Supplementary Appendices

"Tortuga Disease: The Perverse Effects of Illicit Foreign Capital"

June 23, 2016

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Description

In the following appendices we provide summary information and coding details for the key variables used in the analysis. We also provide several additional specifications to help rule out alternative explanations, or to address possible estimation biases.

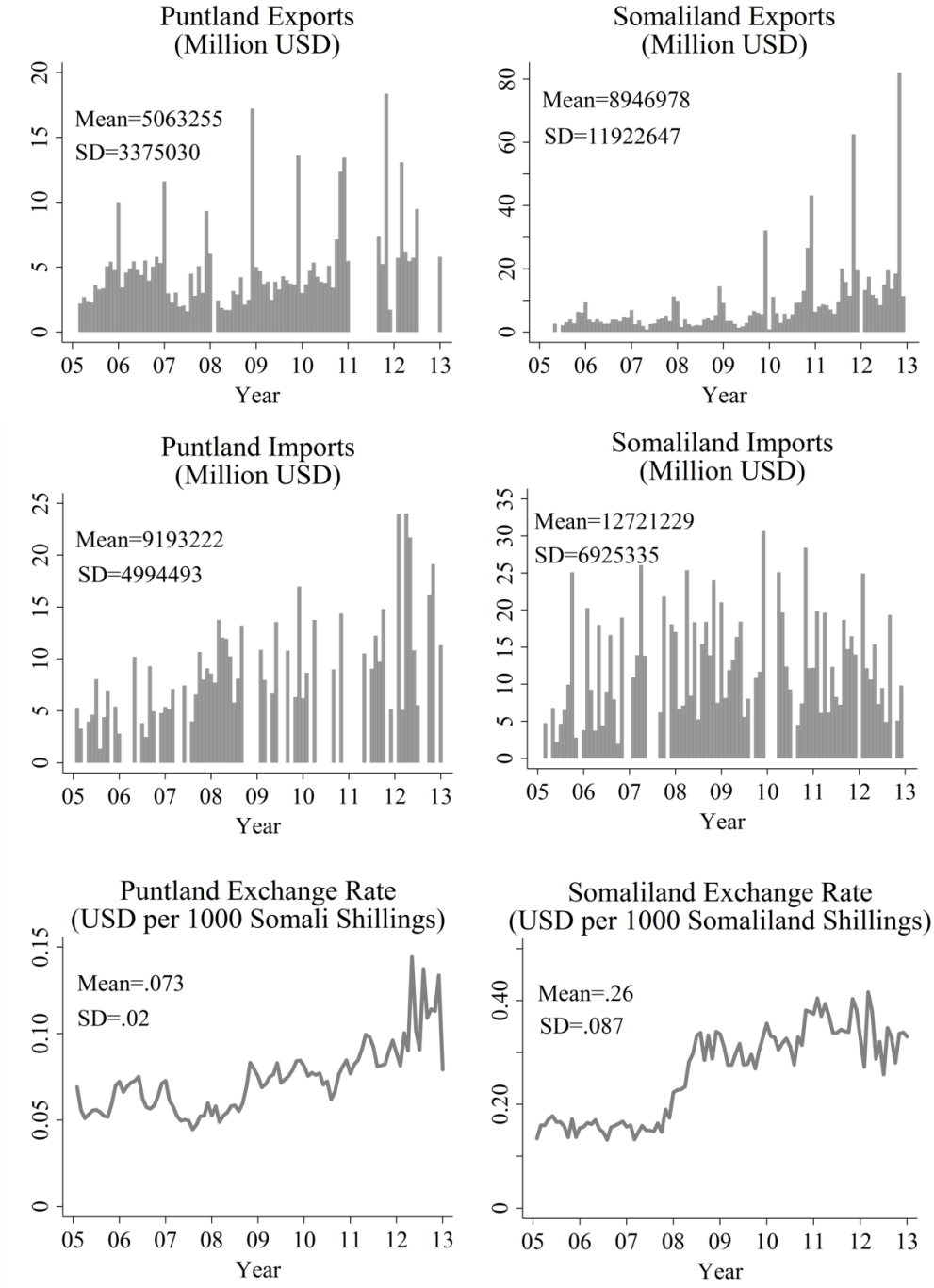
In Appendix A you will find a set of figures showing trends and summary information for each of our dependent variables. We also provide comparisons between the trends for Puntland and Somaliland. We provide these detailed trends in order to substantiate our claims about common trends in the economies of Puntland and Somaliland. In the second part of Appendix A you will find a number of additional specifications for all of our main results. The justification for these alternative specifications are described in the main text and in the notes associated with each table. Details on the coding of ransoms and financial data in Puntland and Somaliland are provided in the subsequent Appendix B.

In Appendix B you will find detailed coding information for many of our variables. In the first part, we describe how we collected and coded information on ransom payments into Puntland. We then provide comparisons between our ransom data and other coding efforts in order to help rule out possible coder reliability issues. We also describe our instrumentation technique to help rule out reporting bias in the size of ransom amounts. We next provide the details of how we calculate exchange rates for Puntland and Somaliland, along with our estimates for the Consumer Price Index in each region. In the final section, we describe some estimates for an alternative source of illicit wealth in Puntland – human trafficking. We include these estimates to ensure that ransoms are not correlated with other sources of criminal activity in ways that bias our results.

Appendix A: Supplementary Tables and Figures

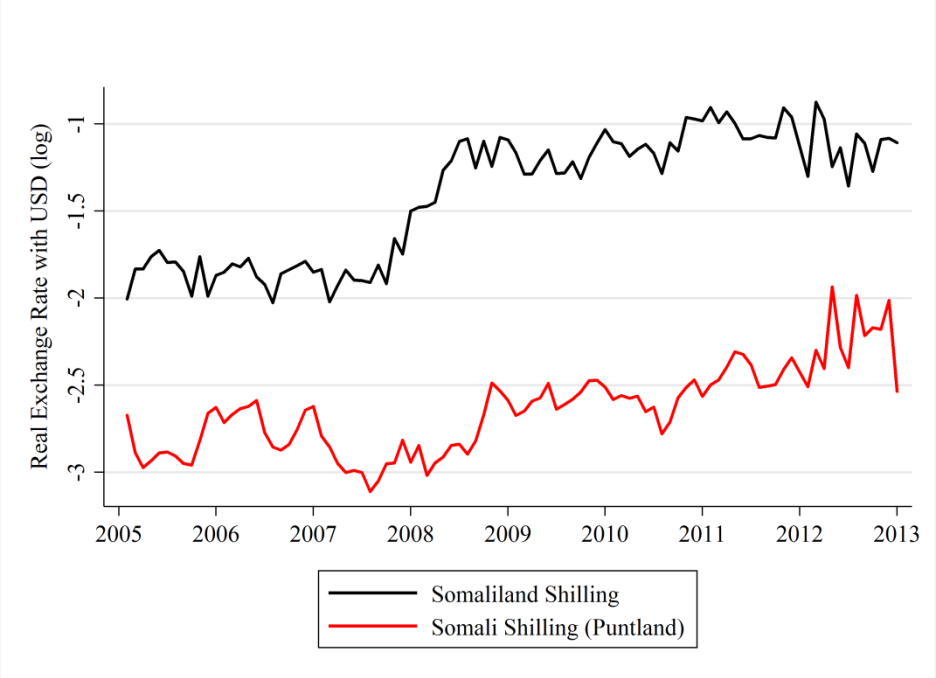
I. Supplementary Figures

Figure A1: Summary Economic Data for Puntland and Somaliland



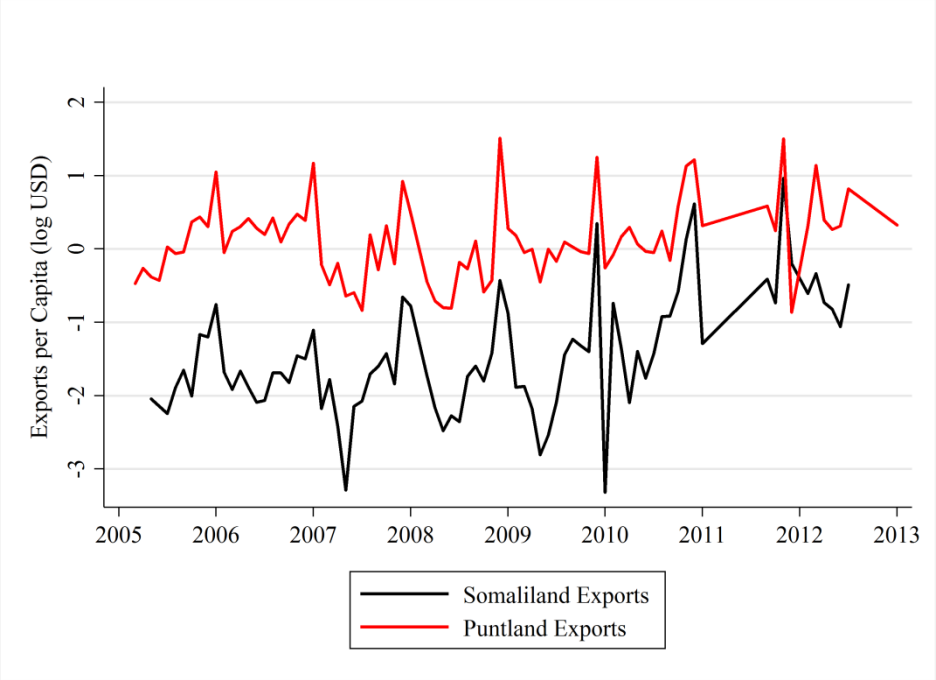
All values normalized to 2000 U.S. dollars unless otherwise noted.

Figure A2: Trends in Somaliland and Somali Real Exchange Rates



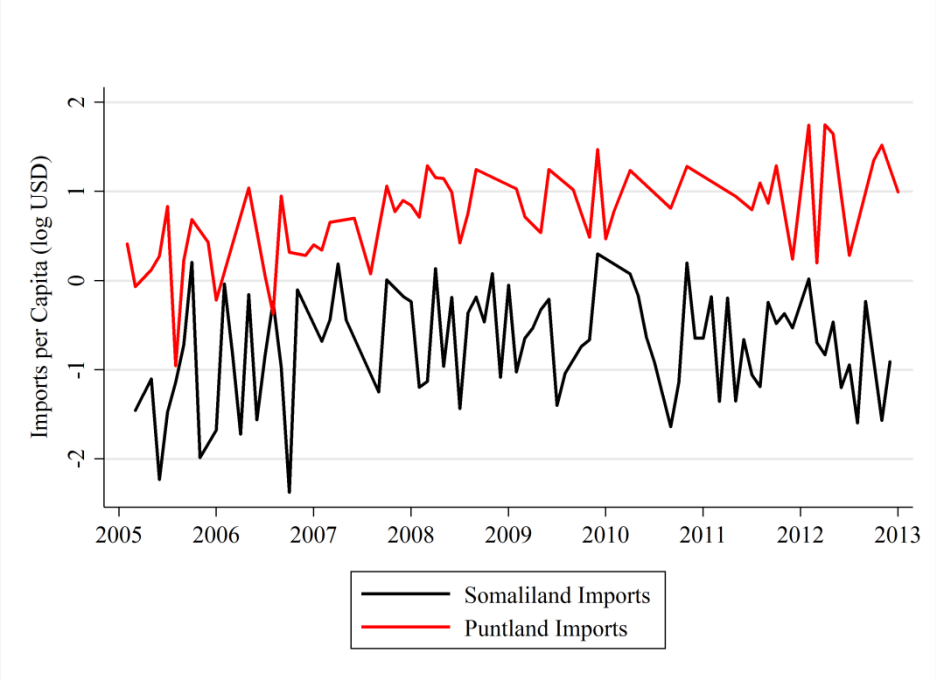
This figure shows trends in the real Somali Shilling exchange rate (from Puntland markets) and Somaliland shilling exchange rate (from Somaliland Markets) in 1000 shillings. Data come from FSNAU (2014)

Figure A3: Trends in Puntland and Somaliland Exports



This figure shows trends in livestock exports from Somaliland and Puntland (from the Bosaso and Berbera Ports). Data come from FSNAU (2014)

Figure A4: Trends in Puntland and Somaliland Imports



This figure shows trends in imports from Somaliland and Puntland (from the Bosaso and Berbera Ports). Data come from FSNAU (2014)

II. Supplementary Tables

Table A1: The Effect of Ransoms on Import and Export Volumes

	(1) Export Volume	(2) Import Volume
Log(Ransom)*Puntland	-0.028**	0.014
	0.012	0.010
Log(Ransom)	-0.000	0.004
	0.011	0.007
Puntland	-0.192	-0.430***
	0.105	0.101
Log(Pirate Attacks)	0.026	0.003
	0.046	0.074
Log(Shipping)	-0.119	1.79***
	0.791	0.528
Monsoon	-0.644*	0.226
	0.360	0.197
GDP Growth	-0.008	-0.005
	0.005	0.003
Ramadan	-0.133	-0.250*
	0.135	0.147
Saudi Livestock Ban	-0.708**	-0.023
	0.267	0.147
Maritime Police Force	0.132	0.225
	0.215	0.141
Observations	186	138
R-squared	0.41	0.982
Durbin-Watson Statistic	1.93	1.84

*significant at 10%; **significant at 5%; ***significant at 1%. Robust standard errors in parentheses adjusted for autocorrelation. Model 1 shows the effect of ransoms on the log of livestock export volumes in kilograms. Model 2 shows the effect of ransoms on the log of rice, sugar and wheat import volumes in kilograms.

This table re-estimates our export and import results using the volume of trade rather than the value of trade. We run this alternative specification to ensure that our results are not purely driven by the inflationary effect of ransoms on the prices of tradable goods.

Table A2: The Effect of Ransoms with Additional Controls

	Conflict/Naval Variables			Financial Variables			Institutional Fragility Variables		
	(1) Exchange	(2) Exports	(3) Imports	(4) Exchange	(5) Exports	(6) Imports	(7) Exchange	(8) Exports	(9) Imports
$Log(Ransom)_{t-1}$	0.003*			0.003			0.004**		
	0.002			0.002			0.002		
Log(Ransom)		-0.013	0.022		-0.016**	0.014*		-0.019***	0.020**
		0.008	0.013		0.007	0.008		0.007	0.008
Log(Pirate Attacks)	-0.003	-0.013	-0.057	-0.021*	-0.015	-0.051	-0.012	0.000	-0.014
	0.011	0.066	0.097	0.012	0.057	0.045	0.014	0.056	0.056
Log(Shipping)	-0.056	-2.016**	3.076***	-0.423**	-0.566	1.401*	-0.583**	-1.010	1.567
	0.276	0.754	0.947	0.205	0.833	0.714	0.268	0.862	1.022
Monsoon	-0.078	-1.144**	-0.254	-0.194***	-0.752*	0.102	-0.139**	-0.756**	0.207
	0.070	0.426	0.316	0.048	0.400	0.342	0.066	0.369	0.299
GDP Growth	0.000	-0.017**	-0.017	-0.002*	-0.001	-0.007	-0.001	-0.001	-0.011*
	0.003	0.008	0.010	0.001	0.005	0.005	0.002	0.004	0.006
Ramadan	0.013	-0.161	-0.129	0.048	-0.290*	-0.063	0.051	-0.250	-0.123
	0.024	0.180	0.164	0.043	0.172	0.139	0.042	0.167	0.149
Saudi Livestock Ban	-0.043	-0.349	0.355	-0.070	-0.380	0.029	-0.130**	-0.374	-0.168
	0.043	0.371	0.249	0.048	0.275	0.231	0.058	0.236	0.259
Maritime Police Force				0.242**	0.519**	0.448	0.322**	0.472*	0.708**
				0.100	0.256	0.274	0.150	0.254	0.297
Log(Civil Conflict Events)	0.000	-0.078	0.111						
	0.043	0.203	0.422						
Log(Naval Patrols)	0.135	-0.937**	0.310						
	0.126	0.377	0.502						
Puntland Financial Crisis				-0.194***	-0.257	-0.054			
				0.053	0.197	0.165			

Log(Foreign Aid)				0.263***	-0.079	0.511***			
				0.047	0.250	0.177			
Log(Foreign Investment)				-0.062	0.076	-0.003			
				0.041	0.105	0.099			
Government Effectiveness							-0.186	-0.226	-1.114
							0.290	0.825	0.873
Observations	61	60	43	94	81	59	94	81	59
R-squared	0.919	0.856	0.996	0.832	0.919	0.998	0.788	0.899	0.993

*significant at 10%; **significant at 5%; ***significant at 1%. Robust standard errors in parentheses, adjusted for autocorrelation. Included but not shown are month fixed effects.

This Table shows estimates after controlling for additional variables which might have a confounding effect. Naval Patrols is a count of the number of vessels patrolling the waters off of Somalia (Jablonski and Oliver 2013); Puntland Financial Crisis is a dummy variable which equals one between February and May 2008 and zero otherwise. This period was associated with inflation and budget problems in Puntland (Jablonski and Oliver 2013). Foreign Aid is the yearly sum of foreign aid into Somalia (World Bank 2014). Foreign Investment is the yearly sum of flows of foreign direct investment into Somalia (World Bank 2014). Government Effectiveness is a perception-based index of governing effectiveness in Somalia from the World Bank (Kauffman et al. 2011). It varies from -2.5 to +2.5.

Table A3: Alternate Lag Structures for Puntland

	(1) Exch.	(2) Exch.	(3) Exch.	(4) Exch.	(5) Exports	(6) Exports	(7) Exports	(8) Exports	(9) Imports	(10) Imports	(11) Imports	(12) Imports
Log(Ransom)	0.000	0.003	0.002	0.002	-0.019**	-0.018**	-0.018**	-0.016**	0.023**	0.024**	0.023**	0.021**
	0.002	0.002	0.002	0.002	0.007	0.006	0.006	0.006	0.008	0.008	0.008	0.009
$Log(Ransom)_{t-1}$		0.006**	0.005**	0.006**		-0.012	-0.011	-0.010		-0.003	-0.005	-0.005
		0.002	0.002	0.002		0.008	0.007	0.007		0.009	0.009	0.010
$Log(Ransom)_{t-2}$			-0.001	0.001			-0.008	-0.007			0.010	0.009
			0.002	0.002			0.008	0.008			0.009	0.009
$Log(Ransom)_{t-3}$				0.004**				-0.007				0.007
				0.002				0.009				0.012
Observations	95	94	93	92	81	81	80	79	59	58	57	57
R-squared	0.732	0.796	0.804	0.815	0.897	0.874	0.893	0.876	0.993	0.993	0.994	0.994

*significant at 10%; **significant at 5%; ***significant at 1%. Robust standard errors in parentheses, adjusted for autocorrelation. Included but not shown are month fixed effects.

This table shows alternative lag structures for our independent variable in order to evaluate the timing of ransom effects on the Puntland economy. The results suggest that most of the impact of a ransom occurs in the first couple months; however there are also persistent effects in following months.

Table A4: First Differences Estimates

	(1) Exchange (FD)	(2) Exports (FD)	(3) Imports (FD)
Log(Ransom) –Log(Ransom)$_{t-1}$		-0.012*	0.012
		0.007	0.019
Log(Ransom)$_{t-1}$ – Log(Ransom)$_{t-2}$	0.003*		
	0.002		
Log(Pirate Attacks) – Log(Pirate Attacks)$_{t-1}$	-0.023*	0.118	-0.090
	0.012	0.073	0.193
Log(Shipping) – Log(Shipping)$_{t-1}$	-0.330	-1.085	5.756
	0.326	2.237	4.337
Monsoon – Monsoon$_{t-1}$	-0.123*	0.082	0.886
	0.074	1.140	0.900
GDP Growth – GDP Growth$_{t-1}$	0.003***	-0.015	-0.094**
	0.001	0.042	0.034
Ramadan–Ramadan$_{t-1}$	0.046	-0.058	-0.502
	0.032	0.182	0.342
Saudi Livestock Ban–Saudi Livestock Ban$_{t-1}$	-0.048	-0.963	1.935*
	0.035	0.957	1.081
Observations	92	76	37
R-squared	0.331	0.320	0.445

*significant at 10%; **significant at 5%; ***significant at 1%. Robust standard errors in parentheses. Included but not shown are month fixed effects. All variables (including the dependent variables) are first differenced.

This table provides first difference estimates for our main results. This is an alternative to the AR1 correction for addressing non-stationarity.

Table A5: Omitting Observations prior to 2008

	(1) Exchange	(2) Exports	(3) Imports
Log(Ransom)t-1	0.005*		
	0.002		
Log(RansomValue)		-0.020***	0.007
		0.007	0.017
Log(Pirate Attacks)	-0.007	-0.051	-0.008
	0.018	0.055	0.070
Log(Shipping)	-0.637	1.105	0.136
	0.381	0.739	2.447
Monsoon	-0.244***	-1.343***	0.221
	0.065	0.399	0.592
GDP Growth	0.002	-0.004	0.005
	0.002	0.003	0.014
Ramadan	0.110	-1.285***	-0.123
	0.078	0.271	0.253
Saudi Livestock Ban	-0.156	-0.829***	-0.134
	0.127	0.182	0.778
Maritime Police Force	0.235**	0.681***	0.186
	0.094	0.138	0.553
Observations	59	46	33
R-squared	0.826	0.998	0.999

*significant at 10%; **significant at 5%; ***significant at 1%. Robust standard errors in parentheses. Included but not shown are month fixed effects.

This table re-estimates our results excluding observations prior to 2008. We include this alternative specification to validate that our results are not substantially biased by the inclusion of the smaller ransom amounts in the 2005-2008 period.

Appendix B: Coding Details

I. Collecting and Coding Data on Ransoms Amounts

Here we describe the collection and coding of disbursal dates as well as ransom amounts tied to specific ransom events. The appendix also describes how we validate our data on ransom amounts against similar data on ransom amounts collected independently by other scholars.

We began by compiling a list of vessels captured during the sample period using monthly circulars on piracy and armed-robbery at sea issued by the International Maritime Organization (IMO), the maritime arm of the United Nations. These data originated from reports made by ship operators who experience an actual or attempted attack, and usually include information on the vessel involved, latitude and longitude of the attack, vessel type, flag, tonnage, vessel IMO number, date of event, time of the event, location, details of the incident, consequences, and reporting agency. We limited our sample to ships that were held off of Somalia.

For each instance in which a vessel was successfully hijacked, we searched news archives, such as Lexis Nexus, for additional information on the ship. In almost all cases, we were able to fill-in the remaining details of the event, including the date of a vessel's (and crews') capture as well as date of release and the disbursal of the ransom paid for its release. We also collected information on the ransom reportedly paid for the vessel's release as well as information on where the vessel and crew were held. Where sources disagree, we rely on the most authoritative or recent source. In some cases, the most authoritative sources only provide a range of ransom amount. In these cases, we used the average of the range. We were able to estimate ransom amounts in this manner for 79% of reported cases. Instances without ransom information are likely vessels were released without a ransom; so the actual coverage is likely greater than 79%.

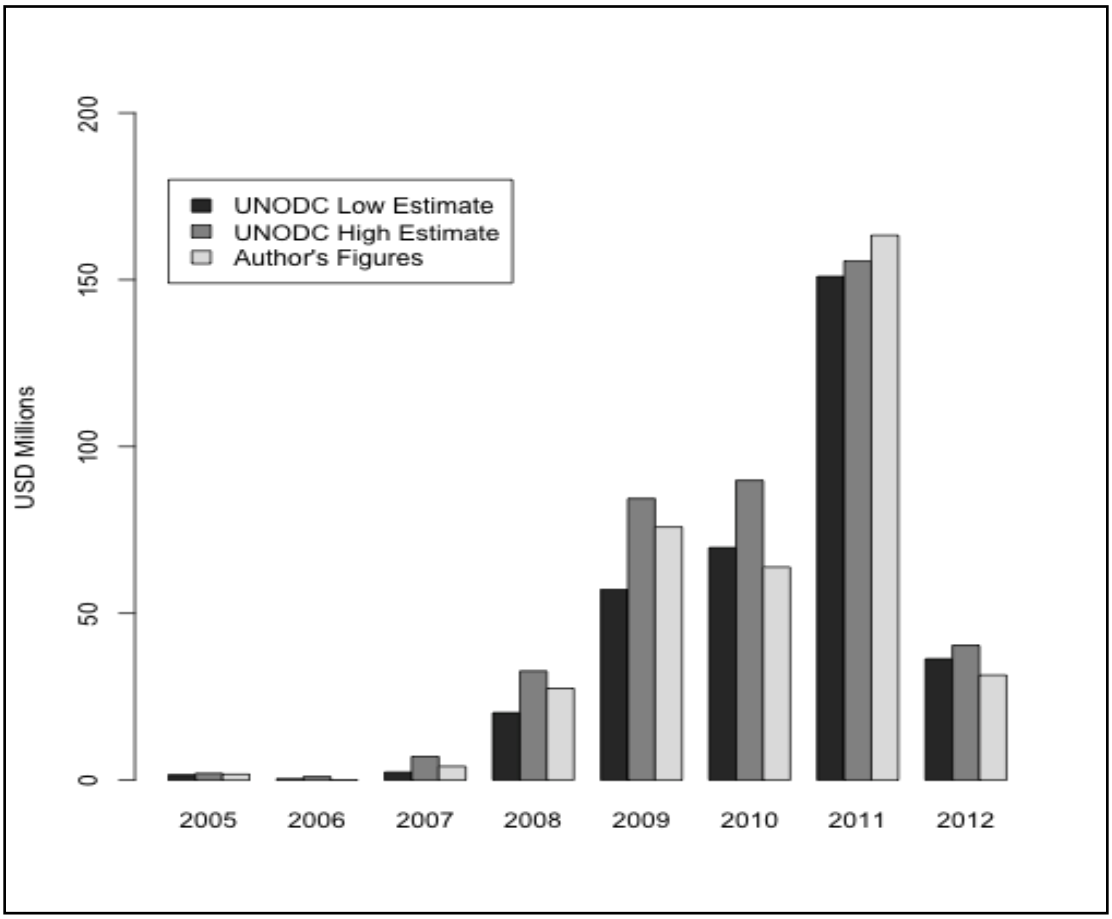
II. Validation of Ransom Amounts

In order to validate data on reported ransom amounts used in this paper, we compare figures for ransom amounts contained in our dataset with similar data collected by other scholars. We were able to identify two independent efforts to collect data on ransom amounts tied to individual ransom events: First, scholars working for the UNODC and the World Bank have collected a dataset of ransoms—the UNODC-World Bank (2012) Dataset on Pirate Ransoms—with coverage from 1 January 2005 through 31 December 2012. Detailed description of how data was collected and coded to create this dataset can be found in Do (2013) and World Bank (2013). Second, the Oceans Beyond Piracy (OBP) project sponsored by the One Earth Foundation (OEF)

has also collected data on ransoms paid from 1 January 2011 through 31 December 2012. Detailed description of the data can be found in Bowden (2012) and Bellish (2013).[1]

Unfortunately, the UNODC-World Bank dataset has not yet been made available for use by scholars outside of the UN or World Bank. However, World Bank (2013) reports the annual total for estimated ransom amounts linked to individual ransom events contained in the dataset. Figure B1 below compares the annual totals reported in Figure 4.2 of World Bank (2013) with annual totals calculated from individual ransom events contained in the dataset used in this paper.

Figure B1: Comparison of Annual Total of Ransoms Amounts Reported by UNODC-World Bank (2012) and Authors' Dataset



Although there are discrepancies between the annual totals reported in World Bank (2013) and the annual totals calculated from ransom amounts in our dataset, these discrepancies appear to be

[1] In the process of conducting this research, a related effort has begun by the Maritime Piracy Dataset (MPD) to also code ransom amounts. Unlike our effort, the MPD dataset attempts to code ransoms demanded rather than ransoms received Coggins (2012).

relatively minor. Without access to the UNODC-World Bank dataset, we cannot determine the source of discrepancies with certainty. However, we note two points: First, the overall total of ransom amounts paid between 2005 and 2012 and included in our dataset is USD 367.8 million. This number is between the low and high estimates of USD 338.73 million and USD 413.1 million from the UNODC-World Bank dataset. Second, variation in annual totals calculated from either dataset reflect the broadly understood trend in the growth of ransoms from 2005 to their peak in 2011, followed by a sharp decline in the annual total for 2012. The consistency in the overall totals and trends of annual totals calculated from either dataset gives us confidence that our dataset captures changes in ransoms over time as well as the UNODC-World Bank dataset.

Given that the UNODC-World Bank dataset is currently unavailable, we use data collected by the OBP project and published in their annual *Economic Costs of Piracy* reports to further validate estimated ransom amounts contained in our dataset. The appendices of annual reports by Bowden (2012) and Bellish (2013) contain estimated ransom amounts paid prior to the release of specific vessels by Somali pirates in 2011 and 2012, respectively. According to Bellish (2013), officials from the Baltic and International Maritime Council (BIMCO), the largest international shipping trade association by membership, audited calculations presented in the OBP reports.

Table B1 below directly compares the estimated ransom amounts published in the appendices of the OBP reports and ransom amounts contained in the dataset used in this paper.

Table B1: Comparison to Ransom Amounts listed in OBP Reports

Vessel Name	Date Hijacked	Date Released	Reported Ransom Amount (Authors')	Reported Ransom Amount (OBP)	Difference
MOTIVATOR	4-Jul-10	16-Jan-11	4.50	4.97	-0.47
IZUMI	10-Oct-10	26-Feb-11	4.50	4.50	0.00
EMS RIVER	26-Dec-10	2-Mar-11	3.00	3.00	0.00
YORK	23-Oct-10	10-Mar-11	4.50	4.50	0.00
JAHAN MONI	5-Dec-10	14-Mar-11	4.62	4.00	0.62
RAK AFRIKANA	11-Apr-10	16-Mar-11	2.00	1.20	0.80
IRENE SL	9-Feb-11	8-Apr-11	13.50	13.50	0.00
THOR NEXUS	25-Dec-10	12-Apr-11	4.70	5.00	-0.30
BELUGA NOMINATION	22-Jan-11	13-Apr-11	5.00	5.00	0.00
ASPHALT VENTURE	28-Sep-10	17-Apr-11	3.50	3.60	-0.10
SINAR KUDUS	11-Dec-10	23-Apr-11	6.00	4.50	1.50
RENUAR	12-Dec-10	23-Apr-11	6.00	6.00	0.00
VEGA 5	31-Dec-10	14-May-11	5.00	5.00	0.00
HANNIBAL II	11-Nov-10	16-May-11	2.00	2.00	0.00
KHALED	20-Jan-11	26-May-11	2.50	2.50	0.00

MUHIEDDINE					
YUAN XIANG	14-Nov-10	8-Jun-11	2.10	3.60	-1.50
ZIRKU	28-Mar-11	10-Jun-11	12.00	12.00	0.00
SUEZ	2-Aug-10	13-Jun-11	2.10	2.10	0.00
SUSAN K	7-Apr-11	15-Jun-11	4.00	5.70	-1.70
JUBA	16-Jul-11	28-Jul-11	0.20	0.20	0.00
SININ	1-Feb-11	14-Aug-11	4.50	4.00	0.50
POLAR	30-Oct-10	26-Aug-11	7.70	7.70	0.00
ING	24-Feb-11	6-Sep-11	6.00	3.00	0.00
PANAMA	10-Dec-10	13-Sep-11	7.00	7.00	0.00
HOANG SON SUN	17-Jan-11	16-Sep-11	4.50	4.50	0.00
DOVER	28-Feb-11	28-Sep-11	3.80	3.50	0.30
EAGLE	17-Jan-11	29-Sep-11	6.00	4.00	2.00
BLIDA	1-Jan-11	3-Nov-11	2.60	3.50	-0.90
SAVINA CAYLYN	8-Feb-11	21-Dec-11	11.50	11.50	0.00
ROSALIA D'AMATO	21-Apr-11	26-Dec-11	6.00	6.00	0.00
GEMINI	30-Apr-11	30-Dec-11	4.00	4.05	-0.05
OLIB G	8-Sep-10	8-Jan-12	3.00	3.00	0.00
FAIRCHEM BOGEY	20-Aug-11	12-Jan-12	8.00	8.00	0.00
LEILA	15-Feb-12	12-Apr-12	0.15	0.25	-0.10
ENRICO IEVOLI	27-Dec-11	22-Apr-12	9.00	9.00	0.00
ALBEDO	12-Nov-10	1-Aug-12	1.20	1.20	0.00
LIQUID VELVET	31-Oct-11	8-Jun-12	4.00	4.00	0.00
FREE GODDESS	7-Feb-12	12-Oct-12	5.70	5.70	0.00
ORNA	20-Dec-10	22-Oct-12	0.40	0.60	-0.20
Total			**183.77**	**183.37**	**0.40**

To note, there do exist discrepancies in the number of ransom events recorded in our dataset and those reported in the appendix of Bowden (2012). Bowden (2012) includes one ransom event not included in our dataset. We decided not to include the reported ransom of USD 8 million that was allegedly paid for the release of the Taiwanese-flagged fishing vessel Jih Chun Tsai No. 68. The vessel itself was sunk following an exchange of fire between pirates using the vessel as a mothership and the USS Theodore W. Groves on 20 May 2011 in the Indian Ocean. According to media reports, the owners of the vessel claimed to have paid the ransom and subsequently sought reparations in that amount from the US Navy.[2] We feel we are justified in our suspicions as to whether or not this ransom was ever paid and thus in our decision not to include this event.

Our dataset also includes two additional ransom events in 2011 that are not reported in Bowden (2012). First, our dataset contains the ransom paid for the release of the Belize flagged fishing

[2] Details regarding this episode and the attempts by family to seek compensation from the US Navy are reported by online (http://www.wantchinatimes.com/news-subclass-cnt.aspx?id=20110529000148&cid=1101).

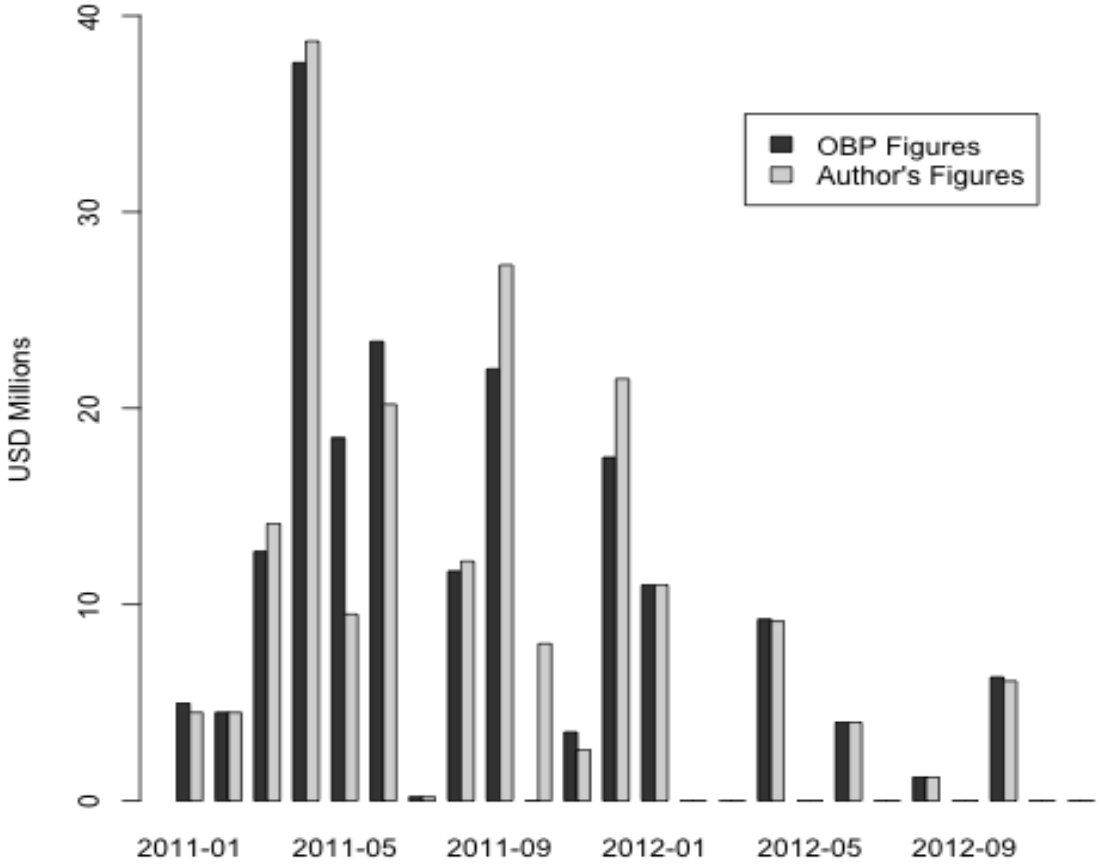
vessel Tai Yuan 227 on 28 January 2011.[3] Second, our dataset contains a second ransom paid for the release of the Danish flagged yacht ING on 6 September 2011.[4]

Regardless of these discrepancies, ransom amounts for individual ransom events correspond closely between the two datasets with a correlation coefficient of 0.98. Moreover, the difference sum total of ransom amounts paid during 2011 and 2012 is only USD 0.4 million.

Of course, the independent variable used in the paper is not individual ransom amounts but rather the monthly ransom amount disbursed. Figure B2 below compares monthly totals for ransoms disbursed in each month from January 2011 through December 2012.

[3] The release of the Tai Yuan 227 was reported by authorities with EU NAVFOR (http://www.eunavfor.eu/2011/01/fv-tai-yuan-227-released-from-pirate-control/).
[4] Somalia Report reported the release of the crew of the ING after the payment of a ransom in two installments (http://www.somaliareport.com/index.php/post/1518/Danish_Hostages_Released).

Figure B2: Comparison of Monthly Ransom Amount Disbursed



As expected, total monthly ransom amounts calculated from our dataset correspond closely with those calculated from data contained in appendices of the OBP reports with a correlation coefficient is 0.96. The month in which the biggest discrepancy is May 2011, the month in which the OBP reports include what we judge to be the suspect ransom of the Jih Chun Tsai No. 68. Taken altogether, we feel that estimates for ransom amounts contained in our dataset are as good if not better than similar data collected by other scholars.

III. Instrumenting for Ransom Amounts

As we discuss in the main draft, there are reasons to be concerned that pirates and vessel owners misreport the actual amount of each ransom. This potentially introduces unmeasured bias into our estimates.

We adopt an approach which is often used to address response bias in survey contexts: we create an instrument for reported ransom amounts which is uncorrelated with any response bias.[5] First, we estimate the value of ransoms using available data on the ships which were hijacked. Specifically, for each ransom *i* in month *t*, we use *Log(Tonnage)*, the tonnage of the hijacked ship; *OilTanker* , a dummy variable for whether or not a ship was an oil or chemical tanker; *Yacht*, a dummy variable for whether a ship was a small yacht instead of a commercial ship; and *WealthyOwner*, a dummy variable for whether a ship was flagged by an OECD country.are a vector of controls used in the base models (monsoon effects, number of attacks in month *t*, GDP growth, Ramadan effects, and month fixed effects). These data come from authors[6].

The instruments in this regression explain 18% of the variance in ransoms (R^2=0.18).

(1) $Ransom_{it} = \beta Log(Tonnage)_{it} + \beta OilTanker_{it} + \beta Yacht_{it} + \beta WealthyOwner_{it} + \varphi X_{it}$

The instrument from equation (1) does not, of itself, represent a valid instrument for the *total* value of ransoms in a month. Instead, and following Wooldridge[7], we use the sum of the predicted ransoms from equation (1) to instrument for the total value of ransoms in a month. Using the predictions from equation (2), we then instrument for monthly ransoms using a standard two stage least squares approach (Eq 3) with a lagged dependent variable to adjust for autocorrelation.

(1) $Log(\sum Ransom)_t = \beta Log(\sum \widehat{Ransom})_t + \beta Log(\sum Tonnage)_t + \beta \sum OilTanker_{it} + \beta \sum Yacht_{it} + \beta \sum WealthyOwner_t$

(2) $Y_t = \beta Log(\sum \widehat{Ransom})_t + \varphi X_t + Y_{t-1}$

Since the characteristics of ships are likely to be exogenous to any response bias in ransom amounts, this approach allows us to rule out the possibility that our results are significantly biased by misreporting.

IV. Calculating Real Exchange Rates

[5] Orley Ashenfelter and Alan Krueger, "Estimates of the Economic Return to Schooling from a New Sample of Twins," *The American Economic Review* 84, no. 5 (December 1, 1994): 1157–1173, doi:10.2307/2117766; John Bound, Charles Brown, and Nancy Mathiowetz, "Chapter 59 Measurement Error in Survey Data," in *Handbook of Econometrics*, ed. J.J. Heckman and E. Leamer, vol. Volume 5 (Elsevier, 2001), 3705–3843, http://www.sciencedirect.com/science/article/pii/S1573441201050127.

[6] 2012

[7] Wooldridge, J.M. 2002. Econometric analysis of cross section and panel data. The MIT press.

The real exchange rate adjusts the exchange rate for differences in prices between the United States and Puntland or Somaliland. The formula is shown below:

$$RealSomaliExchangeRate_t = Dollar\ per\ Somali\ Shillings_t * \frac{United\ States\ CPI_t}{Puntland\ CPI_t}$$

$$RealSomalilandExchangeRate_t = Dollar\ per\ Somaliland\ Shillings_t * \frac{United\ States\ CPI_t}{Somaliland\ CPI_t}$$

where *Dollars per Somali Shillings* and *Dollars per Somaliland Shillings* equals the average exchange rate between the U.S. Dollar and the Somali and Somaliland shillings as reported by FSNAU monitors in Puntland and Somaliland markets markets[8]. *Puntland CPI*, *Somaliland CPI* and *United States CPI* are the monthly consumer price indexed for Puntland, Somaliland and the United States. The numbers for the United States' CPI are from the United States Bureau of Labor Statistics[9]. The calculation of Puntland and Somaliland's CPI is discussed below.

[8] "Food Security Analysis Unit—Somalia. Web Enabled Integrated Database System," accessed January 7, 2013, http://www.fsnau.org/ids.
[9] "Bureau of Labor Statistics," accessed December 1, 2012, http://www.bls.gov/cpi/.

V. Calculating the Consumer Price Index (CPI) for Puntland and Somaliland

We estimate Puntland's CPI using a formula developed by the Food Security Analysis Unit for Somalia. The formula uses an index calculated from the prices of a basket of commodities. This basket consists of the minimum quantity of essential and basic food items for a family of 6-7 living in an urban area in Northern Somalia (Table B2). It comprises the food necessary to provide an individual with 2,100 calories per day, along with other essential items. This basket was calculated by the Food Security Nutritional Analysis Unit (FSNAU) based upon their Urban Baseline Livelihood Surveys.[10]

Table B2: Basket of Commodities for Calculating CPI

Commodity[11]	**Quantity**
Red Sorghum	95kg
Wheat Flour	3.75kg
Sugar	5kg
Vegetable Oil	4kg
Milk (Camel)	20L
Meat[12]	10kg
Cowpeas	4kg
Kerosene	1.5L
Water	5 x 20L cans

Using this basket, along with price data for these commodities, we can calculate the consumer price index using the following formula:

$$CPI = \frac{\sum_{i=1}^{n} P_i \, Q_i}{\sum_{i=1}^{n} P_o \, Q_o} * 100$$

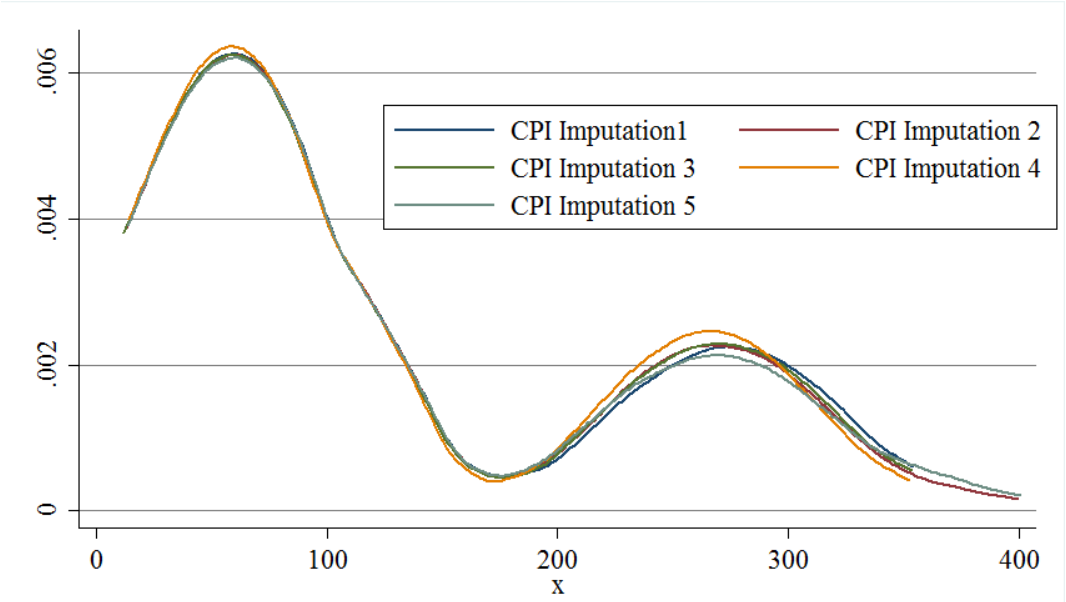
where P_i is the price of commodity *i* and Q_i is the quantity of commodity *i* required based upon the above basket. P_o is the price of the commodity for the reference month, which in our case is January 2005.

[10] "Cost of Minimum Expenditure Basket (CMB)," accessed January 7, 2012, http://www.fsnau.org/downloads/FSNAU_CMB_CPI_for_Somalia.pdf.
[11] The Food Security Analysis Unit also includes soap, tea, firewood, salt, drugs, school fees, grinding costs, clothes, and social tax in this list. Since data on these commodities were not collected for the duration of our analysis, we exclude them from the calculation of CPI.
[12] Meat equals the cheapest of the available meats in a market from a selection of of camel, goat and beef.

In a small number of cases, price data were not available for a particular commodity in a certain month (about 8% of the price data is missing). Rather than drop these cases, we impute the missing data using the imputation algorithm implemented in King, Honaker, Joseph and Scheve[13]. As predictor variables, we use the logs of non-missing commodity price variables, along with leads and lags of those variables. While this imputation does introduce some uncertainty into our estimates, the uncertainty remains very minimal (Figure B3) and so we ignore it in the estimation process.

[13] G. King et al., "Analyzing Incomplete Political Science Data: An Alternative Algorithm for Multiple Imputation," *American Political Science Review* 95, no. 1 (2001): 49–70.

Figure B3: Variation in CPI Density from Imputation*



*This Figure shows the density for each imputation of the missing data, as determined by the multiple imputation procedure implemented in the R package, Amelia.

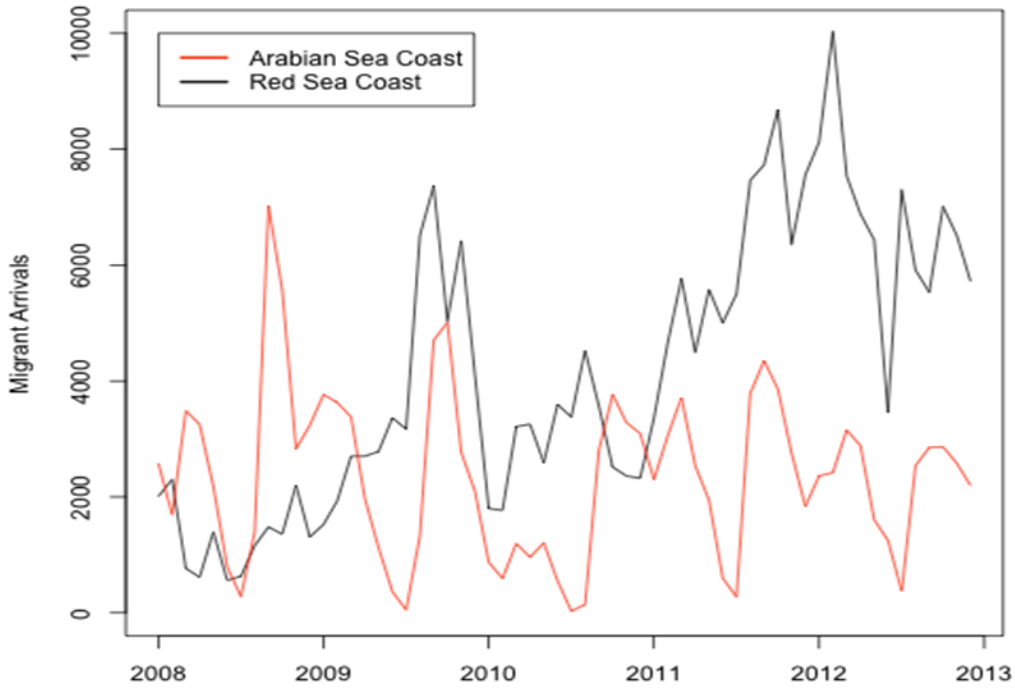
VI. Estimates for Illicit Wealth from Human Trafficking

Illicit wealth generated from activities other than maritime piracy could potentially bias our estimates of the impact of illicit wealth generated from piracy if they trend in consistent ways. For example, the UNODC (2013) also identifies human trafficking as an alternative source of illicit wealth flowing into Somalia. Specifically, the ports of Bosaso, Puntland and Obock, Djibouti are the two main departure points from which migrants leaving the Horn of Africa travel by way of Yemen to seek employment in countries in the Arabian peninsula. According to the Regional Mixed Migration Secretariat (RMMS 2013) an NGO tracking migration in the horn of Africa, approximately 100,000 migrants made the passage to Yemen in 2012 and paid the cost of this passage to human traffickers operating from either Bosaso or Obock,

Figure B4 depicts the trend in the estimated number of migrants arriving in the Arabian peninsula by way of Yemen's Arabian Sea as well as Red Sea coast on a monthly basis from January 2008 through December 2012. Data necessary to construct the figure was collected from monthly summaries of the estimated number of migrants published by the RMMS beginning in 2008 and available from the official website of the RMMS.[14] Arrivals by way of Arabian Sea coast correspond to departures from Bosaso, Puntland and are indicated in red. Arrivals by way of the Red Sea coast correspond to departures from Obock, Djibouti and are indicated in black.

[14] "RMMS Monthly Summaries," accessed April 3, 2014, http://www.regionalmms.org/index.php?id=41

Figure B4: Migrant Arrivals in Yemen



The number of migrants arriving on Yemen's Arabian Sea coast, and presumably departing from Bosaso, Puntland, is relatively stable between 2008 and 2012 with an annual mean of 28,213 migrants arriving by this route. The increase in pirate attacks and ransoms during this period does not appear to influence the trend in the number of migrants arriving by this route. Moreover, the trend demonstrates strong seasonal variation with the number of migrants arriving on Yemen's Arabian Sea coast declining sharply during the southwestern East Indian Ocean monsoon season when high wind and waves make the passage quite hazardous. On the contrary, the annual number of migrants arriving on Yemen's Red Sea coast, and presumably departing from Obock, Djibouti, is upward trending during this period. Of the estimated 100,000 migrants that arrived in Yemen in 2012, approximately 70% arrived by way of its Red Sea coast and only 30% of migrants arrivals on its Arabian Sea coast.

Although monthly summaries published by RMMS do not report the estimated price per passage from either Bosaso or Obock to Yemen, the RMMS (2013) estimates that the price per passage ranges from USD 100 to USD 150. By multiplying these figures by the annual number of migrants arriving on Yemen's Arabian Sea coast, this implies that annual amount of illicit wealth generated from human trafficking and flowing into Puntland was between USD 2.8 million and USD 4.2 million per annum between 2008 and 2012. Even at the height of pirate ransoms in 2011, the estimated amount of illicit wealth generated from human trafficking and flowing into Puntland represented only between 2.0% and 3.1% of the illicit wealth generated from piracy in the same year. Nevertheless, we include the estimated monthly inflows of illicit wealth generated from human trafficking and flowing into Puntland by multiplying the estimated monthly number

of migrants arriving on Yemen's Arabian Sea coast by USD 150 per passage. We include these data as a robustness check in Table B1 below. Our results remain consistent, though with larger standard errors in our imports model. This is not surprising given the considerably smaller sample size we are forced to use.

Table B1: Controlling for Estimated Migrant Capital

	(1) Exchange	(2) Exports	(3) Imports
Log(Ransom)t-1	0.005*		
	0.003		
Log(RansomValue)		-0.022***	0.007
		0.006	0.018
Log(Pirate Attacks)	-0.006	-0.065	-0.008
	0.019	0.055	0.119
Log(Shipping)	-0.436	1.579*	0.129
	0.432	0.807	3.043
Monsoon	-0.217***	-1.278***	0.221
	0.072	0.338	0.649
GDP Growth	0.0004	-0.008**	0.005
	0.001	0.003	0.023
Ramadan	0.074	-1.193***	-0.122
	0.076	0.332	0.321
Saudi Livestock Ban	-0.193	-0.934***	-0.133
	0.129	0.190	0.768
Maritime Police Force	0.265***	0.703***	0.185
	0.085	0.137	0.768
Capital from Migrant Traffic	0.055*	0.177*	-0.001
	0.031	0.088	0.278
Observations	59	46	33
R-squared	0.819	0.999	0.999

*significant at 10%; **significant at 5%; ***significant at 1%. Robust standard errors in parentheses. Included but not shown are month fixed effects. This table re-estimates our results including a control for estimated capital from migrant trafficking.

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