Modeling Insurgencies and Counterinsurgencies

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Abstract: A system dynamics model of insurgencies is built using the US. Army and Marine Counterinsurgency Manual (FM 3-24) as a basis. It must, however, be supplemented by additional theory from outside sources to enable calibration to a historical data set. Parameter and policy analyses are conducted. These highlight the criticality of some features of insurgencies described by FM 3-24 such as the importance of obtaining and maintaining popular support and employing sufficient counterinsurgency forces to gather intelligence. Other features, not highlighted by FM 3-24, also are shown to be important such as how quickly does violence escalate during the insurgency and how easily can detained/eliminated insurgents be replaced. Finally, contraindicating the expectations of FM 3-24 and other conventional wisdom, results from optimization simulations suggest that the level of force used in a counterinsurgency should increase only once a preparatory period of intelligence gathering by those same forces has been completed.

Keywords: System Dynamics; Military; Insurgencies; Terrorism; Escalation; Intelligence

1 Introduction

Over the past half-century, insurgencies have become arguably the preeminent mode of warfare worldwide in terms of geo-political importance (O'Neil, 1990). Almost fifty insurgencies currently are raging worldwide (U.S. Marine Corp's Small Wars Database, 2008). Each of these insurgencies is a source of endless costs in death, displacement, and economic retardation. U.S. armed forces are enmeshed in a number of insurgencies, most prominently in Iraq and Afghanistan and are likely to be involved in many more in the future (Kaplan, 2005). Unfortunately, empirical evidence from past conflicts suggests that large-scale foreign intervention in most insurgencies fails more often than not (Gompert and Gordon, 2008).

Recognizing this, the U.S. Army and U.S. Marine Corps issued a new, joint field manual entitled *Counterinsurgency* (U.S. Army Field Manual 3-24, better known as FM 3-24) in December 2006. FM 3-24 contains a descriptive, dynamic theory upon which it bases its policy recommendations. Yet, as is well known, dynamic conclusions drawn by the examination of many descriptive theories is often incomplete without the insights from quantitative simulation of those theories (Sastry, 1997). Accordingly, we build a formal, quantitative model of insurgencies based upon FM 3-24 and supplement it, when necessary, with theory drawn from other sources. We then test the model to determine (1) whether the theory is sufficient to explain the dynamics often observed in real-world insurgencies, (2) what are the most and least sensitive points of an insurgency from both a parameter and policy perspective, (3) what policy guidelines can be gleaned from this dynamic model, and (4) where these guidelines match and differ from the "conventional wisdom" regarding insurgency suppression, such as that embodied in FM 3-24.

The contributions of this paper include, but are not limited to, the following.

1. Finding support for portions of FM 3-24's descriptive model, by establishing the centrality of (1) employing counterinsurgency in gathering intelligence as well as

directly combating insurgents, (2) the "blowback loop" of counterinsurgency violence leading to reduced popular support for the government, thus increasing "recruiting" by the insurgency, and (3) insurgent intimidation of the populace to disrupt the gathering of intelligence.

2. Demonstrating that the structures from FM 3-24's descriptive theory must be supplemented by additional structures drawn from other sources in order to plausibly explain real-world data drawn from a historical insurgency. These structures include (1) the mutual escalation of insurgent and counterinsurgent violence and (2) the non-replacement of detained insurgents, making the replacement of losses a real burden for the insurgency. Many extant models instead assume that replacement of lost insurgents is relatively easy, even absent any change in popular support for the government.

3. Establishing that gaining popular support for the government through measures to meet popular grievances and appropriately setting the ratio of counterinsurgent troops dedicated to combat vs. intelligence patrols prove to be key policies in successfully suppressing an insurgency. Further, these policies work best in combination with each other and with other policies such as economic stimuli to reduce unemployment among young males and the effective use of propaganda.

4. Suggesting that counterinsurgency troops should initially engage in a period of intensive intelligence gathering prior to ramping up to large scale combat with insurgents. This is in contrast to FM 3-24, which expects that the fraction of troops committed to combat will steadily decline as the counterinsurgency effort progresses.

A brief description of the remainder of the paper follows. Section 2 describes the background in which counterinsurgency theory has developed as well as the extant literature. Section 3 describes the model. Section 4 tests the model against historical data and describes the results of numerous simulation runs to determine parameter and policy sensitivities for the model. Finally, Section 5 concludes with a short discussion of the results and suggestions for future research.

2 Background and Literature Review

Insurgencies are defined (following O'Neill, 1990) as guerilla wars (a.k.a. asymmetric wars), which are characterized by irregular forces relying on non-conventional military tactics, such as raids, ambushes, bombings, etc., that are joined to some revolutionary purpose, most generally a desire to change a regime, governmental structure, or social structure. The use of terror is typically, though not always, a component of insurgencies, particularly intimidation of the citizenry to prevent intelligence gathering as seen in the Vietnam conflict (Beckett, 2001). However, terrorism in the sense of relying solely on asymmetric attacks outside a disputed area (in the nature of the 2001 World Trade Center Bombings) will not in and of itself constitute an insurgency for the purposes of this paper.

Manuals on counterinsurgency, the discipline of how to suppress an insurgency, followed in the wake of studies of the first major successful modern insurgencies, the Arab Revolt (1916-1918) and the Anglo-Irish War (1919-21) (Beckett, 2001). The most notable counterinsurgency work for many years was the *U.S. Marine Corps Small Wars Manual* (1940), based on the United States' numerous interventions in insurgencies up through the Second World War. (Note that counterinsurgency and counterinsurgent are often referred to in their abbreviated form, "COIN," a practice that we will often follow throughout this paper.) Amazingly, this manual was somehow essentially forgotten for many years following the Second World War, which explains much of U.S. unpreparedness during later COIN interventions (Kaplan, 2005). Later Taber's *War of the Flea* (1965), which studied Cuba's and other developing-world nations' insurgencies during the collapse of imperialism, became quite influential. So too did Galula's *Counterinsurgency Warfare: Theory and Practice* (1964), which detailed counterinsurgency lessons from the French perspective, informed as it was by Algeria and Vietnam. After the end of the cold war, many new studies emerged, probably the most influential being O'Neill (1990), Beckett (2001), Kaplan (2000, 2005), and Nagl (2002). Nagl went on to be one of the major authors behind FM 3-24.

Several works of system dynamics have treated insurgencies. Coyle (1985) proposed a qualitative system dynamics treatment of rural insurgencies. Anderson (2007a) presented a simple quantitative model of urban insurgencies. Wils et al. (1998), Pavlov et al. (2005), and

Choucri et al. (2007) published broader works encompassing insurgencies within the framework of a state's capability to sustain itself from a political, military, and economic perspective. Richmond's model (presented in Peterson, 2004) of terrorism, while focusing on the recruitment of terrorists, has structures that bear directly upon insurgent recruiting. Finally, Grynkewich and Reifel (2006) and Anderson (2007b) modeled the impact of finance upon the evolution of insurgencies. None of these works examined the effect of military intelligence, so central to FM 3-24 and many other authors' recipes for successful counterinsurgencies. Nor do any focus, with the exception of Coyle's (1985) model, on the protection of the population from intimidation, another central tenet of counterinsurgency theory. Recently, Kress and Szechtman (2008) proposed a control-theoretic model focusing on intelligence. In contrast to the SD models, however, their model contains no explicit representation of popular support for the government. Support instead is captured implicitly by making the rate of insurgent recruitment a non-delayed, increasing function of counterinsurgent troop strength, i.e.

$$\frac{dI(t)}{dt} = \text{detention/capture rate} + \gamma G(t)\left\{1 - m\left[G(t)\right]\left[1 - \frac{I(t)}{P}\right]\right\} \tag{1}$$

where *I(t)* is the number of insurgents at time *t*, *G(t)* is the number of counterinsurgency troops, γ is a constant, *m[G(t)]* is the level of intelligence (which increases with the number of COIN troops), and *P* is the population (a constant). Implicitly representing popular support in terms of insurgent numbers has several implications as detailed in Section 3. Additionally, this model's detention/capture formulation accounts for intelligence gathering, but not insurgent intimidation.

3 The Model

3.1 Overview and Boundaries

The purpose of this model is to examine how an insurgency and its relationship to the population it claims to represent dynamically evolve in response to counterinsurgency interventions. The primary policy levers open to the government in this model are (1) what types of missions (i.e. directly combating the insurgents vs. gathering intelligence on the insurgency) COIN forces undertake, (2) how many counterinsurgency troops are employed, and (3) increasing popular support for the government by redressing grievances espoused by the insurgents. The government's military commanders are assumed to control the first lever. The government's political officials (and any outside intervening power such as the United States) control the second and third levers. Hence, the variables representing these policies are exogenous to the model. The results of these policies—including the evolution of the number of insurgents and their activity, other dynamic factors that influence popular support, and the effectiveness of COIN troops in gathering intelligence and eliminating insurgents—are modeled endogenously.

The full listing of the equations of the model is too long for the space constraints of this paper. However, they have been made available to the reviewers and are available upon request from the authors. The model's major dynamic structures are summarized below. Insurgent Recruiting Stock and Flow Structure

Figure 1 presents the basic stock and flow structure that determines the number of insurgents. The number of *potential insurgents* is a pool of people who might become insurgents if the conditions are right. This number is determined by the population as modified by the *fraction potentially sympathetic to the insurgency*, the *joining age in years* of the typical insurgent, and the *average insurgent career in months*. The fraction of the population potentially sympathetic to the insurgency may be much less than 100%, e.g. an insurgency representing Arab Sunnis in Iraq, who comprise only 10% of the population. Moreover, insurgents will overwhelmingly be young males of a certain age, typically between the late teens and late twenties (Hart, chap. 5). We model this by assuming that insurgents join the insurgency at the age of 18 and drop out of the insurgency after 10 years (Hart, 2003, chap. 5).

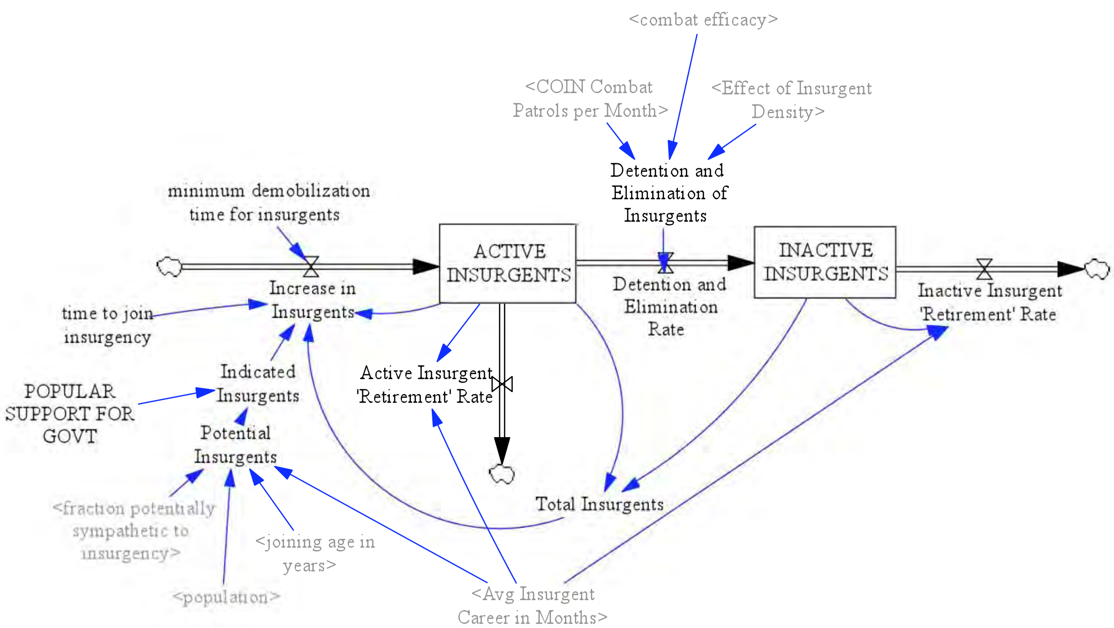

Figure 1: The Insurgent Recruiting Stock and Flow Structure

Only a small fraction of potential insurgents ever actually pick up arms and fight (FM 3-24, 1-108). This fraction is modeled by a decreasing function of the *popular support for the government.* The product of these two factors and the *potential insurgents* determine the *indicated insurgents*. Indicated insurgents over time join the insurgency and become *active insurgents.* If popular support for the government decreases, note that the *increase in insurgents* can actually be negative as active insurgents drop their arms and go back to civilian life. Otherwise, insurgents eventually become too old and drop out of the insurgency, which is represented by the *active insurgent 'retirement' rate.* Or they can be detained or killed by counterinsurgency forces and become *inactive insurgents*. This outflow is determined by the number of *COIN combat patrols per month* as modified by the *combat efficacy* of the COIN troops and the *effect of insurgent density*. The *combat efficacy* of COIN troops is primarily a function of intelligence collection and dissemination. Following Kress and Szechtman (2008) and Anderson (2007a), a low *insurgent density* makes it more difficult to find insurgents *ceteris paribus*.

There is a balancing loop between the indicated number of insurgents and total insurgents, both active and inactive, because once a potential insurgent decides whether or not to pick up arms and join (or not join) the insurgency, that decision is not going to change *ceteris paribus*. Hence, absent any change in public support for the government, those potential insurgents that are motivated to pick up arms when the insurgency starts will remain insurgents until they "retire" or the conflict ends, and those that decide not to pick up arms will remain out of combat. This is a slight simplification of reality, but it reflects the fact that insurgent losses cannot easily be made up without a change in public support for the insurgency. Coercion has been attempted by various insurgencies to replace losses but has generally proven unsuccessful (O'Neil, 1990, chapter 5). The one exception to this modeling structure is that over time young boys will mature and eventually become part of the pool of *potential insurgents*. Some fraction of these new potential insurgents will become *active insurgents* thus providing replacements for those insurgents who "retire" from "old age."

3.2 Suppression Loop

The remainder of the model will be presented in causal loop form. The insurgent recruiting structure described in the previous section is represented in Figure 2 as the *recruiting loop.* If the recruiting loop were left to itself, the insurgency would persist indefinitely. What reduces the number of insurgents begins with the *suppression loop.* As the number of insurgents increases, so to will the number of *insurgent incidents*, such as raids, sniper attacks, and bombings. That increases the *pressure to reduce incidents*, which in turn results in an increased number of patrols against the insurgents. Depending on the *fraction combat vs. intelligence patrols* decision variable, a fraction of these increased patrols will be sent to combat the insurgents. These increasing *COIN combat patrols* over time reduce the number of insurgents through either detention or elimination, resulting in a balancing loop.

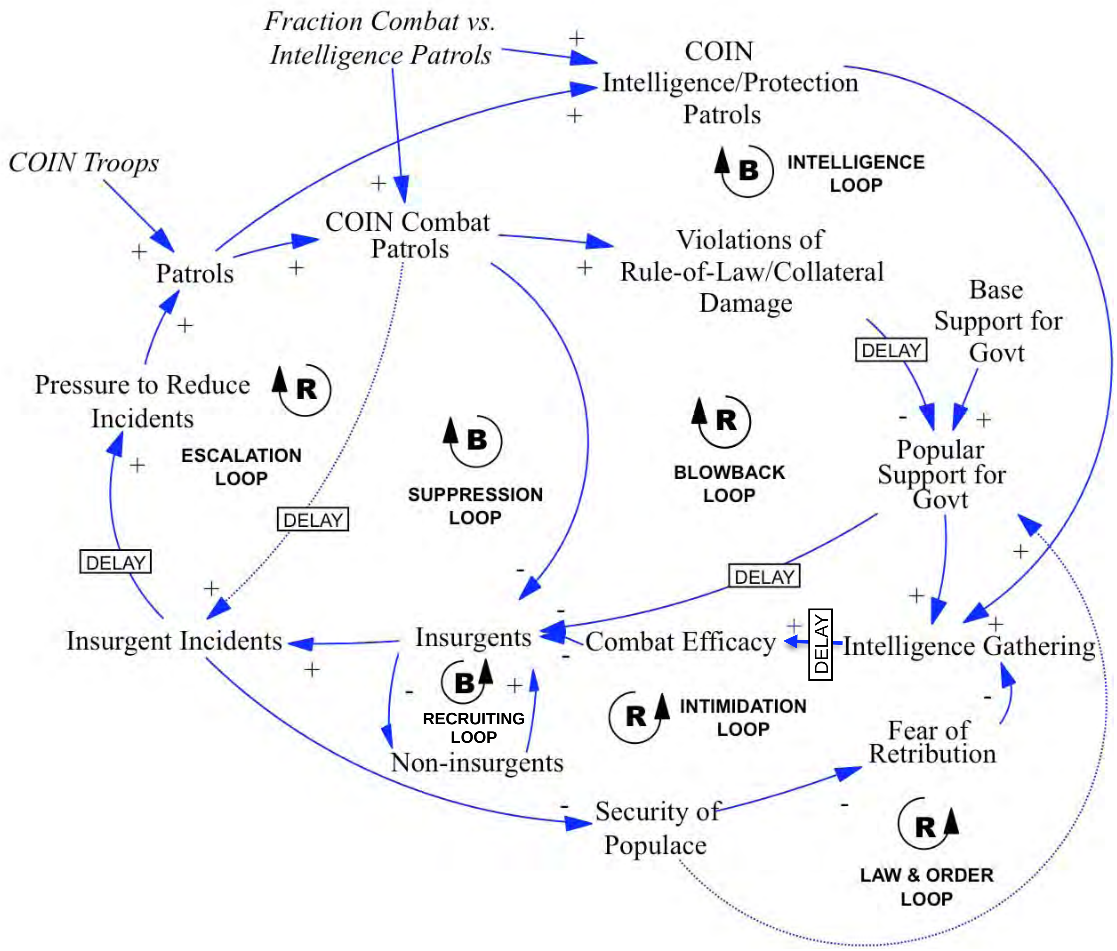

Figure 2: Causal Loop Diagram of Full Insurgency Model
(Note that variables in *italics* are exogenous to the model)

3.3 Escalation Loop

In Figure 2, as COIN combat patrols increase, the insurgents begin to retaliate by committing more incidents per insurgent. This increases the *pressure to reduce incidents* and ultimately the number of combat patrols per COIN troop, creating a reinforcing loop of escalation in violence. This loop is not directly referred to in FM 3-24. However, adding this element to the model is necessary to explain the following trend observed in violence data from the Anglo-Irish War of 1919-1921.

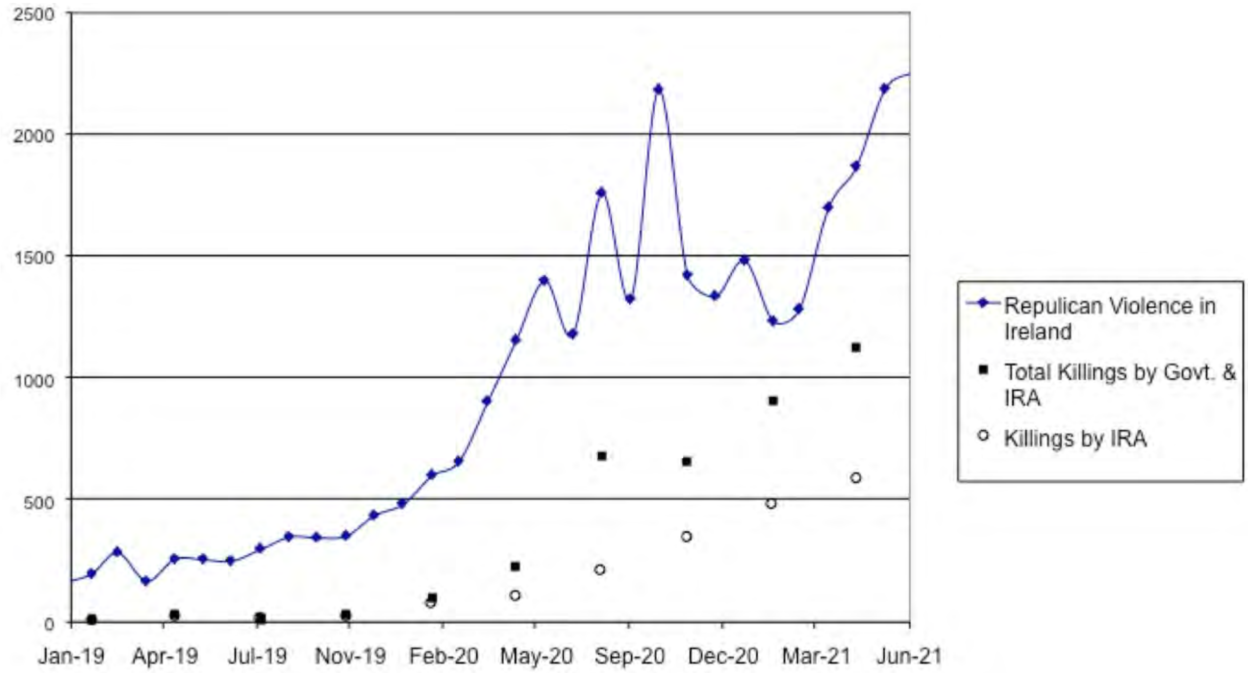

Figure 3: Violence during the Anglo-Irish War from 1919 to 1921

Sources: Republican Violence in Ireland is the official British government tabulation of Irish Office Statistics of Outrages (Kautt, 1999, p. 81). The killings series are provided by Hart (2003, pp. 66-67) and are enumerated by quarter.

During the latter stages of that war, the number of IRA incidents resulting in violence continued to increase (Figure 3) even while *the number of active insurgents was actually declining* (Hopkinson, 2002). The only explanation for these conflicting trends is that the number of incidents increased per active insurgent throughout the duration of the insurgency, creating a reinforcing loop of violence escalation.

While there are no published quantitative system dynamics models containing explicit loops of the escalation of organized violence in insurgencies, qualitative models of this phenomenon are widespread in related contexts such as arms races (Senge, 1990) and the Palestinian-Israeli conflict (Stroh, 2002). Additionally, quantitative models of the phenomenon have been proposed in a non-SD context by authors such as Coleman et al. (2008). To capture this escalation effect, we use a first-order exponential smooth of recent COIN combat patrol activity to simulate insurgent exposure to combat and then use this value to increase the number of incidents committed by each insurgent per month (Figure 4). To incorporate the hysteresis, i.e. violence tends to escalate faster than it de-escalates, suggested by Coleman et al. (2008), the model assumes that the *escalation time* is greater than the *de-escalation time*.

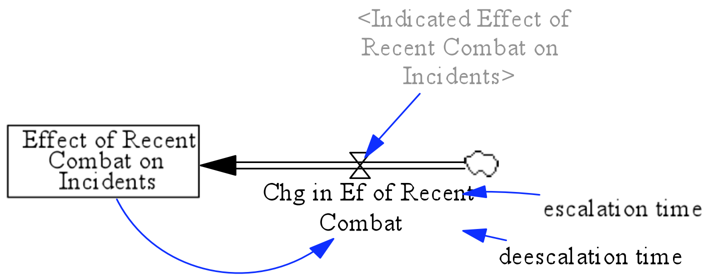

Figure 4: Escalation Structure

Testing of this loop later in the paper reveals that it not only is necessary to explain the historical data in Section 4.2; it also has serious sensitivity and policy implications as shown in Section 4.3. Moreover, it probably does help explain why governments are so often "behind the curve" in initiating their counterinsurgency efforts (O'Neill, p. 127) because the number of insurgent incidents early in an insurgency does not accurately reflect the size of the insurgency in number of insurgents.

3.4 Blowback Loop

Of critical importance is that COIN combat patrols have a negative effect on *popular support for the government* because of their associated violations of the rule-of-law and collateral damage. Because more of the populace is dissatisfied with the government, more potential insurgents decide to pick up arms and become active insurgents. Reduced popular support for the government also creates the secondary effect of hampering *intelligence gathering* and in turn the *combat efficacy* of COIN combat patrols, which reduces the number of insurgents captured or killed per combat patrol and again increases the number of insurgents. This "blowback" loop is arguably the prime growth engine for insurgencies (FM 3-24, 1-152) and creates a tremendous paradox, because the very act of detaining and eliminating insurgents creates yet more insurgents. This hampers all counterinsurgency efforts (English, 2003; FM 3-24, 2006, 1-150; Long, 2006).

The importance of this loop is underscored by FM 3-24, which states that "Legitimacy is the main objective" of COIN operations (FM 3-24, 1-113). Legitimacy in FM 3-24's context is essentially the extent to which the government can rule with the consent of the populace rather than through coercion. Because of the debate upon the nature of legitimacy, we shall refer to this construct instead as *popular support for the government* for the sake of clarity. The list of factors creating legitimacy in FM 3-24 (which are similar to some other sources in the literature, see e.g. Alagappa, 1995) include:

1. Protection of the populace from external and internal threats
2. Government leaders are selected in a manner considered just by the populace
3. High level of participation or support for government processes
4. Culturally acceptable level of corruption
5. Culturally acceptable level of development
6. Acceptance of the regime by major social institutions

The blowback loop strikes directly at popular support through the first and third of these factors. However, there are potentially two mitigating factors. One is that popular support, like all other popular opinions, takes time to accumulate and to lose (Sterman, 2000). Another is that the blowback loop might be mitigated by other factors in the list, which we capture in the variable *base support for the government.* A government with high *base support* can afford to engage in a greater number of combat patrols without igniting the blowback loop.

3.5 Intelligence Loop

To combat insurgents effectively, COIN forces must gather intelligence on the enemy, chiefly by means of active patrols among the civilian populace so as to get to know them, their environment, and pick up information (FM 3-24, 1-125, 1-149, 1-151). This enables combat patrols to be more effective in targeting and eliminating a greater number of insurgents per patrol (or alternately, this could equally well be interpreted as reducing the collateral damage per insurgent detained or eliminated, FM 3-24, 3-128; Cavoli, 2006). In short, better intelligence enables "surgical" strikes that obviate the worst aspects of the blowback loop.

While FM 3-24 establishes that combat and intelligence gathering are to some extent separate activities (FM 3-24, 1-149, 1-153), how to model this explicitly is not immediately obvious from the text. We borrow a structure from Coyle (1985), which separated patrols into combat patrols, which destroyed insurgents, and protection patrols, which protected village leaders. We modify this structure slightly so that there are *combat patrols*, which detain or destroy insurgents, and *intelligence patrols*, which gather intelligence by "walking the beat" much like police, doing military operations other than warfare (sometimes referred to by its acronym, MOOTW), such as holding dental clinics and helping construction efforts. All these activities provide a great deal of military intelligence (Kaplan, 2005), as most recently seen in Afghanistan (Cavoli, 2006; Phillips, 2007).

To complete tracing the intelligence loop, note that increased *intelligence gathering* results over time in increased *combat efficacy*, which ultimately results in fewer *insurgents*. Reducing the number of insurgents in turn reduces the number of *insurgent incidents* and hence the need for further *intelligence patrols*, which completes the balancing loop.

3.6 Intimidation Loop and Law & Order Loop

For patrols to gather intelligence effectively, the populace must be willing to talk to them or at least talk to each other in the patrols' vicinity. However, this will not occur if individual citizens are concerned with retribution from the insurgents. Hence, "the cornerstone of any COIN effort is establishing security for the civilian populace" (FM 3-24, 1-131). In the model, this is reflected by the fact that as the number of *insurgent incidents* increases, efforts at intimidation are more credible, leading to a reduction in the *security of the populace*. This in turn results in an increased *fear of retribution* and, *ceteris paribus*, reduced *intelligence gathering*. Over time, this reduces the *combat efficacy* of COIN combat patrols, resulting eventually in even more *insurgents* and *insurgent incidents*, thus completing the reinforcing loop.

A parallel effect arises from the *Law & Order Loop*. To the extent that the insurgents can disrupt public law and order through *insurgent incidents, popular support for the government* will decline, resulting in less effective *intelligence gathering* and ultimately another reinforcing loop (FM 3-24, 1-116).

4 Sensitivity Analysis

4.1 Data

The data available from any insurgency is problematic for system dynamics calibration on a number of levels. One is that the number of active insurgents is deliberately kept secret by the insurgency and often does not find its way into governmental archives, which are generally classified in any case. The second is that the researchers most interested in this data, political scientists and historians, often collect a great deal of numerical data, but not in the time-series format most useful to calibrating a system dynamics model. And if they do collect time-series, it is often at the wrong level of aggregation (see e.g. Hart, chapter 2, for examples of both these issues). Another issue is that the number of government troops in an affected area may not be an accurate portrayal of the number of forces actually employed in counterinsurgency activities (e.g. armored units are generally useless for COIN work).

That said, some conflicts have more data available than others. Data from the Anglo-Irish Conflict of 1919-21 are attractive for several reasons. It is often considered the first modern urban insurgency (Keegan and Wheatcroft, 2001). Because of its age and the fact that the records were kept in English on both sides, much of the extant data is declassified. Finally, unlike the current situations in Iraq and Afghanistan, the insurgency itself was a straightforward conflict, comprised essentially of just one insurgent group representing one constituency, the Catholic Irish.

The primary data available to us is as follows:

- Population and the annual natural and net population growth rates (Central Statistics Office of Ireland from 1926 census).
- Insurgent Incidents (sources shown in Figure 3): This series, correlated as it is with many other measures of violence, is the most solid and lengthy time-series data of the conflict.
- Detained insurgents (from Townshend, 1975, p. 223) and killed insurgents (Augusteijn, 1996, p.180). Combined together, the detention and casualty series give us figures for inactive insurgents for January, April, and July 1921.
- Active Insurgents**:** Accurate data is lacking other than captured documents from the IRA in May, 1920 estimate an effective strength of "over 5000" (Townshend, 1975, p. 179). This number is declining near the end of the conflict (Hopkinson, 2002).
- COIN Troop Level: Effective COIN troops are approximately 15,000 throughout the conflict (Fitzpatrick, 1998, p. 92). Auxiliary paramilitary forces rose from 10,000 troops at the beginning of the conflict to 16,000 by its end (Townshend, 1975, pp. 211-212). This time-series is used as an exogenous input to the base case.

4.2 Calibration

As shown in Figure 5, when calibrated with the parameters in Appendix 1, the results simulated by the model match up quite well with the historical data. Note that month 0.0 corresponds to the beginning of January 1919. Also note that the historical data in inactive insurgents is difficult to see in Figure 5 because it lies almost on top of the simulated data.

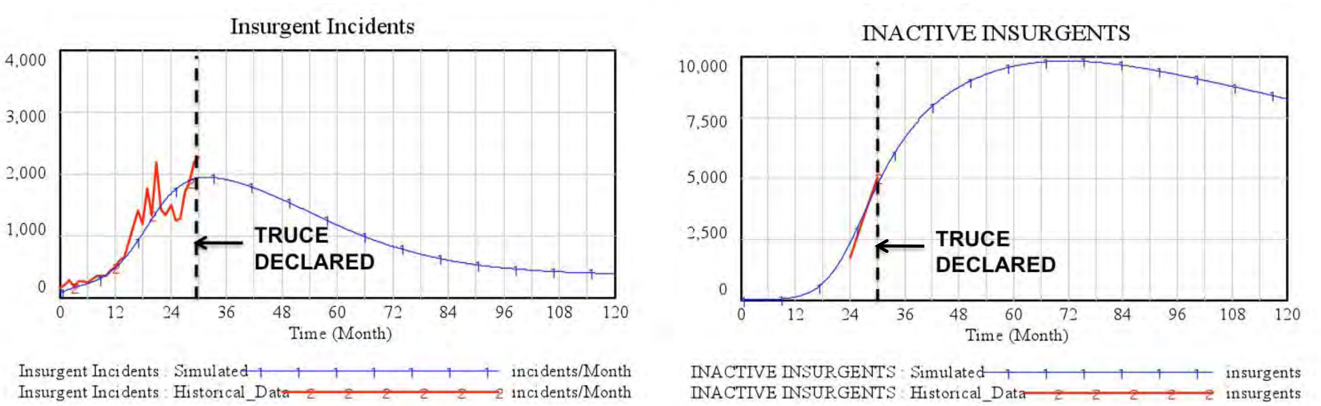

Figure 5: Historical and Simulated Time-series of Incidents and Insurgents for the Anglo-Irish War

Additionally, Figure 6 shows the time-series for active insurgents. While the actual historical time-series for this variable does not exist, the maximum at 5500 insurgents and decline thereafter to 4900 insurgents in month 30 seems to fit the qualitative data from the IRA leadership reasonably well.

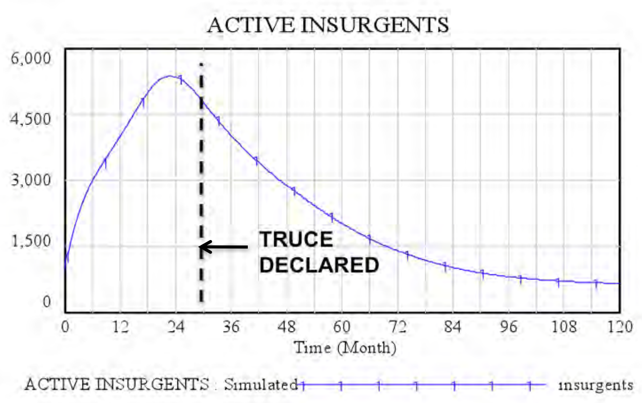

Figure 6: Simulated Number of Insurgents for the Anglo-Irish Conflict

While fitting a model to historical data does not prove that the model is accurate, it does test plausibility (Sterman, 2000). For example, when constraining the model to reasonable values for constants and parameters, it became obvious fairly quickly that an escalation loop needed to be added to the model in order for the number of insurgent incidents to increase while the number of insurgents was declining, as described in Section 3.4. In addition, the need to match active insurgents' and inactive insurgents' simulated values to their historical time-series necessitated a change in the model from first to third-order exponential smoothing delays for both the effect of *pressure to reduce incidents* on the number of *patrols* per COIN troop and the effect of *information gathering* upon COIN *combat efficacy*. Given the multiple delays in digesting information, developing policies, disseminating them to the troops, and the troops executing the policies, this shift seemed much more reasonable than extending the length of these delays beyond the realm of plausibility. A related issue arose with the *popular support for the govt*, which was modeled as a first-order exponential smooth of *indicated popular support for the govt*. A reasonable calibration of the model could not be fitted initially using this structure. The solution to this comes from observing that popular support is in essence a perception of service quality. Following the quality literature (Oliva and Sterman, 2001), the model was modified to differentiate the value for the *time to gain support* from that of the *time to lose support*, which allows the more reasonable calibration shown in the figures above.

4.3 Parameter and Policy Sensitivity

Throughout the sensitivity analysis, the *base_case* run is that from the calibrated model of the Anglo-Irish War calibrated in Section 4.2.

4.3.1 Sensitivity to the Escalation Loop

Overall, the model's behavior is highly sensitive to the escalation loop. When the loop is removed from the base case, peak insurgent incidents are much higher overall (Figure 7). This is because the insurgents never need to climb the "escalation curve" over time but begin at their full level of violence initially. It should be noted that both cases approach an equilibrium "smoldering" state at the end of the simulation in which the difficulty of rooting out an insurgent through combat creates a blowback in popular support that can maintain the insurgency. This is a common feature of many insurgencies (O'Neil, 1990; Kress and Szechman, 2008.)

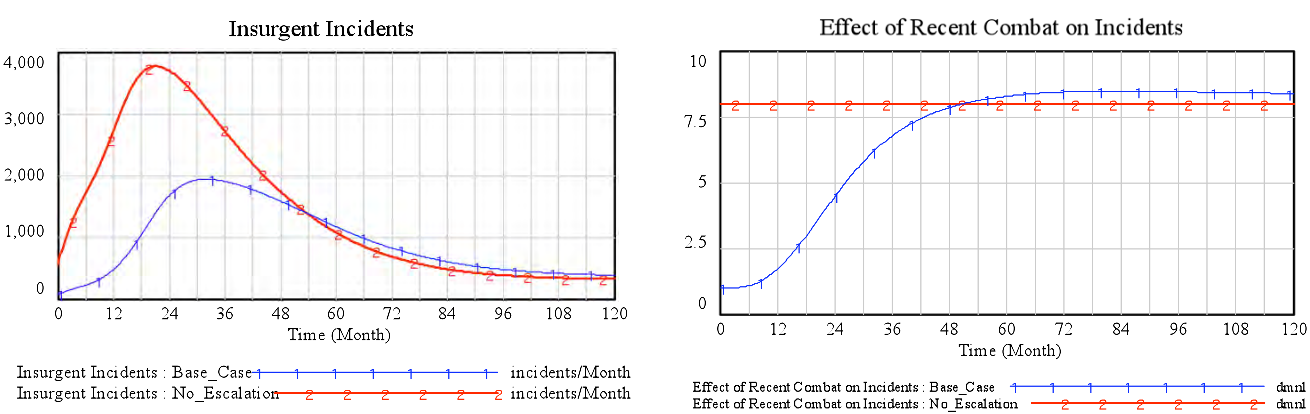

Figure 7: Effect of Removing the Escalation Loop

4.3.2 Sensitivity to the Blowback Loop

Figure 8 shows that the model's behavior is also highly sensitive to the *blowback loop*. While the simulated insurgency without the blowback loop takes several years to suppress, its overall intensity is miniscule compared with the base case.

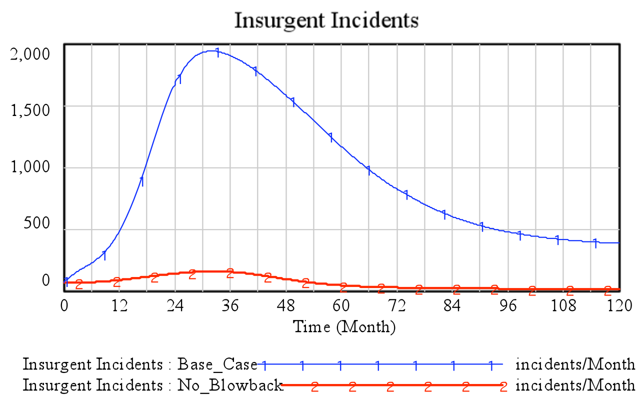

Figure 8: Effect of Removing the Blowback Loop

4.3.3 Sensitivity to Populace Security Effects

As discussed in section 2, Kress and Szechtman (2008) have built an analytic model incorporating intelligence and certain aspects of blowback into combat efficacy, which is a significant improvement over prior models. However, to permit analytic tractability, the Kress-Szechtman model also assumes that the rate of increase in active insurgents is as shown in Equation (1). This equation implies that:

1. The *security of the populace* does not affect the quality of *intelligence gathering* (*intimidation loop)* or *popular support* (*law & order loop);* and

2. Popular support is not an exponentially smoothed variable (i.e. it is not a stock).

We attempt to determine whether these loops affect our model by removing the delay in forming *popular support* and severing the connections between the security of the populace and intelligence gathering through both the *intimidation* and *support loops.* The effect of these adjustments is shown in Figure 9. We note that this is clearly not an "apples-to-apples" comparison with Kress and Szechtman's (2008) model as many other aspects of these two models differ (e.g. their model has no recruiting loop). Nonetheless, it does indicate that the assumptions from FM 3-24 (FM 3-24, 1-131 and 1-116) regarding security of the populace may materially affect an insurgency's outcome and need to be included in future insurgency models.

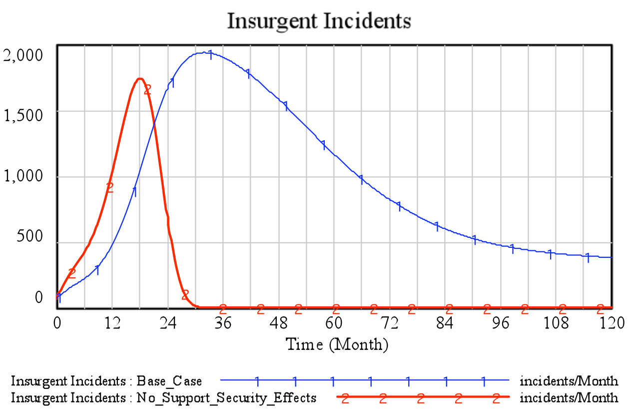

Figure 9: Effect of the Removing Populace Security Loops
(Note: Popular Support is also converted from a stock to an auxiliary variable)

4.3.4 Sensitivity to COIN Troop Levels—The Magic Number

Dobbins (2003) suggested that a "magic number" of 20 troops on the ground per 1000 inhabitants might be necessary to successfully rebuild Afghanistan. We test this in the simulation by taking the base case of the calibrated model and increasing the number of COIN troops in the simulation to 60,000, which ensures that the magic number is met or exceeded throughout the simulation. Increasing COIN troops to the magic number does reduce the overall severity of the insurgency, particularly in the medium-term (Figure 10). However, after about month 110, *insurgent incidents* end up at approximately the same level, *despite almost double the number of COIN troops in the affected area*. Figure 10 shows that this occurs because the increased COIN combat patrols activate the blowback loop and reduces *popular support*, creating enough new active insurgents to counterbalance the increased number of COIN troops. Blowback also reduces the level of COIN intelligence and ultimately COIN combat efficacy.

This suggests that increasing COIN troop numbers alone, without implementing any complementary policies, can weaken the insurgency in the short-run but not eliminate it.

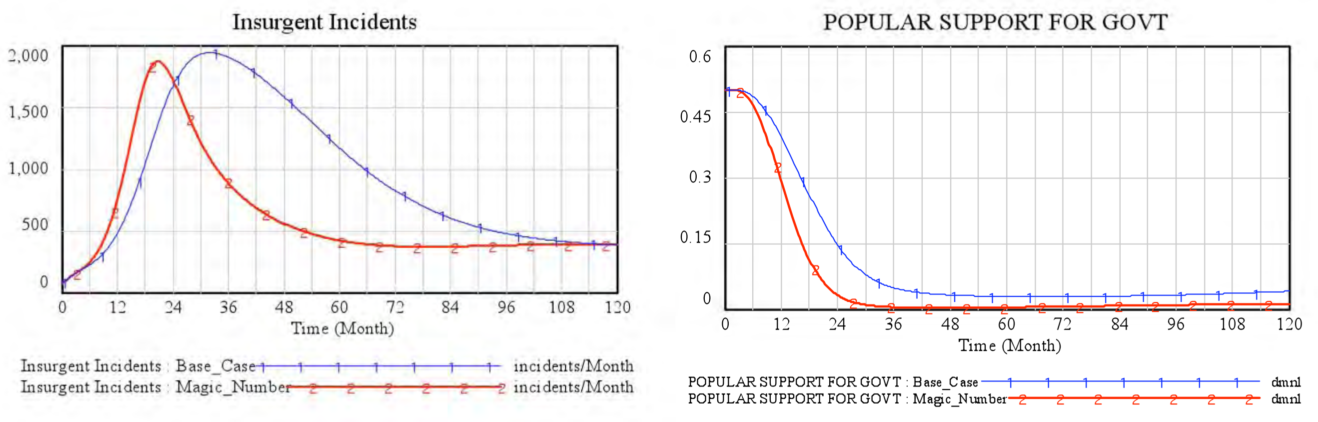

Figure 10: Effects of Increasing COIN Troops to the "Magic Number"

4.3.5 Population Growth

Given that the overwhelming majority of insurgents are young males, one would expect that an insurgency would be larger *ceteris paribus* in an affected area with a greater population growth rate, which tends to exaggerate the number of younger citizens in comparison with older citizens. Additionally, a high population growth rate implies that each year the size of the population that becomes of age to potentially become insurgents is also higher. This enables an insurgency to more easily replace any lost insurgents. To examine these effects in the model, we compare the base case of the Anglo-Irish War (Ireland experience about a 4% net annual population decrease throughout the conflict) with three other cases: annual net growth rate of 0% (no growth), 4% (similar to Afghanistan), and 10% (the approximate limit of natural population growth). To attempt to present an "apples-to-apples" comparison of the development of the insurgency under different growth scenarios, the *base insurgent fraction* is adjusted in the runs shown in Figure 12 to compensate for the increase or decrease in the fraction of the population in the insurgent age range. This causes the initial development of the insurgency to be similar under all four scenarios.

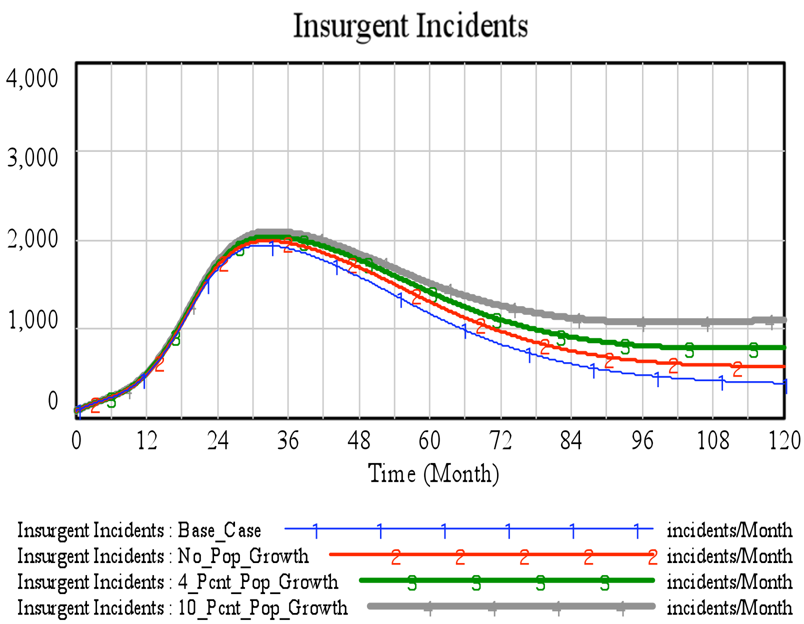

Figure 12: Effects of Population Growth Rate

The effect of increased annual population growth upon the smoldering state at the end of the simulation (via the increased replacement rate of insurgents) is startling. Even despite the controls just mentioned, the scenario with 4% annual growth rate essentially doubles the incident level at the end of the simulation versus the base case. This suggests that insurgencies in countries with high population growth rates will be much more difficult to control over the long-term.

4.4 Policy Sensitivity

4.4.1 Popular Support

Because Great Britain was suppressing one of the first urban insurgencies in the Anglo-Irish War, its forces did not know what constituted a viable COIN strategy (Beckett, 2001). Hence, the counterinsurgency started with many handicaps. One was a long history of poor relations with the Irish (Johnson, 1992; Kautt, 1999). The IRA exploited this disenchantment to gain the support of the citizenry, anticipating Mao's famous dictum that guerrillas are like fish in an ocean of citizens, suggesting that a great ocean of support is needed to support an insurgency and that insurgents cannot survive outside of it (Lynn, 2005). The most effective method of separating the fish from the ocean in an urban environment is often to redress the political grievances of the populace represented by the insurgent group (FM 3-24, 1-113; also O'Neil, 1990). In particular, we model one potential strategy that the British government could have taken by simulating the impact of giving Ireland control over its internal affairs (as had been proposed in 1914) to increase the legitimacy of the Irish government. This is modeled by decreasing the *time to gain support* from 60 to 6 months and increasing the initial *popular support for the government* from 0.5 to 0.8 (on a scale of 0.0 to 1.0). The results are shown in Figure 13.

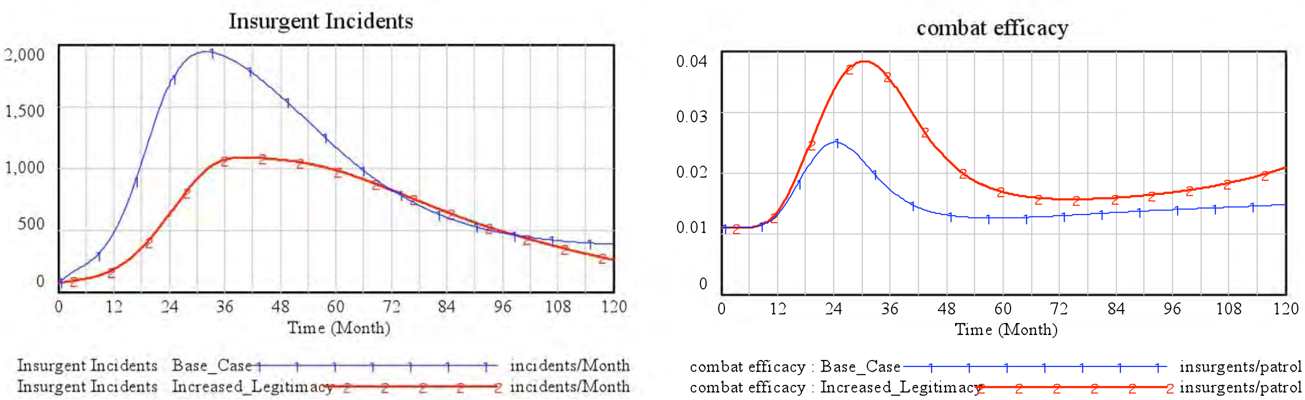

Figure 13: Effects of Increasing Public Support for the Government

The extent of the insurgency is generally lower because of increased combat efficacy resulting from increased popular support and less intimidation of the populace by the insurgents. However, it is still not extinguished after month 120 indicating that some blowback is still present and that other complementary strategies need also be implemented.

4.4.2 Sensitivity to Combat vs. Intelligence Gathering

Most British COIN troops' effort was spent in direct combat rather than gathering intelligence (Beckett, 2001). This goes against the main message of FM 3-24, which is that actively gathering of intelligence by military patrols increases combat efficacy and reduces blowback (FM 3-24, 1-149). To test this hypothesis, the *fraction combat vs. intel(ligence) patrols* is adjusted from 0.8 to 0.5 to create a more equitable balance between the two types of patrols.

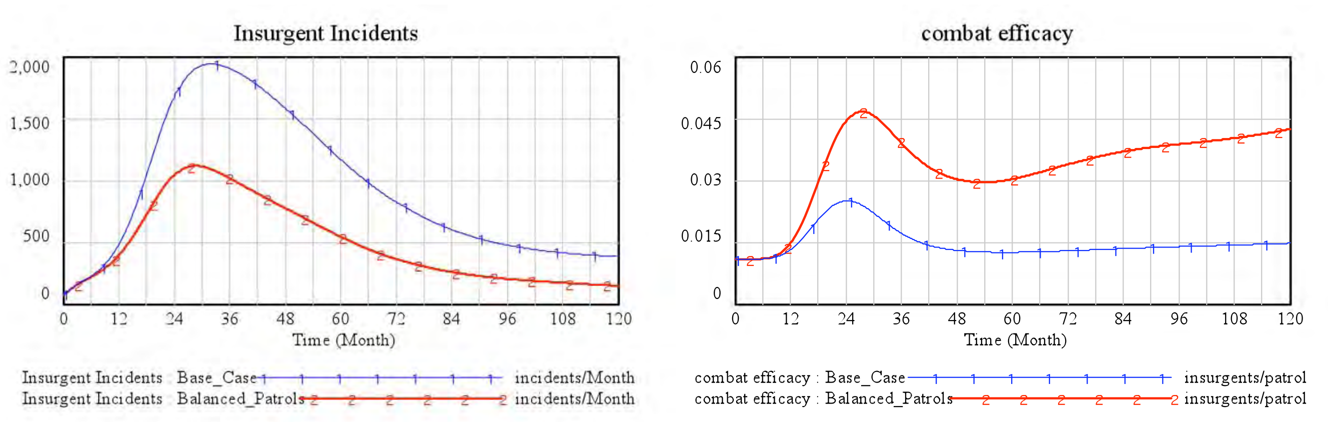

Figure 14: Effects of Increasing the Fraction of Intelligence Patrols

This policy seems to have a material effect on the insurgency' severity (Figure 14) by increasing the efficacy of combat patrols, which results from gathering more intelligence. Such increased efficacy by each combat patrol more than offsets their reduced numbers. Hence, the model's sensitivity in this respect accords with the theory in FM 3-24.

4.4.3 Combined Policies—The Wedge Strategy

Where any one policy may not achieve desired effects, several policies bundled together may be more effective (Anderson, 2007a). This is sometimes called a "wedge strategy" by analogizing the defeat of an insurgency to the eating of a pie, in the sense that a pie can be eaten much more quickly if several people each have a slice. To test the impact of this idea upon the simulation model, three bundles of combined policies are compared with the base case in Figure 15. The *Impr_Prop_and_Economy* run represents a combination of an effective propaganda (to tell the government's side of the story and discredit the insurgents' so as to improve support for the government) and economic stimulus (to tie up young males with jobs preventing them from joining the insurgency). This is simulated by increasing the *public support for the governement* by 25% and decreasing *potential insurgents* by 25%, all other things being equal. Together, these two policies reduce the peak intensity of the insurgency by about half. However, the combined policies are much less effective once the insurgency reaches a smoldering state at the end of simulation.

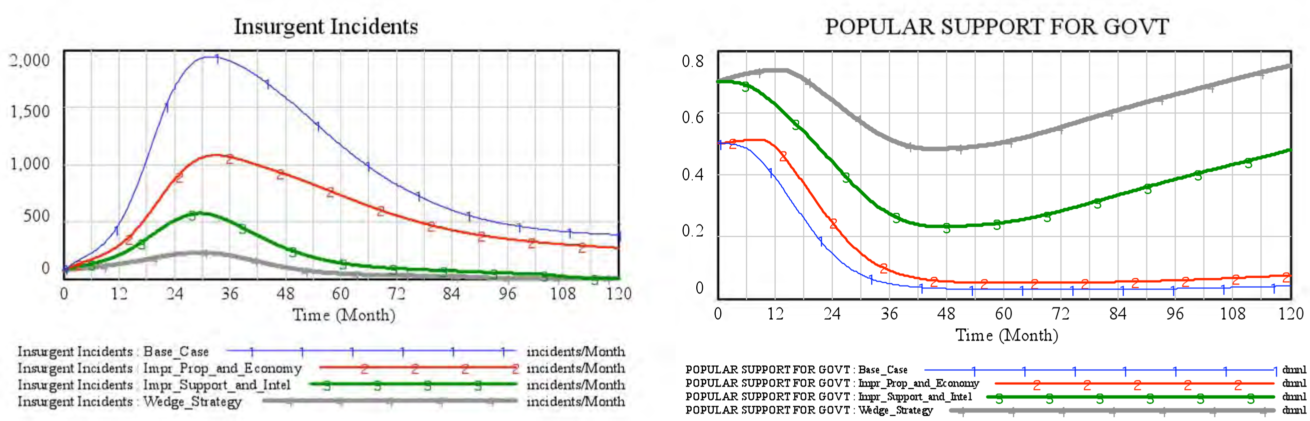

Figure 15: Effects of Combined Policies

The *Impr_Support_and_Intel* run combines the policies of improving *popular support for the govt* in Section 4.4.1 and balancing intelligence and combat patrols in Section 4.4.2. This combination of policies seems to be more effective, effectively ending the insurgency at about month 110. Finally, combining all four strategies in this section into a *wedge_strategy* yields synergistic payoffs by keeping the insurgency's peak intensity very low and eliminating the insurgency completely around month 96.

4.4.4 Dynamic Patrol Balancing

Finally, one key recommendation from FM 3-24 is that "the more successful a counterinsurgency is, the less force can be used." (FM 3-24, 1-151). The reason for this, according to FM 3-24, is that as the insurgency's intensity begins to decline, the rule of law-and-order becomes more important to the populace and the importance of police-like work (i.e. intelligence gathering) increases. Hence, one would expect that the most efficient use of troops would be to employ more of them for combat during the earlier phases of the insurgency relative to later phases. We test this by using the Vensim® (version 5.5d) package's Powell hill-climbing algorithm (Powell 1972) to optimize the fraction of combat versus intelligence patrols for each six months of the simulation for the first five years, after which the fraction is held constant. The number of COIN troops is the same as in the base case. The goal of the optimization is to minimize the number of insurgent incidents over the simulation. The results are shown in Figure 16 for when this dynamic policy is used with the base case scenario and with the wedge strategy from the previous section. In both cases—as well as for many others that have been tested under many different scenarios and penalty functions—the consistent finding is that the most productive use of troops initially is primarily to gather intelligence. Once this intelligence is gathered, then a significant fraction of troops can be diverted to combat.

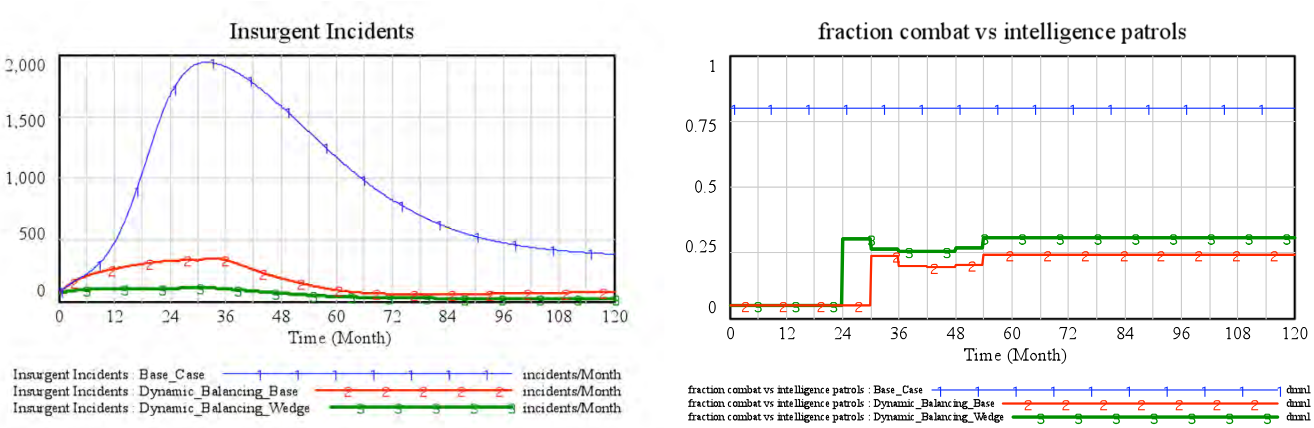

Figure 16: Effects from Dynamically Balancing Combat vs. Intelligence Patrols

The reason for this pattern is that, until they have gathered sufficient intelligence, COIN combat patrols create blowback that overwhelms any short-term improvement they may make in reducing active insurgents. Hence, the vast majority of them would be better off employed as intelligence gathering patrols, which expedites the time when some of them can be cut loose for combat. At that point, the combat fraction may be adjusted upwards or downwards slightly depending upon the scenario and the penalty function being optimized.

4.4.5 Revisiting the Escalation Loop

As mentioned earlier in Section 4.3.1, there is no explicit representation of the escalation loop in FM 3-24, despite substantial documentation of its existence in insurgencies (e.g. Hart, 2003, chap. 4). However, the presence of escalation has a serious impact upon the system. For one thing, any introduction of counterinsurgency troops by the government is *ceteris paribus* guaranteed to increase the severity of the insurgency in the short run. This is because COIN troop combat with insurgents escalates the number of incidents performed by each active insurgent per month. This effect is shown in Figure 17 in which the base case and the *30_Pcnt_Combat* run (in which 30 percent of patrols are allocated to combat) are compared with the *no_coin_troop* run (in which no COIN troops are ever introduced into the simulation). In both cases in which coin troops are introduced, insurgent incidents climb much higher than if the coin troops had never been deployed. This is true even in the 30 percent combat patrol run, despite the fact that it reduces the severity of the insurgency after month 50.

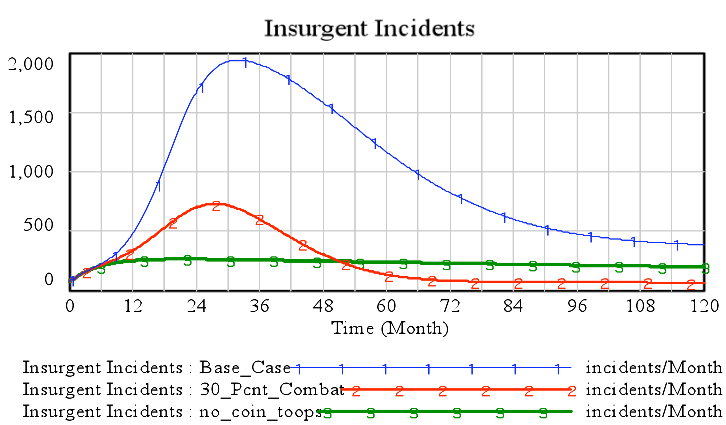

Figure 17: Dynamic Patrol Balancing when the Escalation Loop is Turned Off

Another problem with excluding the escalation loop from consideration is its impact upon policy.

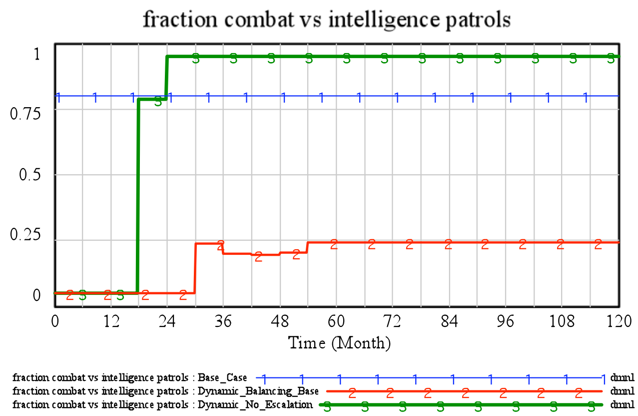

Figure 18: Dynamic Patrol Balancing when the Escalation Loop is Turned Off

For example, the optimal dynamic balance between combat and intelligence as performed in the previous section becomes highly distorted when the escalation loop is neglected. To see this, consider Figure 18. The optimal dynamic fraction of combat patrols, neglecting the effect of escalation, is compared with the *dynamic_balancing_base* run from the previous section (which includes the effect of escalation) and with the *base_case* (for reference). Because combat with the insurgents does not increase the rate of incidents per insurgent, there is much less penalty for combating the insurgents. Hence, neglecting the effect of escalation leads to COIN troops engaging in combat earlier and with much more force than is optimal if the escalation loop is active. Thus, neglecting the escalation loop in policy formulation is likely to lead to critical errors in execution of COIN policy.

4.4.6 Troop Withdrawal

Most governments would like to lower the number of troops deployed in counterinsurgency efforts as quickly as possible, particularly if they are supplied by a foreign intervening power. Yet the timing of the withdrawal is highly critical. Figure 19 shows the effects of troop withdrawal timing on the "wedge" strategy proposed in Section 4.4.3. The *wedge_strategy* run in Figure 19 assumes that troops are never withdrawn while executing the wedge strategy. In contrast, the *wedge_withdrawal_36* and *wedge_withdrawal_45* runs assume that COIN troops are withdrawn (by being reduced to zero in the simulation) after months 36 and 45 respectively.

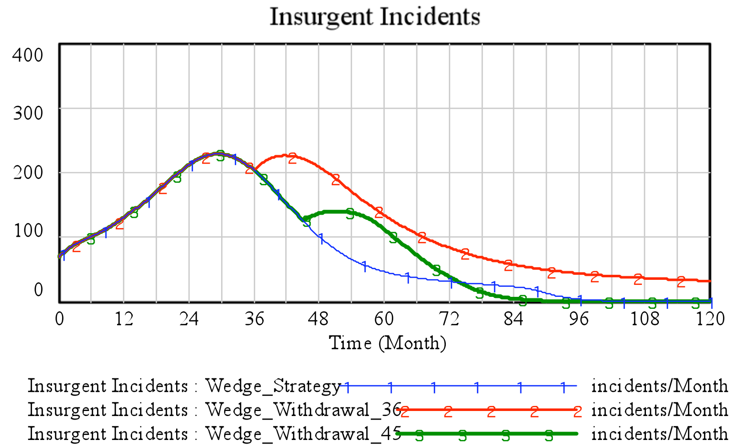

Figure 19: Timing of COIN Troop Withdrawal

In both cases, troop withdrawals allow violence to bloom again in the short term. If troops are withdrawn after month 36, the insurgency is never completely suppressed. However, a withdrawal in month 45 actually expedites the suppression of the insurgency because it reduces the "footprint" of blowback against which the insurgency needs to maintain itself. Hence, premature withdrawal of COIN troops, much like a partial application of a course of medical treatment, can lead to a worsening of the ultimate results of the counterinsurgency effort.

5 Discussion and Conclusion

We began this paper by asking several questions about counterinsurgency theory. What parts of the theory are most crucial? Are some crucial parts of the descriptive theory missing? Where are the points of leverage? What is the efficacy of various policies? What should the magnitude timing and magnitude of those policies be?

In this paper, we have begun to answer these questions as follows:

- Blowback, intelligence gathering, and security of the populace are of the utmost importance in the evolution of insurgencies as predicted by FM 3-24. However, calibration work in this paper indicates that violence escalation and the recruiting loop, which are not explicitly mentioned by FM 3-24, are also vital to understanding insurgencies.

- Introducing counterinsurgency troops inevitably increases the severity of an insurgency because of escalation and blowback. However, a counterinsurgency cannot be won without deploying counterinsurgency troops. This creates a classic "worse before better" situation in which long-term insurgency suppression necessitates worsening the insurgency in the short-run.

- The overwhelming majority of simulation runs in this paper indicate that, after the short-term worsening of the insurgency created by the introduction of COIN troops, the intensity of the insurgency will decrease. However, *this improvement does not indicate that the insurgency will eventually be suppressed*. Rather the insurgency may instead evolve towards a high long-run equilibrium of insurgent violence (Figure 15). Furthermore, this level may actually be higher than if COIN troops had never been deployed in the first place (Figure 17).

- The long-run level of violence in a smoldering insurgency increases with the rate of population growth. Hence, quick suppression of an insurgency becomes more critical if an affected area has a high rate of population growth.

- Both short and long-run COIN outcomes can be improved by (1) improving base popular support for the government through redressing some of the grievances that fuel the insurgency, (2) improving propaganda to effectively advocate the government's position and highlight the shortcomings of the insurgents, and (3) using economic stimulus packages to reduce the number of young males able to join the insurgency. Furthermore, these efforts tend to be mutually reinforcing and should be deployed as a package.

- Balancing combat patrols with intelligence gathering is critically important in winning an insurgency. Gathering intelligence can be accomplished in a number of ways, holding medical and dental clinics (Kaplan, 2005), executing civil improvement projects in conjunction with the locals (Kaplan, 2005), or patrolling the streets, much like a police officer "walking the beat" (FM 3-24, 1-149). All of these methods, however, put COIN troops at more physical risk than if they instead retreated into secure compounds to protect themselves. (Phillips, 2007).

- Timing is also critical. Contrary to the implications of FM 3-24, simulation in this paper suggest that a preparatory period of high intelligence gathering by COIN forces is necessary before ramping up combat levels. Good intelligence is an antidote for blowback, but it takes time to accumulate and disseminate, leaving the government open to charges that it is doing "nothing" to combat the insurgency.

- Suppressing an insurgency takes time and effort. Withdrawing troops prematurely can lead to a second blooming of insurgent violence, which might never end.

- Perhaps the greatest purpose of any model is to highlight what sort of data should be collected, particularly in terms of lead indicators. Clearly, estimates of active insurgents and COIN troop combat efficacy, while they are often gathered, need to be of higher quality. On the other hand, measures of popular support in particular do not seem to be gathered on anything approaching a regular basis in most insurgencies, yet popular support appears crucial to determining how to prosecute the counterinsurgency effort. Hence, much effort should be expended in these directions.

Finally, this model has not tackled some of the extremely complex issues that bedevil many current insurgencies. One is that most insurgencies are actually a collection of smaller insurgencies, each of which battles each other as well as the government. Another is the impact of attempts to cut off funding and weapons to the insurgency. While this has resulted in some insurgencies turning to crime and extortion that delegitimizes the insurgency (Grynkewich and Reifel, 2006), other insurgencies have created war-bond schemes that have effectively strengthened the insurgency (Hopkinson, 2002). There is also a global linkage between many extant insurgencies, fueled by shared ideology (in Islamic insurgencies) and sometimes expedience (the linkage between leftist and narco-insurgencies in Latin America). Tackling these issues are the logical next steps in modeling the evolution of insurgencies in the 21st century.

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