Modeling the Cycles of Gang and Criminal Behavior: Understanding the Social and Economic Influences

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Abstract

In a study done by Saeed and Pavlov a generic microstructure of resource competition was developed and stylized using the dynastic cycles that occurred throughout Chinese history. The result was a model that demonstrated how economic drivers contribute to the cycles observed in the rise and fall of dynasties and lawlessness. Using their structure, with only a few substitutions of names, the same model suitably describes numerous systems where similar cycles in resource levels can be observed. Yet, in some systems, such as gangs, the economic motivations alone do not adequately describe the social factors clearly evident in rise and fall of criminal behavior attributed to gangs. This paper explores the social influence gaps in the purely economic model, identifies a social structure that can be used instead of the economic mechanisms, and then examines implications of a model that combines both aspects of the system. The result of this research indicates that both economic and social influences are capable of producing cycles and when combined, only further exacerbate the problem. These findings have import implications on policy design, suggesting that solutions will need to simultaneously consider both aspects.

Introduction

One of the challenges in developing policy for dealing with asocial behavior, such as burglary, vehicle theft, or violent crimes is the seemingly unpredictable rise and fall of activity. In retrospect these cycles in crime are often attributed to changes in factors such the size of a police force, level unemployment, or high school drop-out rate. What causes changes in these factors can sometimes be external to a local community, such as economic shifts affecting tax revenue, however many are internally linked. For example when crime is high, there is a call for more police and when crime is low, there is a justification for reducing the size of the force. Therefore, understanding how these factors are linked together as a whole may allow for better policies that reduce asocial behavior further and create more stability in the long term.

To approach this problem, this paper will discuss an extension of a generic structure developed by Khalid Saeed and Oleg Pavlov (2007) that explores the role of resource allocation in creating cycles in political economies, markets, and other systems with competition over resources. Figure 1 provides an overview of this structure, where three interconnected stocks compete for a resource, affecting one another directly or indirectly. Through this structure control resources are collected and put towards combating asocial behaviors. However, the collection of control resources in the form of taxes also reduces social freedom and economic prosperity, which increases motivations for asocial activity and thus counteracts some of the gains made in controlling asocial behaviors. Only the civilian resources stock has a direct positive effect on

welfare, and yet it is caught in the middle of those seeking to control the system and those seeking to exploit it.
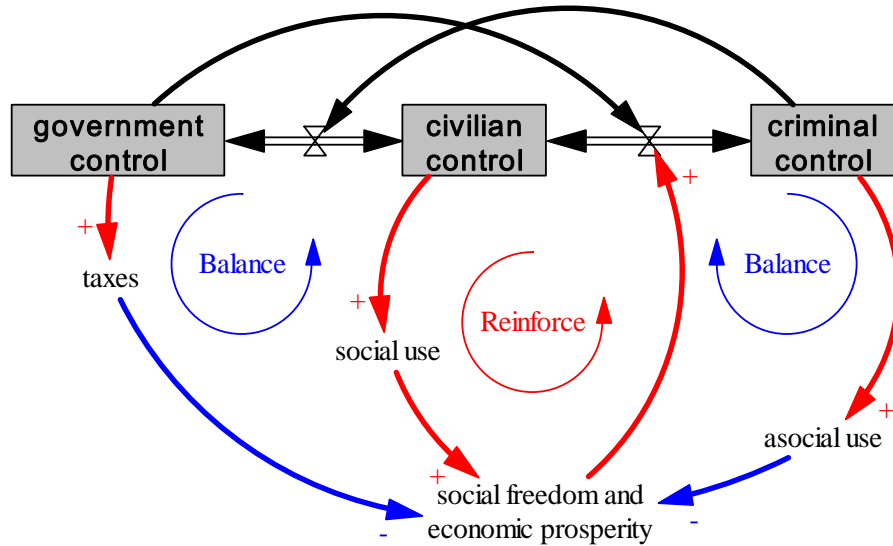
Figure 1: Generic resource allocation microstructure

In the study done by Saeed and Pavlov, this generic microstructure was stylized using the dynastic cycles that occurred throughout Chinese history. The result was a model that demonstrated how the economic drivers introduced in Figure 1 can create the cycles observed in the rise and fall of dynasties and lawlessness. Using their structure, with only a few substitutions of names, the same model suitably describes numerous systems where similar cycles in resource levels can be observed. Yet, in some systems, such as gangs, the economic motivations alone do not adequately describe the social factors clearly evident in rise and fall of criminal behavior attributed to gangs. This paper explores the social influence gaps in the purely economic model, identifies a social structure that can be used instead of the economic mechanisms, and then examines implications of a model that combines both aspects of the system. The result of this research indicates that both economic and social influences are capable of producing cycles and when combined, only further exacerbate the problem. These findings have import implications on policy design, suggesting that solutions will need to simultaneously consider both aspects.

Cycles in Criminal and Gang Behavior

In examining data on the instances of crime in communities, it is clear that there are significant oscillations in activity from year to year. While not all of this crime can be attributed to organized gangs, the role of social groups of some form is important to the livelihood of asocial behavior. Examining the data compiled from the Bureau of Justice Statistics (2008) provided numerous examples of these cycles in states across the United States (Figure 2). An exemplar of this behavior after a spike in crime in the city of Worcester is shown in Figure 3 and will serve as a reference mode for model simulations.
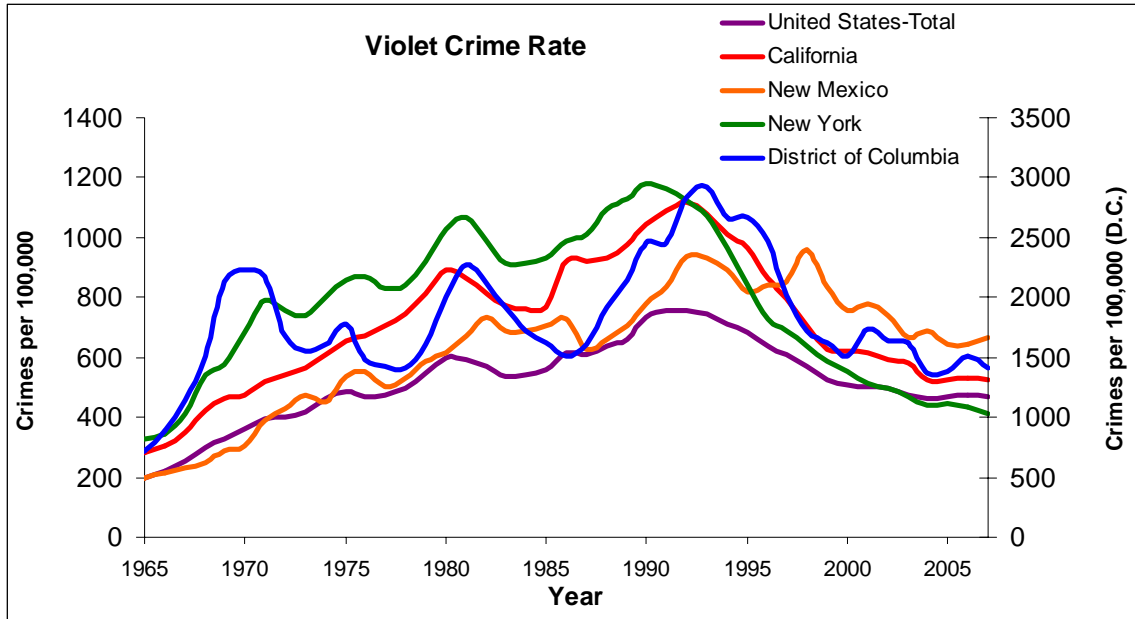
Figure 2: Crime rates across the United States

Using this data, several additional reference modes can be extracted to explore both perturbations of the model and potential policy changes. In particular this paper will explore the following questions:

- Given an exogenous change, does the model produce similar oscillations?
- Given a spike in criminal activity, does the model follow a similar trend of decline and continued oscillations?
- If there is a temporary increase in government such as adding extra police, can crime be lowered for the long term?
- If there are changes to the economic productivity of either criminal or legitimate markets, what will the impact be on crime?
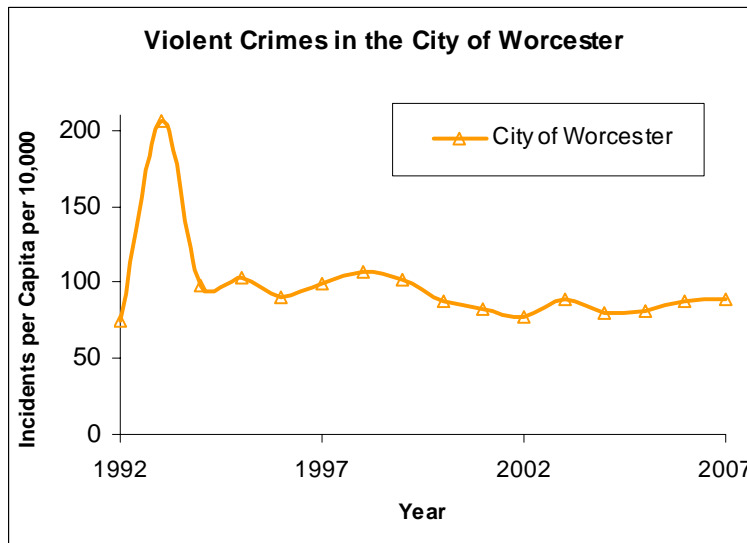

Figure 3: Violent Crimes in the City of Worcester

In addition to the cycles in criminal activity there are similar cycles in how much can be attributed to gangs. In examining the percentage of violent crimes attributed to gangs across the U.S (Harrell, 2005), the same periodic rise and fall of activity persists. This is not to say that gangs are the only cause for changes in asocial behavior, but rather that there is some interaction between the levels of criminal and gang activity. As discussed by Tita and Ridgeway (2007) empirical evidence does support models of facilitation where social processes within gangs accelerate individual involvement in criminal activity. This interaction will play an important part as the social causal influences are explored in greater detail.

Economic Causal Influences

Before examining the social causal influences, it is helpful to briefly review the economic causal structure developed by Saeed and Pavlov (2007). As shown in Figure 4, in this structure, the majority of the reinforcing feedback loops are responsible for pushing the flow of people in the same direction as crime. These loops therefore reinforce growth and decline. In periods of growth in gangs, the lure of illicit income along with the pressure of taxes and limited opportunity from legitimate income pushes for more gang growth. Yet as the threat to society increases, balancing feedback loops in the system react, creating a growth in government. This leads to more state control, which eventually reverses the trend.
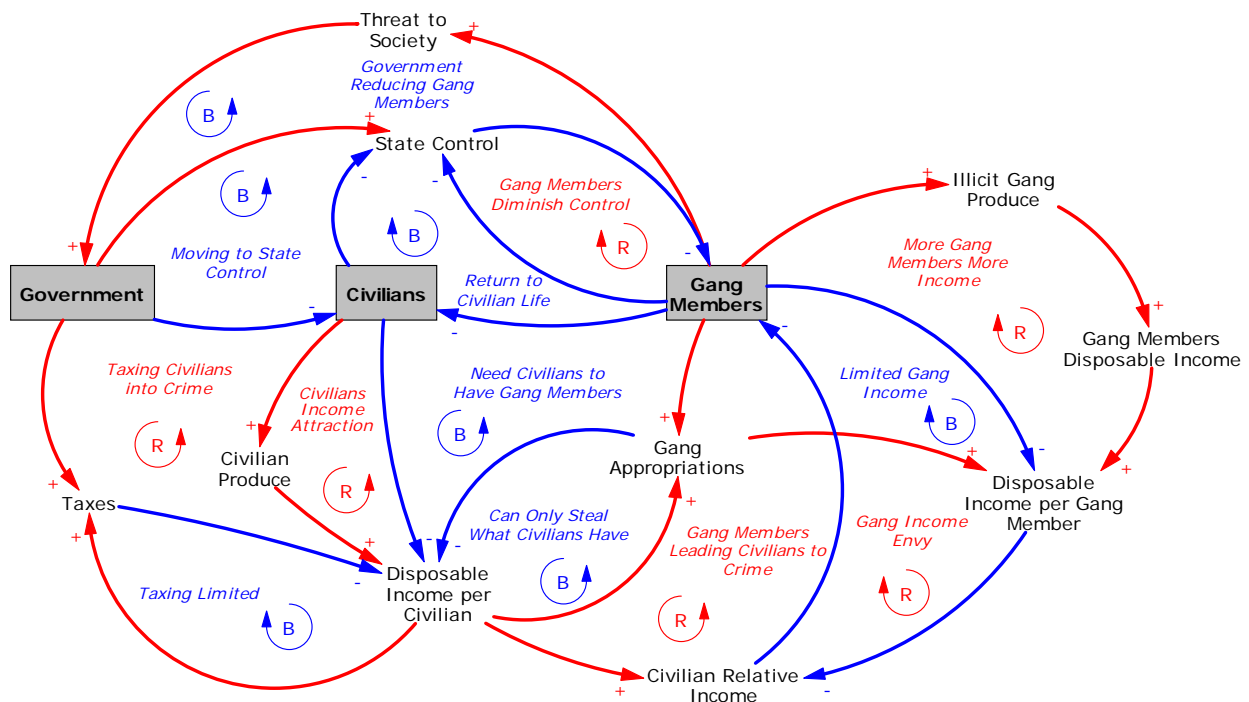
Figure 4: Economic Causal Influence Diagram

The market forces at work in gangs and crime deterrence are particularly evident in drug trafficking (Mansour et al., 2006). In this case, the rise of drug trafficking has been met with significant increases in drug enforcement, and yet the problem has proven to be quite persistent and adaptable. Mansour identifies several market structures similar to those in Figure 4 that counteract the gains made with drug seizures. For example, reductions in the drug supply increase the value of drugs, which provides higher income incentive for gangs, leading to more drug trafficking.

While the diagram in Figure 4 does capture certain aspects of gang activity, a large portion of the literature on gangs examines the numerous social and cultural aspects leading individuals to join gangs. For example, in a summary of youth gangs, Howell (1998) lists a variety of social influences including:

- the desire for status and prestige
- the opportunity for excitement
- sense of identity or belonging

A further review of social behaviors linked to deviant activity provides additional social mechanisms that may allow for cycles similar to those in the economic structure. The next section describes these mechanisms to provide an alternative explanation for the formation of dynastic and crime cycles.

Social Causal Influences

The literature on what leads groups and individuals to delinquent and criminal behaviors covers a large range of issues including cultural differences, economic disparities, child development, and social rules and norms. The theoretical approaches also differ, with some focusing more on the human ecology paradigm while others draw more from social psychology (Kontos et al., 2003). In the human ecology paradigm, researchers seek to understand the factors contributing to the formation of delinquent subcultures (Cloward, 1960). Using this approach, the evolution of a group is put in the context of discrepancies between social desire and opportunities. Within this framework, social desires, such as "the American dream," may come into conflict with ecological factors such as economic and cultural differences. The result creates a fertile ground for the growth of subcultures where norms and goals that are deviant from society at large can be established. In comparison, social psychology approaches explore the different psychological mechanisms observed in humans that play an important part in deviant behavior.

While both of the approaches provide important insights into the formation and persistence of gangs, this paper focuses on the social psychology that enables asocial behavior. Since this model is intended to capture mostly endogenous factors that are relatively generalizable, many of the human ecology factors are not well suited. A review of the social psychology literature, however, produced several factors that explain how individuals come to engage in deviant behaviors.

One factor identified as a major contributor to an increase in the number of gang members is the extent to which individuals considering joining feel deindividualized, or a "loss of a sense of individuality" (Kassin, et al., 2008). Typically, those who feel deindividualized are more likely to commit deviant acts (or acts consistent with the group behavior) because they feel less responsible for their actions. Deindividuation and deviant behavior depends upon two main cues taken from the social situation—**accountability** and **attention** (Prentice-Dunn & Rogers, 1982—from Kassin).

Accountability Cues

Before performing deviant behaviors, individuals weigh the costs against the rewards. In other words, they determine how accountable they will be for their actions. Those who are deindividualized feel less accountable because they feel less identifiable and this leads to increases in deviant behavior. For instance, in one study, participants were asked to indicate the one thing they would do if they were 100 percent sure they would never be identified (Dodd,

1985—from Kassin). The results indicated that 26 percent of participants would commit a crime, and 15 percent of those crime offenders would rob a bank (Dodd, 1985). Two key components that contribute to the extent to which an individual feels accountable are group size and physical anonymity.

The size of the group influences how anonymous an individual feels; thereby, decreasing feelings of accountability and increasing feelings of deindividuation. The larger the group, then typically the more anonymous and less responsible and accountable an individual will feel. In fact, one study found that the size of the mob influenced the outcome of a lynching. More specifically, larger mobs were more likely to commit more violent acts during the lynching, e.g., burning, beating, dismembering. the individuals in the larger mobs also felt less personally responsible for the actions of the group (Mullen, 1986 as cited in Myers, 2008). Looking across 21 instances where a crowd was present when an individual was threatening to jump off a bridge or building, researchers examined what factors contributed to bystanders actively encouraging those threatening to jump off a bridge or building (e.g., yelling "Jump", Mann, 1981). The size of the group significantly contributed to increased jeering, such that the larger the group, the more jeering occurred, suggesting again that individuals feel less accountable for their individual behavior when in the presence of a larger group (Mann, 1981). Applying this to gangs, suggests that the larger the group, the more deindividualized each gang member will feel, and subsequently the less responsible and accountable each he or she will feel for the acts committed. This decrease in feeling personally accountable and responsible should result in more deviant, violent, and harmful behaviors being conducted by a gang.

The extent to which an individual is physically anonymous (e.g., wearing a mask vs. not wearing a mask) also contributes to feelings of deindividuation and deviant behavior. For instance, when looking across 500 interpersonal attacks that occurred in Northern Ireland, researchers found a trend that the most violent attacks occurred when the offenders were masked or disguised (Silke, 2003—From Kassin). Likewise, individuals in convertibles with the top down are less likely to honk their horns than individuals in covered vehicles (Ellison, Govern, et al., 1995—from Myers).

In addition to historical analyses and field studies, physical anonymity has been manipulated in the laboratory to see the direct effects on deviant behavior. In one study, half the women participants wore white coats and hoods (they looked similar to the uniforms of the Klu Klux Klan), and the other half wore large name tags (making them easily identifiable; Zimbardo, 1970, 2002—from Myers). All the participants were then asked to administer electric shocks to another "participant" (who was a confederate and did not actually receive the shocks). The researchers found that the cloaked and masked women administered the shocks for twice as long as those wearing the large name tags, suggesting that physical anonymity increases feelings of deindividuation, decreases feelings of accountability and increases the likelihood of deviant behavior if the situation calls for it (Zimbardo, 1970).

Attentional Cues

The amount of self-awareness (or self-attention) an individual has also contributes to deindividuation. The less self-conscious (or self-aware) a person feels, then the more their attention is diverted from their own morals and values. This leads to in an increased likelihood in feeling deindividualized, and subsequently (as with accountability) increases in deviant behavior. For example, people made self-aware are less likely to cheat (Beaman and others, 1979).

Replicating the Halloween study mentioned earlier, when trick-or-treaters had to look in a mirror when taking candy, they were less likely to steal candy than when they did not look in a mirror (Beaman, Klentz, Diener, & Svanum, 1979). Two key components contribute to attentional cues: group size and arousing and distracting activities.

Not only does group size increase how anonymous an individual feels, but being part of a group, especially a large group, decreases feelings of self-consciousness and increases consciousness of the group and its intentions. Thus, individuals focus less on their own morals and values and instead, with increased group size, focus on the morals and values of the group. Relating this back to the research conducted on group size and encouraging those threatening to jump off a building or bridge to jump, the researchers not only found that those in larger groups jeered more, but they found that the most jeering occurred from large groups at night and the least amount of jeering occurred from small groups during the day (Mills, 1981). Thus, group size and anonymity interact, and the underlying rationale is that individuals in larger groups will feel more anonymous, less self-aware and self-conscious, and will be more in-tune with the group's intentions, and subsequently be more likely to focus on the group's values at that moment then their own. Applying this to gangs, suggests that the larger the group, then the more in-tune with the group and less self-conscious each member will feel. This discarding of self-awareness should result in more emulation of the gang's overall behavior and lead to increases in deviant behavior by each member.

In addition to group size, the degree to which an individual is aroused or distracted, especially in a group setting, also contributes to decreased self-awareness and increased deindividuation. For instance, loud and arousing group activities (e.g., group shouting, chanting, cheering, clapping, and dancing) consistently reduce self-consciousness, self-awareness, inhibitions, and increase responsiveness to the situation and acting without thinking (Diener, 1976, 1979, 1980; Prentice-Dunn & Rogers, 1980, 1989—From Myers). Relating group size together with increased arousal, one study aroused participants by having them purposefully angered by another participant (who was a confederate). After the arousal, all the angered participants had to administer shocks to others either in a group or alone. The angered participants administered stronger shocks when they were in a group than when they were alone (Jaffee et al., 1981—From Myers). Thus, increased arousal and increased distraction (that typically comes from being part of a group, especially a large group) help to make an individual feel less self-conscious and less self-aware; thereby, increasing feelings of deindividuation and increasing the likelihood that individuals will be responsive to the group's activities (whether deviant behavior or not). Relating this to gang behaviors, the more aroused a member feels or the more distracted the he or she is from those around, then the less self-conscious and self-aware the individual will feel. In addition, more non-gang members will be more likely to join if they are recruited when they are highly aroused or distracted by the behavior of the gang.

Another factor affecting attentional cues is desensitization towards a stimulus or behavior. With increased exposure to a stimulus or behavior, the stimulus or behavior becomes less and less novel, and subsequently individuals are more likely to become desensitized (or less likely to experience a strong reaction to the stimulus or behavior). The more desensitized an individual becomes towards a stimulus or behavior, then the chances of being more approving or accepting of the once-arousing stimuli or behavior increases. For instance, in one study half the participants played a violent video game (e.g., Mortal Kombat) or a non-violent video game (e.g., Tetris; see Carnagey, et al., 2007—from Kassin). After playing the video games, all

participants viewed videos of real violence (e.g., shootings, physical fights, etc.), and the experimenters measured participant's arousal as they watched these violence scenes using galvanic skin response (a measure of emotional arousal) and heart rates. Those who had played the violent video games showed much less arousal when watching the violent scenes than those who had played the non-violent video games, suggesting that the previous exposure to violent via the violent video games desensitized participants in this condition toward the violent images viewed later.

Increased desensitization also leads to increased acceptance of the once arousing stimulus or behavior, and may even lead to an increased likelihood of behaving in a manner consistent with the once-arousing stimulus. For example, Anderson & Murphy (2003) found that females who played violent video games were more likely to behave more aggressively to an opponent in a subsequent task (by delivering more loud blasts of noise towards the opponent) than females who played non-violent video games. The findings of this research suggest that once individuals become desensitized, they may be more willing to act in manners that coincide with the once-arousing stimulus.

Extending this research towards modeling gang behavior suggests that increased exposure to an arousing stimulus or behavior (e.g., violently attacking civilians), should lead to increased desensitization towards this once arousing behavior. This increased desensitization should make the once arousing stimulus seem more acceptable, and subsequently should allow for increased behavior that is consistent with the now desensitized stimulus (e.g., gangs acting more violently over time).

A final factor influencing attentional cues is the availability heuristic, or the "tendency to estimate the likelihood that an event will occur by how easily instances of it come to mind" (Kassin et al., 2008). However, the ease to which something comes to mind is not always correlated with how frequently it actually occurs. For instance, in one study, participants were asked which occurred more frequently in the English language; words that started with the letter "r" or words that contained "r" as the third letter (Tversky & Kahneman, 1973). Most participants believed it was words that began with the letter "r" because they more easily came to mind; however, words that contain "r" as the third letter are actually more common (Tversky & Kahneman, 1973). Another inherent problem with the availability heuristic is that it can lead to a false-consensus effect where individuals consequently believe that more people share their attitudes, their thoughts, and perform the same behaviors than actually do (Kassin et al., 2008). For example, participants rated themselves on different personality traits, and then they estimated the percentage of people in the general population who shared these traits (Krueger, 2000—from Kassin). The results indicated that people overestimated the extent to which others shared the same traits they had.

Applying this to the cycles in gangs and criminal behavior, when estimating the number of gang members, individuals will rely on what more easily comes to minds. Subsequently he or she may believe there are more gang members in the population than there actually are. This could influence the number of people who join gangs, and it may also influence the perceived need for increasing (or decreasing) the size of government.

The availability heuristic can also come into play when perceiving personal loss and risk. If an incident of loss comes more readily to mind (e.g., remember reading about someone else being vandalized by gangs or remembering one's own personal loss), individuals will believe that more

personal loss is occurring than may actually be true. For instance, after September 11th, people were more likely to believe that their plane would be attacked by terrorists than probability would suggest (Kassin et al., 2008). Related to risk, the same errors in overestimating will apply. If incidents of gang members getting caught more readily come to mind, then the perception will be that criminal behavior is more risky than it might be. In contrast, if incidents of gangs getting away with their acts come to mind, then the perception will be that committing a crime is less risky than it actually is.

Causal Influence Diagram

The diagram below (Figure 5) outlines how the social influences discussed above might be used instead of or in addition to the economic motivations of the current model. These additions include several new stocks that primarily accumulate perceptions over time. The first is the sense of deindividuation which is tied to the accountability and attentional (self awareness) cues. Both cues lead to reinforcing behaviors in the growth and decline of gangs. Growth in the gang population reinforces the *deindividuation* of its members and the community at large and thus lowers the sense of accountability. With a lower sense of accountability, becoming a gang member is seen as simply doing what everyone else is doing. As the gang population continues to grow and become more organized, self awareness also declines leading more people to join because they see it as becoming part of something greater than themselves (*losing sense of self*).

The second new stock is the average level of violence. As the number of gang members grows, more violence can be expected. This increase in violence can also undergo *perception amplification* (availability heuristic) leading the general population to believe that there are more gang members then they really are. In this case, if they *can't beat them, they might as well join them*. The average level of violence also affects the final new stock, the average sensitivity to violence. As violence becomes the norm, it can create a *riot effect* where people join in escalating arousing activities, thus amplifying the loss of self and *desensitization* that is feeding the decay in the sense of accountability. The usage of disguises for physical anonymity also affects accountability, allowing members to further escape responsibility. Later in this paper, when this structure is simulated in isolation of the economic influences, only the effects of the *Government Reducing Gang Members* loop from the economic causal diagram act to balance out any growth in gangs.
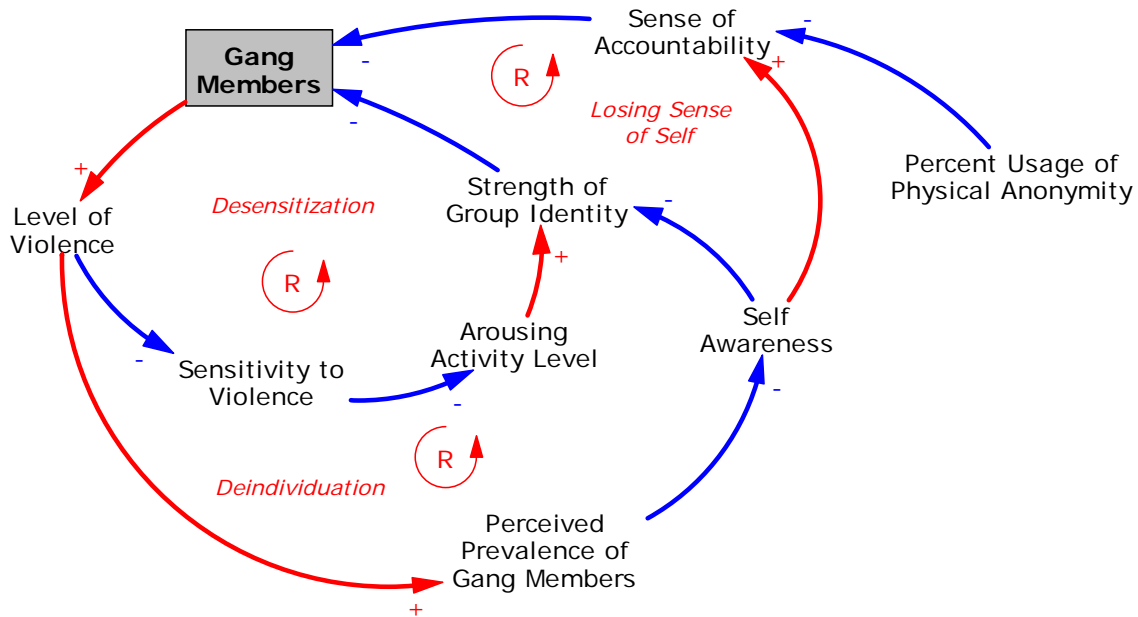
Figure 5: Social Causal Influences Diagram

Simulation Model

The numerous factors and influences in this model clearly necessitate the creation of a model that can be simulated. In creating a simulation model, it becomes possible to explore both structures in isolation and in concert. This allows for the exploration of all the important components of the system as well as the potential policy implications. For clarity, the model will be presented in the same two sectors as before; economic and social.

Economic Influences Sector

The economic sector (Figure 6) is an exact replica of the original model developed by Saeed and Pavlov aside from changes to variable names. In this model, it is primarily the perceived difference in income between civilians and gang members that affects the gang recruitment and attrition flow. For a complete description of the model please see Saeed and Pavlov, 2007.
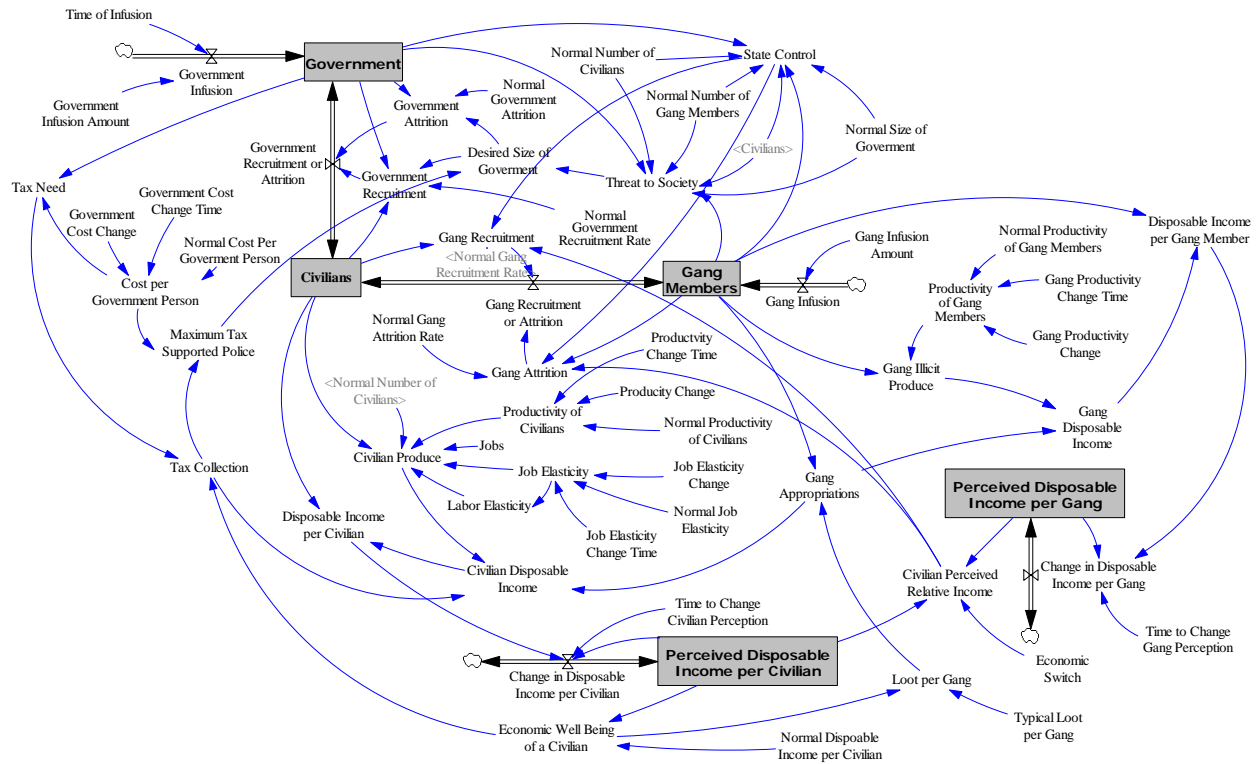
Figure 6: Model of Economic Influences

Social Influences Sector

The social influences sector (Figure 7) uses the same three interconnected resource stocks as the economic sector. All the formulations influencing adjustments to the government remain unchanged. Only the normal gang recruitment and attrition flow is modified to include the effects of social influences. These effects are simply the average of the *strength of group identity* and the reciprocal of the *sense of accountability*. Gang attrition is divided by this average and gang recruitment is multiplied. Therefore, when the average is greater than 1, the recruitment will be larger than normal and the attrition will be lower.

The sense of accountability is the average of the level of self awareness and use of physical anonymity. Self awareness is determined by the perceived prevalence of gang members, which calculated by comparing the level of perceived gang violence against the "normal" level of violence. As the number of gang members increases, self awareness declines leading to a lower sense of accountability (as discussed in the accountability cues). Declines of self awareness also lead to increases in the strength of group identity (deindividuation) since the current strength of identity is the amount of arousing activity divided by self awareness. This is to say that when individuals engage in arousing activities, their deindividuation will be greater if they are either or both less self aware or the activity level is greater than normal. The changes to deindividuation are also smoothed over a period of a month.

Arousing activities increase as the sensitivity to violence declines (attentional cues). The sensitivity to violence is another smooth that is taken over a period of two months of the current perceived level of violence as compared to what is normal.

11

The last addition to the model is the perception of violence, which influences the sensitivity to violence as opposed to actual level of violence. This is model assumption is based on the availability heuristic discussed earlier, where media information can help to increase the perception of violence. With the addition of these variables the model now includes some of the social psychology factors that can be used to explain how people come to engage in deviant behavior. The next section will explore how these factors influence the behavior of model simulations.
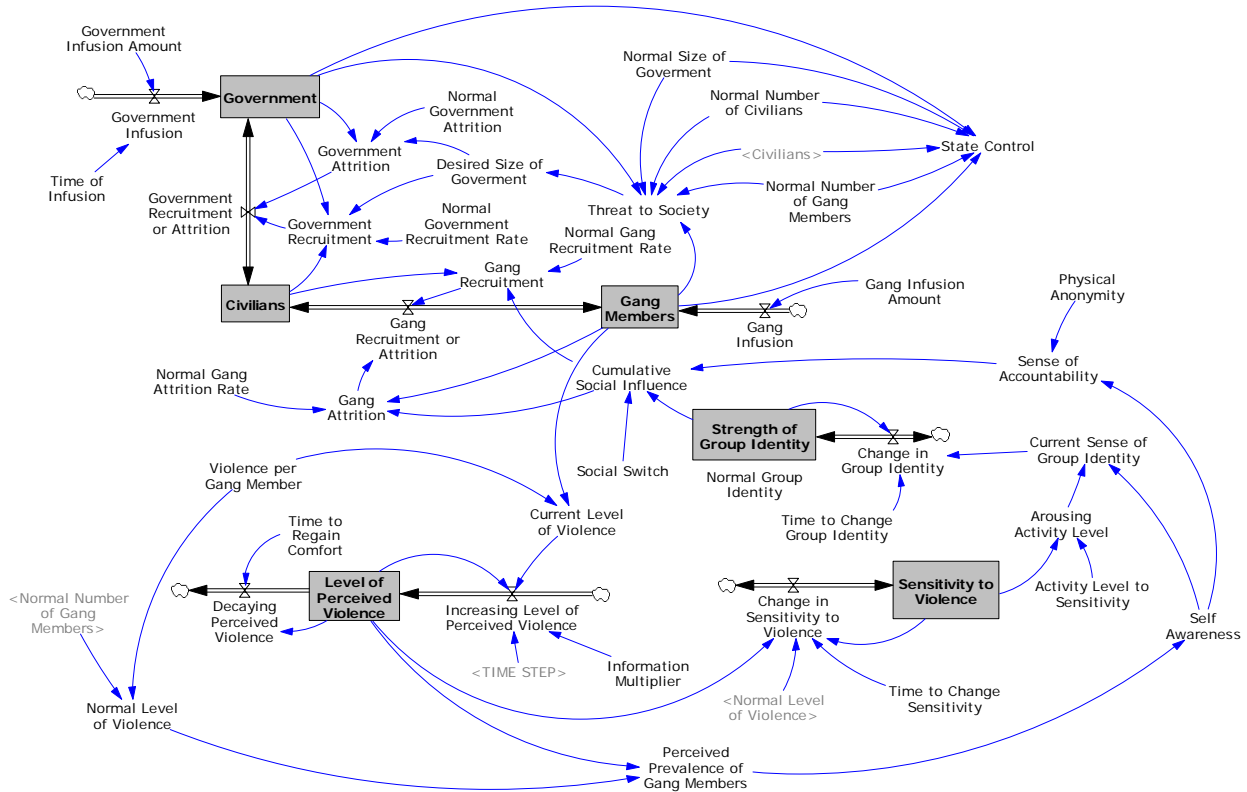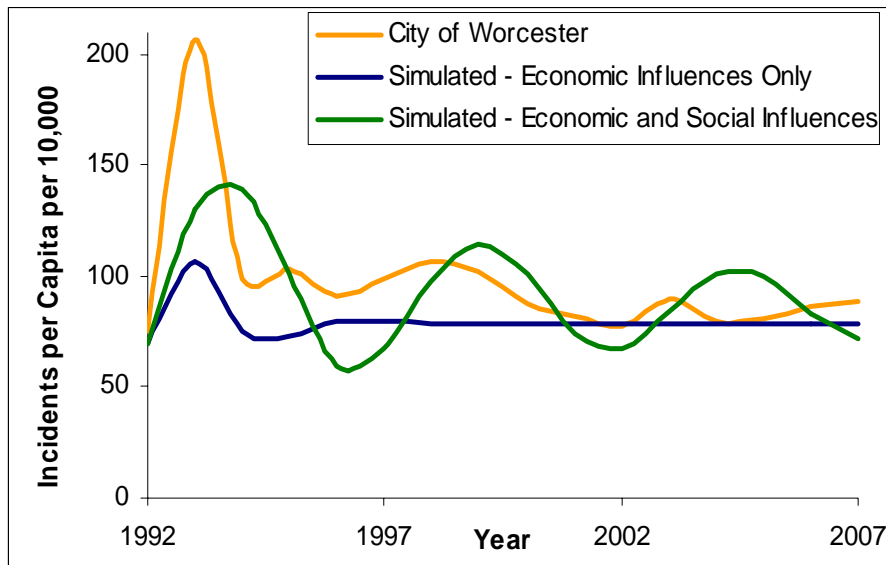

Figure 7: Model of Social Influences

Model Behaviors

The model is first parameterized to run in equilibrium as shown in Figure 8. Without perturbation, the number of civilians, gang members, and government remains constant, as does the level of violence. In the real world, however, the parameters do not remain constant, but rather change in response to events outside the system. Similar changes can be injected into the model, pushing it out of equilibrium to reveal the behavior response of the system. For example, certain events in a city, such as a new gang connection to a drug supplier, may lead to a sudden increase in the number of gang members. In another case, an economic downturn may lead an increased unemployment, creating more financial incentive to become involved with gangs. This section will explore how these changes affect the overall model behavior, revealing interesting insights about the problem and potential policy solutions.
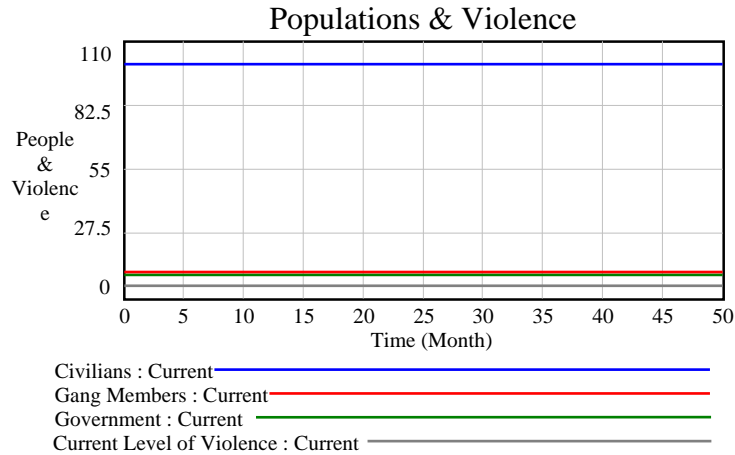
Figure 8: Model Equilibrium

The first comparison of model behavior is to that of the reference mode shown in real data. The chart in Figure 9 plots the violent crime in the city of Worcester from 1992 to 2007 along with the output of two simulation runs. In examining the Worcester data it is clear that in 1993 there was a large increase in the amount of violence that was followed by a quick reduction with some damped oscillation. Research on the reason for the increase could not be found, so to perturb the model, the number of gang members was doubled shortly after the start of a run. If the model only includes the economic influences the system oscillates briefly, quickly returning to equilibrium. Including the social influences however causes greater instability, allowing damped oscillations to occur for a number of years. This initial comparison suggests the model is capable of producing changes in the level of violence comparable to real world data, yet additional runs are needed to see if other aspects of the model are consistent with reality.

Figure 9: City of Worcester and Simulated Violent Crime

Before exploring additional parts of the model, it will be useful to examine why the addition of social influences produces behavior that is different. In comparing simulations of the economic,

social, and combined structures, after an infusion in gang membership (Figure 10), the economic model behaves markedly different without any social influences. Shown in blue, the economic only structure has an immediate decline in gang activity as police crack down. Yet, in the model with social only and the combined model, there is actually a small increase in membership after the initial infusion, and the following decline is more gradual than that in the economic only model. The reason for this is explained by the reinforcing loops shown in the original causal view of the social influences. When gang membership is higher than normal, the *losing sense of self, deindividuation, and desensitization* feedback loops act to reinforce membership, despite the increased government presence. The effect of the social factors also becomes more apparent as other parts of the model are explored.
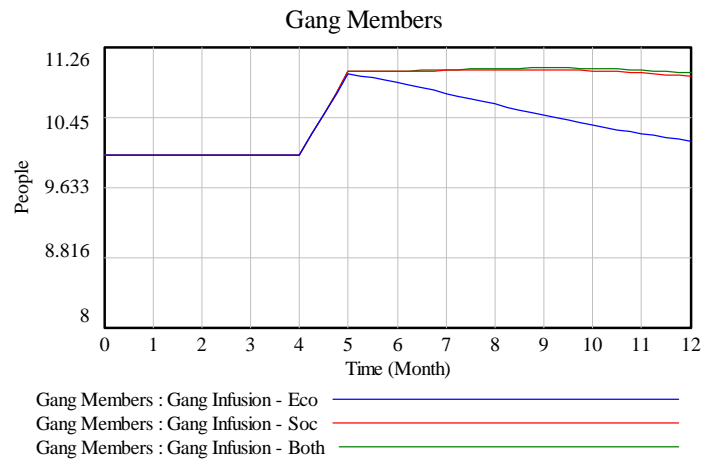
Figure 10: Comparing Gang Membership

In order to highlight the differences in model runs, it is helpful to create a few variables that summarize the tradeoffs occurring in the model over time. For this model, the variable on the freedoms formulated as follows by Saeed and Pavlov (2007) was used:

$$\text{Freedoms} = \frac{\left(\dfrac{\text{Civilians}}{(\text{Police} + \text{Gang Members})}\right)}{\left(\dfrac{\text{Normal Number of Civilans}}{(\text{NormalNumber of Police} + \text{NormalNumber of Gang Members})}\right)}$$

In this formulation, while in equilibrium, the value of freedoms is one. Yet as the number of gang members and police increases, the social freedoms are decreased as compared to what is normal. This represents a change towards a more "state controlled" society whereas an opposite change represents one with greater social freedom. Another useful summary variable is one on the legitimacy of the local economy, formulated below (Saeed & Pavlov, 2007):

$$\text{Economic Legitimacy} = \left(\frac{\text{Civilian Produce}}{\text{Gang Disposable Income}}\right) * \left(\frac{\text{NormalNumber of Gang Members}}{\text{TotalPopulation}}\right)$$

Using this variable, when gang membership and gang disposable income are up compared to legitimate income from the total population, the legitimacy is low. This represents a more crime driven economy, as compared to one that is primarily legitimate. Plotting these variables against each other creates the quadrants shown in Figure 11. In equilibrium, the model will remain in the

center of the chart, but with a perturbation, the system is kicked into oscillations that spiral in on a new equilibrium. Examining where the system re-stabilizes provides a convenient means for comparing different changes in the model and policies.
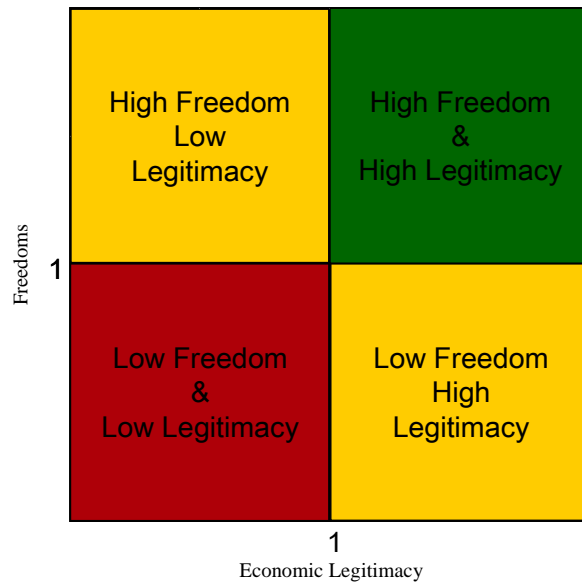

Figure 11: Economic Legitimacy and Freedoms Tradeoffs

In the first experiment the model is stimulated with a 10% infusion of gang members (Figure 12), which provides some interesting insights on the inclusion of social effects. In this plot, each dot represents a time step in the model. Following the path of dots shows how each run responds to a push away from the initial equilibrium in the center of the chart. The resulting behavior seen is the model being pushed to a new point (the straight line of points behind the arrow) with the increase in gang members before settling around a new equilibrium (points spiraling in around the star). The most notable difference between models with and without social influences is the greater initial reduction in social freedoms as well the settling around a new and different equilibrium that is lower in both economic legitimacy and freedoms.
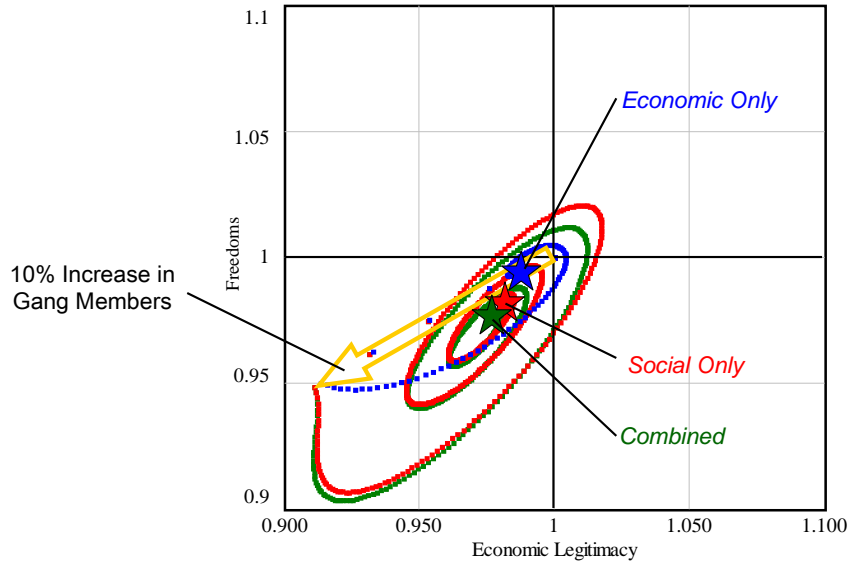
Figure 12: Gang Infusion Comparisons

In comparing differences between the infusions of gang members versus government (Figure 13), there are again wider swings with the inclusion of social factors. With a 10% increase in government, however, the initial period is marked with lower freedom yet greater economic legitimacy as opposed to a lower period for both variables as seen with the 10% gang infusion. An interesting potential insight is that in both cases the system pulls it back towards a similar new equilibrium that represents a stronger police state that still has economic legitimacy issues.
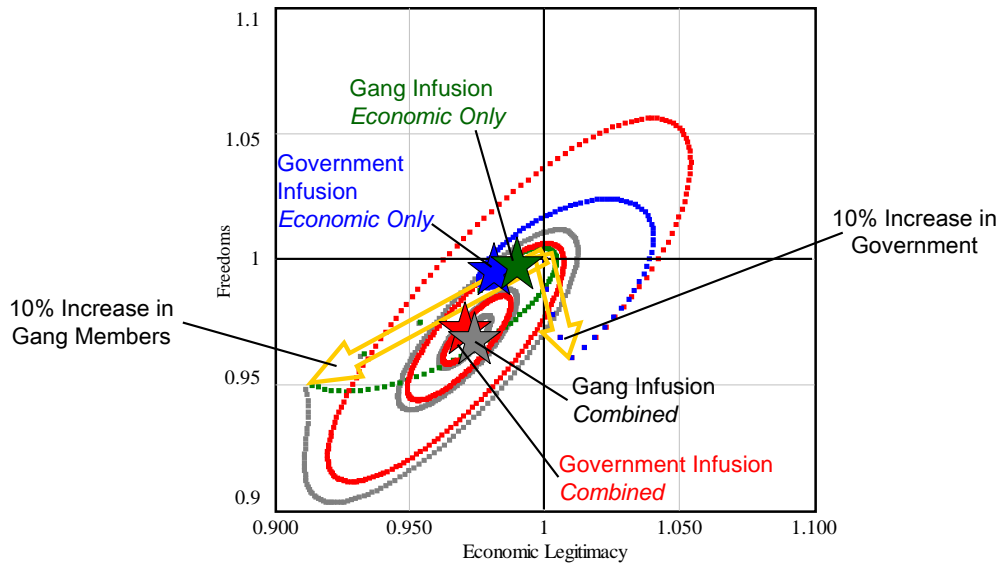

Figure 13: Police versus Gang Infusions

Changes that increase productivity by 20% in gangs (.1) versus civilians (24) show some additional differences (Figure 14). In the case of greater productivity in civilian activities, the amplifying social affects lead to a new equilibrium that has even greater freedom and economic legitimacy. In the case of a 20% increase in the profitability (.1) of gang robberies, (i.e. loot per gang in the model), the effect of social influences is less noticeable with little change to the

location of the new equilibrium. This is an encouraging feature since it suggests that improvements to the legitimate economy may have a greater impact than an increase in value of illicit activity.
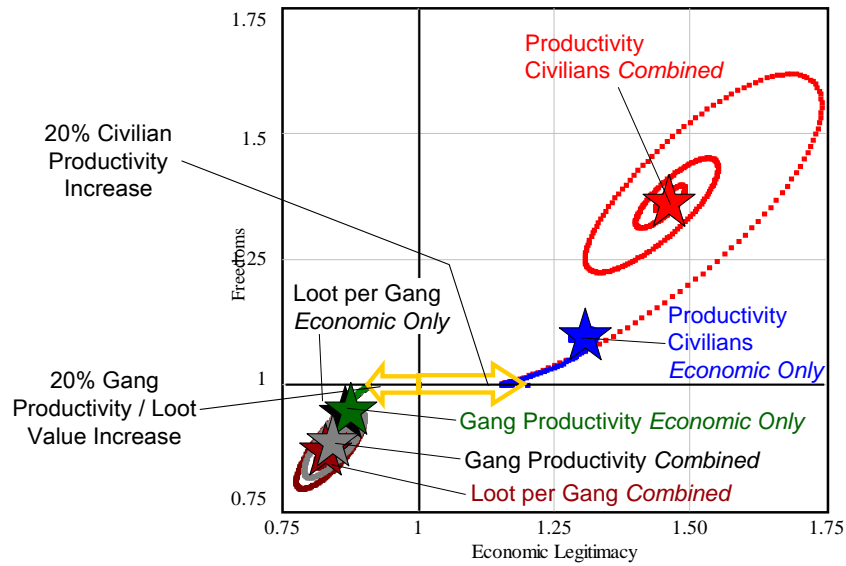
Figure 14: Comparing Gang and Civilian Productivity Changes

The final comparison to be explored is the impact of 20% increases versus decreases in productivity for both civilians and gangs (Figure 15). The output again highlights the significance of civilian productivity, since increases still create the greatest gains, while a decrease creates the worst outcome. As expected, a cut in the gang productivity does still produce a positive outcome, yet it isn't as significant as a corresponding increase in the civilian sector.
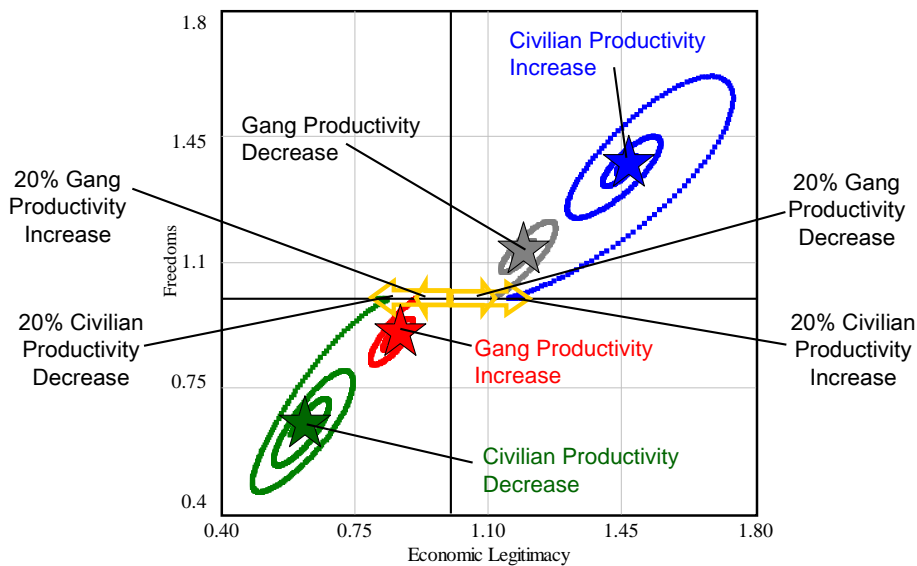
Figure 15: Increases versus Decreases in Productivity

Conclusions

The results of the simulations suggest several conclusions that have implications for both explaining gang cycles and potential polices. The first is that both the economic structure and the social structure are independently capable of reproducing the cyclic nature of gang activity. When compared to real world data, the oscillating behavior of the model does appear to be consistent with both small and larger perturbations. Furthermore, the addition of the social factors appeared to create behavior that was more consistent with the data since the oscillations were stronger and more persistent. This implies that any approach to dealing with gangs will need to address both the social and economic aspects of the problem.

Another conclusion that can be drawn for the model output is that policies that act to increase the productivity of civilian activities may have the most positive impacts on total social well being. While policies such as a surge in the number of police may create a period of improvement, in the long term, the system returns to a lower level. In addition, in policies that seek to reduce the productivity of gangs, such as decreases in drug trafficking, the end result is indeed positive, but may not be as efficient as improving the productivity in legitimate markets.

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