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Behavior Influence Assessment of Impacts of the Grand Ethiopian Renaissance Dam on Unrest and Popular Support within Egypt

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Abstract

The construction of the Grand Ethiopian Renaissance Dam (GERD) has generated tensions between Egypt and Ethiopia over control of the Nile River in Northern Africa. However, tensions within Egypt have also been pronounced, leading up to and following the Arab Spring uprising of 2011. This study used the Behavior Influence Assessment (BIA) framework to simulate a dynamic hypothesis regarding how tensions within Egypt may evolve given the impacts of the GERD. Primarily, we addressed the interplay between four parties over an upcoming ten-year period: the Egyptian Regime, the Military-Elite, the Militant population, and the non-Militant population. The core tenant of the hypothesis is that rising food prices was a strong driver to the unrest leading up to the Arab Spring events and that this same type of economic stress could be driven by the GERD—albeit with different political undertones. Namely, the GERD offers the Regime a target for inciting nationalism, and while this may buy the regime time to fix the underlying economic impacts, ultimately there exists a tipping point beyond which exponentially increasing unrest is unavoidable without implementing strong measures, such as state militarization.

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Keywords: Egypt, Ethopia, GERD, Cognitive Modeling; Social Modeling; Systems Modeling; and Country Assessments

1. Introduction

Decision makers can benefit from greater insight into the dynamics that can lead to conflict within and between nations. Particularly important is developing the type of insight that produces measures that effectively mitigate potential conflicts. With this goal in mind, Sandia National Laboratories (Sandia) is developing modeling and simulation approaches to evaluate how systems within water, energy, agriculture, ecology, climate, and population

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sectors interact with social, political and economic systems to affect regional and national stability, conflict, and peace. To help accomplish this, this effort integrates five distinct modeling capabilities developed at Sandia that address agriculture, hydrology, population resiliency, economic, and social systems. The first phase of this effort addresses potential conflict in Egypt associated with the Grand Ethiopian Renaissance Dam (GERD) project in Ethiopia. The GERD is expected to reduce freshwater availability, which could have social and economic impacts in Egypt. The modeling and approaches applied to this problem can be modified to address a wide range of regional, national, and international security and stability topics around the world. The GERD, currently under construction in Ethiopia and due for completion in 2017, will store 63 billion cubic meters of water in its reservoir and produce 6,000 MW of hydroelectric power for Ethiopia. The dam construction project has raised fears among Egyptians that their freshwater supply will be impaired and that agricultural production, food availability, and the overall well-being of the population may be affected. In some circles, military action against Ethiopia has been considered.

To represent and assesses psychosocial, geopolitical, and behavioral-economic systems, Sandia's Behavioral Influence Assessment (BIA) framework was used [1, 2]. The BIA framework is a theory-based, dynamic systems modeling capability intended to assess the effects of events, actions, and counter-actions within and among groups of people within a country or group of countries. Specifically, BIA can quantifiably address the social/political/military/economic dynamics between individuals, groups, and countries, as well as unanticipated, higher-order consequences of events or actions. Included in this assessment are considerations of the dynamics that drive stability and instability. This study used BIA to simulate one set of dynamic hypotheses about beliefs, motivations, intentions, and ultimately actions of the aforementioned parties within Egypt during and following the future period when the GERD is filling and Egypt is experiencing decreased Nile River flows. We find there is considerable expectation of subsidized food prices within Egypt by both the Militant (typically non-Western oriented, following very traditional, sometimes violent, local-cultural norms) and non-Militant population. To fulfill these expectations, Egypt's Regime has historically relied on the food subsidy program as a buffer between external food price drivers and the price paid by their population. However, the Regime may have to borrow from other sectors of the economy to maintain these subsidies given a relatively large hit to food prices or food production. If economic conditions worsen enough, they may borrow from programs targeted at benefiting other groups that hold sway within Egypt, such as the Military Elite (those who hold upper echelon military positions and/or businesses within Egypt). For the work presented herein, the BIA approach was applied to lend insight to the following questions:

1. How might unrest within Egypt progress and toward whom would it be directed given different assumptions about the impact of the Grand Ethiopian Renaissance Dam (GERD)?
2. How do different Egyptian economic policies and factors such as the use of food and energy subsidies, military spending, and external food or energy price shocks affect the population's response to the GERD?
3. How do Egyptian non-economic policies such as suppression of unrest and the spread of propaganda influence how the population will respond to impacts from the GERD?

1.1. Entities and Decisions

BIA models represent macro-level societal interactions as well as micro-level socio-political entities that are inclusive of various groups within a society. These entities are represented using a cognitive-behavioral modeling structure in which cues lead to perceptions, perceptions to motivations, and ultimately to behaviors. This enables the representation of decisions among and between specific groups in response to events. After discussions with subject matter experts, the following set of cognitive entities were developed for the above set of questions regarding Egypt:

- The Regime: Assumed to be composed of a set of former military/elite individuals, the Regime is primarily interested in improving the economy of Egypt, decreasing the perception of instability by internal and external parties, and maintaining power.
- The Military Elite: The Military Elite represents the business owners and executives as well as the high-ranking officials within the Egyptian military. They are motivated to keep their positions of wealth and power.
- The Militants: This group represents the minority within Egypt that is motivated to increase the role of conservative Islam within the Egyptian government. While the Muslim Brotherhood has made headlines in

Egypt [3], the Militants in this model represent a broader set of motivators and opinions, including a strong inclination toward greater and more open democracy within Egypt.

- The general population: In essence, the general population is everyone else. Both the general population and the Militants are quite poor by Western standards [4]. Beliefs include a high sense of pride and the belief that Egypt remains the leader of the Arab world. Motivations stem from distrust of corrupt regimes and distrust of colonial influencers (from Alexander the Great to British colonization), balanced with a buildup of fatigue from recent instability and economic hardship.

These entities can be thought of as existing within a causal structure where decisions of certain entities define the strength of relationships (many more relationships exist within the model—such as communication within and between entities). By determining the relationships between the entities, a list of potential behaviors, motivations for these behaviors, and cues that would activate these motivations was generated. This set of potential behaviors, motivations, and cues, along with how they are related to one another is the core cognitive input that defines this modeling structure.

1.2. The World Model

Cognitive entities do not only interact with each other in the BIA model, they also interact with the world around them. This is represented by a world model within BIA. For this effort, the world model represents the effect of food and energy subsidies on the finances of the cognitive entities, the income dependencies of the government, and the balance of protestors and enforcement in the streets. The controlled inputs to the world model provide insight into how internal and external facets of the economy may influence future behavior within Egypt. These inputs include: 1) size of GERD's impact on agricultural production; 2) timing of GERD's impact on agricultural production; 3) size of GERD's impact on energy production; 4) timing of GERD's impact on energy production; 5) price elasticity of food and energy supply; 5) external food or energy price shock; and 6) efficiency of food and energy subsidies.

1.3. Behavior of the Base Case: Effective Diplomacy

To generate a basic dynamic hypothesis of response to the GERD's impacts, a base case was developed in which the only changes in food and energy prices are due to the reservoir-filling period for the GERD. These modeling results should be taken as a dynamic hypothesis and not a prediction. They are a starting point to discuss how conditions are linked to cues, which are then linked to behaviors, which ultimately change conditions in Egypt. This scenario assumes the GERD will be filled over a period of 7 years. It also assumes that the Regime has enough influence to decrease the GERD's impacts through diplomacy.

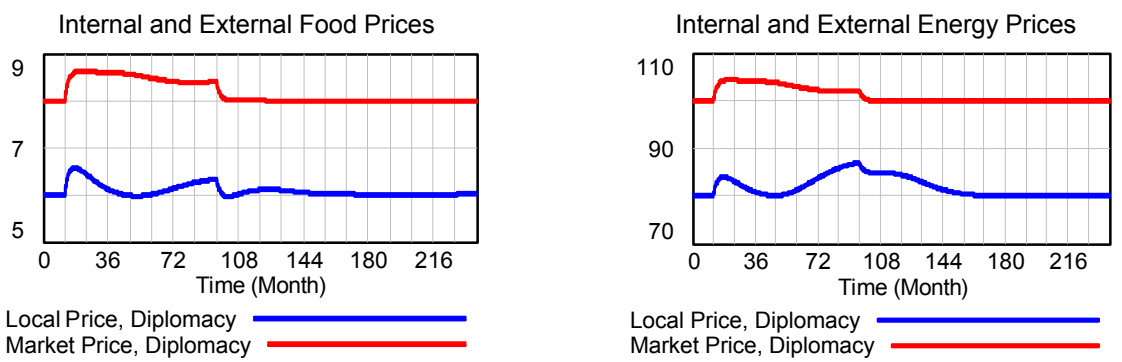

Figure 1. Response of food (left) and energy (right) prices before and after subsidy because of the GERD. The market impacts of the GERD (red) decline slightly as a result of diplomatic actions by Egypt. The local food price (blue) varies as a result of food subsidy dynamics.

Figure 1 shows the price effects of a 15 percent impact on agricultural production and a 15 percent impact on energy production lasting seven years. Because of price elasticity and market delays, the red lines in Figure 1 exhibit a dampened and lagged response of prices to these changes. Food prices increase over the first year and settle at a 10 percent increase. Energy prices have a similar dynamic and settle at a 10% increase. The blue lines in Figure 1 represent the status of the internal market price for food and energy, which are lower because of subsidies. Other economic models have not verified these results at this time.

One of the primary hypotheses demonstrated by this model is that perceived income inequality is a direct driver of population discontent [5]. To test this hypothesis, the world model simulates the impact to household disposable income, and the cognitive entities compare their own discretionary income to that of others in this model. The discretionary income for Militants and the general population is graphed in Figure 2. The red curve does not show up in this graph because it is directly behind the blue curve. In the model, Militants and the general population are economically identical. They work in the same jobs and live in the same buildings [6]. At the beginning of the GERD's potential impact, Egyptians receive a large hit (nearly 20 percent) to their discretionary income, which begins to recover as the Regime increases food and energy subsidies. However, the Regime cannot afford these subsidies for the entire length of the disruption, and discretionary income of the population begins to decline again. The Military Elite (not shown) experience almost no impact to their discretionary income. In fact, some have hypothesized that this group will capitalize on higher food and energy prices, but this effect was not modeled [7].

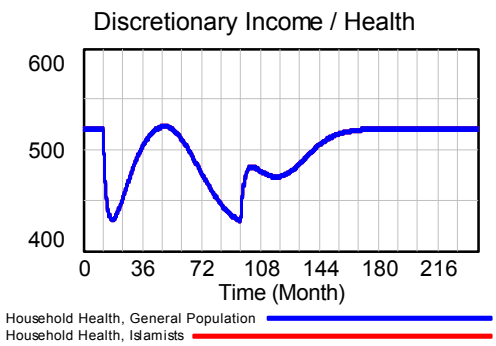

Figure 2. Discretionary income for Militants and the General Population.
These line up right on top of one another.

The Regime in the base case is attempting to recover the economy by making new investments in the Military Elite that take time to manifest. These investments may include development of new resources such as natural gas or mineral deposits, or development of military strength to improve competitive stature in the region. In the meantime, they increase subsidies for food and energy and attempt to direct public opinion toward negative views of the GERD and away from negative views of the Regime. This economic and emotional balancing act largely drives their success in avoiding large protests and the aforementioned unrest tipping point. Figure 4 shows how the Regime blames the GERD, and through use of propaganda, how this affects the populations and the Military Elite's views of the GERD. The graph at left can be interpreted as the relative amount of effort the Regime is putting into blaming one cause versus another for hardships. The graph at right represents what entities are saying about the GERD, where higher than 0.5 means they are saying negative things, and lower than 0.5 means they are saying positive things. Notably, the Militants respond much faster to the messaging. This is because they are assumed to be a more cohesive group in which opinion can spread more quickly, as opposed to the larger, more diverse general population, and the Military Elite who are less affected by messaging and propaganda.

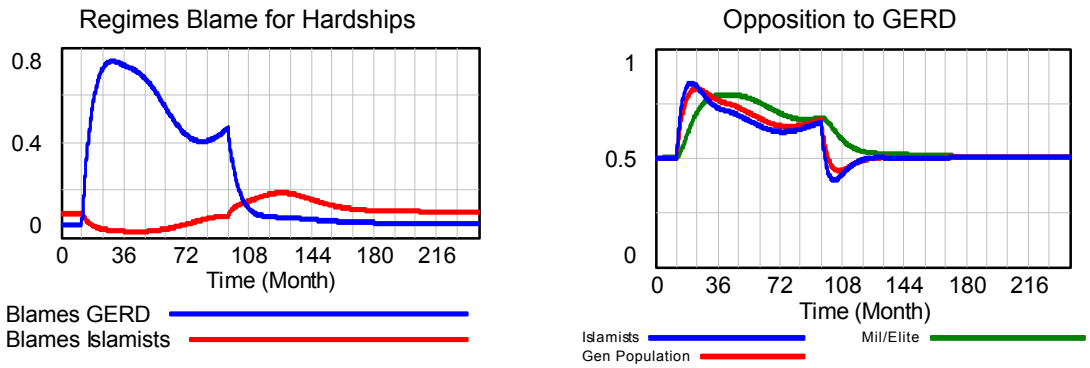

Figure 3. Percentage of propaganda activity by the Regime (left),
and opposition to the GERD by different entities (right).

While the population is worse off and perceives a comparative disadvantage to the Military Elite, their outrage toward the GERD offsets much of the dissatisfaction that they would otherwise have toward the Regime. The left graph in Figure 4 shows the strength of negative opinions by the cognitive entities. Because the subsidies and the opinion against the GERD take time to manifest, negative communications about the Regime increase for the first year of impacts, but are slowly replaced by relatively positive opinions as groups direct their anger toward the GERD. By the fourth year of impacts, as the Regime can no longer afford subsidies, and as dissatisfaction toward the Regime's inaction against the GERD builds, opinion shifts against the Regime. The 'dissatisfaction with inaction' component is shown on the right graph of Figure 4. The slight dip in this graph around month sixty is because of the Regime taking diplomatic action against the GERD, but soon thereafter the population becomes again dissatisfied, as the Regime's actions do not completely eliminate the effects of the GERD. The Regime's diplomatic action is the cause of the slow decline in market food and energy prices exhibited in Figure 1.

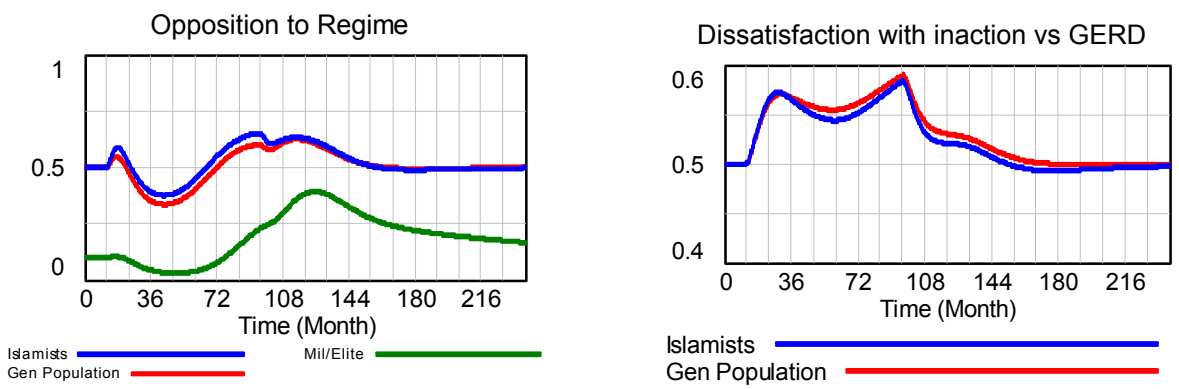

Figure 5. Negative communications directed toward the Regime (left) and
dissatisfaction with the Regime's inaction against the GERD (right).

The actual number of protestors in the model is a function of the population's opposition to the Regime and the ability of the Regime to suppress and deter unrest. The Regime can suppress and deter more unrest successfully if they have military support. Figure 5 at left shows the funding that the Regime is funneling to the Military Elite. In the very initial stages of impacts, the Regime is trying to increase this funding as an investment in the recovery. As subsidies become too expensive, the Regime chooses to defund the Military Elite programs, which results in the decay of the Military Elite's support for the Regime as evidenced in the green curve of Figure 4. This decreasing

support is another potential source for an unrest tipping point, but does not become a problem in the base case simulation, where diplomacy is at least marginally effective at decreasing the GERD's impacts. The amount of unrest declines well after the impacts of the dam are over—in fact unrest peaks right as the GERD is almost full. This dynamic is due to the slippage of food and energy subsidies, the resulting decrease in discretionary income for the public, and the use of suppression by the government during the upswing in protests. All of this serves to show that unrest can be a heavily lagging indicator of actual problems, and that the Regime's balance of sentiment management and funding decisions is critical to understand when assessing an external shock such as the GERD.

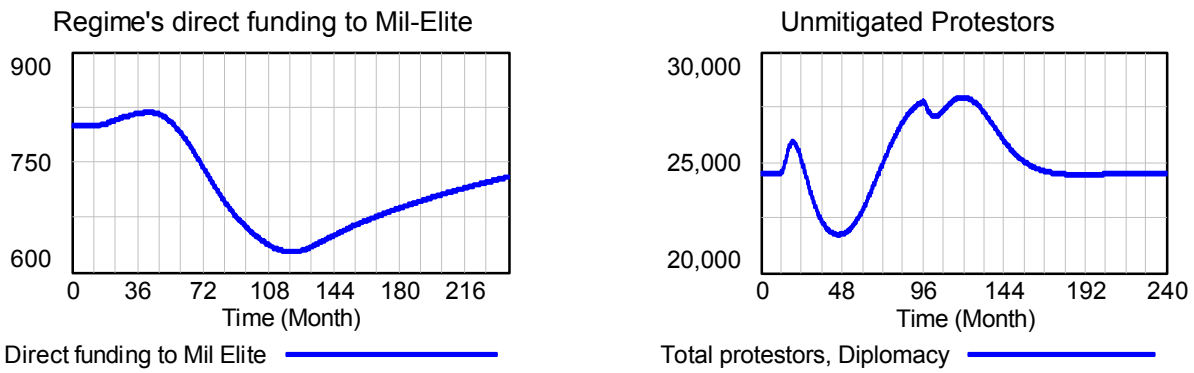

Figure 5. The funding of Military and Elite programs (left) and the number of actual protestors (right). Defunding of the Military Elite could lead to their refusing to support the Regime in their suppression of unrest.

1.4. Tipping Point: Ineffective Diplomacy

The behavior of the base case exhibits high opposition to the Regime, erosion of Military Elite support, and heavy government debt at the end of the 7-year GERD impact period. What is saving the Regime is their ability to show that they are effectively doing something about the GERD's impacts through diplomatic action, thereby maintaining their legitimacy. This section describes the case in which that diplomacy is ineffective. No parametric changes were made to the model for this scenario, only a change in the effectiveness of Egypt's diplomacy with Ethiopia.

A smaller set of graphs is used to show the major differences from the base case. Figure 6 shows food prices and the Militants' dissatisfaction with the Regime's inaction against the GERD. Notably, when diplomacy is ineffective, pre-subsidy food prices remain high until the GERD is full. The population builds much more dissatisfaction than with the base case. Without effective diplomacy, two factors compound to create higher dissatisfaction. First, because the impacts of the GERD remain high, the government food and energy subsidies do not last as long under the Regime's limited budget, leading to lower discretionary income in the general and Militant populations. Second, the expectation by the population that the Regime will do something about the GERD impacts is never met, leading to a shift away from blaming the GERD and toward blaming the Regime for hardships.

Opposition to the Regime is more pronounced during the GERD impacts in this scenario, as evidenced by Figure 7 (left). Other model output shows that the primary difference is that the Regime accumulates much more debt, defunds more Military Elite programs, and loses the support of the Military Elite more rapidly. Due to this lack of support, the efficiency of suppression is greatly reduced, leading to more brutal or more unjust suppression measures taken by the Regime, assumed by the model. This positive feedback loop is the source of a tipping point: higher dissatisfaction -> more unrest -> more oppression -> higher dissatisfaction, and this loop is strengthened the more the Military Elite decreases their support. The high residual dissatisfaction due to Regime inaction also has an effect on the population's greater opposition. These factors lead to the exposure of the suppression tipping point and unrest spikes until the Regime's economic situation is improved as illustrated in Figure 7 (right). This study does not suppose the level of unrest necessary to change or overthrow the Regime.

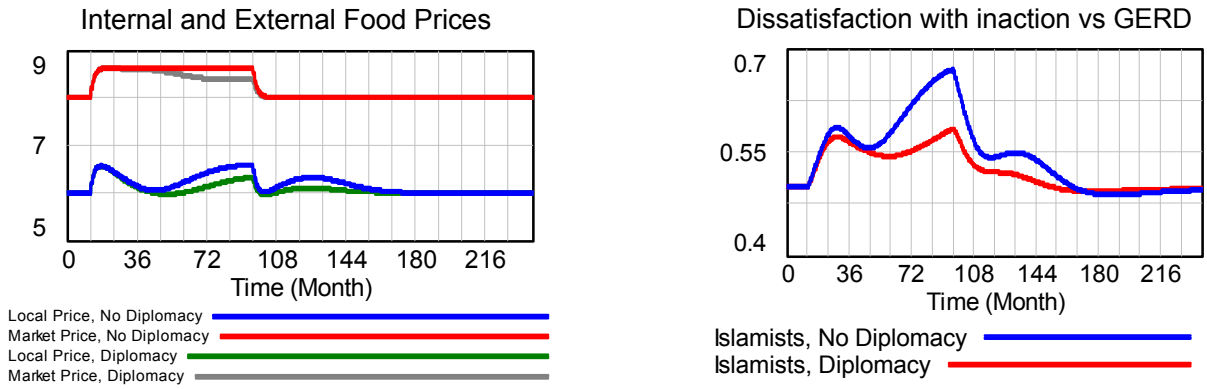

Figure 6. Pre- and post-subsidy food prices (left) and Militant dissatisfaction with Regime inaction (right) with and without effective diplomacy.

The contrast between two assumptions about diplomacy effectiveness illustrates the existence of the unrest tipping point, and the danger of entering into a situation where suppression is the main inhibitor of unrest.

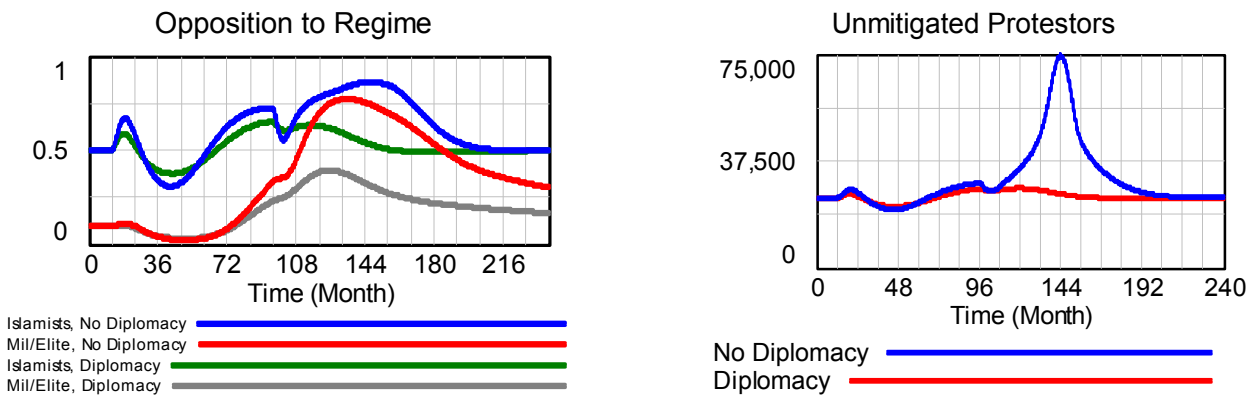

Figure 7. A comparison of Militant and Military Elite opposition to the Regime (left) and total unrest (right) with and without effective diplomacy.

1.5. Summary

1.5.1. Insights, Conclusions, and Future Work

This work is meant to be a dynamic hypothesis of the relationships that affect unrest in Egypt between the most important groups during the period in which the GERD is refilling. We simulated many other scenarios that were not published in this manuscript. Some early insights include:

- Unrest, combined with suppression of unrest and an emboldened population exhibits tipping point behavior.
- It is common to find the highest unrest well after the GERD's impacts are over. This counter-intuitive finding is largely due to the long delays in the system. Structurally, unrest is buffered by the Regime's ability to decrease the economic hardship of the population, and also by its ability to spread propaganda against the GERD.

- Propaganda against the GERD and food/energy subsides only delay unrest. The best way to prevent unrest is to prevent or mitigate the GERD's impacts. Effective diplomacy is one strategy that was tested and found to prevent extreme unrest.
- External shocks to food prices – not related to the GERD –would have a significant effect on popular support for the regime. A price shock occurring before the GERD filling period has potential to be more disruptive than a price shock after this period.
- Maintaining the support of the military matters, but can be effectively relied upon by the regime as a buffer while it concentrates on satisfying the population. If diplomacy with Ethiopia is ineffective at decreasing GERD impacts, then military support becomes more important later in the period of effects.
- The short, intense filling period is more sensitive to assumptions about diplomacy than the longer filling period.

These insights provide a forum for discussion of the detailed relationships responsible for unrest within Egypt – and ultimately could help to explore the policy space of options to lower the potential for future unrest. Conflict between Egypt and Ethiopia is also important, and should be explored in future versions of this model. Additionally, the economic relationships in this model are approximate, and the use of a more robust economic model should be explored. Finally, confidence-building exercises should be performed with this model. Namely, the model should be tested against historic behavior, with a separate calibration and validation period. The 2011 Arab Spring uprising might be an ideal time series for this effort. An exploration of the most uncertain variables could then be performed, and sensitivity analysis could drive future exploration.

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