Deteriorating Economic Condition and the Emergence of Social Instability

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Abstract

Political protests and civil conflicts are episodic in nature, often stemming from localized conditions. Most quantitative research on these problems, however, has used large, country-level data sets that can shed little light on the evolving dynamics of protest, revolt, and rebellion. Researchers' inability to agree about the relative importance of different economic, political, and social factors has led to calls for additional data collection at sufficient granularity to capture localized conditions prior to and during outbreaks of civil conflict. Collecting high-quality data on local conditions at frequent intervals in countries at high risk for civil violence can be difficult, expensive, and dangerous. The first step in understanding the local dynamics of political protest and civil violence must be conceptual exploration that illustrates the potential utility of high-resolution data collection and helps identify the types of data and relationships that could be most useful for subsequent analysis.

This paper demonstrates how an agent-based modeling approach could allow researchers to explore the effects of changes to individual economic conditions to social stability, especially how deteriorating economic conditions and differing degrees of economic inequality in a community impact the size, frequency, and onset of civil protest. While previous studies using country-level data have not found that economic inequality has a significant effect on civil violence, the agent-based modeling approach suggests that inequality can have significant effects, but that the magnitude and direction of these effects depend on local conditions. The analysis on which this paper is based also highlights the delicate balance between implementing economic reforms to generate long-term growth and social instability that can ensue in the short-run due to deteriorating economic conditions of the most vulnerable.

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On the morning of December 17th 2010, a Tunisian fruit vendor named Mohamed Bouazizi took a can of gasoline and doused himself in front of the local governor's office. Yelling in the middle of a busy street "How do you expect me to make a living?", he struck a match and lit himself on fire. The sole income earner for his family, Bouazizi was upset at having his fruit cart confiscated by local police who frequently harassed vendors in the area. The morning prior, Bouazizi had borrowed money to purchase his inventory only to have his cart and inventory confiscated by the state. With no other means to support his household and now deeply in debt, Bouazizi sought an audience with the local governor who refused to meet with him.

With seemingly no other means of voicing his discontent, Bouazizi embraced an extreme form of protest against his economic condition. The self-immolation and subsequent death of Bouazizi sparked immediate protest in the localities outside of Tunis, quickly increasing in scale and intensity eventually leading to the removal of the central authority. What began as an individual protest of one's economic condition against an agent of the Tunisian state, spread across the Arab world leading to punctuated civil protest, revolt, and in Libya and Syria -- civil war. What has become known as the Arab Spring has dramatically transformed the domestic politics of states in the region and has altered the geo-political calculations of the international community.

Towards Understanding the Dynamics of Localized Civil Conflict

Civil conflicts are episodic in nature often stemming from localized conditions for which large country level data analysis is poorly suited to understand the evolving dynamics of protest and revolt. The lack of consensus on the applicability of some econometric results has lead to calls for additional data collection at sufficient granularity to capture localized conditions prior to and during outbreaks of civil conflict.

Obtaining higher granularity data sets not only requires financial resources, but also are frequently undertaken in difficult conditions and often in areas that threaten the safety of the researchers themselves. Because of the inherent cost and difficulty of gathering data, the first step in developing higher resolution analysis must be conceptual exploration of localized conditions to help identify the most useful observations for subsequent analysis.

This paper is an attempt to meet that challenge by conceptually exploring micro level dynamics of civil conflict, specifically how economic condition of the individual influences the evolution localized protest and revolt. This has the benefit of not only allowing for a better theoretical understanding of what is transpiring at the local level, but serves a practical purpose in defining what data would be useful in understanding the relationship between economic conditions and the emergence of civil conflict. In this regard, agent based models are uniquely suited to explore bottom up approaches and to identify localized dynamics that more traditional methods are unable to capture.

I develop an agent based model of protest that allows us to conceptually explore how changes to the average level of utility, its dispersion about the mean, and its growth affect the onset, size, and frequency of protest. The approach taken allows us to make changes to individual economic condition and then observe the evolution of protest from stability to generalized revolt. I find that lower levels of utility increase the size, frequency, and onset of punctuated civil protest. I also find that the distribution of utility between individuals significantly impacts the magnitude and the frequency of punctuated protest. Most significantly I find that inequality is shown to

have a more complicated relationship with civil protest than previously thought. In higher utility models, inequality has a direct relationship with civil protest, while in lower utility systems it reverses to help engineer greater civil protest. This result highlights a significant problem in most empirical models seeking to test for statistical correlation between inequality and civil conflict. Specifically this result demonstrates that most models that have sought to test the relationship between the two might be mis-specified.

Deducing Benefits for Mobilization: Emergence of the Greed Hypothesis

Rational choice theory of civil war has profoundly shaped scholarship of civil violence, specifically the discussion of causes of civil war over the past 15 years. The papers, books, and case studies generated have served to mold public policy initiatives aimed at reducing the chance of large-scale civil conflict. The work of Grossman and Hirshleifer focused the interests of economists who sought explanations that separated the romantic idealization of the revolutionary leader fighting for freedom towards the conditions that made civil war feasible. Two sets of researchers have moved this area of scholarship forward. Collier & Hoeffler and Fearon & Laitin have articulated and adopted the feasibility hypothesis as a likely explanation for the onset of civil war providing the field with its dominant view of the likely causes of civil conflict.

Collier & Hoeffler formally defined their model of the likelihood of civil war by proposing a utility model of benefits and costs that define the decision of individuals to engage in civil war (Collier & Hoeffler 1998). The model defines a decision of a representative individual to rebel as essentially a profit calculation where benefits minus costs are defined and computed. If the value is strictly non-zero then war will occur. The benefits to the individuals are calculated by summing across periods from the end of hostilities through infinity the gains accrued which itself is a function of the taxable base and the size of the population. The costs to the individual, summed from the onset of rebellion to its conclusion, are lost income and the coordination costs between groups to sustain a rebellion.

The model implicitly assumes that all actors perceive and calculate the benefits and costs equally (or at least on average). The Collier & Hoeffler model moves the conflict literature away from discussions of personal or political grievance as the source of angst and conflict, and towards a model for which aggregated societal decisions about the benefits of rebellion are the determining factor for the emergence of civil war. This model implies that all members of society have access to complete information in order to make their calculation, and that all members of society will at some point reach the cost benefit calculation at the same time. Collier & Hoeffler do not provide a framework on how this phenomenon emerges amongst the populace, only simply to identify the activity as a binary condition (e.g civil war occurs or does not occur).

The model presented in the initial rational choice argument lays out a theoretical framework from which to test specific variables utilizing a logit regression model(Collier & Hoeffler 1998). To test the viability of their theory, Collier & Hoeffler specify independent variables aimed at capturing correlating effects between them and the outbreak of civil war. They test measures of economic activity, political and economic grievance, as well as socio-demographic determinants for civil war (Collier & Hoeffler 1998, 2002). They conclude that high incomes, smaller populations, average social fractionalization are the most stable, while countries with low income, higher levels of natural resources, and average fractionalization increase the level of conflict. Mostly importantly, they find that measures of grievance (levels of democracy, income

inequality, and high ethnic fractionalization) have little to no explanatory power for the emergence of civil war (Collier & Hoeffler 1998, 2002). Yet they do find a strong relationship between specific levels of primary commodity resources (e.g 22-31%) relative to GDP, and measures of economic output (e.g lower GDP per capita and lower economic growth) (Collier & Hoeffler 1998).

Collier & Hoeffler interpret their results in the construct of the benefit cost model for the onset of civil war (Collier 2000, Collier & Hoeffler 2002). The authors explain the significance of primary commodity share of GDP as a readily accessible financing measure for rebels due to the immobility of resources by the government. As the level of primary commodity as a share of GDP increases the value to a potential rebel group increases thereby increasing the benefits accrued to a rebel force. Interestingly, the authors note that the result is not monotonic and instead implies a parabolic shape. They reason that as the share of that primary commodity increases relative to total GDP, there is a greater incentive for the government to protect the resource. While Collier & Hoefeller cite this as strong evidence of rebels motivated by the benefits they accrue from lootable resources, others find the result to be fragile, log-liner in shape, and mostly explained by oil producing countries (Fearon & Laitin 2003, Fearon 2005).

In addition to the benefits obtained from the acquisition of a natural resource such as timber or diamonds, Collier & Hoeffler find that economic measures such as lower GDP per capita and low economic growth increase the probability of an onset of civil war. They reason that lower GDP per capita, acting as a proxy for a person's income, lowers the opportunity cost of joining a rebellion. Additionally, lower economic growth implies fewer jobs thereby also lowering the opportunity cost of joining in a rebellion. Strangely, the authors ignore income per capita as a likely source of individual economic grievance instead choosing to see these results as a measure of joining an alternative work structure (e.g rebellion against the state). The authors also find that increased ethnic fractionalization lowers the probability of an onset of civil war supporting their contention that numerous ethnicities increase the costs of maintaining a unified rebellion. Lastly, they find that large populations apparently correlate with greater probabilities of civil war onset.

The empirical result stemming from Collier & Hoeffler's model defined a relatively narrow view of what generates the onset of civil war. They moved the discussion away from an individual grievance model, and instead focused the analytic efforts on the opportunity for civil war informed by multiple citizen's' calculus of the costs and benefits of a rebellion. This became the basis for what is termed the "greed" hypothesis. In its extreme version, civil war is simply a quasi-criminal activity, with rebels seeking income from looting natural resources while using the language of grievance (e.g inequality, political rights) as part of a larger public relations campaign.

The identification of specific examples such as the conflict in Sierra Leone (e.g diamonds), or the FARC in Columbia (e.g cocaine) provided specific case studies that lend credence to the belief that civil war is simply a quasi-criminal enterprise. However, the greed hypothesis does not appear to be a good model for explaining more recent revolutions in the Arab world (e.g Jordan or Syria). Collier & Hoeffler although acknowledging personal grievance as a factor for rebel support, see the "feasibility" of civil war, defined as the financial and military feasibility of victory, as the definitive determinant of civil war and not group grievance (Collier, Hoeffler & Rohner 2007).

An Alternative Explanation in the Rational Choice Framework

Responding to Collier and Hoeffler and putting forth their own view on the onset and prevalence of civil war, Fearon and Laitin support the rational choice framework but challenge the primary commodity hypothesis (Fearon & Laitin 2003). Fearon and Laitin broadly agree with Collier and Hoefeller's view that civil war is a manifestation of opportunity by rebels rather than a grievance for lack of political rights or economic equality. Yet, while supportive of the rational choice framework in principal, they challenge two primary findings of the Collier and Hoeffler model: the relationship between primary commodities as a share of GDP and the effect of ethnic fractualization. They find that the relationship between primary exports and conflict is both a fragile result and one mostly explained by countries with large percentage of oil based exports (Fearon & Laitin 2003, Fearon 2005). They also note that once they control for income, they are unable to replicate Collier & Hoeffler's findings of a substantial negative relationship between ethnic fractualization and the onset of civil conflict (Fearon & Laitin 2003). Instead, they argue that the lack of governmental strength manifested in weak governance is the primary determinant of civil onset. They also find that similar to Collier and Hoeffler, traditional measures of political and economic grievance do not appear to be significant.

Grievance Arguments in Response to the Rational Choice Hypothesis

The emergence of the rational choice theory and the subsequent articulation of the "greed hypothesis" provided a significant challenge to the broadly accepted grievance theories of previous decades. The shift away from individual or group grievance determinants and towards a feasibility approach to the emergence of civil violence is largely based on the large cross-country datasets used by Collier & Hoeffler and Fearon & Laitin who argue that the principal determinant of civil war onset is the feasibility of the conflict and not any underlying grievance.

The empirical work that formulates the basis of the greed hypothesis has provided some solid statistical evidence. It has pushed the field to address some significant questions concerning the determinants of civil war onset and prevalence, however, despite the claims of its proponents it has yet to refute the contention that grievance of individuals remain an important determinant of civil conflict. Supporters of rational choice theory, specifically the greed hypothesis, have acknowledged weaknesses in the quality of grievance variables, specifically income inequality.

Researchers have also acknowledged that their statistical methods may not be sufficient and have proposed additional work on the subject (Collier 2000). While some evidence in the original Collier & Hoeffler model are supported by others, the lack of consensus on a purely primary commodity explanation for civil violence undermines the universal conclusion that all civil war is a function solely of rent seeking behavior. In fact, other researchers have explicitly stated that there remains no consensus on the issue of income inequality and conflict, arguing that the data is both incomplete and insufficiently transparent to draw the inference that some grievance indicators are unrelated to the onset of civil war (Sambanis 2004).

In the wake of research that minimizes the importance of grievance indicators, supporters of grievance based motivators for civil conflict have more recently explored these outstanding questions by conducting additional studies examining the lack of political representation, ethnic tension, and chronic income disparities and have found that they have been linked to violent action most specifically terrorism (Crenshaw 2007).

Gurr, a strong supporter of individual grievance as a motivator for violent action, has identified that ethnic tensions account for significant numbers of conflicts that can not be explained by resource based arguments (Gurr 2000). Sambanis finds that as you separate ethnic and not ethnic wars, there appears to be a positive relationship between the level of ethnic heterogeneity and civil violence (Sambanis 2001). Others have noted that economic grievance indicators and not primary commodities are shown to help in the intensity of civil wars with grievance factors leading to pent up explosions of frustrations among a populace (Lu & Thies 2011). While others show that drops in foreign aid to countries leads to civil conflict (Nielsen, R & et al 2011)).

So where do we stand in our understanding of the determinants of civil conflict? What is apparent is that while a great deal of statistical work has been done on economic, political, and socio-demographic condition and the probability of civil conflict, there remains significant disagreement on how unorganized protest manifests itself into violent collective action. Grievance based arguments of relative deprivation or group inequality suffer from the dilemma of collective action, while purely greed based arguments fail to incorporate individual or groups grievance as motivation, instead focusing only on rent seeking behavior of individuals. While some empirical evidence supports the economic greed arguments, the lack of quality event data at local levels for grievance estimators calls into question the broader conclusion that individual grievance remains uncorrelated with civil violence.

Moving to Case Studies and Examination of Local Data to Understand Civil Conflict

In the roughly 15 years since the rational choice economic models were proposed, several articles have been published examining the statistical relationship of greed and grievance indicators on social instability. While several earlier papers have confirmed the correlation between economic determinants with civil conflict, later work has called into question the broad applicability of those results to all forms of civil violence (Collier 2000, Collier 2007, Fearon 2005, Epstein 2010, Goldstone et al 2010). Goldstone, Gurr, and others have directly refuted the results claiming that changes to model specifications show that other measures including political institutional structure matter more than economic conditions (Goldstone, Gurr, et al 2010).

While a robust debate has continued, a consensus has emerged where additional exploration of local conditions is required to understand the complex phenomenon occurring in conflict prone areas. A noteworthy voice of this consensus is Nicholas Sambanis. In response to the results presented by proponents of greed-based determinants, Sambanis argues that comparative case studies are required to refine our understanding of the statistical results (Sambanis 2004). He argues that a general weaknesses in the economic models of civil war are that they cannot distinguish civil war from other forms of political violence and have been shown to suffer from problems with measurement error, unit heterogeneity, model misspecification, and lack of clarity about causal mechanisms. The inability for these models to understand the formation of varying degrees of civil conflict from local conditions seriously undercuts our ability to understand political violence (Samabanis 2004).

In response to a call for localized analysis to help refine our understanding of determinants of civil conflict, some case studies and statistical analysis of specific localities have begun to be pursued. Three such articles detailing conditions in Nepal, Nigeria, and India highlight the local

level data required to understand the local conditions that foster social instability (Deraniyagala S (2005), Oyefusi, A (2008), Vadlamannati, K. (2011)).

In the case of Nepal, Deraniyagala examines the economic causes of the civil conflict. He finds that relative deprivation and related economic grievances are key casual factors in the conflict. The resulting civil instability is found to be a byproduct of uneven development policies during a period of economic liberalization (Deraniyagala 2005). Oyefusi's analysis of civil conflict in the oil producing region of Nigeria utilizes extensive surveys of combat aged men in the area. He finds that increasing individual levels of income reduce the probability of men joining a rebellion against the state (Oyefusi 2008). Lastly, Vadlamannati examines local data to understand how economic conditions and political violence in North East India are tied together. He finds that poverty (relative to other areas of India) has a substantial effect on the outbreak of civil violence.

Each of these studies highlights the inherent value in conducting localized analysis to provide greater fidelity to broader statistical results. While case studies and localized statistical analysis are essential, a shortcoming is that while data can be shown to correlate with each other, the lack of a coherent conceptual model that allows us to understand the evolution of political violence is missing. If the current models for economic determinants of civil conflict are insufficient then we require a new construct for which political violence can evolve into its many forms.

A New Conceptual Model: Moving from Individual Economic Condition and towards Individual Grievance

The decision to engage in protest and any subsequent conflict against the state is an inherently personal choice that is driven by an individual's condition and their understanding of the external conditions they face in the society (e.g the presence of security forces, what other citizens are doing, etc). The individual as a singular entity or as part of a identified group experiences what Ted Gurr refers to as relative deprivation (Gurr 1970). The change to relative deprivation can come from a variety of different source: loss of a job, a pay cut, reduction to purchasing power (e. g inflation), or cuts in public transfer payments. The gap between their capability and their expected outcome measures the size of the deprivation. Therefore, while either a job loss or a cut to a government subsidy might cause an increase in their relative deprivation, the loss of a job is likely to lead to greater hardship. The relative deprivation in turn leads to grievance if the situation can be assigned to a specific entity (e.g state or another individual). If the deprivation increase is simply a result of their own actions such as being fired for incompetence, the hardship they face is unlikely to emerge as grievance against another entity. Grievance against the state therefore emerges when an individual or group of individuals assign the source of their deprivation to the central government authority. In the simplest case, an individual who is experiencing extreme economic hardship, and who sees government inaction or policy as the root of that condition, might turn that angst to engage in some form of protest. That protest might be purely expressive in form with the image of a person standing on the corner yelling about the transgressions of the state on the people or in the attacking of a representative of the state.

The intention of the protestor is likely not to radically transform a legislative agenda, but more to express their discontent. It is not infrequent to see individuals during tough economic times erecting tent cities protesting. The "Occupy Wall Street" movement, albeit aimed at corporate entities, is a good example of this phenomenon. However, the grievance people feel might also

turn more violent if that individual decides to cause harm to themselves or others as a way of drawing attention to the problem or as an expression of pure frustration against a system they are individually powerless to change. This instrumental form of protest is likely to have deeper aims than a simple statement of frustration. The self-immolation of Mohammed Bouazizi in Tunisia demonstrates a expressive form of protest, while the subsequent protest and revolt of the Tunisian populace was instrumental.

A New Conceptual Model: From Individual Grievance towards the Emergence of Mass Protest

While the motivations of an individual to vent his frustrations are easy to understand, what becomes more challenging to researchers is how that individual disaffection, even when shared by others, transforms into a mass protest. At the heart of the problem is again an individual's analysis on the likelihood of being successful in venting their discontent while not being arrested or killed by state forces.

The cost of being the first person to demonstrate and thereby bear all the costs of that action is the heart of the collective action problem. From an instrumental standpoint no one wants to be the first person to protest if the costs of that protest are high and the probability of policy change is slim. In free societies where peaceful protest is permitted, the costs of protest are minimized as long as peaceful assembly is maintained. Therefore, the cost to the individual standing on the corner yelling about the transgressions of the state is effectively nothing. However, in less free societies even peaceful protest could be met with arrest, injury, or possibly even death. Therefore no single individual, unless highly risk tolerant or doing it for expressive reasons, is likely to be the first to protest their state of affairs. Instead, they may seek a private regress of grievance, or simply muddle through the hardship they are experiencing. However, if other citizens who are voicing similar concerns are seen by an individual who harbors similar thoughts, the potential for being singled out by police declines thereby reducing the overall disincentive of protest.

In large enough groups, the costs will be minimized to such a degree that it is effectively reduced to zero encouraging an exponential increase in the numbers of persons protesting. This might occur because the number of security forces in a specific geography in the short-run are relatively fixed thereby reducing the ratio of protesters to security forces as the collective action grows[2]. As the protest expands, security forces might intercede and seek to disperse the gathering. Thus, protests can take the form of rapidly increasing protest followed by its quick dispersal. This is known as a punctuated protest.

[2] The collective action problem is outlined in Mancur Olson's "Logic of Collective Action: Public Goods and the Theory of Groups"

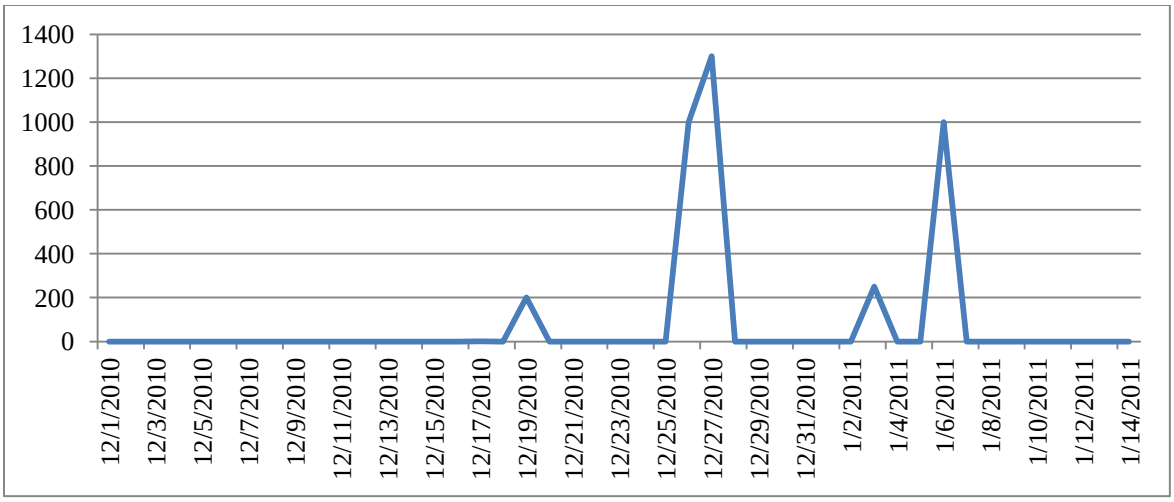


Figure 1: Protesters during the Jasmine Revolution

Figure 1 highlights this phenomenon by graphing the number of protestors during the Tunisian revolution. This figure demonstrates that while the press characterized a general revolt amongst the populace in Tunisia, the form that action took included the emergence of protest, followed by its collapse. The reemergence of protest after police action demonstrates that the underlying grievance of individuals (e.g their relative deprivation) remained unchanged. The introduction of security forces including the use of tear gas broke up the immediate protest, but failed to solve the underlying problem driving the civil unrest. The cycle repeats until the government was toppled in early 2011, satisfying protestor demands and leading to the quelling of protest among the citizenry.

The emergence of individual angst into collective protest against the government stems from a myriad of issues unique in character and weighting to each situation. However, we might find that in general that personal hardship, the level of perceived legitimacy of the government, the actions of other citizens to either protest or not, and the presence of security forces who can maintain the peace or repress citizen action are important.

Significant changes to the initial condition of personal hardship either in its absolute magnitude or to its distribution should have a material effect on the emergence of mass protest, ceteris paribus. Accordingly I explore the proposition that changes to individual condition, on average, in distribution or over time, have an impact on the emergence, size, and magnitude of mass protest. To test this proposition, I utilize a modified form of the Brookings Model to test the effect of these changing conditions.

A New Conceptual Model: Transforming Personal Grievance into Mass Protest

To approach the problem of understanding how a change to individual condition affects the emergence of protest, I utilize a agent based model (ABM) framework derived from the Brookings Institution's "Rebellion" model[3]. ABM simulations attempt to "grow" emergent phenomenon by observing behavior through simple interactions amongst individual agents.

[3] For a detailed examination of this model and its conclusions please see Epstein J., (2002) Modeling Civil Violence: An Agent-Based Computational Approach, Proceedings of the National Academy of Sciences, vol 99, pp 7243-7250.

Utilized by physical and social scientists to understand complex interactions, ABMs provide useful insight into how group behaviors emerge, enabling researchers to understand how simple behavior informs complex system dynamics.

Methodology

I conceptually explore how changes to agent utility, both in magnitude and in its distribution, affect the emergence of civil protest. The models and results presented demonstrate that the economic condition of the individual is a central determinant for the size, frequency, onset, and evolution of civil conflict.

While some results are intuitive (e.g greater hardship associated with greater magnitude protest), others provide fresh insight into the complexities of inequality and economic growth. I expand the Brookings model by changing the distribution used to examine utility, thereby allowing me to change the average level of utility, its variance, and allow for changes over time.

Defining Utility, Protest, Revolt, and Rebellion: How are we Measuring Economic Condition and the Outbreak of Civil Unrest?

The first question we have to address is what we exactly mean by economic condition and civil conflict. This paper puts forth a generic and broad concept of economic condition of the individual. I use both the terms utility and distribution as a way to talk about how individuals are fairing in a society. I define utility to encompass all of the benefit derived by an individual from consuming goods and services that are purchased with their own income or provided by another source (e.g state). In this sense, the measure quantifies all goods and services the individual consumes thereby capturing both individually acquired goods (e.g private income) as well as state provided services and subsidies.

The second term used to describe economic condition of individuals is distribution, specifically distribution of utility. This term is used in two ways. The first is the traditional definition to describe the shape of data relative to its frequency of occurrence (e.g uniform and normal distributions). I also use the word "distribution" when referring to the standard deviation or variance about the mean. Another way to refer to this would be the dispersion about the mean. Formally this is represented by the standard deviation from the mean. Therefore, smaller standard deviations are associated with higher levels of utility equality, and higher standard deviations are associated with greater inequality.

The next set of terms that need a formal treatment in this section are terms that are used frequently but often mean different things to different people: protest, revolt, and rebellion. This paper specifically deals with protest and revolt. I define protest as activity where citizens engage in either violent or nonviolent action against the state. During protest, the state maintains control and has the ability to deploy security forces to disperse protesters. In the model, protest is identified by an eruption of protestors who eventually turn quiet as security forces intervene. This activity is associated with punctuated protests similar to what we saw in Figure 1.

Revolt is a more serious situation where citizens are engaging in violent or nonviolent protest against the state, but where the security forces are *unable* to control and quell citizen action. Unlike protest, which exhibits punctuated citizen activity, revolt generates an equilibrium condition where protesters remain persistent in their voicing of grievance. This distinction allows

us to examine the model results with an eye towards evolutionary change where a stable system can move to protest and finally revolt as the central authority is overwhelmed by citizen action.

Rebellion follows revolt and one where citizens engage in coordinated violence against the state, and where central authority is taking direct military action against rebels. I do not model rebellion in this paper, and while the Brookings Model discusses rebels, it is primarily a model of protest with no citizens being killed (only jailed).

The Brookings Model

The first effort utilizing an ABM framework to study civil violence was put forth by researchers at the Brookings Institution and Santa Fe Institute. They presented two variations of a framework exploring initial conditions of unorganized civil conflict (Epstein, Steinbruner, Parker 2001). The first model analyzes the dynamics of decentralized rebellion against a central government authority. The second model represents the emergence of violence between two ethnic groups. For purposes of discussion in this paper, I focus on the structure of the first model and its corresponding results. I refer to this as the "Brookings" model.

The Brookings Model has two types of actors: citizens and cops. The first type of actor, known as , is representative of an individual in society. The agent is a heterogeneous actor in several aspects including perceived hardship, legitimacy of the central government, individual risk aversion, and finally the knowledge, or vision, of what is happening in the local proximity (Epstein, Steinbruner, Parker 2001).

Hardship (H): This represents the individual citizen's level of perceived hardship. The Brookings Model defines this variable as exogenous taken from a uniform distribution between 0 and 1.

Legitimacy (L): This represents the perceived legitimacy of the central authority. This variable is exogenously provided by the researcher and is constant amongst all agents with a value between 0 and 1.

Grievance (G): This represents one part of the citizen's decision to rebel against a central authority and is a function of both their individual hardship and the perception of the central government's legitimacy. The simple calculation of grievance follows as:

$$G=H(1-L)$$

The authors note that the impetus for the grievance calculation is such that agents with high levels of hardship are less likely to rebel in societies with highly legitimate governments. They cite the example of the London Blitz during World War II as an example where extreme hardship was imposed on the populace, but given their resolve and support of the central government, no civil violence emerged. Likewise, a highly illegitimate government is more likely to see civil disruption in the presence of increasing hardship.

Risk Aversion (R): This represents the citizen's individual risk aversion. This variable is heterogeneous across agents and is taken from a uniform distribution between 0 and 1. This variable does not change during the citizen's lifetime.

Citizen Vision (v): This value represents the number of positions on the lattice that the agent can see that might be occupied by other agents and cops. Since the citizen's vision is limited, information is local to its position.

Estimated Arrest Probability (P): This represents the probability that an agent is arrested. The citizen's calculus for estimating its arrest probability is a function of the local ratio of the number of cops to active agents in their field of vision. The authors note that the logic behind this estimate is such that citizens are less likely to be arrested when more citizens are rebelling, citing that it is less risky to be the 10,001st rebelling citizen versus the first.

$$P = \left(1 - e^{-k\left(\frac{C}{A}\right)}\right)$$

Citizen Net Risk of Arrest (N): This represents the citizen's overall risk of arrest. This incorporates not only the probability of risk but also the consequence of being caught, namely being placed in jail for a period of time.

$$N=RPJ^{\alpha}$$

The citizen's net risk is a function therefore of the citizen's own Risk Aversion (R), estimated arrest probability (P), and finally the jail-term (J).

Citizen Decision Rule (Rule A): Based on the identified citizen characteristics cited above the agents make decisions to rebel when grievance minus their net risk of arrest is greater than some threshold T.

If G-N>T be Active; Otherwise, be Quiet

The second type of actor in the Brookings Model is a cop. Cops represent the security forces of the central government and arrest any active agents. Cops unlike the agents have only a single variable, their vision (v*).

Vision (v*): This is the cop vision, or the number of lattice positions that the cop is able to inspect. It is exogenous across all cops. The cops have one rule:

Cop Rule C: Inspect all sites within v* and arrest a random active citizen.

The authors cite five major findings from their runs of the Brookings Model. The central findings from the model include:

1) Citizens engage in deceptive behavior changing their status based on the presence of cops;
2) Free assembly catalyzes rebellious outbursts, with congregations of citizens to precede a outburst of activity;
3) The model generates periods of punctuated protest where periods of quiet are followed by extreme activity among citizens;
4) The emergent behavior finds that there all exists a distribution of the outburst size and their frequency
5) They find that there is an index for the ripeness of protest serving to identify tension in the system.

Those results are explored in detail in Epstein 2001 and in Epstein, Steinbruner, and Parker 2002, and are not discussed in this paper.

A limitation of the Brookings Model is the inability to change the hardship of citizens in the model. The imposition of a uniform distribution on the hardship variable, effectively fixes the variable at 0.5. The central aim of the Brookings Model was not to represent a detailed exploration of each citizen motivation, more to demonstrate the type of results that are obtained through ABM modeling. This limitation however serves as a motivation for this paper to explore the conceptual insights we can obtain through changes to this measure of agent's economic condition.

Introducing the Revised Brookings Model

The model presented in this paper introduces two changes to the original Brookings model. The first major divergence from the original model changes the distribution of utility (e.g hardship) in the system. In the original model, hardship for each citizen is randomly assigned a value between 0 and 1 from a uniform distribution. This variable is assigned during the setup of the simulation and does not change during the entire run. There are two problems with this approach. First, the original model assumes a mean hardship of 0.5 no matter how many times the model is run. Second, the imposition of the uniform distribution evenly distributes hardship between the lower bound of zero and an upper bound of one. By imposing a consistent mean of 0.5 and a uniform distribution, the original model *can only test one specific case of hardship*. The ability to modify these initial conditions opens up a new avenue of research that sheds light on the relationship between average utility, distribution, and the emergence of protest and generalized revolt.

The second major change to the original Brookings model incorporates the dimension of agent memory. This new dimension to the model allows us to evaluate how changes in the utility, and the variability of that change over all agents, affects the emergence of violence. Each agent therefore does not simply look at their utility level in the present period but weighs it across several periods. To achieve this, the calculation of utility is expanded from the grievance equation above to incorporate a citizen's utility values, weighted, over the current period t and the previous 6 periods. The function is weighted such that nearer term utility are counted more than previous values. The equation represented below calculates its grievance as the product of their perception of the central governments legitimacy and their relative economic condition averaged over the previous six periods. By averaging the economic condition of the citizen we can smooth how a person values their utility level thereby reducing the chance that a single period change in an agent's utility greatly changes the weighted utility level.

$$G_{i,n} = 1 - (\propto U_{i,n} + \beta U_{i,n-1} + \gamma U_{i,n-2} + \delta U_{i,n-3} + \varepsilon U_{i,n-4} + \vartheta U_{i,n-5}) * (1 - L)$$

Where for each ith citizen, and each time period (n) and $\alpha > \beta > \gamma > \delta > \varepsilon > \vartheta$

$$\alpha + \beta + \gamma + \delta + \varepsilon + \vartheta = 1$$

G = Grievance
U = Utility ~N(μ, θ)

L = Legitimacy
$\propto$ = Citizen Utility Weighting in Period n
β = Citizen Utility Weighting in Period n − 1
γ = Citizen Utility Weighting in Period n − 2
δ = Citizen Utility Weighting in Period n − 3
ε = Citizen Utility Weighting in Period n − 4
ϑ = Citizen Utility Weighting in Period n − 5

All model runs utilize the same values to exogenous variables with the exception of measures of utility and utility growth. The number of citizens is set to 762 with 54 cops in the system. The cop's vision is set to 7. The rebellion threshold is set to 0.20, while government legitimacy is set to 0.70. The maximum jail-term is set to 15 turns.

The first set of model runs are designed to test the effect that differences in mean utility and its distribution have on the outbreak of violence. The values for citizen utility are normally distributed about different means and standard deviations. Values for mean utility range between 0.9 and 0.1, while measures of standard deviation that are tested include values of 0.01, 0.05, 0.1, 0.15, and 0.2.

$$U_n \sim N(\mu, \theta)$$

where:
$\mu = 0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.35, 0.3, 0.2, 0.1$

$\theta = 0.01, 0.05, 0.1, 0.15, 0.2$

The second set of model runs are designed to capture the effects of changing utility over time. While the static models explicitly tested the effect of changes to utility mean and distribution on rebellion, dynamic model runs are designed to explore how changes in utility over time affect the frequency and magnitude of rebellion.

$$U_{n,i} = U_{n,i} + V_i$$

Where:
$U_n \sim N(\mu, \theta)$

$V_i \sim N(\tau, \varphi)$

$\mu = 0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.35, 0.3, 0.2, 0.1$

$\theta = 0.01, 0.05, 0.1, 0.15, 0.2$

$\tau = -.0001\ per\ iteration$

$\varphi = 0\ (Assuming\ all\ agents\ suffer\ equally)$

Finding 1: Lower levels of average utility are associated with higher magnitude protests, regardless of utility dispersion about the mean.

Simulations with lower levels of starting utility, holding distribution[4] and utility change over time constant, demonstrated increasing numbers of both peak and average protesters across 50 variants of the model. Tables 1 & 2 provide data on the peak and average numbers of protesters generated in the model variants. Each table illustrates how lowering average utility from 0.9 to 0.1 corresponds with increases in the number of protesters generated in the simulation regardless of the starting variance. For example with a starting mean of 0.9 and a standard deviation of 0.15, we find that peak rebellion increases from 0 active citizens to over 630 as we slide starting utility to 0.1. Likewise, the average level of active citizens in the simulation increase from 0 to 340 as we move from 0.9 to 0.1 mean utility. There appears to be a hard threshold at utility level 0.33 and standard deviation 0 for which the system moves from complete stability (e.g no protesting) to large scale protest. This implies that the population of agents below this threshold directly affects the protest figures and onset.

	Average Number of Protesters						
Mean Utility	**Standard Deviation**						
		0	**0.01**	**0.05**	**0.1**	**0.15**	**0.2**
	0.9	0	0	0	0	0	0
	0.8	0	0	0	0	0	0
	0.7	0	0	0	0	0	0
	0.6	0	0	0	0	0	0
	0.5	0	0	0	0	1	1
	0.4	0	0	2	2	4	14
	0.35	0	1	30	56	51	43
	0.3	375	383	195	115	77	95
	0.2	386	382	382	318	232	169
	0.1	386	382	382	377	340	294

Table 1: Average Number of Protesters

Finding 2: Lower levels of utility are associated with higher frequency of protests, regardless of the dispersion about the mean.

[4] The term distribution is referring specifically to the size of the variance or the standard deviation.

The simulation produces increased levels of protest as the level of average utility declines. As we see in Table 3, regardless of the starting standard deviation, we see increasing frequency of punctuated protest in the model as we move from model variants with high average utility (0.9-0.6) to lower levels (0.3-0.1). As we move closer to the threshold value (T) for protest, greater numbers of citizens begin to protest until the punctuated equilibrium of outbursts devolves into sustained revolt[5]. Similar to the first finding, this result is not entirely surprising given that higher grieved citizens are more likely to be prone to either start or join an ongoing protest thereby increasing the chances of an outburst of activity.

Frequency of Protest							
Mean Utility	**Standard Deviation**						
		0	**0.01**	**0.05**	**0.1**	**0.15**	**0.2**
	0.9	0%	0%	0%	0%	0%	0%
	0.8	0%	0%	0%	0%	0%	0%
	0.7	0%	0%	0%	0%	0%	0%
	0.6	0%	0%	0%	0%	0%	0%
	0.5	0%	0%	0%	0%	6%	11%
	0.4	0%	0%	1%	7%	14%	34%
	0.35	0%	0%	13%	36%	30%	33%
	0.3	100%	100%	99%	57%	65%	64%
	0.2	100%	100%	100%	100%	100%	100%
	0.1	100%	100%	100%	100%	100%	100%

Table 2: Frequency of Protest

Finding 3: Variance of utility is associated with the earlier onset of protest

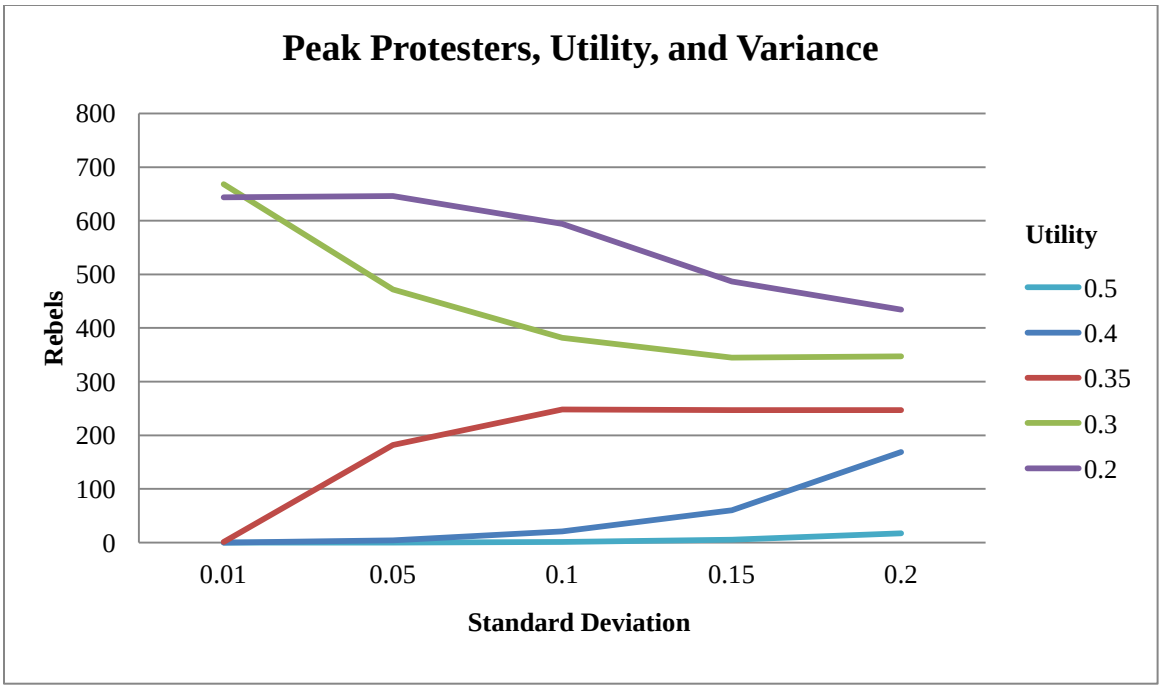
As the utility's dispersion about the mean is increased, the onset of protest occurs at higher levels of average utility. Tables 1& 2 demonstrate this finding. For a mean utility level of 0.5 and standard deviation of .01, there are no active citizens in the model. As we move horizontally across both tables, we note the emergence of active citizens in the model. Increasing the dispersion of utility about the mean appears tied to the emergence of protest at higher levels of utility as compared to cases where the dispersion is narrow. At the most basic level, as the

[5] When the frequency of protest reaches 100%, the central authority is unable to quell citizen outburst thereby reaching the definition of revolt in this paper.

distribution of utility widens, more citizens with lower utility are present in the model. The citizens with lower utility are then prone to protest when either their net risk calculus changes (as security forces move) or other citizens protest within their vision. Moving between extremes, we can see this quite clearly. In a model variant that has an average utility of 0.5 and a standard deviation of zero, we do not record any active citizens over 2000 iterations of the model. If we define low utility citizens as ones with utility levels of 0.25 and below, we would have no low utility citizens in the model, when the standard deviation is zero. As we move from a standard deviation of zero to 0.2 however, the peak protester count moves from 0 to 17. Again, in practical terms this means that although the mean utility for all citizens remains 0.5, some citizens in the model have utility levels well below this value, thereby creating some low utility citizens each that have higher levels of grievance. These more aggrieved citizens are then more sensitive to the spatial interplay between security forces (cops) in their field of vision as well as to the activity of others around them. Finally, if we move to the results of the original Brookings model with a uniform distribution, we see peak number of rebels swell to over 600. The much wider uniform distribution dramatically increases the number of more aggrieved citizens in the lattice, thereby increasing the number of citizens more likely to rebel even as average utility remains high.

Finding 4: In high average utility models, higher variance *increases* magnitude and frequency of protest; a lower utility model with higher variance *lowers* magnitude and frequency of protest.

The relationship between utility variance and its effect on the magnitude and frequency of violence is the most interesting and surprising result of the model. The result from the data imply a bifurcated result. In models that have higher levels of average utility, magnitude and frequency of protest grow as we increase the variance of utility (e.g higher standard deviation about the mean); however, in lower average utility models higher variance is associated with *smaller and less frequent* protest. In other words, as we increase the inequality between agents in better off societies social instability grows. However in societies that are worse off and that are below a threshold for protest, increasing inequality reduces protest in the society. This result is surprising as it implies that increasing utility variance, or inequality of utility between citizens, is not always associated with higher and more frequent levels of protest. If in fact distributional affects of utility are bifurcated, then empirical tests of measures inequality such as a gini coefficient on the outbreak of civil violence are obfuscated. This result demonstrates that other measures of inequality will be better testable variables in empirical testing.



This particular result should be of broad interest to the research community, as inequality measures have not been linked to increase likelihood of civil conflict. This result implies that distributional effects of individual well-being are more complicated than has been discussed in the conflict literature. If in fact a bifurcated relationship exists, then the results of a model that assumes a direct relationship mispecifies the true relationship and could generate results that are insignificant.

The central problem with past approaches in testing for the effect of inequality and conflict revolves around how we think about conditions for individuals. In the simplest terms, proponents of the argument that inequality is a determinant for civil conflict contend that as utility or income become more divergent in a society, the grievance level amongst individuals grows significantly. Conversely, more equal outcomes amongst individuals are less likely to provoke these interpersonal conflicts thereby removing motivation for larger scale violence. It is possible to imagine a situation however, when greater distribution of utility might in fact be more stabilizing? In a extreme case where all individuals have the same utility or income, but that level is below a minimum amount acceptable by the population you are likely to see protests. *All individuals are equally starving*. In this case you would have a perfectly equitable society with a gini coefficient of 0, but still likely to see violence from a desperate starving mob. A greater distribution however, would place some individuals above the minimum level reducing motivation by those individuals to protest. If the distribution were great enough a larger group of elites who have no stake in participating in violent protest would remain as islands of stability. While this result is interesting it does not capture all of the possible dynamics in the society. This model does not allow for citizens to compare their situation with others. There is no representation of horizontal equity which would likely affect the outcome of protest. This finding is specifically aimed at understanding how individual deprivation alone might affect decisions to protest.

The lack of statistical correlation remains a significant barrier in our understanding the relationship between inequality and determinants of civil conflict. The example discussed above illustrates a central problem with using a gini coefficient alone as a measure of inequality in empirical modeling. If in fact a gini coefficient is used, then a specification for higher and lower income countries would need to be added to account for the bifurcated nature of distribution of utility on protest levels. To date this has not been done, with researchers primarily testing for a direct relationship between the gini coefficient and the outbreak of civil conflict. All find that the measure is neither statistically significant nor of a value of any consequence. Sambanis in particular has argued that the problems with model specification and data quality have made the testing of inequality difficult. The no growth model's findings explain why empirical testing of gini coefficients alone might not be the right variable of choice.

Finding 5: Decreasing average utility over time leads to punctuated protest followed by the outbreak of revolt

This finding is similar to the first finding of this chapter, but demonstrates how changes to utility over time can destabilize a system leading stable societies towards growing protest and finally generalized revolt as conditions worsen. The introduction of negative utility growth over time (e.g -.0001 utile per iteration) introduces three phases to our model. The first phase is one with no active citizens observed. The second phase, marked by punctuated protest, emerges with some citizens choosing to protest at greater intensity only to be suppressed by security forces. Finally, punctuated citizen activity gives way to revolt as cops are unable to suppress active citizens in the system. The three phases are not homogenous as we do see differences in magnitude and frequency as distribution changes; however, the transition of the model from one phase to the next remains constant across all simulations.

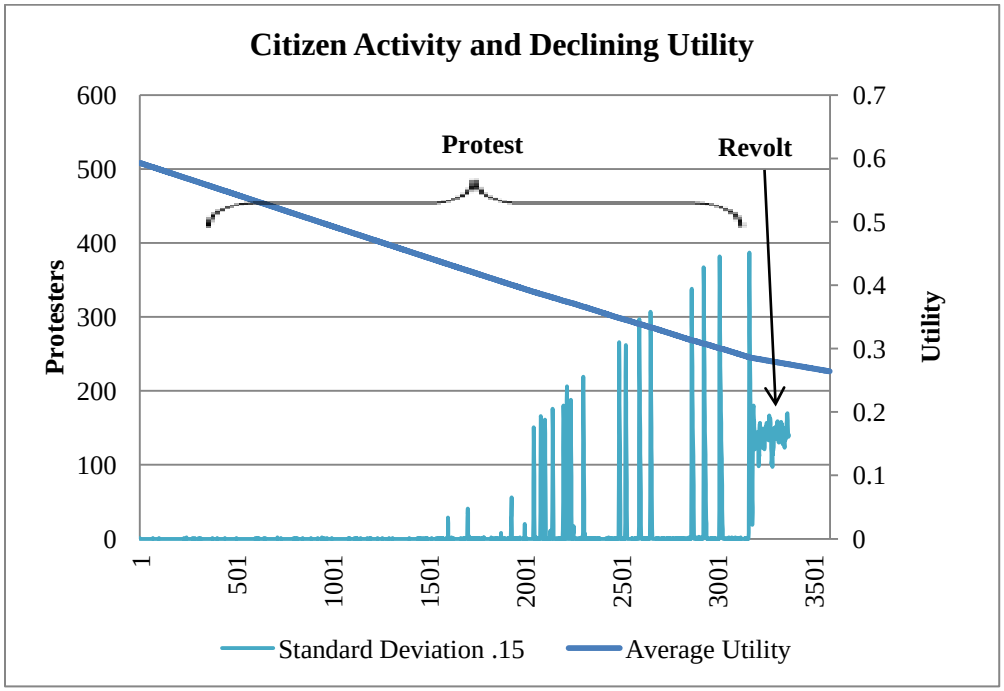


Figure 2: Utility Dispersion and Evolving Social Instability

In figure 3 we see the transition from stability, to punctuated protest, and finally to citizen revolt. The magnitude, frequency and the speed from one phase to the next are correlated with changes to the utility distribution (e.g standard deviation of utility).

Finding 6: Decreasing average utility associated with *higher magnitude* of protest

When we reduce utility across all citizens by 0.0001 utiles per model iteration, average utility is in turn lowered. As we move from higher average utility levels to lower levels of utility, we begin to introduce instability as grievance levels increase among citizens. The increase in grievance introduces both higher magnitudes of violence as well as increasing frequency of initial punctuated citizen activity, followed by revolt. We see this pattern demonstrated in Figure 6, where over time the magnitude and frequency of active citizens increases both in punctuated protest and revolt. More specifically, we see the increasing intensity of protest and revolt in declining utility environments in Table 3.

Events by Utility Levels Averaged across all Distributions					
Events Categorized by Protester Counts	**Utility 0.5**	**Utility 0.4**	**Utility 0.35**	**Utility 0.3**	**Utility 0.2**
1-25	100%	89.8%	65.5%	20.9%	0.4%
26-50	0%	3.9%	4.2%	2.6%	0.0%
51-75	0%	1.9%	4.0%	2.3%	0.0%
76-100	0%	2.1%	4.6%	3.1%	0.0%
101-125	0%	1.1%	4.3%	3.5%	0.0%
126-150	0%	0.8%	4.0%	2.7%	0.9%
151-175	0%	0.5%	3.5%	3.5%	12.7%
176-200	0%	0.0%	3.5%	18.0%	6.3%
201 +	0%	0.0%	6.3%	43.5%	79.7%

Table 3: Magnitude of Protest in Declining Utility Environment

Finding 7: Higher initial utility distribution leads to *earlier* and more frequent punctuated protest

As utility levels are decreased over time, punctuated protest occurs earlier and more frequently with higher distribution levels. In figures 4 & 5, we see that an initially stable system moves to a period of punctuated protest followed by the emergence of citizen revolt.

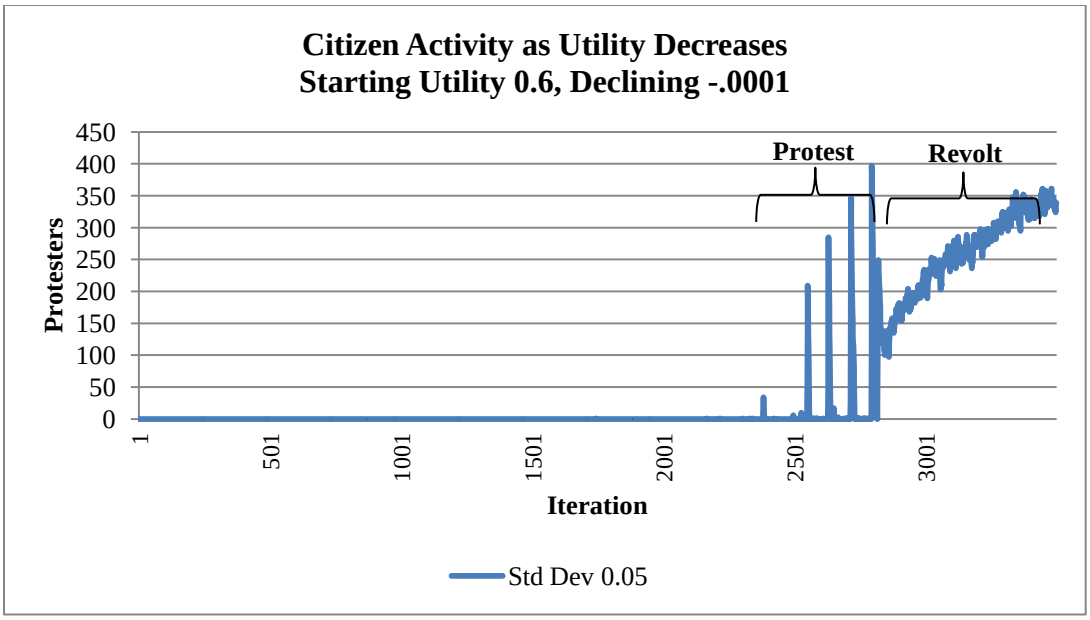


Figure 4: Citizen Activity as Utility with Distribution of 0.05 Declines over Time

The onset of punctuated protest does differ however as we change distribution of utility among citizens. We can visually check this in the two figures. Our simulation with a standard deviation of 0.15 begins seeing punctuated protest around model iteration 1604, while in the smaller distribution of 0.05 we do not see this activity until model iteration 2384.

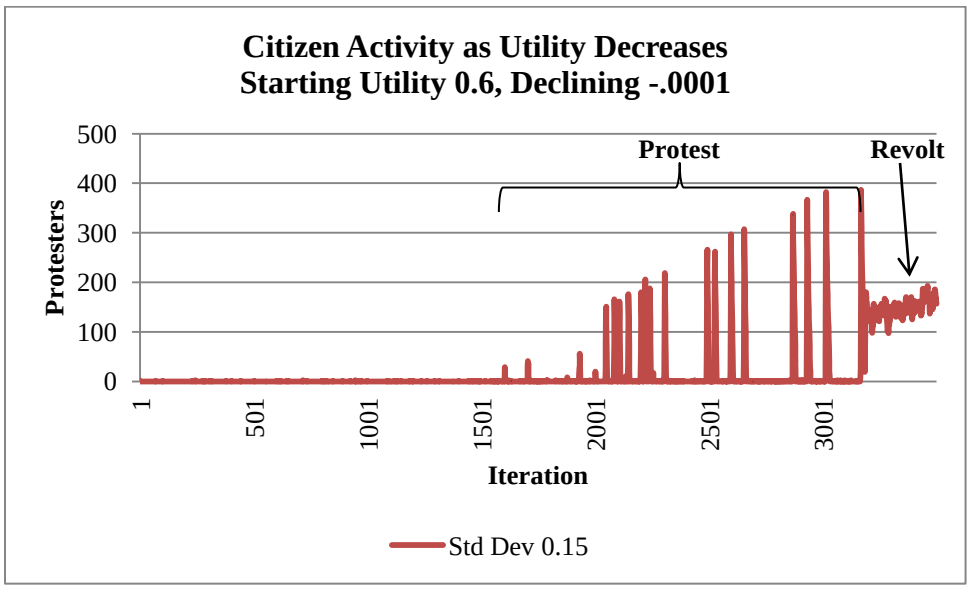


Figure 5: Citizen Activity as Utility with Distribution of 0.15 Declines over Time

. Change to utility, and thereby hardship, both in its level and distribution provided decidedly distinct results from the Brookings model. The magnitude, frequency, and onset of protest and revolt are affected by the distribution of utility amongst citizens within the system. The change to

activity in three phases of citizen behavior, stability, punctuated protest and revolt inform us to how selection and peer effects in the model influence the outbreak and sustainability of revolt.

The model results show how human expression of grievance can evolve from the angst of single individual into a broad movement demanding the removal of a central authority. The manner in which protest stems from the economic condition of the individual and his peers is the focus of the paper. The characteristics of a protest, specifically the onset, magnitude, and frequency of civil unrest is explored by expanding on the Brookings Model. The results of the simulation lay out specific relationships between protest and changes to the average level of utility, its distribution, and rate of change of utility in a system of agents.

This approach is distinctly different from most research in civil conflict as it avoids statistical modeling and instead utilizes an agent based computational approach. This method allows us to develop a coherent theory of how individual motivation transforms into group behavior and allows us to analyze both multi points of equilibrium as well as states of disequilibrium. Our results from this effort provide coherent, consistent, and in some cases surprising conceptual results that expand our understanding of the dynamics of protest. These results suggest that the level and distribution of individual utility play important roles in how mass protest emerges and develops in a system of agents. The importance of citizen's economic well-being therefore becomes an important policy concern as governments and international agencies evaluate the efficacy of reform programs. While economic interests in the long-term are served by substantial subsidy reform or decreases in state supported employment, the short-term consequences to social stability are important factors that should be considered.

Implications for Public Policy

Understanding how protest emerges from individualized grievance and how it progresses to a coherent and large-scale movement in a society remains an important goal for policy makers eager to address issues that help to forestall significant social upheaval. The recent protests, revolts, and rebellions of the Arab Spring serve as an enduring reminder to the speed and magnitude of social unrest in seemingly stable countries. The findings in this study demonstrate that the level of utility, its dispersion, and rate of change can matter substantially. While we have focused on expanding a conceptual model of protest in a system of agents, the findings can provide useful insight into how protest forms, evolves, and expands. Therefore understanding these dynamics is useful to policy makers who are concerned about state stability while in a period of economic transition and reform.

While the speed and severity of Arab Spring protests served to highlight to much of the world the problem of civil conflict, significant research on the subject has been ongoing. The most recent work has explored socio-economic, geographic, and demographic variables deemed to be important determinants of civil conflict. Chief among these findings are that measures of income and economic growth are found to be strong correlates with outbreaks of civil war. Yet while some of these results have been accepted into the orthodoxy of civil conflict research (e.g. measures of income per capita), they tend to interpret the behavior of rebels as a form of rent seeking behavior or as an indicator of central state weakness not as a form of individual grievance as motivator to protest, revolt, and eventually rebellion. While this might be good at explaining quasi criminal conflicts in Sierra Leone or in the drug producing regions of Columbia, they are less successful in explaining the origins and evolution of political protest found in the

Arab Spring, where individual action lead to protest, growing in size and intensity. If individual condition remains an important factor in social stability, leaders in weak states should consider the impact policy changes have on its most vulnerable citizens.

Implications for Subsidy Reform

International organizations and central authorities expend a great deal of effort in understanding the complexities of underperforming economies, developing reasonable action plans, and finally managing the process of economic reform. The objective of both organizations and their government partners is to boost national income. Often part of the strategy is to reform subsidy programs to help foster faster growth leading to increasing incomes for citizens. These reform efforts often call for removal of state support of common household staples such as cooking gas or bread. These reforms reduce government expenditures on price supports, that can then be used in areas that are more productive. In the end, the economy grows as the government allocates resources more efficiently. These efforts are well intentioned and serve to solve the larger structural problems in the economy, but they largely ignore possible short-run social stability concerns. The removal of state subsidies on highly demand inelastic goods such as cooking fuel, reduces household income as individuals are unable to substitute away from these goods. While wealthy or middle class households are unlikely to suffer significantly under this type of reform, low income households might find it more difficult to survive. If stretched enough, an individual or group might see no alternative but to voice their discontent.

Increasing Individual Deprivation: Jordanian Subsidy Reform

On February 4th 2011, an explosion destroyed a pipeline to Israel and Jordan, significantly disrupting fuel supplies to both countries. This was the latest in a series of attacks against pipelines since the Arab Spring uprisings in Egypt forced Hosni Mubarak from power.[6] This attack forced Jordan to import its energy by other means, significantly increasing the cost of energy in the Kingdom. The Jordanian government maintained state subsidies to help insulate the populace from increased prices, but at the cost of increasing central government expenditures on fuel subsides in 2011 and the first half of 2012. Prime Minister Fayez al-Tarawneh estimated that the additional cost to the budget had reached roughly 2.5 billion Jordanian Dinars by mid 2012.[7]

Facing a yawning budget deficit and needing to reduce expenditures, the government announced on September 1st 2012 a modest 10% increase in fuel prices. The following day, Jordanians from Amman to the southern city of Ma'an rallied for the immediate resignation of Prime Minister Fayez al-Tarawneh in the face of increased prices.[8] The protesters were reported to be numbered in the thousands.[9] On September 3rd, the Jordanian King acquiescing to the demonstrators, announced a suspension to increased of fuel prices. While the King's announcement appeared for the moment to mollify the populace, political demonstrations returned on October 5th and reportedly attracted up to 10,000 people calling on the government to take up needed economic

[6] http://www.nytimes.com/2012/02/05/world/middleeast/egyptian-pipeline-supplying-israel-is-attacked.html?ref=sabotage&_r=0
[7] http://jordantimes.com/per-capita-fuel-subsidy-compensation-set-tentatively-at-jd70-a-year-for-limited-income-households
[8] http://en.trend.az/regions/met/arabicr/2060982.html
[9] Ibid

reforms.[10] After the October rally, street demonstrations appeared to ebb with the government raising the prospects of new elections to meet many of the protesters demands.

On November 13th , 2012 the cabinet announced that subsidy reforms would be carried out resulting in a increase in gasoline, cooking and heating gas. The Jordanian government indicated that without support payments from foreign partners, specifically Saudi Arabia, they were unable to keep the supports in place[11]. The reform was reintroduced as the budget deficit from increased fuel payments swelled above 3 billion dinar. Gasoline prices for 90 Octane increased from JD 0.70 per liter to JD 0.80. Diesel fuel increased from JD 0.515 to JD 0.685 per liter, a 33% increase. Gas for cooking increased the most rising from JD 6.50 to JD 10.00, a 54% in the price for a single gas cylinder.[12]

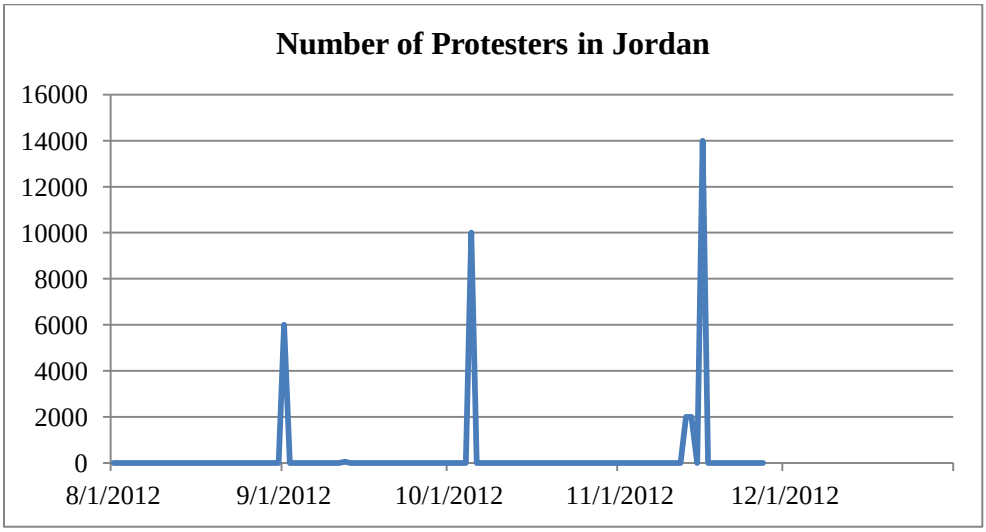


Figure 6: Protest Numbers in Jordan 2012

Once again, violent protests erupted from November 13th through the 15th with thousands taking to the streets in over 100 different demonstrations demanding the cessation of the subsidy reform program.[13] The government, previously willing to suspend the subsidy reform program, found itself unable to, primarily because of the increasing deficit being driven by the higher fuel costs. In a bid to soften the impact to poor households, the government introduced proposals to provide direct cash payments of up to JD 420 per year for families whose income did not surpass JD 10,000.[14] At the time of the writing , it is not clear if the protests centered around energy subsidy reform in Jordan will continue. However, what this particular example demonstrates is the sensitivity of subsidy reform on households and the possible protest it can trigger. Although this

[10] http://www.nytimes.com/2012/11/14/world/middleeast/jordan-faces-protests-after-gas-price-proposal.html?pagewanted=all
[11] http://jordantimes.com/jordan-reaches-out-to-wealthy-arab-states--for-urgent-financial-aid
[12] http://www.albawaba.com/business/jordan-fuel-451968
[13] http://www.nytimes.com/2012/11/14/world/middleeast/jordan-faces-protests-after-gas-price-proposal.html?pagewanted=all
[14] http://jordantimes.com/per-capita-fuel-subsidy-compensation-set-tentatively-at-jd70-a-year-for-limited-income-households

is a single case example, it nicely frames a core concept of this paper, the economic conditions of the individual help to drive the emergence of protest, its magnitude, and frequency. While each example of political protest, revolt, or rebellion is multi faceted the role of grievance stemming from individual deprivation should be considered as a significant determinant of political protest.

Tying Subsidy Reform to the Growth Model

The story of Jordanian subsidy is an interesting case study, but can it be tied to the model presented in this paper to help us understand how emergent protest forms? The model presented in this paper while purely conceptual does provide us a framework to understand how changes to subsidy programs in Jordan can influence social stability. This extension simply allows for differing growth to utility among citizens in our model. To achieve variable growth, I simply allow the amount of utility added to citizens to vary by a standard deviation greater than zero. This allows us to examine average growth to citizens in the model, but varies the amount of growth each individual citizen experiences. Therefore, if the *average* growth of utility is .001 utiles per iteration of the model, but varies with a standard deviation of 0.005 we find that some citizens will add utility at a level greater than .001, while others experience negative utility growth. This action simulates inequality of growth in the model and is an important extension as we discuss how subsidy reform affects economic growth and social stability.

In Figure 6 we show the reported protests in Jordan before and after the announcement of fuel subsidy reform. Prior to the announcement on September 1st 2012, there were no protests reported as noted by no spikes in the graph prior to that date[15]. We can compare that initial condition with our model output represented in Figure 7. We have a initial system that has a level of utility of 0.5 (blue line) that remains constant through the first 500 iterations of the model. Beginning with iteration 501 we reduce the level of utility for all citizens by .01 for 10 periods.

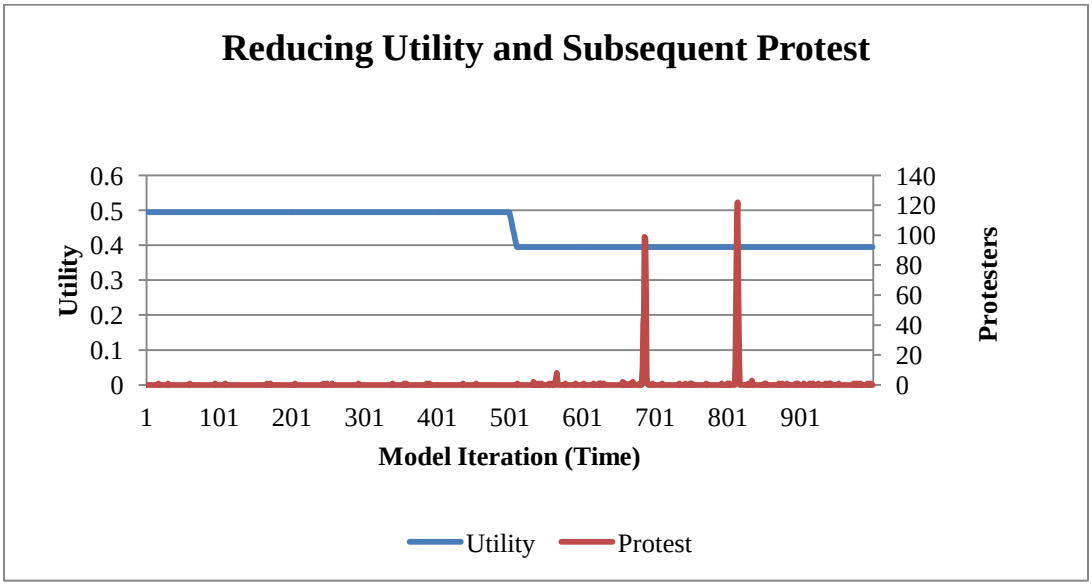


Figure 7: Reducing Utility and Subsequent Protest

[15] Earlier protests in 2011 were tied to general economic problems such as unemployment, but as this specific example is tied to subsidy reform I do not discuss them.

This serves to reduce utility by 0.1 to a new level 0.4. This is meant to simulate the reduction in citizen well-being stemming from the removal of subsides. In our Jordanian example, this would represent either the initial subsidy reform announcement on September 1st 2012, or the second announcement on November 13th 2012. We can see in Figure 7 that once we reduce utility punctuated protest forms around the 560th, 700th , and 800th iteration with the largest protest reaching around 120 active citizens. Do we see the same phenomenon in our real world example? If we again look at Figure 6, we see after the announcement on September 1st and again on November 13th large protests erupting in Jordan. While not an exhaustive analysis on the efficacy of the model, this simple example allows us to draw a linkage between real world events and our model presented in this paper.

The subsidy reform effort in Jordan was primarily aimed at reducing financial support to better off households who were receiving benefits at the expense of the central government.[16] By reducing inefficient subsidy support, along with other reform measures the International Monetary Fund seeks increase economic growth in the country and to improve its overall fiscal position.[17] However, if subsidy support is removed for all households in an attempt to generate long-term economic gains is there a risk for both short-term social instability even as the country is growing?

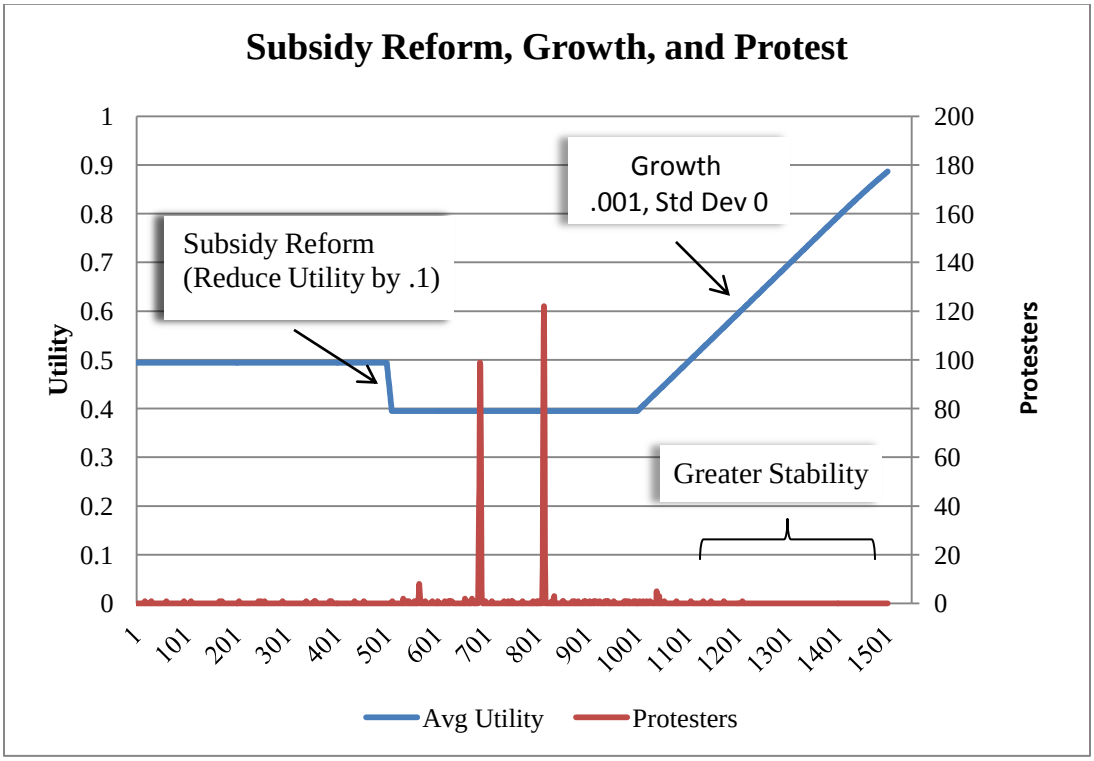


Figure 8: Subsidy Reform, Growth, and Protest

In Figure 8, we again revisit a model that shows a system that has a starting utility of 0.5, but introduces subsidy reform at iteration 500. The subsidy reform reduces average utility to 0.4 generating punctuated protest, something we predict from our discussion thus far. At iteration

[16] https://www.imf.org/external/pubs/ft/survey/so/2012/int080312a.htm
[17] Ibid

1000 we introduce economic growth by adding the same utility increment to *every* citizen (e.g .001 utiles per iteration). Protest evaporates from the system leading us to conclude that although short-term instability is a real problem with subsidy reform, in the long-run stability returns with all agents becoming better off. Does this proposition hold when growth is uneven?

In the discussion above, we stepped through how the model can help us understand protest dynamics associated with subsidy reform, however our analysis was limited to equal growth shared by all citizens. If we allow growth among citizens to vary do we get the same result?

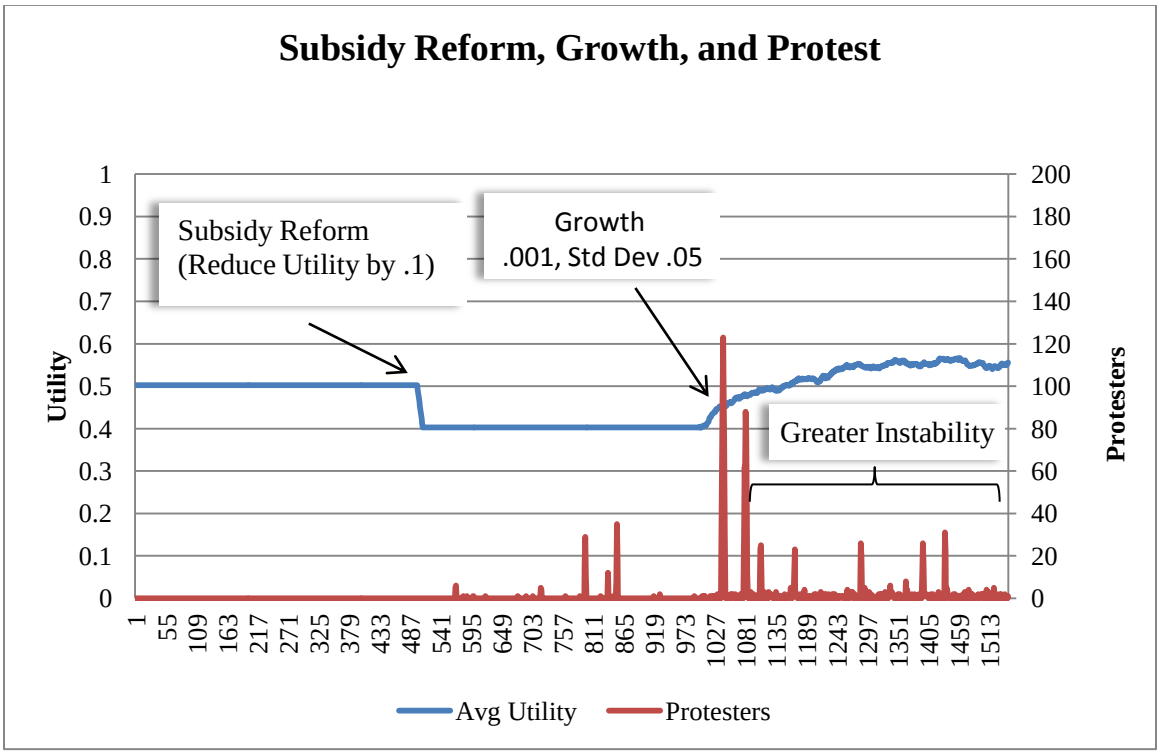


Figure 9: Subsidy Reform, Growth, and Protest

Figure 9 is similar to Figure 8 in that the system begins with the same initial utility and is subject to subsidy reform at iteration 500, lowering average utility in the system by 0.1. However, while Figure 9 introduced economic growth for all citizens at iteration 1000, Figure 10 allows growth to vary among citizens. By introducing variable growth we see a different result. Even through average utility increases overall for the system social stability erodes as some agents capture more of the benefits of economic growth. If this model is to be believed, then while reform efforts might be successful in increasing overall growth in a country, an unintended consequence might by increased social instability for a longer period. This is an important issue for policy makers and researchers as it highlights a deeper and more complex set of interactions among citizens and the state.

Conclusions

Through the course of this paper, we have explored a conceptual approach to understanding the emergence and evolution of political protest. By using an agent based model approach and

extending earlier work we find that the level, distribution, and rate of change of utility affects the onset, frequency, and magnitude of political protest in a system of agents. Specifically we find:

- Lower levels of average utility are correlated with higher magnitude protests, regardless of utility dispersion about the mean.
- Lower levels of utility are associated with higher frequency of protests, regardless of the dispersion about the mean.
- Variance of utility is associated with the earlier onset of protest.
- In high average utility models, higher variance ***increases*** magnitude and frequency of protest; a lower utility model with higher variance ***lowers*** magnitude and frequency of protest.
- Decreasing average utility over time leads to punctuated protest followed by the outbreak of revolt.
- Decreasing average utility associated with *higher magnitude* of protest.
- Higher initial utility distribution leads to *earlier* and more frequent punctuated protest.

This approach is markedly different from analysis that has utilized case study or statistical models to draw correlations between variables and the onset of civil war. While these studies have been useful for identifying some determinants of increased probability of civil violence, they are limited in their function. Our agent based modeling approach allows us to explore multiple iterations providing a conceptual framework that yields consistent and coherent results that should and could become the starting point for additional empirical analysis.

The protests, revolts, and revolutions of the Arab spring serve as a reminder of the importance of understanding the underlying causes of social instability. Seemingly isolated acts of desperation can have profound geo-political consequences. With the speed and breadth of modern telecommunications ideas and social upheaval can move faster and further than ever before. This requires a deep understanding of the determinants and evolution of conflict so that reasonable policies can be put in place to address grievance before social instability manifests itself and moves beyond our control. By addressing the underlying concerns of people yearning for a better life, we help maintain our own.

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