Unsettled Borders in a Market Context*

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Abstract

Border disputes between states can result in major disruptions in trade. Scholars traditionally expect these costs and disruptions to place pressure on states to avoid or resolve these disputes quickly. Trade complexity, as well as the costs of exiting the web of trading activity across borders, can have important effects on disputes and dispute behavior. Variation in the composition of trade, whether characterized by uniqueness on the global market or readily available substitutes, conditions attempts to manage border disputes. We examine the effects of this variation on dispute behavior using an original dataset that combines product-level trade data (spanning from 1962-2001) with ICOW territorial claims data, allowing for the analysis of how exit costs affect initiation, escalation, and settlement of border disputes. This analysis helps us better understand the role trade plays in managing border disputes, and furthers our understanding of the economic impact of unsettled borders.

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Introduction

In June 2020, a skirmish between Indian and Chinese soldiers along a disputed Indian-Chinese border in the Himalayas resulted in dozens of casualties (Safi, Ellis-Petersen & Davidson 2020). The violence was the culmination of a series of mini-brinkmanship moments. Tensions over the border were rising since Chinese and Indian militaries clashed over the disputed territory in the previous month. Indian officials in Delhi argued that Chinese forces had crossed the "Line of Actual Control" between the two nations' territories. Three months and six rounds of talks later, both sides still struggled to find a path to reduced tensions.

Conflict between nuclear-powered states is always worrisome. In this case, it is also surprising, given recent attempts to strike a more conciliatory tone over border disputes and bolster economic ties. At a bilateral summit in October 2019, Chinese President Xi and Indian Prime Minister Modi discussed ways to increase trade, establish regular meetings to reduce India's trade deficit with China, and improve economic ties more generally. Pointedly, Modi announced that "we have decided to manage our differences prudently, and not let them become 'disputes'" (Pasricha 2019). How can this broader economic context help us understand the risks surrounding the 2020 border dispute? More broadly, when do economic ties dis-incentivize border-related conflict, as reflected by Prime Minister Modhi's comments, versus encouraging states to leverage economic interdependence for their own advantage? How do economic costs of severing trade affect the politics surrounding territorial claims?

To answer these questions, we examine how complex trade ties affect the onset and management of territorial issues. Drawing from literatures on economics and conflict, as well as territory and violence, we focus on the specific links between economic ties and disputes over territory. We show that tightening economic connections reduce the fear of exit, introducing a moral hazard effect that makes territorial claims more likely. Objections to the claims are expected, as are the constraints on the target's response. Rising exit costs also

increase the propensity for low-level violence in existing claims, again with the expectation that the fear of economic exit will limit the escalation beyond minor clashes. Finally, we expect rising exit costs to decrease the ability of leaders to negotiate settlements. Navigating the complexities of compromise becomes more difficult when economic ties increase attention to the crisis. Moreover, when resolving territorial disputes risks power shifts which can affect local economic markets, at least one side of the dispute will hesitate to resolve the conflict (Gent & Crescenzi 2021).

We develop a new measurement of bilateral exit costs based on trade flows and trade complexity to evaluate the impact of trade and exit costs on dispute management. Drawing on a dataset of nearly 1,400 traded commodities over five decades, we use principal component analysis to identify patterns of trade that are both monetarily large and categorically unique. Trade flows with these attributes characterize bilateral relationships with high exit costs. This unsupervised learning approach allows us to avoid *a priori* pre-selection of relevant commodities or developing subjective weighting schemes for different types of commodities. The process allows us to identify when two states are linked by economic ties that are highly valuable and difficult to substitute, thereby constituting high exit costs. We then apply this measure of exit costs to analyses of territorial dispute onset and resolution, and illustrate these dynamics with a qualitative study of the Aegean dispute between Greece and Turkey.

Our research makes two contributions to the literature on economic exchange and international conflict. First, it provides insight into how interdependence can affect the onset and management of territorial disputes. While existing work largely focuses on the economic impact of unsettled borders (Simmons 2005, Schultz 2015, Gent & Crescenzi 2021), we explore how economic exchange may affect the initiation new territorial disputes. Second, it presents a novel measure of exit cost in bilateral trade that can be employed in many analyses of international interaction.

We turn now to a review of the existing literature on trade, conflict, and territorial disputes, and then present our argument for how increasing levels of economic interdependence can encourage low-level hostilities between states. Next, we present our measure of exit cost and validate it by comparison with existing conceptualizations and measures. With then apply this measure to analyses of territorial dispute onset and resolution, and illustrate these dynamics with a qualitative study of the Aegean dispute between Greece and Turkey.

Trade, Conflict and Territorial Disputes

Scholarship on the linkage between trade and conflict on the one hand, and the role of territorial disputes in conflict on the other, are well established, mature literatures and have much to teach us. The complex interdependence of territorial disputes, conflict, and trade, however, is not yet fully understood. This is especially relevant when we consider the role that increasing economic integration has in promoting the peaceful settlement of conflict or perhaps the escalation of conflict over territory. Schultz (2015) explicitly calls for a systematic analysis of this triad of phenomena, and Gibler (2012) notes the corrosive effects that territorial disputes can have on economic ties. Here we examine these rich bodies of knowledge to help focus our examination of the reverse relationship: the effects of economic ties on territorial disputes.

Unsettled Borders: the Pernicious Effects of Territorial Disputes

Research demonstrates a robust positive relationship between unsettled territorial claims and increased risk of military conflict between disputants (Vasquez & Henehan 2001, Hensel 2001, Hensel 1996, Kocs 1995). Territorial disputes have also been linked to the rise of long-term rivalries between disputant states (Owsiak & Rider 2013, Rider & Owsiak 2015). The in-

creased propensity for conflict and rivalry has been linked to a propensity for a larger standing military and increased centralization of the government within disputants (Gibler 2012). Accordingly, even when conflict does not occur between neighbors engaged in territorial disputes there are more economic resources that are being used in service of guns rather than butter. Due to the apparent high costs associated with unsettled borders and violence, several studies have attempted to pin down under what conditions conflicting territorial claims are initiated (Hensel 1996, Abramson & Carter 2016, Carter 2017, Carter & Goemans 2011, Carter & Goemans 2013); under what conditions these claims escalate to war (Carter 2010, Huth & Allee 2002, Huth, Croco & Appel 2012); and how these claims are resolved (Huth, Croco & Appel 2011, Mattes 2008). Settling disputed borders has also been shown to promote the reduction in conflict between neighbors (Owsiak 2012, Kocs 1995, Tir 2006, Schultz 2014).

Even when borders do not result in militarized disputes, unsettled borders are linked to economic loss due to institutional uncertainty. Simmons (2005) argues that unsettled borders may increase transaction costs associated with moving goods across borders due to unclear jurisdiction. Economic actors within states may avoid trade with the disputant state because of the risk of trade disrupting behavior. In a subsequent study, Schultz (2017) finds evidence that much of the trade dampening impact of unsettled borders comes from risk of trade disrupting behavior. Moreover, foreign direct investment suffers during periods of competing territorial claims between states (Lee & Mitchell 2012, Carter, Wellhausen & Huth 2018). The anticipated economic gains from resolving territorial provide incentives for promoting peaceful border settlement (Schultz 2015).

Exit Costs: The Complex Ties Between Trade and Conflict

Scholars have classically debated three forms of the theorized relationship between trade and conflict: 1) greater dyadic trade interdependence results in decreased probability of

conflict in the dyad (Oneal & Russet 1997); 2) greater dyadic trade interdependence results in increased hostility in the dyad (Barbieri 1996, Barbieri 2002); and 3) trade is unimportant in the decision for states to go to war. Proponents of interdependence inducing peace note two underlying mechanisms: signaling or opportunity cost (Gartzke, Li & Boehmer 2001, Polachek & Xiang 2010). If these two mechanisms are correct, we should observe that dyads with higher levels of bilateral trade are more peaceful than those with lower levels. Others note that gains from trade do not accrue evenly between partners and that these asymmetries may actually induce conflict (Hirschman 1945, Barbieri 1996). Still others argue that information about strategic dynamics are needed to evaluate the overarching relationship (Crescenzi 2005). The entire discussion is suggestive of the janus-faced nature of trade when it comes to the ways in which it can promote peaceful or conflictual relations between states.

These divergent findings are due in part to the sensitivity of empirical tests to the qualities of trade that are being measured (Mansfield & Pollins 2001). Scholars using aggregate bilateral trade flows or trade asymmetries may arrive at conflicting findings due to the ways in which they operationalize this interdependence. Some have dealt with this issue by focusing on the emergence of exit costs between interdependent states(Crescenzi 2005, Peterson 2014). We use this focus on the exit cost mechanism to consider both the extent and substitutability of economic ties as sources of opportunity cost. Higher levels of aggregate trade do not necessarily instill restraint between disputants if both can easily re-route trade to alternative markets. Alternatively, relatively small amounts of bilateral trade may be peace inducing if neither trade partner can reap similar gains if trade is re-routed.

A similar logic may be applied when considering territorial disputes. In her work on the role of borders and trade, Simmons (2005) suggests an underlying opportunity cost mechanism regarding unsettled borders similar to that of the broader literature on trade interdependence and conflict. The lack of resolution of territorial boundaries results in a

dampening of bilateral trade between partners, but do higher levels of opportunity cost instill caution between potential disputants? In her work, Simmons does not directly hypothesize the substitutability of trade partners for disputant states given that substituting contiguous trade partners is unlikely to absorb all foregone trade. This likely varies depending on the composition of trade between potential disputants. Further, the potential asymmetry in a dyadic trade relationship between disputants informs the opportunity cost of unsettled borders. The opportunity cost of exiting a relationship with a contiguous state likely influences when new disputes arise and when disputes escalate.

Reconciling Territorial Conflict in the Presence of Economic Integration

If we focus on this particular form of economic integration — situations where removal from the economic exchange would be politically and economically costly — exit costs may help us understand the effects of economic ties on territorial dispute behavior. Here we leverage the assumption that both sides in a dispute are fully aware of the existence of high exit costs, and may rely on them as a deterrent to major conflict. Crescenzi (2005) theoretically demonstrates that high exit costs may deter escalation, but at the same time can enable claims and low-level violence. The knowledge that one's opponent may be constrained by economic ties can constitute a moral hazard, emboldening claims over unsettled borders. We expand on this argument below, parsing our hypotheses and analyses into two stages: the onset of territorial claims and their management.

In the first stage, where states issue new claims over territory, high exit costs may increase the propensity to issue a new territorial claim. While this may seem counter-intuitive, claim-making when exit costs are high can potentially shield states from the possibility of

escalation to a high levels of violence, such as a fatal MID. At this stage, states that initiate a claim are engaged in a game of brinkmanship where they hope to coerce their targets into making concessions while relying on economic interdependence to prevent the outbreak of more dangerous hostilities. This logic of coercion yields the following hypothesis:

> **Hypothesis 1:** When exit costs increase for at least one state in a contiguous dyad, a territorial claim is more likely to be initiated.

At the second stage, once a claim has already been initiated, the impact of exit costs on the maintenance of an ongoing dispute exacerbates the moral hazard problem. As exit costs increase, state leaders perceive leverage, which inhibits settlement, enabling escalation to militarized violence (although we do not expect escalation all the way to war). This follows Crescenzi's (2005) expectations regarding the inability of exit costs to provide a check on low-level conflict, making bargaining via the economic relationship shared in the dyad difficult to leverage. This results in the following hypothesis:

> **Hypothesis 2:** If a territorial claim exists, increasing exit cost increases the likelihood of conflict.

The choice that states in a dispute face is not a binary one between escalation of violence and maintenance of the status quo. They can also seek to resolve the dispute peacefully, whether bilaterally or as part of a multilateral mediation process. Settlement attempts may also occur bilaterally in international institutions such as the International Court of Justice or the International Tribunal for the Law of the Sea. Settlement attempts are complex processes that vary greatly in the degree to which proposals are binding, the level of outside enforcement, and the timeline for resolution (Owsiak & Mitchell 2019, Wiegand, Powell & McDowell 2020). Many disputes witness several rounds of settlement attempts without success, and even peacefully resolution frequently takes many attempts.

Once a claim has been initiated, increasing exit costs may actually decrease the

propensity for a state to attempt to settle its territorial claims via negotiation. Similar to the increased propensity for conflict, exit costs on the higher end may be ineffective when leveraged to resolve a dispute. Rather than settling a territorial dispute unfavorably due to the economic leverage the partner state may impose, states may prefer to maintain the status-quo and not resolve their disputes. This logic suggests a commitment problem where disputants at a disadvantage economically are unwilling to settle on unfavorable terms due to fears that their adversary will continue to grow in strength (Fearon 1995, Powell 2002, Gent & Crescenzi 2021). States in this situation prefer to continue lowered absolute gains from trade than risk relative gains to their adversary with the resolution of the dispute and the transfer of the territory. This results in the following hypothesis:

> **Hypothesis 3:** If a territorial claim exists, declining exit costs will increase the propensity for settlement, and increasing exit costs will decrease the propensity for settlement.

With our hypotheses in place, we now turn to our empirical test of the above hypotheses. A primary focus of this discussion concerns the measurement of exit costs in bilateral trade relationships.

Research Design

We test our predictions in a sample of all contiguous dyad-years in the international system from 1962 to 2001. Our unit of analysis is the directed-dyad-year, as each state in a bilateral trading relationship can face asymmetric exit costs due to differences in their overall export portfolio. Focusing our analysis on all contiguous dyads allows us to consider all states that may have territorial disputes. In this analysis, we define a contiguous dyad as two states that either share a land border or are separated by less than 400 miles of water. These dyads are taken from the ICOW contiguous dyad dataset (Stinnett, Tir, Diehl, Schafer &

Gochman 2002). The UN Comtrade data that we use to measure exit costs begin in 1962, so this sets the starting point for our analyses, and the ICOW data end in 2001, determining the end of our sample.

Dispute Onset and Outcome

For our onset hypothesis, we first require a measurement of whether or not a territorial claim is made in a given year. We develop a binary dependent variable which takes on the value of 1 if there is a territorial claim made in a year and 0 if no claim is made. This indicator is taken from the ICOW territorial claims dataset (Frederick, Hensel & Macaulay 2017). The ICOW territorial claims dataset defines a territorial claim as being present when there are "explicit competing claims to territorial sovereignty" and those claims are made by government officials. Accordingly, we select claims made by contiguous dyads, as defined above, for our analysis.

For our second set of hypotheses regarding the maintenance stage of a territorial dispute, we only include dyads that currently have an ongoing dispute, which limits our number of directed-dyad-years. For this set of hypotheses we develop an unordered indicator that can take on four values. The first value is *Status Quo* which indicates that no escalation or attempts at settling the dispute occurred in a given year. Next we code an *Escalation* as occurring if there is a report in an increase in the maximum hostility index created by the ICOW territorial dispute dataset for that given dyad year. We code a *Settlement Attempt* as occurring if there is a record in the ICOW territorial dispute dataset that an attempted bilateral negotiation occurred in a dyad year. Finally, we code a variable *Both* if both a settlement attempt and an escalation occurred in the same year.

Exit Costs

In order to operationalize the actual cost of exiting an economic relationship with a disputant, we develop a yearly measurement of exit costs for each directed-dyad. While the termination of a trading relationship entails the loss of profits to the exporter and the loss of access to commodities to the importer, we focus on the exporter's perspective. The loss of revenue from exports to a trading partner directly impacts the financial situation of the exporterAccordingly, we develop a measurement of State i's exit cost from ending economic interaction with State j and similarly State j's exit cost from ending economic interaction with State i, i.e., the export dependence of one state on another.

Crescenzi's (2005) operationalization of exit costs is unfortunately static across time and limited to the latter half of the last century. Peterson (2014) improves upon this work and develops commodity-level measurements of elasticity by country and two digit SITC commodity code. The result is a measure of exit costs that is both more specific and more dynamic.

In this study, we refine Peterson's strategy by employing the UN Comtrade data that underlie the Feenstra, Romalis & Schott (2002) data. The Comtrade data offer multiple advantages over these earlier data. First, they begin in 1962 instead of 1972, allowing us to include an additional 10 years in our analyses. They are also available through 2018 so while our analyses end in 2001 due the temporal scope of the ICOW data, we are able to generate measures of exit cost for an additional 17 years compared to the Feenstra et al. data's endpoint of 2001. Second, the Feenstra et al. data are disaggregated to the four digit SITC commodity code level, while the Comtrade data are disaggregated to the five digit level. This allows us to develop a more nuanced measure of exit costs as we discuss below. Finally, Kim, Liao & Imai (2019, 5) find that the Feenstra et al. data have missing values for over 200,000 observations that have positive values in the Comtrade data for 1962 alone. By

using the more complete Comtrade data, we are able to construct a more accurate measure of exit costs in bilateral trade.

Commodities are represented by five digit Standard International Trade Classification (SITC) commodity codes. Each digit describes successively more differentiated product categories. Figure 1 illustrates the structure of the data from one to five digit SITC commodity codes for commodity `28792: Tungsten ore and concentrate`. The two digit code `28` also contains copper, aluminum, and titanium ore, precious metals, and steel scrap. Each of these metallic commodities serve very different roles in production chains, and command different prices. Aggregating all of them together, along with 15 other commodities, under the two digit code discards large amounts of information and treats all nonferrous ore and scrap metal as substitutable in the eyes of a state needing to find new export markets after ending a trade relationship.

```
2: Crude materials, inedible, except fuels
  28: Metalliferous ores and metal scrap
    287: Ores and concentrates of base metals, nes
      2879: Ores and concentrates of other non-ferrous base metals
        28792: Tungsten ore and concentrate
```

Figure 1: Structure of commodity codes for `28792: Tungsten ore and concentrate`

The unit of observation in the Comtrade data is the reporter, which is a state that reports trade flows from a partner. States report both their imports and exports, so each directed-dyad-commodity trade flow appears in the data twice. This double reporting may seem redundant, but there are extensive discrepancies in reporting throughout the data. For example, Cuba reports importing $38,450 of knitted undergarments from the United States in 1991, while the United States does not report this transaction.[1] The UN notes that discrepancies in official trade statistics can be due to differences in partner attribution (whether overseas territories are included in their parent country or not), the use of different cost of freight measures, and the use of different systems to aggregate national trade statistics

[1]The text of the entry is "`Under garments knitted, not elast. Nor rubberd`"

(Statistics Division; Economic Statistics Branch 2019). However, this specific case almost certainly cannot be attributed to these sources of incidental reporting error as the United States has maintained a near total embargo on Cuba since 1962, excepting food and medicine.

Although we cannot know the source of this discrepancy, it does highlight that some reporting discrepancies may be due to deliberate and strategic processes on the parts of reporters. In light of these patterns, we account for discrepancies in a way that previous studies do not. Kim, Liao & Imai (2019) use importer reports when available, and exporter reports when not available, based on the assumption that importers will more accurately know the true value of the transaction. This approach treats discrepancies as non-random, but systematic and straightforward sources of measurement error. The Cuba case above suggests that discrepancies may be most prominent in the cases most likely to be involved in territorial disputes and could reflect illicit smuggling flows between the two states. To address this possibility, we use the mean of importer and exporter reports for each directed-dyad-commodity flow. While this strategy does not explicitly model the sources of discrepancy, it should reduce measurement error in the most relevant cases.

The dyadic exit cost measure in Peterson (2014) is a sum of the dyadic exit cost measures for all SITC two digit commodities traded by the dyad in a given year. This assumes that the supply and demand of each subcomponent of each SITC two digit category is equally elastic. For example, the SITC two digit code 28 `Metalliferous ores and metal scrap` contains the SITC 5 digits codes 28399 `Other ores & conc.of non ferrous base metals`, 28393 `Ores & conc.of titanium,vanadium,molybdem,etc.`, and 28501 `Ores & conc.of silver,platinum,etc.`. The demand for precious metals is likely to be more inelastic in an economy with a large electronic component manufacturing sector due to the profitability of these industries. Using highly aggregated commodity categories like these masks important variation in the patterns of trade between states. To illustrate the scale of this issue, there are 68 different SITC two digit commodity codes and 1,396 different SITC

five digit commodity codes traded between 1962 and 1991.

Moving to more disaggregated trade data presents new challenges, however. Applying Peterson's strategy would require running over five million regressions, an enormous computational task. To deal with this problem, we employ principal component analysis (PCA), a standard technique for dimensionality reduction from the unsupervised learning literature. We first discuss the mathematical properties of PCA and then highlight how they align closely with common conceptualizations of exit cost.

The Comtrade data are organized into an $n \times p$ matrix $\mathbf{X}$ with n directed-dyad-years and p commodities. The transformation maps each row vector $\mathbf{x}_i$ to a new vector of principal components scores $\mathbf{t}_{(i)} = (t_1, \ldots, t_k)_{(i)}$ using a vector of weights $\mathbf{w}_{(k)} = (w_1, \ldots, w_p)_{(k)}$. The scores are calculated as $\mathbf{t}_{(k)} = \mathbf{w}'_{(k)}\mathbf{X}$ such that each successive set of scores $\mathbf{t}_{(k)}$ contains the maximum amount of variation possible from $\mathbf{X}$ (Jolliffe 2002). The weights for the first principal component $\mathbf{w}_1$ that maximize the variance in $\mathbf{t}_{(1)} = \mathbf{w}'_{(1)}\mathbf{X}$ are often found via singular value decomposition (Hastie, Friedman & Tibshirani 2009, 534-541).

The second principal component $\mathbf{t}_{(2)}$ is found such that it maximizes variance while being uncorrelated with $\mathbf{w}'_{(1)}\mathbf{X}$ (Jolliffe 2002). The full principal components decomposition of $\mathbf{X}$ can be given by $\mathbf{T} = \mathbf{XW}$, where $\mathbf{W}$ is a $p \times k$ weights matrix. Setting $k < p$ retains the first k components, yielding uncorrelated components that can explain a portion of variance in the data. Intuitively, features (commodities) with higher variance contribute more information toward predicting an outcome (border disputes) because they cover a larger range of potential values. PCA yields components with the maximum possible successive variance, making it ideal for reducing multicollinearity in a regression context. This property is a good match with our substantive goal of measuring exit costs in dyadic trade relationships, and we detail how PCA captures this process below.

Consider a hypothetical in which several states trade two commodities, c_1 and c_2,

and we wish to use PCA to reduce two dimensions of trade to one. If all states trade a roughly equal amount of c_1 while c_2 is unevenly traded with some states importing and exporting large amounts, and other states abstaining from trade, c_1's contributions to the first principal component $\mathbf{t}_{(1)}$ will be eclipsed by c_2. States would have a very low exit cost for c_1 as any state i that ceases trade in commodity c_1 with state j would lose only a small amount of trade revenue and would have many alternative trading partners $-j$. As c_2 is unevenly traded, states that refrain from trade in c_2 would have zero exit cost for c_2, while states that trade heavily in c_2 would face high exit costs due to the higher amount of foregone trade revenue and the limited number of alternative partners.

Following common practice for such dimensionality reduction (Jolliffe 2002), we perform PCA using a range of values $k \ll p$ and plot the number of components against the cumulative proportion of variance explained in Figure 2. We do this for each year separately to account for the fact that the composition of global trade fluctuates over time and PCA assumes that data are *iid*.[2] We set $k = 25$, which preserves approximately 95% of total variance in the trade data[3]. In doing so, we extract the underlying dimensions of trade with the highest variation, and thus the highest exit costs for exporters that are outliers on those dimensions. We take the average of all 25 components to construct our measure of *exit cost*, which is measured at the directed-dyad-year level, analogous to how Peterson (2014) creates an exit cost measure by summing the results for each two digit commodity.

In sum, our approach to measuring exit costs in bilateral trade offers multiple advantages over previous strategies. First, by incorporating all 1,396 commodity codes into our measure, we do not assume that all commodities under each two digit code are traded equally and are equally important to states. Second, PCA captures the underlying varia-

[2]While this approach avoids violating the *iid* assumption, it introduces other issues as the components of trade are dependent on annual trade patterns and thus no longer directly comparable across years. We account for this temporal dependence in our modeling strategy, discussed below.

[3]As a robustness check, we also replicate our models with $k = 10$ and $k = 50$ components. Our findings are consistent using these alternative specifications.

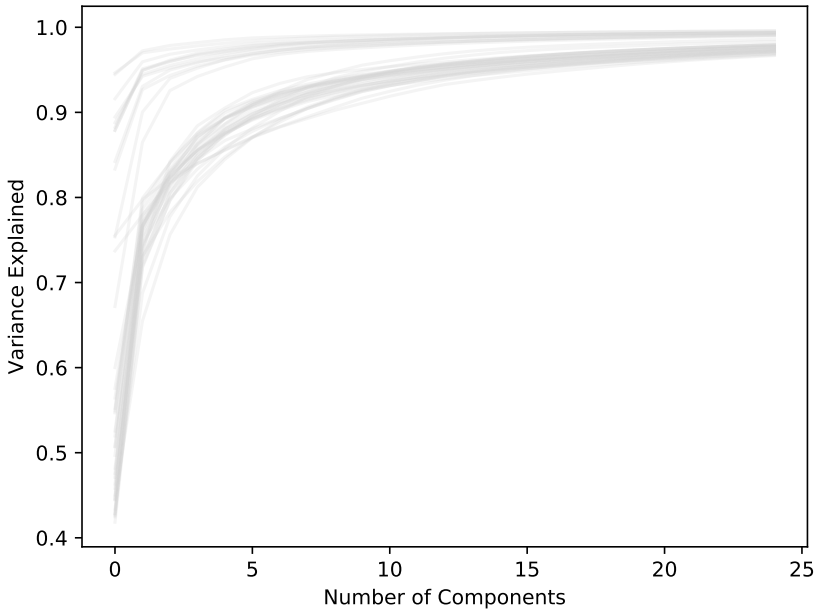

Figure 2: Cumulative proportion of total variance in trade explained by year

tion in trade data while omitting statistical noise, improving the efficiency of our eventual analysis. Third, it produces a measure that varies yearly, unlike the elasticity measure that Peterson (2014) develops.

Before discussing our statistical tests, we first examine the properties of our PCA-derived estimates of exit cost to validate the measure. Recall that the kth principal component is a linear combination of the data $\mathbf{X}$ and a weight vector $\mathbf{w}_k$. Thus $\mathbf{w}_k$ represents the marginal contribution of commodity p to component k. Identifying the commodities that make the largest contribution to the first principal several components allows us to assess the face validity of our measure by comparing them to commonly held understandings of exit cost in international trade.

Figure 3 presents the three largest weights $\mathbf{w}_1$, $\mathbf{w}_2$, $\mathbf{w}_3$ for the first three components for each year in our sample. The first and second component have commodities with weights that appear consistently across the time-series, suggesting that there is a continuity to the

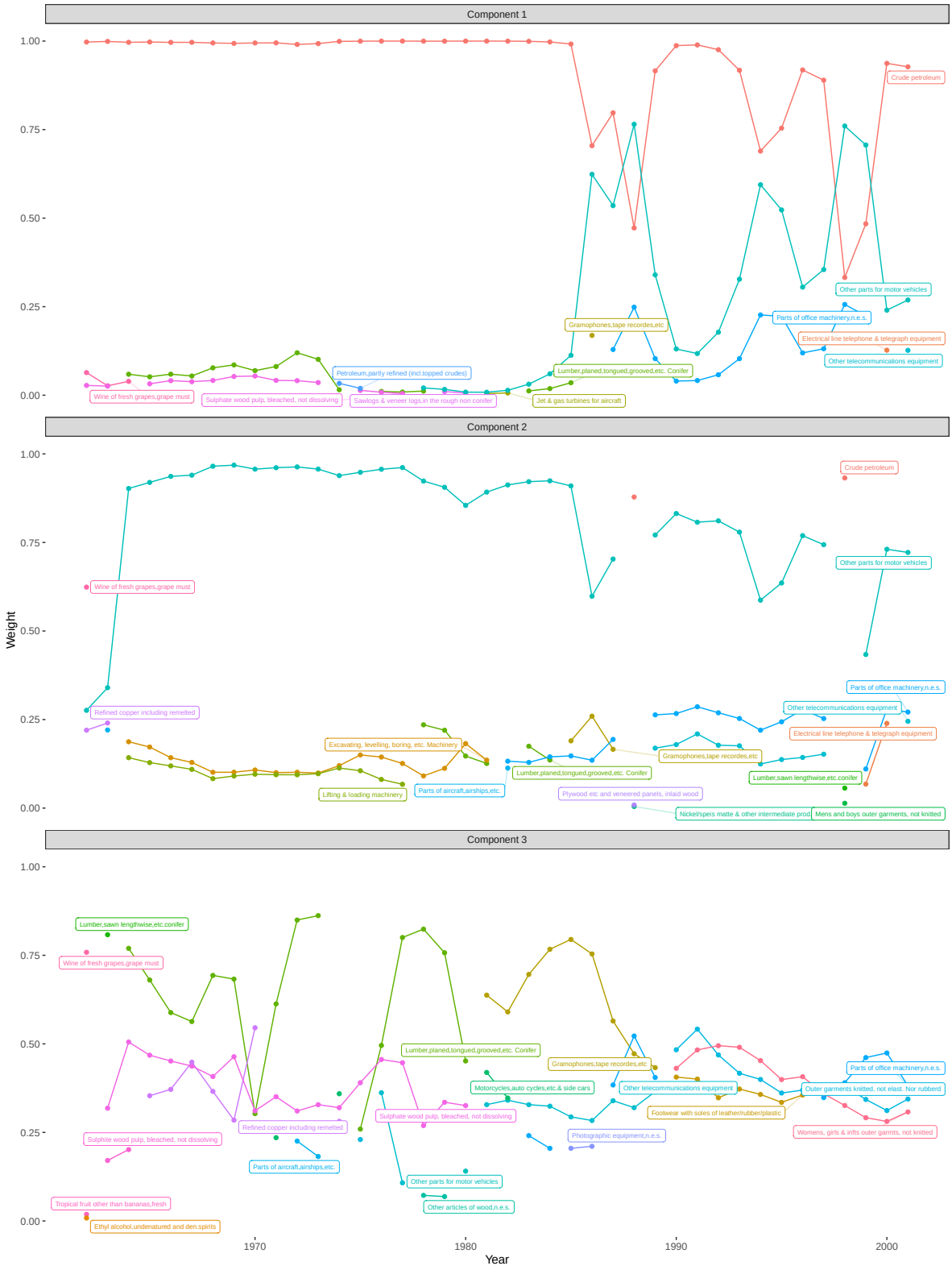

Figure 3: Three largest weights for first three components annually

measure from year to year. The third component has fewer uninterrupted appearances in the top three weights, indicating the the first two components are more stable over time. This pattern indicates a trade regime where a handful of commodities are characterized by persistently high exit costs while others vary more over time.

The dominant commodity in the first component is `331010 Crude petroleum` by a wide margin. Oil is vital to the functioning of an industrialized economy and commands a high price, so terminating a trade relationship that includes high oil flows would be very costly. Although oil has the largest weight for the first component for much of our sample period, this does not mean that our measure is dominated by oil flows. Oil is the largest contributor to the first component, which contains the largest amount of variation, but it is not nearly as dominant in subsequent components. The measure accounts for the importance of oil flows while also incorporating information on other commodities that are unevenly traded across the international system and thus have high exit costs. In the two of three years where the weight on oil for the first component dipped below the weight on motor vehicle parts, oil is the commodity with the largest weight for the second component. This pattern tells us that oil was a smaller contributor to exit costs in those two years because there was less variance in trade patterns for oil. These two years correspond to large downturns in the price of oil, which is consistent with oil contributing less to exit costs in those years.[4]

The largest weights for the first three components also include many capital intensive commodities such as `71842 Excavating, levelling, boring, etc. Machinery`, `19391 Lifting & loading machinery`, `73289 Other parts for motor vehicles`, `72499 Other telecommunications equipment`, and `73492 Parts of aircraft,airships,etc.`. These commodities are important to industrialized economies and are also available from a limited number of trading partners. It is important to remember that the values in Fig-

[4]See the SI for a detailed presentation of these oil price data.

ure 3 are the commodity-specific *weights*, and not the resulting components. Even though crude petroleum is the largest weight for the first component, this does not mean that the first component is entirely petroleum-driven as all other commodities also contribute to the component.

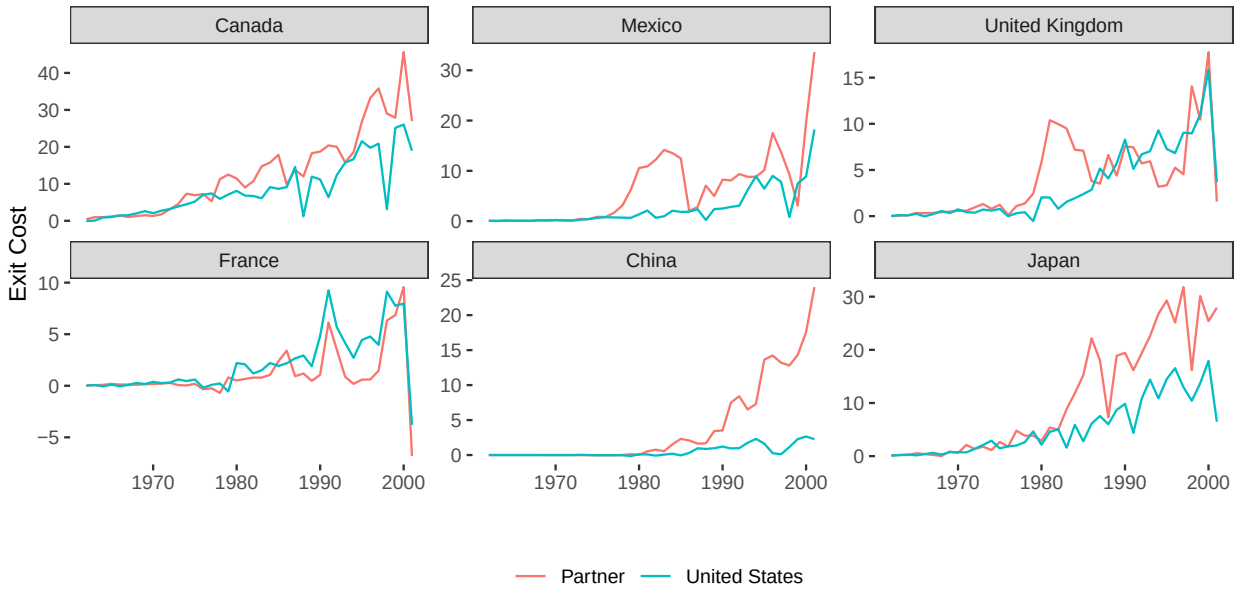

Figure 4: Exit cost time-series for the United States and trading partners

To further validate our measure of exit cost, we also explore patterns of the overall exit cost measure between states over time. Figure 4 displays exit costs for the United States and six trade partners for the sample period. In general, the United States has lower exit costs than its trading partners, reflecting the fact that the US is a large consumer of products from around the world. Exit costs in the US-China dyad are jointly low through 1990, but as Chinese imports to the US increase from 1990 onward, Chinese exit costs increase dramatically, highlighting the dependence of China on exports to the US. Exit costs in relationships with neighboring Canada and Mexico are more symmetric, mirroring the frequent economic exchange in both direction across borders.

While we limit our empirical analysis to contiguous dyads due to the importance of contiguity for the initiation of border disputes, we create our measure of exit costs using

the entire global trade dataset. If country i trades a large amount of a commodity with country j, this would appear as a high exit cost if few other countries in the contiguous-dyad sample trade the commodity. However, if many other countries not in the contiguous-dyad sample trade comparable amounts of the commodity, state i's exit costs will be lower as they are losing only a small fraction of their trade revenue from the commodity. Our exit cost measure thus accounts for the fact that states are integrated into the global economy and have a wealth of potential alternative trade partners beyond their immediate neighbors.

Control Variables

Following the literature on territorial disputes, we include a number of control variables to account for relevant factors in our analyses. We control for the size of the economies involved in the potential dispute by including the natural log of the *lower GDP* in the dyad (Peterson 2014). We also control for the balance of military capabilities between states in the dyad (Huth & Allee 2002) using the log of the *ratio* of the challenger's CINC score to the target's (Singer 1988). In addition, we include the *joint polity* score (Marshall, Gurr & Jaggers 2014) of the dyad, which ranges from -20 to 20 (Peterson 2014). We include information regarding whether both states in the dyad are OECD countries. We include another indicator regarding whether or not the actions we are studying occur during or after the *Cold War*, as the propensity for changes to the territorial order increases when there are changes to the international balance of power (Abramson & Carter 2016). We include a measurement of the log of the number of commodities traded in a dyad in a given year to control for the potential size of the trade relationship. We note whether both states in a dyad are in an *alliance* (Leeds, Ritter, Mitchell & Long 2002) as alliance partners may be more likely to resolve their disputes through alternative channels rather than issue a territorial claim. We include a control for the presence of a *preferential trade agreement* from Mansfield & Milner (2000). Joint participation in the GATT/WTO increases trade within

a dyad. Accordingly, we include two dummy indicators for participation in GATT/WTO based on Tomz et al. (2007).

In contrast with many other studies of economic interdependence and conflict, we do not include a variable that captures the concept of trade dependence. Typically studies include a variable that measures the share of each state's GDP generated by trade in their measure of exit cost. However, our measure of exit cost extracts the dimensions of trade with the highest exit costs, so states that have a high value on our measure have a high exit cost. As we include the lower GDP in the dyad, this effectively controls for the size of the economies in (potential) dispute, removing the need to include a measure of trade dependence in each state's economy.

This common practice carries with it the, often implicit, assumption that all sectors of trade are equally important to a government from a domestic political perspective. Given the extensive body of literature on trade policy lobbying by firms (Grossman & Helpman 1994, Kim 2017), this assumption is potentially problematic. If a state cuts off all trade with a neighboring state due to a border dispute, the political costs to the leader are not constant in the monetary costs to the affected industries. Industries that support the leader are more likely to punish them for infringing on their profits. By seeking out dimensions of trade with high variance, our measure has the side effect of discovering dimensions of trade where certain countries enjoy a comparative advantage. Any state with a high value on a component of trade will export much more of that component than the majority of other countries. The specific industries within that country that contribute to its high score on that component are likely to enjoy outsize political influence domestically. Our measure of exit cost also yields components of trade where those exit costs will likely be highly salient to leaders, freeing us from the need to measure trade dependence or salience.

Model

We evaluate Hypothesis 1 using logistic regression due to the binary nature of the outcome variable. To account for time dependence, we follow Carter & Signorino (2010), and include the cubic polynomial of the time since the last territorial dispute onset. We measure time from the last onset of a claim over the same dispute in a dyad for the full time of the ICOW territorial claims data starting in 1816. A claim is considered to be a new issuance pursuant to the coding rules of the ICOW territorial claims dataset.

We test Hypotheses 2 and 3 using multinomial logistic regression due to the categorical nature of the outcome variable. While *Status Quo* is a natural baseline outcome, there is no inherent ordering to *Settlement Attempts*, *Militarized Escalation*, and *Both* settlement and escalation. We thus use *Status Quo* as the omitted category for our analyses. In addition, in order to attempt to control for time dependence we include measurements taken from the ICOW territorial claims dataset to account for previous attempts at settlement or previous conflicts. The first is a count of the years since a war was fought over the territory weighted by how recent the conflict was. We also include two measurements of the years since a settlement attempt occurred in the dyad, one indicates whether there was successful attempt and the other an unsuccessful attempt.

In both analyses we employ robust clustered standard errors, clustered on the dyad to account for unobserved heterogeneity at the dyad level. This corrects for the fact that observations within dyads are likely to be more highly correlated than those between dyads. We cluster on the undirected-dyad as the unobserved characteristics in a dyad are at the state level and thus are constant regardless of whether a state is the challenger or target. As our data are reported annually, all predictors are lagged one year to reduce endogeneity concerns.

Results

Table 1 presents the results for our first hypothesis in numerical form. The base model presented first is a simple bivariate analysis and the second model is our full specification. Exit cost is a positive and significant predictor of a new territorial claim onset against a neighboring trading partner. This provides initial support for the first hypothesis which contends that increasing exit costs may prompt states to issue new claims as the propensity for a trade partner to exit declines as the relative uniqueness of trade increases. As discussed above all predictors are lagged one year to reduce the possibility of endogeneity bias.

Figure 5 presents the predicted probability of territorial claim onset as a function of exit cost. All other variables are held at their central tendencies. At low values of exit costs, the predicted probability of a dispute onset is low and begins to increase as exit costs increase.

This finding aligns with our expectations about the relationship between exit costs and the initiation of territorial claims against neighbors. When exit costs are low, states face very few penalties for terminating trade. As costs increase, the price to pay for ending or restricting the trading relationship increases for both parties, a new claim is a relatively cheap signal.

Table 2 presents the results for our second and third hypotheses in numeric form. The coefficient for settlement attempts is negative and statistically significant. This is consistent with our hypothesis that as states become more deeply interconnected and their trade becomes harder to replace, they will be less likely to see a settlement attempt. The coefficient for exit cost is not statistically significant for either escalation or the both category.

Figure 6 presents the predicted probability of potential statuses of ongoing territorial disputes as a function of exit cost. The predicted probability plot adds some nuance to

	Model 1	
	Base Model	Full Model
Exit Cost	0.188*	0.0956*
	(0.000)	(0.000)
Joint Polity		-0.0133
		(0.477)
ln(Capability Ratio)		-0.0334
		(0.697)
Ally		-0.0636
		(0.778)
ln(Minimum GDP)		0.283*
		(0.000)
Commodities		0.000412
		(0.432)
Cold War		0.250
		(0.363)
Joint OECD		0.202
		(0.447)
PTA		0.0706
		(0.745)
Both WTO		-0.428
		(0.193)
One WTO		0.128
		(0.693)
(Constant)	-5.329*	-4.802*
	(0.000)	(0.000)
Polynomial Time		✓
N	23,490	23,490

standard errors in parentheses

* $p < 0.05$

Table 1: Logistic regression of territorial claim onset

our findings. Status quo outcomes serve as the baseline category, with all other outcomes predicted relative to it. At lower exit costs, negotiated settlement attempts are the most likely outcome. The predicted probability of both a settlement attempt and a militarized escalation remains consistently indistinguishable from zero across the range of exit costs.

The predicted probabilities align with our theoretical expectations for hypothesis 3 and do not lend support to hypothesis 2. As exit costs increase, the probability of a

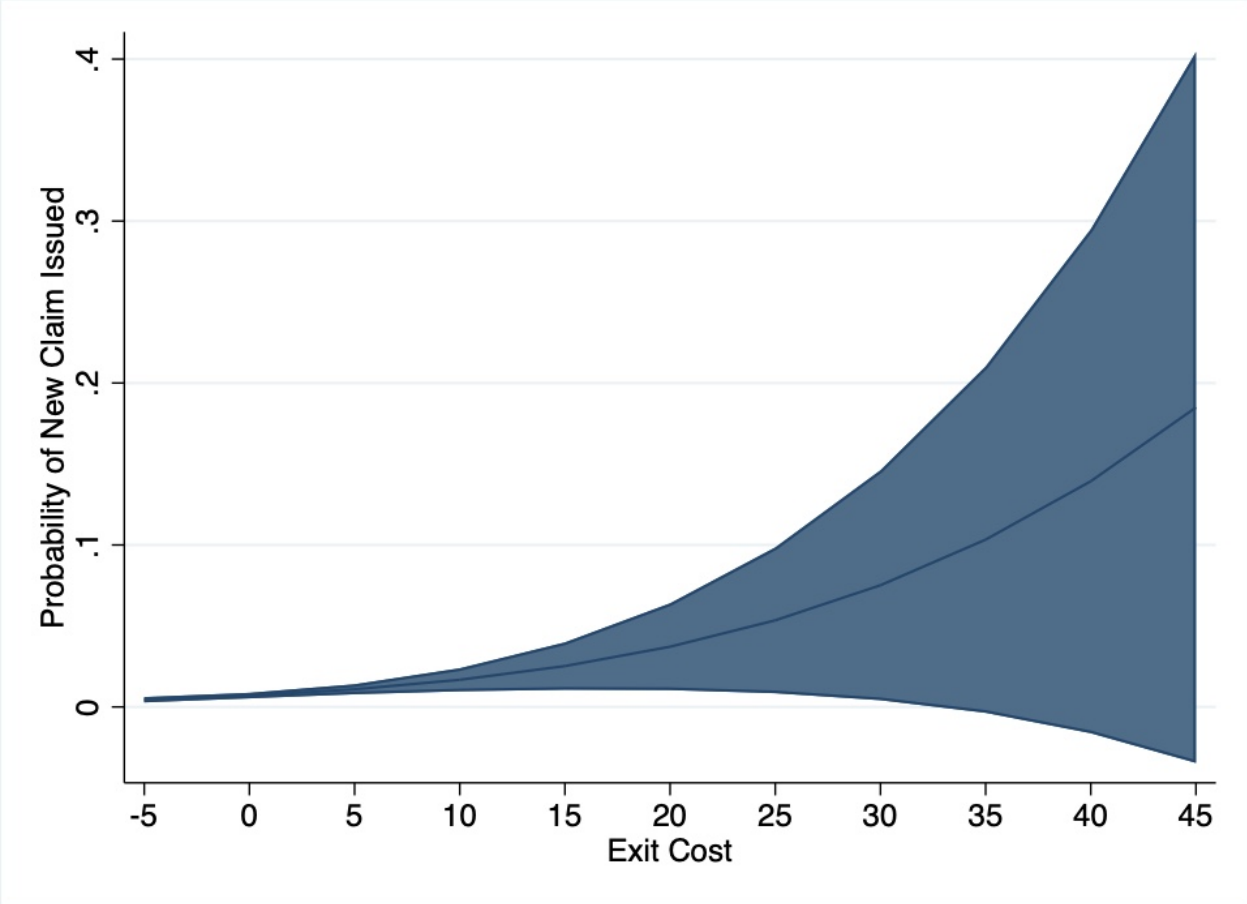

Figure 5: Predicted probability of new territorial claim onset. All other variables held at their central tendencies. Shaded region represents 95% confidence interval.

settlement attempt declines. This makes sense as the majority of territories under dispute in this analysis are coded as economically or strategically salient. These disputes thus involve claims over territory that can alter the balance of power between states. When exit costs for the challenger are high, they have higher leverage over the target. While the challenger must forgo increasing revenue, the target will be deprived of more important commodities.

The statistically significant and negative coefficient for exit costs for settlement attempts might suggest a more nuanced and complex relationship to settlement. Exit costs can reach a tipping point in higher ends of our measure such that it becomes prudent for states to reach a strategic stalemate rather than attempt to settle their dispute as demonstrated by the predicted probability plot.

	Model 2		
	Settlement	Escalation	Both
Exit Cost	-0.0397*	-0.0101	-0.0239
	(0.000)	(0.301)	(0.106)
Joint Polity	0.00199	0.0162	0.00461
	(0.795)	(0.111)	(0.767)
ln(Capability Ratio)	0.00265	-0.00709	0.00309
	(0.225)	(0.078)	(0.433)
Ally	0.281	-0.362*	0.427
	(0.073)	(0.026)	(0.144)
ln(Minimum GDP)	0.120	0.289*	0.0460
	(0.074)	(0.005)	(0.679)
Commodities	0.000145	-0.000673	-0.000240
	(0.658)	(0.141)	(0.650)
Cold War	-0.221*	0.0633	-0.277
	(0.037)	(0.663)	(0.174)
Joint OECD	0.0492	-0.737*	-0.973*
	(0.821)	(0.030)	(0.002)
PTA	0.196	0.633*	0.212
	(0.083)	(0.000)	(0.321)
Both WTO	-0.360*	0.314*	0.299
	(0.004)	(0.019)	(0.130)
One WTO	-0.116	0.227	0.410*
	(0.323)	(0.284)	(0.035)
W Last War	0.129*	0.502*	0.487*
	(0.030)	(0.000)	(0.000)
W Last Sett Yes	0.279*	0.200*	0.158*
	(0.009)	(0.0545)	(0.044)
W Last Sett No	0.291*	0.0461	0.227*
	(0.000)	(0.369)	(0.000)
(Constant)	-3.601*	-5.111*	-3.601*
	(0.000)	(0.000)	(0.000)
N		4303	

standard errors in parentheses

* $p < 0.05$

Table 2: Multinomial logistic regression of territorial claim management

Discussion

To illustrate our cross-national findings, we now turn to a brief historical account of a dispute between Turkey and Greece over their unsettled territorial claims. The Aegean

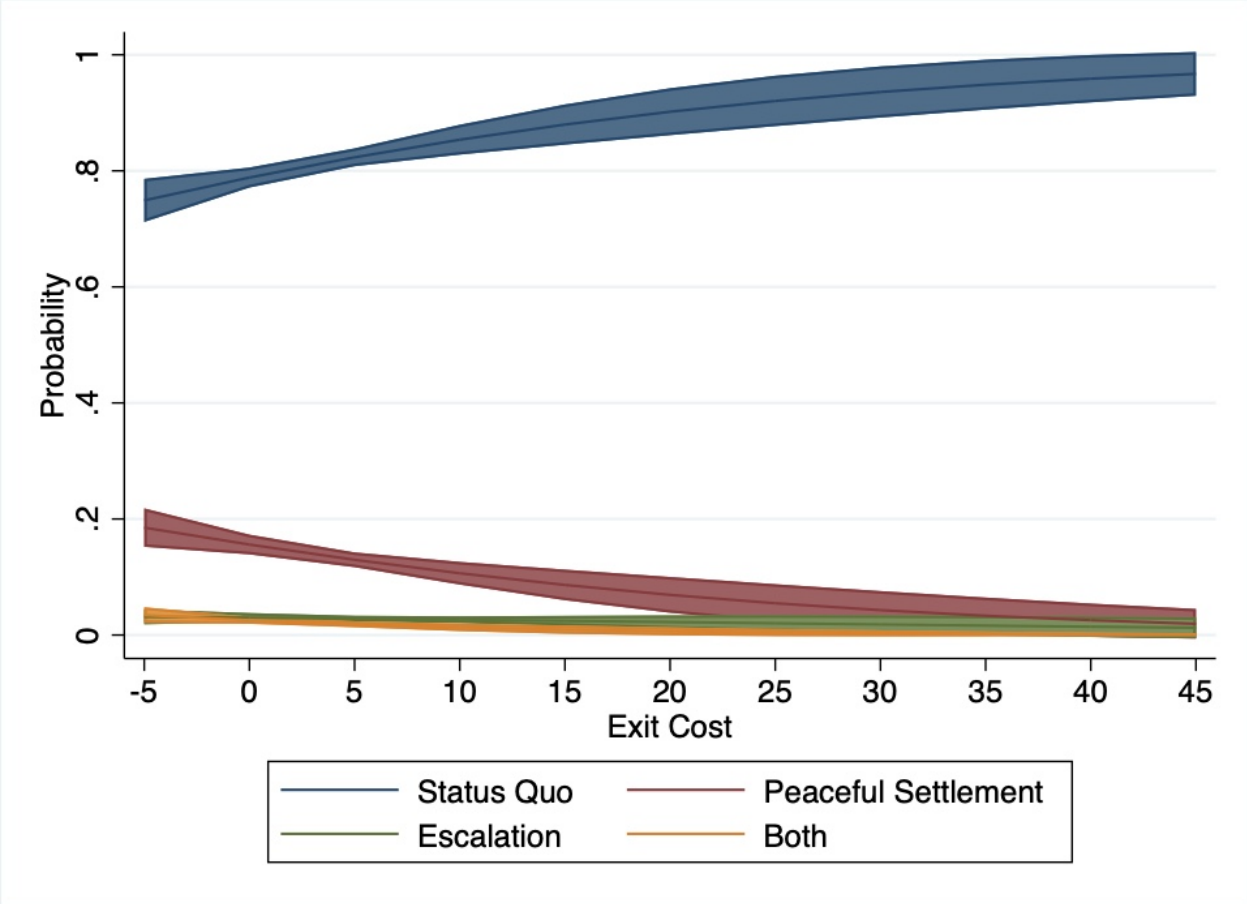

Figure 6: Predicted probability of settlement and escalation for ongoing territorial claims as a function of exit cost obtained via the delta method. Shaded regions represent 95% confidence intervals.

dispute between these two states provides an interesting look into the effects of economic exit costs on the dispute dynamic. While the Issue Correlates of War dataset lists the Aegean dispute as beginning in 1964, the disagreement did not become entrenched until Turkey granted petroleum exploration permits in the region in the 1970s (Yiallourides 2019, 43). In response, Greece filed a case with the International Court of Justice (ICJ) in 1976, asking that both nations suspend unilateral petroleum exploration and that the court delimit the continental shelf. The court found that it did not have jurisdiction and did not issue a ruling (International Court of Justice 1978). This decision set the stage for continuing disputes over the Sea.

In early 1996 Greece and Turkey narrowly avoided a conflict over a rocky outcropping off the shore of Turkey referred to as Imia by Greece and Kardak by Turkey (AP 1996). In the wake of this confrontation, the US and NATO applied pressure to seek a resolution to the dispute. Later that year, in opposing letters to the Secretary General of the UN, Greece claimed it was within its rights to extend its territorial waters from their current six nautical mile limit to the accepted 12 nautical mile distance recognized in the United Nations Convention on the Law of the Sea (Zacharakis 1995), while Turkey claimed that doing so would deny it access to the Aegean and transform it into a "Greek lake" (İnal Batu 1995). The dispute remains unresolved to this date, with Greece recently seeking to expand its territorial waters from six to 12 nautical miles along its Western, Italian-facing coast in an attempt to further buttress its claims in the Aegean (Walker & Pop 2020).

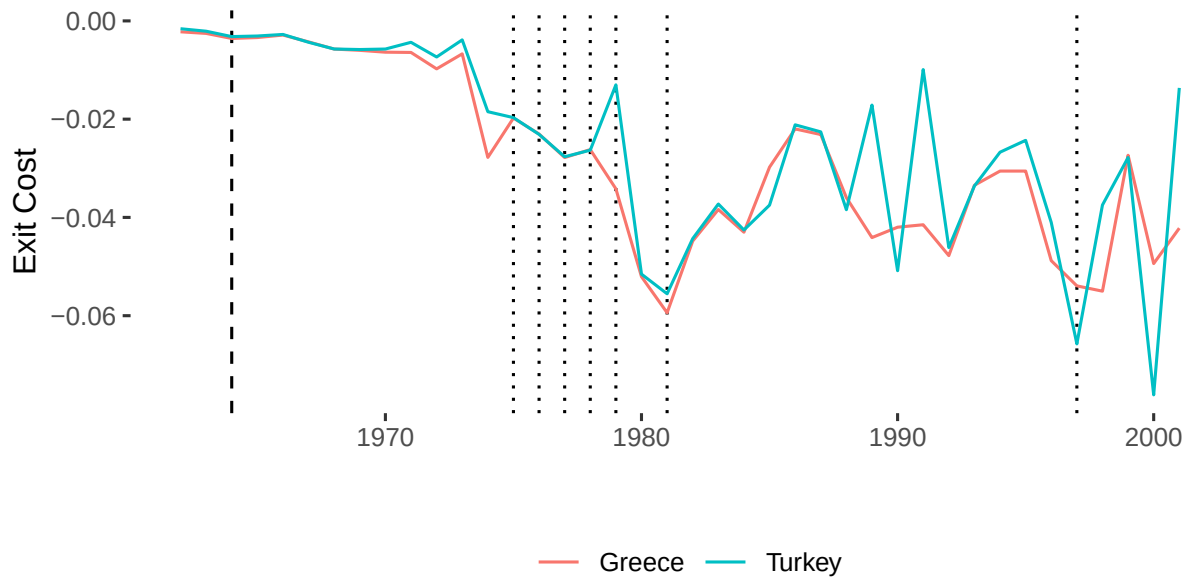

Figure 7: Exit cost in the Aegean dispute. The dashed line represents the first territorial claim in the dispute and the dotted lines represent settlement attempts

Figure 7 presents the history of each nation's exist costs during the dispute through the end of our sample period in 2001. Although the dispute officially began in 1964 (represented by the dashed vertical line), neither Greece nor Turkey made any attempt to settle the matter until 1975. Each dotted vertical line represents a year with settlement attempts

by both parties. There are no years in the data where Greece seeks to resolve the dispute while Turkey refuses to come to the bargaining table, or vice versa.

The first attempt at resolution in the 1970s occurred after a notable drop in joint exit costs. Multiple subsequent settlement attempts are accompanied by decreasing exit costs, reflecting the finding in Table 2 that exit cost is negatively associated with settlement attempts. Similarly, the settlement attempt in 1996 falls in a precipitous drop in exit cost between two higher points, suggesting that as leverage over the other side decreased, both parties were more willing to attempt to settle the dispute.

This pattern reflects the unwillingness of states to engage in settlement attempts when the potential costs are high. If one or both states have a high degree of economic leverage, they can propose highly unfavorable terms. When exit cost is low, the opposing state possess less leverage over the proposing state, so terms will be more favorable. By only engaging in settlement attempts when exit costs are low, each side can claim to be acting in good faith towards the resolution of the dispute. However, this behavior is also strategic because it ensures that the ability of the opponent to extract concessions will be minimized.

Conclusion

This paper examines how exit costs affect the propensity for territorial claim-making in dyads as well as their impact on settlement attempts and escalation to violence in ongoing disputes. To address this, we develop a novel measurement of exit costs using two billion observations of product-level trade data and principal component analysis to capture the ability of states to supplement a disputant's trade based on how unique that trade relationship is relative to the global economy. Our measure extends previous work by incorporating all 1,396 commodity codes into our measure, capturing the underlying variation in trade data while omitting

statistical noise, producing a measure that varies yearly. Using this measure, we find that increasing exit costs increase the propensity for new-claims to be initiated in a dyad. At the second stage, we find that increasing exit costs decrease the likelihood that settlement attempts will be made. No statistically significant relationship exists between exit costs and the escalation to violence, but this could be in part a function of the constraints on high-level violence imposed by exit costs.

By deriving this measure from the full depth and breadth of economic exchange between states, we provide a flexible and dynamic measure of the costs of severing economic ties. The severity of weaponized interdependence depends not only on the volume of trade, but its uniqueness. If one trade partner has many alternative trading partners that can meet the same composition of goods and services, the threat of withdrawn exchange is greatly lessened. Operationalizing exit costs in this way enables a new analysis of the complex ties between economics and conflict.

The unsupervised nature of PCA means scholars can avoid *a priori* identification of strategic or salient commodities.All commodities are equally eligible to contribute to the measure, allowing it to better capture dynamics of economic dependence over time. The weights assigned to various commodities in the procedure used to generate the principal components align with preexisting understandings of which commodities, such as petroleum products and advanced manufactured goods, are especially salient in international trade. Our measure of exit cost thus has concurrent validity with previous measures while introducing more nuance via the inclusion of more differentiated commodity data.

While intuitive and derived from rich product-level trade data, the measure also has limitations that are important to discuss. First, the measure is agnostic to the structure of markets. A commodity with a highly monopolistic market characterized by many buyers and few sellers is likely to have different effects on interactions between trading partners than a monopsonistic one with many sellers and few buyers. PCA compares state i's export

portfolio with state j to state i's export portfolio with all other states in year t to generate a measure of how unique that export portfolio is compared to all others. It does not consider where those exports are going to, or where else each trading partner is importing the same goods from. As such, the measure captures exit cost in terms of trade flows, but not in terms of market structure.

A second limitation is theoretical, rather than mechanical. We conceptualize exit cost in terms of export dependence, i.e., how much revenue will a state i lose if it ceases to export to a trading partner j. We do not measure whether the loss of imports due to the termination of a trading relationship would deprive state j's economy of essential inputs to further production or necessary consumer goods. Thus, China having a high exit cost estimate for its relationship with the United States is a necessary but not sufficient condition for declaring that the United States is dependent on China for imports of specific commodities. That question can only be answered in the context of US imports from all other trading partners.

Both of these limitations may be addressed in future work by employing network analysis techniques. These methods consider the directionality and magnitude of all trade flows, allowing researchers to estimate the importance of one trading partner in the context of all other trading partners (Ward, Stovel & Sacks 2011). However, any network-derived measure may be more difficult to employ in standard analyses of international phenomena than our export portfolio-based measure due to the complexity of network analysis models.

The nature of the trading relationship between India and China highlights the importance of continued research into all aspects of economic interdependence. Solar panels and generic drugs are two of India's largest exports, but a sizable majority of the photovoltaic cells and active pharmaceutical ingredients used to produce them are imported from China (Dhar & Rao 2020). Both sides stand to lose in this showdown; India may lose access to key inputs for its exports, but if China cannot readily find alternative markets to buy

these intermediary products, then it too will suffer a significant loss. Foreign ministers from both states proclaimed their mutual desire to deescalate the situation and work towards disengagement at the Shanghai Cooperation Organisation meeting in Moscow on September 10 (Crossley & Miglani 2020), but the complex series of dependencies between the two states may frustrate these efforts as each side wields considerable economic leverage over the other.

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A Descriptive Statistics

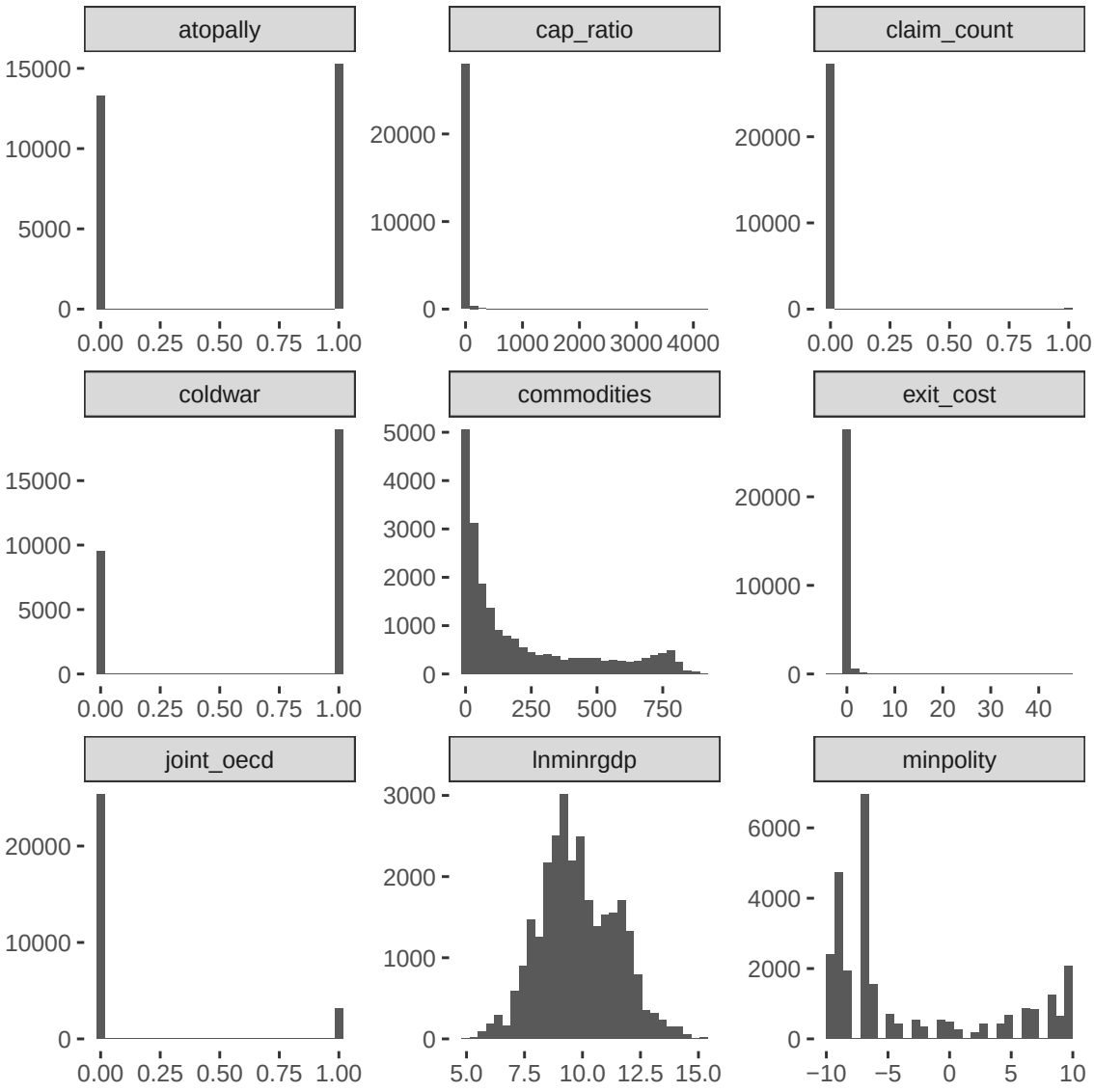

Figure 8: Distributions of variables in onset analysis.

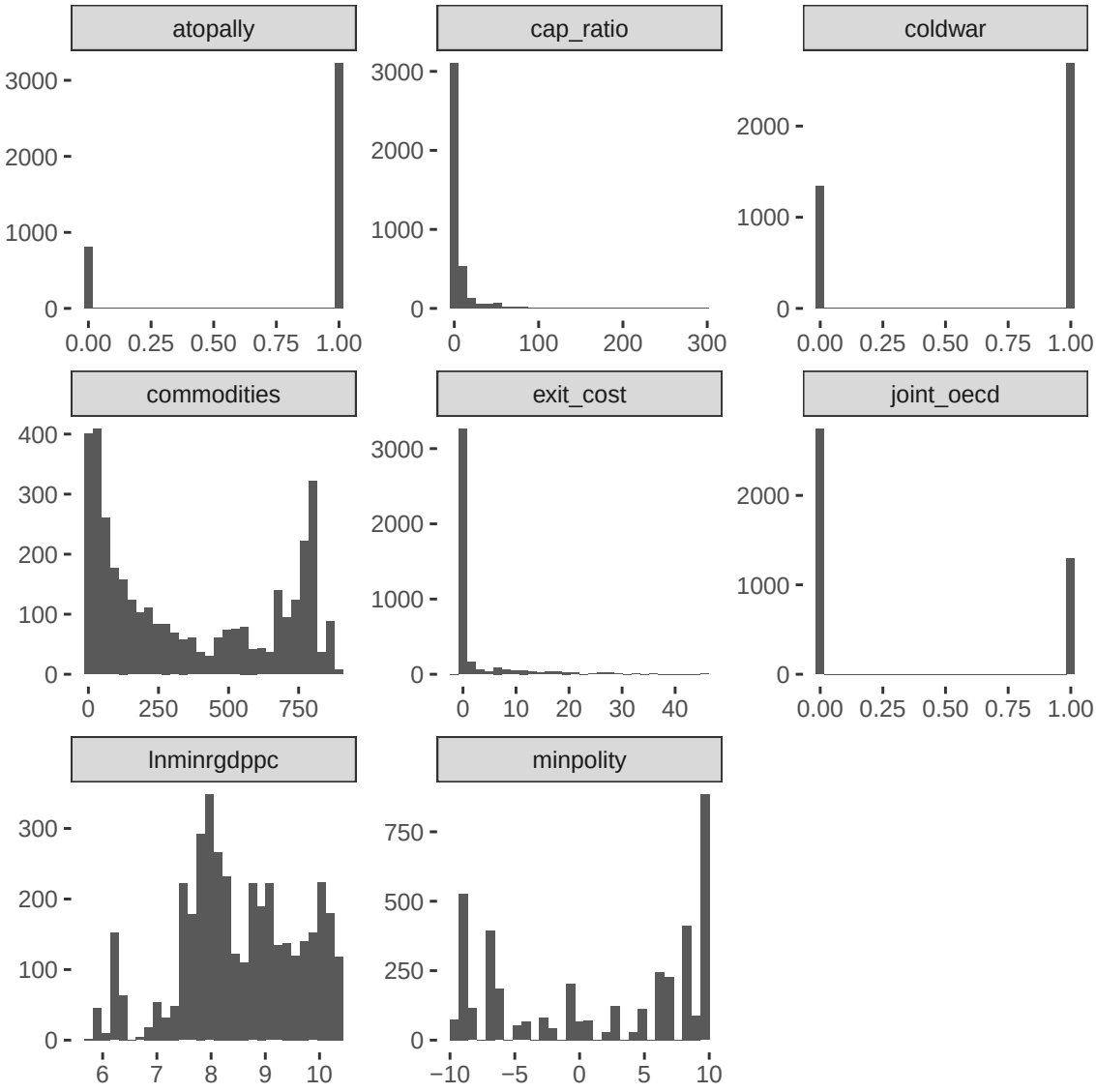

Figure 9: Distributions of variables in management analysis.

B Alternative Model Specifications - Logit

	Peaceful Attempt	Violent Attempt
Exit Cost	-0.0520**	-0.00727
	(0.003)	(0.673)
Ally	0.490**	0.322
	(0.005)	(0.242)
Capability Ratio	0.00364	-0.00280
	(0.105)	(0.634)
Minimum Polity	-0.000173	0.0305
	(0.988)	(0.132)
Commodities	0.000268	-0.000933
	(0.511)	(0.112)
OECD	-0.210	-1.265**
	(0.433)	(0.002)
ln(Minimum GDP)	0.0930	0.196
	(0.348)	(0.054)
Cold War	-0.307*	-0.0846
	(0.029)	(0.663)
W Last War	0.156	0.818***
	(0.062)	(0.000)
W Last Sett No	0.405***	0.120***
	(0.000)	(0.000)
W Last Sett Yes	0.312***	0.0724
	(0.000)	(0.389)
N	4022	4022

p-values in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Models presented in the table above show the results of two separate logistic regressions in place of the multinomial probit conducted in the analysis of the main text. The first model's dependent variable is whether a peaceful settlement attempt took place in that year. As can be seen, the results for our model are consistent with those presented in the main body of this article. In particular, our measurement of Exit Cost is negative and statistically significant. The second model's dependent variable is whether there was a violent attempt in a given year. This model is also consistent with the results presented in the main text. The coefficient for Exit Cost is negative but not statistically significant.