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# THE GEOPOLITICS OF INTERNATIONAL TRADE IN SOUTHEAST ASIA

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**ABSTRACT**

Motivated by the historically tense geopolitical situation in Southeast Asia, we simulate the potential closure of key maritime waterways in the region to predict the impact on trade and welfare. We generate initial (unobstructed) and counterfactual (rerouted) least-cost maritime paths between trading countries, and use the distances of these routes in a workhorse model of international trade to estimate welfare effects. We find heterogeneous and economically significant reductions in real GDP, and show the magnitude of welfare loss is directly correlated with military spending as a proportion of GDP, suggesting nations may be responding to economic security threats posed by such potential conflicts.

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# 1 Introduction

Among other economic and environmental benefits, oceans are vital for the transport of an overwhelming share of world trade. The long-held principle of the "freedom of the seas" is crucial for safe and frictionless international movement of maritime cargo. At present, the United Nations Convention on the Law of the Seas (UNCLOS) is the international legal framework around the freedom of the seas, establishing guidelines for resource extraction, trade, and sovereignty over the oceans (UNCLOS, 1982). Importantly, the UNCLOS gives nations territorial claims on waters up to 12 nautical miles offshore, but allows transit passage (also called "innocent passage") for all countries' military and civilian ships through both territorial waters and the high seas beyond.[1]

In recent years, however, numerous geopolitical tensions and threats by state actors seem to potentially impede freedom of movement through international waters. The Strait of Hormuz, through which twenty percent of global oil supply flows, has witnessed multiple attacks on oil tankers in 2019 amid the escalating confrontation between Iran and the United States. In Southeast Asia, several nations have disputes over island chains in the South China Sea. The efforts of China to transform offshore reefs and shoals into artificial islands and build naval bases, as well as the "Freedom of Navigation Operations" by the U.S. and British navies, have further heightened uncertainty in the region.[2] These tensions were reflected by a stand-off between Chinese and Vietnamese navy ships on July 2019 over geological surveys in disputed waters.[3]

This paper investigates the impact of a potential long-run disruption of navigation

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[1] The principle of 'freedom of the seas' dates back to a treatise by Dutch philosopher Hugo Grotius titled *Mare Liberum* (The Free Sea) published in 1609. In 1918, Woodrow Wilson argued for it as one of his Fourteen Points for peace negotiations after World War I (Wilson, 1918). The UNCLOS was signed 1982 and most recently amended in 1994. The convention has been ratified by 167 states. To this date, a number of countries including the United States, Israel and Turkey refuse to sign the convention.

[2] For a detailed description of the situation in Southeast Asia, see https://www.belfercenter.org/publication/freedom-navigation-south-china-sea-practical-guide.

[3] https://on.ft.com/32xtkTW

through the Southeast Asian sea lanes on trade and welfare. In particular, we simulate a complete shutdown of maritime shipping through the South China Sea and all the east-west passages in the Indonesian archipelago, causing shipping between the Pacific and Indian oceans to reroute south of Australia. We do so by solving for the shortest actual and counterfactual maritime trade routes between existing ports and the associated sea distances using GIS software. Using the increased distances in a quantitative general equilibrium model, we calculate the trade and welfare effects of moving from the initial to the counterfactual state. Depending on parameterization, the average welfare loss from the disruption of regional maritime trade ranges from 6.2 to 12.4 percent for the countries in the East Asia, South East Asia, and Pacific regions. For these countries, the magnitude of real GDP losses is also correlated with their military spending as a proportion of GDP, suggesting that they respond to the perceived risk and cost of a possible conflict.

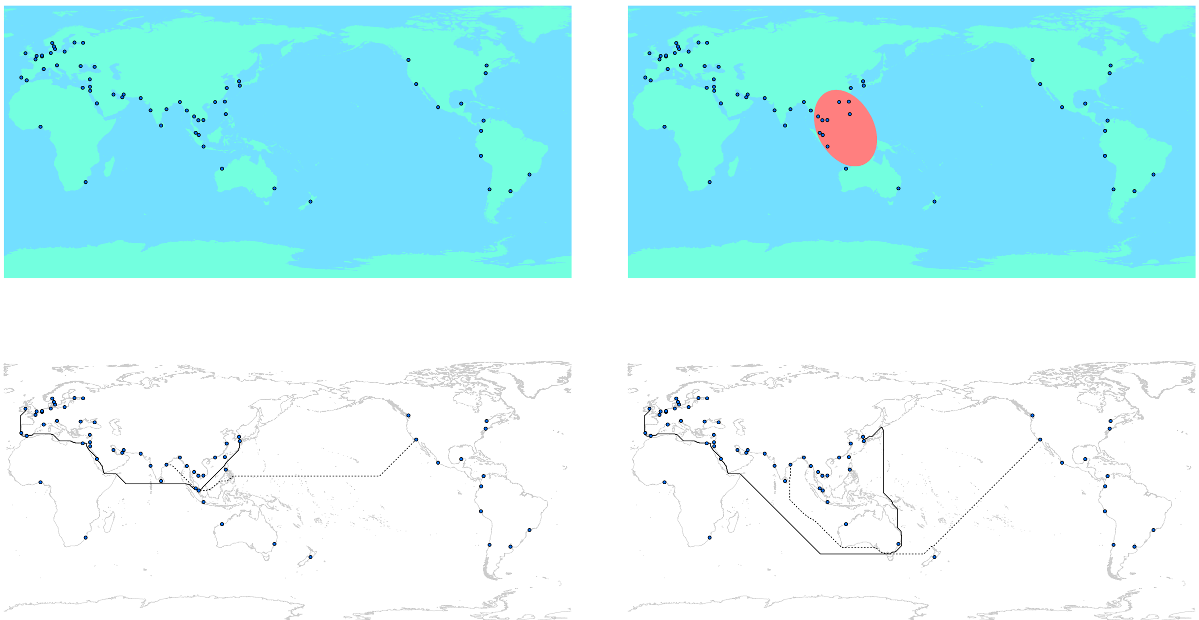
Antecedent work on the rerouting of maritime trade falls into two lines. The first uses the opening and closure of major canals as quasi-natural experiments to causally estimate the effect of trade on incomes (Feyrer, 2009; Maurer and Rauch, 2019). The second line uses these events to estimate distance elasticities of trade and quantify equilibrium trade and welfare effects (Hugot and Dajud, 2016, 2017). To our knowledge, we are the first to apply quantitative trade analysis to counterfactual scenarios involving the South China Sea.[4]

## 2 Data

We limit our analysis to the 50 largest world economies according to the 2015 World Bank World Development Indicators (WDI) data plus four economies relevant to the region of interest but not in the top 50 (Cambodia, Myanmar, Sri Lanka, and Taiwan). Removing

[4] Noer and Gregory (1996) provides an extensive documentation of the geography of Southeast Asia as it pertains to international shipping and discusses hypothetical scenarios involving the closing of key choke points in the region from an economic and military point of view.

Figure 1: Ports, the Closed Region, and Exemplary Rerouting



*Notes:* All panels display the 61 ports in 51 countries that we include in the data. The red area in the top right panel shows the region assumed to be unnavigable in the counterfactual analysis. The dashed lines in the bottom panels are the maritime routes between the ports of Los Angeles and Visakhapatnam. The solid lines connect London and Nagasaki. The bottom left panel displays unconstrained shortest sea routes in the baseline. The counterfactual routes on the bottom right panel assume that the blocked area in Figure 1 is infinitely costly to traverse.

three landlocked countries from this group (Switzerland, Austria, and Czechia), we are left with 51 economies which make up over 92% of world GDP.

The geographic data on sea boundaries and port locations come from Natural Earth.[5] For 41 countries, we use the largest sea port as the only point through which that country engages in maritime trade. Ten countries in our sample have coasts on separate seas, so we endow them with two ports.[6]

[5] http://www.naturalearthdata.com/

[6] These countries are Australia, Canada, Colombia, France, India, Israel, Mexico, Russia, Saudi Arabia, and the US. Note that we place Russia's secondary port on the Black Sea, not the Sea of Japan or the Sea of Okhotsk, as there is limited overland transportation across Siberia. Largest ports for the countries in the sample are chosen according to World Port Rankings 2015, a dataset produced by the American Association of Port Authorities, available for download at www.aapa-ports.org/unifying/content.aspx?ItemNumber=21048.

Figure 1 shows the 61 ports and the region that we focus on in our counterfactual exercise. We use GIS software to calculate the shortest sea routes between all pairs of ports. In the counterfactual scenario, we close the circle on the right panel to navigation. We choose this "closed" zone to capture a scenario in which a large swath of the South China Sea the waterways connecting the Pacific and Indian oceans are inaccessible due to conflict or other military action. In particular, we do not allow trade through the passages along the northern coast of Australia. The bottom panel of Figure 1 provides an example of how the closure impacts the sea routes between two sets of ports. In our counterfactual scenario, almost all of the trade that normally travels through the Malacca Strait or the South China Sea instead passes south of Australia, substantially increasing the distance, and thus the trade costs, between affected countries.[7]

In the counterfactual, all maritime trade involving a port in the circle as source or destination ceases. There are nine countries whose only ports are entirely within the closed area: Cambodia, Hong Kong, Indonesia, Malaysia, the Philippines, Singapore, Taiwan, Thailand, and Vietnam.[8] These countries are assumed to be completely cut off from maritime shipping. They can still trade overland, but only with their neighbors, i.e., we assume away airborne and transit overland trade beyond contiguous pairs. For example, Thailand?s port is in the blocked area. In the counterfactual, it continues trading with its neighbors Malaysia, Myanmar and Cambodia. Of these three neighbors, Myanmar?s port is not in the conflict zone. We do not, however, allow Thailand to trade with third countries (such as the EU or Japan) by re-routing through Myanmar.

In addition to geographic data, we use the 2015 bilateral World Trade Flows data, which

7 The waterways involved are the straits of Malacca, Sunda, Lombok, Ombai and Torres as well as the passage to the east of Timor Leste. Located between Australia, Indonesia and New Guinea, the Torres Strait is not a viable alternate route to the Malacca strait because it is not navigable by large vessels due to coral reefs and its very shallow depth.

8 We refer to the Hong Kong Special Administrative Region (SAR) of China and Taiwan as countries because data on separate trade flows are available.

report trade between the 51 countries in our sample and are publicly available at Robert Feenstra's website.[9,10] We also use data from Costinot and Rodríguez-Clare (2014) and the World Bank to calculate the share of expenditure on tradable domestic goods.[11] Data on shared borders and languages come from CEPII (Head et al., 2010). Finally, we use data on military expenditures and conflict from the Stockholm International Peace Research Institute and the Correlates of War Project (Sarkees and Wayman, 2010), respectively.[12]

# 3 Model

As shown by Arkolakis et al. (2012), henceforth ACR, welfare losses due to higher trade costs in a set of workhorse models of trade can be calculated using a sufficient statistic under the same assumptions that make these models admit a structural gravity equation describing bilateral trade flows. The sufficient statistic is the expenditure share of country $i$ on its domestic goods, $\lambda_{ii}$. Changes in trade costs—in our case induced by increased port-to-port distances or the shutdown of a country's maritime access—lead to changes in countries' expenditure shares on purchases from all countries, including themselves. Given the elasticity of trade with respect to trade costs $\epsilon$, welfare change for each country is then given by:

$$\hat{W}_i \equiv \frac{W_i'}{W_i} = \left(\frac{\lambda_{ii}'}{\lambda_{ii}}\right)^{\frac{1}{\epsilon}} = \hat{\lambda}_i^{\frac{1}{\epsilon}}, \tag{1}$$

where $W_i$ and $W_i'$ are the welfare levels in country $i$ before and after the change in trade costs, respectively. Similarly, $\lambda_{ii}$ and $\lambda_{ii}'$ are domestic expenditure shares before and after

9 https://www.robertcfeenstra.com/data.html

10 Since there is no data on trade flows by mode of transportation between a large sample of countries, we assume that all trade observed between non-neighboring countries in the data is seaborne. Given that the majority of world trade is maritime, this simplification is reasonable. We assume that trade between neighboring countries is overland and is thus not impacted by the closure of sea lines.

11 https://data.worldbank.org/indicator/NV.SRV.TOTL.ZS

12 https://www.sipri.org/databases/milex and https://correlatesofwar.org/data-sets/COW-war.

trade cost changes, respectively.

In what follows, we assume an environment satisfying the restrictions in ACR, so that the value of goods imported by country $n$ from country $i$ is given by

$$X_{ni} = \frac{Y_i}{\Omega_i} \cdot \frac{X_n}{\Phi_n} \cdot t_{ni}^{\epsilon}, \quad (2)$$

where $t_{ni} \geq 1$ is the cost of trade between the two countries, $Y_i$ is the income of country $i$, and $X_n = \sum_i X_{ni}$ is the value of an importer's expenditure on all source countries. $\Omega_i$ and $\Phi_n$ are the "multilateral resistance" terms capturing the general equilibrium forces:

$$\Omega_i = \sum_{\ell} \frac{t_{\ell i}^{\epsilon} X_{\ell}}{\Phi_{\ell}} \quad \text{and} \quad \Phi_n = \sum_{\ell} \frac{t_{n\ell}^{\epsilon} Y_{\ell}}{\Omega_{\ell}}.$$

Assuming away trade deficits, countries' incomes equal their exports in equilibrium:

$$Y_i = \sum_n X_{ni}.$$

Expenditure shares are in turn given by $\lambda_{ni} = X_{ni}/X_n$. Finally, a fixed supply of labor $L_i$ is the sole factor of production in each country, so that labor earnings equal total income: $w_i L_i = Y_i$.

## 3.1 Estimating trade costs

In order to solve the model and calculate its welfare implications, we first need to specify and estimate trade costs $t_{ni}$ and $t'_{ni}$ in the initial and counterfactual states, respectively. We start with the canonical form:

$$t_{ni} = dist_{ni}^{\rho} \cdot b_1^{\mathcal{I}_{ni}^{cont}} \cdot b_2^{\mathcal{I}_{ni}^{lang}} \cdot b_3^{\mathcal{I}_{ni}^{self}}, \quad (3)$$

where $dist_{ni}$ is the sea distance between countries $n$ and $i$, and $\rho$ is the distance elasticity of trade costs. Dummy variables $\mathcal{I}_{ni}^{cont}$ and $\mathcal{I}_{ni}^{lang}$ are equal to one if the countries are contiguous and share a common language, respectively, and zero otherwise. Dummy variable $\mathcal{I}_{ni}^{self}$ capturing border effects is equal to one if $n = i$, and zero otherwise.

We substitute equation (3) into (2), take logs and, following standard practice, estimate the resulting equation with importer and exporter country fixed effects to capture the multilateral resistance terms:

$$\ln(X_{ni}) \; = \; a_n + a_i + \underbrace{\epsilon \cdot \rho}_{=\alpha} \cdot \ln(dist_{ni}) + \epsilon \cdot b_1 \cdot \mathcal{I}_{ni}^{cont} + \epsilon \cdot b_2 \cdot \mathcal{I}_{ni}^{lang} + \epsilon \cdot b_3 \cdot \mathcal{I}_{ni}^{self} + \varepsilon_{ni}. \qquad (4)$$

Bilateral distances used in the estimation of (4) are unconstrained sea distances associated with the shortest maritime path between countries' ports. The problem of empirical zero trade flows, which is incompatible with the standard gravity equation (4), is less acute in our sample of the largest economies. Of the total 2,601 ($= 51^2$) possible combinations, only 17 flows are zero in the 2015 data that we use. Still, we estimate equation (4) using both OLS and PPML specifications. In the OLS estimation, we use the 2,584 observations with non-zero trade flows. In the PPML estimation, the dependent variable is in levels and zeros are included. We also estimate (4) using only the sub-sample of non-contiguous pairs, so that our use of sea distances is consistent with our assumption that all trade between contiguous countries, and only trade between contiguous countries, is overland.

Table 1 reports the results. The coefficient estimates are in line with the values typically obtained in the literature (Head and Mayer, 2014). The coefficients on log of distance estimated using PPML are significantly smaller (in absolute value) than the coefficients estimated using OLS. This result is also consistent with the literature and the design of PPML. In what follows, we report results using the parameters from column (3), the PPML regression with all countries, as our preferred specification. Since $\alpha$ captures the responsiveness of trade costs to increased sea distances in our counterfactual, using the

Table 1: Gravity Estimation

| | $\ln(trade_{ni})$ | $\ln(trade_{ni})$ | $trade_{ni}$ | $trade_{ni}$ |
|---|---|---|---|---|
| (log) Distance ($\alpha$) | -0.827 | -0.977 | -0.495 | -0.676 |
| | (0.028) | (0.041) | (0.035) | (0.042) |
| Contiguity | 0.467 | | 0.814 | |
| | (0.13) | | (0.30) | |
| Shared Language | 0.368 | 0.282 | 0.493 | 0.125 |
| | (0.08) | (0.08) | (0.12) | (0.08) |
| Same Country | 1.119 | | 1.052 | |
| | (0.205) | | (0.140) | |
| Specification | OLS | OLS | PPML | PPML |
| Non-contiguous pairs only | - | Y | - | Y |
| Observations | 2,584 | 2,193 | 2,601 | 2,204 |
| Adjusted $R^2$ | 0.828 | 0.823 | - | - |

*Notes:* Standard errors in parentheses.

smallest elasticity among our estimates yields a conservative lower bound on welfare effects.

Note that the closure of Southeast Asian waterways only impacts sea distances in the specification of trade costs (3), but not the other bilateral variables. The change in trade costs to the power of the trade elasticity $\epsilon$ from the baseline to the counterfactual is therefore given by:

$$\hat{t}^{\epsilon}_{ni} = \left(\frac{t'_{ni}}{t_{ni}}\right)^{\epsilon} = \left(\frac{dist'_{ni}}{dist_{ni}}\right)^{\alpha}, \tag{5}$$

where we use the fact that $t \propto dist^{\rho}$ and $\alpha = \epsilon\rho$. Using the preferred estimate of $\alpha$ and the simulated increases in sea distances, we obtain bilateral $\hat{t}^{\epsilon}_{ni}$ values. Next, we use these values to solve the model in changes and to predict the welfare effects.

### 3.2 Model solution

As shown by Dekle et al. (2008) and Costinot and Rodríguez-Clare (2014), changes in expenditure share due to trade cost shocks take the following form in structural gravity models:

$$\hat{\lambda}_{ni} = \frac{\lambda'_{ni}}{\lambda_{ni}} = \frac{(\hat{Y}_n \hat{t}_{ni})^{\epsilon}}{\sum_{\ell} \lambda_{\ell i} (\hat{Y}_{\ell} \hat{t}_{\ell i})^{\epsilon}}. \tag{6}$$

Plugging these into the market clearing condition $\hat{Y}_i = (\sum_n \lambda'_{ni} X'_n)/Y_i$ yields:

$$\hat{Y}_i = \frac{1}{Y_i} \sum_n \hat{\lambda}_{ni} \lambda_{ni} \hat{Y}_n X_n = \frac{1}{Y_i} \sum_n \frac{\lambda_{ni} \hat{Y}_i^{\epsilon} \hat{t}_{ni}^{\epsilon}}{\sum_{\ell} \lambda_{n\ell} \hat{Y}_{\ell}^{\epsilon} \hat{t}_{n\ell}^{\epsilon}} \hat{Y}_n X_n. \tag{7}$$

Given the initial income levels, trade shares, and $\hat{t}_{n\ell}^{\epsilon}$ calculated in section 3.1, equation (7) defines a system of equations that determine $\hat{Y}_i$ for each country. The final step is to use trade cost shocks and $\hat{Y}_i$'s in equation (6) to solve for $\hat{\lambda}$'s, which in turn imply welfare changes by equation (1). To do so, we need a value for $\epsilon$. The median value of $\epsilon$ from the literature reported by Head and Mayer (2014) is -5.03. We solve the model and report results for values of $\epsilon$ equal to -3, -5, and -7, taking the middle value as our baseline.

## 4 Results

Table 2 reports, for various values of the trade elasticity $\epsilon$, the welfare effects of moving from the initial to the counterfactual state for the 19 countries in our sample that are in the World Bank's East Asia, South East Asia and Pacific regions. Since they are located in the impacted region, these countries also rank at the top of welfare losses for all $\epsilon$ values. Maritime trade ceases for nine countries because their ports are located within the blocked region: Cambodia, Indonesia, Hong Kong, Malaysia, the Philippines, Singapore, Taiwan, Thailand, and Vietnam.[13]

As expected, the nine countries with their ports located within the blocked region incur the largest losses. For the baseline value of $\epsilon = -5$, Taiwan experiences a predicted real income loss of 34 percent. The effects on Japan and Korea are between 2 and 3 percent. Two countries outside this region also incur sizable welfare costs: we predict United Arab Emirates and Saudi Arabia to contract by 5 and 3 percent, respectively. Being important exporters of oil to the region, the cessation of trade has a large impact on these countries.

Note that the global heterogeneous increase in trade costs could in principle result in welfare gains for some countries. For instance, countries with limited trade ties to the impacted region could have potential market share gains in third markets due to higher costs of shipping between the impacted region and these third markets. Remarkably, every single country in our data except Ireland sees a welfare loss in the baseline simulation. This result is driven by both the fact that the countries that lost maritime trade ties are substantial contributors to global trade, and also that a vast amount of trade passes through the Southeast Asian waterways specifically because alternative routes are significantly longer.

Considering the wide-reaching and substantial welfare effects implied by a potential closing of the South China Sea and surrounding straits, it is not surprising that large countries in the region, such as China, might exert a greater political or military presence there. Since the mid-1990s, China has been consolidating claims in the South China Sea and especially increasing jurisdiction over maritime rights. Since the mid-2000s, the pace of that consolidation has increased (Fravel, 2011). Our results do not suggest a clear incentive for China to close the Malacca Straits or other parts of the South China Sea: it incurs a welfare loss around one percent if the elasticity of substitution $\epsilon$ is between -3 and -5, but

[13] Note that overland trade with adjacent countries continues. That is, all pairs for which the contiguity dummy in the trade cost estimation equals one can still trade with each other. We do not allow transit trade with non-neighboring countries.

Table 2: Predicted Welfare Losses for Countries in the Region

| | $\epsilon = -3$ | $\epsilon = -5$ | $\epsilon = -7$ |
|---|---|---|---|
| Taiwan | 49.23 | 33.64 | 25.45 |
| Singapore | 33.94 | 22.17 | 13.28 |
| Hong Kong | 23.12 | 15.03 | 18.43 |
| Vietnam | 20.80 | 13.23 | 10.31 |
| Thailand | 20.97 | 13.19 | 9.150 |
| Philippines | 17.37 | 10.78 | 7.840 |
| Malaysia | 17.25 | 10.72 | 9.870 |
| Cambodia | 15.50 | 9.710 | 7.170 |
| Indonesia | 9.210 | 5.640 | 4.070 |
| Myanmar | 5.650 | 3.390 | 2.850 |
| Republic of Korea | 4.170 | 2.560 | 2.220 |
| Japan | 3.540 | 2.150 | 1.690 |
| Bangladesh | 3.480 | 2.010 | 1.590 |
| Australia | 3.080 | 1.850 | 1.440 |
| Sri Lanka | 2.310 | 1.320 | 0.980 |
| New Zealand | 2.050 | 1.210 | 1.020 |
| India | 1.670 | 0.970 | 0.770 |
| Pakistan | 1.200 | 0.680 | 0.570 |
| China | 1.220 | 0.670 | -0.720 |
| Average | 12.41 | 7.94 | 6.21 |

*Notes:* Welfare losses are the absolute values of simulated % reductions in real GDP ranked by descending order for the 19 countries in the East Asia, South East Asia and Pacific regions according to the World Bank definition. $\epsilon$ is the trade elasticity.

a slight welfare gain for $\epsilon = -7$.[14] More broadly, our results emphasize the possibility of a large country maintaining control over the region by imposing substantial costs on smaller countries.

Given the high welfare losses attributed with a closure of the Southeast Asian seaways, it is conceivable that countries standing to lose most from a potential conflict in the region would spend more heavily on defense and security. To check this, we use the SIPRI Military

[14] The source of this welfare gain is the terms of trade effect due to increased trade costs imposed on its regional trade partners. For instance, Hong Kong's trade with all countries other than China ceases in the simulation.

Expenditure Database and calculate the 2001-2018 average military expenditures of the countries in Table 2 as a percentage of their GDPs. Hong Kong is the only country for which separate military expenditure data are not available. For the remaining 18 countries in the region, we test whether a higher predicted welfare loss due to an interruption of maritime trade is associated with a higher military expenditure in an effort to deter such a scenario. We do so by projecting military expenditures as a share of GDP on the absolute values of simulated percentage welfare losses, i.e., the values in Table 2 for $\epsilon = -5$. We control for distance to the Malacca Strait and its interaction with the predicted welfare loss since the effect is expected to be stronger for nearby countries. We also control for whether a country is engaged in an intra-state or a regional inter-state conflict beyond 1999 that may be a direct factor in high military spending.[15]

Table 3 reports the estimates from an OLS specification in columns (1)-(2) and a WLS specification in columns (3)-(4) using country population as weights. In columns (2) and (4), we also control for the size of the country. Evidently, higher predicted GDP reductions are associated with higher military expenditures, and more so for countries that are closer to the Malacca Strait, the epicenter of a potential conflict. Figure 2 presents the added variable plot of the relationship between military expenditures and simulated welfare losses corresponding to the specification in column (1) of Table 3. The relationship is robust to excluding each observation at a time, with the exception that the coefficient of interest is imprecisely estimated in the OLS specification when Singapore is excluded from the dataset.

The magnitude of the impact is economically important as well: using the results from

[15] We use the latest versions of the Inter-, Extra- and Intra-State Conflict Datasets from the Correlates of War Project. A country's conflict variable assumes the value of one if it is involved in a conflict that has either ended after 1999 or is still active. Among the interstate conflicts, we drop Australia's involvement in the Afghanistan and Iraq wars since it is not a regional conflict that will cause a sustained military expenditure for Australia. On the contrary, we treat South Korea as in a regional conflict since it still has not signed a peace treaty with North Korea, and the current armistice frequently turns into a low-level confrontation in the Korean peninsula. As a result, the conflict dummy equals one for the following set of countries and zero for the others: Pakistan, India, Sri Lanka, Myanmar, Philippines, Indonesia, and South Korea.

Table 3: Military Expenditures and Predicted Welfare Losses

| | $\% \frac{Military\ Expenditure}{GDP}$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Welfare loss | 0.287 | 0.289 | 0.628 | 0.638 |
| | (0.146) | (0.150) | (0.180) | (0.178) |
| (log) Distance | 0.500 | 0.504 | 1.372 | 1.359 |
| | (0.395) | (0.406) | (0.447) | (0.487) |
| Welfare loss × (log) Distance | -0.034 | -0.034 | -0.078 | -0.078 |
| | (0.018) | (0.018) | (0.021) | (0.022) |
| Conflict | 0.877 | 0.873 | 0.716 | 0.722 |
| | (0.422) | (0.437) | (0.176) | (0.178) |
| (log) Population | | 0.009 | | 0.051 |
| | | (0.100) | | (0.156) |
| Specification | OLS | OLS | WLS | WLS |
| Observations | 18 | 18 | 18 | 18 |
| $R^2$ | 0.477 | 0.478 | 0.608 | 0.612 |
| Adjusted $R^2$ | 0.317 | 0.260 | 0.487 | 0.451 |
| p-value $Prob > F$ | 0.0001 | 0.001 | 0.001 | 0.002 |

*Notes:* Specifications in columns (1)-(2) are OLS, (3)-(4) are WLS with population as weights. Welfare loss is the absolute value of the simulated % real GDP loss. Robust standard values in parentheses. Regression constant not reported. Sample consists of countries in Table 2 except Hong Kong for which military expenditures are not separately reported. See text for further details and data sources.

column (1), for a country at the average distance that is otherwise not experiencing a conflict, a one standard deviation increase in predicted GDP loss due to a conflict of the type that we simulated (about 8.8 percentage points) increases military expenditure as a percent of GDP by 0.31 percentage points, compared to the average military expenditure/GDP ratio of 2.03 percent. As to the interaction effect, a simultaneous one standard deviation increase in predicted GDP loss and a one standard deviation decrease in log distance increases the dependent variable by 0.62 percentage points.

Given the sample size and the nature of the exercise, we do not claim to demonstrate a causal relationship. There are multiple considerations that factor in to military spending decisions, such as perceived threats and alliances. Still, the relationship is intriguing considering how unrelated these data may at first seem.

Figure 2: Conditional Correlation Between Military Spending and Welfare Losses


*Notes:* The slope, standard error and the fitted line in this added variable plot follow from the regression presented in column 1 of Table 3. Welfare loss in the $x$-axis is the expectation of model-implied counterfactual real GDP reduction conditional on the controls in the regression. The $y$-axis is expectation of 2001-2018 average military expenditure as a share of GDP conditional on the controls in the regression. Sample consists of countries in Table 2 except Hong Kong for which military expenditures are not separately reported. See text for further details and data sources.

# 5 Discussion

Motivated by the historically tense geopolitical situation and the current political climate, we simulate the potential closure of key maritime waterways in Southeast Asia in order to predict the impact on regional trade, global trade, and GDP. We generate initial and counterfactual least-cost routes between countries, and use the distances of these routes to solve a conventional model of international trade estimating the potential welfare effects. We find heterogeneous and economically significant reductions in real GDP. We also show that, for countries in the region, the magnitude of welfare losses is directly correlated with military spending as a proportion of GDP, suggesting that these countries may be responding to the economic security threats posed by such a potential geopolitical conflict. Our results illustrate the importance of maritime trade through the Southeast Asian seas, and the strong economic incentives behind political and military movements.

There are a number of limitations to our study. One may question the plausibility of a simultaneous closing of all the critical waterways linking the Indian and the Pacific Oceans through the north of Australia, forcing all maritime trade to go along Australia?s southern coast. Only closing the Malacca strait and allowing navigation through other passages would mechanically decrease the welfare impact by shortening re-routed distances. All such scenarios are equally speculative. We present one particular case with a large-scale regional impact, but admit that alternative scenarios are possible.

A related and important limitation is that we do not observe the modal distribution of trade by sea, by land, or by air. Heterogeneous differences in transportation methods across countries would impact the results. Despite the historically relevant threat of maritime or overland embargoes, air transport is a viable—yet more expensive—way of continuing to trade for countries whose international access may be constrained. The importance of this alternative has been demonstrated in the 1948 Berlin Airlift and by the response of Qatar to the overland embargo by Saudi Arabia in 2018.

Another limitation is the aggregate nature of the trade model used in the analysis. Trade in certain goods and commodities is harder to substitute for some importing countries, especially when it involves energy imports. The importance of energy imports for the region is reflected by the large GDP losses for the United Arab Emirates and Saudi Arabia in our scenario, and the fact that territorial disputes in the South China Sea are partially motivated by search for offshore hydrocarbon energy deposits. One avenue for future research would be conducting counterfactual exercises using a multi-industry model, to account for the importance to the gains from trade of critical industries with low elasticity of substitution (Ossa, 2015).

Despite the limitations, our results show that there are large and economically important gains from maritime trade through the Southeast Asian waterways. Geopolitical events that increase insecurity in critical maritime regions could have substantial welfare effects. We provide evidence consistent with the idea that these perceived threats could set in motion a rapid arms race for the countries involved.

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