An Economic Theory of War*

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Abstract
When does war occur for economic reasons? The aggregate wealth two states can divide depends on how efficiently each of them is able to invest its own resources. Depending on the degree of institutionalization of the international economy and the size of each state’s sphere of influence, stronger states may be able to constrain weaker states’ access to resources and markets they need in order to grow efficiently. When stronger states fear their security will be undermined by weaker states’ economic growth, they will impose such constraints, producing an economic hold-up problem that may make peace inefficient. War happens when fighting is expected to eliminate this hold-up, leading to faster growth. This explanation for war results from a stronger state’s economic commitment problem, namely its inability to commit to grant weaker states generous terms of access to resources and markets vital to their economic growth. This mechanism accounts for wars launched by weaker states, even if they are rising, and helps account for how the current global free-trade regime promotes peace. We illustrate our theory by analyzing the economic roots of World War II in Europe and the Pacific.

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1 Introduction

When does war happen for economic reasons? Existing work focuses on the potential that trade and economic growth have to generate conflict. Before trade and growth take place, however, states must allocate their resources to economic production. We show how international constraints on states’ ability to invest their resource endowments efficiently can lead to war.

Powerful states can condition others’ ability to access resources they need in order to invest their own resource endowments efficiently. They can also condition the terms under which others can trade their products and services internationally. When powerful states expect negative security externalities to result from weaker states’ economic growth, they will be willing to impose such constraints, generating an economic hold-up problem by undermining weaker states’ ability to utilize their resource endowments efficiently, and hamstringing their economic growth. When this hold-up problem is sufficiently severe, war may be a rational strategy for the weaker state. Although fighting is costly and the state’s relative weakness makes victory less likely, winning would allow it to invest its resources efficiently, maximizing future growth. War happens when it is expected to produce a gain in economic efficiency large enough to make the expected outcome of fighting better than the continuation of an inefficient peace.

This argument highlights how the postwar global free-trade regime supports peace by undermining an incentive for war: the need to alleviate economic hold-up problems (Carnegie, 2014) resulting from powerful states’ ability to set the terms on which weak states can access resources and markets they need for efficient growth. In the highly institutionalized contemporary global trade setting, even powerful states would pay a heavy price for attempting to deny weaker states access to vital economic resources or markets (Ikenberry, 2001; Lake, 2009; Milner, 2010). This allows weak states to invest their resource endowments efficiently, eliminating incentives to fight in order to boost growth.

Our argument also sheds light on how power transitions may lead to conflict. According
to existing scholarship, power transitions lead to conflict either when declining states launch a preventive war (Powell, 1999; Copeland, 2000; Powell, 2006; Copeland, 2015) or when, having risen, states launch a war to revise a status quo that no longer reflects their relative power (Organski and Kugler, 1980; Gilpin, 1981). Shifts in power only lead weaker states to launch a war when they anticipate their position to decline further (Sagan, 1988; Paul, 1994). The conventional view is that it is not rational for weaker rising states to resort to arms. We account for why a weaker state may rationally launch a war even if the continuation of peace would allow its relative power to rise. When a weaker state expects fighting to result in faster growth, it will resort to arms. War is rational not depending on whether the state is rising, therefore, but on whether fighting is expected to hasten growth.

In our theory, war is caused by a previously unspecified commitment problem stemming from a powerful state’s difficulty in committing not to exploit its dominant international economic position. This commitment problem leads to war in the absence of information problems even when a bargain is feasible. Canonical perfect information models (Fearon, 1995; Powell, 2006) produce war only when a state’s minimum demand is unfeasible, i.e., greater than the total object of bargaining. Our model produces war when both demands are feasible but incompatible, i.e., when one state’s minimum demand exceeds the other’s maximum offer. When future surpluses depend on investment decisions, a state might demand more to avoid fighting than another is willing to offer. Specifically, when economic surpluses are expected to grow faster after war than if an inefficient peace were maintained, war is expected to be less costly than peace, becoming efficient.

The following section discusses the literature on economic growth and war. Section 3 introduces our argument, and Section 4 formalizes it in a game-theoretic model. Section 5 illustrates our theory by highlighting the economic dimension of the causes of World War II [WWII], which was launched by comparatively weaker states – Germany and Japan – that were rising prior to the conflict. Extensions to our baseline model and proofs of the formal results are in the Appendix (to be placed online).
2 The International Environment, Growth, and War

How does the structure of the international economy condition growth and, thereby, the odds of international conflict?

According to a common argument, trade increases the opportunity cost of war or otherwise obviates the need for territorial conquest, supporting peace (Polachek, 1980; Rosecrance, 1986; Crescenzi, 2003). While intuitive, this idea has been questioned using three lines of criticism. First, this argument glosses over complex strategic effects. As the opportunity cost of fighting increases, a state may be less willing to declare war. Anticipating this, another state may be more willing to escalate a conflict. As a result, the net effect of trade on the likelihood of war may be indeterminate (Morrow, 1999; Gartzke, Li and Boehmer, 2001).¹ Second, the pacifying effect of trade may depend not on its levels but on trade policy. To promote peace, trade must result from pro-trade policies rather than technological advances (McDonald, 2009).² Finally, economic exchanges reinforce peace only when expectations of future trade do not decrease (Copeland, 2015).³ A state that is highly reliant on trade may worry that being “cut off” by its partner(s) would result in economic decline, leading it to strike preventively (Copeland, 2015).

By emphasizing the role of expectations about future growth, Copeland (2015)’s argument is an important step toward understanding the links between trade, economic growth, and conflict. Yet, although Copeland (2015, 43-47) discusses several factors that may cause shifts in trade expectations, he does not connect these subjective expectations to the fundamental features of the international system in a way that would allow us to formulate predictions on how basic features of a state’s position – say, its relative power – would affect the odds of war for economic reasons. Without such a theory of whence shifts in trade expectations originate, however, Copeland’s argument only goes part of the way toward building a testable economic

¹Moving beyond a simple bilateral model of trade would further complicate the analysis of strategic interactions, see e.g. Martin, Mayer and Thoenig (2008); Chatagnier and Kavakli (forthcoming).
²For more on connections between trade, domestic politics, and war, see Chapman, McDonald and Moser (2015).
³This argument builds on the general point made by Waltz (1979, 142) about the potential for economic interdependence to generate conflict by bolstering state’s sense of economic vulnerability.
theory of war. As Snyder (2016, 180) argues, scholarship should build on Copeland’s work “along lines that are less inclined to take subjective trade expectations at face value [and] that anchor strategic choice more firmly on the state’s structural position in the international system.” The theory we introduce below follows Snyder’s injunction, accounting for one state’s strategic choice to restrict trade – and another state’s decision to launch a war in response to the lower growth expectations produced by this restriction – by looking at structural factors, namely, states’ relative power, the magnitude of the security externalities produced by economic growth, the magnitude of states’ autarkic spheres of influence, and the degree of institutionalization of the international economy.

The connection between trade, economic growth, and conflict is closely related to the issue of power transitions, an important and widely acknowledged cause of war. According to the conventional argument in this literature, anticipated large and rapid shifts in economic power may produce war by providing incentives for powerful states to launch preventive conflicts in order to forestall their own decline (Fearon, 1995; Powell, 1999; Copeland, 2000; Powell, 2006; Copeland, 2015). Such large and rapid economic shifts are exceedingly rare, however (Debs and Monteiro, 2014, 4-5). Furthermore, as Organski (1968, 294-295) noted early in the study of power transitions, “[n]ations with preponderant power have indeed dominated their neighbors, but they have not been the ones to start the major wars that have marked recent [XXth Century] history. That role has fallen almost without exception to the weaker side.”

What might lead a weaker state to start a war for economic reasons despite its disadvantage in relative power? A first argument extends the preventive logic laid out above to weaker states, which may decide to fight for fear that their status quo will deteriorate even further (Sagan, 1988, 920; Paul, 1994, 16-19, 30-31). Additionally, Van Evera (1999, 108-109) claims that when the offense-defense balance favors the offense, weak states may attack stronger peers in an attempt to conquer resource-rich territory; such was, Van Evera claims, the case with Germany and Japan in WWII. Finally, Mearsheimer (1983) argues that a weaker state
will resort to arms when it faces an unfavorable status quo and is able to identify a clever military strategy that would result in a quick victory without bringing about a prolonged attrition war; such was, Mearsheimer claims, the case with Germany in WWII.

While useful, these arguments on why weaker states might resort to fighting for economic reasons are imprecise. Van Evera ignores the possibility that states adjust for shifts in the offense-defense balance, avoiding war.\footnote{For a discussion of such adjustments, see Fearon (2015).} Also, Mearsheimer’s argument elides the fact that even clever military strategies that promise quick victory entail a cost, so that the decision to launch a war only makes sense when, despite this cost, the outcome of fighting is expected to be superior to that of maintaining peace. These conditions remain unspecified.

In sum, we lack a compelling economic argument accounting for wars launched by relatively weak states. Of particular interest is the absence of arguments accounting for wars launched by weak \textit{and rising} states. According to the existing literature, weak rising states have a vested interest in maintaining peace, allowing their relative power to increase. Yet, important wars were initiated by weak rising states. Such was the case with WWII, started in Europe and Asia by, respectively, Germany and Japan. These two countries were at the center of what Kennedy (1989, 249-447) labeled the “crisis of the ‘middle powers.’” The rise of Russia and the United States as continental powers that had access to resources and markets far greater than those controlled by any of their smaller peer competitors placed these ‘middle powers’ in a tough predicament: how to guarantee access to the resources and markets necessary to compete with the American and Soviet juggernauts? Germany and Japan ultimately decided that war was the best way to attempt to break out of this constraint, despite their relative economic rise in the years leading up to the war.

The limitations of existing work on the economic causes of war result from an incomplete conceptualization of economic interactions. The canonical model assumes that the object of states’ bargaining has a value that is fixed and independent of their action (Fearon, 1995; Powell, 2006).\footnote{A partial exception to this feature is the literature on bargaining over objects that affect future bargaining...} But this assumption is not appropriate when states negotiate over the distri...
bution of aggregate wealth. States determine their aggregate wealth by choosing economic policies and investing their resource endowments. The set of possible policies includes economic interaction – through flows of economic resources as well as finished products and services – which may increase their aggregate wealth. Understanding the economic causes of war requires a richer conceptualization of economic interactions in peacetime.

3 An Economic Theory of War

Our theory focuses on how international economic interactions may constrain the efficiency with which states can invest their resources and grow efficiently. This requires us to make economic growth the endogenous product of states’ investment decisions. Countries rarely possess all resources necessary for efficient economic growth and often procure them internationally. The more powerful a state is, the greater the influence it will have on global resource markets, impacting others’ terms of access to them, for example by manipulating prices, imposing sanctions, or adopting export controls (Gowa and Mansfield, 2004). We theorize a situation in which a weaker challenger is dependent on a stronger state, the hegemon, for access to resources it needs in order to convert its own resource endowment into output efficiently, maximizing growth. We define dependency as a situation in which the hegemon has the ability to set the cost the weaker challenger pays for resources it needs.

By endogenizing growth and considering the possibility that a weaker state’s access to

(Fearon, 1996; Powell, 2013). Yet these models predict that peace should prevail, given that war is costly, unless the following hold: states are risk-acceptant, there are bargaining indivisibilities, discontinuous jumps in the effect of economic conditions on the balance of power (Fearon, 1996) or contingent spoils available after the elimination of another state (Powell, 2013). We discuss these papers in further details in section 4.3.

An earlier and inconclusive debate examined how the prospect of “relative gains” from trade, which might lead to differential rates of economic growth and, therefore, to shifts in relative military power, impacted the odds of states engaging in economic cooperation and trade (Grieco, 1988; Powell, 1991; Snidal, 1991; Morrow, 1997). Although our argument is related, we focus on a different outcome: war.

We use the labels ‘hegemon’ and ‘challenger’ because our empirical focus is on great-power dynamics. Strictly, what defines the hegemon is its ability to constrain the challenger’s access to resources it needs for economic growth. Conversely, the challenger is defined by its dependency on the hegemon to access these resources. Therefore, our theory can also account for relations within any other dyads of states (or even sub-state actors) as long as these conditions hold.
resources be constrained by a stronger state, we uncover a new mechanism connecting economic interaction and war. In the anarchic international environment, an economic hegemon faces a hitherto unexamined commitment problem: it cannot commit to refrain from using its economic power to extract the best possible terms it can from weaker states. But if the hegemon uses its power to appropriate a disproportionate share of the gains in its interactions with a challenger, the latter will believe that it could grow more quickly if it overturned the status quo by military means.\(^8\)

Incorporating these power imbalances at play in the international political economy – and recognizing the hegemon’s commitment problem described above – allows us to build an economic theory of war. Other papers have argued that peace can be inefficient (Powell, 1993, 1999, 2006; Fearon, 2008; Coe, 2012; Debs and Monteiro, 2014). Yet no existing scholarship has endogenized the value of the aggregate wealth states can divide – the ‘pie’ – while highlighting this commitment problem.\(^9\)

The hegemon is more likely to impose terms that preclude the challenger’s efficient growth when two conditions are present. First, the challenger’s growth presents negative externalities for the hegemon’s security.\(^10\) Access to a key economic resource might allow the challenger to grow and threaten the hegemon’s security or that of vulnerable third states. Second, the cost the hegemon would pay for constraining the challenger’s growth is low. Such is the case when international economic interaction is weakly institutionalized, allowing the hegemon to single out the challenger’s resource access; and when the challenger does not possess a large sphere of influence, which would limit the ability of the hegemon to constrain its growth.\(^11\)

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\(^8\)For a recent application in the international political economy literature, see Carnegie (2014).

\(^9\)Coe (2012) argues that war may occur when a powerful patron commits to a linear tax rate, which creates economic distortions. The timing of the game assumes away the commitment problem, however (Coe, 2012, 52). The two states bargain over a tax scheme. If they agree, production takes place and taxes are paid according to the agreed upon tax scheme. The patron does not have the option to renege on the agreed upon tax scheme. In this game, lump-sum transfers do not create economic distortions; they should lead to peace under complete and perfect information.

\(^10\)On security externalities associated with trade, see Gowa and Mansfield (1993); Gowa (1994). Other factors, such as market and economic structures, may contribute to variation in the extent to which the hegemon is able to constrain the challenger’s ability to invest its economic resources efficiently.

\(^11\)Other factors that may limit the hegemon’s ability to constrain weaker states’ access to resources may include normative and domestic politics considerations.
When the hegemon constrains the challenger’s economic growth, the challenger will be tempted to fight. All other things equal, the higher is the growth inefficiency imposed by the hegemon on weaker states, the higher is the likelihood of conflict. This mechanism highlights how certain features of the international system – namely, the presence of large security externalities from economic growth, weakly institutionalized trade, power imbalances that favor an economic hegemon, and challengers that do not possess well established spheres of economic influence – increase the value of conquering resource-rich territory, making conflict more likely. This logic allows us, in contrast with Copeland (2015)’s trade expectations theory, to offer predictions about the conditions under which economic dependency is more likely to result in conflict. (See proposition 1 below.) Copeland (2015) argues that war happens *when* expectations about economic interaction shift. Our argument is about *why* particular expectations about economic interaction – i.e. expectations about how efficiently the challenger will be able to grow – emerge.

In particular, our argument helps explain why how the post-WWII global economic regime of open trade supports peace. An open international economy supported by institutions that make it more costly for powerful states to exploit their weaker peers is a force for peace (Gowa, 1994; Mansfield, 1994; Goldstein and Gowa, 2002; Milner, 2005; Davis and Wilf, 2014). The contemporary free-trade structure of the global economy alleviates economic hold-up problems that might affect weaker states if their access to resources were to be controlled by powerful states, as was the case in earlier historical periods. Today, given the highly institutionalized character of international trade, the costs of excluding a state from accessing resources it needs for growth would be particularly high, even for the the United States, which possesses the largest economy in the world.

This logic has consequences for the relationship between power shifts and war. Whereas existing literature focuses on relative power trajectories – investigating whether it is rising or declining states that launch wars – our argument highlights a different strategic calculus. Regardless of whether they are rising or declining, challengers decide whether to resort to
arms by comparing the expected outcome of peace and war. The odds of conflict depend on the magnitude of the economic inefficiency that the hegemon imposes on the challenger. Whenever this inefficiency is greater than the cost of war, conflict is likely to ensue regardless of the power trajectory of the challenger relative to the hegemon. Furthermore, the weaker the challenger is, the greater this inefficiency. Therefore, war happens only when the challenger’s probability of victory is not too high – i.e., when the challenger is not too strong.

Certainly, a weak challenger is less likely to prevail in war. By the same token, however, a weak challenger cannot use the threat of war effectively to obtain favorable terms of peace. The higher is the probability that the challenger wins the war, the greater the threat it represents to the hegemon, who will offer it more favorable terms peacefully. Thus, the higher the probability that the challenger wins the war, the more efficiently it will be able to invest in economic output, and the lower the inefficiency of peace. It is relatively weak states that may need to fight in order to obtain favorable terms of economic interaction. Only relatively weak challengers are likely to launch wars for economic reasons.

Conflict may be rational for the challenger even if peace would allow for its power to rise in relative terms, as long as war is expected to accelerate this rise. Whenever the challenger expects fighting to result in less inefficiency than the maintenance of peace, it will declare war. If the challenger’s power is rising, it will be able to extract better terms from the hegemon in the future, resulting in more efficient future investments in economic growth. Therefore, there is no case in which war would be rational after the challenger has greater relative power but does not presently make sense. Conflict will always occur before, not after, a challenger’s rise in power. This explains why even weaker rising challengers may rationally go to war.

Our argument also has implications for rationalist explanations for war. In the standard framework, war between rational states under complete information results from a military commitment problem. Unable to commit not to use its military power in the future, a rising state may induce a declining state to declare war preventively (Fearon, 1995; Powell, 2006).
In this framework, war happens because when the declining state anticipates a sufficiently large and rapid adverse shift in relative power, the minimum demand it is willing to accept is not feasible – i.e. it is greater than the entire object in dispute, or “pie.” Under the constraints of a fixed pie, and given that war is costly, a bargaining range always exists – i.e. the minimum demand of a rising state is always less than the maximum offer of a declining state. The rising state always gains from peace, which allows the balance of power to shift in its favor.

But, as we have seen, the assumption that the pie over which states bargain is fixed does not capture essential features of states’ economic interaction, including their decisions to allocate resources to producing tradeable goods and services, which determines the value of the surplus to be divided. When we allow the value of the object over which states bargain to vary according to the states’ decisions to invest in a tradeable surplus, however, the bargaining range may be eliminated. When the cost the challenger has to pay for resources essential to its economic growth is sufficiently high, and when the challenger expects war to eliminate this inefficiency, the minimum demand it would accept may become higher than the maximum offer the hegemon is willing to make. When this is the case, the two states’ demands are no longer compatible, the bargaining range is eliminated, and war is the rational course of action even for a challenger that is weak and rising.

In sum, our argument entails three steps. Current economic growth can lead to negative security externalities by imperiling vulnerable third states and allowing for shifts in military power. Aware of these externalities, powerful states may be willing to curtail weaker states’ access to resources they need to invest their own resource endowments efficiently. Indeed, given their dominant economic position, powerful states cannot commit to refrain from constraining weaker states’ access to such resources. If, as a result of such constraints, weaker states expect their economic growth to be hastened by going to war, peace will break down. This economic commitment problem worsens as the challenger becomes weaker, its sphere of influence shrinks, and the degree of institutionalization of the international economy is lower.
This argument allows us to make two central contributions. To rationalist explanations for war, we contribute a novel commitment problem, capturing the key friction causing war for economic reasons. The economic commitment problem we introduce helps us unlock long-standing theoretical puzzles, such as whether rising or declining states can rationally resort to arms. As we show, war can be a rational strategy for both, depending on its expected effect on economic growth. Analyzing this commitment problem also allows us to contribute to the literature on trade and conflict, by offering predictions on the likelihood of war for economic reasons as a function of structural factors that ameliorate this commitment problem, such as the size of the challenger’s sphere of influence and the strength of international institutions. As we will see in section 5 below, these empirical implications of our theory help us account for the economic dimension of important historical cases.

4 The Model

4.1 Set-Up

We model a strategic game between two states. Call the first state \( H \) for ‘hegemon’ and the second state \( C \) for ‘challenger.’ The first state is defined as a ‘hegemon’ because of its influence on the international political economy. The challenger enters international markets to purchase an input, which it uses to generate economic output. The hegemon controls the input needed by the challenger, and can set its price. Furthermore, the hegemon can intervene on international markets to prevent the challenger from enjoying its economic output. We evaluate how the hegemon’s influence over the international political economy affects the prospects for peace.

Formally, let \( C \) purchase an input \( i \) from \( H \) at price \( p_i \). \( C \) can then choose a level of investment \( I \) to convert the input into an economic output, or a ‘pie,’ of size \( \pi(I) \).\(^{12}\) Assume that \( \pi(I) \) is increasing and concave in \( I \), with the marginal return of investment arbitrarily

\(^{12}\)The assumption that only \( C \) is investing in creating a pie is made for simplicity. For a richer model, where \( C \) and \( H \) are trading inputs and investing in creating a pie, see section 7.2.
large at \( I = 0 \), i.e. \( \pi'(I) > 0 \), \( \pi''(I) < 0 \), and \( \lim_{I \to 0} \pi'(I) = \infty \). Finally, let \( \pi(0) > 0 \), so that there is still economic value attached to the inputs; in this way, we retrieve the canonical model, where the two countries divide a fixed pie of exogenous value (Fearon, 1995). In addition to its ‘economic value,’ the pie creates an externality of \( \sigma \) per unit, so that its total value is \( \pi(I)(1 + \sigma) \). The externality \( \sigma \) represents the fact that the economic output could be used to advance military operations against third parties. Let \( \sigma \) take one of two values, \( \sigma \in \{ \sigma, \overline{\sigma} \} \), where \( \sigma = 0 \) and \( \overline{\sigma} \) is ‘large’ (proofs provide the minimal bound for \( \overline{\sigma} \)).

\( H \) can use its influence on the international political economy to prevent \( C \) from enjoying the value of the pie that it created. \( H \)’s intervention could take multiple forms, allowing for different interpretations. For example, \( H \) could demand a tax on \( C \)’s economic output. Alternatively, \( H \) could manipulate currencies or impose economic sanctions on \( C \), preventing it from trading its economic output for its full value on international markets. Finally, \( H \) could prevent \( C \) from using its economic power to seize resources from neighboring countries by force. For all these scenarios, if \( H \) intervenes, then it offers \( C \) a payoff of \( z \) and keeps the difference \( \pi(I)(1 + \sigma) - z \).

We assume that intervening is costly for \( H \). Write \( k_m \) for the cost that \( H \) pays for intervening on the market. For simplicity, assume that \( k_m \) takes one of two values, \( k_m \in \{ \underline{k}_m, \overline{k}_m \} \), where \( \underline{k}_m \) is ‘small’ and \( \overline{k}_m \) is ‘large’ (proofs provide the bounds on \( \underline{k}_m \) and \( \overline{k}_m \)). We assume that it is easier for \( H \) to intervene in a market if international institutions are weak or if \( C \) does not possess its own sphere of influence. Put differently, the cost of intervention is more likely to be high, everything else equal, the greater is the size of the challenger’s sphere of influence and the stronger are international institutions.

States can interact peacefully or go to war. They can disagree over the price of the input or the division of the output.\(^{13}\) If states go to war over the price of the input, then the winner of the war controls the input, chooses the level of investment, and obtains the total

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\(^{13}\) When states bargain over the price \( p_i \) of the input, \( H \) moves first in proposing a price. This assumption is done for simplicity and does not affect the results. At the same time, this assumption reflects \( H \)’s influence on the international political economy and is in keeping with the canonical bargaining model, where the currently most powerful state moves first.
value of the output. If states go to war over the division of the output, then the winner of the war obtains the total value of the output. Any war is won by $C$ with probability $p(\kappa)$, where $\kappa$ is a measure of its capabilities. Let $p(\kappa)$ be strictly between 0 and 1, increasing in capabilities at a decreasing rate, i.e. $p(.) \in [p_{min}, p_{max}] \subset (0,1)$, $p'(.) > 0$, $p''(.) < 0$, and $\lim_{\kappa \to \infty} p'(\kappa) = 0$. Any war is costly (Fearon, 1995). Let $c_s$ be the cost paid by state $s$ if a war is fought, where $s \in \{C,H\}$. We assume that $c_s > 0, \forall s \in \{C,H\}$, and we call $c_C + c_H$ the cost of war. Following the canonical model, we assume that the players’ reservation values are interior, i.e. $p_{min} > \frac{c_C}{\pi(0)}$ and $p_{max} < 1 - \frac{c_H}{\pi(0)}$.

To recap, assume that the value of the key parameters $\sigma$ and $k_m$, the value of the externalities and the cost of intervention, respectively, are first set and become common knowledge. The game is then played as follows (for a graphical illustration, see Figure 1):

1. $H$ demands a price $p_i$ for the input or decides to declare war;
2. $C$ accepts $H$’s price $p_i$ or decides to declare war.

If peace prevails in the negotiations over $p_i$, then the game proceeds as follows:

1. $C$ chooses the level of investment $I$;
2. The pie $\pi(I)$ is created;
3. $H$ decides whether to acquiesce to $C$’s acquisition of the pie or intervene on the market, offering $z$ to $C$ and keeping $\pi(I)(1 + \sigma) - z$;
4. If $H$ intervened on the market and offered $z$, then $C$ decides whether to accept $z$ or declare war.

If war obtained in the negotiations over $p_i$, then the winner of the war chooses the level of investment $I$, the pie $\pi(I)$ is created, and its proceeds accrue to the winner of the war.

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14The assumption that $C$’s capabilities are exogenous is made for simplicity. For a richer model, where $C$ can invest in its military capabilities, see section 7.2.
Throughout the interaction between $C$ and $H$, we assume perfect and complete information. We solve for a subgame-perfect Nash equilibrium of this game.

4.2 Solution

We proceed by backward induction. First assume that war obtained in the negotiations over the price of the input $p_i$. Then the problem for the winner of the war is straightforward. Since it gets the full value of the pie it creates, then it chooses the efficient level of investment:

**Lemma 1** Assume that war obtained in the negotiations over the price of the input $p_i$. Then the winner of the war chooses the efficient level of investment, i.e. $I^{fb}(\sigma)$ such that $\pi'(I^{fb}(\sigma)) = \frac{k}{1+\sigma}$. **Proof.** Straightforward. ■

Now assume that peace prevailed in the negotiations over $p_i$. Consider $C$’s decision to accept or reject $z$, assuming that $H$ has intervened on the market. $C$ accepts $z$ if and only if it receives as much in peace as it expects in war, i.e. if $z \geq p(\kappa)\pi(I)(1+\sigma) - c_C$.

Moving up, consider $H$’s optimal offer $z$ after intervention. $H$ prefers to see its offer accepted rather than rejected if and only if $\pi(I)(1+\sigma) - z \geq (1 - p(\kappa))\pi(I)(1+\sigma) - c_H$. Since war is costly, there is a bargaining range and there are values of $z$ that satisfy both states (Fearon, 1995). Thus, if $H$ intervenes on the market, it makes an offer that leaves $C$ indifferent between war and peace, i.e. $z = p(\kappa)\pi(I)(1+\sigma) - c_C$.

Next, consider $H$’s decision to acquiesce to $C$’s creation of the surplus or intervene. Intervening is costly but provides $H$ with some of the pie generated by $C$. The greater is the value of the externality, the more tempted $H$ is to intervene. $H$ prefers to intervene if and only if $-k_m + (1 - p(\kappa))\pi(I)(1+\sigma) + c_C \geq 0$, or the cost of intervention is low relative to the value of the externality. Under convenient assumptions on parameter values, this condition holds for any level of investment $I$ if the cost of intervention is low and the value of the
externalities is high, and otherwise fails for any level of investment $I$ (see the proof of lemma 2 below).

Moving up, consider $C$’s investment decision. When the cost of intervention is high or the value of externalities is low, $C$ expects to obtain the full value of any pie it creates. In this case, $C$ chooses the efficient level of investment. In contrast, when the cost of intervention is low and the value of externalities is high, then $C$ anticipates that it will not get the full value of the pie it creates, because $H$ will intervene. In this case, the fraction of the pie that $C$ obtains is commensurate with its military capabilities, which determine its ability to use military threats to secure some of the pie. Summing up, if peace prevails in negotiations over the price of the input $p_i$, then equilibrium strategies are as follows:

**Lemma 2** Assume that peace prevailed in the negotiations over the price of the input $p_i$. There exist values $k_m'$, $k_m''$, $k_m$, $\sigma'$ such that if $k_m \in (k_m', k_m'')$, $k_m > k_m'$, and $\sigma > \sigma'$, then the following holds:

- If the cost of intervention is high ($k_m = k_m$) or the value of externalities is low ($\sigma = \sigma$), then $C$ chooses the efficient level of investment, i.e. $I^{fb}(\sigma)$ as defined above such that $\pi'(I^{fb}(\sigma)) = \frac{k}{1+\sigma}$; $H$ does not intervene; $C$ accepts $z$ if and only if $z \geq p(\kappa)\pi(I)(1 + \sigma) - c_C$.

- If the cost of intervention is low ($k_m = k_m$) and the value of externalities is high ($\sigma = \sigma$), then $C$ chooses a level of investment $I^*(\sigma, \kappa)$ such that $\pi'(I^*(\sigma, \kappa)) = \frac{k}{p(\kappa)(1+\sigma)}$; $H$ intervenes on the market and offers $z = p(\kappa)\pi(I)(1 + \sigma) - c_C$; $C$ accepts $z$ if and only if $z \geq p(\kappa)\pi(I)(1 + \sigma) - c_C$.

**Proof.** Follows from the above. For the bounds on $\sigma$ and $k_m$, see the Appendix.

The two possible levels of investment after peace are represented graphically in Figure 2. The fact that $H$ could intervene and prevent $C$ from obtaining the value of the pie it creates generates an inefficiency, with the value of $C$’s investment being sub-optimally low.
Comparing the outcome of the game (lemmas 1 and 2), we see that peace can lead to inefficiencies. If peace prevails, then C is subject to H’s economic influence. H’s economic commitment problem – i.e. its inability to commit to refrain from using its economic influence – induces C’s investment to be sub-optimally low, when the cost of intervention is low and the value of externality is high. This inefficiency may be sufficient to trigger war.

Write $W_s(s')$ for state $s$’s payoff if negotiations over the input end in war and were won by state $s'$; and $P_s(\kappa)$ for state $s$’s payoff if negotiations over the input ended peacefully and C’s capabilities are $\kappa$. The maximum price that C is willing to pay for the input is such that 

$$-p_i + P_C(\kappa) \geq p(\kappa)W_C(C) + (1-p(\kappa))W_C(H) - c_C.$$ 

The minimum price $p_i$ that H requests from C is such that 

$$p_i + P_H(\kappa) \geq (1-p(\kappa))W_H(H) + p(\kappa)W_H(C) - c_H.$$ 

A bargaining range exists, and thus peace prevails, if and only if 

$$ (W_C(C) + W_H(C)) - (P_C(\kappa) + P_H(\kappa)) \leq c_C + c_H $$

(1)

The right-hand side of the inequality is strictly positive, since war is costly. Given the above, the left-hand side of the inequality is weakly positive. A country that wins a war chooses the efficient level of investment, since it expects to reap the full benefit of its investment. In contrast, a challenger may choose a sub-optimal level of investment. Since the hegemon cannot commit to refrain from using its influence on the international market, the challenger may expect to reap only part of the benefit of its investment and thus choose an inefficiently low level of investment. Peace prevails if and only if this inefficiency is smaller than the cost of war.

Thus, war obtains only if the hegemon is expected to intervene on international markets, i.e. if the cost of capture is low and the value of the externality is high. Any factor that increases the expected cost of intervention is a force for peace. The strength of international institutions and the size of the challenger’s sphere of influence, by increasing the probability
that the cost of intervention is high, reduce the probability of war.

In addition, when the cost of intervention is low and the value of the externality is high, the inefficiency of peace decreases with $C$’s capabilities, $\kappa$. Whereas total payoffs after war are fixed, total payoffs after peace increase continuously with $\kappa$. The greater is $\kappa$, the greater is the share of the surplus that the challenger expects to obtain, and the closer is its investment to the efficient level. Summing up the above discussion:

**Proposition 1** (i) War occurs if and only if the cost of intervention is low, the value of the externalities is high, and the capabilities of the challenger are low; (ii) The probability of war is decreasing with the size of the challenger’s sphere of influence and with the strength of international institutions. **Proof.** See section 7.1 in the Appendix. ■

### 4.3 Discussion

Now let us highlight the differences between our model and the canonical model, drawing lessons for our understanding of the nature of commitment problems, and the relationship between power and war (formal results are in section 7.3 in the Appendix).

In the canonical model, war is caused by a *military* commitment problem. A rising state cannot commit to refrain from using its future military power. As a result, a declining state may declare war to prevent the adverse shift in the balance of power. War happens only when the shift in the distribution of power is large and rapid, in fact greater than the cost of war (see Powell, 2006, 182 and also Fearon, 1995; Powell, 2004, 236). Only the declining state declares war. The rising power has a stake in maintaining peace so that its own power rises and would never declare war.\(^{15}\)

In our model, war is caused by an *economic* commitment problem. An economically powerful state cannot commit to refrain from using its economic power. Understanding that

\(^{15}\)Some formal models have a rising state declaring war, e.g. Kim and Morrow (1992); Powell (1996) and Powell (1999, Chapter 4), but none produces war in a game of complete information, when bargaining is allowed.
its growth may be stunted by its adversary, a challenger may want to mount a military challenge against the hegemon. War happens when the inefficiency of peace is greater than the cost of war (see equation (1)). Under this condition, either state may declare war. Certainly, a challenger may go to war, hopeful to achieve faster growth after victory. A hegemon may also declare war, realizing that peace is unsustainable.

Put differently, the condition for war in the canonical model is a feasibility constraint: the minimum demand of one state is less than the maximum offer of the other state, but the bargaining range does not intersect with the set of feasible offers. In contrast, our argument is one where war results from a compatibility constraint: the minimum demand of one state is greater than the maximum offer of the other state.

In thinking about the relationship between power and war, it is important to separate concerns about the causes of a war and concerns about its timing. Certainly, a state wants to fight a war on the best possible terms. A declining state should go to war before it declines in power; a rising state should wait before going to war. This does not mean, however, that the trend in power causes the war. A theory of war is not complete if it explains the breakout of war by assuming that war would have happened in the future; at best, such a theory explains the timing of war.

Our theory highlights the economic commitment problem as the fundamental friction that causes war, generating empirical predictions, as presented in Proposition 1. Factors that worsen the economic commitment problem, such as the challenger’s military weakness, the smallness of its sphere of influence, or the weakness of international institutions, undermine peace.

Similarly, the economic commitment problem is worsened when there is a tight link between economic growth and future military power. For example, if we consider a dynamic game where the share of the pie that the challenger keeps in the current period affects its future military power, then the hegemon would be especially tempted to intervene to prevent the rise of the challenger. Seeing that its growth would be stunted, the challenger perceives
peace to be inefficient, and may prefer to mount a military challenge against the hegemon. Herein ultimately lies the connection between the two types of commitment problems—economic and military—that may produce war.

Previous papers do allow for bargaining over objects that affect future bargaining (Fearon, 1996; Powell, 2013). Yet they generate war under limited circumstances. In Fearon (1996), war occurs if leaders are risk-acceptant, the pie is imperfectly divisible, or there are discontinuous jumps in the balance of power. In Powell (2013), war occurs when (exogenous) contingent spoils become available after one party consolidates power over another. Our model imposes none of these conditions. Instead, we explain war by endogenizing the pie divided between the two states, and modeling the economic commitment problem. Fearing a link between the challenger’s economic growth and its future military power, the hegemon may intervene; seeing its growth stunted, the challenger may go to war.

5 Empirical Illustrations

We now apply our framework to shed new light on the causes of the Second World War in Europe and the Pacific. We focus on Japan’s decision to attack the United States at Pearl Harbor on December 7, 1941; and on Germany’s decision to declare war on the United States four days later—a declaration to which Berlin was not obliged by its treaty commitments toward Tokyo.

To be clear, like other major conflicts, WWII resulted from a conjunction of causes. Of these, economic factors are arguably among the most important. In what follows, we highlight the economic dimension of Tokyo’s and Berlin’s decision making leading to the war. Our claim is not that economic factors were solely responsible for the conflict. Rather, these factors were an important facet of the structure of the situation faced by these two middle powers, pushing their decision makers toward war.

In the run-up to the war, Germany and Japan depended on the United States for access
to vital resources they needed for economic growth. Neither country controlled spheres of influence that ensured unrestrained access to the resources it needed for growth. Furthermore, international economic interactions at the time were weakly institutionalized. Aware of the potentially grave security externalities of German and Japanese access to key economic resources – which would further these countries’ ability to endanger world order and put them within reach of regional hegemony in, respectively, Europe and East Asia – the United States sought to constrain their growth. This decision created serious hold-up problems in the German and Japanese economies, contributing to Berlin’s and Tokyo’s option for war.

Both countries were considerably weaker than the United States. In 1938, its last year at peace, the German economy represented a mere 43% of the U.S. economy, at the time the largest in the world. Japan was even weaker. By 1940, the year prior to the onset of hostilities with the United States, it’s economy represented 23% of the U.S.’s. Furthermore, both countries were rising, from, respectively, 31% and 15% of the U.S. economy in 1929.\textsuperscript{16} As such, WWII was launched by rising weaker powers at least partially for the economic hold-up reasons captured by our mechanism.

5.1 The Economic Roots of Japan’s Decision to Attack the United States

There is a vast debate on the causes of WWII in the Pacific. Some scholars question the usefulness of a rationalist approach to the conflict, claiming that it was due to excessive optimism on the part of the Japanese (Snyder (1991, chapter 4); Taliaferro (2004, chapter 4); Record (2009, 1-5)). Others accept a rationalist account, arguing that, when compared to the decline to which peace fated Japan, war was the lesser of two evils (Russett, 1967).\textsuperscript{17}

\textsuperscript{16}Source: Bolt and van Zanden (2014); values in constant 1990 international dollars.

\textsuperscript{17}Another set of scholars claims that the war was due to bureaucratic overreach in Tokyo (see: Russett (1967, 99); Sagan (1988, 916)) or in Washington (see: Utley (2005); Sagan (1988)). Finally, there is a debate on whether FDR adopted a tough policy toward Tokyo in order to deter a Japanese attack on the USSR (Heinrichs, 1988, 1990) or provoke the Japanese as a back-door entry into a war with Nazi Germany (see Trachtenberg (2006); Schuessler (2010); Copeland (2015) and the debate in Reiter and Schuessler (2010)). We discuss these views below in footnote 18.
Yet no account explains the strategic underpinnings that led Japan to conclude that war was the lesser evil.

Our framework sheds light on how the economic interaction between the United States and Japan was at least in part responsible for WWII in the Pacific. Economic motivations were a key driver of Japanese foreign policy in the lead-up to the war. With limited resources of its own, Japan was highly dependent on foreign markets for raw materials, including energy. In a series of endeavors since the late 19th century, Japan gradually acquired access to additional economic resources by conquering territory in East Asia: Taiwan after the first Sino-Japanese War (1894-5); the Liaotung peninsula, after the Russo-Japanese war (1904-5); and resource-rich Manchuria, in March 1932 (Barnhart, 1987, 27-33). Continuing Japan’s drive to control additional resources, the long and costly second Sino-Japanese war erupted in 1937. Three years later, in August 1940, Japanese foreign minister Matsuoka Yosuke expanded the projected sphere of influence, now called the “Greater East Asia Co-Prosperity Sphere,” to include Australia, Borneo, Burma, India, Indochina, Malaya, New Zealand, the Dutch East Indies, and Thailand (Iriye, 1987, 131; LaFeber, 1997, 192-193).

The United States consistently opposed these Japanese attempts to establish a sphere of influence in Asia. Washington had a long-standing commitment to defend the Open Door policy in China. In fact, according to historian Walter LaFeber, “[e]verything [U.S. Secretary of State Cordell] Hull had tried to achieve since he had entered the State Department was aimed precisely at destroying such regional blocs and Japan’s (or any non-American) ‘Monroe Doctrine.’ Roosevelt, with less passion, agreed” (LaFeber, 1997, 193). After the escalation of hostilities in the second Sino-Japanese war in 1937, Roosevelt made a famous “Quarantine Speech,” calling for “peace-loving nations” to contain the spread of war (Barnhart, 1987, 123; Utley, 2005, 16). Furthermore, the United States imposed a series of “moral embargoes” on Japanese trade.

Germany’s invasion of the Soviet Union in June 1941 presented Japan with a window of opportunity to grab the territories it needed to control the resources necessary for economic
expansion (see, e.g., Heinrichs (1990); LaFeber (1997); Paul (1994); Copeland (2015)). Foreign Minister Matsuoka favored an immediate attack on the Soviet Union (Ike, 1967, 60). Well aware of this strategic situation, Washington worried that Tokyo would open a second front against the USSR, which was already overwhelmed by the German attack – Operation Barbarossa (see, e.g. Wohlstetter (1962, 107,126)). Such a development would endanger the survival of the Soviet Union, making it possible for the entire Eurasian landmass to fall under the control of the Axis powers.

At the Imperial Conference of July 2nd, the Japanese cabinet decided instead to proceed with a Southern Advance – aimed at accessing resources in Southeast Asia, particularly oil – “no matter what obstacles may be encountered” (Ike, 1967, 78). Japanese leaders became increasingly convinced that war with the United States was inevitable. As Prime Minister Konoye clarified: “In carrying out the plans outlined … we will not be deterred by the possibility of being involved in a war with England and America,” noting that “all plans, especially the use of armed forces, will be carried out in such a way as to place no serious obstacles in the path of our basic military preparations for a war with England and America” (quoted in Wohlstetter, 1962, 345-346).

On July 24th Japan launched the Southern Advance. The next day – aware of the grave security externalities that Japanese access to additional resources would have, endangering the Soviet Union and placing twin regional hegemonies within reach of Germany and Japan – the United States responded with a complete embargo on sales of oil to Japan. Importing so much of its oil from the United States, Japan faced two undesirable choices: war against a much stronger economy or a hold-up problem severe enough to bring about economic collapse (Wohlsteter, 1962, 356-357). The Japanese government eventually reached the conclusion that its policies were “mutually incompatible” with those of the United States: Japanese attempts to acquire control over the territories necessary to access the resources it needed to maximize its economic growth would no doubt lead Washington to restrain Japanese access to resources controlled by the United States, so that this conflict between the strategies of
the two countries “will ultimately lead to war” (Ike, 1967, 152).

After months of tense negotiations, Japanese decision-makers chose war, and on December 7th, 1941, attacked the U.S. Pacific Fleet at Pearl Harbor. Whether or not the cabinet debated the strategic consequences of a direct attack – the topic of a lively debate in the historiography – it had endorsed a war with the United States. In retrospect, the failure to anticipate the effect of an attack on Pearl Harbor may help explain why Japan opted for this risky opening gambit, which may in turn help account for the outcome of the conflict. But it does not explain the initiation of war itself.

To account for the deep causes of the war one has to understand why Tokyo decided to attack a far more powerful country despite rising Japanese economic power. The answer lies in Washington’s hegemonic position in the international economic – and, more specifically, its ability to constrain Japanese access to vital resources. This position made possible the U.S. decision of the summer of 1941 to restrain Tokyo’s access to oil. To understand this decision by the FDR Administration, in turn, we need to focus on the increased negative security externality that Washington associated with Japanese access to key economic resources such as oil once Operation Barbarossa started. Tokyo no longer faced a Soviet threat in mainland Asia, giving it a freer hand in continuing Japanese territorial expansion; and, worse, Tokyo might well decide to attack the Soviet Union directly, furthering its demise and opening the door to a dual regional hegemony of Germany and Japan over the Eurasian landmass. The essence of these dynamics is captured by the theoretical mechanism introduced in this article.

Many have argued that Japan’s dependence on U.S. oil, and the fear of decline it produced in Tokyo, were a cause of conflict (Waltz (1979, 142); Copeland (2015)). Since Japan lacked the resources to become self-sufficient, it needed an empire of adequate size to become so. In this way fear combined with ambition. For example, Paine (2012, 25) argues that “if the West would not trade, then Japan would turn to the alternate economic model of the time, autarky, or economic self-sufficiency.” This perspective is incomplete, however. Given that war is costly and destructive, it is not clear why expectations of lower economic growth
would lead to the breakout of hostilities (Fearon 1996). The same weakness that made Japan dependent on resources controlled by the United States also made it unlikely to prevail in a war against U.S. forces. Both options – war as well as limited growth in peace – were unattractive. To account for the origins of the war, therefore, we need to understand how Japanese weakness made the expected outcome of peace even worse than that of war against a far more powerful adversary. By focusing on the role that relative plays in magnifying economic hold-up problems – put succinctly, on the relationship between power and war – our theory provides an account of this dynamic of crucial importance in the origins of the Pacific war. We agree with existing explanations (Russett, 1967; Sagan, 1988; Paul, 1994; Copeland, 2015) that highlight how Japanese leaders found both war and peace to be unattractive options. Our contribution is to provide an account of why war seemed the least unpalatable of the two.

In sum, Japan’s inability to access the necessary resources for economic grow in the U.S.-dominated international economic system contributed to Tokyo’s decision to launch a war. Japan was relatively weak and dependent on access to foreign resources that were to a great extent controlled by the United States. When the security externalities of Japanese access to key resources – namely, oil – increased, Washington restricted Japanese access to it. Facing a severe economic hold-up problem, Japan initiated the Pacific War. By declaring war on the United States, Japan took on a much stronger enemy, which had far more latent power and ultimately imposed severe damage and obtained unconditional surrender. Our mechanism highlights how the dire security externalities that unconstrained Japanese access to key economic resources potentially had after the German invasion of the Soviet Union in June 1941 led Washington to constrain Tokyo’s ability to procure such resources, generating a serious economic hold-up problem in the Japanese economy during the summer of 1941, and in turn leading decisionmakers in Tokyo to prefer war against a far more powerful adversary over the maintenance of peace. War could be attractive even if it was expected to be costly, because victory would allow Japan better to solve its hold-up problem and grow efficiently.\textsuperscript{18}

\textsuperscript{18}A rationalist account focusing on the strategic calculations comparing war and peace is thus sufficient to
5.2 The Economic Roots of Germany’s Decision to Declare War on the United States

The day after the Japanese attack on Pearl Harbor of December 7, 1941, the U.S. Congress declared war on Japan. Three days later, on December 11, 1941, Germany declared war on the United States. Already entangled in a massive war with the Soviet Union, Germany would now be simultaneously taking on the most powerful economy on earth. Moreover, since Japan had not been attacked, Berlin was not obliged to assist Tokyo in its war against the United States. Why did Hitler make what would prove to be one of the most puzzling decisions of WWII (Kershaw, 2007, 382); one that would prove to be among the greatest strategic blunders of the twentieth century?

Although the importance of the United States in Hitler’s thinking is often overlooked, he had devoted considerable thought to the United States since the 1920s. The clearest articulation of Hitler’s views on the matter can be found in his Zweites Buch, dictated in 1928 but never published or widely circulated until well after the fall of the Third Reich (Hitler, 2003). There, Hitler’s well-rehearsed arguments on the need to rearm the nation, followed by a military conflict in Eastern Europe aimed at acquiring sufficient Lebensraum for the German people – a goal that required the destruction of the Soviet Union and the annihilation of its population – are presented as merely a means to an end: a struggle for world domination between a German-controlled Europe and the United States. In historian Richard Evans’ words, the core of Hitler’s foreign policy was to “create in eastern Europe what he thought of as the equivalent of the American West – a kind of bread basket for Germany.

explain the onset of hostilities. It is unnecessary to invoke factors such as bureaucratic overreach in Japan; Japanese decision-makers clearly endorsed a decision to declare war on the United States. It is unclear that there was bureaucratic overreach in Washington. Indeed, the argument that FDR lost control of policy is disputed (see: Heinrichs (1988, 141-142); Heinrichs (1990, 165); Schnessler (2010, 159); Trachtenberg (2006, 99-100)). It appears that Acheson was instructed by under-Secretary Sumner Welles to deny requests for oil while Roosevelt away was meeting with Churchill (Heinrichs, 1990, 165). There is good reason to believe that Welles was conveying Roosevelt’s preferences. Roosevelt knew that the oil embargo may drive Japan to aggressive action, and he certainly considered the possibility of relaxing the embargo if necessary (see, e.g., Trachtenberg, 2006, 96, 98). A tough policy towards Japan would have made sense for FDR regardless of whether his goal was to deter Japan from attacking the USSR or induce them to attack the United States so as to allow Washington to enter the war with Nazi Germany.
Somewhere where industrial resources, agricultural resources, would make Germany into a world power capable of standing head-to-head with America in the longer run” (Evans, n.d.). Even before coming to power in 1933, Hitler considered the United States to be “the toughest rival possible” in economic terms (quoted in Kershaw (2007, 387)).

Hitler’s reasoning on this point reflected Germany’s experience of dependency on U.S. capital during the 1920s. The 1919 Versailles Treaty required Germany to pay substantial reparations to Allied powers for causing WWI (Trachtenberg, 1980; Schuker, 1988; Kent, 1989; Boemeke, Feldman and Glaser, 1998; Cohrs, 2006). When Germany defaulted on its reparation payments, it triggered a chain of events that led the German currency to collapse, producing hyperinflation (Schuker, 1988; Ferguson, 1996). This crisis prompted Washington to attempt to create a more stable “reparations regime” in order to ensure European stability (Costigliola, 1984, 119-123; Cohrs, 2006, 137). The resulting Dawes Plan of 1924 lowered German reparation payments for 1924-27 and included a large U.S. private loan to the German government, leading to a boom in U.S. private loans to Germany (Marks, 1978, 245-249; Schuker, 1988). In effect, U.S. lending to Germany created a financial “merry-go-round” in which all participants had a stake: Germany obtained credit from the United States, enabling it to make reparation payments to Britain and France, which could then repay their inter-allied war debts to the United States (Tooze, 2006, 6).

For Berlin, this meant financial dependency on Washington, and by 1927 “German dependence on American capital seemed to be an inevitable fact of life” (McNeil, 1986, 161). Yet the economic benefits were substantial. The flow of American capital into Weimar Germany was “one of the greatest proportional transfers of wealth in modern history” (Schuker, 1988, 120). Germany received far more funds in U.S. private loans (27 billion marks) than the totality of the reparations it had to pay (19.1 billion marks) in 1921-1931 (Marks, 1978, 254).

Starting in late 1928, however, the U.S. credit market tightened and interest rates rose, ending long-term loans to Germany (McNeil, 1986, 217-219; Tooze, 2006, 14). Unable to
access U.S. capital in favorable terms, Germany demanded another revision of the reparations regime, resulting in the Young Plan of June 1929, which, among other things, consolidated German dependency on U.S. capital, by relying on loans by U.S. banks to finance the majority of the payments (Leffler, 1979, 195, 202-216, 228-229; Enssle, 1980, 182; Costigliola, 1984, 210-217). But even before the Plan would come into effect in January 1930, the U.S. economy suffered the October 24, 1929, “Black Thursday” stock market crash (Leffler, 1979, 215-216; Kindleberger, 1986, 118).

The onset of the U.S. Great Depression thus had a profound effect on German economic growth. Over the next three years, U.S. banks drastically curtailed the availability of capital to the German economy.19 As Burke writes, “it was American policy that established the system of international exchange. The cycle of reparations and war debts payments was financially dependent on American loans. When the outflow of capital from the United States dried up, the system was bound to founder” (Burke, 1994, 128). When the system foundered, so did Germany’s ability to invest its resource endowment efficiently. Germany experienced a sharp drop in national income and industrial production, with unemployment rising dramatically. By the time Hitler was appointed Chancellor in early 1933, a third of the labor force was unemployed (Kolb, 2004, 111).

Shaped by this experience, Hitler’s broader strategic vision was one in which “Fordist” America – his preferred term for the industrialized economy of the United States – was both Germany’s ultimate competitor and its greatest role model. Germany needed a domestic market commensurable with the U.S.’s; and control over commensurable amounts of economic resources. Without the scale of America’s natural and human resources, Hitler thought, Germany would be destined to have the status of “Holland or Switzerland or Denmark” (Hitler, 2003, 128). As Tooze (2006, 10) put it, “Fordism ... required Lebensraum,” concluding:

19Many claim that the German economic trouble was compounded by the protectionist Smoot-Hawley Tariff Act trade of June 1930 (Costigliola, 1984, 231; Tooze, 2006, 14). As Irwin (2012, 15-16) shows, this measure had a limited impact.
America should provide the pivot for our understanding of the Third Reich. In seeking to explain the urgency of Hitler’s aggression, historians have underestimated his acute awareness of the threat posed to Germany ... by the emergence of the United States as the dominant global superpower. ... The originality of National Socialism was that, rather than meekly accepting a place for Germany within the global economic order dominated by the affluent English-speaking countries, Hitler sought to mobilize the pent-up frustrations of his population to mount an epic challenge to this order. ... Germany would carve out its own imperial hinterland; by one last great land grab in the East it would create a self-sufficient basis both for domestic affluence and the platform necessary to prevail in the coming super-power competition with the United States. (Tooze, 2006, xxiv)\(^{20}\)

While Hitler’s long-term vision of independence from – and competition with – the United States may account in part for his attempt to conquer Eastern Europe and for Germany’s attack on the Soviet Union, it is not sufficient to explain his decision to declare war on the United States. In fact, there is considerable debate on whether Hitler envisioned U.S.-German competition to be peaceful or a military showdown. Hitler’s position on the matter was ambiguous. Sometimes he projected a military showdown with the United States, writing that “it is thoughtless to believe that the conflict between Europe and America would always be of a peaceful economic nature” (Hitler, 2003, 116). But through most of the 1930s, the United States did not feature prominently among the Nazi leadership’s concerns or rhetoric. A showdown with the United States, it seemed, would not become a concern for Germany until after expansion in Europe was completed and its territorial gains consolidated (Kershaw, 2007, 386-391).

Therefore, Hitler spent the 1930s rearming Germany and preparing it for a military challenge to the European status quo. His aim was to acquire a sphere of influence that

\(^{20}\)See also Tooze (2006, 656-671).
would ensure German control over the resources and markets needed to ensure the country would be able to compete with the United States in the long-term. Capture of land in Eastern Europe alleviated Germany’s vulnerability to U.S. decisions to intervene in the markets by giving it a sizable economic base and control over vital natural resources – just as Japanese capture of East and Southeast Asia would enable Japan to escape its vulnerability to U.S. market power. Acquiring land in Eastern Europe would boost German economic power, and therefore ameliorate the U.S.’s economic commitment problem highlighted in our theory. As Tooze (2006) documents, the German economy was considerably weaker than that of continental-sized powers such as the United States or Soviet Union. To compete with the U.S. behemoth, therefore, Hitler needed to capture territory in the East.\footnote{Our argument is thus distinct from Taylor (1966)’s infamous view that Hitler was a security-seeker. To the contrary, Hitler’s strategy was deeply revisionist in that he wanted to overturn the status quo if necessary by force in order to make Germany a first-rate power, capable of competing with the United States. That required a vast economic basis, which in turn required the conquest and domination of large swaths of territory in Eurasia.} Whether or not he intended all along to use the resources acquired by conquering Europe and North Africa as a springboard to defeat the United States – as argued by Schweller (1998, 93-120) and Goda (1998) – remains unclear.

Hitler’s decision to declare war on the United States would ultimately be driven by the U.S. reaction to these expansionary designs. Even before Hitler’s armed conquest of Poland in September 1939, the FDR Administration made clear its opposition to German expansion. Washington did not want Berlin to acquire a sphere of influence, because greater economic German power meant greater German military power, which might enable Berlin to become a regional hegemon in Europe and exercise greater global influence. From Washington’s perspective, therefore, German expansion entailed considerable risks. But what ensured that Washinton would indeed abide by this promise once Germany agreed to remain a comparatively weaker middle power?

U.S. pressure became apparent with FDR’s speech of Oct. 5, 1937, in which the U.S. president called for the “quarantining” – i.e., the isolation, with dire economic consequences – of any country that invades the territory of others (Kershaw, 2007, 391). Eighteen months
later, on April 14, 1939, FDR sent a message to Hitler asking him to renounce attacking any of a list of over thirty countries in Europe and the Middle East; and committing to consider arms control and free trade in exchange (Kershaw, 2007, 392-393). This offer highlights the connection between economic growth and future military power. Washington was willing to consider removing any trade barriers with Germany on condition that Berlin renounce using its military power to conquer additional territory.

U.S. pressure intensified once WWII started in Europe on September 1, 1939; and, particularly, after the German invasion of the Soviet Union on June 22, 1941. Already in June 1940, during the swift German invasion of France, FDR “publicly avowed to ‘extend to the opponents of force’ [i.e., those invaded by Germany] the material resources of the United States” (Kershaw, 2007, 396). On July 19, after France had capitulated, FDR made clear his intention to extend continued support to Britain (Kershaw, 2007, 396). Before the year was over, the Administration proposed the Lend-Lease program providing military aid to German’s adversaries in the war and FDR declared the United States to be “the arsenal of democracy” (Kershaw, 2007, 397). The German army’s high command interpreted these measures as equivalent to “a declaration of war on Germany” (quoted in Kershaw (2007, 399)). Hitler concurred, reacting to the Lend Lease Act by saying that “it will come to war with the United States one way or another” (quoted in Kershaw (2007, 399)).

Washington was reaching the same conclusion. The U.S. military stated in its “Victory Program” of September 11, 1941, that, in the event of a war, “the United States would be well advised to adopt a ‘Europe-first’ strategy,” because

a German superpower ... in command of the resources of the entire continent of Europe, and no longer blocked by British naval power, would threaten the security of the Western Hemisphere. ... To be sure, a Germany triumphant in Europe might not want to go to war with America right away. After having conquered all of Europe, according to the authors of the Victory Program, Nazi Germany ‘might then wish to establish peace with the United States for several years,
for the purpose of organizing her gains, restoring her economic situation, and increasing her military establishment.’ But in doing those things, the Germans would be preparing for ‘the eventual conquest of South America and the military defeat of the United States.’ (Trachtenberg, 2006, 118)

That same day, FDR announced that the U.S. Navy would shoot any German warships in the West Atlantic “on-sight” – an order that was interpreted in Berlin as an unofficial declaration of war (Kershaw, 2007, 409). Clearly, by the summer of 1941, as Germany was making stunning progress in its invasion of the Soviet Union, Washington was increasingly worried about the externalities for its own security that would result from German control over Eurasia’s resources and markets.

Reacting to increasing U.S. antagonism to German expansion, by late 1941 Hitler’s view of the United States was back to his thinking of the 1920s (Kershaw, 2007, 406). It was clear that Washington would not allow Germany to develop its own sphere of influence, nor would it ensure its access to vital resources in an open market. To the contrary, Washington was quickly becoming a key impediment to a Germany victory in the war.

In the end, Hitler declared war on the United States after being convinced that Washington would do whatever it could to stifle German expansion, out of fear of the consequences of German economic growth. Fighting was ultimately inevitable because German weakness relative to the United States made it vulnerable to American control over resources and markets. Determined to extricate Germany from this subaltern position, Hitler decided to expand the German sphere of influence by force. When Washington, leery of a more powerful Germany, gradually intervened in the war on the side of Berlin’s adversaries, Hitler decided to go to war. As Kershaw (2007, 423) put it, “from Hitler’s perspective [his declaration of war on the United States] was only anticipating the inevitable.”

The window of opportunity opened by Japan’s attack on the U.S. fleet at Pearl Harbor – at a moment when U.S. land forces were not yet prepared to open a second front in Europe and German forces were at the gates of Moscow – helps accounting for the timing of Hitler’s
decision. Germany decided to fight the United States when it thought Washington would concentrate its efforts in the Pacific theater, containing Japan. If, as Hitler expected, German forces would soon be able to finish off the war in Russia, this strategic outlook might permit Germany to cut-off U.S. supplies to Britain, bringing it to a negotiated peace and thereby removing Washington’s remaining allied in Europe, which in turn might lead Washington to settle for an agreement with Berlin that left Germany in control of continental Europe.

This logic, however, does not account for the deep causes of Hitler’s decision to declare war on the United States. The cost of war with America was expected to be vast. Therefore, Germany’s unprompted declaration of war only makes sense if Berlin thought that fighting was unavoidable sooner or later. This view that Germany would have declared war on the United States independently of the Japanese attack against Pearl Harbor is corroborated by Hitler’s comment to Nazi party leaders the day after his declaration of war that “even if Japan had not joined the war, [Germany] would have had to declare war on the Americans sooner or later” (quoted in Kershaw (2007, 382)).

Our contribution is to explain why Hitler thought war with the United States was ultimately unavoidable. To account for this belief, we highlight the serious economic commitment problem of the United States; a problem that was intensified by German weakness, combined with the absence of a sizable German sphere of influence and the weak institutionalization of the international economy. Washington tried to constrain German expansion because of its negative security externalities given the link between economic growth and military power. War against the United States became, from Berlin’s perspective, preferable to remaining at peace with America.

6 Conclusion

This article introduced a theory of the economic roots of war, explaining how a weaker state’s need to access the resources necessary for efficient economic growth – when conjoined with a powerful state’s incentives to constrain its access to those resources for fear that the weaker
state’s economic growth will generate negative security externalities – may produce incentives
for conflict. We illustrate how this mechanism contributed to Japan’s decision to attack the
United States in 1941 and Germany’s decision to declare war on the United States days later.

More generally, our argument provides a framework for assessing the risks of war due
to economic motivations, shedding light on the historical pattern and providing lessons for
future scenarios. In comparison with the U.S. interactions with Germany and Japan that
we examined, America’s rise in the late 19th century was more likely to remain peaceful.
Since the United States already possessed a sphere of economic influence on the American
continent, bolstered by the Monroe Doctrine, it was less likely that Britain would restrain
U.S. access to resources; which in turn made it less likely that Washington would challenge
Britain militarily.

With the end of the Second World War, two factors have reduced the odds of great power
conflict. First, nuclear weapons have raised the cost of war. Second, the institutionalization
of trade has increased the United States would pay to constrain another country’s economic
growth. Our theory makes it easier to understand how together these dynamics may have
contributed to the relatively lower incidence of interstate conflict since 1945.

Although analyzing the origins of the institutional regime that regulates trade in the
postwar era is beyond the scope of this article, it is conceivable that the U.S. decision to
push for greater institutionalization in the international economy in the late 1940s resulted
from its unprecedented relative economic power, which magnified the economic commitment
problem at the core of our theory. To the extent that this force contributed to the current
economic regime, its creation is related to second-order consequences of the mechanism we
highlight.

Applying these lessons to the U.S.-Soviet rivalry, we see that there was little economic
incentive for a direct confrontation. Both countries controlled significant markets for goods
and resources. Furthermore, the two blocs traded little between them, limiting their ability to
restrict each other’s access to the resources they needed for economic growth. In light of the
potential destruction that nuclear war would bring about, fighting over additional markets would be highly unlikely to result in faster growth for either superpower. Despite the intense rivalry between the two, competition between them never broke into direct military conflict.

The explanation for war we introduce is also able to account for smaller conflicts. For example, the United States decided to use force to expel Iraq from Kuwait in 1991 in part out of concern that, were Iraq to launch an offensive over Saudi oil fields in close proximity to Kuwait, it would acquire a great ability to control U.S. access to oil – and its cost – putting Saddam Hussein in a position that allowed him to constrain U.S. economic growth. Going back in history, our mechanism may also account for the dynamics at play in wars of colonial conquest. A stronger state may want to launch a war so as to gain control over a weaker state’s resources, which it can then invest more efficiently. This dynamic may have contributed to European states scrambling to acquire territory overseas.

Looking ahead, we can use our framework to analyze the odds that U.S.-China relations will remain peaceful. Given both countries’ nuclear status, the costs of war remain particularly high. Furthermore, and although China possesses a large and growing domestic market, Beijing is relatively dependent on access to international markets for its economic growth. This could present a problem for peace. At the same time, Washington would pay a high cost to attempt to restrict Chinese access to these markets, due to the high degree of institutionalization of the international economy, namely, the fact that China is a member of the World Trade Organization. As long as these fundamental features of U.S.-China economic interactions remain, the economic dimension of U.S.-China relations will continue to be a force for peace.

7 Online Appendix

This Appendix consists of five parts. Section 7.1 presents a proof of the formal results of the baseline model presented in section 4. Section 7.2 tests the robustness of our argument, presenting a formal treatment of the extensions mentioned in section 4.1. Section 7.3 discusses
the implications of our model on the relationship between power and war, formalizing the comparison of our model with the canonical model, as laid out in section 4.3. Proofs of sections 7.2 and 7.3 are in sections 7.4 and 7.5, respectively.

7.1 Baseline Model: Proof of the Results

The proof of lemma 1 is straightforward and therefore omitted.

Proof. (Proof of lemma 2). Clearly, if $H$ intervenes, $C$ accepts $z$ if and only if $z \geq p(\kappa)\pi(I)(1 + \sigma) - c_C$. Assuming that $H$ intervenes if and only if $\sigma = \bar{\sigma}$ and $k_m = \bar{k}_m$, then it is straightforward to establish $C$’s investment decision. Now let us establish that $H$ intervenes if and only if $\sigma = \bar{\sigma}$ and $k_m = \bar{k}_m$.

$H$ does not intervene if $\sigma = \bar{\sigma} = 0$ if $-k_m + (1 - p(\kappa))\pi(I) + c_C \leq 0$. This condition holds for any $\kappa$, $I \leq I^{fb}(\bar{\sigma})$, $k_m$ if and only if

$$k_m \geq (1 - p_{\text{min}})\pi(I^{fb}(\bar{\sigma})) + c_C$$

(2)

$H$ does not intervene if $\sigma = \bar{\sigma}$ and $k_m = \bar{k}_m$ if $-\bar{k}_m + (1 - p(\kappa))\pi(I)(1 + \bar{\sigma}) + c_C \leq 0$. This condition holds for any $\kappa$, $I \leq I^{fb}(\bar{\sigma})$ if and only if

$$\bar{k}_m \geq (1 - p_{\text{min}})\pi(I^{fb}(\bar{\sigma}))(1 + \bar{\sigma}) + c_C$$

(3)

$H$ intervenes if $\sigma = \bar{\sigma}$ and $k_m = \bar{k}_m$ if $-\bar{k}_m + (1 - p(\kappa))\pi(I)(1 + \bar{\sigma}) + c_C > 0$. This condition holds for any $\kappa$, $I$ if and only if

$$\bar{k}_m < (1 - p_{\text{max}})\pi(0)(1 + \bar{\sigma}) + c_C$$

(4)

Note that conditions (2) and (4) are compatible if and only if

$$1 + \bar{\sigma} > \frac{1 - p_{\text{min}}}{1 - p_{\text{max}}} \frac{\pi(I^{fb}(\bar{\sigma}))}{\pi(0)}$$

(5)
Moving up, consider C’s investment. Clearly, C chooses the first-best level of investment if the value of externalities is low or the cost of intervention is high. Now assume that the value of externalities is high and the cost of intervention is low. C’s problem is to choose \( I \) to maximize \(-kI + p(\kappa)\pi(I) - c_C\). Given that the marginal return of investment at 0 is arbitrarily large, i.e. \( \lim_{I \to 0} \pi'(I) = \infty \), then C’s optimal level of investment is strictly positive, and given by the first-order condition in the lemma.

**Proof.** (Proof of proposition 1). Given lemmas 1 and 2, we conclude that the following form equilibrium strategies of \( H \) and C’s bargaining over \( p_i \). H’s strategy is as follows: if condition (1) holds, then \( H \) demands \( p_i = p_iC \), where

\[
p_{iC} = P_C(\kappa) - p(\kappa)W_C(C) - (1 - p(\kappa))W_C(H) + c_C
\]

and payoffs \( P_s(\kappa) \) and \( W_s(s') \) are as described below. If condition (1) fails, then either \( H \) declares war or demands \( p_i > p_iC \). C’s strategy is to accept \( p_i \) if and only if \( p_i \leq p_iC \),

Consider part (i). Payoffs after war are \( W_s(s') = 0 \) if \( s \neq s' \) and \( W_s(s) = -kI^{fb}(\sigma) + \pi(I^{fb}(\sigma))(1 + \sigma) \), so that total payoffs after war are, for any \( s \),

\[
W_C(s) + W_H(s) = -kI^{fb}(\sigma) + \pi(I^{fb}(\sigma))(1 + \sigma)
\]

Payoffs after peace depend on the cost of capture and the value of externalities.

First consider the case where the cost of capture is high or the value of externalities is low, \((k_m, \sigma) \neq (\bar{k}_m, \bar{\sigma})\). Then \( P_H(\kappa) = 0 \) and \( P_C(\kappa) = W_C(C) \). Therefore, \( P_C(\kappa) + P_H(\kappa) = W_C(s) + W_H(s) \) for any \( s \), and condition (1) holds.

Second consider the case where the cost of capture is low and the value of externalities is high, i.e. \((k_m, \sigma) = (\bar{k}_m, \bar{\sigma})\). We have \( P_C(\kappa) = -kI^*(\bar{\sigma}, \kappa) + p(\kappa)\pi(I^*(\bar{\sigma}, \kappa))(1 + \bar{\sigma}) - c_C \) and \( P_H(\kappa) = -k_m + (1 - p(\kappa))\pi(I^*(\bar{\sigma}, \kappa))(1 + \bar{\sigma}) + c_C \), so that total payoffs after peace are:

\[
P_C(\kappa) + P_H(\kappa) = -k_m - kI^*(\bar{\sigma}, \kappa) + \pi(I^*(\bar{\sigma}, \kappa))(1 + \bar{\sigma})
\]
Thus, the difference in total payoffs, after war and peace, i.e. the left-hand side of condition (1), is strictly positive \( \forall \kappa \) (since \( k_m > 0 \) and \( I^*(\sigma, \kappa) < I^{fb}(\sigma) \)) and decreasing in \( \kappa \) (since \( I^*(\sigma, \kappa) \) is increasing in \( \kappa \) and \( I^*(\sigma, \kappa) < I^{fb}(\sigma) \)). This completes the proof of part (i).

Now consider part (ii). The conclusion is straightforward since war occurs only if the cost of intervention is low, which is less likely, the greater is the size of the challenger’s sphere of influence and the strength of international institutions.

7.2 Robustness: Set-Up and Solution

Now, we consider two extensions to test the robustness of our argument. First, we enrich our model of trade, allowing both states to be involved in creating economic value, and both states to trade productive resources. Second, we allow the challenger to increase its military capabilities, through an investment in ‘guns.’ We show that in each case, the results of the baseline model continue to hold.

7.2.1 Trade of Inputs: Set-up and Solution

Assume that each country possesses an input at the start of the game, call it \( i_1 \) for \( H \)’s input and \( i_2 \) for \( C \)’s input, which they can trade for each other. After their decision to trade inputs or not, the state owning input \( i_n \) chooses a level of investment \( I_n \) to convert it into a pie \( \pi_n(I_n), n \in \{1, 2\} \). As above, \( H \) can intervene in the markets and claim part of \( C \)’s output at a cost \( k_m \). Let \( k_m \) depend on the size of the challenger’s sphere of influence and the strength of international institutions, as in the baseline model, and also on the degree of ‘economic interdependence’ of the two states. More precisely, the cost \( k_m \) is either high or low, i.e. \( k_m \in \{k_m, \overline{k_m}\} \), where bounds on such parameters are given below. Everything else equal, the greater is the size of the challenger’s sphere of influence, the strength of international institutions, and the degree of economic interdependence between the two states, the more likely the cost of \( H \)’s intervention in the markets is to be high.

In addition, we vary the relative importance of the input \( i_n \) in the production of the pie
π_n(I_n). More precisely, we adopt Cobb-Douglass production functions π_n(I_n) = 1 + A(i_n)I_n^\alpha, where α ∈ (0, 1). This function satisfies the conditions of the baseline model, where a greater A(i_n) corresponds to a ‘more important’ input, i.e. one that increases both the value of the output and the marginal return to an investment I_n.

We allow the two states to offer side payments, whether or not trade takes place. Let p_T and p_{NT} be the price that C pays to H if they trade inputs or if they keep their inputs, respectively; either price could take any value (positive, negative, or null).

The timing of the game is the same as in the baseline model. The value of the key parameters σ and k_m – respectively, the value of the externalities and the cost of intervention – is set and becomes common knowledge, and the game is then played as follows:

1. H demands prices p_T, p_{NT} or decides to declare war;

2. C accepts H’s price p_T or p_{NT} or decides to declare war.

If peace prevails in the negotiations over p_T and p_{NT}, then the game proceeds as follows:

1. State owning input i_n chooses a level of investment I_n;

2. The pies π_1(I_1) and π_2(I_2) are created;

3. H decides whether to acquiesce to C’s acquisition of the pie it created or to intervene on the market. If C owns input i_n and H intervenes, H offers z_n to C, keeping π_n(I_n)(1 + σ) − z_n

4. If H intervened on the market and offered z_n, then C decides whether to accept z_n or declare war.

If war obtained in the negotiations over p_T, p_{NT}, then the winner of the war owns both inputs and chooses the levels of investment I_1, I_2, the pies π_1(I_1) and π_2(I_2) are created, and its proceeds accrue to the winner of the war.

Solving this game, we can show that the equivalent of lemmas 1 and 2 hold. After war, we have the following:
Lemma 3  Assume that war obtained in the negotiations over the trade of inputs. Then the winner of the war chooses the efficient level of investment for each pie, i.e. \( I^b_n(\sigma) \) such that \( \pi'_n(I^b_n(\sigma)) = \frac{k}{1+\sigma} \) for \( n \in \{1,2\} \). \textbf{Proof.} Straightforward. ■

After peace, the hegemon intervenes if and only if the cost of intervention \( k_m \) is low and the value of externalities \( \sigma \) is high, and parameters satisfy certain conditions, similar to those expressed in the proof of lemma 2. Then we obtain:

Lemma 4  Assume that peace prevailed in the negotiations over the trade of inputs and that, after these negotiations, \( C \) owns input \( i_n \) and \( H \) owns input \( i'_n \). There exists values \( k_m' \), \( k_m'' \), \( \overline{k}_m \), \( \overline{\sigma}' \) such that if \( k_m \in (k_m', k_m'') \), \( \overline{k}_m > \overline{k}_m' \), and \( \sigma > \overline{\sigma}' \), then the following holds:

- If the cost of intervention is high (\( k_m = \overline{k}_m \)) or the value of externalities is low (\( \sigma = \overline{\sigma} \)), then \( C \) and \( H \) choose \( I^b_n(\sigma) \) and \( I^b_n'(\sigma) \) defined above; \( H \) does not intervene; \( C \) accepts \( z_n \) if and only if \( z_n \geq p(\kappa)\pi_n(I_n)(1+\sigma) - c_C \).

- If the cost of intervention is low (\( k_m = \overline{k}_m \)) and the value of externalities is high (\( \sigma = \overline{\sigma} \)), then \( C \) chooses \( I^*_n(\overline{\sigma}, \kappa) \), such that \( \pi'_n(I^*_n(\overline{\sigma}, \kappa)) = \frac{k}{p(\kappa)(1+\overline{\sigma})} \) and \( H \) chooses \( I^b_n'(\sigma) \); \( H \) intervenes and offers \( z_n = p(\kappa)\pi_n(I_n)(1+\sigma) - c_C \); \( C \) accepts \( z_n \) if and only if \( z_n \geq p(\kappa)\pi_n(I_n)(1+\sigma) - c_C \).

\textbf{Proof.} Follows the same logic as lemma 2 of the baseline model. ■

Write \( W_s(s') \) for the payoff of player \( s \) if negotiations over the trade of inputs ended in war, which was won by state \( s' \). Write \( P_s(\kappa, \tau) \) for the payoff of state \( s \) if negotiations over the trade of inputs ended in peace, \( C \)'s capabilities are \( \kappa \) and trade occurred (\( \tau = T \)) or not (\( \tau = NT \)). The maximum price that \( C \) is willing to pay so that inputs are traded is \(-p_T + P_C(\kappa, T) \geq p(\kappa)W_C(C) + (1 - p(\kappa))W_C(H) - c_C \). The minimum price \( p_T \) that \( H \) requests from \( C \) is such that \( p_T + P_H(\kappa, T) \geq (1 - p(\kappa))W_H(H) + p(\kappa)W_H(C) - c_H \). A bargaining range exists for the trade of inputs if and only if

\[
(W_C(C) + W_H(C)) - (P_C(\kappa, T) + P_H(\kappa, T)) \leq c_C + c_H
\]  (9)
By the same logic, a bargaining range exists for each state to keep its input if and only if

\[(W_C(C) + W_H(C)) - (P_C(\kappa, NT) + P_H(\kappa, NT)) \leq c_C + c_H \] (10)

Taking stock, peace prevails if and only if condition (9) or condition (10) holds. If the cost of intervention is high or the value of the externalities is low, then \(H\) would not intervene in the markets and peace is not inefficient; the left-hand side of both conditions (9) and (10) is zero, and peace prevails. If the cost of intervention is low and the value of externalities is high, then the left-hand side of both conditions is strictly positive, and war could happen if the challenger is sufficiently weak.

We can thus retrieve the main conclusions of the baseline model. In addition, we reach the conclusion that greater economic interdependence is a force for peace, by increasing the cost of intervention for the hegemon, and reducing the inefficiency of peace:

**Proposition 2**

(i) War occurs if and only if the cost of intervention is low, the value of the externalities is high, and the capabilities of the challenger are low; (ii) The probability of war is decreasing with the size of the challenger’s sphere of influence, the strength of international institutions, and the degree of economic interdependence between the two states. **Proof.** Follows the above and the logic of the proof of Proposition 1. ■

If we retain the conclusions of the baseline model, and produce the intuitive result that greater economic interdependence is a force for peace, the model nevertheless produces a somewhat counter-intuitive result about the effect of trade on conflict. Comparing conditions (9) and (10), we see that trade reduces the inefficiency of peace if and only if it makes the challenger less vulnerable to the hegemon’s economic commitment problem, i.e. if the input that \(C\) obtains through trade, \(i_1\), is less important to the production of the pie.

**Proposition 3** Peace may prevail under trade, when war would otherwise be unavoidable, if and only if \(A(i_1) < A(i_2)\). **Proof.** See section 7.4.1. ■
As such, it is not trade per se that facilitates peace, but whether it ameliorates the hegemon’s commitment problem, the key friction that causes war.

7.2.2 Guns and Butter: Set-up and Solution

Now let us amend the baseline model so that the player making the investment decision can simultaneously choose how much to spend in guns and how to spend in creating the economic pie. This set-up captures the standard guns versus butter trade-off.

An investment in guns costs \(k_g > 0\) per unit and produces a favorable change in relative power. Let \(C\)'s total capabilities be the sum of its exogenous capabilities \(\kappa\) and its investment in guns \(g\), so that the probability that \(C\) wins a war after an investment in guns is \(p(\kappa + g)\). (The probability that \(C\) wins a war before the investment in guns, i.e., when bargaining over the price of the input \(p_i\), is \(p(\kappa)\)). As before, assume that the probability that \(C\) wins a war is strictly between 0 and 1 and increases with capabilities at a decreasing rate, i.e., \(p(.) \in [p_{\text{min}}, p_{\text{max}}] \subset (0, 1)\), \(p'(.) > 0\), \(p''(.) < 0\), and \(\lim_{\kappa \to \infty} p'(\kappa) = 0\). We write the bounds on the possible values of exogenous capabilities \(\kappa\) as \(\kappa_{\text{min}}\) and \(\kappa_{\text{max}}\) and assume that \(\kappa_{\text{max}}\) is arbitrarily large.

We solve the game by backward induction. Assume that bargaining over the price of the input resulted in war. The winner of the war reaps the full value of the pie it creates. Its problem is to choose \(g\) and \(I\) to maximize \(-k_g g - kI + \pi(I)(1 + \sigma)\). As a result, the winner chooses the first-best investment decision:

**Lemma 5** Assume that war obtained in the negotiations over the price of the input \(p_i\). Then the winner of the war chooses the efficient level of investment, i.e. \(g^{fb} = 0\) and \(I^{fb}(\sigma)\) such that \(\pi'(I^{fb}(\sigma)) = \frac{\kappa}{1 + \sigma}\). **Proof:** Straightforward.

Now assume that bargaining over the price of the input resulted in peace. As in the baseline model, \(H\) intervenes in markets if and only if the cost of intervention is low and the value of externalities is high, given appropriate assumptions on the value of parameters.
Moving up, $C$ chooses the first-best level of investment if the cost of intervention is high or the value of externalities is low. In contrast, if the cost of capture is low and the value of externalities is high, $C$’s problem is to choose $g$ and $I$ to maximize $-k_g g - kI + p(\kappa + g)\pi(I)(1 + \bar{\sigma}) - c_C$. This problem is well defined and has a unique solution, under general conditions on $p(.)$ and $\pi(.)$ ensuring that the objective function is globally concave. The solution of this problem is illustrated graphically in Figure 3.

The figure represents an ‘isocost function’ $(k_g g + kI = k_0)$ and an ‘indifference curve’ $(p(\kappa + g)\pi(I)(1 + \bar{\sigma}) = u_0)$. There is a value of exogenous capabilities $\kappa_s$ dividing up the parameter space. A weak $C$ (with $\kappa < \kappa_s$) is at an ‘interior solution,’ investing in guns and bringing its total capabilities to $\kappa_s$. A strong $C$ (with $\kappa \geq \kappa_s$) is at a ‘corner solution’ and does not invest in guns. Any $C$ chooses a strictly positive investment $I$ in butter, which is optimal given its total capabilities. Summing up, we obtain the following:

**Lemma 6** Assume that peace prevailed in the negotiations over the price of the input $p_i$. There exists values $k_m', k_m'', \bar{k}_m, \bar{\sigma}'$ such that if $k_m \in (k_m', k_m'')$, \( \bar{k}_m > \bar{k}_m' \), and $\bar{\sigma} > \bar{\sigma}'$, then the following holds:

- If the cost of intervention is high ($k_m = \bar{k}_m$) or the value of externalities is low ($\sigma = \sigma$), then $C$ chooses the efficient level of investment, i.e. $g^{fb} = 0$ and $I^{fb}(\sigma)$ as defined above, such that $\pi'(I^{fb}(\sigma)) = \frac{k}{1 + \sigma}$; $H$ does not intervene; $C$ accepts $z$ if and only if $z \geq p(\kappa + g)\pi(I)(1 + \sigma) - c_C$.

- If the cost of intervention is low ($k_m = \bar{k}_m$) and the value of externalities is high ($\sigma = \bar{\sigma}$), then there is a value $\kappa_s \in [\kappa_{min}, \kappa_{max})$ such that the following holds:

  - for $\kappa \in [\kappa_{min}, \kappa_s)$, $C$ chooses an investment in guns $g^* = \kappa_s - \kappa$ and an investment in butter $I^*(\bar{\sigma}, \kappa_s)$ defined by $\pi'(I^*(\bar{\sigma}, \kappa_s)) = \frac{k}{p(\kappa_s)(1 + \bar{\sigma})}$; $H$ intervenes and offers $z = p(\kappa + g)\pi(I)(1 + \sigma) - c_C$; $C$ accepts $z$ if and only if $z \geq p(\kappa + g)\pi(I)(1 + \sigma) - c_C$. 

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– for $\kappa \in [\kappa_s, \kappa_{max}]$, $C$ chooses an investment in guns $g^* = 0$ and an investment in butter $I^*(\sigma, \kappa)$ defined by $\pi'(I^*(\sigma, \kappa)) = \frac{k}{p(\kappa)(1+\sigma)}$; $H$ intervenes and offers $z = p(\kappa + g)\pi(I)(1+\sigma) - c_C; C$ accepts $z$ if and only if $z \geq p(\kappa + g)\pi(I)(1+\sigma) - c_C$.

Note that $\kappa_s$ is such that for any $\sigma$, there is a value $k_g(\sigma)$ such that $\kappa_s = \kappa_{min}$ if $k_g \geq k_g(\sigma)$ and $\kappa_s > \kappa_{min}$ if $k_g < k_g(\sigma)$.

**Proof.** See section 7.4.2. ■

Thus, we see that the baseline model, in which capabilities are assumed to be exogenous, is a special case of this broader model, in which the challenger can invest in guns but the cost of doing so is prohibitively high. Let us now assume that the cost of guns is not too high, so that there is a positive investment in guns for some values of exogenous capabilities.

Comparing lemmas 5 and 6, we see that peace can lead to inefficiencies, given $H$’s economic influence. As in the baseline model, $C$’s investment in butter may be sub-optimally low. In addition, $C$ may invest in guns, so as to increase its share of the economic pie. By ensuring itself a larger share of the pie that it creates, $C$’s investment in butter will be closer to the socially optimal level. However, the very fact of investing in guns is socially inefficient.

As in the baseline model, a bargaining range exists over the price of the input if and only if condition (1) holds. If the cost of intervention is high or the value of externalities is low, then this condition holds, since $C$ chooses the efficient level of investment and war is costly.

Now assume that the cost of intervention is low and the value of externalities is high. Then peace is inefficient, as explained above. Thus, peace is facilitated by any factor that increases the expected cost of intervention, such as the strength of international institutions and the size of the challenger’s sphere of influence.

In addition, the greater $C$’s exogenous capabilities $\kappa$ are, the more easily peace is obtained. To see this, note that a weak $C$ (with $\kappa \in [\kappa_{min}, \kappa_s]$) chooses an investment in guns that brings its total capabilities to $\kappa_s$ and an investment $I$ in butter commensurate with these total capabilities. Therefore, the stronger $C$ is, the smaller is the investment in guns, and
the lower is the inefficiency of peace. A strong \( C \) (with \( \kappa \in [\kappa_s, \kappa_{\text{max}}] \)) does not invest in guns and choose an investment \( I \) in butter that is increasing in its exogenous capabilities. Therefore, the stronger \( C \) is, the more credible is its threat to use force and the greater is the share of the surplus that it expects to keep for itself. Thus, its investment \( I \) in butter is closer to the efficient level. In short, we reproduce the result of Proposition 1:

**Proposition 4** (i) War occurs if and only if the cost of intervention is low, the value of the externalities is high, and the exogenous capabilities of the challenger are low; (ii) The probability of war is decreasing with the size of the challenger’s sphere of influence and with the strength of international institutions. **Proof.** See section 7.4.2 in the Appendix.

7.3 Discussion: Set-Up and Solution

In this section, we offer a formal presentation of the results discussed in section 4.3, comparing our model to the canonical model, and discussing the relationship between power and war.

7.3.1 The Canonical Model: Set-Up and Solution

First, note that the condition for war in our model – equation 1 – can be read as a *compatibility* constraint, where the minimum demand of the challenger is greater than the maximum offer of the hegemon, and thus there is no bargaining range. Now we establish that, by contrast, the condition for war in the canonical model is best described as a *feasibility* constraint, where the minimum demand of the (rising) challenger is less than the maximum offer of the (declining) hegemon, and thus a bargaining range exists, but this bargaining range does not intersect with the set of feasible offers.

Formally, assume that the balance of power is exogenous and states divide a pie of exogenous size (normalized to one) in each period of an infinite-horizon game, and that in some period the hegemon’s relative power declines. The timing of the game in each period is as follows: The hegemon decides whether to declare war or to offer a division of the pie. If the hegemon made an offer, the challenger decides whether to accept or reject it. War is a costly
lottery and a game-ending move, with the winner of the war receiving the pie in the current period and in any future period. We can show:

**Lemma 7** Consider the canonical model with a fixed and exogenous pie and exogenous shifts in the balance of power. (i) The minimum demand of the challenger is lower than the maximum offer of the hegemon. (ii) If war occurs in equilibrium, then the declining hegemon strictly prefers war to peace; the rising challenger prefers peace under any terms to war.

**Proof.** See section 7.5.1.

This lemma shows that the minimum demand of the challenger is smaller than the maximum offer of the hegemon, given that war is costly. In that sense, there is bargaining range. War occurs if the shift in the balance of power is so large that the declining hegemon prefers to go to war and prevent the adverse shift rather than obtain the full pie today and the maximum future payoff that the challenger could credibly concede in the future. In contrast, the rising challenger benefits from peace. When war occurs, the rising challenger would be willing to accept any peaceful division of the pie, even if it expects to receive the least generous payoffs that are credible in the future. As such, it can hardly be said that a rising challenger would ‘cause a war,’ since it would accept any division of the pie.

Note also that, in the canonical model, exogenous shifts in power play a crucial role as a cause of war. To expand the comparison of our framework with the canonical model, we now introduce a dynamic version of our model, where the challenger’s power changes over time, first in a simple two-period game and then in an infinite-horizon game.

**7.3.2 Two-Period Game: Set-Up and Solution**

Consider a two-period game, in which the challenger’s capabilities rise over time, should peace prevail, and may increase with the challenger’s peaceful payoffs in period 1 (or, put differently, there are ‘dynamic consequences to peace’). Formally, write \( \kappa_2 = f(\kappa_1, s_1) \) for the capabilities of the challenger as a function of its capabilities in period 1, \( \kappa_1 \), and the value \( s_1 \) that it obtains at peace in period 1, \( s_1 = z_1 \) if \( H \) intervenes in the market and
$s_1 = \pi_1(I_1)(1 + \sigma_1)$ if $H$ does not intervene), where $f(\kappa_1, s_1) \geq \kappa_1$ and $f(\kappa_1, s_1)$ is weakly increasing in $s_1$.

We assume that after any war, the winner controls the input, makes any future investment decision, and obtains the full value of the pie it creates. This assumption allows us to capture situations in which a challenger would go to war in period 1 to create its own sphere of influence and free itself from the economic power of the hegemon in period 2. Technically, this assumption mirrors the canonical model, where the pie is exogenous and war is a ‘game-ending move.’ Here, since the pie is endogenous, we must let the game continue so as to determine the value of future pies and future payoffs.

For simplicity, assume that the value of the parameters $k_m, \sigma$ is realized at the start of the game and remains the same in each period. Each period then follows the timing of the baseline model as long as peace prevails. We can show the following:

**Lemma 8** Consider a two-period game where the challenger’s capabilities would increase between periods 1 and 2, if peace prevails in period 1. Assume that the cost of intervention is low and the value of externalities is high. There exists values $k_m', k_m'', \sigma'$ such that if $k_m \in (k_m', k_m'')$, and $\sigma > \sigma'$, then the following holds:

- If peace prevails in period 1, then war occurs in period 2.
- War occurs in period 1.

**Proof.** See section 7.5.2. ■

This lemma builds on the result of the baseline model to conclude that war may occur in period 2 if the challenger is too weak. By extension, war is inevitable in period 1, when the challenger is even weaker. In the proof of the lemma, we observe that dynamic consequences to peace facilitate war, by strengthening the hegemon’s incentive to intervene in period 1. However, they are not a necessary condition for war, since war would occur in period 2, even when they are absent. In fact, as we show below, dynamic consequences to peace do play an important role in an infinite-horizon game.
7.3.3 Infinite-Horizon Game: Set-Up and Solution

Now consider an infinite-horizon game. The challenger’s capabilities in period $t$ are $\kappa_t = f(\kappa_{t-1}, s_{t-1})$, weakly increasing in $s_{t-1}$. Specifically, we assume that the challenger’s capabilities would be (weakly) smaller if it receives none of the pie and (weakly) greater if it receives the full value of the efficient pie, i.e. $f(\kappa_t, 0) \leq \kappa_t \leq f(\kappa_t, \pi(I^H(\sigma))(1 + \sigma))$.

Exploiting the infinite horizon set-up, we vary the length of time during which the winner of a war controls the input and reaps the full value of its investment. Each period follows the timing of the baseline model, as long as peace prevails. If there is a war in period $T$, then from then on until period $T + N$, the winner of a war controls the input and reaps the full value of the pie. In period $T + N + 1$, $C$’s capabilities return to the pre-war level, $\kappa_T$, and each subsequent period follows the same timing as in the baseline model, as long as peace prevails. We say that $N$ measures the effectiveness of war. While the war is effective, we say that the loser of the war does not have military capabilities. We let $N \in \mathbb{N}_0 \cup \infty$, where “$N = \infty$” if the winner of the war reaps the full value of the pie for the rest of game.

Countries discount the future by factor $\delta \in (0, 1)$. Following the set-up of the two-period game, we assume that the value of the cost of intervention and the value of externalities are set at the beginning of the game and remain constant. Here, we solve the game where the cost of intervention is low and the value of the externalities is high.

First, we show that there is a Markov Perfect Equilibrium where war happens in every period, when both players have military capabilities, if the challenger’s capabilities are sufficiently small. The logic is as follows. Anticipating that there would be a future war, $H$ intervenes in the market. Anticipating that $H$ would intervene and capture some of the pie it creates, $C$’s investment is suboptimal. Thus, peace is inefficient and war happens in the current period. Formally, we state:

**Lemma 9** There are values $\sigma'$ and $\delta'$ such that for any $\sigma > \sigma'$, $\delta \in (\delta', 1)$, there is a Markov Perfect Equilibrium where war occurs in every period where both players have military
capabilities, if and only if, for every \( t \),
\[
(W_C(C) + W_H(C)) - (P_C(\kappa_t) + P_H(\kappa_t)) > \frac{1 - \delta}{1 - \delta^{N+1}}(c_C + c_H)
\]
(11)

where \( W_C(C) + W_H(C) \) and \( P_C(\kappa_t) + P_H(\kappa_t) \) are the aggregate payoffs in the stage game if respectively, war and peace prevail in bargaining over \( p_t \).\(^{22}\)

**Proof.** See section 7.5.3. ■

Observe the condition for war as we vary the effectiveness of fighting. Everything else equal, an increase in \( N \) decreases the right-hand side and makes it easier to sustain an MPE with war. When \( N = 0 \), then we retrieve the same condition for war as in the baseline model.

When \( N = \infty \), then war is inevitable for any value of the challenger’s capabilities, as long as players are sufficiently patient. The logic is as follows. Assume that there is an MPE where war occurs in every period. War would occur in period \( t + 1 \) if peace prevails in period \( t \). The benefit of a war in period \( t \) is to obtain an additional period of efficient investment; the drawback of war is to pay the cost of fighting one period sooner. As players become sufficiently patient (\( \delta \) goes to 1), this drawback becomes negligible, making war inevitable.

Next we ask the following question: if there is an MPE where war obtains in every period, could efficient peace be sustained in a subgame-perfect equilibrium, if players are sufficiently patient and any deviation triggers a reversion to the MPE where war obtains in every period (when both states have military capabilities)?

First, it is useful to consider the case where the challenger’s capabilities are exogenous and constant over time. In this case, we can construct a stationary subgame-perfect Nash equilibrium where peace prevails:\(^{23}\)

\(^{22}\)These are the same values as in the baseline model, i.e. \( W_C(C) + W_H(C) = -kI^{fb}(\bar{\sigma}) + \pi(I^{fb}(\bar{\sigma}))(1 + \bar{\sigma}) \), \( P_C(\kappa_t) + P_H(\kappa_t) = -k_m - kI^*(\bar{\sigma}, \kappa_t) + \pi(I^*(\bar{\sigma}, \kappa_t))(1 + \bar{\sigma}) \), where \( I^*(\bar{\sigma}, \kappa_t) \) is such that \( \pi'(I^*(\bar{\sigma}, \kappa_t)) = \frac{k}{\bar{\sigma}(\kappa_t)^{1 + \bar{\sigma}}} \).

\(^{23}\)A stationary subgame-perfect equilibrium is such that, along the equilibrium path, \( H \) and \( C \) agree on a transfer \( p_t(\kappa_t) \) that is solely a function of \( C \)’s capabilities at time \( t \), \( C \) chooses the efficient level of investment \( I^{fb}(\bar{\sigma}) \) and \( H \) does not intervene.
**Lemma 10** In the infinite-horizon game where the challenger’s capabilities are exogenous and constant over time (i.e. \( f(\kappa_t, s_t) = \kappa_t = \kappa \forall t, s_t \)), the efficient outcome can be sustained as part of a stationary subgame-perfect Nash equilibrium if players are sufficiently patient. **Proof.** See section 7.5.3. ■

In this equilibrium, each player gets a share of the total payoffs commensurate with its power. Any deviation – say, if \( H \) steals part of the surplus – would bring a short-term gain and long-term losses, after reversion to the inefficient MPE where war obtains in every period. If players are sufficiently patient, the short-term gain is outweighed by the long-term losses. Therefore, there is a sense in which the economic commitment problem of the hegemon can be disciplined by the threat of future punishment.

Second, we consider the case where the challenger’s capabilities would increase under efficient peace. Then we show that war may obtain:

**Lemma 11** In the infinite-horizon game where the challenger’s capabilities would strictly increase under efficiency (i.e. for some \( t \), we have \( f(\kappa_t, \pi(I^b(\sigma))(1 + \sigma)) > \kappa_t \)), there is a value for the effectiveness of war \( \bar{N} \) such that if \( N > \bar{N} \), then war ensues. **Proof.** See section 7.5.3. ■

Intuitively, in any subgame-perfect equilibrium, each country should get a share of the aggregate payoffs that is commensurate with its relative power. Yet if \( C \)’s capabilities would strictly increase under efficiency, then \( H \) would be tempted to intervene so as to prevent \( C \)’s rise in power. A necessary condition for peace is that the increase in \( C \)’s capabilities, if \( H \) does not intervene, is less than the cost of war, i.e.

\[
(p(f(\kappa_t, \pi(I^b(\sigma))(1 + \sigma)) - p(\kappa_t))W_C(C) < \frac{1 - \delta}{1 - \delta^{N+1}}(c_C + c_H)
\]

(12)

The cost of war encourages peace, but becomes insufficient as the effectiveness of war increases and players are sufficiently patient: as \( \delta \) goes to 1, the right-hand side of the inequality goes to \( \frac{c_C + c_H}{N+1} \), which goes to zero as \( N \) goes to infinity. By intervening and threatening \( C \) with
war, $H$ can secure a share of the efficient payoffs under the current balance of power for an increasingly long period of time.

The key difference with the canonical model is that the pie is endogenous and $H$ faces an economic commitment problem. It is this feature which allows for an MPE where war obtains in every period. As a result, war can become a self-fulfilling prophecy, even if it is costly. $H$ is tempted to intervene, given $C$'s expected rise. $H$’s intervention makes $C$’s investment sub-optimal, peace becomes inefficient, and war ensues.

### 7.4 Robustness: Proof of the Results

#### 7.4.1 Trade of Inputs: Proof of the Results

**Proof.** (Proof of Proposition 3). If the cost of intervention is high or the value of the externalities is low, then the left-hand side of conditions (9) and (10) is zero. If the cost of intervention is low and the value of the externalities is high, then we can show that $P_C(\kappa, T) + P_H(\kappa, T) > P_C(\kappa, NT) + P_H(\kappa, NT)$ if and only if $A(i_1) < A(i_2)$.

To see this, note that $P_C(\kappa, T) + P_H(\kappa, T) > P_C(\kappa, NT) + P_H(\kappa, NT)$ if and only if the difference in aggregate payoffs between the first-best investment and the constrained optimal level of investment, call it $\Delta_n$, is increasing in $A(i_n)$. Indeed, let

$$\Delta_n = [-kI_n^b(\sigma) + \pi_n(I_n^b(\sigma))(1 + \sigma)] - [-kI_n^*(\sigma, \kappa) + \pi_n(I_n^*(\sigma, \kappa))(1 + \sigma)] \tag{13}$$

Then, we have

$$\frac{\partial \Delta_n}{\partial A(i_n)} = (I_n^b(\sigma)\alpha - I_n^*(\sigma, \kappa)\alpha)(1 + \sigma) - [-k + A(i_n)\alpha I_n^*(\sigma, \kappa)\alpha^{-1}(1 + \sigma)] \frac{\partial I_n^*(\sigma, \kappa)}{\partial A(i_n)} \tag{14}$$

$$= I_n^b(\sigma)\alpha(1 + \sigma)[1 - p(\kappa)\frac{\alpha}{1 - \alpha}(1 + (1 - p(\kappa))\frac{\alpha}{1 - \alpha})] > 0 \tag{15}$$

where the first equality uses the envelope theorem, the second equality uses the values of $I_n^b(\sigma)$ and $I_n^*(\sigma, \kappa)$, and the inequality follows from the fact that the term is squared brackets decreases in $p(\kappa)$ and is equal to 0 at the limit where $p(\kappa)$ tends to 1. ■
7.4.2 Guns and Butter: Proof of the Results

**Proof.** (Proof of lemma 6). It is clear that if \( H \) intervenes, then \( C \) accepts \( z \) if and only if \( z \geq p(\kappa + g)\pi(I)(1 + \sigma) - c_C \). Assume that parameters \( \sigma \) and \( k_m \) are such that \( H \) intervenes if and only if \( \sigma = \overline{\sigma} \) and \( k_m = \overline{k_m} \). If \( \sigma = \sigma \) or \( k_m = k_m \), then \( C \) chooses the efficient level of investment. If \( \sigma = \overline{\sigma} \) and \( k_m = \overline{k_m} \), then \( C \)'s problem is to pick \( g \) and \( I \) so as to maximize

\[
-k_g + p'((\kappa + g)\pi(I)(1 + \sigma)) - c_C
\]

This objective function is strictly concave if \( p''(.) < 0 \), \( \pi''(.) < 0 \), and \( \frac{p''(.)}{p'(.)} \frac{\pi''(.)}{\pi'(.)} > 0 \). The solution is a vector \((g, I) = (g^*(\overline{\sigma}, \kappa), I^*(\overline{\sigma}, \kappa))\) which satisfies the first-order conditions, respectively:

\[
-k_g + p'(\kappa + g)\pi(I)(1 + \sigma) \leq 0 \tag{16}
\]

\[
-k + p(\kappa + g)\pi'(I)(1 + \sigma) \leq 0 \tag{17}
\]

with complementary slackness condition \((g^*(\overline{\sigma}, \kappa) > 0 \) if and only if condition (16) holds with equality; \( I^*(\overline{\sigma}, \kappa) > 0 \) if and only if condition (17) holds with equality). 

First consider condition (17). Since \( \lim_{I \to 0} \pi'(I) = \infty \), then condition (17) must hold with equality and \( I^*(\overline{\sigma}, \kappa) > 0 \). Also note that \( I^*(\overline{\sigma}, \kappa) < I^{fb}(\overline{\sigma}) \) since \( p(.) < 1 \).

Second consider condition (16). Note first that both first-order conditions are functions of \( C \)'s total capabilities, \( \kappa + g \). Define \( \kappa_s \) such that conditions (16) and (17) hold with equality for \( g = 0 \). If \( \kappa < \kappa_s \), \( C \) chooses an investment in guns \( g^*(\overline{\sigma}, \kappa) = \kappa_s - \kappa \) and an investment in butter \( I^*(\overline{\sigma}, \kappa_s) \) such that \( \pi'(I^*(\overline{\sigma}, \kappa_s)) = \frac{k}{p(\kappa_s)(1 + \sigma)} \). If \( \kappa \geq \kappa_s \), \( C \) chooses an investment in guns \( g^*(\overline{\sigma}, \kappa) = 0 \) and an investment in butter \( I^*(\overline{\sigma}, \kappa) \) such that \( \pi'(I^*(\overline{\sigma}, \kappa)) = \frac{k}{p(\kappa)(1 + \sigma)} \).

Now let us establish some properties of \( \kappa_s \). First, we can verify that \( \kappa_s < \kappa_{max} \), since \( \kappa_s \) is bounded for any finite \( \sigma \) and \( \kappa_{max} \) is arbitrarily large.\(^{24}\) Next, we conclude that \( \kappa_s > \kappa_{min} \) if and only if

\[
-k_g + p'(\kappa_{min})\pi(I^*(\overline{\sigma}, \kappa_{min}))(1 + \sigma) > 0 \tag{18}
\]

\(^{24}\)More precisely, define \( \kappa' \) such that \( -k_g + p'(\kappa')\pi(I^{fb}(\overline{\sigma}))(1 + \sigma) = 0 \). Clearly, \( \kappa_s < \kappa' \) so that a sufficient condition for \( \kappa_s < \kappa_{max} \) is \( \kappa' \leq \kappa_{max} \).
where \( I^*(\bar{\sigma}, \kappa_{\text{min}}) \) is such that \( \pi'(I^*(\bar{\sigma}, \kappa_{\text{min}})) = \frac{k}{p(\kappa_{\text{min}})(1+\sigma)} \). We note that the left-hand side of condition (18) is decreasing in \( k_g \) and increasing in \( \bar{\sigma} \). Therefore, for any \( \bar{\sigma} \), there is a value \( k_g(\bar{\sigma}) \) such that condition (18) holds if and only if \( k_g < k_g(\bar{\sigma}) \).

Moving up, we can easily verify that conditions (2) through (4) ensure that \( H \) intervenes if and only if \( \sigma = \bar{\sigma} \) and \( k_m = k_m^* \).

**Proof.** (Proof of proposition 4). As in the baseline model, we conclude that the following form equilibrium strategies of \( H \) and \( C \)'s bargaining over the price of the input \( p_i \). If condition (1) holds, then \( H \) demands \( p_i = p_i^C \), and if condition (1) fails, then either \( H \) declares war or demands \( p_i > p_i^C \); \( C \) accepts \( p_i \) if and only if \( p_i \leq p_i^C \), where \( p_i^C \) is given by equation (6), with expected payoffs after peace \( P_C(\kappa) \) and \( P_H(\kappa) \) as given below (expected payoffs after war remain the same as in the baseline model).

Consider part (i). Payoffs after peace depend on the cost of intervention and the value of externalities. If the cost of intervention is high or the value of externalities is low, i.e., \( (k_m, \sigma) \neq (\bar{k}_m, \bar{\sigma}) \), then \( P_H(\kappa) = 0, P_C(\kappa) = W_C(C) \), so that the total payoffs after peace are equal to total payoffs after war, i.e., \( P_C(\kappa) + P_H(\kappa) = W_C(C) + W_H(C) \) and condition (1) holds, given that war is costly.

Now consider the case where the cost of intervention is low and the value of externalities is high, i.e., \( (k_m, \sigma) = (\bar{k}_m, \bar{\sigma}) \).

For \( \kappa \in [\kappa_{\text{min}}, \kappa_s] \), we have 
\[
P_C(\kappa) = -kI^*(\bar{\sigma}, \kappa_s) - k_g(\kappa_s - \kappa) + p(\kappa_s)\pi(I^*(\bar{\sigma}, \kappa_s))(1+\sigma) - c_C
\]
and 
\[
P_H(\kappa) = -k_m + (1 - p(\kappa_s))\pi(I^*(\bar{\sigma}, \kappa_s))(1 + \sigma) + c_C,
\]
so that total payoffs after peace are
\[
P_C(\kappa) + P_H(\kappa) = -k_m - kI^*(\bar{\sigma}, \kappa_s) - k_g(\kappa_s - \kappa) + \pi(I^*(\bar{\sigma}, \kappa_s))(1 + \sigma) \tag{19}
\]

For \( \kappa \in [\kappa_s, \kappa_{\text{max}}] \), we have 
\[
P_C(\kappa) = -kI^*(\bar{\sigma}, \kappa) + p(\kappa)\pi(I^*(\bar{\sigma}, \kappa))(1 + \sigma) - c_C
\]
and 
\[
P_H(\kappa) = -k_m + (1 - p(\kappa_s))\pi(I^*(\bar{\sigma}, \kappa))(1 + \sigma) + c_C,
\]
so that total payoffs after peace are
\[
P_C(\kappa) + P_H(\kappa) = -k_m - kI^*(\bar{\sigma}, \kappa) + \pi(I^*(\bar{\sigma}, \kappa))(1 + \sigma) \tag{20}
\]
Thus, we observe that total payoffs after peace are continuous and increasing in $\kappa \forall \kappa \in [\kappa_{\text{min}}, \kappa_{\text{max}}]$. Thus, we conclude that part (i) holds.

For part (ii), the argument is the same as in the baseline model. ■

7.5 Discussion: Proof of the Results

7.5.1 The Canonical Model: Proof of the Results

Proof. (Proof of lemma 7). Consider an infinite-horizon game where, in each period, two states divide an exogenous pie (of size normalized to 1) and the balance of power shifts exogenously. We use here the notation of Powell (2006), except that we relabel the states as $C$ and $H$, corresponding, respectively, to states 1 and 2 in Powell (2006)’s set-up. In each period, $H$ either goes to war or makes an offer, let us call it $z_t$, to $C$, keeping $1 - z_t$; if $H$ makes an offer, $C$ decides whether to accept or reject it; if $H$ makes an offer that $C$ accepts, it is implemented, payoffs are accrued, and the game continues to period $t + 1$; if $H$ declares war or makes an offer that $C$ rejects, the game ends and countries get their war payoffs.

The war payoffs are computed as follows. A war in period $t$ is won by $C$ with probability $p_t$. The state that wins a war in period $t$ gets the flow of benefits from period $t$ onwards. War is costly, destroying a fraction $d > 0$ of the pie in each period. Write $M_s(t)$ for the war payoff of state $s$ if a war is fought in period $t$. We have $M_C(t) = \frac{p_t(1-d)}{1-\delta}$ and $M_H(t) = \frac{(1-p_t)(1-d)}{1-\delta}$. Let us write $V_s(t)$ for the value of the game for state $s$ starting with period $t$ (when no war has been fought in the past), given equilibrium strategies.

Consider claim (i). Fix an equilibrium of the continuation game. An offer $z_t$ is acceptable to $C$ if and only if $z_t + \delta V_C(t + 1) \geq \frac{p_t(1-d)}{1-\delta}$. Write $z_t$ for $C$’s minimum demand (the value $z_t$ such that the condition holds with equality). An offer $z_t$ is acceptable to $H$ if and only if $1 - z_t + \delta V_H(t + 1) \geq \frac{(1-p_t(\kappa_t))(1-d)}{1-\delta}$. Write $\overline{z}_t$ for $H$’s maximum offer (the value $z_t$ such that the condition holds with equality). A bargaining range exists in period $t$ if and only if $\underline{z}_t \leq \overline{z}_t$, or $1 + \delta [V_C(t + 1) + V_H(t + 1)] \geq \frac{(1-d)}{1-\delta}$. This inequality holds, since $V_C(t + 1) + V_H(t + 1) \geq \frac{1-d}{1-\delta}$. 54
Consider claim (ii). The condition for war in the canonical model is

\[
\delta M_C(t + 1) - M_C(t) > B - [M_C(t) + M_H(t)]
\]  

(21)

where \( B = \frac{1}{1-\delta} \) is the flow of future pies to be divided between the two states (Powell, 2006, 182). The condition says that war occurs when the shift in the balance of power is greater than the bargaining surplus, or the difference between what the two states divide among themselves and what each state can secure for itself by going to war. This condition can also be written as \( 1 + \delta V_H(t + 1) < M_H(t) \), replacing for \( V_H(t + 1) = B - M_C(t + 1) \). Put differently, the condition for war is \( z_t < 0 \) for any equilibrium of the continuation game. In turn, this implies, using claim (i), that if condition (21) holds, then \( z_t < z_t < 0 \) for any equilibrium of the continuation game.

### 7.5.2 Two-Period Game: Proof of the Results

**Proof.** (Proof of lemma 8). We solve this game by backward induction. Use index \( t \) for the value of a variable in period \( t \) and let players discount future payoffs by factor \( \delta \).

If peace prevails in period 1, then period 2 is played as in the baseline model (see lemmas 1 and 2), where \( C \)'s capabilities are \( \kappa_2 \). If war obtained in period 1, then in period 2 the winner of the war chooses the first-best level of investment. We consider the case where war occurs in period 2 if peace prevailed in period 1.

Now consider period 1. If war obtains in bargaining over the price of the input, the winner of the war chooses the efficient level of investment.

Assume that peace obtains in bargaining over the price of the input. If \( H \) intervenes, then a price \( z_1 \) is acceptable to \( C \) and \( H \), respectively, if and only if

\[
z_1 + \delta V_C(f(\kappa_1, z_1)) \geq p(\kappa_1)[\pi(I_1)(1 + \sigma_1) + \delta W_C(C)] - c_C
\]

(22)

\[
\pi(I_1)(1 + \sigma_1) - z_1 + \delta V_H(f(\kappa_1, z_1)) \geq (1 - p(\kappa_1))[\pi(I_1)(1 + \sigma_1) + \delta W_H(H)] - c_H
\]

(23)
where $V_s(\kappa_2)$ is the value of the game for state $s$ at the start of period 2 if peace prevailed in period 1 and $C$’s capabilities are $\kappa_2$, and, following the notation of the baseline model, $W_s(s')$ is the value of the game for state $s$ at the start of period 2 if war obtained in period 1 and was won by $s'$. We can verify that there exists values $z_1$ that satisfy both conditions, since war is expected to occur at the start of period 2 and war is costly ($c_C + c_H > 0$).

Now consider $H$’s decision to intervene or not. If $H$ intervenes, it would pick $z_1$ to keep $C$ indifferent between war and peace. $H$ prefers to intervene if and only if

$$k_m \leq (1 - p(\kappa_1))\pi(I_1)(1 + \sigma_1) + c_C$$

$$+ \delta[(p(f(\kappa_1, \pi(I_1)(1 + \sigma_1))) - p(\kappa_1))W_C(C) - c_C]$$

Note that since $p(f(\kappa_1, \pi(I_1)(1 + \sigma_1))) > p(\kappa_1)$ and $W_C(C)$ is increasing in $\overline{\sigma}$, then there is a value $\overline{\sigma}'$ such that if $\overline{\sigma}'$, then the term is squared brackets is positive. Put differently, the dynamic consequences to peace facilitate $H$’s decision to intervene in markets. Thus, if condition (4) holds, then a fortiori condition (24) holds.

Moving up, consider $C$’s investment decision. $C$’s problem is to maximize $-kI_1 + z_1 + \delta V_C(f(\kappa_1, z_1))$, where $z_1$ is such that condition (22) holds with equality. This is the same problem as in the baseline model. Thus, $C$ chooses $I_1^*(\overline{\sigma}, \kappa_1)$ as given by the first-order condition $-k + p(\kappa_1)\pi'(I_1^*(\overline{\sigma}, \kappa_1))(1 + \overline{\sigma})) = 0$.

Moving up, consider $C$ and $H$’s bargaining over the price of the input in period 1, $p_{i1}$. A price $p_{i1}$ is acceptable to $C$ and $H$, respectively, if and only if

$$-p_{i1} - kI_1^*(\overline{\sigma}, \kappa_1) + p(\kappa_1)\pi(I_1^*(\overline{\sigma}, \kappa_1)(1 + \overline{\sigma})) - c_C + \delta p(\kappa_1)W_C(C) \geq p(\kappa_1)(1 + \delta)W_C(C) - c_C$$

$$p_{i1} - k_m + (1 - p(\kappa_1))\pi(I_1^*(\overline{\sigma}, \kappa_1)(1 + \overline{\sigma})) + c_C + \delta[(1 - p(\kappa_1))W_C(C) - (c_C + c_H)]$$

$$\geq (1 - p(\kappa_1))(1 + \delta)W_H(H) - c_H$$
Conditions (25) and (26) are compatible if and only if the following condition holds:

\[
[W_C(C) + W_H(C)] - [P_C(\kappa_1) + P_H(\kappa_1)] \leq (1 - \delta)(c_C + c_H)
\]  

(27)

where \(W_C(C) + W_H(C) = -kI^b_1(\bar{\sigma}) + \pi(I^b_1(\bar{\sigma}))(1 + \bar{\sigma})\) and \(P_C(\kappa_1) + P_H(\kappa_1) = -k_m - kI^*_1(\bar{\sigma}, \kappa_1) + \pi(I^*_1(\bar{\sigma}, \kappa_1))(1 + \bar{\sigma})\). Put differently, peace obtains if the inefficiency of peace in the current period is less than the (discounted) cost of war.

Thus, we conclude that if the challenger is rising \((f(\kappa_1, s_1) > \kappa_1 \forall s_1)\) and war is expected in period 2, then war is inevitable in period 1. First, since the challenger is rising, then the inefficiency of peace is greater in period 1 than it would be in period 2 (the left-hand side of condition (27) is greater than the left-hand side of condition (1)). Second, since war is expected in period 2, then going to war in period 1 avoids a war in period 2 (the right-hand side of condition (27) is smaller than the left-hand side of condition (1)).

### 7.5.3 Infinite-Horizon Game: Proof of the Results

**Proof.** (Proof of lemma 9). We construct an MPE where war occurs in every period, when both states begin with military capabilities, assuming that if peace prevailed, \(H\) would intervene in markets. Before we write the strategies in full, let us compute stage-game payoffs and the value of the game for both players.

Write \(W_s(s')\) for the stage-game payoff of state \(s\) if one state enters the period without military capabilities, country \(s'\) having won a war recently and controlling the input and reaping the full benefit of its investment. We have:

\[W_s(s) = -kI^b(\bar{\sigma}) + \pi(I^b(\bar{\sigma}))(1 + \bar{\sigma}), W_s(s') = 0\text{ if } s \neq s'.\]

Write \(P_s(\kappa_t)\) for the stage-game payoff of state \(s\) if the period starts with both states having military capabilities, and \(C\)'s capabilities being \(\kappa_t\). In equilibrium, we have:

\[P_C(\kappa_t) = -kI^*(\bar{\sigma}, \kappa_t) + \tilde{z}(I^*(\bar{\sigma}, \kappa_t))\text{ and}\]

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\[ P_H(\kappa_t) = -k_m + \pi(I^*(\bar{\sigma}, \kappa_t))(1 + \bar{\sigma}) - z(I^*(\bar{\sigma}, \kappa_t)), \]
where \(z(I_t)\) satisfies
\[
z(I_t) + \frac{\delta p(f(\kappa_t, z(I_t)))W_C(C)}{1-\delta} = p(\kappa_t)\pi(I_t)(1 + \bar{\sigma}) + \frac{\delta p(\kappa_t)W_C(C)}{1-\delta} - \frac{(1-\delta)c_C}{1-\delta^{N+1}} \quad (28)
\]
and \(I^*(\bar{\sigma}, \kappa_t)\) is such that \(\pi'(I^*(\kappa_t)) = \frac{k}{p(\kappa_t)(1+\bar{\sigma})} \).

In this equilibrium, the value of the game for \(C\) and \(H\) is, respectively:

\[
V_{MPE}^C(\kappa_t) = \frac{p(\kappa_t)W_C(C)}{1-\delta} - \frac{c_C}{1-\delta^{N+1}} \quad (29)
\]
\[
V_{MPE}^H(\kappa_t) = \frac{(1-p(\kappa_t))W_C(C)}{1-\delta} - \frac{c_H}{1-\delta^{N+1}} \quad (30)
\]

With these expressions in mind, we can show that there is a value \(\bar{\sigma}'\) such that if \(\bar{\sigma} > \bar{\sigma}'\), then the following form an MPE:

In a period where one state begins with no military capabilities, the state with military capabilities chooses \(I_{fb}(\bar{\sigma})\), reaping the full value of the pie.

In a period where both states begin with military capabilities, strategies are as follows: \(H\) either declares war or offers \(p_{it} > p_{iC}\); \(C\) accepts any \(p_{it} \leq p_{iC}\), where

\[
p_{iC} = P_C(\kappa_t) - V_{MPE}^C(\kappa_t) + \delta V_{MPE}^C(f(\kappa_t, z(I^*(\bar{\sigma}, \kappa_t)))) \quad (31)
\]

If peace obtained in bargaining over \(p_{it}\), \(C\) chooses \(I_t = I^*(\bar{\sigma}, \kappa_t)\); \(H\) intervenes and offers \(z_t = z(I_t)\); \(C\) accepts \(z_t\) if and only if \(z_t \geq z(I_t)\). If war obtained in bargaining over \(p_{it}\), then the winner of the war chooses \(I_{fb}(\bar{\sigma})\) and reaps the full value of the pie.

Let us verify that these form equilibrium strategies.

If a state does not have military capabilities, the optimal strategy is straightforward, since strategies are not history-dependent and future military capabilities are independent of current strategies when a state does not have military capabilities.

Consider a period where both state have military capabilities and proceed by backward
induction. If \( H \) intervenes, then \( z_t \) is acceptable to \( C \) and \( H \), respectively, if and only if

\[
z_t + \delta V^MPE_C(f(\kappa_t, z_t)) \geq p(\kappa_t)\pi(I_t)(1+\bar{\sigma}) - c_C + \frac{\delta(1-\delta\bar{\sigma})p(\kappa_t)W_C(C)}{1-\delta} + \delta^{N+1}V^MPE_C(\kappa_t) \tag{32}
\]

\[
\pi(I_t)(1+\bar{\sigma}) - z_t + \delta V^MPE_H(f(\kappa_t, z_t)) \geq (1-p(\kappa_t))\pi(I_t)(1+\bar{\sigma}) - c_H + \frac{\delta(1-\delta\bar{\sigma})(1-p(\kappa_t))W_H(H)}{1-\delta} + \delta^{N+1}V^MPE_H(\kappa_t) \tag{33}
\]

We can verify that these two conditions are compatible since war is costly. Consider condition (32). The left-hand side of the inequality is strictly increasing in \( z_t \); the inequality holds strictly at \( z_t = \pi(I_t)(1+\bar{\sigma}) \) and fails at \( z_t = 0 \) if \( \bar{\sigma} \) is sufficiently large. Thus, there is a value \( \bar{\sigma}' \) such that if \( \bar{\sigma} > \bar{\sigma}' \), then \( C \) accepts \( z_t \) if and only if \( z_t \geq z(I_t) \), as given in equation (28), where \( z(I_t) \in (0, \pi(I_t)(1+\bar{\sigma})) \). Moving up, if \( H \) intervenes, it offers \( z_t = z(I_t) \).

Moving up, consider \( H \)'s decision to intervene or not. \( H \) prefers to intervene if and only if \( k_m < \pi(I_t)(1+\bar{\sigma}) - z(I_t) + \delta[V^MPE_H(f(\kappa_t, z(I_t)))] - V^MPE_H(f(\kappa_t, \pi(I_t)(1+\bar{\sigma}))) \]. The right-hand side of this inequality is strictly increasing in \( \bar{\sigma} \). Therefore, there is a value \( \bar{\sigma}' \) such that \( H \) prefers to intervene if \( \bar{\sigma} > \bar{\sigma}' \).

Now consider \( C \)'s investment decision. \( H \) is expected to intervene and offer \( z = z(I_t) \), leaving \( C \) indifferent between war and peace. Thus, \( C \)'s optimal investment maximizes \( -kI_t + p(\kappa_t)\pi(I_t)(1+\bar{\sigma}) \); it is equal to \( I^*(\bar{\sigma}, \kappa_t) \) as defined above.

Moving up, consider \( H \) and \( C \)'s bargaining over \( p_{it} \). \( p_{it} \) is acceptable to \( C \) if and only if \( p_{it} \leq p_{iC} \), as given by equation (31). \( p_{it} \) is acceptable to \( H \) if and only if \( p_{it} \geq p_{iH} \), where

\[
p_{iH} = -P_H(\kappa_t) + V^MPE_H(\kappa_t) - \delta V^MPE_H(f(\kappa_t, z(I^*(\kappa_t)))) \tag{34}
\]

Bargaining fails and war breaks out if \( p_{iC} < p_{iH} \) or if condition (11) holds.

**Proof.** (Proof of lemma 10) Assume that there is an MPE where war obtains in every period, when both states have military capabilities, i.e. condition (11) is satisfied. We show that
there are values $\sigma'$ and $\delta' < 1$ such that for any $\sigma > \sigma'$ and $\delta \in (\delta', 1)$, then the following forms a stationary subgame-perfect Nash equilibrium:

In period 1 and in every period $t > 1$ if there has been no deviation in any previous period, strategies are as follows: $H$ sets $p_i^t(\kappa) \in ((1-p(\kappa))W_C(C) - \frac{(1-\delta)C_H}{1-\delta^{N+1}}, (1-p(\kappa))W_C(C) + \frac{(1-\delta)C_C}{1-\delta^{N+1}})$; $C$ accepts $p_i^t(\kappa)$ and any $p_{it} \neq p_i^t(\kappa)$ if and only if $p_{it} \leq p_{itC} = P_C(\kappa) - (1 - \delta)V^{MPE}_C(\kappa)$, where $P_C(\kappa) = -kI^*(\sigma, \kappa) + z(I_t)$, $z(I^*(\sigma, \kappa))$ is as defined in equation (28), $I^*(\sigma, \kappa)$ as defined in the proof of lemma 9, and $V^{MPE}_C(\kappa)$ is as defined in equation (29); if war obtained in bargaining over $p_{it}$, then the winner of the war chooses $I^{fb}(\sigma)$ and reaps the full value of the pie; if peace prevailed in bargaining over $p_{it}$, then strategies are as follows: $C$’s investment is $I^{fb}(\sigma)$ if there was no deviation in period $t$ and $I^*(\sigma, \kappa)$ if there was a deviation in period $t$; $H$ does not intervene if there was no deviation in period $t$ and $H$ intervenes and offers $z_t = z(I_t)$ if there was a deviation in period $t$; $C$ accepts an offer $z_t$, if $H$ intervenes, if and only if $z_t \geq z(I_t)$.

In any period $t' > t$, after a deviation in period $t$, players revert to the MPE of lemma 9.

Let us now prove that these form an equilibrium.

After any deviation, either in a previous period or in the current period, players expect the MPE of lemma 9 to be played from then on, and no player has a strictly profitable deviation from the above strategies.

If there was no deviation and peace prevailed, $H$ prefers not to intervene if and only if

$$\frac{\delta}{1-\delta}p_i^t(\kappa) \geq -k_m + \pi(I^{fb}(\sigma))(1+\sigma) - z(I^{fb}(\sigma)) + \delta V^{MPE}_H(\kappa)$$

or

$$\delta(p_i^t(\kappa) - (1-p(\kappa))W_H(H) + \frac{(1-\delta)C_H}{1-\delta^{N+1}}) \geq (1-\delta)(-k_m + (1-p(\kappa))\pi(I^{fb}(\sigma))(1+\sigma)) + \frac{(1-\delta)C_C}{1-\delta^{N+1}}$$

(35)

The right-hand side of the inequality is positive for large $\sigma$, going to 0 as $\delta$ goes to 1. Thus, there are values $\delta', \sigma$ such that if $\delta > \delta'$, $\sigma > \sigma'$, then $H$ does not intervene if and only if

$$p_i^t(\kappa) > (1-p(\kappa))W_H(H) - \frac{(1-\delta)C_H}{1-\delta^{N+1}}$$

(36)
Moving up, if there was no deviation and peace prevailed, $C$ prefers the efficient investment $(I^h(\sigma))$ over the best possible deviation $(I^*(\sigma, \kappa))$ if and only if $W_C(C) + \frac{\delta}{1-\delta} [-p^*_i(\kappa) + W_C(C)] \geq -kI^*(\sigma, \kappa) + z(I^*(\sigma, \kappa)) + \delta V_C^{MPE}(\kappa)$, or

$$\delta[(1-p(\kappa))W_C(C) + \frac{1-\delta}{1-\delta N+1} - p^*_i(\kappa)] \geq -(1-\delta)[W_C(C) - (-kI^*(\sigma, \kappa) + p(\kappa)\pi(I^*(\sigma, \kappa))) + \frac{(1-\delta)c_C}{1-\delta N+1}]$$

(37)

The right-hand side of this inequality is negative and tends to 0 as $\delta$ goes to 1. Thus, there is a value $\delta'$ such that if $\delta > \delta'$, then $C$ chooses the efficient level of investment if and only if

$$p^*_i(\kappa) \leq (1-p(\kappa))W_C(C) + \frac{1-\delta}{1-\delta N+1}$$

(38)

Moving up, consider $H$ and $C$'s bargaining over $p_{it}$. $p^*_i(\kappa)$ is preferable to war for $C$ if and only if $\frac{-p^*_i(\kappa) + W_C(C)}{1-\delta} \geq \frac{p(\kappa)W_C(C)}{1-\delta} - \frac{c_C}{1-\delta N+1}$, or condition (38) holds. $p^*_i(\kappa)$ is preferable to war for $H$ if and only if $\frac{p^*_i(\kappa)}{1-\delta} \geq \frac{(1-p(\kappa))W_C(C)}{1-\delta} - \frac{e_H}{1-\delta N+1}$, which is implied by condition (36). $p^*_i(\kappa)$ is preferable to $p_{IC}$ for $H$ if and only if $\frac{p^*_i(\kappa)}{1-\delta} \geq \frac{p_{IC}}{1-\delta} - \frac{k_m + \pi(I^*(\sigma, \kappa))(1+\sigma) - z(I^*(\sigma, \kappa))}{1-\delta N+1} + \delta V_H^{MPE}(\kappa)$. We can verify that there are values $\delta'$, $\sigma'$ such that if $\delta > \delta'$, $\sigma > \sigma'$, then this condition holds if condition (36) holds.

In sum, the equilibrium requires that conditions (36) and (38) hold. These are compatible, since war is costly. ■

**Proof.** (Proof of lemma 11) Assume that there is a subgame-perfect equilibrium where peace and efficiency prevail, where any deviation triggers the MPE of lemma 9. Write $\overline{p}_{t+1}$ for the average per-period price for the input from period $t+1$ onwards: $\overline{p}_{t+1} = (1-\delta) \sum_{u=1}^{\infty} p^*_{t+u}$, where $p^*_{t+u}$ is the equilibrium price for the input in period $t+u$.

This equilibrium exists only if $C$ does not declare war in period $t+1$ and $H$ does not intervene in period $t$. These conditions are, respectively, $\overline{p}_{t+1} + W_C(C) \geq V_C^{MPE}(\kappa_{t+1})$ or

$$\overline{p}_{t+1} \leq (1-p(f(\kappa_t, \pi(I^h(\sigma)))(1+\sigma)))W_C(C) + \frac{(1-\delta)c_C}{1-\delta N+1}$$

(39)
and \[ \frac{\delta p_{i,t+1}}{1-\delta} \geq -k_m + \pi (I^{fb}(\overline{\sigma}))(1 + \overline{\sigma}) - z(I^{fb}(\overline{\sigma})) + \delta V^{MPE}_H(f(\kappa_t, z(I^{fb}(\overline{\sigma})))) \]

or

\[ \delta(p_{i,t+1} - (1 - p(\kappa_t)))W_C(C) + \frac{(1 - \delta)c_H}{1 - \delta N+1} \geq (1-\delta)(-k_m+(1-p(\kappa_t))\pi(I^{fb}(\overline{\sigma}))(1+\overline{\sigma})+\frac{(1 - \delta)c_C}{1 - \delta N+1}) \]

The right-hand side of condition (40) is positive, if \( \overline{\sigma} \) is large, and goes to 0 as \( \delta \) goes to 1. Thus, condition (40) is satisfied for \( \delta \) close to 1 if and only if

\[ p_{i,t+1} > (1 - p(\kappa_t))W_C(C) - \frac{(1 - \delta)c_H}{1 - \delta N+1} \]

(41)

Conditions (39) and (41) can both hold only if condition (12) holds. Yet condition (12) fails, if \( f(\kappa_t, \pi(I^{fb}(\overline{\sigma}))(1 + \overline{\sigma})) > \kappa_t \), if \( N \) tends to infinity and \( \delta \) tends to 1. ■

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Figure 1: Game Tree of the Baseline Model

Nature chooses externalities $\sigma$ and cost of capture $k_c$

- H demands T
  - declares war
  - accepts
  - V chooses investment $b > 0$
  - chooses investment $b = 0$
    - game ends
    - V chooses Investment $b$ ...
  - does not capture
    - captures, offers $z$
    - declares war
      - accepts
      - game ends
    - game ends

C

Note: Payoffs are omitted for simplicity
Figure 2: The Inefficiency of Peace

\[ S'(x_b) = \frac{k_b}{p(1+\sigma)} \]
\[ S'(x_b) = \frac{k_b}{1+\sigma} \]

Surplus

Investment \( x_b \)
Figure 3: The Choice between Guns and Butter

Weak Challengers ($\kappa < \kappa_s$)

$$b^*(\kappa)$$

Strong Challengers ($\kappa \geq \kappa_s$)

$$b^*(\kappa) = \frac{p(\kappa + g)S(b)(1 + \sigma_H)}{u_0}$$

$$k_b b + k_g g = k_0$$