

The Durability of the Security Dilemma: An Empirical Investigation of Action-Reaction Dynamics in States' Military Spending, 1988– 2014

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Abstract

The security dilemma describes the tragic spiral that follows from the attempts of states to enhance their security under anarchy. Even in a world made up solely of status quo-oriented states, the outcome of the dilemma is, in theory, increased conflict and reduced security for all. After the end of the Cold War, however, many voices claimed that the security dilemma was mainly a thing of the past. Others disagreed, arguing that security competition and interstate conflict would still be prominent features of the international system. We provide relevant empirical tests of such stances, attempting to reveal whether action-reaction dynamics have been prevalent in the post-Cold War period, with data covering 150 countries and spanning 1988-2014. Our dependent variable uses data on states' military-spending changes. Our main independent variable codes the weighted average of arms-spending changes among neighbouring states. Thereby we get a novel measure of whether states in general structure their military budgets according to alterations to neighbouring countries' military capacity. Our results indicate that this is indeed the case: the security dilemma, and action-reaction forms of behaviour more broadly (including both 'vicious' and 'virtuous' cycles), are still key mechanisms in the international system. This relationship holds for the entire post-Cold War period, though results are particularly strong for the last 5-6 years.

Introduction

The end of the Cold War sparked substantial optimism about the future of international politics. Many voices claimed that interstate war, security competition and security dilemmas were now all but obsolete in most regions of the world.¹ Recent trends, however, seem to suggest that militarised interstate conflicts and security competition are returning. If they ever disappeared at all, that is. The era of the purported demise of America and ‘rise of the rest’,² thus, could conceivably help vindicate some of the more *pessimistic* predictions from the immediate post-Cold War period; some prominent analysts claimed at the time that history – and with it, intense security competition and arms races – would surely soon return to the anarchic, self-help international system.³

To the extent that history *has* returned and that the ‘world has become normal again’,⁴ we would expect to witness the continued *and general* presence of action-reaction types of state behaviour, which are closely linked to security-dilemma dynamics. International Relations realists argue that the international system’s essential properties remain the same: the ordering principle of anarchy is still the *sine qua non* of what is essentially a self-help system consisting of states that are autonomous, functionally undifferentiated actors each of which must always

¹ Francis Fukuyama, ‘The End of History?’, *National Interest*, Vol. 16:Summer (1989), pp. 3-18; James M. Goldgeier and Michael McFaul, ‘A Tale of Two Worlds: Core and Periphery in the Post-Cold War Era’, *International Organization*, Vol. 46, No. 2 (1992), pp. 467-91; Michael Mandelbaum, ‘Is Major War Obsolete?’, *Survival*, Vol. 40, No. 4 (1998-1999), pp. 20-38; John P. Mueller, *Retreat from Doomsday: The Obsolescence of Major War* (New York, Basic Books, 1989).

² Fareed Zakaria, *The Post-American World* (New York: Norton, 2008), p. 2.

³ John J. Mearsheimer, ‘Back to the Future: Instability in Europe after the Cold War’, *International Security*, Vol. 15, No. 1 (1990), pp. 5-56; Kenneth N. Waltz, ‘The Emerging Structure of International Politics’, *International Security*, Vol. 18, No. 2 (1993), pp. 44-79.

⁴ Robert Kagan, *The Return of History and the End of Dreams* (London: Atlantic Books, 2008), p. 3.

be prepared to fend for itself.⁵ Other states, whose intentions cannot be known for certain, are a potential menace, and states consequently fear each other.⁶ What accordingly still applies, therefore, is the security dilemma, which simply describes a situation where ‘what one does to enhance one’s own security causes reaction that, in the end, can make one less secure’.⁷ The term was coined by John Herz over 60 years ago⁸ – and the core ideas have since been elaborated by, among others, Robert Jervis⁹ and Charles Glaser¹⁰ – though it rests on a centuries-old ‘Hobbesian’ idea that the lack of a sovereign produces pervasive insecurity. This is so even if the world is inhabited solely by status quo-minded security seekers. Anarchy causes security concerns, and security concerns causes power-seeking, which increases others’ security concerns – and these dynamics generate spirals that are effectively self-defeating though not irrational. The security dilemma is therefore in essence a tragic phenomenon.

Our study tests empirically whether or not the security dilemma, and related action-reaction dynamics in the form of armaments policies, are still prominent factors in international politics. We do this by way of a time-series cross-section analysis, with data covering 150

⁵ Kenneth N. Waltz, *Theory of International Politics* (New York: McGraw-Hill, 1979), pp. 111-8.

⁶ John J. Mearsheimer, *The Tragedy of Great Power Politics* (New York: Norton, 2001), p. 31; Sebastian Rosato, ‘The Inscrutable Intentions of Great Powers’, *International Security*, Vol. 39, No. 3 (2014-2015), pp. 48-88.

⁷ Barry R. Posen, ‘The Security Dilemma and Ethnic Conflict’, *Survival*, Vol. 35, No. 1 (1993), p. 28.

⁸ John H. Herz, ‘Idealist Internationalism and the Security Dilemma’, *World Politics*, Vol. 2, No. 2 (1950), pp. 157-80.

⁹ Robert Jervis, *Perception and Misperception in International Politics* (Princeton, NJ: Princeton University Press, 1976), Ch. 3; Robert Jervis, ‘Cooperation under the Security Dilemma’, *World Politics*, Vol. 30, No. 2 (1978), pp. 167-214.

¹⁰ Charles L. Glaser, ‘Political Consequences of Military Strategy: Expanding and Refining the Spiral and Deterrence Models’, *World Politics*, Vol. 44, No. 4 (1992), pp. 497-538; Charles L. Glaser, ‘The Security Dilemma Revisited’, *World Politics*, Vol. 50, No. 1 (1997), pp. 171-201.

countries for the period 1988-2014. The reverse side of the empirical coin is the possible existence of ‘virtuous’ cycles – that is, reciprocal *disarmament* – and this is also subject to empirical investigation herein. Our dependent variable uses data on states’ year-on-year changes in military spending. Our main independent variable codes the weighted average of arms-spending changes among the neighbours of the state in question. Thereby we get a highly useful, and novel, measure of whether states in general tend to structure their military budgets according to the threat (or lack thereof) posed by changes to proximate states’ military capacity, as ‘pessimistic’ arguments would claim. Both the dependent and the independent measure come in three different versions, to ensure robustness. In addition, we control for other theoretically relevant variables that could possibly mitigate or heighten security competition.

Our results indicate that the security dilemma, and action-reaction forms of behaviour more broadly (including both ‘vicious’ and ‘virtuous’ cycles), are still mechanisms to be reckoned with in international politics. Our measure of military-spending changes of neighbouring states is consistently positive and significant. This relationship seems to hold for the entire post-Cold War period. Results are particularly strong for the last 5-6 years, though, possibly as a result of recent changes in the overall balance of power.

The security dilemma and action-reaction dynamics

While the literature also points to possible *internal* causes of competition in armaments,¹¹ much arms-spending changes are likely rooted in *external* causes. Two such basic external sources are highlighted, each of which carries its own distinctive implications in terms of security.¹²

¹¹ Charles L. Glaser, ‘The Causes and Consequences of Arms Races’, *Annual Review of Political Science*, Vol. 3, No. 1 (2000), pp. 256-9.

¹² Charles L. Glaser, ‘When are Arms Races Dangerous? Rational versus Suboptimal Arming’, *International Security*, Vol. 28, No. 4 (2004), pp. 44-84; Colin S. Gray, ‘The Urge to Compete: Rationales for Arms Racing’,

Firstly, the *deterrence* model argues that revisionist or ‘greedy’ states spur arms competition.¹³ The prevailing logic here is that status-quo powers sometimes rationally engage in vigorous arms build-ups in order to balance or deter the purported aggressor state from overturning the status quo. This does not lead to a security dilemma as there is no mutual – only a unilateral – fear that the adversary is a revisionist or ‘greedy’ state.¹⁴

The *security-dilemma* model, for its part, rests on a spiral logic that highlights the self-defeating – tragic – properties of security-seeking in an anarchic world¹⁵; that is to say, a world ‘where one state’s attempts to increase its security appear threatening to others and provoke an unnecessary conflict’.¹⁶ States seek survival and security, and as they cannot be certain of the intentions of others, military capabilities become the ultimate means of protection. But here, suspicion and fear are *mutual*, resulting in a cyclical pattern: one state increases its arms; the other, fearing that the arms build-up may rest on malign intentions, follows suit; the first reacts to this; the second reacts to the first’s reaction, and so on. Both states are pure, defensively-minded security-seekers – but none can afford to trust that the other is of this type.

World Politics, Vol. 26, No. 2 (1974), pp. 207-33; Andrew Kydd, ‘Arms Races and Arms Control: Modeling the Hawk Perspective’, *American Journal of Political Science*, Vol. 44, No. 2 (2000), pp. 228-44.

¹³ Charles L. Glaser, ‘Political Consequences of Military Strategy’; Colin S. Gray, ‘The Urge to Compete’, pp. 210-1; Robert Jervis, *Perception and Misperception*, Ch. 3.

¹⁴ Charles L. Glaser, ‘The Security Dilemma Revisited’, p. 193; Robert Jervis, *Perception and Misperception*, pp. 182-3.

¹⁵ Glenn H. Snyder, ‘The Security Dilemma in Alliance Politics’, *World Politics*, Vol. 36, No. 4 (1984), p. 461. For a fine explication of the many dimensions associated with the security-dilemma logic, see: Shiping Tang, ‘The Security Dilemma: A Conceptual Analysis’, *Security Studies*, Vol. 18, No. 3 (2009), pp. 587-623.

¹⁶ Evan Braden Montgomery, ‘Breaking Out of the Security Dilemma: Realism, Reassurance, and the Problem of Uncertainty’, *International Security*, Vol. 31, No. 2 (2006), p. 152.

Anarchy, tragedy and the security dilemma

The concept of the security dilemma thus catches ‘the unfortunate fact that policies designed to increase the state’s security often have the effect of decreasing the other’s security’.¹⁷ States accumulate power for defence, but considering that ‘no state can know that the power accumulation of others is defensively-motivated only, each must assume that it might be intended for attack. Consequently, each party’s power increments are matched by the others, and all wind up with no more security than when the vicious cycle began’.¹⁸ Such tragic spirals ‘between states that want nothing more than to preserve the status quo’¹⁹ represent, according to some, ‘the *quintessential dilemma* in international politics’.²⁰

It was John Herz²¹ who originally introduced the term, lucidly capturing the key elements on which later scholars – notably Herbert Butterfield,²² Robert Jervis and Charles Glaser – elaborate. The security-dilemma logic has since been used to explain, *inter alia*, the

¹⁷ Robert Jervis, ‘Dilemmas About Security Dilemmas’, *Security Studies*, Vol. 20, No. 3 (2011), p. 416.

¹⁸ Glenn H. Snyder, ‘The Security Dilemma in Alliance Politics’, p. 461.

¹⁹ Glenn H. Snyder, ‘Mearsheimer’s World – Offensive Realism and the Struggle for Security’, *International Security*, Vol. 27, No. 1 (2002), p. 155.

²⁰ Ken Booth and Nicholas J. Wheeler, *The Security Dilemma: Fear, Cooperation and Trust in World Politics* (Basingstoke: Palgrave MacMillan, 2008), p. 2 (emphasis in the original).

²¹ John H. Herz, ‘Idealist Internationalism and the Security Dilemma’.

²² Herbert Butterfield, *History and Human Relations* (London: Collins, 1951).

security environment in East Asia;²³ the First World War;²⁴ the onset and continuation of the Cold War;²⁵ ethnic conflict;²⁶ alliance politics;²⁷ and U.S. ballistic missile defences and Russian countermoves.²⁸

For Herz, it all begins with the structure of the system – of *any* system without any higher authority. In such an anarchic system, he writes, what arises is a

‘security dilemma’ of men, or groups, or their leaders. Groups or individuals living in such a constellation must be, and usually are, concerned about their security from being attacked, subjected, dominated, or annihilated by other groups and individuals. Striving to attain security from such attack, they are driven to acquire more and more power in order to escape the impact of the power of others. This, in turn, renders the others more insecure and compels them to prepare for the worst. Since none can ever feel entirely secure in such a world of competing

²³ Thomas J. Christensen, ‘China, the U.S.–Japan Alliance, and the Security Dilemma in East Asia’, *International Security*, Vol. 23, No. 4 (1999), pp. 49-80; Thomas J. Christensen, ‘The Contemporary Security Dilemma: Deterring a Taiwan Conflict’, *Washington Quarterly*, Vol. 25, No. 4 (2002), pp. 7-21; Adam P. Liff and G. John Ikenberry, ‘Racing toward Tragedy? China’s Rise, Military Competition in the Asia Pacific, and the Security Dilemma’, *International Security*, Vol. 39, No. 2 (2014), pp. 52-91.

²⁴ Stephen Van Evera, ‘The Cult of the Offensive and the Origins of the First World War’, *International Security*, Vol. 9, No. 1 (1984), pp. 58-107.

²⁵ Robert Jervis, ‘Was the Cold War a Security Dilemma?’, *Journal of Cold War Studies*, Vol. 3, No. 1 (2001), pp. 36-60.

²⁶ Barry R. Posen, ‘The Security Dilemma and Ethnic Conflict’; Paul Roe, ‘The Intrastate Security Dilemma: Ethnic Conflict as a “Tragedy”?’’, *Journal of Peace Research*, Vol. 36, No. 2 (1999), pp. 183-202.

²⁷ Glenn H. Snyder, ‘The Security Dilemma in Alliance Politics’.

²⁸ Reuben Steff and Nicholas Khoo, ‘Hard Balancing in the Age of American Unipolarity: The Russian Response to US Ballistic Missile Defense during the Bush Administration’, *Journal of Strategic Studies*, Vol. 37, No. 2 (2014), pp. 222-58.

units, power competition ensues, and the vicious cycle of security and power accumulation is on.²⁹

The dilemma is a structural one. It follows not from characteristics of states or individuals; it is rather based at Kenneth Waltz's third level of analysis,³⁰ arising from the lack of a supranational sovereign – that is, from anarchy.³¹ This is a self-help, competitive system wherein actors or states are constrained with respect to their freedom of maneuver. Security and survival being their fundamental goals, states are apt to err on the side of caution in their security policies, constantly striving either to improve or to keep their power position vis-à-vis others. For not doing so, considering the possibility that the motives or intentions of those others might not be benevolent, involves the risk of being exploited.

This risk, and the fear with which it is associated, 'most strongly drives the security dilemma'.³² Its command generates efforts to maximise security by augmenting relative power. But when two (or more) states simultaneously act according to this logic, both (all) will at the least wind up being no better off in terms of security, and with the added costs that go along with security competition and arms races.³³ Indeed, security should be *reduced* all around

²⁹ John H. Herz, 'Idealist Internationalism and the Security Dilemma', p. 157.

³⁰ Kenneth N. Waltz, *Man, the State and War: A Theoretical Analysis* (New York: Columbia University Press, 1959).

³¹ John H. Hertz, 'Idealist Internationalism and the Security Dilemma', p. 157; Robert Jervis, 'Cooperation under the Security Dilemma', p. 167; Shiping Tang, 'The Security Dilemma', p. 594.

³² Robert Jervis, 'Cooperation under the Security Dilemma', p. 172.

³³ Robert Jervis, *Perception and Misperception*, pp. 64-5; Glenn H. Snyder, 'The Security Dilemma in Alliance Politics', p. 461.

because the vicious spiral enhances mutual suspicion and tensions.³⁴ Worse still, if military technology and prevailing strategies are of such a nature that striking first is rationally tempting, the mechanism of the security dilemma can, by itself, trigger war.³⁵

The security dilemma is a *tragic* dilemma in the sense that states do not seek to become engaged in conflicts and vicious spirals; instead, the structural constraints under which they operate induce or compel them to undertake actions that are in reality self-defeating.³⁶ Mutual security is preferred, but security competition ensues as an *unintended consequence* of moves by ‘decisionmakers finding themselves in a predicament that is not of their own making’.³⁷ The motives or intentions of actors play no necessary role in the tragedy. Others’ intentions cannot be known for certain – and their *future* intentions are most definitely impossible to predict. This means that even in a world made up solely of security-seeking or status quo-oriented states – as opposed to power-seeking, ‘revisionist’ or ‘greedy’ ones –, fear and uncertainty prevail, as does the security dilemma. As Robert Jervis points out, this fear and uncertainty stem not from any ‘limitations on rationality imposed by human psychology nor in a flaw in human nature,

³⁴ Ken Booth and Nicholas J. Wheeler, *The Security Dilemma*, pp. 7-9; Reuben Steff and Nicholas Khoo, ‘Hard Balancing in the Age of American Unipolarity’, p. 229.

³⁵ Robert Jervis, *Perception and Misperception*, p. 66; Andrew Kydd, ‘Sheep in Sheep’s Clothing: Why Security Seekers Do Not Fight Each Other’, *Security Studies*, Vol. 7, No. 1 (1997), pp. 371-2. A number of empirical studies exist that show that arms races (which may or may not be driven by the security dilemma) increase the likelihood of war among rivals. See, for example: Toby J. Rider, Michael G. Findley, and Paul F. Diehl, ‘Just Part of the Game? Arms Races, Rivalry, and War’, *Journal of Peace Research*, Vol. 48, No. 1 (2011), pp. 85-100; Susan G. Sample, ‘The Outcomes of Military Buildups: Minor States vs. Major Powers’, *Journal of Peace Research*, Vol. 39, No. 6 (2002), pp. 669-91; Michael D. Wallace, ‘Arms Races and Escalation: Some New Evidence’, *Journal of Conflict Resolution*, Vol. 23, No. 1 (1979), pp. 3-16.

³⁶ Glenn H. Snyder, ‘The Security Dilemma and Alliance Politics’, p. 461.

³⁷ Paul Roe, ‘Actors’ Responsibility in “Tight”, “Regular” or “Loose” Security Dilemmas’, *Security Dialogue*, Vol. 32, No. 1 (2001), p. 103.

but in a correct appreciation of the consequences of living in a Hobbesian state of nature'.³⁸ The build-up of military capabilities can therefore be viewed as a prudent response to an uncertain future (or present) in which worst-case-scenario planning constitutes an insurance against threats to one's security or survival.³⁹

This fits with the Prisoners' Dilemma analogy, which Robert Jervis in particular has pondered and elaborated:⁴⁰ Each state or player, under conditions of imperfect information, rationally follows a strategy of 'defection', as opposed to one of 'cooperation', to avoid ending up as the game's 'sucker'. Both (or all) having done so, their interaction produces a Pareto sub-optimal outcome, for both (all) would have preferred mutual cooperation to reciprocal defection. But the conflict outcome – its 'solution' – still has the character of a Nash equilibrium, which follows rationally from the game's properties. Again, what drives such a tragic outcome is basically structure (anarchy) coupled with the inescapable information deficiency. This is so even if the players' preference orderings are overwhelmingly status-quo inclined. In such a case, the game is not a Prisoners' Dilemma but a Stag Hunt, which means that mutual cooperation is preferred even to unilateral defection. Yet, so long as the players are uncertain about which game they are really participants of, defection should be the strategy of choice, and conflict should therefore ensue.

³⁸ Robert Jervis, *Perception and Misperception*, p. 62.

³⁹ Charles L. Glaser, 'When Are Arms Races Dangerous?', p. 46; Bruce M. Russett and John R. Oneal, *Triangulating Peace: Democracy, Interdependence, and International Organizations* (New York: Norton, 2001), pp. 22-3.

⁴⁰ Robert Jervis, 'Cooperation under the Security Dilemma'. See also: Robert Axelrod and Robert O. Keohane, 'Achieving Cooperation under Anarchy: Strategies and Institutions', *World Politics*, Vol. 38, No. 1 (1985), pp. 226-54; Kenneth A. Oye, 'Explaining Cooperation under Anarchy: Hypotheses and Strategies', *World Politics*, Vol. 38, No. 1 (1985), pp. 1-24.

The ubiquitous uncertainty notwithstanding, states still try to estimate others' motives; and when trying, they are apt to pay heed to the *behaviour* of potential security competitors. This includes not least the latter's military spending and posture.⁴¹ It is exactly here that the delicate balancing between security-enhancing and self-defeating behaviour commences. This constitutes a dilemma in itself. If a given state has an incentive to signal benign motives to its adversary, it will (depending on the offence-defence balance, which is described later) avoid augmenting military capabilities lest the other will interpret this as signalling malign intentions. At the same time, though, such a decision will necessarily leave the former in a vulnerable position, which it can scarcely afford given the prominence of security concerns under the perilousness of anarchy.⁴² Contrarily, if the state instead increases its military spending, it risks signalling *malign* intentions, in which case the second state would rationally react by doing the same.

Most states, facing this situation, would probably be inclined to settle for the 'least-bad' option, which involves sacrificing the revelation of their true, benign motives on the altar of military capabilities.⁴³ This is still a real quandary that would ultimately make the second state 'doubly insecure'.⁴⁴ That is, the former's arms build-up would signal both enhanced military capacity *and* malevolent intentions. The second state, for its part, would be ill advised to let a

⁴¹ James D. Fearon, 'Signaling Foreign Policy Interests: Tying Hands versus Sinking Costs', *Journal of Conflict Resolution*, Vol. 41, No. 1 (1997), pp. 68-90; Charles L. Glaser, 'The Security Dilemma Revisited'.

⁴² Evan Braden Montgomery, 'Breaking Out of the Security Dilemma'.

⁴³ Ken Booth and Nicholas J. Wheeler, *The Security Dilemma*, p. 1; Charles L. Glaser, 'The Security Dilemma Revisited', p. 192; Robert Jervis, 'Cooperation under the Security Dilemma', p. 182.

⁴⁴ Robert Jervis, *Perception and Misperception*, p. 67.

potentially ‘greedy’⁴⁵ or ‘imperialist’⁴⁶ state gain an unfettered advantage in terms of capabilities. At core here is the reluctance or inability – out of fear, uncertainty or risk aversion – to perceive the situation as a security dilemma, even when that is what it really is. Two states both of which are status-quo oriented may thus end up ‘in a relationship of higher conflict than is required by the objective situation’.⁴⁷

The security dilemma and the intentions of states

Whether or not the security dilemma hinges on the existence of greedy or revisionist states – that is, states whose motives go well beyond security – has been much discussed in the literature.⁴⁸ To an extent, the ‘greed’ versus ‘status quo’ dualism corresponds with the distinction within structural-realist theory; which is to say, that between offensive and defensive realism. The former variant of realism was laid out by John Mearsheimer in *The Tragedy of Great Power Politics*, the title of which alludes to the observation that security competition and wars are, or seem to be, permanent features of the international system. Yet, in Mearsheimer’s conception, these are features that arise not from the evilness of states or their leaders – this in

⁴⁵ Charles L. Glaser, ‘Political Consequences of Military Strategy’, p. 501.

⁴⁶ Hans J. Morgenthau, *Politics among Nations: The Struggle for Power and Peace* [7th ed., revised by Kenneth W. Thompson and W. David Clinton] (Boston, MA: McGraw-Hill, 2006 [1948]), Ch. 5.

⁴⁷ Robert Jervis, ‘Cooperation under the Security Dilemma’, p. 182.

⁴⁸ See, for example: Andrew Kydd, ‘Sheep in Sheep’s Clothing’, pp. 114-5; Glenn H. Snyder, ‘Mearsheimer’s World’, pp. 155-7; Shiping Tang, ‘The Security Dilemma’, p. 594; Charles L. Glaser, ‘The Security Dilemma Revisited’, pp. 506-7; Robert Jervis, ‘Dilemmas about Security Dilemmas’, p. 421; Evan Braden Montgomery, ‘Breaking Out of the Security Dilemma’, p. 152; Ken Booth and Nicholas J. Wheeler, *The Security Dilemma*, pp. 34ff.

contrast to classical realists such as Hans Morgenthau⁴⁹ and Reinhold Niebuhr⁵⁰ – but rather from the predicament in which security-seeking actors find themselves under the structural condition of anarchy. Mearsheimer states that the security dilemma ‘reflects the basic logic of offensive realism’.⁵¹ However, the security dilemma is not necessarily a true ‘dilemma’ in the view of Mearsheimer’s theory; the ever-present security competition in international affairs, considering its outcome, instead approaches a ‘security paradox’.⁵² Offensive realism claims that states seek to maximise security. But whereas Mearsheimer holds that this is achieved through *power* maximisation (a key ingredient of which is arms build-ups), defensive realists – such as Kenneth Waltz (although he did not write much about the security dilemma *per se*) – contends that rational states are rather power *satisficers* that attempt to maintain their position in the system;⁵³ a maximisation of armaments carries inherent self-defeating properties given that this augments insecurity among other states, thereby prompting balancing behaviour that in turn feeds the vicious spiral.⁵⁴

Yet, this does not mean that one should exaggerate the differences between offensive and defensive realism in this respect.⁵⁵ Firstly, Mearsheimer’s power-maximisation states, though revisionist, are also cost-benefit-weighting strategic actors that will rationally choose

⁴⁹ Hans J. Morgenthau, *Politics among Nations*.

⁵⁰ Reinhold Niebuhr, *Moral Man and Immoral Society: A Study in Ethics and Politics* (New York: Continuum, 2005 [1932]). For a different take on the intra-realist division, one that distinguishes between between the two schools of ‘tragedy’ and ‘evil’, see: Michael Spirtas, ‘A House Divided: Tragedy and Evil in Realist Theory’, *Security Studies*, Vol. 5, No. 3 (1996), pp. 385-423.

⁵¹ John J. Mearsheimer, *The Tragedy of Great Power Politics*, pp. 35-6.

⁵² Ken Booth and Nicholas J. Wheeler, *The Security Dilemma*, pp. 7-9.

⁵³ Kenneth N. Waltz, *Theory of International Politics*, p. 126.

⁵⁴ Charles L. Glaser, ‘The Security Dilemma Revisited’, p. 145.

⁵⁵ Glenn H. Snyder, ‘Mearsheimer’s World’, pp. 155-7.

less expansionist policies if the costs and risks of further expansion outweigh the expected gains.⁵⁶ Secondly, defensive realists align more with offensive ones under the condition of offence dominance: an advantage to the offence ‘makes conquest comparatively easy, increases the likelihood of aggressive behaviour, and intensifies the security dilemma between states’.⁵⁷ But still, at root, the ‘tragedy’ of the security dilemma does not rest on the actual existence of any revisionist or ‘greedy’ states (although Randall Schweller states that the *theoretical* possibility of revisionist states is logically necessary for there to be a dilemma at all⁵⁸). This point is emphasised by many, and the security dilemma is therefore usually associated particularly with defensive realism.⁵⁹ A world in which greedy states are prevalent, on the other hand, is a world where status-quo and revisionist states alike rationally attempt to increase their power, in order to balance menacing states, without this leading to self-defeating results; hence, the deterrence model, rather than the spiral model, can best explain such a world.⁶⁰ The understanding of ‘tragedy’ is thus different for defensive realists than for offensive ones. The former see it as a function of more or less pure structure (persistent insecurity under anarchy),

⁵⁶ John J. Mearsheimer, *The Tragedy of Great Power Politics*, p. 37.

⁵⁷ Evan Braden Montgomery, ‘Breaking Out of the Security Dilemma’, p. 156.

⁵⁸ Randall L. Schweller, ‘Neorealism’s Status-quo Bias: What Security Dilemma?’, *Security Studies*, Vol. 5, No. 3 (1996), pp. 90-121. Charles Glaser, however, takes issue with Schweller’s contention, arguing that his criticisms ‘fail to appreciate the central role that uncertainty plays in structural realism’. As states are viewed by structural realism as ‘black boxes’, state *behaviour* becomes key to any assessment of motives. But behavioural outcomes are imperfect yardsticks in that regard; they will not extinguish all uncertainty about motives, and thus, ‘from the perspective of a structural theory, this uncertainty is real, not imagined or the product of misunderstanding. As a result, the state faces a real security dilemma’. See: Charles L. Glaser, ‘The Security Dilemma Revisited’, p. 145.

⁵⁹ Glenn H. Snyder, ‘Mearsheimer’s World’, pp. 155-7; Shiping Tang, ‘The Security Dilemma’, p. 594; Charles L. Glaser, ‘Political Consequences of Military Strategy’, pp. 506-7; Evan Braden Montgomery, ‘Breaking Out of the Security Dilemma’, p. 152.

⁶⁰ Charles L. Glaser, ‘The Security Dilemma Revisited’, p. 174.

whereas the latter's 'models of greedy states must turn to other theories to explain their motivations [such as those that] focus on the characteristics of individual states and/or their leaders'.⁶¹

Drivers, modifiers and manifestations of the security dilemma

The empirical analysis in the latter half of this article investigates whether the security-dilemma mechanism has been in play in the post-Cold War era. Empirically, we focus on the *outcome* of any such mechanism; that is, in terms of measurement, we look for patterns of action-reaction dynamics in states' military spending. Three issues or questions are important to clarify before we proceed with the empirical tests, however. Firstly, is arms spending a useful proxy for manifestations of the security dilemma? Secondly, what determines the *severity* of the security dilemma? Thirdly, is there also room for *positive dynamics* among states – that is, for 'virtuous' cycles of reciprocal disarmament?

As for the first question, it should be obvious that, with regard to outcomes, the security dilemma does not only concern states' military spending. Structural realists, for example, often emphasise that power balancing for security purposes can take two ideal-type forms: internal (i.e. relying on own arms) and external (i.e. through alliances).⁶² Moreover, the quest for power introduces further acts that can spur counter-moves and vicious spirals, including territorial aggrandisement (a consistent theme in John Mearsheimer's work); competition for colonies;⁶³

⁶¹ Charles L. Glaser, 'Political Consequences of Military Strategy', p. 507.

⁶² John J. Mearsheimer, *The Tragedy of Great Power Politics*, pp. 156-7; Kenneth N. Waltz, *Theory of International Politics*, p. 168.

⁶³ Robert Jervis, *Perception and Misperception*, p. 66.

economic policies and diplomacy;⁶⁴ and, more generally, the exertion of influence by a state over others in order to alleviate potentially ‘adverse chain reactions’ before these gain momentum.⁶⁵

Still, while it is true that competition for arms is ‘only the most obvious manifestation’ of the spiral mechanism,⁶⁶ it is also the manifestation that is most commonly discussed in the literature. As Glenn Snyder states, ‘the arms race is seen as the epitome of competition for illusory security’.⁶⁷ There might be several reasons for this. Operationalisation issues are one; geostrategic moves to gain influence over others are certainly much more difficult to measure than are changes in arms budgets. More substantially, in a self-help system, internal balancing, or arming, ‘produces a more reliable improvement in security slowly’;⁶⁸ it is usually ‘more reliable and precise than external balancing’,⁶⁹ as ‘[p]utting together balancing coalitions quickly and making them function smoothly is often difficult’.⁷⁰ For such reasons, it seems, states ‘usually try to increase their security by building up their arms supplies’.⁷¹

The second point we need to clarify concerns the determinants of the severity of the security dilemma. In theory and in the empirical world, of course, the prevalence and impact of

⁶⁴ Jeffrey W. Taliaferro, ‘Security Seeking under Anarchy, Defensive Realism Revisited’, *International Security*, Vol. 25, No. 3 (2000-2001), pp. 128-9.

⁶⁵ Michael Mandelbaum, *The Fate of Nations: The Search for National Security in the Nineteenth and Twentieth Centuries* (Cambridge: Cambridge University Press, 1988).

⁶⁶ Robert Jervis, *Perception and Misperception*, p. 66.

⁶⁷ Glenn H. Snyder, ‘The Security Dilemma in Alliance Politics’, p. 461.

⁶⁸ James D. Morrow, ‘Arms Versus Allies: Trade-Offs in the Search for Security’, *International Organization*, Vol. 47, No. 2 (1993), p. 231.

⁶⁹ Kenneth N. Waltz, *Theory of International Politics*, p. 168.

⁷⁰ John J. Mearsheimer, *The Tragedy of Great Power Politics*, p. 156.

⁷¹ Paul Roe, ‘Actors’ Responsibility’, p. 104.

spiral mechanisms are likely to vary considerably over time as well as between regions or dyads.

Says Charles Glaser:

To appreciate the central role of variations in the severity of the security dilemma in structural-realist theory, consider the implications of anarchy if there were no security dilemma. States that were seeking only security could deploy adequate military capabilities without threatening other states. Moreover, uncertainty about motives would be reduced, if not eliminated, since security-seekers would not need offensive capabilities. Insecurity could be virtually eliminated. Competition would arise only if one or more major powers were motivated by greed, rather than security'.⁷²

The literature points to a small handful of 'modifiers' that work to condition its manifestation. Most prominent among these are 'military technology, geography, and estimates of adversaries' intentions and motives'⁷³ – along with the ubiquitously important balance or distribution of power.⁷⁴ One of the modifiers – intentions and motives – has been outlined earlier.⁷⁵ The second one – geography or proximity – is more amenable to modelling, and this dimension is fully captured by our main independent variable in the subsequent empirical analysis. It is also a dimension of considerable import to the issues herein. Stephen Walt, for example, emphasises

⁷² Charles L. Glaser, 'Realists as Optimists: Cooperation as Self-Help', *International Security*, Vol. 19, No. 3 (1994), p. 64.

⁷³ Evan Braden Montgomery, 'Breaking Out of the Security Dilemma', p. 152.

⁷⁴ Jeffrey W. Taliaferro, 'Security Seeking under Anarchy', p. 137.

⁷⁵ It is really a moot point whether or not the international system in the post-Cold War decades has only consisted of status-quo states, or if revisionist states have constituted a small or large fraction of it, or if its composition has changed over the period on this score. Unfortunately, it is in any case not possible, in a general statistical investigation such as ours, to disentangle these two ideal-type motivations.

the salience of proximity when laying out his ‘balance-of-threat’ theory; he simply (and correctly) asserts that ‘[b]ecause the ability to project power declines with distance, states that are nearby pose a greater threat than those that are far away’.⁷⁶ Empirical studies have found strong evidence suggesting that the majority of wars and militarised crises involve disputes over territory between neighbours.⁷⁷ Logically, the link between the security dilemma and dyadic action-reaction mechanisms should not differ much from this pattern. The one key exception to this, of course, are the great powers of the system, which should be inclined to react to the behaviour and armaments of other great powers, irrespective of geographic proximity.⁷⁸

The third determinant of the severity of the security dilemma is the balance of power; that is, the overall, or ‘gross’,⁷⁹ distribution of resources and influence in the system. The end of the Cold War was the midwife of one key *structural* systemic change: a rapid shift from

⁷⁶ Stephen M. Walt, *The Origins of Alliance* (Ithaca, NY: Cornell University Press, 1987), p. 23. See also: Scott F. Abramson and David B. Carter, ‘The Historical Origins of Territorial Disputes’, *American Political Science Review*, Vol. 110, No. 4 (2016), p. 675; Dominic D. P. Johnson and Monica Duffy Toft, ‘Grounds for War: The Evolution of Territorial Conflict’, *International Security*, Vol. 38, No. 3 (2013-2014), pp. 7-38; John J. Mearsheimer, *The Tragedy of Great Power Politics*, p. 44.

⁷⁷ Douglas M. Gibler, ‘Bordering on Peace: Democracy, Territorial Issues, and Conflict’, *International Studies Quarterly*, Vol. 51, No. 3 (2007), pp. 509-532. Stephen A. Kocs, ‘Territorial Disputes and Interstate War, 1945-1987’, *Journal of Politics*, Vol. 57, No. 1 (1995), pp. 159-75; Paul D. Senese, ‘Territory, Contiguity, and International Conflict: Assessing a New Joint Explanation’, *American Journal of Political Science*, Vol. 49, No. 4 (2005), pp. 769-79; John A. Vasquez, ‘Why Do Neighbors Fight? Proximity, Interaction, or Territoriality’, *Journal of Peace Research*, Vol. 32, No. 3 (1995), pp. 277-93. For recent reviews of this literature, see: Scott F. Abramson and David B. Carter, ‘The Historical Origins of Territorial Disputes’; Monica Duffy Toft, ‘Territory and War’, *Journal of Peace Research*, Vol. 51, No. 2 (2014), pp. 185-98.

⁷⁸ Douglas Lemke and William Reed, ‘The Relevance of Politically Relevant Dyads’, *Journal of Conflict Resolution*, Vol. 45, No. 1 (2001), pp. 126-44.

⁷⁹ Jeffrey W. Taliaferro, ‘Security Seeking under Anarchy’, p. 137.

bipolarity to unipolarity. This, according to adherents of hegemonic stability theory, worked to bolster peace and order and to constrain security competition (at least for a while).⁸⁰ According to William Wohlforth, unipolarity – or *Pax Americana* – ‘favors the absence of war among the great powers and comparatively low levels of competition for prestige or security for two reasons: the leading state’s power advantage removes the problem of hegemonic rivalry from world politics, and it reduces the salience and stakes of balance-of-power politics among the major states’.⁸¹ Of course, such effects that follow from quasi-authority or hierarchy, though they might manifest in a *general* dampening of interstate rivalry, would not be all-encompassing. Barry Posen points out that the demise of sub-regional ‘sovereigns’ – particularly the Soviet Union and Yugoslavia – spurred instant security dilemmas at the intra-state level.⁸² Of course, the flip side of this argument commensurates with hegemonic stability: it is the *collapse* of local, regional or global authority that ‘can be profitably viewed as a problem of “emerging anarchy”’⁸³ – or, one may add, of emerging security dilemmas.

But *Pax Americana* was but a temporary state of affairs, it has often been held. Under anarchy, preponderant power would eventually be balanced and security competition would ensue; America’s dominance and global commitments, thus, could not possibly last forever.⁸⁴ This has important implications for our empirical analysis. To the extent that we already have

⁸⁰ William C. Wohlforth, ‘The Stability of a Unipolar World’, *International Security*, Vol. 24, No. 1 (1999), pp. 5-41; Stephen G. Brooks and William C. Wohlforth, *World Out of Balance: International Relations and the Challenge of American Primacy* (Princeton, NJ: Princeton University Press, 2008).

⁸¹ William C. Wohlforth, ‘The Stability of a Unipolar World’, p. 23.

⁸² Barry R. Posen, ‘The Security Dilemma and Ethnic Conflict’, pp. 27-8.

⁸³ Barry R. Posen, ‘The Security Dilemma and Ethnic Conflict’, p. 27.

⁸⁴ Christopher Layne, ‘The Unipolar Illusion Revisited: The Coming End of the United States’ Unipolar Moment’, *International Security*, Vol. 31, No. 2 (2006), pp. 7-41; John J. Mearsheimer, ‘Back to the Future’; Kenneth N. Waltz, ‘The Emerging Structure of International Politics’.

experienced a ‘return of history’,⁸⁵ or a ‘return of geopolitics’,⁸⁶ as an effect of the end of unipolarity, we would expect this to be visible in our results in the form of an increased presence of action-reaction dynamics for the last few years. It is hard to pinpoint *a priori* the exact timing of any such shift, however. At the level of symptoms, though, the years 2008-2009, which coincided with the financial crisis, might have indicated a somewhat rising level of tensions. Russia’s brief war with Georgia, writes Jeffrey Mankoff, ‘reflected a calculation in Moscow that the strategic pause ... following the collapse of the Soviet Union was over’.⁸⁷ Others pointed to China’s ‘more truculent posture’ in the wake of the global financial crisis,⁸⁸ which seems to symbolise the emergence of ‘an even more volatile climate and a potentially vicious cycle of arming and rearming’ in the Asia-Pacific.⁸⁹

The fourth and last main determinant of the severity of the security dilemma is the offence-defence balance.⁹⁰ While definitions are unclear and do not easily lend themselves to operationalisation,⁹¹ the concept simply embraces the idea that it matters greatly whether or not

⁸⁵ Robert Kagan, *The Return of History*.

⁸⁶ Walter Russell Mead, ‘The Return of Geopolitics: The Revenge of the Revisionist Powers’, *Foreign Affairs*, Vol. 93, No. 3 (2014), pp. 69-79.

⁸⁷ Jeffrey Mankoff, *Russian Foreign Policy* (Lanham, MD: Rowman and Littlefield, 2011).

⁸⁸ Thomas J. Christensen, ‘The Advantages of an Assertive China: Responding to Beijing’s Abrasive Diplomacy’, *Foreign Affairs*, Vol. 90, No. 2 (2011), p. 54.

⁸⁹ Adam P. Liff and G. John Ikenberry, ‘Racing toward Tragedy?’, p. 52.

⁹⁰ Stephen Van Evera, *Causes of War: Power and the Roots of Conflict* (Ithaca, NY: Cornell University Press, 1999), pp. 117ff; Robert Jervis, ‘Cooperation under the Security Dilemma’, pp. 186-94; Evan Braden Montgomery, ‘Breaking Out of the Security Dilemma’.

⁹¹ Jack S. Levy, ‘The Offensive/Defensive Balance of Military Technology: A Theoretical and Historical Analysis’, *International Studies Quarterly*, Vol. 28, No. 2 (1984), pp. 219-38; Keir A. Lieber, ‘Grasping the Technological Peace: The Offense-Defense Balance and International Security’, *International Security*, Vol. 25, No. 1 (2000), pp. 74-5.

military technology, in particular,⁹² works to give an edge to the offence over the defence. If this is the case, it is ‘easier to destroy the other’s army and take its territory than it is to defend one’s own. When the defence has the advantage, it is easier to protect and to hold than it is to move forward, destroy, and take’.⁹³ The offence-defence balance is hence ‘the amount of resources that a state must invest in offense to offset an adversary’s investment in defense. It is the offense-defense investment ratio required for the offensive state to achieve victory’.⁹⁴

This is the first of two important sub-dimensions to the balance.⁹⁵ If the offence has a clear enough advantage, security concerns and dilemmas will be rife; if the opposite is the case, cooperation and peace can more easily be promoted and the security dilemma ameliorated.⁹⁶ The second, related sub-dimension concerns the ease with which offence and defence can be differentiated.⁹⁷ If they can, which means that defensive weapons cannot easily be used for offensive purposes, ‘the basic postulate of the security dilemma no longer applies. A state can increase its own security without decreasing that of others’.⁹⁸ But if they cannot be differentiated, and offensive objectives can be furthered by the use of ‘defensive’ weapons,

⁹² Other factors that may affect the offence-defence balance include military doctrine, geography, national social structure and diplomatic arrangements such as alliances and balancing; see: Stephen Van Evera, ‘Offense, Defense, and the Causes of War’, *International Security*, Vol. 22, No. 4 (1998), p. 6. The vast majority of scholarly works, however, focuses on technology when discussing the offence-defence balance, see: Sean M. Lynn-Jones, ‘Offense-Defense Theory and Its Critics’, *Security Studies*, Vol. 4, No. 4 (1995), p. 668.

⁹³ Robert Jervis, ‘Cooperation under the Security Dilemma’, p. 187.

⁹⁴ Sean M. Lynn-Jones, ‘Offense-Defense Theory and Its Critics’, p. 665.

⁹⁵ Robert Jervis, ‘Cooperation under the Security Dilemma’, pp. 186ff.

⁹⁶ Keir A. Lieber, ‘Grasping the Technological Peace’, p. 74; Charles L. Glaser and Chaim Kaufmann, ‘What is the Offense-Defense Balance and Can We Measure it?’, *International Security*, Vol. 22, No. 4 (1998), p. 47.

⁹⁷ Robert Jervis 1978, ‘Cooperation under the Security Dilemma’, pp. 199ff; Charles L. Glaser, ‘The Security Dilemma Revisited’, pp. 185-92; Charles L. Glaser, ‘Realists as Optimists’, pp. 66-7.

⁹⁸ Robert Jervis, ‘Cooperation under the Security Dilemma’, p. 199.

tragedy materialises as even the most benevolent status quo-seekers cannot reveal their true, benign preferences through their armaments policies.⁹⁹

This implies the following, according to Robert Jervis: ‘The advantage of the defence can only ameliorate the security dilemma. A differentiation between offensive and defensive stances comes close to abolishing it’.¹⁰⁰ But what kind of offence-defence mix that has characterised the post-Cold War system is a hugely difficult question to answer. One can perhaps offer a general statement to the effect that ‘it is almost always easier to defend than to attack’,¹⁰¹ which echoes what Carl von Clausewitz wrote almost two centuries ago.¹⁰² If that is the case, and we do believe this is generally so, we should expect our analysis to reveal at most the presence of *tamed* action-reaction spirals. Nuclear weapons, at least if they are positively survivable so that mutual assured destruction applies, likely strengthen defence dominance.¹⁰³ On the other hand, and with respect to differentiation, ‘clear distinctions between offensive and defensive capabilities are historically rare’,¹⁰⁴ which means that the offence-defence balance probably cannot on its own eradicate manifestations of the security-dilemma

⁹⁹ Charles L. Glaser, ‘Political Consequences of Military Strategy’, p. 508; Charles L. Glaser, ‘The Security Dilemma Revisited’, p. 186; Evan Braden Montgomery, ‘Breaking Out of the Security Dilemma’, p. 154.

¹⁰⁰ Robert Jervis, ‘Cooperation under the Security Dilemma’, p. 199.

¹⁰¹ Keir A. Lieber, ‘Grasping the Technological Peace’, p. 75.

¹⁰² Carl von Clausewitz, *On War* [translated by Michael Howard and Peter Paret] (Oxford: Oxford University Press, 2007 [1832]), p. 24.

¹⁰³ Robert Jervis, ‘Cooperation under the Security Dilemma’, pp. 206-10; Kenneth N. Waltz, ‘More May Be Better’, in Scott D. Sagan and Kenneth N. Waltz, eds. *The Spread of Nuclear Weapons: A Debate Renewed* (New York: W.W. Norton, 2003 [1995]), Ch. 1; Kenneth N. Waltz, *Theory of International Politics*, pp. 186-7; Sean M. Lynn-Jones, ‘Offense-Defense Theory and Its Critics’, p. 667; Stephen Van Evera, ‘Primed for Peace: Europe after the Cold War’, *International Security*, Vol. 15, No. 3 (1990-1991), pp. 7-57.

¹⁰⁴ Barry R. Posen, ‘The Security Dilemma and Ethnic Conflict’, p. 29.

mechanism. Some ‘defensive’ weapons, moreover, by themselves augment instability and may easily contribute to exacerbating tensions. Ballistic missile defences are an obvious case in point, as they in addition to providing possible cover against incoming missiles also increase the possibility that an offensive by the ‘defender’ will succeed.¹⁰⁵ Such defences have been a prominent and controversial issue in recent international politics, in particular since the late 1990s. Overall, however, we do not have reason to expect that this or other military-technological innovations will impact on our results in a major way.

Can cycles be ‘virtuous’?

This brings us to the third issue we need to clarify. It is questionable, both in theory and in the real world, that status quo-oriented states can, with ease, draw on any offence-defence differentiation for purposes of assuring other states. Even ‘while states can often demonstrate their intentions’, writes Evan Montgomery, ‘the conditions under which benign actors can reveal their underlying motives without also increasing their vulnerability are significantly restricted’.¹⁰⁶ But are there other factors that can spur positive dynamics among states? In other words, can ‘virtuous’ cycles of reciprocal disarmament and reassurance be attained?

Following the end of the Cold War, many claimed that the international political environment would henceforth be relatively benign. Adherents to the ‘obsolescence of (major-power) war’ thesis held that the use or threat of military force had gradually lost its relevance

¹⁰⁵ Thomas J. Christensen, ‘The Security Dilemma in East Asia’, p. 51; Jack S. Levy, ‘The Offensive/Defensive Balance of Military Technology’, p. 226; Reuben Steff and Nicholas Khoo, ‘Hard Balancing in the Age of American Unipolarity’.

¹⁰⁶ Evan Braden Montgomery, ‘Breaking Out of the Security Dilemma’, p. 153.

as a tool of foreign policy, at least for the wealthy nations.¹⁰⁷ This was allegedly the case in a world that had gradually become less violence-prone.¹⁰⁸ One of the forces that was particularly highlighted was the spread of *political* liberalism, which, according to adherents of the democratic peace theory, would or could enhance trust among nations and significantly ease security dilemmas due to institutional and normative constraints on warfare.¹⁰⁹ A few years earlier, Michael Doyle had reinvigorated academic interest in the democratic peace thesis, pointing out that, at the dyadic level, ‘the effects of international anarchy have been tamed in the relations among states of a similarly liberal character’.¹¹⁰ This was certainly the case in the ‘security community’ of Western Europe.¹¹¹ The dyadic democratic peace thesis does hold merit, and its purported mechanisms might well influence results of our empirical analysis. At the same time, however, there is very little or no evidence to suggest that the European model is about to spread globally in any straightforward way. And even if it were, the logic of the security dilemma would not be rendered wholly invalid as a result. Indeed, Doyle himself stressed that ‘[I]beral states have not escaped from the Realists’ “security dilemma”’.¹¹²

¹⁰⁷ Francis Fukuyama, ‘The End of History?’; James M. Goldgeier and Michael McFaul, ‘A Tale of Two Worlds’; Michael Mandelbaum, ‘Is Major War Obsolete?’; John P. Mueller, *Retreat from Doomsday*.

¹⁰⁸ Steven Pinker, *The Better Angels of Our Nature* (London: Penguin Books, 2011).

¹⁰⁹ Bruce Bueno de Mesquita, James D. Morrow, Randolph M. Siverson and Alastair Smith, ‘An Institutional Explanation of the Democratic Peace’, *American Political Science Review*, Vol. 93, No. 4 (1999), pp. 791-807; Zeev Maoz and Bruce Russett, ‘Normative and Structural Causes of Democratic Peace’, *American Political Science Review*, Vol. 87, No. 3 (1993), pp. 624-38.

¹¹⁰ Michael W. Doyle, ‘Kant, Liberal Legacies, and Foreign Affairs’, *Philosophy & Public Affairs*, Vol. 12, No. 3 (1983), p. 232.

¹¹¹ Emanuel Adler and Michael Barnett, *Security Communities* (Cambridge, MA: Cambridge University Press, 1998); Vincent Pouliot, ‘The Logic of Practicality: A Theory of Practice of Security Communities’, *International Organization*, Vol. 62, No. 2 (2008), pp. 257-88.

¹¹² Micheal W. Doyle, ‘Kant, Liberal Legacies, and Foreign Affairs’, p. 232.

Another possible source of virtuous cycles is found in the formal logic of the security dilemma itself. As indicated earlier, this logic is associated with the Prisoners' Dilemma. Further, the logic of arms control or disarmament – and of security-dilemma mitigation – rests on the metaphor of a *repeated* prisoners' dilemma.¹¹³ Whereas the one-shot version of such a game represents the formalised symbol of spiral theories that envisage a 'tragic' outcome,¹¹⁴ the equilibrium outcome of a repeated Prisoners' Dilemma (with no fixed end game) is famously shown to be made up of a conjunction of cooperative strategies.¹¹⁵ The conscious application of tit-for-tat strategies helps realise a Pareto-efficient outcome under the shadow of the future.¹¹⁶ The caveat here, by no means a minor issue in the real world, is that this (in theory) requires an unlimited time horizon, which is much harder to envision in security affairs than on, say, economic matters.¹¹⁷ Alternatively, positive spiral dynamics can be made more likely through the 'manipulation' of preferences. If, say, the gains from the cooperation outcome (both states choose cooperation, or C) are increased, the game would approach a Stag Hunt, whose equilibrium outcome is CC.¹¹⁸ Similarly, a reduction in the possible gains from unilateral (DC) or mutual defection (DD) would increase the incentives to cooperate. Such 'manipulation' of preferences can be effectuated by, *inter alia*, an increase in the flow, speed and reliability of

¹¹³ Andrew Kydd, 'Arms Races and Arms Control', p. 229; Robert Jervis, 'Cooperation under the Security Dilemma'.

¹¹⁴ Marc D. Kilgour and Frank C. Zagare, 'Credibility, Uncertainty, and Deterrence', *American Journal of Political Science*, Vol. 35, No. 2 (1991), pp. 305-34; Glenn H. Snyder and Paul Diesing, *Conflict among Nations* (Princeton, NJ: Princeton University Press, 1977).

¹¹⁵ Robert Axelrod, *The Evolution of Cooperation* (New York: Basic Books, 1984).

¹¹⁶ Kenneth A. Oye, 'Explaining Cooperation under Anarchy', pp. 12ff; Robert Axelrod and Robert O. Keohane, 'Achieving Cooperation under Anarchy', pp. 232-4.

¹¹⁷ Robert Jervis, 'Cooperation under the Security Dilemma'.

¹¹⁸ Robert Jervis, 'Cooperation under the Security Dilemma', p. 171.

information between the parties in question.¹¹⁹ As Charles Glaser asserts, ‘improving the country’s ability to monitor an agreement reduces the difference between the adversary getting a lead and starting the race on equal footing, that is, it reduces [the difference between] CD-DD, thereby making cooperation more desirable’.¹²⁰ In other words, reaching, or at least approaching, the Stag Hunt ideal of reciprocal assurance, while obviously challenging, *is* possible. It certainly is so in some dyads, and perhaps also in some sub-regions or even whole regions. Still, the *logic* of the security dilemma surely persist, even if it in some instances can be counteracted.

Methods and variables

The empirical analysis endeavours to test whether or not the security dilemma and action-reaction dynamics have been – and if they are – a prominent feature in post-Cold War interstate relations. Using data covering 150 countries over the period 1988-2014, we employ a time-series cross-section design to measure the extent of such dynamics in states’ arms build-ups.¹²¹

¹¹⁹ Robert Axelrod and Robert O. Keohane, ‘Achieving Cooperation under Anarchy’, p. 232.

¹²⁰ Charles L. Glaser, ‘Realists as Optimists’, p. 82.

¹²¹ Two things in particular set this study apart from other quantitative analyses of action-reaction dynamics in military spending. Firstly, while there do exist many studies of the effects of arms races on war and militarised disputes, we rather take an interest in what causes arms build-ups and reductions in the first place. Secondly, we do not focus on arms races per se; instead we attempt to identify very general patterns of military expenditures that, in theory, are valid for all countries in the period under study. For empirical studies investigating the relationship between arms races and military conflict, see: Paul F. Diehl and Jean Kingston, ‘Messenger or Message? Military Buildups and the Initiation of Conflict’, *Journal of Politics*, Vol. 49, No. 3 (1987), pp. 801-13; Douglas M. Gibler, Toby R. Rider and Marc L. Hutchison, ‘Taking Arms against a Sea of Troubles: Conventional Arms Races during Periods of Rivalry’, *Journal of Peace Research*, Vol. 42, No. 2 (2005), pp. 131-47; Toby J.

The dependent variable

Our dependent variable – which we have given the generic name *Milex* – uses data from Stockholm Peace Research Institute (SIPRI)¹²² to calculate changes in military expenditures (measured in constant U.S. dollars). We constructed three different versions of this variable. A single-year expression of arms spending is not amenable to capturing action-reaction dynamics, though. Changes in military budgets, both positive and negative ones, can be fairly slow processes (which is also why we lag all independent variables by one year). In addition, single years may witness unusual bumps in expenditures due, for example, to extraordinary acquisitions of expensive military hardware. To smooth out the data, we therefore calculated a variable representing the three-year moving average of changes in military expenditures (*Milex_XM*). This was simply done by adding the value on military-spending changes to the values of the previous year and the following year (and dividing by 3) for each country-year. Note also that, for much the same reasons, quantitative arms-race studies regularly use a similar procedure in their operational definitions.¹²³

The second version of the dependent variable – *Milex_XML* – uses the natural logarithm of this three-year moving average measure.¹²⁴ The third version is based on a dummy variable taking the value 1 if military expenditures rose (or stayed exactly the same) from one year to the next, and 0 if they decreased. We created a three-year moving average variant of this dummy

Rider, Michael G. Findley and Paul F. Diehl, ‘Arms Races, Rivalry, and War’; Susan G. Sample, ‘The Outcomes of Military Buildups’.

¹²² Available at: {<http://www.sipri.org/research/armaments/milex>}.

¹²³ See, for example, Douglas M. Gibler, Toby J. Rider and Marc L. Hutchison, ‘Conventional Arms Races during Periods of Rivalry’, p. 137.

¹²⁴ Since many country-years have negative values, which precludes calculation of the natural logarithm, prior to logging we added +44 to the score of all units.

(*Milex_XMD*), with the value 1 if military-spending changes were positive over the whole three-year period (that is, the current, previous and following year).¹²⁵

The independent variable

The main independent variable of interest – generically: *Milexneighb* – codes the weighted average of arms-spending changes (in percentage terms or by way of a dummy signalling an increase/decrease) among the neighbours of the state in question. This variable also comes in three versions, each of which carries a postfix similar to that of the corresponding dependent variable. For example, in models employing *Milex_XM* as the dependent, we also use the three-year moving average measure of the independent (i.e., *Milexneighb_XM*).

In order to calculate this variable, an $n \times n$ spatial weights matrix that defines the neighbours of each country was constructed for each year. We adopted the Correlates of War (COW) Project's Type-2 definition of neighbouring states. This includes all states sharing land or river borders as well as those separated by 12 miles or less of water, a distance that corresponds to the limit of a state's territorial waters.¹²⁶ Whereas a definition that only counts as neighbours countries that share a border (COW's Type 1) is clearly too stringent for our purposes, others are too encompassing; the 'stopping power of water' generally makes power projection across substantial distances quite demanding,¹²⁷ hence sharply reducing the level of

¹²⁵ Correlations among these three alternatives of the dependent variable ranges from 0.35 (*Milex_XM* and *Milex_XMD*) to 0.71 (*Milex_XM* and *Milex_XML*)

¹²⁶ Douglas M. Stinnett, Jaroslav Tir, Philip Schafer, Paul F. Diehl and Charles Gochman, 'The Correlates of War Project Direct Contiguity Data', *Conflict Management and Peace Science*, Vol. 19, No. 2 (2002), pp. 58-66. The dataset – *Direct Contiguity Data, 1816–2006* (Version 3.1) – is available at: {<http://correlatesofwar.org>}.

¹²⁷ John J. Mearsheimer, *The Tragedy of Great Power Politics*, pp. 87-96.

threat and thus also the likelihood of action-reaction armaments patterns.¹²⁸ The Type-2 definition ensures, for example, that Russia and the United States are counted as neighbours (via the Bering Strait), as are Great Britain and France (though not Great Britain and Belgium).

Changes in state borders necessitated the construction of several matrices each of which corresponds to one specific year. Notably, changes affecting our data took place in the periods and years 1990-1993 (the break-up of the Soviet Union and Yugoslavia, the reunification of Germany, the Czechoslovak ‘divorce’, the unification of Yemen and the independence of Eritrea); 2002 (East Timor); 2006 (Montenegro); and 2011 (South Sudan). Some of these changes to the map had substantial ripple effects with respect to our main independent variables. For example, Russia, the official successor state to the Soviet Union, went from having 13 neighbours (1988-1990), to 22 (1991), to 16 (from 1992 onwards). We take into account all these alterations in the computations we make.

Missing data for our military-expenditures variables did pose some challenges, especially for *Milexneighb*. Prior to constructing the *Milexneighb* measures, we needed to fill in missing values of *Milex* for every country-year to avoid random, unexplained shifts in *Milexneighb*. For cases with missing observations in the first years of the time-series, a backward three-year running average was used to extrapolate our values. In cases with missing observations at the end of the time-series, a forward three-year running average was used. Missing values within the time-series were replaced by way of linear interpolation. (Note that in the regression analyses, we do not use the interpolated versions of the dependent variables (*Milex*)). Further, a small handful of countries lack military-expenditures data altogether, and these are neither included among the country-years under study nor in the *Milexneighb*

¹²⁸ COW’s Type 1 contiguity uses cut-off values of 400 (Type 5) and 150 (Type 4) miles. COW’s contiguity Type 3 is 24 miles, which we considered using *in lieu* of Type 2 (though this would only have added to the dataset an additional 32 neighbours).

measures. This is unlikely to affect our models in any profound way, though, as it overwhelmingly concerns tiny states (such as Andorra, Barbados and Kiribati), with Somalia, Myanmar and North Korea constituting the only notable exceptions to this. (Given the high stakes and militarisation in play on the Korean Peninsula, we then also had to remove South Korea from our analyses.) Ten additional states, for which SIPRI does provide data, were also excluded from our models, as these are island states without any neighbouring countries as per the COW's Type-2 definition.¹²⁹

The *Milxneighb* variables reflect changes in the military spending of a given country(-year)'s neighbours; except for the dummies, the changes are measured in percentage terms. Before calculating these changes, we added together the spending of all neighbours in question (rather than, say, using the mean value of the neighbours' military spending) so as to give additional weight to the most powerful neighbour(s).

Four points can especially be highlighted in order to justify the mode of calculation of *Milxneighb*. Firstly, the variable underlines relevant differences in relative power among one's neighbours; it obviously makes more sense for, say, Estonia, to fear any arms-budget increases undertaken by Russia than any similar moves by Latvia. Secondly, *Milxneighb* should, in theory, be a potentially potent predictor of military-spending changes irrespective of the offence-defence balance. Even if the advantage rests mainly with the defence, at least a modicum of action-reaction dynamics could or should be present in many cases nonetheless.¹³⁰ Thirdly, the coding avoids *a priori* assumptions about the existence of any current serious (territorial) disputes between or among neighbours. Analytically and logically, such assumptions are not unproblematic, as states can be international competitors or rivals on many

¹²⁹ These are the Cape Verde Islands, Cuba, Fiji, Iceland, Jamaica, Madagascar, Malta, Seychelles, Mauritius and New Zealand.

¹³⁰ Robert Jervis, 'Cooperation under the Security Dilemma', p. 188.

dimensions ‘without ever experiencing an armed encounter, and using disputes to establish the rivalry periods biases the sample’.¹³¹ Neither realist theory nor the logic of the security dilemma distinguishes between rivals or non-rivals; and the ‘tragedy’ of the security dilemma does not rest on the actual existence of any revisionist or ‘greedy’ states. Fourthly, our variable emphasises proximity as key to action-reaction patterns, thereby implicitly presuming both that distance matters, and that territory is the primary issue at stake in most wars and militarised conflicts.

Control variables – base models

We need to control for several variables that we have reasons to believe might be affecting values on our dependent variable. Our base model contains four such controls, all of which are lagged by one year in the models. Obviously, the rate of growth of the national economy acts as a vital constraint on changes in military budgets. Therefore, we include a measure of the annual per-capita percentage growth rate, with data from the World Bank’s World Development Indicators (WDI) (*Growth*).¹³² Similarly, one can presume that natural resource-rich economies are generally able to translate windfall economic gains into military spending; therefore, we include a measure of total resources rents as a percentage of GDP, with data from the World Bank’s WDI (*Natrent*).¹³³

Thirdly, we also control the total defence burden of a country. To include a static measure of military expenditures is vital considering that the dependent variable is a dynamic process; the potential for high growth rates in military spending should, all else being equal, be

¹³¹ Douglas M. Gibler et al., ‘Conventional Arms Races during Periods of Rivalry’, p. 137.

¹³² Available at: {<http://data.worldbank.org/>}.

¹³³ Rents are defined by the World Bank as the difference between the value of natural resources and their production costs. The measure is the sum of rents from oil, natural gas, coal, mineral and forest.

larger for states with a low level of current capabilities.¹³⁴ The variable reflects military spending as a percentage of GDP (and logged), with data from SIPRI (*Milexgdp_L*). Furthermore, there are obviously grounds for expecting that nations involved in war are more inclined than others to increase their military budgets, *ceteris paribus*.¹³⁵ We therefore control such involvement by including a dummy measure that takes the value 1 if the country-year in question is currently involved in a war with at least 1,000 yearly battle deaths (*War1000_D*). The dummy was computed on the basis of definitions and data provided by Uppsala University and Peace Research Institute Oslo (PRIO).¹³⁶ To code countries at war we used their ‘Location’ variable, which denotes the government(s) with a primary interest in the conflict in question.

In three of the six base models, we also include dummies controlling time and regions. Year dummies are potentially important to account for swings in the relatively interconnected global economy. To include region dummies is also theoretically advisable; many contend, for example, that Western Europe and North America constitute a security community that has all but shunned militarisation of intra-regional affairs.¹³⁷ Others point out that the United States is a regional hegemon, which should contribute to dampening security competition in the

¹³⁴ Susan G. Sample, ‘Military Buildups, War, and Realpolitik: A Multivariate Model’, *Journal of Conflict Resolution*, Vol. 42, No. 2 (1998), pp. 164-5.

¹³⁵ William Nordhaus, John R. Oneal and Bruce Russett, ‘Effects of the International Security Environment on National Military Expenditures: A Multicountry Study’, *International Organization*, Vol. 66, No. 3 (2012), pp. 497-8.

¹³⁶ Nils Petter Gleditsch, Peter Wallensteen, Mikael Eriksson, Margareta Sollenberg and Håvard Strand, ‘Armed Conflict 1946-2001: A New Dataset’, *Journal of Peace Research*, Vol. 39, No. 5 (2002), pp. 615-637. The data are available at: {<http://www.pcr.uu.se/data/>}.

¹³⁷ Emanuel Adler and Michael Barnett, *Security Communities* (Cambridge, MA: Cambridge University Press, 1998); Stephen Van Evera, ‘Primed for Peace’, p. 9.

Americas.¹³⁸ The classification of region dummies is based on data provided by the Quality of Government Institute, which, in turn, draws on Axel Hadenius and Jan Teorell's separation of the world into ten regions based on politico-geographic criteria.¹³⁹

Control variables – extended models

We also present a few extended models that include a number of theoretically interesting variables that we have reasons to expect are causally linked to the dependent. The level of economic development might matter, so we include as a control GDP per capita measured at market-exchange rates in constant 2005 US\$ (before logging), with data from the World Bank's WDI (*Gdppc_L*). We also include an additional economic variable – *Trade_L* –, which equals the sum of imports and exports of goods and services (divided by GDP and logged). This we do to account for the peace-through-trade argument.¹⁴⁰

Regime type could also matter. To account for the democratic peace theory, we include a measure of level of democracy. Data are from the Polity IV Project.¹⁴¹ The variable *Polity*

¹³⁸ Robert D. Kaplan, *The Revenge of Geography: What the Map Tells Us about Coming Conflicts and the Battle against Fate* (New York: Random House, 2012), pp. 92-3; John J. Mearsheimer, *The Tragedy of Great Power Politics*, pp. 40-1, 141.

¹³⁹ Axel Hadenius and Jan Teorell, 'Pathways from Authoritarianism', *Journal of Democracy*, Vol. 18, No. 1 (2007), pp. 143-157. The data are available at: {<http://qog.pol.gu.se/data/datadownloads/qogbasicdata>}. The ten regions include: Eastern Europe and post-Soviet Union; Latin America; North Africa and the Middle East; Sub-Saharan Africa; Western Europe and North America (including Australia and New Zealand); East Asia; South-East Asia; South Asia; the Pacific; the Caribbean.

¹⁴⁰ Erik Gartzke and Oliver Westerwinter, 'The Complex Structure of Commercial Peace Contrasting Trade Interdependence, Asymmetry, and Multipolarity', *Journal of Peace Research*, Vol. 53, No. 3 (2016), pp. 325-43.

¹⁴¹ Monty G. Marshall, Ted Robert Gurr and Keith Jagers, 'Polity IV Project: Political Regime Characteristics and Transitions, 1800-2009. Dataset Users' Manual' (Vienna, VA: Center for Systemic Peace, 2010).

ranges from -10 (fully institutionalised autocracy) to +10 (fully institutionalised democracy). Furthermore, democracies tend, as Immanuel Kant foresaw over two centuries ago, to cluster in ‘zones of peace’,¹⁴² which might dampen security competition and dilemmas. The most prominent such zone is arguably the European Union, membership of which we control in our extended models (*EU*).

Interstate and civil war are not the only categories of conflict that can spur a state’s military spending. In particular since 2001, many countries have been afflicted by (the threat of) terrorism. We therefore control the yearly (logged) number of terrorist attacks per 100,000 population, with data from START’s Global Terrorism Database (*Gtdpc_L*).¹⁴³ Furthermore, whether or not military service is mandatory likely reflects the actual or perceived external security environment. We therefore control military conscription, which is a dummy variable based on information from several sources (*Conscription_D*).¹⁴⁴ An additional ‘military’ dimension need also be controlled. *UStroops_L* is a logged measure of the number of U.S.

¹⁴² Immanuel Kant, *Principles of Politics and Perpetual Peace* [edited and translated by W. Hastie] (Boston, MA: Digireads, 2010).

¹⁴³ Data are available at: {<http://www.start.umd.edu/gtd/>}. To avoid missing observations, country-years without any terrorist attacks were set to 0.1 before logging.

¹⁴⁴ We use, as a base, data from the Military Recruitment Dataset (Nathan Toronto, ‘Military Recruitment Data Set, Codebook, Version 2005.1’), see: {<http://fmso.leavenworth.army.mil/documents/mildat/RecruitmentCodebook.pdf>}, which provides information up until 2004/2005 (depending on the country). We use *Chartsbin* for 2010 and 2011 values (see: {<http://chartsbin.com/view/1887>}), and normally also for the 5-6 previous years. *CIA World Factbook* is generally drawn on for the years 2012-2014, see: {<https://www.cia.gov/library/publications/the-world-factbook/fields/2024.html>}. Any missing country-years are set to the same values as those of these three sources if they correspond with each other. If they do not, we use alternative sources of information about the exact year of change in military recruitment policy (usually we rely on *War Resistance International*, see: {<http://www.wri-irg.org/en>}).

troops deployed in the country in question.¹⁴⁵ Theoretically, U.S. extended-deterrence policies should work to dampen arms-build-up proclivities in states that enjoy clear-cut U.S. security guarantees in the form of a ‘trip-wire’.

Lastly, following Stuart Bremer’s reasoning on the matter,¹⁴⁶ in the extended models we also control differences in military power between the country in question and its neighbours, as others do.¹⁴⁷ Three dummies are constructed. *Powdifflarge_D* is coded 1 if the country(-year) is outspent by its neighbours by a ratio of 10 or more. *Powdiffmedium_L* reflects a ratio between 3 and 10 (in favour of the neighbours). *Powdiffsmall_D*, which is the reference category, takes the value 1 if the ratio is less than 3. These variables are constructed using SIPRI’s measure of inflation-adjusted military expenditures. Descriptive statistics are shown in *Table 1*.

Table 1. Descriptive statistics

Variable	Obs.	Mean	St. dev.	Min.	Max.
Milcons_XM	3,152	4.75	21.90	-43.96	480.34
Milcons_XML	3,152	3.84	0.31	-3.26	6.26
Milcons_XMD	3,152	0.65	0.48	0	1
Milconsnieghb_XM	3,668	3.23	11.00	-54.62	187.91
Milconsneighb_XML	3,668	4.05	0.22	-0.97	5.49

¹⁴⁵ For data up to and including 2005, we rely on the *Heritage Foundation* (see: {<http://www.heritage.org/research/reports/2006/05/global-us-troop-deployment-1950-2005>}), while *Vetfriends* provides data for 2006-2012 (see {<https://www.vetfriends.com/US-deployment-overseas/>}). Data for 2013 and 2014 are from various editions of the U.S. Defense Department’s Base Structure Reports (links to these are provided at: {<http://www.globalsecurity.org/military/facility/reference.htm>}); we draw on the entry that lists the number of active duty troops (as opposed to that which also counts reserve troops and civilians), which corresponds closely to definitions used by the other two sources.

¹⁴⁶ Stuart A. Bremer, ‘Dangerous Dyads: Conditions Affecting the Likelihood of Interstate War, 1816-1965’, *Journal of Conflict Resolution*, Vol. 36, No. 2 (1992), pp. 322-3.

¹⁴⁷ Susan G. Sample, ‘Military Buildups, War, and Realpolitik’; Susan G. Sample, ‘The Outcomes of Military Buildups’.

Milconsneighb_XMD	3,668	0.69	0.46	0	1
Growth	3,449	3.81	4.94	-50.25	38.20
Natrent	3,350	9.73	13.85	0	80.11
Milexgdp_L	3,468	0.60	0.78	-2.61	4.77
War1000_D	3,551	0.04	0.21	0	1
GDPpc_L	3,432	8.05	1.64	4.73	11.36
Conscription_D	3,521	0.48	0.50	0	1
Gtdpc_L	3,441	-6.74	4.35	-11.51	2.44
EU	3,546	0.14	0.35	0	1
Polity	3,399	3.79	6.47	-10	10
Trade_L	3,404	4.27	0.53	2.37	6.09
USStroops_L	3,525	2.38	3.14	-2.30	12.42
Powdifflarge_D	3,297	0.57	0.50	0	1
Powdiffmedium_D	3,297	0.24	0.43	0	1
Powdiffsmall_D	3,297	0.20	0.40	0	1

Methods

The action-reaction dynamics of the security dilemma conform to a class of empirical models that seek to capture strategic interaction among governments. These models generate jurisdictional reaction functions, and the empirical task is to estimate these. If the estimated slope of a reaction function is non-zero, this confirms that there is indeed strategic interaction.¹⁴⁸

Within the context of the security dilemma, each government i sets its own level of arms-spending y_i , but the government is also affected by the y 's chosen by neighbouring states' governments. There exists, theoretically, a spillover effect between neighbouring states in arms spending, and the objective function of government i may therefore be written as

$$V(y_i, y_{-i}; X_i), \quad (1)$$

¹⁴⁸ Jan K. Brueckner, 'Strategic Interaction among Governments: An Overview of Empirical Studies', *International Regional Science Review*, Vol. 26, No. 2 (2003), pp. 175-88.

where y_{-i} is the vector of y 's for the neighbouring states and X_i is a vector of characteristics of i that co-determine government preferences for arms spending y_i .

Government i will choose the level of arms spending y_i that maximises equation (1), so that $\partial V/\partial y_i \equiv V_{y_i} = 0$. Since this derivative depends on the spending decisions of neighbouring state governments y_{-i} and on the country's own characteristics X_i , the solution can be formulated as

$$y_i = R(y_{-i}; X_i). \quad (2)$$

The R represents the reaction function that defines the optimal level of arms spending for government i in response to the arms-spending decisions of neighbouring states and the characteristics of the state itself. The equation to be estimated may be expressed as

$$y_i = \beta \sum_{j \neq i} \omega_{ij} y_j + X_i \theta + \varepsilon_i. \quad (3)$$

The β and the vector θ are the parameters to be estimated and ε_i is the error term. The ω_{ij} are the weights that define if other states are of strategic relevance to the arms-spending decisions of a government. As stated above, our weighting scheme is based on the Correlates of War Project's Type-2 definition of neighbouring states. If, by this definition, a state is a neighbour, then $\omega_{ij} = 1$; in any other case $\omega_{ij} = 0$. When the pattern of strategic interaction is established, the weights are normalised row-wise so that they sum to unity. Since we have panel data for the years 1988 to 2014, the estimating equation of (3) should be expanded to reflect the temporal dimension. The expanded equation can be written as

$$y_{it} = \beta \sum_{j \neq i} \omega_{ijt-1} y_{jt-1} + X_{it-1} \theta + \varepsilon_{it}. \quad (4)$$

The t subscript reflects the temporal dimension, and for the determinants the subscript is t_{-1} to reflect time lags in both the action-reaction dynamics among neighbouring countries and in the adjustment of arms spending that depends on the state's own characteristics.

Empirical analysis

Base models

Table 2 depicts the base models, which include four salient control variables. *Milexneighb* is here positively and significantly related to arms-spending changes at a high level of confidence. Military-expenditures patterns seem to be shaped, in part, by the spending patterns of one's neighbours. In the first model, for example, if we move from the median level of *Milexneighb* up to the 75th percentile (2.44→7.08), the predicted value of our dependent variable changes by 14 percentage points (4.86→5.55).

What is clearly of importance as well is economic potential (that is, *Growth* and *Natrent*); the already-existing defence burden (*Milexgdp_L*), which works to lower the potential of increases in arms budgets; and the current security environment, as proxied by the measure of war with over 1,000 battle-related deaths. All this makes perfect sense. But so, too, do the results on *Milexneighb*, whether in its 'raw' (Models 1–2), logged (Models 3–4) or dummy (Models 5–6) version.

Spending on armaments evidently moves up and down in part as a function of the threat posed by military-spending decisions of one's most powerful neighbours – irrespective of both economic potential or constraints and the presence of more immediate security hazards. For purposes of robustness, a bootstrap analysis of the standard errors of the basic 3-year logged moving average model (Model 3) was performed. This allowed us to check for any bias due to potential violations of the distributional assumptions. The model was estimated with 1,000

randomly-drawn samples with replacement and a sample size equal to n . The resulting bootstrap standard errors are consistent with our original, reported analysis.

Table 2. Base model, determinants of change in military expenditures 1988-2014, 3-year moving-average change (non-logged and logged), maximum likelihood estimation

	1	2	3	4	5	6
	Milex_XM	Milex_XM	Milex_XML	Milex_XML	Milex_XMD	Milex_XMD
	1988-2014	1988-2014	1988-2014	1988-2014	1988-2014	1988-2014
MILEXNEIGHB_XM	0.148** (0.049)	0.154** (0.052)				
MILEXNEIGHB_XML			0.108*** (0.028)	0.086** (0.029)		
MILEXNEIGHB_XMD					0.124*** (0.019)	0.090*** (0.020)
GROWTH	0.364*** (0.089)	0.370*** (0.093)	0.015*** (0.001)	0.015*** (0.001)	0.017*** (0.002)	0.015*** (0.002)
NATRENT	0.167*** (0.045)	0.173*** (0.049)	0.003*** (0.001)	0.003*** (0.001)	0.003** (0.001)	0.002 (0.001)
MILEXGDP_L	-4.022*** (0.865)	-4.912*** (1.016)	-0.065*** (0.012)	-0.068*** (0.013)	-0.095*** (0.018)	-0.092*** (0.020)
WAR1000_D	17.472*** (2.149)	17.401*** (2.204)	0.155*** (0.030)	0.149*** (0.030)	0.135** (0.045)	0.095* (0.045)
CONSTANT	3.202 (1.069)	2.331 (2.532)	3.357*** (0.113)	3.435*** (0.122)	0.521*** (0.026)	0.548*** (0.054)
REGION DUMMIES	NO	YES	NO	YES	NO	YES
TIME DUMMIES	NO	YES	NO	YES	NO	YES
OBSERVATIONS	2,755	2,747	2,755	2,747	2,755	2,747
GROUPS	148	148	148	148	148	148
LOG LIKELIHOOD	-12,340.67	-12,288.04	-601.312	-581.36	-1,674.47	-1,626.41

Notes: Standard errors in parentheses; level of statistical significance indicated by asterisk: *** $p < 0.001$, **

$p < 0.01$, * $p < 0.05$; all independent variables are lagged one year; postfix 'X' = change, postfix 'M' = 3-year moving average; postfix 'L' = logged; postfix 'D' = dummy.

States, or so our results indicate, do balance against capabilities, as the realist school of thought typically contends. The corollary of this is that they also *reduce* spending if others do likewise; butter is preferred to guns if the security environment is judged to be (come) reasonably benign. A second main (temporary) conclusion to be made is that the action-reaction

dynamics are likely intimately associated with contiguity and power. The modelling of our main independent variable is based on the assumption that both proximity and capabilities matter for security concerns. We have earlier cited several studies that have argued and found that those who fight are overwhelmingly neighbours, and they often fight over territorial issues. And obviously, weighting neighbours by military might is key to get a fairly precise picture of the dynamics involved.

The last versions of our base model – Models 5 and 6 – use dummy variables to capture arms-spending changes and eventual security dilemmas. This is done under the presumption that action-reaction patterns need not necessarily approach a one-to-one character. As Robert Jervis argues: especially under defensive dominance, ‘[a]lthough an increase in one side’s arms and security will still decrease the other’s security, the former’s increase will be larger than the latter’s decrease. So if one side increases its arms, the other can bring its security back up to its previous level by adding a smaller amount to its forces. And if the first side reacts to this change, its increase will also be smaller than the stimulus that produced it’.¹⁴⁹ And results do indeed suggest the existence of such an empirical relationship: *Milexneighb_XMD* is significant at the 0.001 level.

Extended models

It would be prudent to investigate the effects of *Milexneighb* in the presence of a more elaborate set of controls as well. Considering also the novelty of our research design, it makes sense to attempt to identify potentially important determinants of arms-spending changes. This we do in *Table 3*. As we see from there, the expanded models do not yield vastly different results with respect to our main independents. What seems to be consistent across the models depicted in *Tables 2-3* are the following: Firstly, *Milexneighb* is consistently positively and significantly

¹⁴⁹ Robert Jervis, ‘Cooperation under the Security Dilemma’, p. 188.

related to the dependent measure. Secondly, the non-dummy measures (i.e., *Milexneighb_XM* and *Milexneighb_XML*) ‘perform’ somewhat worse than the dummy moving average (*Milexneighb_XMD*); indeed, the latter is always significant at the highest level of confidence, whereas the two former measures exhibit lower levels of significance that also vary a bit across models. This is not surprising: results on the *_XMD* measure tell us that countries’ armament strategies are in general and in part shaped by the current *trajectory* of the arms-spending of (the most powerful) neighbouring countries. That is to say, increased (decreased) arms spending by one’s neighbours in any given period means that oneself is also inclined to increase (decrease) such spending. This imitative pattern, though, stops well short of any complete match with regard to exact percentage change – a result that perhaps simply obtains, to cite Carl von Clausewitz, because ‘defense is a stronger form of fighting than attack’,¹⁵⁰ hence obviating the need for a one-to-one action-reaction pattern.

Table 3. Determinants of change in military expenditures 1988-2014, extended model with three different dependents, maximum likelihood estimation

	7	8	9
	Milex_XM	Milex_XML	Milex_XMD
	1988-2014	1988-2014	1988-2014
MILEXNEIGHB_XM	0.129* (0.055)		
MILEXNEIGHB_XML		0.070* (0.031)	
MILEXNEIGHB_XMD			0.074*** (0.021)
GROWTH	0.421*** (0.101)	0.016*** (0.001)	0.016*** (0.002)
NATRENT	0.209** (0.062)	0.003*** (0.001)	0.001 (0.001)
MILEXGDP_L	-6.169*** (1.160)	-0.076*** (0.014)	-0.106*** (0.021)
WAR1000_D	18.089***	0.169***	0.115*

¹⁵⁰ Carl von Clausewitz, *On War*, p. 24.

	(2.416)	(0.033)	(0.048)
GDPPC_L	0.023	0.002	0.001
	(0.933)	(0.010)	(0.017)
CONSCRIPTION_D	3.896**	0.049**	0.081**
	(1.463)	(2.74)	(0.029)
GTDPC_L	0.328*	0.002	0.002
	(0.132)	(0.002)	(0.003)
EU	-2.176	-0.061	-0.131**
	(2.482)	(0.031)	(0.048)
POLITY	0.092	0.001	-0.003
	(0.142)	(0.002)	(0.003)
TRADE_L	3.786*	0.047*	0.058
	(1.706)	(0.020)	(0.032)
USTROOPS_L	-0.208	-0.001	0.004
	(0.287)	(0.004)	(0.006)
POWDIFFLARGE_D	-0.665	-0.036	-0.046
	(2.135)	(0.024)	(0.040)
POWDIFFMEDIUM_D	0.557	-0.011	-0.015
	(2.017)	(0.024)	(0.039)
CONSTANT	-14.333	3.299***	0.354
	(10.522)	(0.168)	(0.196)
REGION DUMMIES	YES	YES	YES
TIME DUMMIES	YES	YES	YES
OBSERVATIONS	2,550	2,550	2,550
GROUPS	141	141	141
LOG LIKELIHOOD	-11,451.09	-582.07	-1,493.13

Notes: Standard errors in parentheses; level of statistical significance indicated by asterisk: *** p<0.001, ** p<0.01, * p<0.05; all independent variables are lagged one year; postfix 'X' = change, postfix 'M' = 3-year moving average; postfix 'L' = logged; postfix 'D' = dummy.

Moving on to the control variables, the conclusion that arises is that very few of the additional measures, despite the existence of a theoretical justification for their inclusion, exhibit any significant relationship to *Milex*. In fact, the only notable exception is the measure of mandatory military service: *Conscription_D*, which should reflect the perilousness of the security environment, is positive and significant at the 0.01 level in all three models. One other security-related control – *Gtdpc_L*, which measures the number of terrorist attacks – just reaches significance in the first model, though its effect is likely repressed because *War1000_D* already catches some of the same security issues. We can also establish that the presence of

U.S. troops is uncorrelated with armaments policies, which commensurates with the notion of a self-help system. Neither do military-power differences (between a state and its neighbours *in toto*) matter.

The four remaining controls are all, to some degree, associated with the liberal International Relations paradigm. Commercial or economic peace theory holds that economic development and trade links promote peace. That may or may not be the case – our analysis cannot provide any such answers – but at least such traits do not affect arms-spending changes (in fact, *Trade_L* is *positively* and weakly significantly related to the dependent). Neither are there any differences between democracies and non-democracies in this respect. Lastly, state members of the European Union, which undoubtedly form a security community of some sort, tend to exhibit a slightly lower level of military-budget increases (or a larger level of such decreases) than non-members.

A two-pronged conclusion is thus taking form. Firstly, the security environment matters greatly to arms-spending decisions, as is evident from the strong results on our measures of war and military conscription. Secondly and most importantly given the subject matter herein, arms-spending trends exhibited by one's neighbours also have a significant impact on one's own military-budget trajectory. This, of course, works to bolster the first conclusion above: that the regional or local security environment is an overriding concern for most countries. In sum, arms-spending trends are typically a function of geographically proximate security threats (or the absence of such threats).

Additional analyses

The analysis has hitherto provided indications to suggest the existence *in general* of security dilemmas (and, a corollary, of reciprocal arms-spending reductions). We also performed a number of additional tests to obtain a more complete empirical picture of the relationship among

our key variables. Firstly, we estimated models that contained measures of *single-year* changes in arms-spending (as opposed to moving averages) both for the dependent and the main independent. In terms of direction, results did not change, though levels of significance were lower. This is not surprising, considering that single years can be associated with spending ‘bumps’ that affect correlations. Moreover, the reaction to any military-spending changes of neighbouring countries – that is, decisions on military spending and investment and the process of implementing those decisions – is bound to take some time.

Furthermore, there is perhaps reason to suspect that this relationship might vary between sub-periods. The late 1980s and the 1990s were, in many respects at least, a decade of optimism with regard to international security in general. However, when we split the sample into two different time periods (using the base model), we found no manifest difference between 1988-2002 and 2003-2014. When we used a different suspected ‘turning point’, though, running the numbers for the period 2008-2014, all three *Milxneighb* variants were significant at the 0.001 level. This, we surmise, might imply that a ‘shift’ in regional and local security environments took place toward the end of the first decade of the new millennium.

We also checked for regional differences, specifying six geopolitically relevant regions.¹⁵¹ In general, variation is not large, and results do not diverge greatly from the global ones that we have already reported. The most notable exception is, unsurprisingly, the European Union: patterns of change in military spending there are virtually exclusively a function of economic growth rates; the security environment evidently plays no role in our study’s time period. Alliance patterns might also play a role. Our main independent variable was insignificant when we isolated NATO members and when we restricted our sample to countries with which the United States has a formal defence pact (which foremost encompasses European

¹⁵¹ These are: the European Union; non-EU Europe (including Russia and Central Asia); the Americas; Asia (including the Pacific, excluding the Middle East); Sub-Saharan Africa; and the Middle East and North Africa.

NATO and the Americas (through the Organization of American States)). Furthermore, we also tested for any interaction effects between relative military power (between any given country and its neighbours) and changes in the military budgets of neighbours. It turns out that reciprocal arms-spending moves are most common when power differences are large (that is, if the ratio is 10 or more in the neighbours' favor) and least common for the 'medium' category (ratio between 3 and 10). This might reflect: (a) that issues of security and survival are most pressing for states suffering from a large relative-power deficit; and (b) that the middle category encompasses states that are strong enough to be reasonably secure (under the presumption that defence normally holds the advantage) yet, unlike states in the category depicting small power differences, too weak to participate in any regional rivalry.¹⁵²

We also ran models that only contained nuclear-weapons states. This limits the sample size considerably. Still, the main independent variable is significant at the highest level of confidence. This suggests that the presumed 'defensive' properties of nuclear weapons do not cancel out security-dilemma dynamics. What may apply instead is the 'stability-instability paradox', which basically states that the overwhelming destructive power of these weapons effectively prohibits their rational use in almost any conceivable situation, thereby 'allowing' rational actors to engage in limited warfare.¹⁵³ In other words, nuclear weapons do not necessarily negate arms competition at the conventional level.

Lastly, using the base model as our point of departure, we conducted sundry additional tests investigating the relationship between the dependent measures and a total of 81 additional

¹⁵² See also: Jo Jakobsen, Tor G. Jakobsen and Eirin Rande Ekevold, 'Democratic Peace and the Norms of the Public: A Multilevel Analysis of the Relationship between Regime Type and Citizens' Bellicosity, 1981-2008', *Review of International Studies*, Vol. 42, No. 5 (2016), pp. 986-7.

¹⁵³ Robert Rauchhaus, 'Evaluating the Nuclear Peace Hypothesis: A Quantitative Approach', *Journal of Conflict Resolution*, Vol. 53, No. 2 (2009), pp. 258-77.

variables (see *Appendix*). A very brief synopsis of this supplementary analysis goes as follows: Firstly, the main independent variables of interest (that is, *Milexneighb* in its three moving-average versions) were by and large unaffected. Secondly, overall results corroborate our earlier conclusion that only a few other factors seem to affect changes in military budgets. These are, as noted before, economic prerequisites and characteristics of the security environment. Regarding the latter, the experience of current and recent militarised disputes affects the dependent measure to a degree, although less so than participation in (current or recent) actual wars. All in all, results reported earlier in this text uphold: alterations in defence spending are driven by just a small handful of factors, of which similar decisions by one's neighbours are clearly among the most important ones.

Conclusion

Overall results suggest that the security dilemma is alive and well in the post-Cold War period. Most states still perceive their external environment as a potentially threatening one; that is, one in which other states, whose intentions cannot be precisely estimated, represent security risks. Their armaments are thus countered reciprocally (as are their *disarmaments*). Thereby an action-reaction pattern develops, one that may have little or nothing to do with 'greediness' or offensive objectives on the part of individual states; instead, it can be seen as the outcome of rational responses to a competitive, anarchic international system in which survival and security are (still) the key goals. In that sense, our study does belong rather squarely in the 'pessimistic' camp of International Relations: security competition seems to be an abiding characteristic of the international system. Our results also indicate that the *entire* post-Cold War period saw action-reaction patterns in all of the world's major regions (save for the possible exception of the European Union).

Security-dilemma theory emphasises that its implications – spirals of moves and counter-moves – represent ‘tragedy’ even for pure security-seeking states interacting with other, equally defensive-minded states. Escaping from this predicament is difficult. Still, the literature highlights a few potentially key moderators, or determinants, of the severity of the dilemma. One of these – states’ motives or intentions, or the distribution of ‘greedy’ versus status quo-oriented states – we cannot operationalise or model. A second determinant – geographic proximity – on the other hand, represents a key factor of our empirical tests. All else being equal, proximate states, in particular powerful ones, do represent a far bigger security worry than distant states.

The third key factor that can modify the security dilemma is the offence-defence balance. We cannot confidently say that the post-Cold War decades have witnessed any *major* change in this balance at the system level. On the other hand, some relatively recent military-technological developments might foreshadow a period of less stability in many dyads because they ostensibly favour the offence.¹⁵⁴ The proliferation of ballistic missiles – and the concomitant prevalence of ballistic missile defences – is one example. Another is the increased importance of command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) networks among more advanced powers; these make for tempting targets for first strikes in serious crises. But perhaps the growth of cyber-warfare capabilities are a particular concern, as ‘the prevalent belief [is] that cyberspace favors the offense’.¹⁵⁵ We cannot say for sure whether our results are affected by any such change. We do not believe they are, however. Partly this is because such developments are likely too recent to have had any

¹⁵⁴ Avery Goldstein, ‘First Things First: The Pressing Danger of Crisis Instability in U.S.-China Relations’, *International Security*, Vol. 37, No. 4 (2013), pp. 66-8.

¹⁵⁵ Rebecca Slayton, ‘What Is the Cyber Offense-Defense Balance?: Conceptions, Causes, and Assessment’, *International Security*, Vol. 41, No. 3 (2016-2017), p. 72.

significant impact on our study, whose endpoint is 2014. But we might also recall the results we obtained on the power-differences variables. That is, when we tested for interaction effects between relative military power and military-spending changes, results suggested that security concerns – and thus action-reaction patterns – were not widespread for states whose ‘power deficit’ vis-à-vis neighbouring states was limited (i.e. a ratio between 3 and 10). This indicates that, at least for the period under study here, the offence-defence balance is, overall, favouring the defence. This conclusion is also bolstered by the fact that, of the three measures we use, the (three-year moving-average) *dummy* variable is the one whose effect is the strongest. This implies that the arms-spending decision of states are foremost shaped by the *trajectory* – as opposed to the *absolute* levels of increases or decreases – of arms-spending decisions by (powerful) proximate states.

The fourth major factor that may condition the relationship between the security dilemma and arms spending is the overall distribution of power in the system – in other words, polarity. Here, results are indicative of a possible change taking place that also encompasses the latter part of this study’s time period. Many scholars have long anticipated the end of unipolarity and, perforce, of any *Pax Americana*,¹⁵⁶ not least considering the increase of Chinese power relative to the United States. Such a process is or will likely be lengthy, though, and one cannot realistically identify any single year as representing a clear inflection point. Still, and while our analysis has established that the post-Cold War period *as a whole* has witnessed action-reaction dynamics, results are particularly strong for the last few years – that is, since 2008. This coincides with some key events and processes in international affairs, including the financial crisis, Russia’s war with Georgia and China’s increased foreign-policy

¹⁵⁶ Christopher Layne, ‘This Time It’s Real: The End of Unipolarity and *Pax Americana*’, *International Studies Quarterly*, Vol. 56, No. 1 (2012), pp. 203-13; Paul K. MacDonald and Joseph M. Parent, ‘Graceful Decline? The Surprising Success of Great Power Retrenchment’, *International Security*, Vol. 35, No. 4 (2011): pp. 7-44.

assertiveness. To the extent that such developments *are* linked a gradual decline of U.S. power, they may betoken a future where the security dilemma becomes *more* relevant.

Of course, our investigation admittedly operates at a very general level – and it is also the case that in some instances, our main independent variable, the way it is coded, fails to capture some clearly relevant dyads. What we have done is to establish empirically that states, to a significant degree, tend to let their military spending be shaped by their neighbours' spending decisions. But there are, of course, bound to be many exceptions to this general tendency, exceptions that certainly deserve a closer scrutiny by future research. Other studies could also productively delve on additional manifestations of the security dilemma. Whereas, for most states, internal balancing (i.e. arms-buildups) is likely the most obvious response to security-dilemma pressures, additional geostrategic moves are undoubtedly also of importance. In other words, future studies should explore the link between the security dilemma and, *inter alia*, alliance formation, diplomacy, geoeconomic strategies, cyber 'warfare' and, more broadly, policies that aim at gaining influence over other states.

Unavoidable caveats notwithstanding, our study has produced some valuable general evidence. What one's most powerful (and thus most potentially threatening) neighbours do or don't do in terms of armaments has a strong impact on one's own military-budget trajectory. The action-reaction cycle, to be sure, is sometimes 'virtuous'; reciprocal *disarmament* clearly fits within the logic demonstrated by our empirical results. But so, too, does the 'vicious' version of such a cycle. The security dilemma is – unfortunately – alive and well.

Appendix

All results are from the base model (including year and region dummies) where the variable in question has been included; ^ denotes that the variable substitutes for another variable from the base model with which it is highly correlated; *** = significant at the .001 level, ** = significant at the .01 level, * = significant at the .05 level; asterisks in parantheses denote that the direction of the coefficient is unexpected; the column ‘Sig. Milexneighbor’ presents levels of significance for our main independent variable – i.e. changes in military spending of neighbouring countries – in the models in question (with ‘/’ separating the three model variants); in variable names: L denotes logarithmic transformation, A denotes period average, M denotes three-year moving average, X denotes percentage changes, D denotes dummy variable; full results and do-files are available from the corresponding author upon request.

Variable	Sig. Milex XM	Sig. Milex XML	Sig. Milex XMD	Sig. Milex neighbor	Variable description	Source
Economic and financial status						
GrowthM^	***	***	***	**/**/**	GDP growth rate, 3-year moving average	World Bank (World Development Indicators)
GdpL				**/**/**	GDP (constant 2005 US\$), log	As above
GdppcL				**/**/**	GDP per capita (constant 2005 US\$), log	As above
InflationL	***		(*)	**/**/**	Inflation (consumer prices), log (+19 pre-log)	As above
Xratevolatility	***			**/**/**	Absolute exchange-rate volatility vis-à-vis US\$, %	As above
Fuelexport^	***	***		**/**/**	Fuel exports (% of merchandise exp.)	As above
Oilrent^	**	***	*	**/**/**	Oil rents (% of GDP)	As above
Mineralrent^			*	**/**/**	Mineral rents (% of GDP)	As above
Gasrent^				**/**/**	Natural gas rents (% of GDP)	As above
Militarization & power						
TroopspcL^			***	**/**/**	Armed forces personnel, % of pop., log	As above
ConscriptionD	**	*	**	**/**/**	Military conscription dummy: 1=non-voluntary recruitment	Military Recruitment Dataset and own coding based on: Chartsbin; CIA World Factbook; War Resistance International
Icrgmilitary				*/**/**	Military in politics, 0–6 scale	International Country Risk Guide
ExecmilitaryD				**/**/**	Dummy: Chief executive military officer	World Bank (DPI)
Nuclear				**/**/**	Nuclear weapons inventories	Kristensen & Norris (2013)
NuclearD				**/**/**	Dummy: Nuclear weapons state	As above
PowdifflargeD				**/**/**	Dummy: Military power, large difference vis-à-vis neighbors (>10:1 advantage neighbors)	Own calculations based on SIPRI data and our <i>Milexneighbor</i> variable
PowdiffmediumD				**/**/**	Dummy: Mil. power, medium diff vs. neighbors (3:1–10:1 twoway)	As above
PowdiffsmallD				**/**/**	Dummy: Mil. power, small diff. vs. neighbors (<3:1 twoway)	As above
Security environment						
<i>War</i>						
warinter25D^			*	**/**/**	Dummy: Interstate war (min. 25 brd) in country	Based on Uppsala/PRIOD data
warinter25extD^	**	**	*	**/**/**	Dummy: Interstate war (25brd), all participating governments coded as 1	As above
warinter1000extD^	***	**		**/**/**	Dummy: Interstate war (1000brd), all participating governments coded as 1	As above
war25A5D^				**/**/**	Dummy: War (25brd) in country; coded 1 if war in current or previous 4 years	As above
war25A10D^		(*)	(**)	**/**/**	Dummy: War (25brd) in country; coded 1 if war in current or previous 9 years	As above
war1000A5D^	***			**/**/**	Dummy: War (1000brd) in country; coded 1 if war in current or previous 4 years	As above

war1000A10D^	**			**/**/**	Dummy: War (1000brd) in country; coded 1 if war in current or previous 9 years	As above
<i>Militarised interstate disputes</i>						
Midno		*		**/**/**	Militarised interstate disputes (MIDs), no. of	Based on Correlates of War data
Midfatalhi				**/**/**	Highest fatality level from MIDs, 1–6 scale	As above
Midhostilhi	**	*		**/**/**	Highest hostility level of MIDs, 1–5 scale	As above
MidnoD	*	*		**/**/**	Dummy: 1 if one or more MIDs in country-year	As above
MidhostilhiD1				**/**/**	Dummy: 1 if MID hostility level = ‘War’	As above
MidhostilhiD2	*			**/**/**	Dummy: 1 if MID hostility level = ‘War’ or ‘Use of force’	As above
MidnoA5				**/**/**	Average no. of MIDs current and previous 4 years	As above
MidnoA10				**/**/**	Average no. of MIDs current and previous 9 years	As above
midnoA3D				**/**/**	Dummy: 1 if MID in current or previous 2 years	As above
midhostilhiA5D1			(*)	**/**/**	Dummy: 1 if MID hostility level = ‘War’ in current or previous 4 years	As above
midhostilhiA10D1				**/**/**	Dummy: 1 if MID hostility level = ‘War’ in current or previous 9 years	As above
midhostilhiA5D2				**/**/**	Dummy: 1 if MID hostility level = ‘War’ or ‘Use of force’ in current or previous 4 years	As above
midhostilA10D2				**/**/**	Dummy: 1 if MID hostility level = ‘War’ or ‘Use of force’ in current or previous 9 years	As above
<i>Security environment – other</i>						
GtdL	***			**/**/**	Terrorism events, country-year total, log	Global Terrorism Database
GtdpcL	*			**/**/**	Terrorism events per capita, log	As above
Hctbombings				**/**/**	High-casualty terrorist bombings	Center for Systemic Peace
Icrgintconflict	***			**/**/**	Internal conflict, 0–12 scale	International Country risk Guide
Icrgextconflict	*		*	**/**/**	External conflict, 0–12 scale	As above
Mepvtotal^	***	***		**/**/**	Major episodes of political violence, total societal and interstate MEPV	Center for Systemic Peace
Mepvtotalneigh				**/**/**	Major episodes of political violence, total societal and interstate MEPV for all neighbors	As above
Liberal peace						
<i>Democratic peace</i>						
Polity				**/**/**	Polity IV democracy score (-10 – +10 scale)	As above
PolitydemoD				**/**/**	Dummy: Full democracy (>= +8 on Polity scale)	Based on data from Center for Systemic Peace
PolitysemidemoD				**/**/**	Dummy: Semi-democracy (>+1 & <8 on Polity scale)	As above
PolityautocracyD				**/**/**	Dummy: Autocracy (<=0 on Polity scale)	As above
Freedomhouse				**/**/**	Freedom House democracy: Political Rights + Civil Rights	Freedom House
Demovanhanen			*	**/**/**	Vanhanen index of democracy	Quality of Government Institute
DemoD	*		*	**/**/**	Dummy: Democracy	Quality of Government Institute; original data from Cheibub et al. (2010)
Polcon				**/**/**	Political Constraint Index (0–1 scale)	Henisz (2000)
Polconv				**/**/**	Political Constraint Index, with judiciary and sub-federal entities as additional veto points	As above

Ciriphysrights	**			**/**/**	Cingranelli–Richards’ Physical Integrity Rights Index (0–8 scale)	CIRI Human Rights Data Project
Ciriempower	*			**/**/**	Cingranelli–Richards’ Empowerment Rights Index (0–14 scale)	As above
Ptsamnesty	**	*		**/**/**	Political Terror Scale, Amnesty International (1–5 scale)	The Political Terror Scale
Ptsusstate	**			**/**/**	Political Terror Scale, US State Department (1–5 scale)	As above
Icrgdemoaccount				*/**/**	Democratic accountability (0–6 scale)	International Country Risk Guide
EuD		*	**	**/**/**	Dummy: European Union member state	European Union
<i>Economic peace</i>						
TradeL				**/**/**	Trade (exports+imports), share of GDP, log	World Bank (World Development Indicators)
FdigdpL	(*)	(**)	(*)	**/**/**	FDI inflows as share of GDP, log	As above
FdistockgdpL				**/**/**	FDI inward stock as share of GDP, log	United Nations Conference on Trade and Development
Ecofreefraser				**/**/**	Economic Freedom Index	Fraser Institute
Ecofreeheritage	***			/**/**	Economic Freedom Index	Quality of Government Institute; original data from Heritage Foundation
Freetradeheritage	***	**		/**/**	Trade Freedom Index	As above
Hdi				**/**/**	Human Development Index, linear interpolation	UN Development Programme
Globaecon				**/**/**	KOF Index of Economic Globalization	ETH Zürich
Globasoc				**/**/**	KOF Index of Social Globalization	As above
Globapol			(*)	**/**/**	KOF Index of Political Globalization	As above
Globatotal				**/**/**	KOF Index, total Globalization score	As above
OecdD				**/**/**	Dummy: OECD membership	Organization for Economic Co-operation and Development
WtoD		(*)	(*)	**/**/**	Dummy: World Trade Organization membership	World Trade Organization
<i>Hegemonic peace</i>						
NatoD			*	**/**/**	Dummy: NATO membership	North Atlantic Treaty Organization
UsdefencepactD			*	**/**/**	Dummy: Formal defence pact with US	Own coding
Ustroops				**/**/**	US troops deployment, log	Heritage Foundation; Vetfriends; Department of Defense Base Structure Reports
UstroopsD100				**/**/**	Dummy: US troops deployment (1=min. 100 troops)	As above
UstroopsD250				**/**/**	Dummy: US troops deployment (1=min. 250 troops)	As above
UstroopsD500				**/**/**	Dummy: US troops deployment (1=min. 500 troops)	As above
UstroopsD1000				**/**/**	Dummy: US troops deployment (1=min. 1000 troops)	As above