

Mass Relocations after Nuclear Disasters

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- We have grown used to thinking of displaced persons as a developing-world problem
- Hopefully, citizens in the developed world will rarely become political refugees (fleeing war or persecution):
 - But numerous types of events can lead to mass relocations
- Examples can include nuclear accidents (Fukushima, Chernobyl):
 - As well as nuclear or radiological terrorism
- Moreover, displaced persons have fewer legal protections than political refugees (Rose, 2013)



Goals of This Talk

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- (1) Review the literature on the magnitude of nuclear relocations, and their economic and social impacts
 - (2) Identify characteristics that may lead relocations to differ from each other in important ways
 - (3) Identify future research needs to better understand the impacts of mass relocation, and how to mitigate those impacts



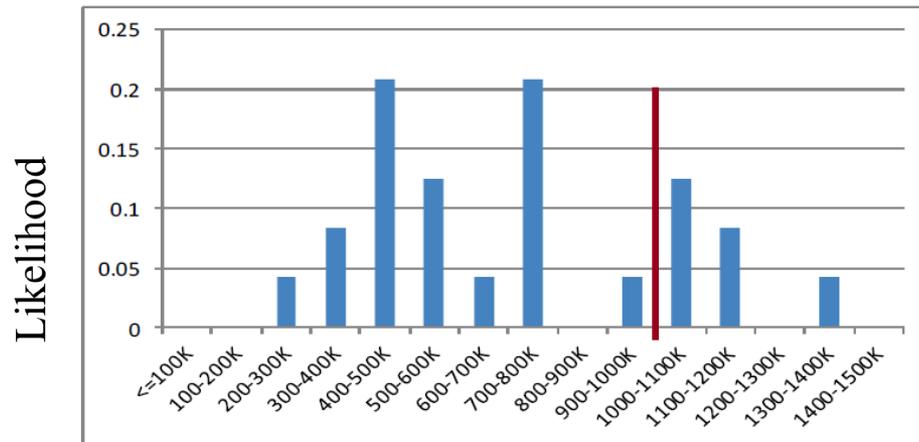
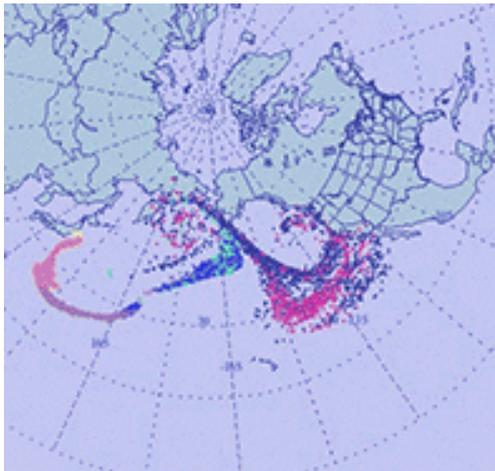
Magnitude of Relocations

- Fukushima (2011) resulted in about 164,000 evacuees:
 - Additional evacuees due to the earthquake and tsunami damage
- This included 81,000 mandated evacuations
- Many people died (mainly elderly) due to the displacement itself:
 - Quite possibly exceeding the eventual mortality due to radiation
- Almost 100,000 people have still not returned home



Magnitude of Relocations

- The Japanese accident could have been worse if the wind had been blowing in a less favorable direction
- Similar accidents at U.S. plants in highly populated areas could result in the need to relocate more than a million people



Population relocated



Magnitude of Relocations

- Chernobyl (1986):
 - Roughly 350,000 people were evacuated and resettled from areas of Belarus, Russia, and Ukraine
 - Those relocated from the rural area surrounding Chernobyl to other regions often did not fare well in the ensuing decades
- Spent-fuel fire (hypothetical):
 - Contamination could lead to relocating up to 18 million people, depending on the wind direction and the population density
- Improvised nuclear device (hypothetical):
 - 10-kiloton device in Washington, D.C., could lead to relocating approximately 1.5 million people for at least a year



- Population relocation can cause significant economic impacts (e.g., due to business interruption and loss of housing):
 - Even with neither extensive loss of life nor property damage
- Silva et al. (2014) and Comerio (1998) find relocation and loss of housing to be one of the largest impacts of a disaster:
 - So number of people relocated is a good proxy for disruption
- Ongoing lawsuits in Japan may eventually provide a basis for monetizing noneconomic aspects of social disruption:
 - E.g., “loss of homeland,” depression, and suicide



- Fukushima:
 - Decommissioning, compensation, decontamination, and waste management costs amounted to \$200 billion by December 2016
- Chernobyl:
 - Direct economic losses on the order of \$7 billion
 - Total losses estimated to be on the order of \$15 billion (possibly \$20 to \$30 billion for a similar accident in the U.S.)
 - Some estimates approach \$200 billion for Ukraine and Belarus, due to ongoing compensation of the exposed populace
- Spent-fuel fire:
 - Potentially “trillion-dollar consequences”



Characteristics of Relocations

- Duration (including whether temporary or permanent)
- Nature of interdicted assets
- Distributional effects
- Magnitude (number of people needing to be relocated)
- Anticipated vs. unanticipated
- Difficulty of planning



- Some relocations may be **temporary** (e.g., due to terrorism):
 - While others are likely to be **permanent** (e.g., sea-level rise)
- Long-term consequences of migration are quite different depending on whether it is seen as permanent:
 - Temporary migrants generally acclimate much less thoroughly
- Impact per time unit may be non-monotonic in **duration**:
 - Brief evacuations may be minimally disruptive, if people return and businesses resume operations within a few days
 - Relocation of a few months or a year is much more disruptive
 - Eventually, costs per day could approach zero, as society reaches “a new normal”



- Costs may vary greatly depending on the **nature of the assets that are interdicted**
- For example, loss of a major tourist resort may be almost completely compensated by increases in tourism elsewhere:
 - While loss of housing or unique production facilities may cause significant costs until replacements can be built
- Loss of housing is one of the largest economic consequences of a disaster (at least in developed countries):
 - When an entire community is relocated, there are also significant costs to rebuild and replace preexisting infrastructure/services



- Relocation has **disproportionate impacts on the vulnerable**
- Homeless and renters are disproportionately affected:
 - But federal assistance tends to emphasize homeowners
- Demographic factors also play a large part in who returns:
 - After Katrina, “blacks, young adults, and the never married were much less likely to return to their homes”...
 - “those who did not return fared worse than those who did return”
- Forced relocation is disproportionately difficult for those without strong community or labor-market ties:
 - Social capital seems to mitigate the effects of relocation
- Forced relocation does not offer the same opportunities as economically motivated migration

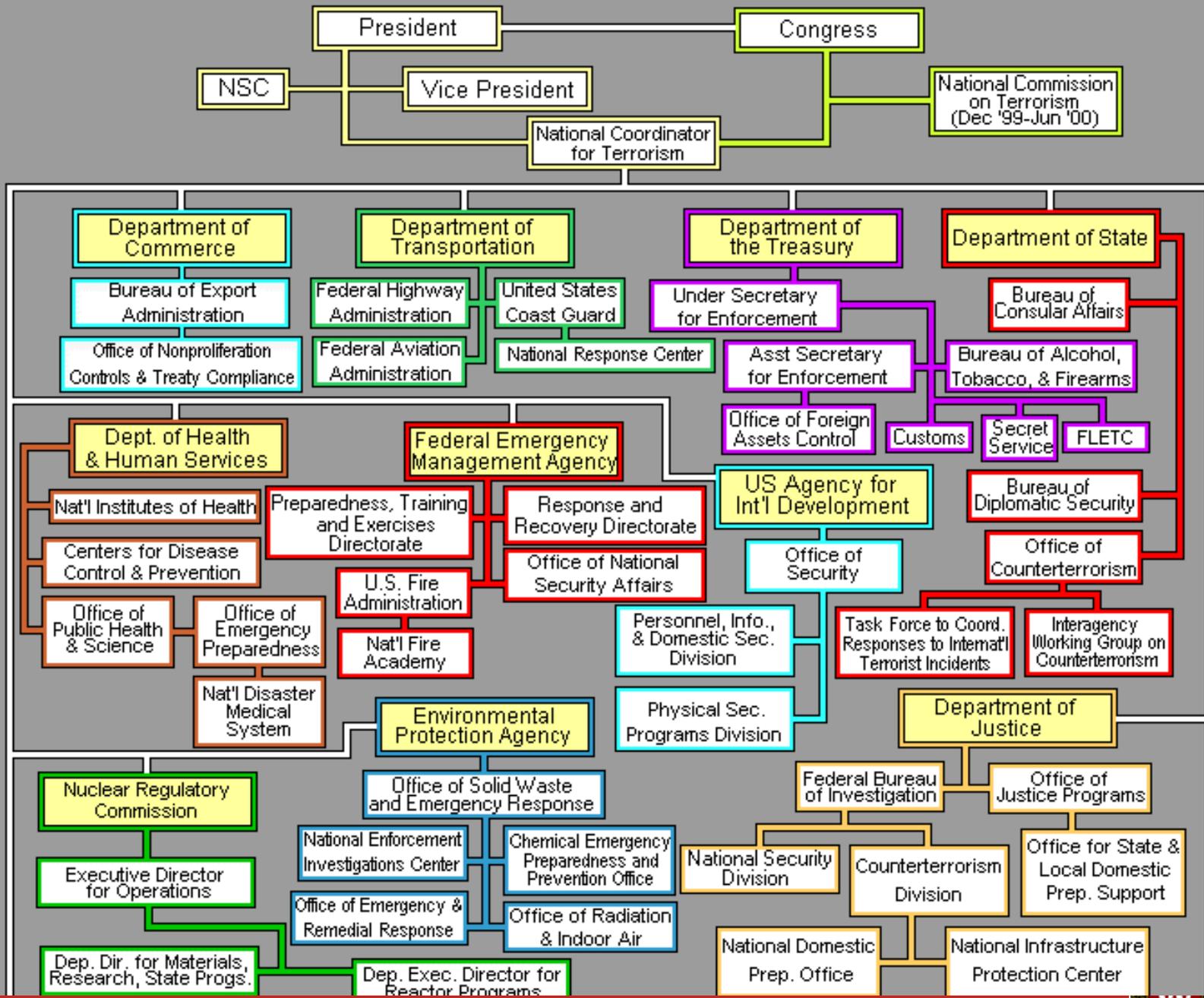


- Large relocations can also have **distributional impacts on receiving areas**:
 - Although most studies do not focus on receiving areas
- Massive relocations may drive up housing prices, causing hardship to low-income renters:
 - Although the impact will depend on prior vacancy rates
- For example, after Katrina:
 - Some studies found a 1-2% reduction in wages in Houston
 - And a 0.5% decrease in the probability of employment



- It may be **impossible to predict** which areas will be affected until an accident or terrorism event occurs:
 - Making it impractical to relocate people proactively
- Even if the need for relocation could be **predicted**:
 - That does not ensure that it will be effectively **planned**
- The inherent difficulties of planning for large relocations are exacerbated by the wide range of agencies that have a role
- Humanitarian response does not function as a single “system”:
 - This fragmentation can turn emergency planning and response into a “bureaucratic nightmare”





- Surprisingly little is known about long-term mass relocations
- Levine et al. (2007):
 - “For too long, we have regarded major disasters as singular, one-time, localized events, rather than as repeated...
 - “Until...these concerns are investigated, adequate policy responses cannot be developed, much less implemented”
- Disaster planning in the U.S. addresses emergency housing:
 - But little or no provision for long-term post-disaster housing
- Understanding the economic and social impacts of relocations would help to inform policy choices—e.g.:
 - Slightly higher dose thresholds to reduce relocations
 - Additional safety measures in highly populated areas
 - Strategies for expedited decontamination

