

The Bioeconomic Causes of War

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Wars are fought not only for material goals but for intangible ends such as honor and prestige. In biological terms the ultimate functional motives for fighting are food and sex, the essential elements of reproductive success. Like many other animals, humans seek food and sex directly, but also indirectly via dominance and prestige. In modern times the direct food and sex motives for warfare have waned. But, although largely disconnected from reproductive success, intangible goals such as prestige, dominance, and respect—amplified by the ‘affiliative instinct’—remain with us as continuing causes of war. © 1998 John Wiley & Sons, Ltd.

On August 3, 1914 Sir Edward Grey, the British Foreign Minister, asked the House of Commons to approve an ultimatum to Germany:

I ask the House from the point of view of British interests to consider what may be at stake. If France is beaten to her knees... if Belgium fell under the same dominating influence... if, in a crisis like this, we run away from these obligations of honor and interest... we should, I believe, sacrifice our respect and good name and reputation before the world and should not escape the most serious and grave economic consequences.¹

Notice the allusions both to *material goals* (‘British interests’, ‘economic consequences’) and *intangible considerations* (‘honor’, ‘respect’, ‘good name’).

And on the German side, earlier in 1914 Chancellor von Bethmann Hollweg declared:

... every day Germany sees its population growing by leaps and bounds; its navy, its trade and industry are making unparalleled developments... it is forced to expand somehow or other; it has not yet found that ‘place in the sun’ which is its due.²

Here again, at least an undertone suggests an intangible factor: ‘place in the sun’ connotes a desire for respect and esteem apart from material assets like territory.

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Turning to a different era, the redoubtable Genghis Khan (1167–1227) is supposed to have said:

The greatest pleasure is to vanquish your enemies, to chase them before you, to rob them of their wealth, to see their near and dear bathed in tears, to ride their horses and sleep on the white bellies of their wives and daughters.³

Genghis Khan was hardly indifferent to material goals, but his tone rather suggests that an intangible—glorying in the humiliation of others—was his primary motivation.

Or consider World War II. For Germany, *lebensraum* was a material goal. But Adolf Hitler’s psychic drives, which became translated into German national policy, centered around sheer malevolence, mainly on racial lines. The Nazi extermination program was pursued even at the expense of Germany’s chances of victory.

As the *final causes* of human actions, the sources of our preferences and goals, whether material or intangible, are usually regarded as outside the analytic boundaries of mainline economics. For traditional economics, preferences are exogenous brute facts, coming from outer space so to speak. It is at this point that bioeconomics steps in to rescue and complete economic thought. The premise of bioeconomics is that our preferences have themselves evolved to serve economic functions in a very broad sense: those preferences were selected that promoted survival in a world of scarcity and competition.

But I am getting ahead of my story a bit. I first want to analyse the *contingent causes* of peace or war, that is, the proximate reasons for choosing the war option or the peace option, given any particular set of final goals.

MATERIAL GOALS AND THE CONTINGENT CAUSES OF WAR AND PEACE

To highlight the contingent causes leading to the choice of the war option or the peace option, I start with the simplest possible assumption about final goals: that the contending parties are strictly self-interested and materialistic, aiming solely to maximize own-income. Also, following the main analytic tradition of economics, I will be assuming rational behavior on each side.

In Figure 1 each point represents the incomes attained by the two contenders—call them Red and Blue. Blue's income I_B is scaled along the horizontal axis: Blue wants to attain a position as far to the right as possible. (His indifference curves are vertical lines.) Red's income I_R is scaled along the vertical axis: Red wants to attain a position as high up as possible. (Her indifference curves are horizontal lines.) The curve QQ is the upper bound of the *settlement opportunity set*—the range of peaceful outcomes achievable if war can be avoided. P_B is Blue's estimate of the outcome of war, and P_R is Red's estimate. As shown

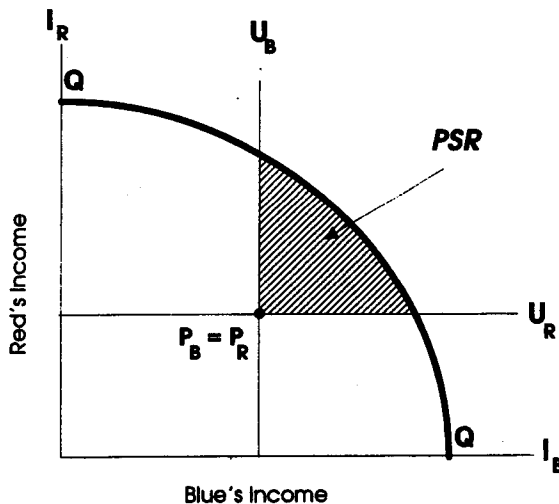


Figure 1. Potential Settlement Region (PSR): moderate complementarity, agreed perceptions.

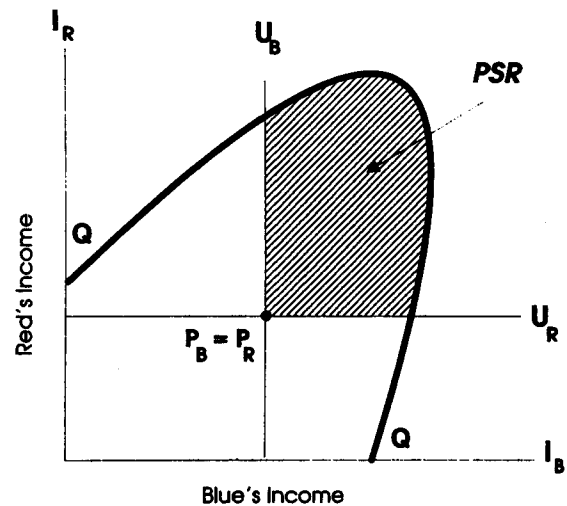


Figure 2. Potential Settlement Region (PSR): strong complementarity, agreed perceptions.

in the diagram, by assumption here the estimates are in agreement, defining a unique *perception point* $P_B = P_R$. The shaded *Potential Settlement Region* (PSR) shows the set of possible peaceful arrangements that both sides perceive as yielding a better outcome than war.

Since war is costly, under strictly materialist motivations a *Potential Settlement Region* always exists—assuming the parties correctly assess the opportunity set QQ and the outcome of war (perception point). To that extent, peace always has the edge on war.

A number of influences can affect the magnitude of the Potential Settlement Region, or even its existence. These influences can operate via *opportunities, perceptions, or preferences*.

Figure 2 illustrates the effect of changed opportunities. In comparison with Figure 1, here the QQ locus displays a stronger degree of productive complementarity. If the parties can only agree, they now have much more to gain: the PSR is larger.

It is at least a plausible presumption that, *the larger the PSR, the better the prospects for settlement*. If so, since trade enlarges the income opportunities associated with peace⁴, we would expect the extent of trading to be inversely associated with fighting. There is a problem of the direction of causation here: rather than trade leading to peace, it may be that peace leads to trade. Still, subject to this and other statistical cavils, the empirical results of Polachek (1992) and Mansfield (1994) do broadly support the contention.

Turning to *diverging perceptions*, neither the outcome of war nor the true shape of the peaceful opportunity boundary QQ can ever be fully known. However, the result of war is likely to be even more in doubt than the consequences of peace: 'War is the province of uncertainty' (Clausewitz).⁵ So I will simplify by postulating that doubt attaches *only* to the location of the perception point, that is, to the incomes attainable on each side in the aftermath, were war to occur.

In Figure 3, the perception point has now split into two: P_R for Red and P_B for Blue. By assumption here each side is *relatively optimistic* about its prospects: P_R lies to the northwest of P_B . In the situation pictured, Red will not accept any settlement to the south of the horizontal line through P_R , while Blue will refuse any settlement to the west of the vertical through P_B . So, we see, *relative optimism about the outcome of war shrinks the Potential Settlement Region* (shaded area). In fact, a slightly greater degree of relative optimism on either side could have eliminated the PSR entirely.⁶

Relative optimism is related to, though not quite the same as *over-confidence*. The former compares the contenders' beliefs with one another; the latter compares their beliefs with the actual truth. As shown in Figure 3, owing to relative optimism Red's perception point P_R lies to the northwest of Blue's P_B , thus reducing the prospects for peace. Over-confidence would do the same, also shrinking the Potential Settlement

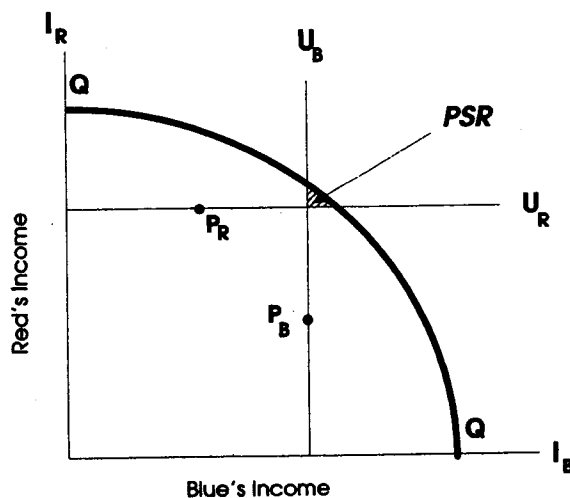


Figure 3. Potential Settlement Region (PSR): moderate complementarity, 'optimistic' perceptions.

Region but in a different way—moving the perception point or points outward from the origin.

There is reason to believe that over-confidence is very widely characteristic of human nature. Thus, Adam Smith:

The overweening conceit which the greater part of men have of their own abilities, is an ancient evil remarked by the philosophers and moralists of all ages. (*Wealth of Nations*, Smith, 1776 (1937), p. 107))

And modern psychologists have produced a great deal of evidence to much the same effect.⁷

Such errors of belief lie at the heart of Blainey's *The Causes of War* (Blainey, 1973). On Blainey's view, going to war is rather like going to school. Countries make war because one or both sides needs a lesson. In the course of the conflict, at least one side learns the sad truth (that it is not as strong as it thought, or that the costs are greater than expected) and so eventually becomes willing to settle. Thus, eventually peace becomes possible, or at any rate more possible than before.⁸

Figures 1–3 displayed merely neutral interpersonal preferences. Let us now consider *benevolence or malevolence*—'wishing well' or 'wishing ill' to one's opponent. Although interpersonal preferences are intangibles in a sense, assume to begin with that each side wishes well or wishes ill only in terms of material income. A benevolent person would sacrifice some own-income to enrich other parties; a malevolent person would sacrifice some own-income to impoverish others. (At a later point I will be looking into the bioeconomic sources of 'well-wishing' or 'ill-wishing'.)

Figure 4 reflects mutual *benevolence*. Instead of Blue being concerned solely with maximizing his own income, and Red solely with maximizing her own income, each now attaches positive utility to the other's material well-being. The utility indifference curves, which under the strict self-interest assumption were horizontal lines for Red and vertical lines for Blue, now have the familiar 'convex' shapes. As can be seen in the diagram, mutual benevolence enlarges the Potential Settlement Region.

In contrast, Figure 5 pictures mutual *malevolence*: each side is willing to incur a material sacrifice to reduce the other's income. In consequence, the indifference curves now have positive slope. Mutual malevolence compresses the Potential Settlement Region, though not necessarily to

FINAL CAUSES: THE BIOECONOMIC SOURCES OF BENEVOLENCE/MALEVOLENCE

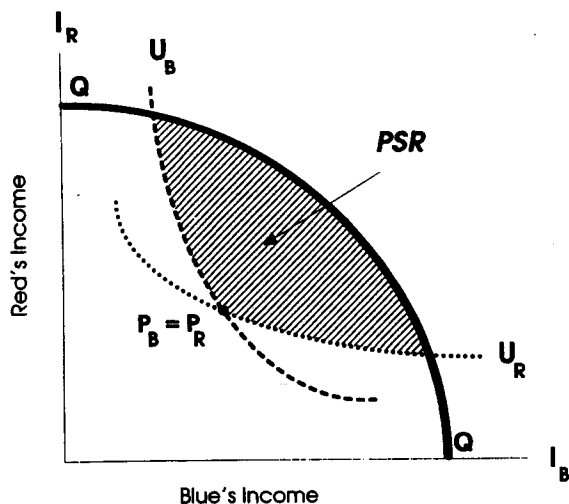


Figure 4. Potential Settlement Region (PSR): moderate complementarity, agreed perceptions, benevolent preferences.

the point of eliminating it entirely. (If the contingent circumstances are otherwise sufficiently favorable, even intrinsically hostile parties may find it advisable to come to and abide by a settlement. Hence the aphorism—a dangerous one, yet sometimes a valid reminder: ‘You don’t make peace with your friends but with your enemies’.)

A variety of asymmetric patterns are also possible, for example, where one side is benevolent and the other neutral or malevolent.

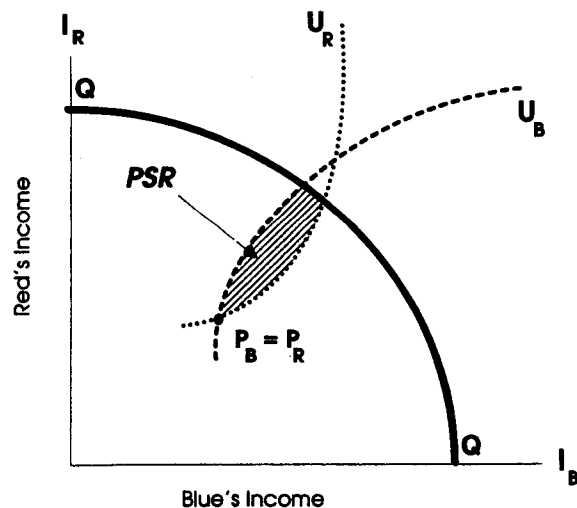


Figure 5. Potential Settlement Region (PSR): moderate complementarity, agreed perceptions, malevolent preferences.

So far I have taken the *final causes*—the ends or goals that lead people to choose war and peace—as given. But where do these benevolent or malevolent desires stem from? And how are they balanced against the more direct appetite for material income?

To start with a familiar point, sociobiologists emphasize the role of *kinship* in determining attitudes toward others. Animals and humans tend to be benevolent primarily to their own offspring, and after that to more distant relatives. Sociobiological reasoning suggests that benevolence reflects the proportion of shared genes: you share half your genes with your sibling, a quarter with a half-sib, an eighth with a cousin, etc.

In its simplest version, Hamilton’s Rule (Hamilton, 1964) states that, other things equal, evolutionary selection will lead a Donor organism D to aid a Recipient organism R if the *cost-benefit ratio* c_D/b_R is less than their *relatedness* r_{DR} :

$$c_D/b_R < r_{DR} \tag{1}$$

Here cost c_D and benefit b_R are measured in increments to the ‘fitness’ (i.e. reproductive survival) of Donor and Recipient, respectively. The biological logic is that the gene for helping is (so to speak) indifferent between the survival of its own host or the survival of an identical copy in the body of a related organism—where relatedness measures the chance of the latter occurring. So although the genes are still selfish, the organism will now display a degree of altruism to kin.

Most discussions emphasize only the positive aspects of the kinship factor, but kinship may provide a basis for malevolence as well. To see this, let us first generalize the helping/hurting rule (1).⁹ Now Donor D will be motivated to take any action on the margin for which:

$$\sum_i r_{Di} c_i < \sum_j r_{Dj} b_j \tag{2}$$

where i is an index running over all the *losers* from Donor’s action whereas j is an index running over all the *gainers*. (Donor will count himself, with a relatedness of unity, on whichever side of the inequality is appropriate.)

In terms of the categorization above, costs and benefits referred to *opportunities*; only relatedness

was the direct source of interpersonal *preferences*. Under the rationality assumption of the previous section, a choosing individual would keep opportunities and preferences quite separate in applying inequality (1) or (2). But natural selection, in shaping the psyches of humans and other organisms, may not have always made such a sharp distinction. If certain aspects of the opportunities have occurred normally and repeatedly in the ancestral environment, Mother Nature may have 'hard-wired' attitudes regarding them into preferences rather than relying upon organisms making rational fitness calculations.

As usual, Adam Smith said it best:

Self-preservation, and the propagation of the species, are the great ends which nature seems to have proposed in the formation of all animals. . . . But. . . it has not been entrusted to the slow and uncertain determinations of our reason, to find out the proper means of bringing them about. Nature has directed us. . . by original and immediate instincts. Hunger, thirst, the passion which unites the two sexes, the love of pleasure, and the dread of pain, prompt us to apply those means for their own sakes, and without any consideration of their tendency to those beneficent ends which the great Director of nature intended to produce by them. (*Theory of Moral Sentiments*, Smith, 1759 (1969), p. 152.)

Indeed, we hardly attribute rationality at all to non-human organisms. Puppies tend to be friendly to humans, but not out of calculated choice. Rather, since humans over evolutionary time were more likely to feed affectionate puppies, natural selection ingrained affectionate attitudes into the genetic heritage of domesticated dogs. (In this case deliberate artificial breeding by humans very likely also played a role.) As for humans, a number of innate likes and dislikes have been identified that are similarly correlated with the results of favorable or unfavorable experiences in the course of evolutionary time. On the negative side are phobias or instinctive aversions, for example to snakes, certain insects, and to potentially threatening strangers. On the positive side are likings for dogs, cats, young children, and so forth.

Returning to sources of malevolence, a major determinant of the costs and benefits associated with helping/hurting actions is the intensity of competition. At the extreme, what might be called *absolute competition*¹⁰ is defined by the condition:

$$\sum_i c_i = \sum_j b_j. \quad (3)$$

That is, the individuals concerned are playing in a constant-sum game.

In two-party absolute competition the ratio c_i/b_j is necessarily unity; in such an environment we would not expect to observe favorable attitudes even toward the closest of kin. (Since no-one can be closer to you than you are yourself.) Among birds, extreme sibling hostility sometimes evolves where within-nest competition is severe, and possible human analogs come to mind.

Let us rewrite the generalized helping/hurting rule (2) in the following form, where \bar{r} is the *average* relatedness of members of the population to Donor:

$$\sum_i c_i(r_{iD} - \bar{r}) < \sum_j b_j(r_{jD} - \bar{r}).^{11} \quad (4)$$

So, under absolute competition, it is not simple relatedness but *relatedness greater or less than the average in the population* that serves as the factor weighting costs and benefits. Paraphrasing Hamilton (1970): 'Anyone is your enemy who is less closely related to you than the average in the population'. Thus, a degree of xenophobia rather than mere indifference toward strangers is indicated.

Chagnon (1983) describes how inter-group hostility in a present-day primitive society responds to the influence of kinship. The Yanomamo are dispersed into separate small villages consisting essentially of extended families, continually at war with one another. For various reasons a village may sometimes grow in population, a process that inevitably reduces average relatedness. Predictably, internal squabbling tends to increase, and the village ultimately splits up along kinship lines—often to the accompaniment of violence.

That biological relatedness is a dominant factor in *primitive* fighting seems plausible enough. But can kinship ties have any bearing for modern warfare? You are only related by 1/8 to your first cousin, and beyond that relatedness falls off rapidly toward zero. So human groups even of very moderate size consist essentially of non-kin. The British soldiers who fought at Omdurman (1898) were quantitatively about as closely related to the fuzzy-wuzzies as they were to Queen Victoria. For all practical purposes, they were not related at all.¹²

However, what serves much the same integrative function as kinship, from ancient to modern times human beings have possessed an *affiliative instinct*: a readiness to divide the world between 'us' and 'them'. Even where kinship is not a factor, cultural influences may lead us to identify our affiliation-group on the basis of shared social class, native language, or even more arbitrary criteria. Affiliations based upon religion, for instance in the Moslem conquests starting in the 10th century, in the Christian crusades that followed them, in the Thirty Years War in Germany and so on down to modern times in the Near East, have been immensely important in the history of warfare. And I hardly need say anything about the importance of patriotism, that is, affiliation defined in terms of nationality. Remarkably, even when the assignment of individuals to groups is quite arbitrary, and known to be so, strong group identification commonly emerges (Sherif and Sherif, 1964).

The bonding that stems from the affiliative instinct can elicit extreme self-sacrificial behavior, as when a soldier throws himself on a live grenade to save his comrades. It can also spread over huge communities, so that citizens of great and highly diverse nations like the United States are likely to be as patriotic and self-sacrificial as citizens of tiny states like Andorra or Luxembourg. As a secondary point, though bonding does easily extend beyond biological relatedness, it almost always draws support from what may be called *fictive kinship*. Members of one's affiliation-group may be referred to as brothers and sisters, and the group leader as the father of his people.

'INTANGIBLE' FINAL GOALS: MOTIVES VERSUS FUNCTIONS

So far I have limited the discussion to 'materialist' final ends. Individuals certainly do seek material benefits for themselves, for kin, and more generally for fellow-members of an affiliation-group. But what of *non-material* motives like honor or pride or the desire for dominance? People evidently care about such things, care enough to kill or be killed. Can they be worked into the picture in some analytically useful way? I think the answer is yes, but doing so requires going back—to way back—to fundamentals.

In interpreting human behavior we usually think in terms of psychological *motives* like greed or envy or revenge. But in dealing with animals, we typically look for explanations in terms of *biological functions*. We do not say that lions attack antelopes out of hatred or dislike, but for a solid functional reason: getting food. Male lions also battle one another for females, and here the functional aim is again obvious: achieving sexual access. Food and sex are both sought for the same ultimate evolutionary reason: over the generations, those lions able to eat better and mate better left more descendants. Essentially the same holds for other observed types of animal conflict, for example battles over territory or for pecking-order dominance. Territory is a source of food and shelter, and contributes to sexual access as well. (Since females prefer to mate with territorial proprietors.) Similarly for dominance battles: winners gain better access to food and other material resources, and also to the opposite sex.

If we were to shift our thinking and terminology back from functions to motives, what would we say about animal fighting? Since lions attack antelopes for food, I suppose we would class that as a material or 'economic' motive. Would the quest for sexual access then be 'non-economic'? Perhaps, but when it comes to achieving the functional end of reproductive success, the two are on an equal footing.

Similarly, seeking territory might be classified as a material end, and seeking dominance over others as non-materialistic. But once again the two are quite on a par. Territory and dominance are intermediate goals that, at one remove, provide the food and sexual access which more directly determine reproductive success.

So why then do we speak of *motives* in dealing with humans and of evolutionary *functions* in dealing with animals? Referring back to the Adam Smith quotation just above, Nature, distrusting 'the slow and uncertain determinations' of reason, has provided animals with *instincts* or *drives* that impel them to behaviors effective for acquiring food and mates. And, Smith also suggested, humans are not so very different.

In short, Mother Nature did not trust humans to figure out the means of winning out in the evolutionary struggle. Instead she gave us—just as she gave the animals—'original and immediate instincts' for food, sex, and so forth that pay off in terms of reproductive success.

Functionally speaking, we have seen, lions fight for food and sex. What of humans? As functional aims of primitive human conflict, Chagnon (1983) emphasizes female capture while Harris (1984) makes resource capture primary. Manson and Wrangham (1991) found that, of 25 primitive human foraging societies where functional causes could be determined, acquiring *resources* was the purpose in 15 instances and acquiring *women* in ten. Allowing for multiple causation, Keeley (1996) provides a tabulation showing that 'economic' factors (booty, land, poaching, slaves) were reported as contributing to 70% of wars among American Indian societies, women to 58%, and 'personal' factors (prestige, trophies, visions) to 36%.¹³ (But, as argued above, these 'personal' factors may also have been connected to the quest for reproductive success.)

In *The Descent of Man and Selection in Relation to Sex* (Darwin, 1871), Darwin distinguished two main mechanisms of sexual selection: male combat and female choice. Males can leave more descendants by fighting off other males, or by attracting the favorable attention of females. Military exploits have aspects of both. On the male combat side, by defeating external enemies the warrior protects the females of his own group and may win access to those of the enemy group. In addition, the reputation earned in battle may also discourage internal rivals from challenging him. And to the extent that females have a choice, the honor and glory gained by military exploits demonstrate his possession of 'good genes'. That Yanomamo men who have killed enemies in battle do produce more offspring has been demonstrated by Chagnon (1983).¹⁴

To summarize at this point: Mother Nature has instilled within us a complex structure of motivations and impulses selected on the basis of effectiveness in promoting reproductive success. As the foundation, the hunger and sex drives conduce directly to this end. Beyond these a variety of ingrained inclinations indirectly lead to the same ends. Most important are the related goals of dominance/prestige/respect, all being status considerations that promote access to food and sex. In a somewhat different category is the previously described affiliative instinct: individuals in tightly knit groups can more effectively take advantage of returns to scale in contending for ultimate biological goals.¹⁵

LOOKING TOWARD MODERN TIMES

In comparison with primitive social groups, modern societies unite huge numbers of individuals in pursuit of common ends. The kinship barrier that kept primitive groups small has somehow been overcome; individuals have become *citizens*, largely independent of relatedness. Diamond (1997) argues that the key step was 'religion', which he defines as an ideology that manipulates group members to become peaceful and obedient internally, and suicidally brave when it comes to external warfare. Speaking more generally and less cynically, advanced societies have somehow hit upon ways to trigger the affiliative instinct by cues such as a shared faith or language or way of life, or common deference to a charismatic leader.

But does that mean that food and sex, the basic bioeconomic motivations for warfare, are no longer relevant? Once we leave the relatively egalitarian realm of primitive societies, it becomes increasingly important to distinguish the purposes of *leaders* from the aims of ordinary citizens. Nevertheless, when it comes to food and other material ends the difference may not be very great. Generals get the biggest share of any booty available, but ordinary soldiers get something too.

Sex is trickier. At least up to ancient times, even in 'civilized' warfare it was common to slaughter all the males but retain the females alive. (For illustrative instances see *Deuteronomy* 20: 12–14, or consider the fate of Troy as described in *The Iliad*.) But over the years the sex motive for war does seem to have receded in importance. One possible reason: leaders of large societies have less incentive to capture women from outside, simply because the internal opportunities may suffice! In ancient times leaders of early civilized societies had very favorable mating opportunities even apart from war (Betzig, 1993), and more recent examples also spring to mind.

Of the two routes to reproductive success—sexual access and acquisition of resources—few would claim that the quest for sexual access plays more than the most minor role in explaining modern warfare. And improving technology, the enlarged scope of internal and external trade, and growth of wealth have surely made the peaceful economic process of production and exchange an increasingly attractive alternative to violent aggression as a way of acquiring resources. Never-

theless, 'economic'—that is, materialist—explanations for war surely retain some validity.

One commonly cited material cause of war, based squarely upon biological function, is Malthusian population pressure. Colinvau (1980) maintains that human history may be said to have begun when technological ingenuity in production of food and other goods allows populations to multiply within the same territorial area. But ultimately a limit is reached, at which point an attempt may be made to invade the niche-space of other populations. The German demand for *lebensraum* appears to be a case in point.

Of course, the driving force here is not literal starvation. Rather, modern populations have conventional notions of an acceptable living standard. Also, though this may be quite recent, the expectation nowadays is that the standard should be rising over time. With these qualifications, Malthusian pressures (the *lebensraum* motive) may possibly still continue to play a very considerable role.

Still, on the whole, what we are seeing in modern times is a kind of *revolt from reproductive success*. Sex is still sought, but it has been largely disconnected from fertility. Food is still sought, but its nutritional function plays only a minor role. Power and dominance are still sought, though often yielding not very much in the way of sex and food and even less in terms of reproductive success (see, e.g. Vining, 1986).

The waning of the biological stakes should, one might have anticipated, have been accompanied by a reduction in the intensity and lethality of warfare. Indeed, such a trend appeared for a while to be occurring in the modern era, only to be reversed by the great wars in the first half of the 20th century. That change of direction may have been due to the increased deadliness and 'overkill' tendency of weaponry. Arguably, warfare in the last quarter of this century has been moving the other way, thanks to precision munitions and the increasing predominance of military skill over mere mass.

SUMMARY AND CONCLUDING REMARKS

The final causes of war are the same as the causes of peace. War and peace are alternative strategic options for achieving the same ends. It is the contingent causes—mainly, opportunities and

perceptions—that determine the actual choices made.

Starting with the final causes, although the direct drive for reproductive success has less saliency in the modern era, nevertheless the elements in our psychic makeup that conduce to warfare are outgrowths of our biological heritage. Mother Nature has given us drives that promoted reproductive success over the long course of evolutionary time. The most fundamental of these are the sex and hunger drives, which translate directly into desires for mates and for resources. Benevolence toward kin and malevolence toward non-kin also have direct biological significance. At a further remove are psychological instincts or drives that conduce to sexual access or resource acquisition, in particular the closely grouped ends of honor/respect/glory/prestige.

However, these motivations concern individual behavior, whereas the wars of modern interest concern large human aggregations. Under the impulse of the affiliative instinct, fellow group members become one's fictive kin. Although readiness to form such groups is biological, the actual partition lines—the ways that people define 'us' versus 'them'—are culturally determined. Group identifications in terms of language and religion and class and personal loyalties have all been historically important, but warfare in modern times has mainly been associated with nationality: itself a somewhat amorphous category, but one evidently capable of motivating human beings to great heights of within-group self-sacrifice and equally extreme depths of depravity toward out-groups.

So what is the overall answer as to the bioeconomic causes of war in modern times? For reasons I have partially explained earlier, the biological stakes of warfare have been dwindling. Wars are no longer aimed at sexual access, and even resources are more importantly valued as symbols—Chancellor Bethmann's 'a place in the sun'—rather than for actual material benefits. True, some nations will always be expanding in population and industry, others falling behind. A growing nation is likely to feel entitled to a larger fraction of the world's resources, which the status quo powers will be reluctant to concede. But, I suggest, were it not for the symbolic or prestige aspect, disputes over resources would be solvable without recourse to war.

Turning to the contingent causes, I summarized these under the headings of opportunities and

perceptions. As for the influence of *perceptions*, that is, relative optimism and/or over-confidence about the outcome of conflict, little seems to have changed. War has always been the province of uncertainty, and the outcome does not seem to have become more predictable than it ever was. With regard to *opportunities*, so far as material ends are concerned the reasons for going to war are diminishing. The costs of war, even for the winners, have risen (and for nuclear wars, the costs have become unbearable even to contemplate). Meanwhile, the possible gains from war have shrunk in comparison with the benefits of peaceful trade. Yet the *symbolic* objects of war—honor, prestige, glory—remain as scarce as ever, since they constitute a zero-sum game. So wars, when they occur, are increasingly likely to turn upon perceived aspirations for 'a place in the sun'.

To end on a somewhat encouraging note, I referred earlier to the rather cynical contention in Diamond (1997) that ideologies and religions were invented mainly to make societies fight better against outsiders. But there are also universalistic ideologies and religions. Now that we are somewhat freed from the imperatives of striving for reproductive success, these more pacific ideologies are less handicapped in the competition for influence over how humans think and act.

NOTES

1. Quoted in Tuchman (1962).
2. Quoted in Kagan (1995).
3. Royle (1989).
4. Trade implies the existence of more than one commodity, whereas the diagrams here deal with a single 'income' good. However, the vertical and horizontal axes of Figures 1 and 2 can be re-interpreted as representing suitable *index numbers* of real income defined over a number of goods.
5. Quoted in Shafritz (1990).
6. For optimism as a contributing cause of litigation see Gould (1973).
7. For example, Fischhoff *et al.* (1977). A bioeconomic interpretation of over-confidence is offered in Waldman (1994).
8. Blainey's argument is not entirely sound, however. Wittman (1979) points out that while defeat in battle may incline the loser toward peace, the same events are likely to make the opponent more confident than before. Thus the *position* of the PSR—the range of mutually advantageous settlements—could shift, without necessarily increasing the *magnitude* of the PSR. Sparta, after losing the battle of Cyzicus in 410 BCE, offered peace to

Athens on very moderate terms, and did so once again after the battle of Arginusae in 406. But the over-confident Athenians rejected both offers, only to be hopelessly defeated and forced to surrender in 404 BCE.

9. See Hamilton (1970), West Eberhard (1975).
10. The discussion here is adapted in part from Hirshleifer (1978).
11. Using (2) and (3) above leads to:

$$\sum_i r_{iD} c_i - \bar{r} \sum_i c_i < \sum_j r_{jD} b_j - \bar{r} \sum_j b_j$$

Inequality (4) follows immediately.

12. On the other hand, condition (2) might be satisfied if a potential Donor is in a position to help a great many beneficiaries at once, even though no single one of them is a very close relative (West Eberhard, 1975). This consideration may explain the self-sacrificial actions of religious martyrs and military heroes.
13. Keeley (1996) (p. 201).
14. Thanks to the intellectual advance wrought by sociobiology, it is now evident that the 'classic' pre-sociobiology text of Turney-High on primitive war (Turney-High, 1971) fundamentally misconceives the phenomenon. Turney-High hardly noticed any biological function, indeed any function at all, for primitive warfare. He minimized the significance of material resource-capture, and the female-capture aspect appears to have escaped his attention entirely. Accordingly, he was inclined to describe primitive war as 'stupid' or 'childish', aimed at goals he regarded as whimsical or ephemeral, for example prestige. Turney-High never recognized that a warrior who sacrifices material booty for a psycho-social end like prestige need not be stupidly giving up something real for a mere dream or fantasy.
15. These do not exhaust the list of possible ingrained predispositions that might be relevant for warfare. To cite only one more, humans appear to have an *acquisitiveness* instinct that motivates struggle for possessions over and above apparent material needs. Such a trait may substitute for consciously thinking ahead so as to provide for a rainy day. And accumulated possessions may also provide a very readable signal of strength or ability, useful for (among other things) attracting mates.

REFERENCES

- L.L. Betzig (1993). Sex, succession, and stratification in the first six civilizations. In *Social Stratification and Socioeconomic Inequality* (edited by L. Ellis), New York: Praeger, pp. 37–74.
- G. Blainey (1973). *The Causes of War*, New York: The Free Press.
- N.A. Chagnon (1983). *Yanomamo: The Fierce People*, 3rd edn, New York: Holt, Rinehart and Winston.
- P. Colinvaux (1980). *The Fates of Nations*, New York: Simon and Schuster.

- C. Darwin (1871). *The Descent of Man and Selection in Relation to Sex*, London: J. Murray.
- J. Diamond (1997). *Guns, Germs, and Steel*, New York: W.W. Norton & Co.
- B. Fischhoff, P. Slovic and S. Lichtenstein (1977). Knowing with certainty: The appropriateness of extreme confidence. *Journal of Experimental Psychology*, 3, 552-64.
- J.P. Gould (1973). The economics of legal conflicts. *Journal of Legal Studies*, 2, 279-300.
- W.D. Hamilton (1964). The genetical evolution of social behavior, I. *Journal of Theoretical Biology*, 7, 1-17.
- W.D. Hamilton (1970). Selfish and spiteful behaviour in an evolutionary model. *Nature*, 228, 1218-20.
- M. Harris (1984). A cultural materialist theory of band and village warfare: The Yanomamo test. In *Warfare, Culture, and Environment* (edited by R.B. Ferguson), New York: Academic Press), pp. 111-40.
- J. Hirshleifer (1978). Natural economy versus political economy. *Journal of Social and Biological Structures*, 1, 319-37.
- D. Kagan (1995). *On the Origins of War and the Preservation of Peace*, New York: Doubleday.
- L.H. Keeley (1996). *War Before Civilization*, New York: Oxford University Press.
- E.D. Mansfield (1994). *Power, Trade, and War*, Princeton, NJ: Princeton University Press.
- J.H. Manson and R.W. Wrangham (1991). Intergroup aggression in chimpanzees and humans. *Current Anthropology*, 32, 369-90.
- S.W. Polachek (1992). Conflict and trade: An economic approach to political international interactions. In *Economics of Arms Reduction and the Peace Process* (edited by W. Isard and C.H. Anderton), Amsterdam: North-Holland, pp. 89-120.
- T. Royle (1989). *A Dictionary of Military Quotations*, New York: Simon and Schuster.
- J.M. Shafritz (1990). *Words on War*, New York: Prentice Hall.
- M. Sherif and C.W. Sherif (1964). *Reference Groups: Exploration into Conformity and Deviation of Adolescents*, New York: Harper and Row.
- A. Smith (1759 [1969]). *The Theory of Moral Sentiments*, Indianapolis: Liberty Classics.
- A. Smith (1776 [1937]). *The Wealth of Nations*, New York: Modern Library.
- B.W. Tuchman (1962). *The Guns of August*, New York: Macmillan.
- H.H. Turney-High (1971). *Primitive War*, 2nd edn, Columbia, SC: University of South Carolina Press.
- D.R. Vining (1986). Social versus reproductive success: the central theoretical problem of human sociobiology. *Behavioral and Brain Sciences*, 9, 167-216.
- M. Waldman (1994). Systematic errors and the theory of natural selection. *American Economic Review*, 84, 482-97.
- M.J. West Eberhard (1975). The evolution of social behavior by kin selection. *Quarterly Review of Biology*, 50, 1-33.
- D. Wittman (1979). How a war ends. *Journal of Conflict Resolution*, 23, 743-63.