The Economic Impact of Modern Maritime Piracy

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Motivation In some areas the threat of sea piracy is still real in modern times. Due to their location next to the Gulf of Aden and because of their capability of hijacking ships, Somali pirates are the only ones who still have a measurable impact on international trade today.[1] The locations of Somali pirate attacks between 2000 and 2012 are shown on a map in Figure 1. When it comes to quantifying this impact, the current literature is incomplete. On one hand, Besley et al. [2] find an 8% to 12% increase of ship charter prices (in the dry bulk cargo segment) due to increased pirate activity and calculate a resulting 630 million $ welfare loss in the year 2010 alone. But they find no significant effect of piracy on the amount of cargo shipped. On the other hand, Burlando et al. [3] observe a 1.9%, or 25 billion $, annual reduction in trade volumes between 2000 and 2010, but only a 0.45% annual increase in trading costs for bulk cargo.

Table 1:

	Dependent variable: Logarithm of trade volume	
	(1)	(2)
Aden×ln(attacks)	−0.012*	
	(0.007)	
IO×ln(attacks)	−0.018*	
	(0.011)	
Aden×time-dummy		−0.038**
		(0.019)
IO×time-dummy		−0.003
		(0.029)
RTA	−0001	−0.005
	(0.014)	(0.014)
Both WTO	0.210***	0.211***
	(0.074)	(0.074)
EU to ACP	0.078	0.078
	(0.053)	(0.053)
Fixed effects:	*Imp-Year*	*Imp-Year*
	Exp-Year	*Exp-Year*
	Country pair	*Country pair*
Observations	288,149	288,149
R^2	0.899	0.898
Adjusted R^2	0.888	0.888
Residual std. error	1.414	1.414
Degrees of freedom	262,350	262,350

Notes: The standard errors of the coefficient estimates are in parentheses. Robust standard errors adjusted for two-way clustering on the importer and the year are used. *p<0.1; **p<0.05; ***p<0.01

Effect of Piracy on Trade Volumes Building upon Burlando et al. [3], I analyse yearly **data** on bilateral international trade volumes in thousand USD in in the period 2000 to 2019. I use linear least square regression to estimate the coefficients of the **model**:

$$\ln(X_{ijt}) = \beta_1 \cdot Aden_{ij} \cdot \ln(attacks_t) + \beta_2 \cdot IO_{ij} \cdot \ln(attacks_t) + \beta_3 \cdot RTA_{ijt} + \beta_4 \cdot bothWTO_{ijt} + \beta_5 \cdot EUtoACP_{ijt} + \delta_{it} + \delta_{jt} + \delta_{ij} + \varepsilon_{ijt},$$

where X_{ijt} is the amount goods imported from country *i* into country *j* in year *t*, $attacks_t$ is the number of pirate attacks in the respective year, and the other variables are dummies indicating whether *i* and *j* are connected through the Gulf of Aden or the Indian Ocean, taking part in a common regional trade agreement, or members of the WTO, EU or ACP (African, Caribbean, and Pacific Group of States). ε_{ijt} are the *error terms* or *residuals*. To not erroneously assign effects of countries and time to piracy, a dummy variable for each combination of exporter and year is included:

$$\delta_{it} = \beta_6 \cdot 2000ExpChina + \beta_7 \cdot 2001ExpChina + \cdots + \beta_{17} \cdot 2000ExpIndia + \cdots.$$

δ_{jt} is defined analogously for importer-time trends, and δ_{ij} for exporter-importer fixed effects, like the typically intense trade from China to Germany through the Gulf of Aden.

The **results** of the parameter estimation of this model are shown in column (1) of Table 1. We get $\beta_1 = 0.012 \pm 0.007$, i.e. countries connected by a shipping route through the Gulf of Aden X_{ijt} decreases by 0.012% when the number of pirate attacks increases by 1%. This results in an **average annual trade loss of 0.28%, or 3.44 billion $, from 2000 to 2019**. Burlando et al. [3] found a threefold stronger effect but did not take country-pair trends into account and analysed only data from 2000 to 2010.

A major **problem** of the model could be reverse causality: if in years with a lot of trade there are more pirate attacks due to more available targets, we would underestimate the pirate-caused trade reduction. Furthermore, some security measures like hiring armed guards and speeding-up vessels increase the shipping costs while potentially reducing the number of attacks.[5] This again leads to a potential underestimation of the effect of piracy on trade.

An alternative model uses, instead of the attack variable, a time-dummy that is 0 before and including 2007 and 1 afterward (because Somalia is declared as a war risk area since May 2008). The results are in column (2) of Table 1. It tells that trade volumes through the Gulf of Aden between **2008 and 2019 are 0.038%, or 742 million $, lower** than they would be without piracy. The first model gives an average annual loss of 1.571 billion $ for this period, which is approximately twice as much.

Figure 1: from [4]

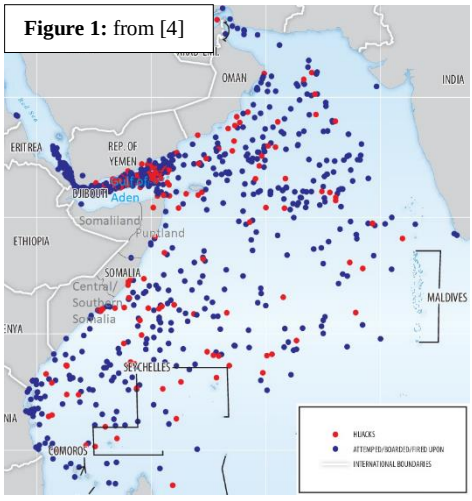

Figure 2:

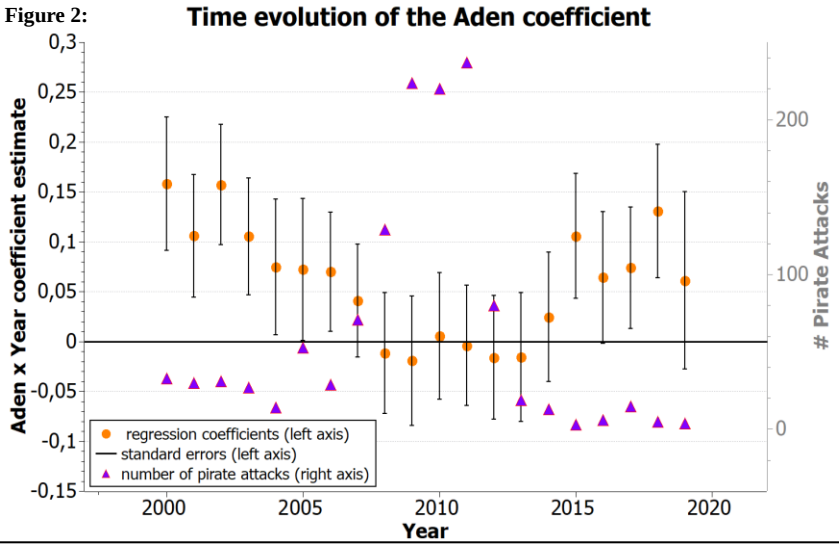

Figure 2 shows the coefficients β_1 to β_{20} of the equation $\ln(X_{ijt}) = \beta_1 \cdot Aden_{ij} \cdot 2000dummy + \cdots + \beta_{20} \cdot Aden_{ij} \cdot 2019dummy + \beta_{21} \cdot \ln(dist_{ij}) + \beta_{22} \cdot comlang + \beta_{23} \cdot colony + \beta_{24} \cdot comcol + \beta_{25} \cdot RTA + \beta_{26} \cdot bothWTO + \beta_{27} \cdot EUtoACP + \delta_{it} + \delta_{jt} + \delta_{ij} + \varepsilon_{ijt}$, where the distance between countries, a common official language, and colonial ties, or a common colonizer are included, because it is not possible to include δ_{ij} in this model.

We can see that in years of intense piracy the positive effect of the Gulf of Aden route on trade disappears. The correlation coefficient between the model coefficients and the number of pirate attacks is -0.612. This is **strong evidence for the existence of a measurable effect of piracy on the quantity of international trade** flows.

Effect of Piracy on Shipping Cost With the gravity model of international trade, $X_{ijt} = \frac{Y_{it}Y_{jt}}{Y_{wt}} \left(\frac{\tau_{ijt}}{P_{it}P_{jt}} \right)^{1-\sigma}$ the effect α_1 of piracy on the trade costs τ_{ijt} can be deduced from β_1, the effect on trade volumes X_{ijt} (see [3], Y is the GDP, w means "world", τ_{ijt} is the trade cost in percentage of the price of the traded goods, P is the CES price index, and $\sigma = 7.5 \pm 2.5$ is the elasticity of substitution across products). We get $\alpha_1 = \frac{\beta_1}{1-\sigma} = (1.8 \pm 1.2) \cdot 10^{-3}$. This would result in a piracy induced **increase of trade cost of only 0.04% on average per year.** Besley et al. [2] estimate the effect of piracy on shipping cost with a regression model and find an 8-12% increase. But if the trends δ_{it} and δ_{jt} are taken into account, the effect vanishes.

Conclusion Using statistical tools of modern empirical economics I find strong evidence that piracy adversely affects trade through the Gulf of Aden, but the effect appears to be smaller than assumed in the literature. This research was conducted as part of my Master's thesis and is of relevance due to the long ongoing issue of taking appropriate anti-piracy measures.

References:
[1] Bensassi, S. & I. Martinez-Zarzoso (2012): How Costly is Modern Maritime Piracy to the International Community? *Review of International Economics*, 20(5), p. 869-883.
[2] Besley, T., T. Fetzer & H. Mueller (2015): The Welfare Cost of Lawlessness: Evidence from Somali Piracy. *Journal of the European Economic Association*, 13(2), p. 203-239.
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[4] Do, Q.-T. (2013): The Pirates of Somalia: Ending the Threat, Rebuilding a Nation. Working Papers 76713, World Bank Group, Regional Vice-Presidency for Africa.
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