The Cascading Dynamics of War Expansion
Kyle A. Joyce
Department of Political Science
University of California, Davis
kjjoyce@ucdavis.edu

Overview
The war between Austria-Hungary and Serbia that began in July 1914 quickly expanded to include additional third-party states. Only three months into the war, two states had joined on the side of Austria-Hungary and five on the side of Serbia. By the time the war ended in November 1918, thirteen additional states had joined; what had began as a war between two states had become World War I. As with most wars that expanded (e.g., World War II, Korea, Vietnam), World War I was one of the deadliest conflicts in history. Yet the vast majority of wars do not expand. In most cases—including many long, highly violent conflicts such as the eight-year war between Iran and Iraq (1980-1988)—a war will end with exactly the same states with which it began. Why do some wars expand while others do not?

This book answers this question by recognizing that when each “third-party” state is deciding whether or not to join an ongoing war (and when, and on which side), it bases its decision not only on the war as it is currently being waged but also on how it expects all the other interconnected states in the international system to respond. Since any state can join the war up until the war ends, each state’s joining decision at each moment is shaped both by which other states it expects to join and how the states expected to join would affect the balance of power and the ultimate outcome of the war.

Specifically, I argue that each third party’s decision is a function of two linked mechanisms:

1) When each third-party state is deciding whether or not to join a war (and if so, on which side to join), it bases its decision both on its relationships with the initial participants in the war and on its expectations about which other third-party states will join and on which side. For example, the United States’ decision to join the Korean War was undoubtedly related to its expectation that China would join the opposing side. Similarly, it stands to reason that the United States’ decision not to intervene in the Six Day War in 1967 influenced the decisions of all other third parties, especially the Soviet Union.

2) Each third-party state updates its joining decision over time as the dynamics of a war—which I define as the shifting balance of power between the two sides—unfold. As a war evolves, the likelihood of victory for one side rises and falls with successes and failures on the battlefield. With each third party attuned to these changes, the dynamics of a war will affect which states, if any, join and at what point during the war. For example, Mongolia’s entry on the side of the Allies only a few days before the end of World War II was likely informed by the impending Allied victory. In turn, third-party joining affects the dynamics of a war, since when a third party joins it affects the likelihood and timing of victory for both sides. For example, if the US had joined World War I earlier, the war would likely have followed a different course, with some states that joined the war instead remaining neutral and other states that remained neutral
instead deciding to join.

These two mechanisms form the foundation of several agent-based computational models, and supported by empirical evidence, which capture the behaviors of historical wars with greater accuracy than previous models. What is more, the models reveal aggregate behavioral patterns that offer new insight into the properties of war. While at the micro-level, each state simply decides what is in its best strategic interest at each time point (i.e., join a side or remain neutral), at the macro-level we see a clear divide between the outcomes of no expansion (the majority of cases) and explosive expansion; as suggested by history, war expansion behaves like an “all or nothing” phenomenon. Moreover, within the wars that expand, my models reveal strong patterns of balancing (third parties joining the weaker side) and/or bandwagoning (third parties joining the stronger side), with little behavior in between. In other words, at the macro-level wars exhibit predictable patterns of stability and instability, lurching between periods where power is balanced between the two sides and periods where one side has a preponderance of power and thus, a large chance of winning the war.

While not inconsistent with previous research on international conflict, these findings are new and exciting, offering a foundational explanation for why some wars expand to become the deadliest conflicts in history while most remain contained among the initial participants. All states in the international system watch how the others respond when a war breaks out, and most states are unlikely to join an ongoing conflict alone. But once some (usually powerful) states join, other states are much more likely to join too, leading to a cascade of joining in the form of the balancing and bandwagoning dynamics. These aggregate patterns are especially interesting because they are in no way driven by individual states intending to produce a grand avalanche of expansion or to balance or bandwagon. Yet despite being unplanned, these emergent properties are powerful. They suggest that third parties considering joining a war should think ahead not only to how the war between the initial participants will play out, but to how the joining decisions of all third parties could snowball into a swift and decisive victory for one side or another.

Chapter Outline

Chapter 1: The Puzzle of War Expansion

I open with a discussion of World War I, motivating the book’s central question: Why do some wars expand while others do not? I use this chapter to review the existing literature on war expansion, which concludes that the third parties most likely to join ongoing wars are those that are relatively powerful, allied with one of the initial participants, and/or geographically contiguous to one of these participants. These contextual factors are certainly important, yet because all wars are witnessed by powerful, allied, and/or geographically contiguous third parties—all of which have the option of joining a war at any time—these variables do not explain why some wars expand while others do not. I then discuss the two mechanisms that I argue can provide an answer: 1) each third party’s expectation of which other third parties will join a war and on which side, and 2) how the dynamics of a war influence each third party’s decision. Since the outcomes of wars that expand, such as World War II, have the potential to change international politics at a fundamental level, an understanding of how wars expand is an important (and exciting) enterprise.
Chapter 2: Methods of Modeling War Expansion
In this chapter, I examine three tools that could be used to model war expansion: decision-theoretic, game-theoretic, and computational. I identify the strengths and weaknesses of each approach and show how decision- and game-theoretic models break down when incorporating the two mechanisms I argue are essential to understanding war expansion. I turn to agent-based computational modeling as a tool that can better account for these two mechanisms. Agent-based models are typically composed of a set of diverse agents (e.g., states) that interact with each other using decision-making rules, adapting their behavior based on their own past behavior and/or that of other agents. Computer simulations run using these models then uncover the behavioral patterns that “emerge” at the macro-level based on the micro-level decisions made by individual agents.

Chapter 3: An Agent-Based Model of War Expansion
In this chapter, I construct an agent-based model consisting of agents that are heterogeneous in both their material capabilities (i.e., military force) and their relationships with each initial participant. The agents are assigned numbers to represent these characteristics so that this “artificial international system” approximates the real world international system. Constructing the artificial international system in this way lends realism to the model (i.e., helps with external validity) and lays the groundwork for evaluating the behavioral patterns generated by the computer simulations when compared with empirical data from real wars.

Following the onset of a “war,” each third-party agent decides in turn whether or not to join. Each agent’s decision is a function of its ability to influence the outcome of the war, the utility it would derive from each of the initial participants winning the war, and how costly it is to join the war. Furthermore, each agent’s decision is endogenous to the war’s dynamics; each time an agent joins it changes the dynamics of the war by shifting the probabilities of each side winning. As the war persists, each neutral agent re-evaluates its decision of whether or not to join. The timing of a war’s ending is also endogenous to the war’s dynamics; when the distribution of capabilities between the two sides exceeds a victory threshold, the war has some probability of ending. As a result, the model simulates both expanding and non-expanding wars.

I then run computer simulations of this model while varying the cost of joining. The results show strong patterns of balancing and/or bandwagoning, and specifically that whether balancing and/or bandwagoning patterns emerge depends on whether or not a major power joins and if so, when. When a major power joins the weaker side early in a war (i.e., balancing), it dramatically shifts the advantage to the weaker side. This advantage will persist throughout a war even though other third parties may join on both sides (i.e., both balancing and bandwagoning). In contrast, if no major power joins a war or if a major power joins but does so late in the course of the war, the war will shift back and forth between the two coalitions of participants as relatively weaker powers join on either side (i.e., both balancing and bandwagoning), and the war will end relatively quickly with the initially stronger side usually winning. In this case, the war is shorter compared to those wars when a major power joins early. Again, what makes these findings interesting is that the behavioral patterns that emerge at the macro-level are not a result of any micro-level desire to balancing or bandwagon by individual agents. Yet what these patterns mean is that the dynamics and ultimate outcome of a war are strongly shaped by the joining decisions of powerful third-party states, since these decisions reverberate through the entire international system.
Chapter 4: An Agent-Based Model of War Expansion and Contraction

In this chapter, I extend the model from Chapter 3 in ways that bring the model more closely in line with our real-world understanding of war. First, during an ongoing war, third parties do not sequentially decide whether or not to join the war; they all decide simultaneously at each point in time. Thus, the model is now executed in parallel, such that at each time point all agents simultaneously decide whether or not to join. Since agents have the opportunity to join the war in each time point, they now pay a per period cost for joining and these costs accumulate over time. Additionally, agents can now exit the war if the accumulated costs of joining outweigh the benefits.

Second, third parties in this model are strategic and forward thinking. In real wars, each third party’s decision to join or not to join is based, in part, on its anticipation of the expected joining decisions of all other third parties in the international system. Thus, agents in this model forecast which third parties are going to join in the next time point and use this information to make their contemporaneous joining decisions. This extension is a key innovation. Whereas most existing models make predictions about which third parties are likely to join ongoing wars, none allow the third parties themselves to use this information when deciding whether or not to join.

I run computer simulations for different per period cost values and derive new behavioral patterns. The behavioral patterns are similar to those found in Chapter 3 but an additional pattern emerges that suggests that war joining occurs in two waves. The first wave occurs soon after the war begins, and if powerful third parties join the war they tend to do so in this period. Weaker third parties anticipate the joining decisions of these more powerful states, and so tend to remain neutral at the outset. However, as the costs of participating accumulate and some of the powerful third parties that had joined the war earlier decide to exit (e.g., Italy in World War II), weaker third parties and/or those that initially derived little utility from which side would win the war tend to join (e.g., Mongolia in World War II), producing a second wave. In short, these results suggest that we should observe balancing and counter-balancing early in a war followed by bandwagoning after it is clear which side will win.

Chapter 5: An Agent-Based Model of War Expansion, Contraction, and Diffusion

This chapter extends the model developed in Chapter 4 to examine how geography influences a third party’s decision to join an ongoing war and how third-party joining affects the spatial diffusion of war. This model unites two separate strands of the extant literature: 1) why third parties join ongoing wars (i.e., expansion), and 2) how their participation influences the geographic size of wars (i.e., diffusion).

In this model, the decision rule used in Chapter 4 is extended so that each third party also considers its proximity to the current geographic location of the war and whether it expects the war to diffuse into its territorial borders. Each third party calculates its distance to the current location of the war and then discounts its ability to influence the outcome of the war accordingly. The closer a state is to the location of the war, the greater the ability the state has to influence the outcome of the war. A war expands spatially by occupying the physical space of some of the agents currently participating in the war. A third party then calculates whether it expects a war to diffuse into its territorial boundaries by counting the number of agents in its neighborhood currently participating in the war. The larger the number of contiguous agents currently participating in the war, the higher a third party’s expectation that the war will
Chapter 6: Testing the Empirical Implications of the Agent-Based Models
The emergent behavioral patterns of war expansion derived from the agent-based models in Chapters 3, 4, and 5 serve as hypotheses that can be tested using data on historical wars. In this chapter, I subject these hypotheses to empirical evaluation using statistical analysis on a sample of 95 wars between 1816 and 2007. The evidence from this analysis suggests that while in most cases no third-party states decide to join an ongoing war, in those cases where a war expands states tend to join in the same wave-like pattern of balancing and bandwagoning behaviors that the agent-based models identified.

Chapter 7: Simulated Case Studies of Three Wars
In this chapter, I conduct a different empirical evaluation using simulated case studies of the First Balkan War (1912-1913), the Second Balkan War (1913), and World War I (1914-1918). These three wars were chosen because they occurred in close temporal proximity and varied significantly in their severity, and importantly, in the number of additional states that became involved in the wars (0, 2, and 13, respectively). These simulated case studies are designed to see how well the agent-based models can predict the behaviors of actual wars. To conduct these simulated case studies, I start each simulation using historical data just prior to the outbreak of the given actual war and then run simulations to see if the model re-produces the number of third parties that joined, when those third parties joined, and the effect those joining decisions had on the dynamics of the war. These case studies serve as demonstrations of how well the model performs in predicting the degree of expansion (small in the Second Balkan War, large in World War I) or non-expansion (First Balkan War) of wars in history, and they complement the statistical analysis by providing insight into how these important wars unfolded.

Chapter 8: Expansion Cascades and their Implications
In this chapter I synthesize the findings from the agent-based models in Chapters 3, 4, and 5 and the empirical evidence gained in Chapters 6 and 7 to round out an answer to why most wars do not expand while some do so explosively, with devastating consequences. The aggregate patterns across the individual decisions of multiple third-party states suggests that joining dynamics are propelled by a strong inertia stemming from the networked nature of all states in the international system. This inertia—in the form of uniform neutrality or waves of joining—explains why some wars expand while others do not and why those that expand do so explosively. Finally, I discuss how the book contributes to our broader understanding of the process of conflict. Since third parties play a crucial role in how a war unfolds, a better understanding of the mechanisms of war expansion has implications as well for research concerning the onset, escalation, duration, and outcome of wars.