Migrants at Sea: Unintended Consequences of Search and Rescue Operations

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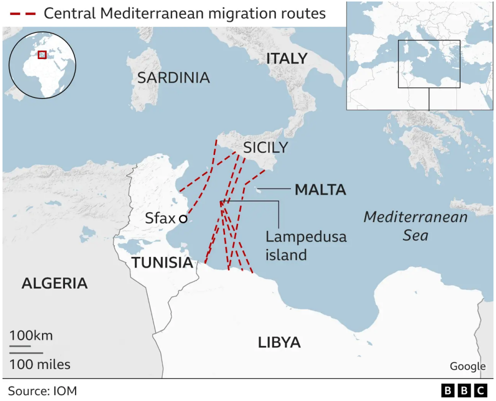
Geography of the Central Mediterranean: The Central Route



- Distances to Tunisia and Libya:
  - Sicily: 150km and 450km
  - Pantelleria: 70km and 410km
  - Lampedusa: 130km and 280km
  - Malta: 300km and 350km
- Starting in 2011 the “Central Route” became one of the most transited and lethal irregular migration corridors on the planet:
  - About 1.2 million people crossed between 2010 and 2024.
  - 25.000 are estimated to have died since 2014.

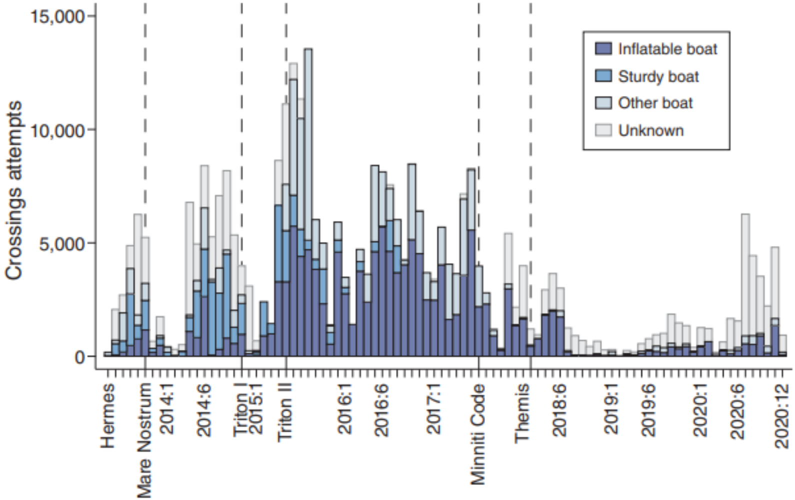
Search and Rescue Operations

- Frontex, the EU's border protection agency, started running search and rescue (SAR) operations on the Central Route.
- These operations intercepted smuggling boats as they neared European shores and rescued the migrants. They also searched for bodies when boats were lost.
- Several NGOs started running their own SAR operations (until 2017).

Data

- Data from the Polizia di Stato records the number of daily crossing attempts (successful crossings + deaths) from 2013 to 2020, as well as the type of boat they used (inflatable vs. sturdy boats). Data on country of departure is available from 2016 onwards.
- SAR operations (both by Frontex and NGOs) are categorised by their intensity. Intense period: Oct 2013 - Aug 2017.
- Data on the wave conditions is obtained daily on several points of the African coast.

Attempted Crossings by Boat Type



The Single Boat Case

- Consider a unit mass of potential migrants i whose utility is defined by:

$$\mathbb{E}[u_i(h,p)] = \alpha_i \cdot \sigma^R(h) - p$$

- α_i is a migrant-specific parameter reflecting the utility from successfully crossing (relative to death), which distributes according to a probability density function $f(\alpha)$.
- $\sigma^R(h)$ is the probability of survival on the crossing as a function of wave height h, when SAR status is R.
- p is the price paid to smugglers.
- Assume a monotone likelihood ratio on $f(\alpha)$: $\lambda(\alpha) = \frac{f(\alpha)}{1-F(\alpha)}$, where $\frac{\partial \lambda}{\partial \alpha} \leq 0$.

The Single Boat Case

$$\sigma^1 > \sigma^0 \; \forall h$$

$$\frac{\partial \sigma^0(h)}{\partial h} \leq \frac{\partial \sigma^1(h)}{\partial h} < 0$$

- Where $R = 1$ means SAR operations are in place, and $R = 0$ means they are not.
- These assumptions imply that the introduction of SARs will unambiguously increase total attempted crossings and reduce the elasticity of crossings to maritime conditions.

The Multiple Boats Case

- Assume there are two types of boat b, such that:

$$\sigma_u^R(h) < \sigma_s^R(h)$$

$$\frac{\partial \sigma_u^R(h)}{\partial h} \leq \frac{\partial \sigma_s^R(h)}{\partial h} < 0$$

$$\sigma_u^1(h) - \sigma_u^0(h) > \sigma_s^1(h) - \sigma_s^0(h) > 0$$

- Henceforth $p_u = c_u < p_s = c_s$.

The Multiple Boats Case: Effect of SARs

- The assumptions imply a SARs lower the threshold value α_u, the lowest α that is willing to cross in an unsafe boat, and increase the threshold value α_s, the lowest α that is willing to cross in a safe boat. This guarantees an increase in total crossings.
- Elasticity of crossings to wave conditions will increase if σ_u^0 is low enough.
- Intuition is that, upon introducing SARs, the benefit for the marginal unsafe boat migrant increases by a lot for every unit of h (since unsafe boats are more susceptible to weather).
- If only safe boats are used (single boat case), elasticity of crossings to wave conditions will *decrease* when SARs are active.

Crossing Risk and Moral Hazard

- Crossing risk $\rho \equiv M_s^R(1-\sigma_s^R) + M_u^R(1-\sigma_u^R)$, where M_b^R is the fraction of migrants attempting crossing on boat type b, is the average probability of death.
- ρ is concave and non-monotonic. An increase of σ_u in equilibrium will:
    - Low σ_u: Increase crossing risk.
    - High σ_u: Decrease crossing risk.
- Given SARs affect σ_s and σ_u differentially, the effect on ρ is ambiguous because of moral hazard. Lower mortality on unsafe boats (an increase of σ_u) will increase the amount of migrants attempting crossing on these boats, which could outweigh the gains in safety from the lower mortality rate.

Crossing Risk Approximation

- Assuming α distributes exponentially, then:

$$\theta \equiv \frac{\sigma_u}{\sigma_s} \approx \frac{\omega_u^R}{\omega_s^R} \left(\frac{p_s - p_u}{p_u} + \frac{\omega_u^R}{\omega_s^R} \right)^{-1}$$

- $\omega_b^R \equiv \frac{\partial M_b^R}{\partial h}$
- This means that under an assumption on relative prices, estimated elasticity of crossings serves as an approximation of the survival ratio, confirming the direction of the effect of SARs on ρ.

Takeaways From The Model

- The effect of SARs on boat choice is not ambiguous: SARs increase the ratio of unsafe to safe boats (as well as total attempted crossings).
- The identifying assumptions don't require exogeneity of SARs, only exogeneity of wave conditions.
- Test #1: A decrease in the elasticity of total crossings to wave conditions when SARs are in place can serve as evidence that total crossings increased.
- Test #2: Using estimated elasticities, the survivability of boat types can shed light on the effect of SARs on ex-post crossing risk.

Empirical Approach

- Since constructing a counterfactual is impossible without exogenous variation in SARs, the approach relies on the prediction that changes in the elasticity of crossings to weather conditions are sufficient to infer the effect of SARs on total attempted crossings and crossing risk.
- The following Poisson quasi-maximum likelihood regression is estimated:

$$c_t = \exp\left[h_t\left(\omega_0 + \omega_1 \cdot PostSAR_t + \omega_2 \cdot \bar{u}_{w(t)} + \omega_3 \cdot \bar{u}_{w(t)} \times PostSAR_t\right) + \mu_{w(t)} + \epsilon_t\right]$$

- c_t is the daily number of crossing attempts and $\bar{u}_{w(t)}$ is the weekly proportion of unsafe boats used.

Empirical Approach

- $\mu_{w(t)}$ is a fixed effect per week.
- All ω interact with the observed wave height on day t, h_t.
- ω_3 captures the effect of SARs when a higher proportion of crossings are undertaken in unsafe boats - analogous to the model.
- ω_1 captures the effect of SARs conditional on unsafe boat usage, ω_2 captures the effect of unsafe boat usage in the absence of SARs.
- From 2016 onwards, a similar specification but with separate parameters for Tunisia and Libya is estimated.
- $PostSAR_t$ refers to the post October 2013 period in the first regression, and the pre August 2017 period in the second regression.

Regression 1: 2013-2016

	Inflatable	Inf. + unknown	Inf. + unk. + other
ω_0	-0.891	-1.43	-1.458
t-value	**2.43**	**2.36**	**2.38**
ω_1	0.209	1.165	1.004
t-value	0.46	1.8	1.38
ω_2	2.135	1.907	1.632
t-value	1.18	1.42	1.44
ω_3	-6.546	-5.45	-4.168
t-value	**3.39**	**3.9**	**3.22**

Regression 1 Interpretation

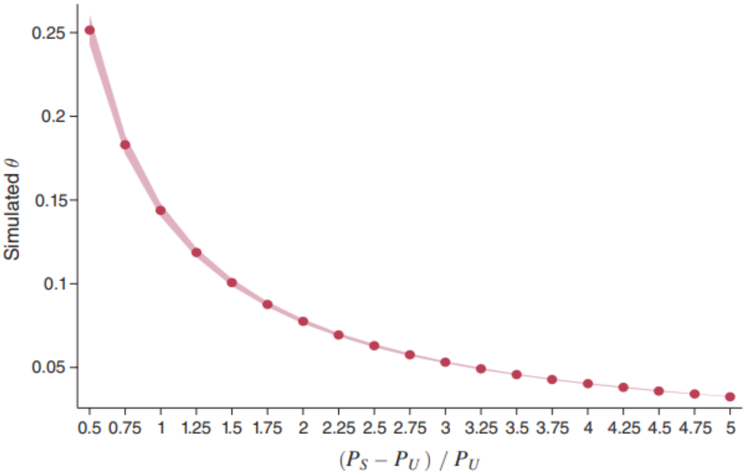
$$\frac{\partial^2 \ln c_t}{\partial h_t \partial PostSAR_t} = \omega_1 + \omega_3 \cdot \bar{u}_{w(t)} \approx -6.546 \cdot \bar{u}_{w(t)}$$

- The statistically significant and negative estimates of ω_3 suggest that unsafe boats are much more sensitive to crossing conditions when SARs are intense.
- The impact of a 0.1m increase in significant wave height decreases crossings by 41.7-65.5% when all boats are unsafe, relative to when all boats are safe.
- The statistically significant and negative estimates of ω_0 are in line with the basic assumption of the model: Wave height is negatively correlated with crossing attempts.

Regression 2: 2016-2020

	Base	× Libya
ω_0	-2.295	1.807
t-value	**6.1**	**2.48**
ω_1	-0.764	2.821
t-value	1.05	1.71
ω_2	-2.374	2.316
t-value	0.86	0.81
ω_3	4.015	-6.974
t-value	1.26	1.88

Simulation of θ



$\hat{\theta}$: Interpretation

- The price ratio is probably between 2 and 3, suggesting $\theta \in [0.05, 0.1]$, i.e. unsafe boats are ex-ante 10-20 times less safe than safe ones.
- This is different from ex-post risk, ρ, which depends on the boat choice of migrants endogenously determined in equilibrium.
- Since σ_u is so low, marginal crossings when SARs are activated are overwhelmingly on unsafe boats and ρ likely increased.
- Consistent with observed increases in raw crossing risk with SARs.

1. Context
2. Model
3. Results
4. Conclusion

Unintended Consequences

- The evidence strongly suggests European decision makers are in the presence of moral hazard: SARs act as partial insurance against the inherent risk of irregular sea crossings, inducing more crossings and shifting them towards less safe (and cheaper) boats, increasing overall deaths.
- One solution is enforcing bans on exports of inflatable boats to Libya and Tunisia, which is likely to make it harder to shift to unsafe vessels.
- This real-life trolley problem has no simple solutions and presents Europe with a gut-wrenching dilemma: Suspend SARs and let migrants drown, or conduct them and induce more deadly crossings?