attempting to understand both the causes and consequences of increased security and fortifications on inter-state borders. With respect to causes, it follows a growing literature emphasising the potential economic interests in securing the border (Carter and Poast, 2017; Rosière and Jones, 2012) and pushes back against the theory that modern day fortifications are merely symbolic (Brown, 2017). In terms of consequences, it provides some insight into the potential impacts of fortifying the border. Scholarship on such impacts on contemporary fortifications have thus far focused mostly on security implications (Avdan and Gelpi, 2017; Linebarger and Braithwaite, 2020) and formal trade (Carter and Poast, 2020). More broadly, my models provide further perspective into policies on border security and fortification in a time where they are very salient due to conflicts in Syria and Palestine, the refugee crisis in Europe, and the ongoing fallout of Trump administration policies in the United States.

3.1 The Competition for Extraction

Existing work suggests that the modal circumstance for border fortifications only involve the efforts of one state. Border fortifications empirically tend to emerge between two states of unequal economic wealth. Wealthy states are argued to use border fortifications as a tool to limit the negative externalities of bordering a lower capacity neighbour. Hassner and Wittenberg (2015) make this point, with the specific emphasis on the function of stopping migrants as the primary economic motivation. Carter and Poast (2017) argue for a broader set of economic purposes for border walls, including the prevention of spill overs from political instability or—most relevantly for this paper—high levels of cross-border illicit activities. It seems a fair conclusion then that in most circumstances only one of the two neighbouring states are actively contemplating the choice of fortifying the border between them. Through this established lesson, the models in this paper take fortifications to be the unilateral choice of one state rather than a strategic problem involving two states.

3.1.1 Borderland Bandits

This paper studies how the strategic actions of illicit and illegitimate actors in the border region affect state preferences for border integrity and fortifications. Such actors include what Andreas (2003) calls “clandestine international actors”, defined as non-state actors operating across state borders, in violation of state laws, and actively evading law enforcement. From the state’s perspective, these actors affect state wealth negatively and states may have an incentive to secure their borders to stop them. In addition, my model focuses on how these clandestine actors may also have strategic interests over future border security arrangements and may adjust their behaviour to influence state policy. I collectively refer to these actors as **bandits**.

Smugglers and traffickers are the most obvious example of bandits. They covertly channel goods produced by the citizens out of the state, making it difficult for the state to tax the revenue associated with their sale. They also illicitly introduce outside goods into the state in a way that prevents the state from extracting tariffs upon them. Powerful corporations that fail to be reined in by the law and organised crime syndicates may also have similar impacts on the border region. These types of illicit enterprises are growing in prominence and now occupy a significant portion of the global economy (Naím, 2005). In turn, states must consider policies to mitigate economic losses from illicit trade. Getmansky, Grossman and Wright (2019) have shown the ability of border walls to mitigate crime and smuggling in a region inadvertently, suggesting that fortifications may be a viable policy to achieve this end.

A related category of bandits may be non-state militias. While armed militias are more often viewed as security threats, their capacity to control territory and forcibly secure resources undoubtedly make them economic threats as well. Violent militias occupy significant supplies, resources and manpower that can spill-over across borders (Bara, 2018) and this spill-over can be contained by fortifications (Linebarger and Braithwaite, 2020). States might then have an interest in fortifying the border to mitigate the economic impact of these militants. Finally, the implications of my model can also be applied in modelling the strategy and responses to migration and refugees; I will discuss this application towards the end of the paper.

3.1.2 A Formal Construction of Bandits

I acknowledge that there is some conceptual overlap between bandits and everyday citizens. At a micro level, citizens are continuously extracting wealth from each other through the exchange of goods and services or through the compensation for labour through wages. However, when citizens exchange wealth amongst each other, this wealth remains within the system and such exchanges are not harmful to state interests. (They may, in fact, actually be a boon as such market exchanges continuously enrich and invigorate the economy.) Herein lies the difference between citizens and bandits: when bandits extract wealth from citizens, that wealth leaves the system to enrich the bandit.

Formally, this difference is reflected in how unrealised pay-offs for the state manifests in the game set-up. In existing models of borderland politics (e.g. Acharya and Lee 2018), when states fail to maximise their pay-offs, this directly leads to an increase in the pay-offs of the citizens. However, in this paper a loss of utility by the state instead leads to an increase in bandit utility. That is, the loss of wealth does not remain "in the system" in the hands of the citizens, but rather is entirely lost to the system into hands of an outside party. This mechanism attempts to capture the difference between illicit extractions by the various types of actors captured by the "Bandits" versus more legitimate transfers of wealth (from the state's perspective). This reflects how, in areas where the power of the state is weak, the vacuum may be filled with non-state actors such as mafias, drug cartels or armed militias who take some of the fruits of the local economy into their own coffers.

Not all bandits are made equal. There can exist both strong bandits whose extractive enterprises are backed by considerable resourcefulness and much weaker bandits where their entire program is kept afloat only through the exploitation of border instability. For example, the Arellano Félix drug trafficking organisation can probably be considered a "strong" type of bandit. The Arellano Félix family, at the height of their powers in the 1990s, monopolised control over the drug trade—and border crossings more generally—in and around the Mexican city of Tijuana (bordering the US city of San Diego). Connections with government, the local wealthy and American gangs come together with a lack of competition to give them great capacity in their trafficking activities (Durán-Martínez, 2018; Naím, 2005). By contrast, on Mexico's southern border with Guatemala, much lower capacity bandits can be seen. The Mexican state of Chiapas and the Guatemalan department of Huehuetenango respectively are amongst each country's poorest regions. Galemba (2012, 2018) documents how, at unmonitored cross-border roads between these two regions, local truckers smuggle goods of relatively little value (most commonly corn) just to make a living. Although organised crime does exist on the Guatemalan side of the border (Galemba, 2018), the local families trading corn and onions are certainly a "weak" type of bandit.

From the perspective of the state, these differences in the "types" of bandits are important as some can be stopped more easily than others. When faced with a weak bandit, states may be interested in fortifying borders to stymie their activities and prevent wealth from escaping. However, this same incentive may not exist against a strong bandit. This is because fortifications can be less effective in the face of the capabilities of the strong bandit. This ineffective deterrence, when combined with the cost of fortification, may result in a net reduction in utility for states compared to maintaining the status quo.

Unfortunately for states, they are not always capable of distinguishing strong and weak bandits. Illicit actors after all thrive in circumstances of uncertainty. In formal terms, the game between states and the borderland bandits is characterised by incomplete information.

In order to discourage the state from taking action, bandits may strategically limit the goods they smuggle today in order to ensure that their enterprise may continue tomorrow. Alternatively, the bandits may choose to put in greater efforts to hide their illicit activity and such obfuscation is formally equivalent to limiting their activities due to the additional costs it imposes. Due to either type of strategic obfuscation, states are unable to perfectly distinguish the type of bandits they are playing against. They can only infer their capabilities using a combination of their prior beliefs and any information they interpret from the bandits by observing their extractive activities, leaving them uncertain of when fortifications will be good policy. Returning to the case in Tijuana, an example of this obfuscation might how Arellano Félix, at the height of their powers, would deliberately avoid overt violence in order to not draw excessive attention that might lead to greater enforcement (Durán-Martínez, 2018).

3.1.3 Timing

The purpose of fortifying borders in the context of this paper is to stop the activities of illicit actors. It follows that the appropriate order of play is for the state to first decide on fortifications before their adversary decides on extractive activities. However, this poses a problem as we have also established that state strategies are informed by the level of illicit activities. In order for this learning to take place, it must also be true that illicit extraction precedes decisions over fortifications. Thus, the game is designed with an infinite horizon to allow the incorporation of both these considerations simultaneously.

The model that follows thus allows states to use past periods as lessons to determine whether or not to fortify in the current period. Should they choose to fortify, then they successfully limit banditry not only in the current period but also in future periods. This is a consequence of fortifications in the model being permanent, and this permanence is reflected in the one-time cost of such fortifications and their permanent restriction upon bandit extraction levels.

One interesting consequence of the repeated design of the game is the timing of state decisions to fortify. States have the option of either waiting to learn what extractive activities reveal about bandit types before deciding on fortifications or to forgo the wait and secure the border immediately. The benefit of waiting and learning is the improved likelihood of making the correct fortification decision with respect to bandit types. However, waiting to learn requires the state to sacrifice their short-term profits as bait for banditry. Thus, the choice of fortifying pre-emptively before waiting to learn bandit types provides guaranteed short-term benefits at the risk of a bad long-term investment.

3.2 The Game

This section introduces the **Border Extraction Game**. There are two players: the State and the Bandit. The State and the Bandit play an infinite horizon game with periods indexed by t. There are two types of bandits, Type H and Type L (representing high types and low types). Types are expressed as $\tau \in \{H, L\}$. A Bandit is Type H with probability p and Type L with probability $1 - p$, where $0 \leq p \leq 1$, or $\mathbb{P}(\tau = H) = p$ and $\mathbb{P}(\tau = L) = 1 - p$. Types remain the private information of the Bandit, though the State does know the probability distributions of unrealised types p.

The game is divided into two states: an Unfortified state and a Fortified state. The game begins Unfortified. When Unfortified, the State has the choice of Fortify or Not Fortify. Choosing to Fortify incurs the State a one-time cost of $k > 1$. If Not Fortify is chosen, the game continues in the Unfortified state and the Bandit then moves to decide the level of extraction $x_t \in [0, 1]$ they take away from the economy. After the extraction level is chosen, pay-offs are realised and the game transitions to a new period. If Fortify is chosen, then the game instead moves to the Fortified state.

There are several differences between the Fortified and the Unfortified states. Most pointedly, the State no longer has a choice over fortifications when Fortified as such fortifications already exist by virtue of their past choices. The choice of Fortify in this game is designed to be permanent: once it is chosen, the game transitions to the Fortified state and stays there. Therefore, only the Bandit has a strategy to choose in the Fortified state. The Bandit's choice however is also impacted when Fortified: their choice over their extraction levels is now limited to $x_t \in [0, \theta_\tau]$. The new upper bound on extraction when Fortified varies by type: Type H has a higher extraction limit than Type L following fortifications. That is, $0 \leq \theta_L < \theta_H \leq 1$. Finally, when Fortified, the game always remains Fortified in the following period.

The design of this game therefore has Bandit types only be different in their extractive capacities when the game is Fortified. I argue this design is justified because it must be post-fortification differences between different types of Bandits that must drive any potential differences in the State's choice of border policy. In order to isolate this effect in my formal inquiry, I focus the design to make the post-fortification limits the primary difference between Bandit types.

Moving on, define $f_t \in \{0, 1\}$ to capture whether or not fortifications were built in period t. The one-period pay-offs are as follows. For the State,

$$u_{State}(x_t, f_t) = 1 - x_t - kf_t$$

and for the Bandit it is simply

$$u_{Bandit}(x_t) = x_t$$

Pay-offs of future periods are discounted by factor $\delta \in (p, 1)$. The specification that δ always be larger than p will later simplify solutions by eliminating the need for additional conditions for equilibrium. This completes the description of the game.

The following itemised order of play summarises the game.

0. Set $t = 0$. Nature draws Bandit type $\tau \in \{H, L\}$, where $\mathbb{P}(\tau = H) = p$. This type is the Bandit's private information.
1. Increase t by 1. The State chooses Fortify or Not Fortify. If Not Fortify was chosen, continue to Step 2. If Fortify was chosen, continue to Step 5.
2. The Bandit chooses an extraction level $x_t \in [0, 1]$.
3. Period pay-offs are revealed. Repeat from Step 1.
4. Increase t by 1.
5. The Bandit chooses an extraction level $x_t \in [0, \theta_\tau]$, where $1 \geq \theta_H > \theta_L \geq 0$.
6. Period pay-offs are revealed. Repeat from Step 4.

The itemised order of play highlights how Steps 1 through 3 represent the Unfortified state whilst Steps 4 through 6 represents the Fortified state.

3.3 Solutions

The solution concept for this game is perfect Bayesian equilibrium and I specifically focus on solutions with only stationary strategies. With what falls out, I hope to sufficiently demonstrate the dynamics between two broad options for the state in dealing with bandits: a reactive wait-and-see approach versus a more pre-emptive and pro-active approach.

3.3.1 Reactive Fortification

Ideally, the State wishes to learn the type of the Bandit before making a decision on fortifications. However, the State has a problem: in any single period of the game, the State decision on fortifications must come before the Bandit acts on their level of extraction. This problem goes away when the game is repeated as the State can learn from the strategies in period $t-1$ to inform their choice in period t.

I begin by first solving for strategies in the Fortified state as it is the simpler of the two states. Recall that the Bandit's pay-offs are strictly increasing in their extraction level x_t. As the State no longer has any strategies to choose from in the Fortified state, there is no strategic incentive for the Bandit to choose anything but their maximum level of extraction. This also reflects how, in the face of decisive state choice on border policy, there is no longer a good reason for bandits to waste resources in hiding their capacities. Thus, when Fortified, the only equilibrium choice is $x_t = \theta_\tau$, for all types and all t.

Staying with the Bandit's strategy, I move to consider their options in the Unfortified state. Here, the bandits have the full range of $[0, 1]$ from which to extract from but may nonetheless have an incentive to restrict their actions (deliberately limit their smuggling and trafficking) in order to influence the future choice of the State. Let q_t be the State's posterior beliefs that the Bandit is Type H in period t. Let $x^\star(q_t)$ represent this possible restricted action given State beliefs and assume that, when Unfortified, the Bandit plays some $x_t = x^\star(q_t)$ as a stationary strategy. This $x^\star(q_t)$, designed to influence the State's choice over fortifications, must then be the action that induces the State to be indifferent between Fortify and Not Fortify under their later posterior beliefs over Bandit type. With the strategies of the Bandit fixed, this indifference point can be determined using the expected utility of the State as follows

$$\begin{aligned}
\mathbb{E}\text{U}_{State}(\text{Fortify}) =& \mathbb{E}\text{U}_{State}(\text{Never Fortify}) \\
1 - x^\star(q_t) + \delta\left(\frac{q_t(1-\theta_H) + (1-q_t)(1-\theta_L)}{1-\delta} - k\right) =& \frac{1 - x^\star(q_t)}{1-\delta} \\
x^\star(q_t) =& (1-\delta)k + q_t\theta_H + (1-q_t)\theta_L
\end{aligned}$$

I refer to $x^\star(q_t)$ as the "critical level" of extraction. This refers to how $x^\star(q_t)$ is the highest amount of extraction under which the state still weakly prefers to Not Fortify. Thus, from the perspective of the Bandit that wants to extract as much wealth possible without inducing the State to Fortify, $x_t = x^\star(q_t = q_{t+1})$ becomes the optimal choice in period t given that it is not until period $t+1$ that the state will act on the information revealed by Bandit action. This critical level $x^\star(q_t = q_{t+1})$ is therefore one of the rationalisable strategies for the Bandit in the Unfortified state. Recognise also that $1 - x^\star(q_t)$ can also be interpreted as the state's expected per period pay-off in a fortified world.

The only times when the Bandit does not play the critical level $x^\star(\cdot)$ in the Unfortified state is when they have no need to encourage the State to Not Fortify. This circumstance manifests only when their post-fortification extraction limit (with some discounting) is greater than the restrained critical level. This is because the purpose of restraint is to maintain the more favourable environment for extraction when the game is Unfortified. After accounting for discounting, this threshold is $1 - \delta + \delta\theta_\tau > x^\star(q_t = p)$. Notice that in this threshold, the critical extraction level is calculated when the posterior matches the prior ($q_t = p$). This is appropriate given that, below this threshold, the Bandit has no incentive to limit their extraction in such a circumstance, leading to a pooling scenario where both Bandit types restrain themselves and the State is unable to update their beliefs.

Note that it is not possible for θ_L to be greater than $x^\star(q_t)$ for any t. Scrutinising the above function of $x^\star(q_t)$, paired with the recognition that $\theta_H > \theta_L$, reveals this. Therefore, only Type H, under certain parameter values, may have an incentive to not play $x^\star(\cdot)$. When such circumstances emerge, these Type H Bandits instead play the maximum possible level of extraction in the Unfortified state $x_t = 1$. Upon observing such a choice, the State correctly concludes that this signal separates out the Bandit as Type H and plays Fortify in response in the next period. In other circumstances, the two Bandit types pool on the critical level $x^\star(\cdot)$ and successfully deter the state from fortifying.

What separates these circumstances is the parameterisation of the game. In particular, the possible equilibria for the Border Extraction Game depend on the relative values of $x^\star(\cdot)$ and

θ_τ. I first focus on when $x^\star(q_t = p) > 1 - \delta + \delta\theta_H$. This parameterisation leads to a "pooling" equilibrium where the Bandits are successful in deterring the State from fortifying the border as both types choose to limit their extraction. Formally,

Proposition 1. *There exists a perfect Bayesian equilibrium to the General Border Extraction game when $x^\star(q_t = p) \geq 1 - \delta + \delta\theta_H$, which I call the* ***Pooling Equilibrium****, such that*

1a When the game is Unfortified, the Bandit plays $x_t = x^\star(q_t = q_{t+1} = p)$,

1b When the game is Fortified, the Bandit plays $x_t = \theta_\tau$,

1c The State plays Not Fortify in the first period, and

1d The State plays Fortify with belief $q_t = 1$ in subsequent periods if the history has ever been that $x_t > x^\star(q_t = p)$, and plays Not Fortify with belief $q_t = p$ otherwise.

Formally, there is a continuum of possible pooling-like equilibrium similar to proposition 1 over a range of possible posterior beliefs q_t that are sufficient to make their choices in 1d rational. (Updating mechanisms that do not conform to this cut-off formula are ruled out by assuming the Bandit only plays stationary strategies, as previously stated.) I posit that the beliefs in proposition 1, where the posterior matches prior when all Bandit types play $x^\star(q_t = p)$, are most appropriate as no updating seems most reasonable when the Bandit types pool their strategies.

Now I move to the other case where $1 - \delta + \delta\theta_H > x^\star(q_t = p)$. This time, the maximum extraction for high types θ_H (after discounting) exceeds the critical extraction level $x^\star(\cdot)$. That is, Type H Bandits no longer have an incentive to limit their extraction to the critical level as the punishment mechanism of wall-building is not as effective on them. The pooling equilibrium thus no longer exists in this case. Instead, Bandits play a separating strategy in the Unfortified state: Type H Bandits extract maximally with $x_t = 1$, whilst Type L continues to moderate but a lower critical x than proposition 1. Note that although there is different critical extraction level played in equilibrium by Type L here, the condition governing the existence of this equilibrium is still dependent on the original $x^\star(\cdot)$.

Proposition 2. *There exists a perfect Bayesian equilibrium to the General Border Extraction game when $k \leq \frac{1-\theta_H}{1-\delta}$ and $1-\delta+\delta\theta_H \geq x^\star(q_t = p)$, which I call the* ***Discriminating Fortification Equilibrium****, such that*

2a When the game is Unfortified, Type H Bandits play $x_t = 1$ and Type L Bandits play $x_t = \frac{1-\delta}{1-p}\left(k(1-p\delta) - p(1-\theta_H)\right) - \theta_L$,

2b When the game is Fortified, the Bandit plays $x_t = \theta_\tau$,

2c The State plays Not Fortify in the first period, and

2d The State plays Fortify with belief $q_t = 1$ in subsequent periods if the history has ever been that $x_t > x^\star(q_t = 0)$, and plays Not Fortify with belief $q_t = 0$ otherwise.

The first condition for proposition 2, $k \leq \frac{1-\theta_H}{1-\delta}$, reflects how the State must value the future enough (high δ) to take expensive and immediate corrective action. It also requires fortification to not be prohibitively expensive (low k) and that there be reasonable economic gains from fortifying (low θ_H, to allow for a substantial drop in extraction after fortifications).

The value $x^\star(q_t = p)$ determines the outcome of the Border Extraction Game. When $x^\star(q_t = p)$ exceeds θ_H (modified with some discounting), the Border Extraction Game reaches a pooling equilibrium where the State does Not Fortify. Only when this pattern is reversed does the outcome of fortifications become a possibility. In other words, we are more likely to see fortifications as $x^\star(q_t = p)$ decreases. As $x^\star(q_t = p)$ is in turn a function of other parameters of the game, a comparative statics analysis helps determine the relationship between these parameters and the decision to Fortify. Recognise that $x^\star(q_t = p) = (1-\delta)k + p\theta_H + (1-p)\theta_L$, from which we can derive

Proposition 3. *Fortifications become more profitable as the cost of fortifications k decreases, as the probability of Type H Bandits p decreases, as the discount factor δ increases, and as the post-extraction extractive capacities of the Bandits θ_τ for all τ decreases.*

Note that the condition $k \leq \frac{1-\theta_H}{1-\delta}$ has comparative statics that point in exactly the same direction as described in proposition 3 and thus do not complicate interpretation.

The effects of each of these parameters are straightforward in their substantive implications through how they increase the value of fortifications as an investment. Decreasing the cost k makes fortifications cheaper, increasing δ improves the future profits secured by fortifications, decreasing the prevalence of powerful Bandits p increases the likelihood that fortifications have a larger impact in curbing extraction (as fortifications are more successful in stopping Type L rather than Type H) and decreasing post-fortification Bandit capacity θ_τ makes the fortifications more effective in curbing fortifications. This latter point is complicated by the fact that $x^\star(q_t = p)$ determines fortifications only relative to θ_H, however the relationship holds under the restriction $p < \delta$.

Some further commentary can help illustrate some finer points of interest surrounding $x^\star(\cdot)$. It is important to recognise that self-restraint by Type L Bandits (and Type H Bandits too if in the pooling equilibrium) is by no means a good thing for States. First, note that $x^\star(\cdot) > \theta_\tau$ for any τ that chooses to play the self-restraint strategy to avoid fortifications when the game is Unfortified. That is, the supposedly restrained extraction level is always worse for the state than how much the Bandit can extract if the border is secured.

Second, note that $x^\star(\cdot)$ is increasing in k. This highlights how Bandits are essentially leveraging the potential costs of fortifications against the State. The costlier the solution to banditry (high k), the worse the banditry problem becomes (high $x^\star(\cdot)$). In other words, the extraction level that Bandits pursue in equilibrium increases as the necessary cost to stop them becomes more expensive. This is because States grow more reluctant to secure their borders with increasing costs and this in turn emboldens the Bandits into higher levels of activity. This facet of the model solution reveals that, when k is high, States must choose between the lesser evil of either an insecure border with rampant illicit activities or the exorbitant expense of stopping them. Given that states with weaker capacities will find the cost of securing their borders k to be relative high, this is consistent with how such states are likely to have less stable borders with significant illicit activities as they are unable to afford the ever increasing necessary investment to secure their frontier.

It may be further illustrative to consider geographic factors such as border length or terrain as part of the determinants of k. A border that is particularly long or rough can be more difficult to fortify. Recognising this difficulty, bandits in turn will feel confident in further scaling up the extent of their enterprise safe in the knowledge that the state will be hesitant to react. The greater this difficulty, the further the bandits will scale up their extraction and this intuition is revealed by how $x^{\star}(\cdot)$ is a function of k. It would thus be naive to use the level of illicit activity to predict border security measures as the two variables are endogenous to each other, and more on this will be discussed later.

3.3.2 Pre-Emptive Fortification

Next, I propose a third possible solution to the game when the State ignores the potential to learn. In this equilibrium, the State plays Fortify immediately without waiting for Bandit type to be revealed. Such a choice is reinforced by the off-the-path strategies of the Bandits and is possible so long as the cost of fortifications k is not prohibitively large.

Proposition 4. *There exists a perfect Bayesian equilibrium to the General Border Extraction game when $k \leq \frac{1-(p\theta_H+(1-p)\theta_L)}{1-\delta}$, which I call the **Pre-Emptive Fortification Equilibrium**, such that*

4a When the game is Unfortified, the Bandit plays $x_t = 1$,

4b When the game is Fortified, the Bandit plays $x_t = \theta_\tau$, and

4c The State plays Fortify with any belief $q_t \in [0, 1]$ in all periods.

It is fairly straightforward to demonstrate that proposition 4 is an equilibrium. When the Bandits plan to extract maximally regardless of circumstance, then the State can only gain positive utility by choosing to Fortify (with the minor exception when fortifications are prohibitively expensive $k > \frac{1-(p\theta_H+(1-p)\theta_L)}{1-\delta}$). Given that fortifications are attractive and that the Bandits behave the same in every period, it is most profitable then for the State to Fortify at the very first opportunity. If the State's strategy is specified as fortifying at any opportunity, then the Bandits have nothing to lose from planning to extract maximally ($x_t = 1$) in the off-the-path Unfortified scenario.

Pre-emptive fortifications are then a rational strategy for a State that has particular assumptions about the Bandits they are facing. In particular, States that assume the worst possible outcome ($x_t = 1$) when Bandits are left unchecked will have an incentive to pre-emptively fortify. In turn, the pre-emptively erected fortifications mean that their assumptions are never challenged, reinforcing their original strategy.

However, is pre-emptive fortification actually good policy? I consider this by comparing the utility of pre-emptive equilibria versus reactive equilibria from the perspective of the State. This is done by comparing the state's expected utility under the pre-emptive outcome with their expected utility under two reactive outcomes, respectively.

Lemma 1. *The expected utility for the State is the same under both the Pooling Equilibrium and the Pre-emptive Fortification Equilibrium.*

Lemma 2. *The expected utility for the State is greater under the Pre-emptive Fortification Equilibrium compared to the Discriminating Fortification Equilibrium when* $k < \frac{\theta_L(1-p)}{(1-\delta)(p\delta-1)}$.

The results of lemmas 1 and 2 suggest that pre-emptive strategies can only be more (or less) profitable than reactive strategies when the Discriminating Fortification Equilibrium is the outcome. Furthermore, recall the results of proposition 3 that describe when the Discriminating Fortification Equilibrium is more profitable relative to the Pooling Equilibrium. Consolidating the lemmas and proposition 3 and focusing on parameters where the comparative statics analyses point in the same direction, we get

Proposition 5. *Pre-emptive fortifications become more profitable as the cost of fortifications k decreases, as the probability of Type H Bandits p decreases, and as the post-extraction extractive capacities of the Type-H Bandits θ_H decreases.*

3.4 Extension: Honour among Thieves

One complication that I have thus far put aside is that there may be more than one bandit at any border and these bandits may be independently deciding on extraction levels. A brief extension in this section will demonstrate that the above results hold when collective action problems amongst bandits are accounted for.

Let there now be n Bandits $i \in \{1, 2, \cdots, n\}$. Each Bandit has an associated type, either Type H or Type L, that is again private and drawn independently at the start of the game from the same distribution of types as before. Each Bandit i also has an associated size $y_i \in (0, 1]$ such that $\sum y_i = 1$. Each Bandit i in each period t individually chooses an extraction level x_{it} and, for the purposes of this extension, the overall level of extraction then becomes $x_t = \sum x_{it} y_i$. Bandits choose their level of extraction simultaneously. The game otherwise continuous as previously designed.

Recognise that, for the Pooling Equilibrium, not much has changed. It will still be an equilibrium for all Bandits to extract $x^\star(q_t = q_{t+1} = p)$ in every period. There is no incentive to deviate from this choice as extracting any more will cause the state to Fortify, an outcome that all Bandits wish to avoid regardless of type when $x^\star(q_t = p) > 1 - \delta + \delta\theta_H$. (And there is, of course, no incentive to extract less.) Note that there are, as typical of this species of collective action problems, other configurations of extraction choices can also lead to similar outcomes so long at $x_t = x^\star(q_t = q_{t+1} = p)$ for all t.

There is also not much change for the Pre-Emptive Fortification Equilibrium. So long as the State intends to Fortify regardless of Bandit choice, and Bandits reinforce this choice by intending to extract maximally, this equilibrium will play out largely the same.

The remaining case then is the Discriminating Fortification Equilibrium. Recall that, when $1 - \delta + \delta\theta_H > x^\star(q_t = p)$, Type H Bandits have no incentive to limit their extraction. Type L Bandits may have an incentive to limit extraction provided that there are few enough Type H Bandits in the bandit population that the State can be convinced not to act. This new level of limited extraction $x^{\star\star}(q_{t+1})$ will vary depending on the proportion of types drawn. Let y_τ represent the sum of the sizes of Bandits of type τ. Provided that Bandits play stationary strategies, the required further limited extraction level to prevent fortifications is $x^{\star\star}(q_{t+1}) = x^\star(q_{t+1}) - y_H$. Type L Bandits will be willing to endure this further self-restraint so long as it still allows them to extract more than they can under fortifications, $x^{\star\star}(q_{t+1}) \geq \theta_L$. This leads to a version of the Discriminating Fortification Equilibrium where the separation of strategies is more constrained, as follows

Proposition 6. *There exists a perfect Bayesian equilibrium to the collective action extension when* $k \leq \frac{1-\theta_H}{1-\delta}$ *and* $1 - \delta + \delta\theta_H > x^\star(q_t = p)$ *such that*

6a *When the game is Unfortified, Type* H *Bandits play* $x_{it} = 1$*, and Type* L *Bandits play* $x_{it} = x^{\star\star}(q_{t+1})$ *when* $1 > x^{\star\star}(q_{t+1}) \geq \theta_L$ *and play* $x_{it} = 1$ *otherwise,*

6b *When the game is Fortified, Bandits play* $x_i t = \theta_\tau$*,*

6c *The State plays Not Fortify in the first period,*

6d *The State plays Fortify in subsequent periods if the history has ever been that* $x_t > x^\star(q_t = p)$ *and plays Not Fortify otherwise, and*

6e *The State believes that Bandit* i *is Type* H *if they have always played* $x_{ti} = 1$ *when the game is Unfortified and believe that they are Type* L *otherwise, for all* $i \in \{1, 2, \cdots, n\}$.

Again, there are minor variations of proposition 6 where the burden of self-restraint amongst Type L Bandits is distributed differently. They will lead to a similar outcome so long as the average level of extraction amongst Type L Bandits is $x^{\star\star}(q_{t+1})$ when the separating strategy is played. There will also be variations where the cut-off formula in 6e is different. Regardless, accounting for collective action problems amongst Bandits reveals that fortifications are slightly more likely. Beyond this, the overall lessons of the model are unchanged.

3.5 Discussion

3.5.1 Violence

A common by-product of illicit trans-border activity is violence. There are several ways of understanding how violence fits into an understanding of what I termed banditry. Given the economic focus of this paper, it follows to assume that violence is one of the tools that bandits might use to further their economic objectives. The reality of drug cartels in the Americas (Durán-Martínez, 2015, 2018), where violence is strategically used (or not used) to protect and facilitate their activities, is perhaps the most prominent example of this. What do my models above imply about the prevalence of this type of violence?

Much like economic externalities, violence attracts government attention. The excessive use of violence in carrying out banditry can therefore invite government intervention (Castillo and Kronick, 2020; Durán-Martínez, 2015). Thus, again much like economic extraction, bandits may have an incentive to limit the use of violence in order to avoid this intervention. The previously invoked anecdote of the Arellano Félix organisation in Tijuana, whom at the height of their powers ruled the local drug trade without overt violence (Durán-Martínez, 2018), supports this logic. The government, on the other hand, wishes to avoid the escalation of violence due to its various externalities on society.

For trans-border operations like Arellano Félix, one particular type of government intervention they specifically wish to avoid is the tightening of border security. Bandits may self-moderate their violence to discourage border fortifications. Once the border has been hardened however, bandits may no longer have an incentive to limit their violence. The consequences of this will vary based on the strengths of the bandits; more powerful groups will wreak greater carnage, whilst the violence of weaker groups will create a smaller splash. Altogether, this recreates the same strategic problem discussed in my models above.

Many of the lessons on the relationship between border policy and the economics of banditry therefore also apply for the relationship between border policy and bandit violence. For governments, securing the border as a policy solution to the potential or realised violence of illicit trans-border actors has the same inefficiencies discussed throughout this paper. This conclusion mirrors existing political science theories where government intervention in the drug trade may have perverse effects (Castillo and Kronick, 2020). For political scientists, this intricate relationship between violence and border enforcement requires us to take care when operationalising predictors of government policies, as will be discussed more generally towards the end of this section.

3.5.2 Application to Migration

Beyond the overtly illicit actors thus far discussed are more innocuous forces such as refugees and other irregular migrants. Although I recognise that there are obvious legal and substantive distinctions, Andreas's (2003) clandestine actors and irregular migrants are all formally equivalent in my models and can both be modelled as Bandits. This is because, for decision-makers on behalf of the state, migrants and refugees are also undesirables that may effect state wealth negatively and states may have an incentive to secure their borders to stop them. More pointedly, I argue that there are also strategic considerations in the phenomenon of migration that make the lessons of the model applicable.

Consider first the interest of the states and their citizens who may see such irregular migrants as economic burdens. Migrants are likely to send a significant portion of earnings back as remittance and are also seen as occupying jobs and resources at the expense of locals (see Hainmueller and Hopkins 2014 for a review). Refugees broadly may be viewed in the same light, especially as there is a growing trend amongst citizens dismissing them as "bogus" (Esses, Medianu and Lawson, 2013; Findor et al., 2021) and conflating them instead with economic migrants (Goodman and Speer, 2007). While land borders may not be the only access point for refugees and migrants, these discursive trends demonstrate that citizens see economic threats looming at their borders. States may in turn act to secure the border against such migration, particularly as border fortifications are shown to be effective means to this end (Feigenberg, 2020).

I turn to discussing some variants of irregular migration and how they might fit the assumptions of the model. Consider first the most relevant category of human smuggling. The literature on human smuggling has long emphasised understanding the phenomenon through a business model of the practice (Salt and Stein, 1997), or perhaps more accurately as a lucrative cross-border criminal enterprise (Aronowitz, 2001) profiting from offering smuggling as a service (Bilger, Hofmann and Jandl, 2006). The smuggled eagerly pay the price as they quickly recoup the fees through their new economic opportunities (Koser, 2008). Much like smugglers of more conventional contraband, human smugglers may have the strategic incentive to limit their activities to protect their future profits by influencing state policy.

Alternatively, it may be neighbouring states themselves that are channelling migrants and refugees for political benefit. Termed blackmailing and back-scratching by Tsourapas (2019) or coercive engineered migration by Greenhill (2010), the most prominent example of this phenomenon is likely the Turkish management of Syrian refugees at their border with the EU. Turkey positions itself as the "gatekeepers" to the EU and, since 2011, will often threaten to open the floodgates of migrants into Europe as a bargaining chip with Brussels (Gökalp Aras, 2019*a*,*b*). The construction of fortifications on the Greek-Turkish border in 2012 may be considered a reactive strategy to Turkish "blackmail". Yet the migrant crisis in 2015 still had a great impact on Europe, reflecting how in the Discriminating Fortification Equilibrium there is still significant extraction $x_t = \theta_H$ as fortifications only serve to avoid the most costly outcome of $x_t = 1$.

3.5.3 Fortification and Fascism

The most interesting lesson of the above model reveals that different approaches to learning about banditry threats are more effective under different circumstances. This suggests different preferred policy approaches for different political actors based on what their assumptions are about banditry. In particular, propositions 4 and 5 highlight some rather unusual assumptions that must be held by border security enthusiasts. Pre-emptive fortification is most profitable when Bandits are likely to be weak (low p and θ_H), yet a pre-emptive fortification outcome requires the State to presume that the Bandits will always wreak maximum havoc ($x_t = 1$) whenever allowed to do so.

This mismatch in beliefs, that threats at the border are simultaneously incompetent but potentially very damaging, parallels very well with some forms of political rhetoric. Stringent border security policies tend to be normally associated with nationalist right-wing politics such as the Alternative for Germany (AfD) party in Germany, the Fidesz party in Hungary or the Republican party in the United States. Such viewpoints contain the necessary contradictions where outsiders will often be considered both as lesser peoples and simultaneously as grave threats that must be actioned upon. This aligns with Umberto Eco's (1995) description of fascism, where "a beehive of contradictions" or "a structured confusion" is employed by design in place of a coherent ideology. Such viewpoints, Eco continues, require that

> "The followers must feel humiliated by the ostentatious wealth and force of their enemies. When I was a boy I was taught to think of Englishmen as the five-meal people. They ate more frequently than the poor but sober Italians. Jews are rich and help each other through a secret web of mutual assistance. However, the followers must be convinced that they can overwhelm the enemies. Thus, by a continuous shifting of rhetorical focus, the enemies are at the same time too strong and too weak" (Eco, 1995).

A concrete example of contradiction in the context of border politics can be seen in US-

Mexican relations. Certain sophists in US politics will denigrate Latin Americans from nations south of their border but at the same time proclaiming the very same potential newcomers they consider incompetent will threaten the employment prospects of the locals (see Johnson 2019). Thus, while the ingredients for pre-emptive fortifications may seem unintuitive, they do seem to spell out a belief system that exists in contemporary politics.

Intriguingly however, these twisted beliefs can actually work to the advantage of the policy-maker as they suppress the capacity for strategic play by the Bandits. By contrast, policy-makers that behave with more strategy, by waiting to learn before deciding on fortifications, are rendered vulnerable to strategy by the Bandits. Waiting to learn gives the Bandits an opportunity to moderate their activities. This, as earlier described, is to the State's disadvantage as it allows the Bandits to leverage the costs of fortifications against the state for their profit. The upside, of course, for going down the reactive route is that the benefit of learning ensures that fortifications will only be invested in when they are needed.

The appropriate conclusion then seems to be that border fortifications are not a particularly efficient investment regardless of approach. This inefficiency stems out from a tendency for fortifications to be deployed against threats that they are not particularly effective against. This is either because fortifications are used indiscriminately in ignorance in the pre-emptive equilibrium or because they are vulnerable to strategy in the reactive equilibria. The policy implications of this model is perhaps to take the possibility of fortifications off the table entirely and find better avenues for government investment to protect economic interests.

3.5.4 Perception versus Realisation of Threats

Conceptualising bandits as strategic actors reveals some important lessons in predicting policies designed to counter them. Fortifications are more likely when the threat of illicit activity is high and this manifests through two separate mechanisms. The first mechanism is that an increase in banditry threat level means that the Discriminating Fortification equilibrium is more likely to end with fortifications. The second mechanism is that, through proposition 5, an increase in threat level means that the pre-emptive decision to fortify is more likely.

It is important not to conflate the threat of banditry, captured by parameter p, and the actual economic impact of banditry, captured by choice x_t. As bandits act strategically, the correlation between the two may not manifest if it is not in the interest of bandits to flex their strength. An appropriate contrast here might be with disaster preparation policies. If a dam is built to prevent floods, then it would appropriate to judge such an investment on both the risk that floods may occur and a comparison of flood damage in times before and after the dam was built. This is because the weather is a not a strategic actor and the rain has no incentive to pour lightly to prevent government intervention. By contrast, bandits are strategic and the connection between threat and action is less direct because they may temper impact to influence state response.

Unfortunately, threat is a more difficult predictor to operationalise than impact. For more organised species of bandits such as militias or crime rings, metrics of strength such as membership, funding, territorial control, international support and so on may be appropriate measures for p. Such measures may be difficult to obtain and may still not perfectly capture the threat assessment of policy-makers, but my model reveals that they should be more appropriate than direct measures of change in border region economic outcomes. These problems reflect the general difficulties that social science has in finding operationalisable measures that match up to our theoretical interests (Bueno de Mesquita and Tyson, 2020).

Furthermore, the model reveals that we must take care in considering how public fears over banditry play into border policymaking. Let the public's prior belief over banditry threat, specifically the probability that the Bandit is of Type H, be r. The relationship between public opinion and foreign policy is complicated. Although neighbours with a land border are closer to home than other foreign nations, such complications may still apply here. One perspective is a top-down theory where elites cue a rationally ignorant public (Berinsky,

2007) that is normally apathetic of foreign affairs (Rosenau, 1964). In such a theory, public beliefs follow elite beliefs; that is, r is a function of p. Under this assumption, using public opinion as a proxy for p can be problematic as it is causally posterior to elite beliefs and such a relationship may be vulnerable to confounders if there are other factors that contribute to r.

More recent scholarship has begun to emphasise a possible bottom-up relationship in public opinion and foreign policy (Kertzer and Zeitzoff, 2017). I discuss two streams through which the public may form foreign policy perspectives if they are independent from elite cues. First, public opinion may be Bayesian and update their fears over bandits based on new information. This suggests that public beliefs over bandits mirror the beliefs of the State in my model above: they learn of banditry threats through assessment of previous period bandit actions. Here, r becomes a function of x_t. Thus, when a Bayesian public erupts in hysteria over threats at the border, it is likely because it has observed a separating strategy where Type H bandits have revealed themselves as high-capacity ($x_t = 1$) and are judged as an imminent threat. However, recall that the model through the Discriminating Fortifying Equilibrium already predicts that policymakers will be incentivised to act to secure the border through their own economic interests when the Bandit is revealed as Type H. Thus, while there would indeed be a correlation between public hysteria and border action, a lesson from this perspective would be that it is spurious to infer a causal relationship as the Bayesian public and elite policymakers are simply responding to the same stimulus.

Alternatively, the public may not form their foreign policy opinions on simply information but also through their personal values (Kertzer et al., 2014; Rathbun et al., 2016). In the context of bandits at the border, the relevant values may be xenophobia or fears over economic insecurity. In this scenario, public opinion would indeed be external to my model above and, if we in turn believe that policymakers will be cued by this public sentiment, then public opinion can be a reasonable operationalisation of p. Such a scenario implies that it is p that is a function of r. This is the most appropriate scenario to use public opinion as a proxy for the perceptions of policy-makers as public beliefs are causally prior to elite beliefs. Thus, quantitative work that uses public opinion to predict border policies must be aware that they are assuming this type of relationship between government and public perceptions, and not any of the others described above. This is, of course, a general lesson for empirical work on similar policies areas where efforts are designed to suppress strategic actors. Combating tax evasion (Andreoni, Erard and Feinstein, 1998; Border and Sobel, 1987) may be the most prominent example of such areas.

3.6 Conclusion

I have developed a formal model that demonstrates the capacity and propensity of trans-border actors to act strategically and limit their illicit activities. They do so in order to influence state policy on border security to ensure favourable conditions for continued illicit activity far into the future. As a result of this strategic interaction, states are therefore at significant disadvantage when defending their borders against illicit activities and my models suggests that the state is vulnerable to at least some form of inefficiency regardless of how they approach border security policies.

Whilst the model in the paper is specific to border fortifications, the result is generalisable to border policy more broadly. States face very similar strategic dilemmas when considering other ways of controlling their borders such as increasing patrols or installing sophisticated technology. All such actions are costly ways in which states can beef up border security. These other policy options are less intuitive in their permanence or upfront costs but are still captured by the model as they may be considered pseudo-permanent due to either the political costs of backing down once stricter border policies are chosen or the actual costs of reversing established policies.

Lastly, my model may provide intuitions into the general proliferation in fortified borders across the globe in recent decades (see for example Carter and Poast 2017). The advancement of communication and transport technologies has led to the proliferation of cross-border trade and other interactions. Rather predictably, such developments have also had the same proliferating effects on cross-border illicit activities (Naím, 2005). The growth in fortified borders may then partially reflect a reaction from some states to the growth in illicit cross-border activity (or a pre-emptive action against the potential growth of such activities). From this perspective, the results of my model may highlight how, in their desperation for a solution to the growth in illicit activity, some states may have fallen for inefficient policies for stabilising and controlling their frontier.

4 Persistent and Self-Perpetuating Political Differences between Neighbouring Communities

Posner (2004) tells the stories of the Chewas and the Tumbukas, two peoples that straddle the border between Zambia and Malawi. In Zambia, Chewas and Tumbukas are political allies and the cultural differences between them are not politically salient. By contrast, political rivalry is prominent between Chewas and Tumbukas in Malawi. Posner (2004) attributes the difference in relationship between these peoples as a consequence of the differences in the electoral arena of the two states. Chewas and Tumbukas both form a significant proportion of the Malawi population, turning these groups into an electorally significant cleavage. However, both peoples are a much smaller proportion of the Zambian population, allowing them to be political allies. Thus, in the case described by Posner (2004), the differences in political institutions on either side of the border between Zambia and Malawi are what enforces and perpetuates the differences in relationship between the Chewas and Tumbukas.

However, there are numerous other studies that show us that political differences between neighbouring communities can persist even when there are no overt present-day political institutions perpetuating the differences. The branch of scholarship known as "legacy studies" looks at exactly such scenarios (see Nunn 2009; Simpser, Slater and Wittenberg 2018 for overviews). I focus here largely on two sets of political differences that has been the attention of existing legacy studies. The first is differences in levels of prejudice, namely the prevalence of anti-Semitism (Homola, Pereira and Tavits, 2020; Voigtländer and Voth, 2012), racism against Blacks (Acharya, Blackwell and Sen, 2016, 2018*a*; Mazumder, 2018) and sexism (Damann, Siow and Tavits, 2023). The second set relates to differences in levels of trust and corruption in society (Becker et al., 2016; Guiso, Sapienza and Zingales, 2016). These studies look to explain these persistent differences in neighbouring communities that otherwise live under largely identical circumstances. There are therefore no overt institutions that continuously enforces and perpetuates the political differences in these cases. Instead, the differences in these cases originate from a divergence in history.

Legacy scholars articulate their theories on why these differences persist in slightly different ways, but they are perhaps best packaged by Acharya, Blackwell and Sen (2018*a*) as "behavioural path dependence". Social science typically associates path dependence with the persistence of overt or "hard" institutions (e.g. North 1990; Pierson 2011). Behavioural path dependence instead highlights social mechanisms (or perhaps "soft" institutions) through which politics may also persist. Behavioural path dependence in legacy studies does not argue that overt institutions are not part of the story. Instead, they serve to theorise why politics maintains a certain shape even when the overt institutions that gave birth to them may have long since ceased to exist.

As Acharya, Blackwell and Sen (2018*a*) writes, behavioural path dependence must address two components to properly explain the divergent legacies effect: (1) the origin of the political difference, and (2) how these differences resist alteration or convergence as history proceeded from the origin to present day. Legacy studies typically focus on—and tend to be very good at—explaining the first component. This paper will largely engage with the second component that addresses the persistence of political differences. The ability to convincingly explain this second persistence component is key to the integrity of behavioural path dependence. This is because in the absence of overt institutions enforcing differences between groups, it is typically argued that they will converge. For example, the cultural evolution literature (Boyd and Richerson, 1985, 2005; Cavalli-Sforza and Feldman, 1981) identifies biases in cultural change that favour convergence towards the more common (conformist bias) and the more successful (prestige bias).

I hope to add to the discussion of persistence mechanisms by discussing how a community's direct neighbours complicates the story. The capacity of political differences to neither influence nor be influenced by their neighbours with different viewpoints is a missing piece in theories of legacy effects. This gap is particularly conspicuous because the empirical design of many legacy studies—including the selection earlier referenced—deliberately pick proximate communities as part of their identification strategy. Why then do their values not bleed between communities to influence each other and what are the conditions necessary to sustain this?

I offer a formal-theoretical model that tracks two separate communities and whether political differences persist between them. Using evolutionary game theory, I design a game played by two neighbouring populations where the types of citizens in the region is allowed to change over time. I introduce a novel parameter into standard evolutionary games to represent "integration" to capture how often citizens of one population interact with those of the other population. Through this parameter, I demonstrate the level of cross-population interactions that are necessary before populations of different types meld together after extended exposure for different game designs. The results show that, under several different games, even fairly high levels of inter-community integration will still lead communities to retain their differences.

My project here is perhaps closest to recent work by Giuliano and Nunn (2021). They argue that a stable environment is what encourages persistence as it allows communities to maintain traditions. By contrast, an unstable environment provoked by external stimulus can incite change as it forces society to adapt. My approach here is related but, rather than considering a generic exogenous stimulus, I specifically consider the influence of neighbouring communities on the possibility that political differences persist. This seems the appropriate next step in applying these ideas to legacy studies as they tend to focus on geographically proximate communities.

More broadly, my results add to the attempts to provide a richer and more comprehensive theoretical understanding to explain the persistence of political differences. In doing so, I specifically hope to provide a theoretical basis for empirical studies of persisting differences in political outcomes across geographically proximate communities (Acharya, Blackwell and Sen, 2016, 2018*a*; Becker et al., 2016; Grosfeld, Rodnyansky and Zhuravskaya, 2013; Guiso, Sapienza and Zingales, 2016; Homola, Pereira and Tavits, 2020; Mazumder, 2018; Voigtländer and Voth, 2012) that is more directly relevant than other theories that have come before (Bisin and Verdier, 2000, 2001; Giuliano and Nunn, 2021; Greif and Tadelis, 2010; Tabellini, 2008). My results also apply more broadly to explaining persistent differences in seemingly integrated communities (Bisin and Verdier, 2000; Nunn and Wantchekon, 2011) as the geographic separation imposed in my models can also be easily replaced by the self-selection of separation between different social groups that otherwise live in the same space.

4.1 Mechanisms of Persistent Differences

There is a growing body of social science scholarship describing the persistence of political differences across time. Such studies take the empirical strategy of comparing communities that are geographically proximate but experience a particular divergence in historical circumstance. This proximity controls for variation between the communities and thus any remaining present day differences can then be attributed to the specific historical divergence. Acharya, Blackwell and Sen (2016, 2018*a*) shows that counties in the US South with higher levels of historical slavery demonstrate higher levels of present day racism. Complementarity, Mazumder (2018) shows that US counties with a greater concentration of civil rights protests in history are now more often Democratic. Moving to Europe, Grosfeld, Rodnyansky and Zhuravskaya (2013) track historic differences in Jewish settlement during the Russian Empire to contemporary differences in market preferences. In Germany, the geographic persistence of anti-Semitism and other forms of prejudice have been shown both leading up to (Voigtländer and Voth, 2012) and in the legacy of (Homola, Pereira and Tavits, 2020) the Nazi regime. Guiso, Sapienza and Zingales (2016) show how parts of northern Italy will have different levels of social capital depending on whether the area was historically within the borders of a free city-state. Becker et al. (2016) show that areas within the borders of the former Habsburg Empire have greater contemporary trust and lower corruption in bureaucracy than those beyond it.

What do these papers have in common? They all discuss the stubborn persistence of differences in neighbouring communities where no overt political institutions are actively enforcing such differences. Why then do these political differences persist between otherwise similar neighbouring communities? Whilst early legacy studies may have been guilty of not elaborating on the mechanisms of persistence, recent scholarship has taken this particular theoretical question much more seriously.

Several different sub-mechanisms are likely collectively responsible for persistence. The most commonly invoked mechanism is often dubbed "intergenerational socialisation", or the passing of political differences from older generations to the younger. A chain of such socialisation connects the origin of political divergences to the present, creating long-term persistence in differences. Acharya, Blackwell and Sen (2018*a*), Homola, Pereira and Tavits (2020) and Mazumder (2018) are examples of works that emphasise this mechanism. Intergenerational socialisation is simultaneously compounded by other mechanisms that help lock the differences in place. This includes the presence of social structures such as schools, churches and industry that kept like-minded people together (Acharya, Blackwell and Sen, 2018*a*) or the operation of psychological effects like cognitive dissonance that re-shape preferences to perpetuate the political differences (Acharya, Blackwell and Sen, 2018*b*).

Outside of the specific context of legacy studies, there have been several major scholarly works attempting to formalise theories of political persistence that are of a similar spirit. Tabellini (2008) describes the inter-generational transmission of cooperative norms as a strategic response to the socio-political environment. Tabellini's results show that parents are more likely to pass down cooperative norms when local institutions encourage such cooperation. This cooperation may in turn be complemented by "endogenous enforcement" as previous generations choose to establish strong institutions to ensure future cooperation. An alternate framework is offered by Bisin and Verdier (2000, 2001) who find that parents are more motivated to invest into socialising their children when they belong to minorities in their community. These results are framed to explain the lack of acculturation of minorities into a “melting pot”.

These broader formal works highlight a theoretical component that theories specific to legacy studies have overlooked. They take more seriously the presence of alternate viewpoints and describes conditions under which political outlooks neither influences nor is influenced by other locally occurring outlooks. Such a component is critical for legacy theories to address as for many studies, such as the ones earlier cited, the presence of a nearby community with divergent politics is part of their identification strategy. In order to isolate the origin of the divergence, the cited legacy studies focus on cases where “treated” and “untreated” observations are geographically proximate. This allows other confounders—such as variance in overt institutions, demographics, and historical experiences other than the divergence of interest—to be minimised.

Having chosen cases where political differences exist in close proximity, theories of legacy effects should then explicitly account for the nearby presence of alternate views when explaining persistence. That is, legacy studies should borrow from and apply the richness of works such as Bisin and Verdier (2000, 2001) and Tabellini (2008) to the specific context of persistent legacies. This is what I hope to offer in this paper.

Through a series of simple formal models, I present a theoretical framework of the legacy effect that centrally accounts for the nearby presence of alternate views. To achieve this, my approach focuses on the persistence of differences specifically in relation to how integrated or isolated a community is from other communities. In this manner, my theory may be most similar to the recent work of Giuliano and Nunn (2021) who theorise that stability is what determines persistence. Stability, which for Giuliano and Nunn refers to as the relative absence of exogenous shocks, allows for communities to practice traditions uninterrupted and leads to their persistence. My theory can be considered a specific application of this idea where, rather than unspecified exogenous shocks, I focus instead on the influence of a neighbouring community of a different persuasion as the external stimulus of interest.

4.2 Persistent Differences in an Evolutionary Setting

I rely on evolutionary game-theoretic models (Maynard Smith and Price, 1973) in my approach and use the standard evolutionary stable states (ESS) (Maynard Smith, 1974) in my solutions. Evolutionary games have several advantages for modelling persistence of legacies. Evolutionary games are explicitly designed to track differences in large populations across an extended period of time. The design therefore contains the appropriate intricacies to capture cases legacies studies are interested in. Yet, despite these underlying intricacies, evolutionary games and their solutions—ESS especially—tend to be simple and elegant.

4.2.1 Motivating the Evolutionary Approach

In evolutionary game theory, a large population of players play iterations of a game with a game partner that is randomly chosen in every period. Players here do not actively choose their strategy in the way typical of standard game-theoretic models. Instead, players are constrained by their "type" that dictates what strategy they will play. Such a constraint is the appropriate mechanism for persisting legacies given how differences in prejudice, trust and the like has been identified to be expressed in behaviour. Consider, for example, a player that is highly prejudiced and a player that is not. These differences held by individual players will be expressed as different player types. In turn, these different player types condition them to approach strategic interactions in different ways.

Strategies cannot be chosen at the precise moment of interaction in evolutionary games. Instead, the types that determine strategy choice can change in between interactions. This allows the model to capture whether differences in neighbouring communities will remain persistent or otherwise. Changes in type occur at the end of every period through "replicator dynamics" that determine the distribution of types in period t given the choices in period $t-1$. Whilst replicator dynamics can be formally specified in numerous ways, the ESS solution to the game will generally be the same regardless of the specification chosen. This is important for my purposes here because—as the earlier cited literature describes—there is likely a collection of interrelated mechanisms simultaneously responsible for persistence. This feature of replicator dynamics allows my model to remain agnostic towards these particular details as I focus on isolating the effect of integration or isolation from neighbouring communities on persistence.

Although I consider a variety of designs later in the paper, I base my initial model on simple coordination games. Coordination games are an attractive starting point for my inquiry as they are more neutral towards political differences. Simple coordination games can offer multiple different Pareto-optimal outcomes, allowing the game to reflect how there can be different yet equally valuable approaches to social interaction.

Furthermore, the use of a coordination game design makes my initial approach robust to "biases" in transmission identified in existing literature. Boyd and Richerson (1985) identify a conformist bias and a prestige bias in cultural change. This is in reference to how culture tends to replicate elements that are either more frequent or more successful. Under a pure coordination game played by a population of players, the successful strategy and the frequently played strategy will be the same as strategies that are more frequently played are more likely to be successful in coordinating. This allows me to simultaneously account for both the conformist bias and the prestige bias.

4.2.2 Modelling Integration and Isolation

Existing evolutionary works in long-term socio-political change include Skyrms (2004) and Bowles and Gintis (2011) who study the possibility of "good" outcomes, such as cooperation or altruism, in an evolutionary setting. A key difference in my project here is that I am not merely interested in the possibility of "good" outcomes, but also in the more difficult outcome where "good" and "bad" communities can exist and persist as neighbours. Thus, my key formal departure here is not the evolutionary structure in itself, but rather the incorporation of two distinct populations of players and a variable level of integration between the two populations.

I explain the persistence of political differences in spite of tendencies towards convergence with a very simple modification of standard evolutionary games. This is achieved by adding a parameter of “integration” (later η) to represent the level of interactions between the neighbouring communities. To facilitate this parameter, I divide the players of the game into two populations. In every period, all players are paired with another player to play a specified game. The integration parameter governs the probability of whether a player is matched within their own population or across populations to play the game. This parameter therefore allows the game to vary whether these populations of players are highly isolated and keep to themselves (low η), highly mobile and frequently interact with outsiders (high η), or somewhere in between. I then ask of the models how much isolation is necessary to resist convergence and maintain differences in interests across the two populations.

My models thus provide a theoretical foundation for the assumption that political differences can remain distinct even across geographically proximate communities. My results also apply to separation that is not based on geography. So long as interactions between two distinct communities are below the thresholds identified, they are appropriately separated enough to prevent convergence. An example might be the work of Nunn and Wantchekon (2011) that finds that ethnic groups raided during the era of slave trades demonstrate lower levels of contemporary trust. If my results here were to be applied to the results of Nunn and Wantchekon, then it might be concluded that the reason differences in trust persist between ethnic groups is because, despite the fact that ethnic groups are more geographically integrated today than in the past, the level of interactions across ethnic groups remains within the thresholds of inter-community integration identified.

4.2.3 Some Comments on My Approach

My use of evolutionary models diverges from existing efforts to theorise the persistence of differences (Bisin and Verdier, 2000, 2001; Giuliano and Nunn, 2021; Tabellini, 2008).

Correspondingly, there are strengths and weaknesses to this design choice. I hope to have persuaded the reader in the previous sub-sections that the evolutionary approach possesses the appropriate similarities that make it worth considering for theorising persistence. Here I will address several weaknesses of the approach.

The overt divergence of the evolutionary approach from existing works is in the lack of agency it allows for actors. This stands in stark contrast to works such as Bisin and Verdier (2000) or Tabellini (2008) where strategic parenting is attributed as the mechanism allowing for long-run persistence. By contrast, the evolutionary approach forgoes the possibility of strategy and my model thus has to motivate how persistence resists convergent forces—present due to the benefits of coordination in the game—without appealing to strategy. Whilst attributing social phenomena to human strategy is often the most attractive answer for political economy, in the context of especially long-term patterns, I believe it is also valuable to consider answers not centred upon strategy. Thus, one contribution of taking the evolutionary approach here may be to explain persistence without relying on strategy and appealing instead to the structure of social interactions.

My model places significant emphasis on transmission as the mechanism for change. Yet, an understanding of human culture is incomplete without allowing for individual innovation as a source of change. Evolutionary models accommodate stochastic individual-level changes through solution concepts, such as ESS, that require not only equilibrium but also stability. Requiring stability requires the model to describe resulting social outcomes whilst accounting for the intrusiveness of individual innovation. Such solutions still greatly prioritise social transmission over individual innovation as the source of change, but this imbalance conforms with existing theories (Boyd, Richerson and Henrich, 2011).

A final—and likely most important—potential criticism of my approach is in how it largely captures political viewpoints as monoliths. In the legacy studies discussed, the pattern observed is typically that one community is significantly more prejudiced, racist and so on than another community on average. Such a pattern is more subtle than the stable outcomes of my model where I find conditions that allow for the neighbouring communities to entirely diverge in type. In other words, my models describe monolithic communities, but real world complements only produce (statistically) different averages. I acknowledge the lack of similarity on this front as a major weakness of my current approach. Ideally, a model of "culture" will allow for more cosmopolitan outcomes that reflect real world diversity. Bednar and Page (2007) and Bednar et al. (2010) are examples of models that achieve this.

Despite this, I hope the reader will still find value in my approach. My primary aim is to formally describe that a mild degree of separation is capable maintaining significant sociopolitical divergences—and my approach has the additional strength of fitting the story of persistent legacies well on several angles. Thus, a combination of the mechanisms I highlight in this paper and the mechanisms allowing for diversity in existing works (Bednar and Page, 2007; Bednar et al., 2010; Bisin and Verdier, 2000; Tabellini, 2008) should begin to give us a picture of society that describes the persistence of different social averages and distributions. I resist the temptation to combine these approaches at this stage in order to focus on the mechanical clarity of my contribution, as should be the objective of a formal model (Ashworth, Berry and Bueno de Mesquita, 2021; Paine and Tyson, 2020).

4.3 Pure Coordination Design

4.3.1 Motivating the Game

		Citizen j: x	Citizen j: y
Citizen i	x	$1, 1$	$0, 0$
	y	$0, 0$	$1, 1$

Figure 3: Pure Coordination Design game

Consider the simplest possible coordination game as expressed in figure 3. Such a game might represent a scenario between, for example, an employer looking to fill a vacancy and a job-seeker. The prospective employer might find the job-seeker to be highly qualified for the advertised position but, upon due diligence in the hiring process, discovers that the job-seeker has previously made political comments that the employer strongly disagrees with on social media. As a result, a coordination failure ensues where the job-seeker fails to land the position and the employer misses out on a highly qualified recruit.

The example economic miscoordination above resulted from how existing political dispositions the actors brought into the interaction constrained their ability to successfully coordinate. Such coordination failures seem a common facet of everyday life: a home-owner may not be comfortable inviting a tradesman with clashing political values to perform repairs, a prospective customer may be deterred from entering shop by a political sign on display that they disagree with, and so on. I capture the repeated experiences of such potential interactions by embedding games like the one in figure 3 into an evolutionary game.

Evolutionary games appropriately capture the scenarios described because players are unable to directly choose actions during interactions. Instead, their choices are constrained by their disposition or "type" that they carry with them into the interaction. These differences in types represent the political differences discussed earlier. For example, one type may represent individuals that hold a particular prejudice, whilst another type represents those that are not subject to such prejudices. Alternatively, types may represent the propensity for trust or corruption. I will later vary the design of the stage game at the base of the evolutionary game to better capture different possible representations, but I begin with simplest possible design in figure 3.

4.3.2 Baseline Game

Let there be two sets of players, P and Q. In every period t, each player $i \in P \cup Q$ is randomly matched with another player $j \neq i \in P \cup Q$ to play the game in figure 3. Each player i in $P \cup Q$ has a particular *type* that predisposes them into playing a particular strategy. Let there be two types in this game, where x-type players always play x and y-type players always play y. The distribution of types in the population is always common knowledge. Define p as the number of x-type players in population P and $1 - p$ as the number of y-type players in population P. Define analogously q and $1 - q$ for population Q.

The game takes place amongst neighbouring communities and the two populations, P and Q, represent citizens of each community. Even if the communities are literally separated only by a line-in-the-sand, it would be reasonable to expect that players are more likely to meet citizens of their own population than those of the other population. To account for this, I take inspiration from the correlation mechanism from Eshel and Cavalli-Sforza (1982) (see also Skyrms 1996).

I introduce a parameter $\eta \in [0, 1]$ to represent cross-community *integration*. As η decreases, any player i is more likely to play someone from the same population, and, as η increases, is more likely to play someone from the other population. Thus, when $\eta = 0$, the game features perfect isolation and players only play fellow citizens. Conversely, when $\eta = 1$, integration between the communities is complete, leading to an equal chance of playing any other player in $P \cup Q$.

The integration parameter achieves its intended effect by weighting the probability of meeting a player from the other community. For individuals in P, their weighted probability of cross-community encounters is

$$e_P = \eta \cdot \frac{|Q|}{|P \cup Q|}$$

and for those in Q it is

$$e_Q = \eta \cdot \frac{|P|}{|P \cup Q|}$$

Players in P and Q, in turn, meet players from the same population $1 - e_P$ and $1 - e_Q$ of the time, respectively. The individual, one-period utility of all players is simply the utility from playing the game in figure 3 with the player they are matched up with. This completes the description of one-period interactions at the base of the larger evolutionary game.

4.3.3 Utility and Replication

The pattern in expected utilities is fairly obvious upon brief inspection. As the only non-zero utilities in figure 3 are of value 1, the expected utility of any player is simply the probability they are paired with a player they will successfully coordinate with. That is, their expected utility is the probability that they are matched up with a player of the same type. Let $\pi_{P,x}$ be the one-period utility of an x-type player from population P. Analogously define π for all combinations of types and populations. The expected utilities for individuals from each respective type-population pair is

$$\pi_{P,x} = (1 - e_P)p + e_P q$$

$$\pi_{P,y} = (1 - e_P)(1 - p) + e_P(1 - q)$$

$$\pi_{Q,x} = e_Q p + (1 - e_Q)q$$

$$\pi_{Q,y} = e_Q(1 - p) + (1 - e_Q)(1 - q)$$

Note that, given large enough numbers of players, these individual expected utilities are exactly analogous to the average utilities of the entire type-population. It is the latter that we are interested in in the evolutionary context I have specified here, though to save on notation I use the same definitions above for average utilities of type-populations.

At the end of each period, the number of players of each type grows or shrinks based on how well its players performed in their two-player interactions in the previous period. That is, if a particular type as a whole does better than the average player in the population, then that type grows in proportion in the population. If the type does worse than average, then it shrinks. This is how the model captures the transmission of different types.

As earlier discussed, for the solution concept used throughout this paper (ESS), many different specifications of the replication process will still lead to the same ultimate outcome. This allows my model to be agnostic as to the exact processes involved in the replication of type. This reflects how the legacy studies literature, through behavioural path dependence (Acharya, Blackwell and Sen, 2018*a*) or other explanations, generally considers there to be a bundle of different mechanisms that collectively allow for persistence. More importantly, abstracting away from the other mechanisms of persistence allows my model to isolate and focus on studying its main interest: how persistence resists the influence of neighbouring communities with dissenting views.

The replication of types in the game occurs separately for the two populations. That is, a type in a particular population grows or shrinks relative to the average performance of individuals from that particular population only. Let $\bar{\pi}_P$ be the average utility of all players from population P. Thus the number of x-type players in population P grows if and only if $\pi_{P,x} > \bar{\pi}_P$, shrinks if and only if $\bar{\pi}_P > \pi_{P,x} \neq 0$ and stays constant if either $\pi_{P,x} = \bar{\pi}_P$ or $\pi_{P,x} = 0$ and so on for all type-population combinations. This aspect of the model design is necessary for results that allow for persistent differences. Without it, the "pull" of converging upon the the same types becomes too strong to resist due to the coordination nature of the problem at the base of the larger game. Substantively, a consequence of this design element might be that the game isolates the "economic" or "transactional" consequences of neighbouring a politically different community and ignores other complications such as marriage markets or migration.

4.3.4 Solution

The standard solution to evolutionary games is to find evolutionary stable states (ESS) (Maynard Smith, 1974) and this applies here. In a standard evolutionary game, ESS are simply strict Nash equilibria to the base games and it is straightforward to motivate what the solutions will be under such circumstances. A straightforward coordination game as in figure 3 has two strict Nash equilibria where either both players play x or both players play y. When integration is complete ($\eta = 1$) and the game is simply the evolutionary equivalent of figure 3, the ESS will reflect these strict Nash equilibria and the ESS are where all players in P and Q are collectively of the same type (be it x-type or y-type). I refer to solutions where all $i \in P \cup Q$ share the same type in equilibrium as a convergent outcome.

However, as the communities grow more integrated, additional solutions become possible. Recognise that, under perfect isolation, citizens only play with players from the same population. Therefore, when $\eta = 0$, there can exist ESS where the citizens of P are all of one type, while the citizens of Q are all of the other type. I refer to such solutions, where P and Q are of different types, as divergent outcomes. There must then be some critical value of η below which the game is capable of sustaining divergent outcomes. Assessing this critical value of η is the goal of this section.

Proposition 1. *A divergent ESS is possible under the Pure Coordination Design when both* $\eta < \frac{|P \cup Q|}{2 \cdot |P|}$ *and* $\eta < \frac{|P \cup Q|}{2 \cdot |Q|}$ *are simultaneously true.*

Proof. Let Population P consist only of x-type individuals and Population Q consist only of y-type individuals. Thus, $p = 1$ and $q = 0$. Population P is at equilibrium when x-type players outperform any invading y-type players. This is true when $\pi_{P,x} > \pi_{P,y}$. Solving for this gives us

$$
\begin{aligned}
\pi_{P,x} &> \pi_{P,y} \\
(1 - e_p)p + e_P q &> (1 - e_p)(1 - p) + e_P(1 - q) \\
1 - e_p &> e_p \\
\eta &< \frac{|P \cup Q|}{2 \cdot |Q|}
\end{aligned}
$$

Similarly, Population Q is at equilibrium when y-type players outperform any invading x-type players. This is true when $\pi_{Q,y} > \pi_{Q,x}$. Solving for this gives us $\eta < \frac{|P \cup Q|}{2 \cdot |P|}$. Thus, these two conditions must satisfied for a divergent ESS to be possible. $\square$

The conditions in proposition 1 mean that so long as more than half of the interactions of any given individual is within their own population, then we can maintain a divergence of types across the two populations. The threshold of half should not be surprising; it is the mixed strategy Nash equilibrium to the game in figure 3. If integration is high enough that cross-community interactions are greater than half, then the game will eventually end up at a convergent equilibrium of whichever type is more numerous at the beginning of the game. However, should the majority of interactions be contained within communities, then a divergent equilibrium will emerge given the conditions in proposition 1 are met and that different types are advantaged at the outset of the game in the two populations.

This result is fairly simple but quite powerful. It shows that under the assumed game, it is possible to have political differences exist between neighbouring communities in a stable manner even at fairly high levels of inter-community interactions. So long as a slim majority of my interactions are within my own community, the political uniqueness of my community will be retained (given that it was indeed unique to begin with). The red line in figure 5 demonstrates the change in the threshold value of η in proposition 1 as relative populations change.

Fixing some parameters allows the force of this result to be further illustrated. Recognise that, when $|P| = |Q|$, any $\eta < 1$ will fulfil the condition in proposition 1 and is sufficient to maintain differences that were originally distinct. Two neighbouring communities of the same size can thus maintain their differences so long as integration falls just short of perfect. As one community grows larger with respect to the other, then the necessary level of separation to maintain differences increases as the citizens of the larger community becomes more successful in coordinating their interactions, influencing the smaller community to adapt. Such a result may suggest that smaller communities may have an incentive to fence-off themselves to restrict cross-community interactions from eroding their views and values of their community. This may provide a social explanation to why some states reinforce their borders to complement recent economic theories for such preferences (Carter and Poast, 2017; Hassner and Wittenberg, 2015).

4.3.5 Empirical Implications

Proposition 1 has potential implications for the design of empirical studies. The critical value of η describes when it is and is not appropriate to assume that political differences have been geographically separated. Provided that (1) cross-community interactions are sufficiently low and (2) history suggests that there were initially political differences, then it is possible to conclude that neighbouring communities will remain politically distinct. Conversely, when cross-community interactions are sufficiently high, then it should be concluded that the communities will become largely similar.

A strength of this critical value of η is that it can be empirically quantified. Travel and trade, for example, are measurable ways of capturing cross-community interactions. When such interactions are measured to be relatively low and reflect that most regular interactions are intra-community, then the above model can be invoked as the theoretical explanation for why political differences persist. The above cited legacy studies describing the persistence of geographic differences are key areas where this result can be applied. Conversely, where cross-community interaction is measured to be relatively high and citizens primarily interact between communities, this can be used as support for political convergence across different communities.

Isolation as the source of persistent differences is consistent with existing empirical results. The results of Voigtländer and Voth (2012) stand out in this respect. Voigtländer and Voth study how Black Death-era pogroms in particular German towns predict anti-Semitism under the Nazi regime in the same locality roughly 600 years later. Later in their paper, Voigtländer and Voth interact their predictor with various local characteristics and discover that the effect of legacy disappears for towns that are members of the Hanseatic League—a confederation of towns in Europe associated strongly with long-distance trade. Using the results of my model, such a result can be interpreted to suggest that towns in the Hanseatic League lose their anti-Semitism because such towns fail the conditions of proposition 1 as they are significantly exposed to outside interactions.

4.4 Further Designs and Applications

I argue that the game in figure 3 is the most appropriate game to model political change in the broad sense. This is because figure 3 is blind to the value of political content; utility only varies based on the success of coordination without accounting for substantive content. This design allows for different and equally valuable ways to skin a cat, which may be fairest way to evaluate political differences. However, I acknowledge that the pure coordination design in figure 3 may not satisfy all the different political dynamics we may be interested in. Thus, the remaining sections will now move to consider other base game designs where welfare does vary on the coordination outcome populations embrace to interrogate the further applicability of my findings. Each variation presents its own critical value of η and the appropriate critical value can be applied depending on the needs of a particular political context.

4.4.1 General Coordination Design

		Citizen j: x	Citizen j: y
Citizen i	x	a, a	$0, 0$
	y	$0, 0$	b, b

Figure 4: Generic Coordination Design game

A first alternative design is a generalisation of the game in figure 3. I will here show how the above result holds under under more generic coordination games. Specifically, I allow for the possibility that one choice is more "efficient" than the other and successful coordination on one strategy gives greater utility than the successful coordination around another. This is represented by the matrix in figure 4, where $a > b > 0$.

The set-up of the game is thus exactly the same, except that individual one-period pay-offs are now represented by figure 4. I present the equivalent to proposition 1, fixing P to be of x-type and Q to be of y-type, under the new generalised version of the game.

Proposition 2. *A divergent ESS, where all players in P play x and all players in Q play y, is possible under the General Coordination Design when both $\eta < \frac{a}{a+b} \cdot \frac{|P \cup Q|}{|P|}$ and $\eta < \frac{b}{a+b} \cdot \frac{|P \cup Q|}{|Q|}$ are simultaneously true.*

The proof for proposition 2 is analogous to the proof for proposition 1.

Now that one type is more "efficient" than the other, the condition for a divergent outcome tightens. Mathematically, this is driven by the condition $\eta < \frac{b}{a+b} \cdot \frac{|P \cup Q|}{|Q|}$. As $a > b$ implies that $\frac{b}{a+b} < \frac{1}{2}$, intra-community interactions now need to be a greater majority under the Generic Coordination Design than the Pure Coordination Design for communities to remain politically separated. Consider this from the perspective of the less efficient type: I must have interactions within my population often enough that adopting the more efficient approach is still not beneficial enough due to the likeliness of coordination failures caused by my more frequent interaction within my own community. Previously, this threshold was at half, but, for the generalised design, replication will tend towards the more efficient type when interactions are in the balance. Thus, the condition for unique separate cultures tightens when one type is advantaged in interactions.

This is visualised in figure 5. The red line represents the maximum η to support divergence under proposition 1. The green, blue and purple lines are for proposition 2 where $\frac{a}{b}$ equals 2, 3 and 5, respectively. This reflects circumstances where one type is two, three and five times more efficient upon successful coordination than the other. The lines indicate that the maximum threshold on η decreases as the advantage grows for the more efficient type, making convergence more likely and separation more difficult.

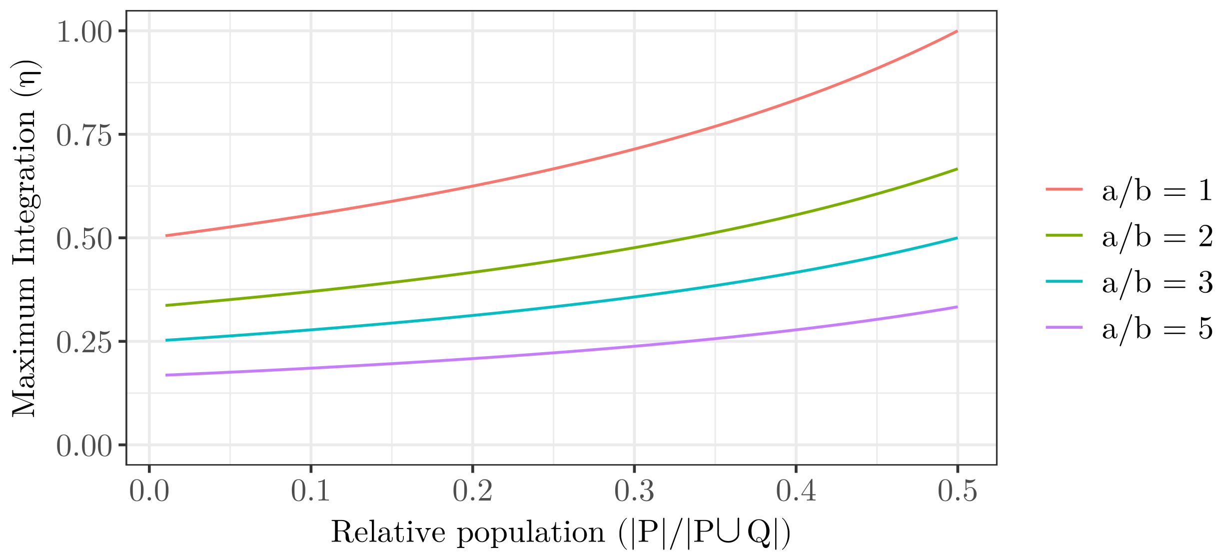

Figure 5: Maximum integration allowing for divergence in proposition 2

4.4.2 Stag Hunt and Prisoner's Dilemma Designs

		Citizen j	
		x	y
Citizen i	x	a, a	$0, b$
	y	$b, 0$	b, b

Figure 6: Stag Hunt Design

Stag Hunts and Prisoner's Dilemmas are typical games used to capture strategic scenarios involving trust. Here, x- and y-type players may represent those with high and low levels of social trust, respectively. Alternatively, they may respectively represent individuals that are less and more prone to engage in corruption.

A Stag Hunt Design, seen in figure 6, is very similar to the previous game in figure 4, where once again $a > b > 0$. However, this time the "basin of attraction" of one type, the hare-hunting y-type, is larger as successful coordination is no longer necessary to obtain a positive pay-off when hunting hares. This makes playing y more attractive and balances out the advantage of efficiency that the x-type possessed in the previous design. As a result, divergence is always easier to enforce under a Stag Hunt Design relative to the General Coordination Design for the same values of a and b.

Proposition 3. *A divergent ESS, where all players in P play x and all players in Q play y, is possible under the Stag Hunt Design when both $\eta < \frac{b}{a} \cdot \frac{|P \cup Q|}{|P|}$ and $\eta < \frac{a-b}{a} \cdot \frac{|P \cup Q|}{|Q|}$ are simultaneously true.*

The plots in figure 7 demonstrate this graphically. It can be seen that the green, blue and purple lines (representing a stag that is two, three and five times more valuable than a hare, respectively) are "higher up" on the plot in figure 7 compared to figure 5. The green line is now superimposed over the red line, showing that a game where a stag is double the value of hare is equally easy to persistently segregate as the game of pure coordination (reflecting how both games have a stage game Nash equilibrium where both choices are played with equal probability).

Adapting a Prisoner's Dilemma for my project here is less straightforward. This is because a standard Prisoner's Dilemma will only have one ESS as it only has one strict Nash equilibrium at the stage game level (where all players Defect). This is incompatible with this paper's attempt to show that two cultures playing different choices can co-exist as neighbours. Fortunately, there is a long literature in adapting the Prisoner's Dilemma to allow for cooperative outcomes. The most typical of such solutions is through repeated play (Axelrod and Hamilton, 1981) which allows for cooperation when coerced by the threat of future punishments (such as Grim Trigger or Tit-for-Tat). In evolutionary settings, similar modifications have allowed for cooperation to persist. Bowles and Gintis (2011) embed a version of the Prisoner's Dilemma into an evolutionary game with a separate "punishment stage". Such a design allows for the use coordinated punishments, not unlike those in iterated play, to support the persistence of cooperative cultures in equilibrium.

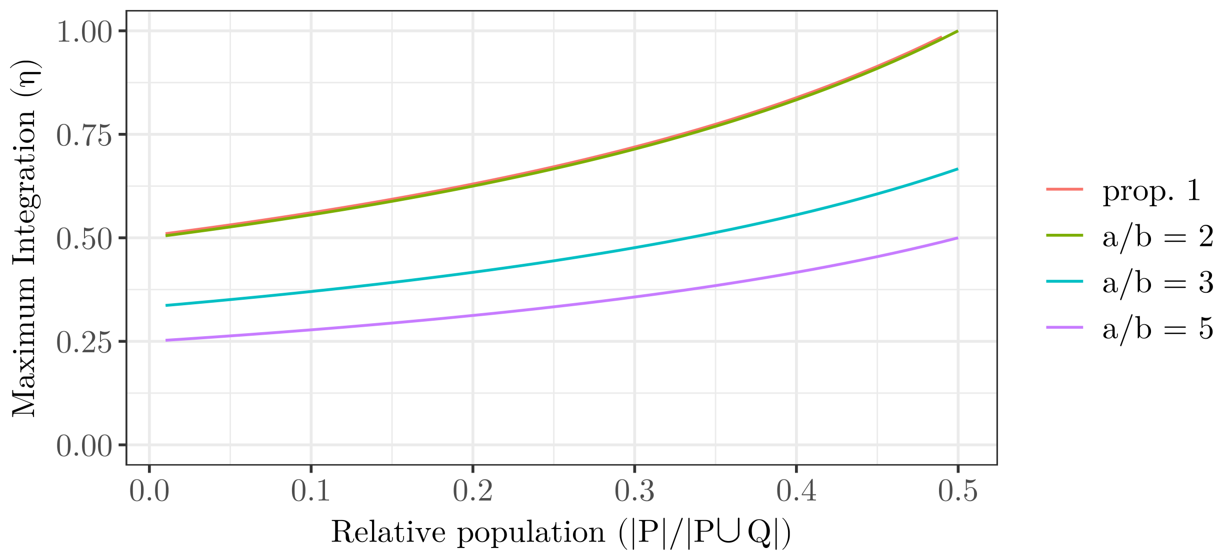

Figure 7: Maximum integration allowing for divergence in proposition 3

It is well established that versions of the Prisoner's Dilemma where cooperation can be enforced through punishment creates a Stag Hunt (see Skyrms 2004). Successful coordination outcomes (playing Cooperate on equilibrium followed by enforcing punishment when necessary) gives greater benefits than non-coordination outcomes (playing Defect). Provided that the punishment mechanism is credible, the incentive to always unilaterally Defect that is characteristic to Prisoner's Dilemmas disappears and the pay-off structure will instead resembles a Stag Hunt. This allows for a game that can support either a cooperative culture or a non-cooperative culture, much like a society that can hunt stags or hunt hares. Through proposition 3, we already know that separation of middling integrity can support neighbouring societies of different Stag Hunt cultures. This in turn implies that modified Prisoner's Dilemmas may also result in segregated levels of trust or corruption in the same way.

The result in proposition 3 thus affirms the empirical findings that cooperative societies can persist despite long-term exposure to neighbouring treacherous societies. This applies regardless of whether we believe situations of trust in society are better modelled by a Stag Hunt outright, as Skyrms (2004) argues, or allowing for coordinated punishments in Prisoner's

Dilemmas, as Bowles and Gintis (2011) argue. Returning to the cited legacy studies, Becker et al. (2016) find that high trust and low corruption persist within the former borders of the Habsburg Empire but not their immediate neighbours, suggesting the persistence of values instilled by the Habsburg's storied bureaucratic efficiency. Similarly, Guiso, Sapienza and Zingales (2016) find that areas of northern Italy that were within the borders of a free city-state in the Middle Ages demonstrate greater "civic capital" (in the manner of Putnam, Leonardi and Nanetti 1993) than their immediate neighbours. This implies the persistence of high civic values cultivated in past eras under city-states that were known for institutions designed to solve collective action and establish (an early version of) rule of law.

My models here provide further theoretical backing for these results to explain why such disparities in trust and civic values persist despite the borders and institutions at the focus of these studies being long defunct. So long as the interactions between cooperative societies and their more treacherous neighbours remain within the identified thresholds, their differences will continue to persist even when the source of those values (the Habsburg Empires or the free city-states) are long gone. Given that thresholds identified by my models are relatively modest requirements, it is in turn not surprising that the disparities identified by Becker et al. (2016) and Guiso, Sapienza and Zingales (2016) manage to persist.

4.4.3 Bach-or-Stravinsky Design

A further alternative design assumes that different populations have different political preferences beyond simply coordinating. That is, individuals first prefer to successfully coordinate and, given that coordination is achieved, also have varying preferences over which coordination outcome is reached. This may be a more nuanced way of modelling dispositions involving prejudice and tolerance. Consider x-types to represent players that are prejudiced towards a particular minority and y-types as more egalitarian. The egalitarians may prefer not to do business with bigots, however they may prefer business with bigots over no business at all. Such preferences suggest a Battle-of-the-Sexes design (as originally introduced by

Dawkins 1976) or here referred to as a Bach-or-Stravinsky design (Osborne, 2004).

Let P population players gain greater utility when coordinating in x and Q population players gain greater utility for coordination under y. Successful coordination in the preferred strategy gives pay-off of a and in the other strategy gives b. Unsuccessful coordination again gives 0. Evolutionary games require that the requisite base game be symmetric, which a standard Bach-or-Stravinsky game is not. Expressing pay-offs for a generic player i in the manner of figure 8, where again $a > b > 0$, resolves this.

when from P (Citizen j):

	x	y
x	a	0
y	0	b

when from Q (Citizen j):

	x	y
x	b	0
y	0	a

Figure 8: Pay-offs for Citizen i under Bach-or-Stravinsky Design

As the populations are no longer symmetric, there are two variations of the divergent outcomes to consider. The first is the more straightforward outcome where each population collectively plays their respective advantaged strategy.

Proposition 4. *A divergent ESS, where all players in P play x and all players in Q play y, is possible under the Bach-or-Stravinsky Design when both $\eta < \frac{a}{a+b} \cdot \frac{|P \cup Q|}{|P|}$ and $\eta < \frac{a}{a+b} \cdot \frac{|P \cup Q|}{|Q|}$ are simultaneously true.*

Alternatively, the reverse outcome where the populations instead collectively play their disadvantaged strategy may also be possible.

Proposition 5. *A divergent ESS, where all players in P play y and all players in Q play x, is possible under the Bach-or-Stravinsky Design when both $\eta < \frac{b}{a+b} \cdot \frac{|P \cup Q|}{|P|}$ and $\eta < \frac{b}{a+b} \cdot \frac{|P \cup Q|}{|Q|}$ are simultaneously true.*

As these propositions highlight, it is easier to enforce outcomes where the strategy played matches the population preferences than outcomes where they mismatch. This emerges in the smaller numerator for the conditions on η for proposition 5, tightening the restriction on η, compared to the larger numerator in proposition 4. Substantively speaking, the outcome in proposition 4 seems more sensible than proposition 5 as it seems more focal (Schelling, 1980) and hence I will suppress the result in proposition 5 from further discussion.

I illustrate graphically the increased ease with which a Bach-or-Stravinsky design, through proposition 4, manages to enforce divergence in figure 9. The red line again represents proposition 1 and the green, blue and purple lines represent where $\frac{a}{b}$ equals 2, 3 and 5, respectively, but this time under the conditions in proposition 4. This pattern demonstrates how the divisiveness of prejudice, captured by both populations' preferences for different coordination outcomes to the other, makes separation increasingly likely and is perhaps illustrative of why prejudice can be stubbornly persistent in certain societies.

Prejudicial beliefs may be built upon a sense of inherent superiority and this perception of superiority may give psychic benefits to doing things "our way". Such an interpretation means that citizens of P prefer playing x out of the psychic utility they obtain from their belief that x is superior. An example might be a business-owner that self-righteously refuses to cater to minorities (and those that support equal rights for minorities). The Bach-or-Stravinsky design captures such intricacies and proposition 4 describes why it is easy to sustain prejudice in the long-run given that such assumptions are appropriate. This provides further theoretical basis for legacy studies that show the persistence of prejudice against Blacks (Acharya, Blackwell and Sen, 2016, 2018*a*; Mazumder, 2018) and Jews (Homola, Pereira and Tavits, 2020; Voigtländer and Voth, 2012) across time that is particularly robust.

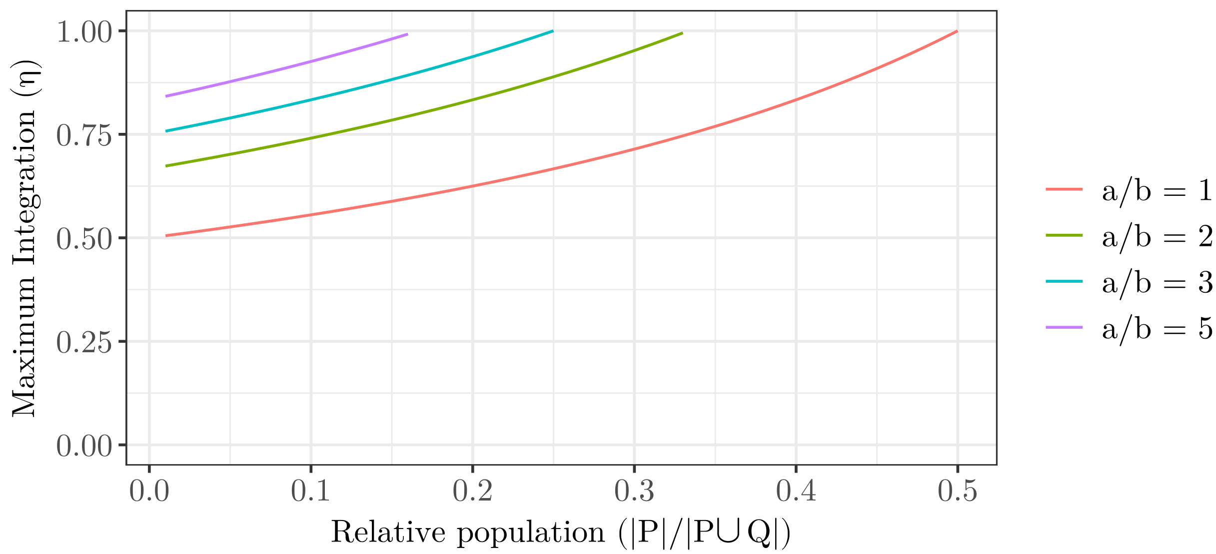

Figure 9: Maximum integration allowing for divergence in proposition 4

It must be noted however that the assumptions of my design here are particularly strong. I manage to show that it is relatively easy for prejudice to persist given that we assume latent prejudice as part of the game design. That is, my game hard-wires prejudice into the citizens through their fixed and permanent preference for a particular strategy. This is a much stronger assumption than simply having citizens be endowed with prejudice at the start of the game through their choice of strategy alone, but I hope that it is sufficient to demonstrate the nature of the problem of interest. Given prevailing psychological theories on inter-group conflict (Tajfel and Turner, 1979) that argue how individuals tend to favour their in-group over their out-group, such an assumption does not seem particularly unpalatable in any case.

The nature of my theory naturally invokes comparisons to contact theory (Allport, 1954; Pettigrew, 1998). Contact theory argues that positive interactions with targets of prejudice can diminish such prejudices. While there are similarities in how my models also argue that attitudes can be changed through interaction, my approach to prejudice (particularly relevant to the Bach-or-Stravinsky Design) does not involve interacting with the targets of prejudice. It instead considers the much weaker stimulus of potential interactions between individuals with and without prejudiced attitudes. This is the appropriate design given that the literature that it speaks to (Homola, Pereira and Tavits, 2020; Grosfeld, Rodnyansky and Zhuravskaya, 2013; Voigtländer and Voth, 2012) considers scenarios where the targets of prejudice are are not necessarily significant proportions of the studies communities. In turn, my results show that these types of interactions are unlikely to change prejudiced attitudes (proposition 4) bringing it in line with contact theory given that my model exposes players to a much milder stimulus than what contact theory argues can bring change.

4.5 Overestimation

This paper has focused on cases of neighbouring communities that have enduring differences despite their similar circumstances. In reality, of course, no two areas are perfectly contiguous in circumstances. My results thus, in some respects, overestimate the necessary separation required to maintain political differences. It may actually be even easier for differences to perpetuate than the already modest requirements found by the above results.

One reason for this overestimation may be the "border effect" (Anderson and van Wincoop, 2003). Border effects describe how even the most minimal barriers can impede cross-border trade due to the need to deal with variations in legal rules or logistical challenges. Thus, even if two communities are geographically neighbours and institutionally similar, small discrepancies as described by the border effect may still incentivise populations into remaining separate.

Alternatively, we can consider this overestimation to be because the model does not account for the possibility that citizens can affect who they choose to play with. Given that my models are largely coordination games, players will typically prefer to be matched with players of like types. In scenarios where divergence is relevant, this means that players will prefer interactions within their own community and will choose to do so given the opportunity. Either mechanism will, in turn, reinforce political differences between the communities and lead to an overestimation of the separation required to maintain differences.

4.6 Conclusion

I have proposed a model of political change that focuses on when communities can and cannot resist the influence of a neighbouring community with political differences. The results of my models suggest that, under a variety of strategic scenarios, even fairly high levels of integration between neighbouring communities may still be capable of resisting political convergence. The results of the models address a gap in theories of long-term persistence of political differences and gives further theoretical grounding for the persistence effect documented by empirical studies. These "legacy studies" have identified the persistent of prejudice (Acharya, Blackwell and Sen, 2016; Homola, Pereira and Tavits, 2020; Mazumder, 2018; Voigtländer and Voth, 2012) and trust (Becker et al., 2016; Guiso, Sapienza and Zingales, 2016; Nunn and Wantchekon, 2011) in spite of their proximity to communities that are comparatively more tolerant or more treacherous, respectively.

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A Appendix A: Proofs for Economic Origins of Border Fortifications

This section provides more formal proof for the propositions proffered in the main text.

Proposition 1. *If $c_i(l^\star) > v$, then there exists a sub-game perfect Nash Equilibrium to the Fortification Game such that*

- *(1a) All players always play the Stable Borders Strategy Profile where $\underline{l} = l_A$ and $\bar{l} = l_B$.*
- *(1b) When activated to fortify, states always choose to Not Fortify.*

Proof.

- (1a) Recall that both functions $c_i(l^\star)$ are weakly increasing as l is further away from i's capital. Thus, when $c_i(l^\star) > v$—that is, when the intersection of the two cost functions is greater than v—there are exist some citizens for which both $c_i(l)$ are greater than v. For these citizens, it is impossible for either state to provide governance at a profitable price as the cost of such governance exceeds the value of governance to these citizens. As a result, there is no overlapping market and instead the market of both states solely consists of monopolies (from their respective capitals up to the intersection of $c_i(l)$ and v). In turn, both states offer price v to all l in their market as this extracts the maximal amount of payment in their respective monopolies. Such a strategy is defined by playing the Stable Borders Strategy Profile where $\underline{l} = l_A$ and $\bar{l} = l_B$.
- (1b) As there is no overlapping market, the construction of fortifications of any kind does not give either of states a larger monopoly market. Hence, states Never Fortify in equilibrium when $c_i(l^\star) > v$.

□

Proposition 2. *Given $c_i(l^\star) < v$ and sufficiently large δ, there exists a sub-game perfect Nash equilibrium to the Fortification Game where*

- *(2a) In the Fortified sub-game, players play the Stable Border Strategy Profile where $\underline{l} = \bar{l} = l^{\dagger}$,*

- *(2b) In the Unfortified sub-game, players play the Unstable Border Strategy Profile,*

- *(2c) State $-i$ plays Fortify at their most preferred location when activated, and*

- *(2d) State i plays the Counter-Fortification Strategy when activated.*

Proof.

- (2a) As explained in the main text, the only equilibrium solution to the Fortified sub-game is the Stable Border Strategy Profile where $\underline{l} = \bar{l} = l^{\dagger}$ as it is the stage game equiibrium in this sub-game.

- (2b) As explained in the main text, the Unstable Border Strategy Profile is always a possible solution to the Unfortified sub-game as it is a stage game equiibrium in this sub-game.

- (2c) By the definition of most preferred, choosing to Fortify at the most preferred fortification location is always a best response to the other state playing the Counter-Fortification Strategy.

- (2d) By the definition of the the Counter-Fortification Strategy, playing the the Counter-Fortification Strategy is always a best response to the other state choosing to Fortify at any location.

□

Proposition 3. *The choice to Fortify at $l^{\dagger}$ becomes more profitable for State i as the profits of stability Δ_i and the size of the market gains $|l^{\dagger} - l^{\star}|$ increase, and the cost of construction $k_i(l^{\dagger})$ decreases.*

Proof. Consider the necessary conditions for there to be no border fortifications built by either state in equilibrium. This is when neither state finds it profitable to fortify given that the other state is never building fortifications. That is, when for all $i \in \{A, B\}$ and for all $l^\dagger \in L$, EU_i(Never Fortify | Never Fortify) $>$ EU_i(Fortify at $l^\star$| Never Fortify). Solving these inequalities reveals the conditions to be

$$\delta > 1 - \frac{\Delta_i + v\left(|l^\dagger - l^\star|\right)}{k_i(l^\dagger)}$$

for all $i \in \{A, B\}$ and for all $l^\dagger \in L$.

Taking the first derivative reveals that the condition on δ is increasing with respect to Δ_i and $|l^\dagger - l^\star|$ and decreasing with respect to $k_i(l^\dagger)$. □

Proposition 4. *Given $c_i(l^\star) < v$ and that both states most prefer fortification location $l^\star$, there exists a sub-game perfect Nash equilibrium where*

- *(4a) In the Fortified sub-game, players play the Stable Border Strategy Profile where $\underline{l} = \bar{l} = l^\dagger$,*
- *(4b) In the Unfortified sub-game, players play the Unstable Border Strategy Profile, and*
- *(4c) When activated, both states play Fortify at $l^\star$ with probability q_i and Never Fortify with probability $1 - q_i$, where $q_A = 1 - \frac{(1-3\delta)k_2 + (1-\delta)(\Delta_B)}{\frac{\delta^2 v(1-l^\star)}{1-\delta} - \delta k_2}$, and $q_B = 1 - \frac{(1-3\delta)k_2 + (1-\delta)(\Delta_A)}{\frac{\delta^2 v l^\star}{1-\delta} - \delta k_2}$.*

Proof.

- (4a) As explained in the main text, the only equilibrium solution to the Fortified sub-game is the Stable Border Strategy Profile where $\underline{l} = \bar{l} = l^\dagger$ as it is the stage game equilibrium in this sub-game.
- (4b) As explained in the main text, the Unstable Border Strategy Profile is always a possible solution to the Unfortified sub-game as it is a stage game equiibrium in this sub-game.
- (4c) The mixed strategy probability q_A is found at the indifference point for State B between playing Fortify at $l^\star$ and Not Fortify given that State A is playing Fortify

at $l^\star$ with probability q_A and Not Fortify with probability $1 - q_A$. That is, q_A is found by solving for $\text{EU}_B(\text{Fortify at } l^\star|(q_A, 1-q_A)) = \text{EU}_B(\text{Not Fortify}|(q_A, 1-q_A))$. Symmetrically, q_B is found with the same method but with the states' roles reversed. The solutions to these equations produce the values for q_A and q_B in 4c.

□

Proposition 5. *Fortifications become more likely as the profits of stability Δ_i decreases, and the cost of construction k_2 increases.*

Proof. Proposition 5 is simply the comparative statics analysis of q_A and q_B from Proposition 4.

$$q_A = 1 - \frac{(1-3\delta)k_2 + (1-\delta)(\Delta_B)}{\frac{\delta^2 v(1-l^\star)}{1-\delta} - \delta k_2}$$

$$q_B = 1 - \frac{(1-3\delta)k_2 + (1-\delta)(\Delta_A)}{\frac{\delta^2 v l^\star}{1-\delta} - \delta k_2}$$

Taking the first derivative reveals that, under certain conditions, q_i for all $i \in \{A, B\}$ is decreasing with respect to Δ_i and increasing with respect to k_2. This is always true when $\delta > \frac{1}{3}$. □

Proposition 6. *Given $c_i(l^\star) < v$ and sufficiently large δ, there exists a sub-game perfect Nash equilibrium to the Fortification Game where*

- *(6a) In the Fortified sub-game, players play the Stable Border Strategy Profile where $\underline{l} = \bar{l} = l^\dagger$,*
- *(6b) In the Unfortified sub-game, so long as the history has always been the Stable Borders Strategy Profile, players play the Stable Border Strategy Profile and, when*

activated, both states play Fortify at $l^\star$ at l_i when $\delta > 1 - \frac{v(|l_i - l^\star|)}{k_3}$ and Never Fortify otherwise, and

- *(6c) In the Unfortified sub-game, if the history has ever departed from the Stable Borders Strategy Profile, players play as described in Proposition 2.*

Proof.

- (6a) As explained in the main text, the only equilibrium solution to the Fortified sub-game is the Stable Border Strategy Profile where $\underline{l} = \bar{l} = l^\dagger$ as it is the stage game equiibrium in this sub-game.
- (6b) Playing the Stable Borders Strategy Profile is an equilibrium solution to the Unfortified sub-game because it is reinforced by the Grim Trigger punishment scheme specified in 6c. The value for the threshold on δ is simply the solution to $\text{EU}_i(\text{Fortify at } l^\star|\text{Never Fortify}) > \text{EU}_i(\text{Not Fortify}|\text{Never Fortify})$.
- (6c) The equilibrium in Proposition 2 serves as a punishment scheme for the Grim Trigger outcome in 6b. See the proof for Proposition 2 to see that Proposition 2 is indeed an equilibrium solution and can serve as a suitable punishment scheme.

□

B Appendix B: Proofs for How to Smuggle Contraband

This appendix provides proofs for the equilibria to the Border Extraction Game.

Proposition 1. *There exists a perfect Bayesian equilibrium to the General Border Extraction game when $x^\star(q_t = p) \geq 1 - \delta + \delta\theta_H$, which I call the **Pooling Equilibrium**, such that*

1a When the game is Unfortified, the Bandit plays $x_t = x^\star(q_t = q_{t+1} = p)$,

1b When the game is Fortified, the Bandit plays $x_t = \theta_\tau$,

1c The State plays Not Fortify in the first period, and

1d The State plays Fortify with belief $q_t = 1$ in subsequent periods if the history has ever been that $x_t > x^\star(q_t = p)$, and plays Not Fortify with belief $q_t = p$ otherwise.

Proof. 1a The most profitable deviation for the Bandit here is to play $x_t = 1$. This triggers the choice to Fortify and reduces their future pay-off in exchange for a high immediate pay-off. The condition for this (for the respective types) is $\delta^\star_{1a} \leq \frac{x^\star(q_t=q_{t+1}=p)}{\theta_H} \leq \frac{x^\star(q_t=q_{t+1}=p)}{\theta_L}$. As $\delta \in [0, 1]$ and $x^\star(q_t = p) > 1 - \delta + \delta\theta_H > 1 - \delta + \delta\theta_L$, this is always true. No deviation.

1b Stage game equilibrium.

1c and 1d By the definition of $x^\star(\cdot)$, the State will never deviate to Fortify so long as the Bandit only plays $x^\star(\cdot)$ when there can be no updating of beliefs.

□

Proposition 2. *There exists a perfect Bayesian equilibrium to the General Border Extraction game when $k \leq \frac{1-\theta_H}{1-\delta}$ and $1 - \delta + \delta\theta_H \geq x^\star(q_t = p)$, which I call the **Discriminating Fortification Equilibrium**, such that*

2a *When the game is Unfortified, Type H Bandits play $x_t = 1$ and Type L Bandits play $x_t = \frac{1-\delta}{1-p}\left(k(1-p\delta) - p(1-\theta_H)\right) - \theta_L$,*

2b *When the game is Fortified, the Bandit plays $x_t = \theta_\tau$,*

2c *The State plays Not Fortify in the first period, and*

2d *The State plays Fortify with belief $q_t = 1$ in subsequent periods if the history has ever been that $x_t > x^\star(q_t = 0)$, and plays Not Fortify with belief $q_t = 0$ otherwise.*

Proof. 2a Type L will not deviate to $x_t = 1$ unless δ is especially small (which I have ruled out by bounding $\delta \in (p, 1)$). For Type H, their most profitable deviation is $x_t = x^\star(q_t = q_{t+1} = p)$ (preventing fortification in 2d), giving the condition $\delta^\star_{2a|H} \geq \frac{x^\star(q_t = q_{t+1})}{\theta_H}$. As $\delta \in [0, 1]$ and $1 - \delta + \delta\theta_H > x^\star(q_t = p)$, this is always true. No deviation.

2b Stage game equilibrium.

2c The State may deviate to pre-emptively Fortify before any signals can be sent. The choice of Type L bandits defined in 2a ensures that the state is indifferent between waiting and acting pre-emptively.

2d The State will prefer to Fortify against Type H (that is, when $q_t = 1$) so long as $k \leq \frac{1-\theta_H}{1-\delta}$. The State will always prefer to Not Fortify against Type L as the condition for this is $x^\star(q_t = 0) \leq k(1-\delta) + \theta_L$, which in equality is exactly the definition of $x^\star(q_t = 0)$.

□

Proposition 3. *Fortifications become more profitable as the cost of fortifications k decreases, as the probability of Type H Bandits p decreases, as the discount factor δ increases, and as the post-extraction extractive capacities of the Bandits θ_τ for all τ decreases.*

Proof. Substituting in $q_t = q_{t+1} = p$, $x^\star(\cdot)$ as a function of the relevant parameters becomes

$x^{\star}(k, p, \delta, \theta_H, \theta_L) = (1-\delta)k + p\theta_H + (1-p)\theta_L$. The partial derivatives of this function are as follows:

$$\frac{dx^{\star}}{dk} = 1 - \delta$$
$$\frac{dx^{\star}}{dp} = \theta_H - \theta_L$$
$$\frac{dx^{\star}}{d\delta} = -k$$
$$\frac{dx^{\star}}{d\theta_H} = p$$
$$\frac{dx^{\star}}{d\theta_L} = 1 - p$$

Thus $\frac{dx^{\star}}{dk}$, $\frac{dx^{\star}}{dp}$, $\frac{dx^{\star}}{d\theta_H}$ and $\frac{dx^{\star}}{d\theta_L}$ are positive, whilst $\frac{dx^{\star}}{d\delta}$ is negative.

Across reactive equilibria, fortifications will only manifest in equilibrium when $1 - \delta + \delta\theta_H \geq x^{\star}(q_{t+1} = p)$. Therefore, fortifications are more likely as $x^{\star}(\cdot)$ decreases. We are thus interested in the partial derivatives of $-x^{\star}(\cdot)$ to study comparative statics. Given the above, $\frac{d{-x^{\star}}}{dk}$, $\frac{d{-x^{\star}}}{dp}$, $\frac{d{-x^{\star}}}{d\theta_H}$ and $\frac{d{-x^{\star}}}{d\theta_L}$ are negative, whilst $\frac{d{-x^{\star}}}{d\delta}$ is positive. Thus, fortifications are more profitable when k, p, θ_H and θ_L decrease, and δ increases.

For δ and θ_H, their presence on the opposite side of the inequality condition can complicate interpretation. However, parameterisations where interpretation of the comparative statics change are eliminated by the constraints $\delta \in (p, 1)$ and $k > 1$, respectively.

Finally, the condition $k \leq \frac{1-\theta_H}{1-\delta}$ required for the Discriminating Fortification Equilibrium is more easily supported as k and θ_H decrease and δ increases. These point in the same direction as the earlier result. $\square$

Proposition 4. *There exists a perfect Bayesian equilibrium to the General Border Extraction game when* $k \leq \frac{1-(p\theta_H+(1-p)\theta_L)}{1-\delta}$, *which I call the* ***Pre-Emptive Fortification Equilibrium****,* *such that*

4a When the game is Unfortified, the Bandit plays $x_t = 1$*,*

4b When the game is Fortified, the Bandit plays $x_t = \theta_\tau$*, and*

4c The State plays Fortify with any belief $q_t \in [0,1]$ *in all periods.*

Proof. 4a Off-equilibrium path behaviour that motivates State choice in (4c).

4b Stage game equilibrium.

4c The State will Fortify when it is more profitable than Not Fortify. Given (4a) and (4b), the condition for this is $k \leq \frac{1-(p\theta_H+(1-p)\theta_L)}{1-\delta}$. As both types of Bandits play the same choice in (4a), any belief can support this choice.

□

Lemma 1. *The expected utility for the State is the same under both the Pooling Equilibrium and the Pre-emptive Fortification Equilibrium.*

Proof.

$$\begin{aligned}
\mathbb{E}\text{U}_{State}(\text{Pooling Eq.}) =& \mathbb{E}\text{U}_{State}(\text{Pre-emptive Eq.}) \\
\frac{1-x^\star(q_t=p)}{1-\delta} =& \frac{p(1-\theta_H)+(1-p)(1-\theta_L)}{1-\delta} - k \\
1-x^\star(q_t=p) =& p(1-\theta_H)+(1-p)(1-\theta_L) - k(1-\delta) \\
1-x^\star(q_t=p) =& 1-((1-\delta)k + p\theta_H + (1-p)\theta_L) \\
x^\star(q_t=p) =& (1-\delta)k + p\theta_H + (1-p)\theta_L
\end{aligned}$$

□

Lemma 2. *The expected utility for the State is greater under the Pre-emptive Fortification Equilibrium compared to the Discriminating Fortification Equilibrium when* $k < \frac{\theta_L(1-p)}{(1-\delta)(p\delta-1)}$.

Proof. Let $x^{\dagger} = \frac{1-\delta}{1-p}\left(k(1-p\delta) - p(1-\theta_H)\right) - \theta_L$, L-type Bandits' equilibrium path choice in the Discriminating Fortification Equilibrium.

$$
\begin{aligned}
\mathbb{E}\mathrm{U}_{State}(\text{Pre-emptive Eq.}) >& \mathbb{E}\mathrm{U}_{State}(\text{Discriminating Eq.}) \\
\frac{p(1-\theta_H) + (1-p)(1-\theta_L)}{1-\delta} - k >& p\left(\frac{\delta(1-\theta_H)}{1-\delta} - \delta k\right) + (1-p)\left(\frac{1-x^{\dagger}}{1-\delta}\right) \\
p(1-\theta_H) + (1-p)(1-\theta_L) - k(1-\delta) >& p\left(\delta(1-\theta_H) - \delta k(1-\delta)\right) + (1-p)\left(1-x^{\dagger}\right) \\
p\delta k(1-\delta) - k(1-\delta) >& p\delta(1-\theta_H) + (1-p)\left(1-x^{\dagger}\right) - \left(p(1-\theta_H) + (1-p)(1-\theta_L)\right) \\
k(p\delta-1)(1-\delta) >& p(\delta-1)(1-\theta_H) + (1-p)(\theta_L - x^{\dagger}) \\
k(p\delta-1)(1-\delta) >& p(\delta-1)(1-\theta_H) + (1-p)(\theta_L - \left(\frac{1-\delta}{1-p}\left(k(1-p\delta) - p(1-\theta_H)\right) - \right. \\
k(p\delta-1)(1-\delta) >& \theta_L(1-p) \\
k <& \frac{\theta_L(1-p)}{(1-\delta)(p\delta-1)}
\end{aligned}
$$

□

Proposition 5. *Pre-emptive fortifications become more profitable as the cost of fortifications k decreases, as the probability of Type H Bandits p decreases, and as the post-extraction extractive capacities of the Type-H Bandits θ_H decreases.*

Proof. By lemmas 1 and 2, Pre-emptive Equilibria are only more profitable than Reactive Equilibria for the State under parameterisations that can lead to the Discriminating Fortification Equilibrium. By proposition 3, this more likely as k, p, θ_H and θ_L decrease, and δ increases.

By the condition in lemma 2, Pre-emptive Fortification Equilibrium is more profitable the Discriminating Fortification Equilibrium when k, p and δ decrease, and θ_L increases. Consolidating only for parameters where the comparative statics point in the same direction between the lemmas and proposition 3, Pre-emptive Equilibria are more profitable than

Reactive Equilibria when k, p, and θ_H decrease. □