CHAPTER TWELVE

Toward a Theory of Long Waves

The theoretical model of the long wave developed in this chapter is both consistent with the findings of chapters 9–11 and resonant with the most promising theories of chapters 2–7.[1] It includes those aspects of war relevant to the long wave but puts off discussion of other aspects of war (war and hegemony) for Part Three.[2]

The long wave theory proposed is a best guess—an approximation, given presently available information both from my own analysis and from the work of other scholars. It is put forward as a working model that is both internally consistent and generally consistent with the evidence. But (like any scientific model) it is incomplete, contains anomalies, and will be subject to modifications as it faces the challenges of new evidence.

I will present this theory in stages, beginning with the most central and most empirically consistent elements—war, prices, and production—and working outward to less well defined elements that may play a role in long waves.[3]

The Long Wave Sequence

The *sequence* of an idealized long wave within cycle time, based on the lagged correlations emerging from chapters 9–11, is depicted in figure 12.1. Starting on the left-hand side, there is a peak[4] in production at about −10 to −15 years in cycle time—the growth of production turns downward. Within a few years capital investment also turns downward, and within ten years the growth of innovation is stimulated, turning upward. Soon after this, about ten years into the

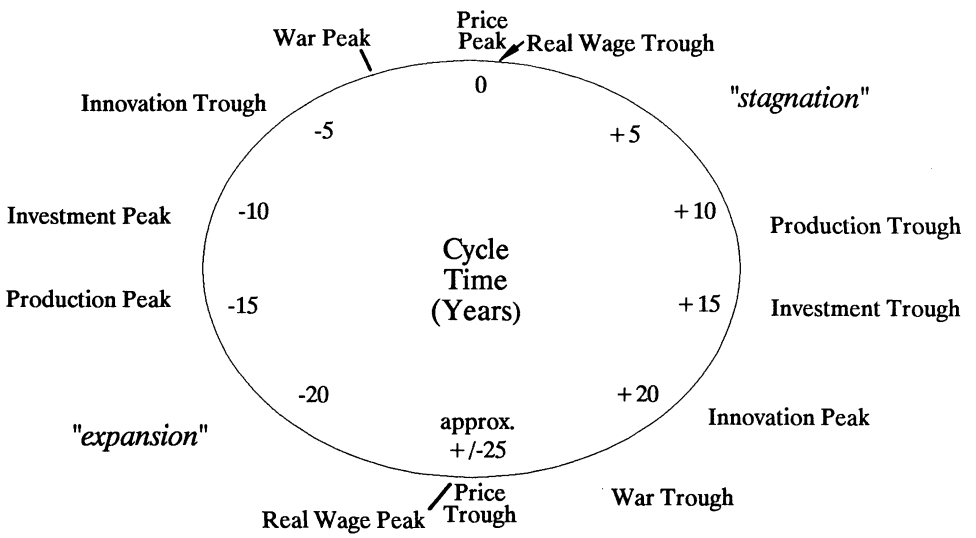
1. The theory attempts to integrate both the *consensual* hypotheses found in Part One and the hypotheses *selected* from mutually contradictory pairs in Part Two.

2. The long waves in systemic severity of war are relevant here, while I leave the longer-term recurrence of hegemonic war for the next chapter. The dynamics of relative national capabilities are mainly left for the hegemony discussion, but are touched on in this chapter as a possible factor in the long wave dynamic.

3. The variables for which weakly supportive evidence was found—innovation and capital investment—are discussed as possible elements in the long wave dynamic. The dynamics of generational change and of relative national capabilities are also taken up as possible contributing elements.

4. *Peak* refers to the end of the upswing phase.

Figure 12.1. Sequence and Timing of Idealized Long Wave



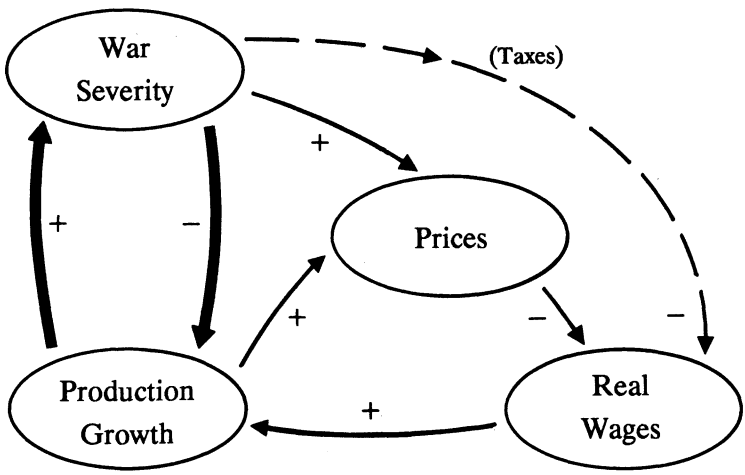
production downswing, the severity of great power war peaks and turns downward. A few years later prices follow and turn downward, and this triggers an upturn in real wages.[5] A decade follows in which the growth of production, war, and prices are all stagnant but innovation grows briskly. Then production growth turns upward, investment follows, innovation is dampened, and, about ten years into the production upswing, war severity turns upward. Prices turn upward following war, and as prices rise, real wages stagnate. This brings on a decade in which production, war, and prices are all growing steadily while innovation stagnates and real wages are held down (money going into war and investment instead).

The *causal* theory of long waves that I adduce comes essentially straight out of this sequence, giving production, war, and prices key roles. I will step through the sequence, elaborating each link in the theory using both theoretical and empirical materials from my own and others' work. My long wave theory is built on lagged structural relationships among variables. Each relationship, marked by an arrow in schematic diagrams in this chapter, will be discussed in turn.

Figure 12.2 shows the connections between production, war, prices, and wages in

5. This timing for wages seems to me anomalous for recent instances. The correlation of wages with long waves was clear in chap. 10, but only British wages were examined.

Figure 12.2. Adduced Causality, Production/War/Prices/Wages



my long wave theory. This sketch will be elaborated toward the end of the chapter with the addition of other elements. I have borrowed the language of system dynamics modelers in sketching out theoretical relationships—arrows indicate causal relationships, and plus or minus signs indicate positive or negative effects on the target variable. The generative dynamics of the long wave may be seen as a set of "negative feedback loops" with time delays.[6]

Production, War, Prices, and Wages

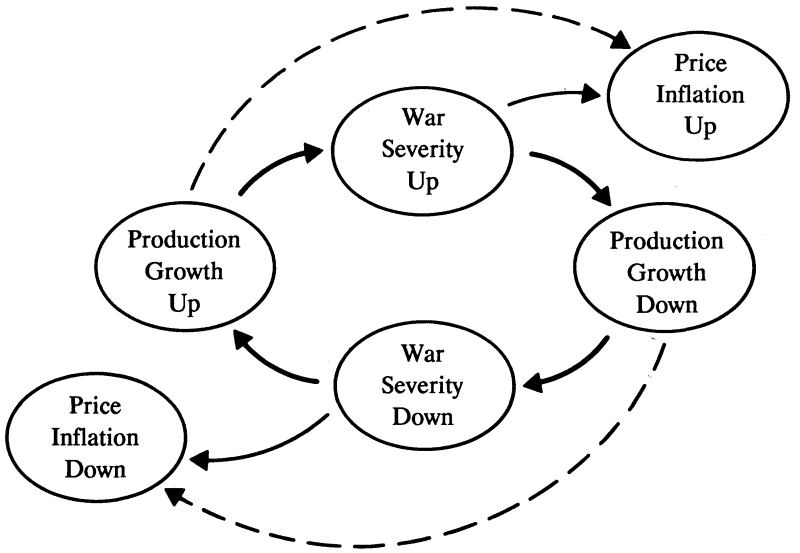
The heart of the theory, as seen in figure 12.2, is the two-way causality between war and production—a dialectical movement in which economic growth generates war and is disrupted by it. Great power war is an expensive activity: it depends on but undermines prosperity.[7]

The cyclical sequence of production and war is illustrated in figure 12.3. A sustained rise in production supports an upturn in great power war. Increased war contributes to a downturn in production growth. Economic stagnation curtails war severity. And low war severity contributes to the resumption of sustained growth. This sequence takes roughly fifty years to complete—forming one long wave. While war and economic growth are the main "driving" variables, prices react primarily to growth and war.

6. The time lags are not indicated on the sketch, but are those shown in fig. 12.1, above.

7. The drive to increase capabilities for purposes of war stimulates long-term secular economic growth (not part of the long wave dynamic), yet that growth is disrupted by recurring wars and lurches forward in 50-year waves.

Figure 12.3. Primary Causal Sequence of Long Wave



The Effect of Production on War

Why should an upturn in economic growth lead, about a decade later, to an upturn in great power war severity?[8] Several theoretical arguments may be adduced in support of this idea.

The first theoretical argument, which I call the "cost of wars" argument, was mentioned in chapter 6 (Farrar 1977). The biggest wars occur only when the core countries can afford them, which is after a sustained period of stable economic growth. When treasuries are full, countries are willing and able to wage big wars; when they are empty, countries are not able to undertake such wars.[9] Thus when the growth of production in the core of the world system accelerates, the war-supporting capacity of the system increases as well, and bigger wars ensue.[10] Hansen ([1932] 1971:97) wrote more than fifty years ago: "Nations do not fight wars after prolonged periods of depression. Following long periods of predominantly good times, in periods of the long-wave up swing, war chests are accumulated, navies are built, and armies are equipped and trained."[11]

One constant over the span of history has been that wars cost money. More than

8. Or a downturn in growth lead to a downturn in war severity.

9. The step between economic growth and full treasuries is taxation (see discussion below).

10. As noted in chap. 11, it is not more frequent nor longer wars that correlate with long waves, but bigger ones.

11. As noted elsewhere, since World War II the contrary view—that depressions (the 1930s) lead to war (the 1940s)—has become popular. But, as I have shown in chap. 11, this was the exception to the historical rule, and Hansen's argument better fits the past five centuries.

two thousand years ago, Sun Tzu wrote in the Chinese classic *The Art of War* that the cost of a military campaign, which generally involved 1,000 four-horse chariots, 1,000 four-horse wagons, and 100,000 troops, would come to 1,000 pieces of gold per day. "After this money is in hand, one hundred thousand troops may be raised" (p. 72). In 1423, the Venetian doge Francesco Foscari warned that in the event of war, "the man who has 10,000 ducats now will be left with a thousand," and so forth across the entire economy (Braudel 1984:120). And in the sixteenth century, the king of Spain was told by his adviser that three things were required to wage war—money, money, and more money!

The cost of wars argument is especially applicable to preindustrial times. In the first few centuries after 1500, wars were fought primarily with money, that is, with mercenaries hired by a monarch. If the mercenaries were not paid, they would not fight—or worse, they might turn on their master. Thus the link between prosperity and war was fairly direct.

Braudel (1972:897–99) identifies two types of wars in Europe around the sixteenth century. "Internal" wars took place within Christendom or Islam, and "external" wars were between these two hostile civilizations. Braudel notes that the second type (jihad or crusade), as well as the outbreaks of anti-Semitic violence in the Christian world, coincide with times of economic depression. But wars of the first type—corresponding more closely to what are here called great power wars—are "usually preceded by a 'boom'; they come speedily to a halt when the economy takes a downward turn" (p. 898).

Braudel (1972) describes fifteenth-to-seventeenth-century European wars as moving in surges—the economy recovered from one war and was in turn drained by the next, bringing war temporarily to a halt. Braudel describes the constraining effect of finances on the Spanish-French war in 1557 (p. 943), the European conquest of Tunis in 1574 (p. 1134), and the Spanish-French war in 1596–97 (p. 1218). In the latter case, the "state bankruptcy of 1596 had once more brought the mighty Spanish war machine to a halt" (p. 1221). Braudel cites a number of cases in which spectacular state bankruptcies, especially by Spain, brought a sharp reduction in war.

In industrial times the costs of war, no longer restricted to purchased mercenaries, continued to place a strain on the total resources of society. Although by industrial times European society was able to sustain a much higher level of economic production and surplus, the costs of war kept pace with this growth (Farrar 1977).[12]

The second argument for why production affects war I call the "lateral pressure" argument. Production upswings bring increased national growth by a number of great powers at once, leading to heightened competition for world resources and markets. This competition increases the propensity toward major conflicts and wars among core countries (even though the things over which they conflict may lie outside the core).

Lateral pressure theory (North and Lagerstrom 1971; Choucri and North 1975;

12. On war costs, see also Bogart (1921) and Warren (1940).

Ashely 1980) seeks to explain linkages between national economic growth and international conflict. It focuses on the importance of a country's population size, level of technology, and domestic resource availability—and changes in these—in shaping that country's international behavior. According to this theory, each member of a population creates demands for (at a minimum) food, water, shelter, clothing, and other basic needs. At higher levels of technology, these demands multiply, since machines and infrastructure must also be supported. These demands create a need for resources, and if the country does not have the needed resources domestically it will tend to seek them internationally.

The propensity to extend activity beyond a country's own borders to help meet demands is called lateral pressure. It can take various forms, including trade, colonial expansion, and military activity. Different countries develop different national capabilities—such as armed forces, merchant marines, financial institutions, and communications networks—that go with different forms of expansion. The intersections of lateral pressure from two or more countries, often in other parts of the world, create competition—for resources, for markets, for trade routes, for military position, and so forth—that can intensify into conflicts.[13]

The lateral pressure literature has not addressed cycles in the past. Since it concerns the effects of economic expansion, the past work has focused on expansionary periods.[14] But the implications for long wave theory are clear. During the upswing of the world economy, demands will rise, countries will expand and intersect, and competition and war will increase.

Kondratieff himself ([1928] 1984:95) attributes the correlation of major wars with economic upswings to a process much like lateral pressure:

> The upward movement in business conditions, and the growth of productive forces, cause a sharpening of the struggle for new markets—in particular, raw materials markets. . . . [This] makes for an aggravation of international political relations, an increase in the occasions for military conflicts, and military conflicts themselves.

Earlier authors have suggested similar effects of economic expansion. Sorokin (1957:565–66) tentatively advances the hypothesis that

> in the life history of nations, the magnitude of war, absolute and relative, tends to grow in the periods of expansion—political, social, cultural, and territorial. . . . In such periods of blossoming the war activities tend to reach the highest points, probably more frequently than in the periods of decay.
>
> The expansion of any empire . . . [except in a sparsely settled area] can be made only at the cost of the territory of other nations. . . . These other nations must be conquered, because

13. Choucri and North (1975) use lateral pressure theory to illuminate the dynamics of six European powers from 1870 to 1914. The study combines econometric analysis with historical narrative to explain the processes that led to the outbreak of World War I. The model is considered a "first-order approximation" of the linkage between domestic growth and international violence. Ashley (1980) uses a lateral pressure approach to examine the dynamics of the United States, Soviet Union, and China, 1950–72.

14. The periods 1870–1914, which began with the long downswing and led into the upswing, ending with World War I, and 1950–72, an upswing.

none is willing to present itself, its population, its territory, and its resources as a free gift to any other nations. Since the victim of the expansion must be subjugated and conquered, this means war, the only real instrument of subjugation. Hence war's increase in the period of expansion.[15]

John Maynard Keynes (1936:381) likewise argues that "war has several causes. . . . [Above all] are the economic causes of war, namely, the pressure of population and the competitive struggle for markets."[16] And Lasswell (1935:121) argues that "in a world divided into states whose ultimate differences are to be settled by violence, prosperity expands markets, intensifies contact, sharpens conflict and war."

The lateral pressure argument, in which sustained economic growth increases the *propensity* for major wars in the system, complements the cost of wars argument, in which sustained growth increases the *ability* to wage bigger wars.

In addition to the cost of wars and lateral pressure arguments, there may be a psychological link from increased economic growth to a kind of "gung-ho" social mood to bigger wars. Lasswell (1935:116–19) considers the political effects of prosperity and depression as articulated through Freudian psychology. Prosperity allows for human impulses to be dealt with indulgently, bringing "a steadily expanding myriad of individual demands." This increases the likelihood of war beacuse "it is the threat of war which counteracts the individualizing tendencies unleashed in prosperity."

Depression, on the other hand, brings "blows to the self-esteem of those affected." The first effect "is to turn aggressive impulses back against the primary self." During times of depression, however, the individuals notice many others similarly affected and hence turn frustration outward onto secondary (political) symbols. The psychology of a depressed economy thus increases "the probability that the ruling order itself may be the target of an attack." The ruling order may, however, avoid such revolutions by "meeting the psychological exigencies of the population".

Lasswell's theory is consistent with the idea that wars occur on upswings and revolutions on downswings. This fits with Braudel's comment (see above) that times of prosperity brought increased war between neighboring great powers, while times of depression brought increased scapegoating—the deflection of internal tensions in Christian Europe against Moslems and Jews.

The Effect of War on Production

While a sustained increase in production tends, with some delay, to increase war severity, increasing war severity in turn dampens the long-term growth of produc-

15. By itself, however, Sorokin does not find a theory of economic causes of war adequate. "None of these factors [economic, psychological, climatic, and so forth] can account for a greater part of the fluctuation of war magnitude" (p. 569).

16. Pigou (1940:21), however, cautions that the economic causes of war are limited. To "seek an exclusively economic interpretation of war would be to neglect evident truths." The economic gains from war, Pigou reasons, could theoretically be greater than the cost of the war but this actually is "improbable." Particular factions, such as financiers with large overseas investments or arms merchants, however, can benefit from war and have some influence in lobbying for war (pp. 24–26).

tion. As Hansen ([1932] 1971:97) argues, "the long-wave up swing . . . produces favorable conditions for the waging of war. But wars and their aftermath tend to produce a reversal of the long-wave movements." Why, theoretically, should more severe wars lead to diminished economic growth?

Despite the popular American belief that "war is good for the economy,"[17] common sense as well as historical experience indicate that war is not, on balance, good for the economy. Resources allocated to war are not available for productive economic purposes (including both consumption and investment), and economic assets destroyed by war (houses, factories, farms, and so forth) no longer contribute to production.

For the twentieth century, in which data are fairly good, war has clearly acted to set back economic growth. In the case of World War I, Burns and Mitchell (1946:90–91) write: "In Great Britain and Germany, production of basic commodities dropped, as did employment. At the same time, the price level soared . . . [and] the output of consumer goods, especially of the durable type, slumped."

Data on total economic output for Britain, France, Germany, and the United States (from Maddison 1977:130) confirm that during World War I the outputs of Germany and France dropped by over 10 percent and 25 percent, respectively, while those of Britain and the United States continued to grow.[18] In World War II the outputs of Germany and France dropped by over 50 percent each, while Britain grew and the United States grew sharply.

National production curves for Britain, France, and the United States (data from sources listed in chapter 8) are graphed in figure 12.4. The clear major disruptions to sustained growth came in the 1914–45 period and were triggered not by the financial crash of 1929 but the outbreak of war in 1914.

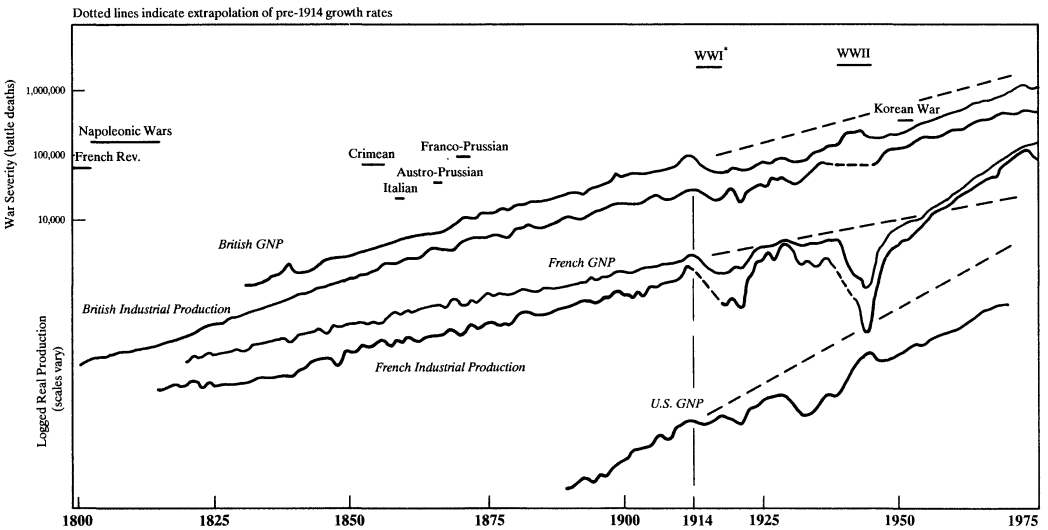
It is noteworthy that each of the three countries shown in figure 12.4 resumed a different growth curve after 1945 from the curve it followed before 1914. The curves are shown on a log scale so that a constant growth rate appears as a straight line. For Britain, a fairly steady growth rate prevails from 1800 until 1914. The curve falls below this trend in 1914–45, then resumes roughly the same growth rate but lags about thirty years behind the original curve (this shows on the figure as a parallel but lower trend line). The disruption to France's pre-1914 growth rate was severe in the 1914–45 period. But after 1945 France resumes a higher growth rate and by the 1960s is above where it would have been on the original growth curve.

For the United States the pre-1914 growth also slows down in the 1914–45 period (and again, not just after 1929). In the World War II years, U.S. production surges but by 1947 has dropped back to where it would have been without the war. Since 1947, U.S. production follows roughly the same growth curve as held from 1933 to 1940, a lower curve than prevailed before 1914. So even in World War II, which

17. This belief is clearly rooted in the American experience of World War II, which seemed to pull the country out of the Great Depression and propel it into the prosperity of the 1950s and 1960s. The same historical case underlies the popular idea that depression causes war (Russett 1983).

18. But not rapidly enough to keep the pace of world production from being diminished by the substantial reductions in other countries.

Figure 12.4. Great Power Wars and National Production



*Followed by Russian Civil War at very low severity (not graphed).

shaped the American belief in the economic "benefits" of war, war appears to have played a significant role not in sustained economic growth but only in the short boom of 1939–44.[19]

In the recent past, there is evidence that the costs of war and of war preparations continue to exert a "drag" on economic growth in the major core countries. The proportion of a country's GNP devoted to the military is inversely correlated with the increase in that country's productivity in 1973–83 (fig. 12.5).

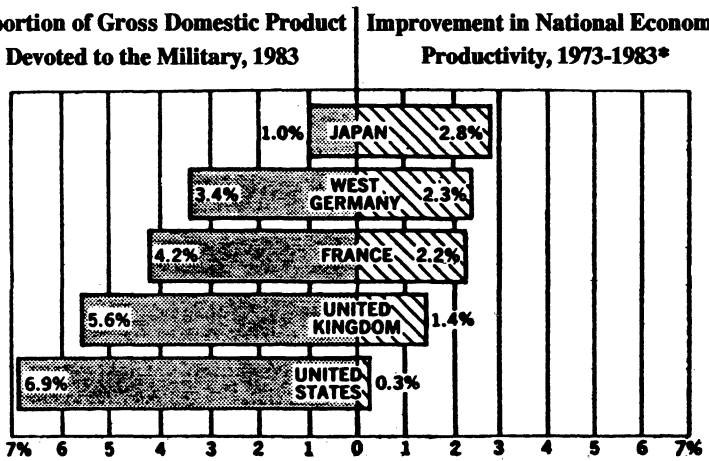
Melman (1986:64) argues that while the U.S. military budget currently is only 6.5 percent of the GNP, "it siphons off a much larger share of the country's production resources." He calculates the ratio of military to civilian capital formation as follows:

USSR	.66
United States	.33
West Germany	.20
Japan	.04

"Those numbers show why Japan has been so successful in international [economic] competition." Melman estimates that the planned buildup of U.S. military forces

19. Nonetheless, the American *victory,* which allowed a restructuring of a stable Western international order led by the United States, may have been a major factor in sustained economic growth in the 1950s and 1960s. This aspect will be considered under "hegemony" in Part Three. But this is different from the idea that war itself increased growth by stimulating demand.

Figure 12.5. Military Spending and Productivity



* Average annual increases in productivity, measured as Gross Domestic Product per employed person.

Note: Data from Stockholm International Peace Research Institute and President's Commission on Industrial Competitiveness.

Source: *The Washington Post*, Dec. 1, 1985: A20.

and budgets would push the U.S. ratio to .87 by 1988. Currently, according to Melman, the United States allocates 70 percent of federally funded research and development to the military. He quotes the American Electronics Association (hardly a peacenik organization!): "We cannot siphon off a disproportionate share of our skills and technical resources to military application and still stay ahead of Japan in commercial markets."[20]

All of the above notwithstanding, war *may* be economically profitable for one country under special circumstances—if the war is fought on foreign territory, knocks out some sizable economic competitors, and one's own side wins the war. World War II met all three conditions for the United States. Japan in World War I experienced similar benefits while sitting out the war. The U.S. war in Vietnam, which met only the first condition, was clearly *not* good for the U.S. economy and seems to have played a major role in the production stagnation that began in the late 1960s.

The impact of wars on long-term economic growth has been statistically analyzed by Wheeler (1980) and by Rasler and Thompson (1985b). Wheeler (1980) uses the data and methods of the Correlates of War project to analyze postwar industrial growth (measured by iron production to 1870, then energy consumption) in major

20. Hiatt and Atkinson (1985) also present evidence of the draining effect of arms spending on the U.S. economy.

nations since 1815. Using multivariate regression analysis for forty-four national cases, Wheeler finds that except for World War II, the effects of war on industrial growth were "overwhelmingly" negative (p. 275).[21] This conclusion converges with the conclusions of five earlier studies by other authors (Wheeler 1980:261–62).

Rasler and Thompson (1985b) use a Box-Tiao statistical analysis in which wars are regarded as an "intervention" in the process of economic growth. The scope of the study was defined by the availability of GNP data—Britain since 1700, the United States and France since about 1800, and Germany and Japan since about 1875. "Global wars" as defined by Modelski's leadership cycle theory (see chapter 6) are distinguished from other interstate wars. Rasler and Thompson find that interstate wars "in general . . . have no statistically significant impact on economic growth." But for global wars, each of which they test separately, eight of the thirteen country-war combinations are statistically significant at the .05 level.

Rasler and Thompson's conclusions are tentative (the statistical significance is borderline and the methodology somewhat ad hoc), and they point out that their results largely contradict those of Wheeler (1980) in terms of the effects of World Wars I and II on economic growth in specific countries. Nonetheless, they conclude that at a minimum, "the evidence indicates that global war does not seem to pay" and does "cost . . . in terms of permanently increasing the costs of maintaining and operating competitive states" (p. 534).

The empirical evidence thus corroborates war's negative impact on production. Theoretical arguments support this conclusion as well. Wars cost money to fight and use up limited resources. And in the war zone itself existing capital plant is damaged and economic output reduced. War conditions, with centralized governmental control and sacrifices on the part of the population, may manage to "squeeze" the maximum production out of the economy in the short-term (using full capacity). But those very conditions disrupt the long-term growth of the economy (growth of capacity).

These arguments have already been mentioned, in the discussion of the war school of the long wave debate, in chapter 2. Silberling (1943:61), for example, argues that the "dislocating effects" of war on the economy "appear to follow long after the event."[22] He concludes that "great wars generate . . . disturbance of such magnitude that the broad course of industrial progress may be appreciably modified for several decades" (p. 63).[23]

21. If World War I is included, the results are "mixed."

22. The disturbing effects of war are particularly felt in the sectors of primary production—agriculture and mineral production—and transportation. In these areas the war triggers emergency demands that stimulate capital-intensive expansion under difficult conditions. Heavy government borrowing for these purposes depletes capital markets (p. 62), forcing banks to "come to the rescue" with loans to producers at favorable rates. Under war conditions, the "temptation to borrow and expand" multiplies indebtedness, and fixed charges on these debts "remain long after the war is over and the prices . . . have probably collapsed" (p. 62).

23. After the war ends, according to Silberling (1943:64), prices deflate faster than wages of industrial wage-earners, creating postwar demand for goods and housing and redistributing income from farmers to

Bernstein (1940:529), another war school writer, argues that even for a neutral country, the effects of war are negative. The *initial* effects of a war can stimulate economic growth for a neutral, due to the increased demand for war goods from belligerents and for raw materials to be used in war industries.[24] But, after two to three years of war, the neutral countries themselves will experience economic depression when "foreign exchange reserves [of belligerents] have been depleted, when shipping has been destroyed, and when blockades have become most effective."

Writers from outside the long wave debate agree with these theoretical arguments of the war school. Pigou (1940:11) writes that there is "a strong presumption that any interference with the free play of economic forces . . . will . . . divert resources from more to less productive channels, and so will make the country somewhat less well-off than it would have been if the claims of defence had been silent." Although a national government can use various techniques to "squeeze out" higher production during wartime (p. 30), these increases are unlikely to match the very high costs involved in fighting war (p. 47). Thus the overall long-term effect on the economy can hardly be positive.

Quincy Wright (1942:1180) agrees that war disrupts long-term growth. The extreme increases in commodity prices and the burdens of war debts combine to reduce purchasing power and dampen long-term growth.

Rostow (1962:145) shares this negative view of war's economic effects.[25] He writes that "the direct contribution of war to economic change has been, on balance, negative."[26]

> War is a process of mobilizing and applying resources for destructive purposes. That is its essence. . . . Over the long period soldiers kill each other. They destroy capital equipment, houses, and ships. They drain resources away from the normal maintenance and enlargement of society's capital stock (p. 148).

Rostow particularly notes the negative effects of war in raising taxes and in indirectly raising taxes through inflation (p. 161). He calls war a form of "communal capital investment" (p. 161) but one that has not by and large paid off: "It must be concluded that war constituted a great net waste of British resources" (p. 164). Rostow finds that some long-term benefits of war, however, may be found in the

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industrial workers (this is consistent with the evidence on real wages presented in chap. 10). But imbalance in the entire economy eventually limits the postwar revival and brings on a secondary postwar depression.

24. In addition, the lagging nonwar production in the belligerent countries may open up new export markets for the neutrals.

25. Rostow (pp. 156–58) examines the British experience in particular, making many of the points that have been stressed earlier in this section—that war diverts economic resources from productive uses, that it destroys capital, that it increases taxes, and that these negative effects are only partially offset by short-term positive effects of war in raising employment and capacity utilization. Rostow details the effects of historical British wars as early as the 16th c. in disrupting the development of trade, production, and domestic investment.

26. This conclusion Rostow also attributes to Nef (1950).

social and political changes it engenders. Precisely because it places society under strain, war may speed up beneficial changes in the organization of society that ultimately allow sustained growth to continue (p. 165).

Tinbergen and Polak (1950:131) also share the negative assessment of "the consequences of wars on the long-run process of development." They stress (p. 137) the scarcity of all three factors of production—labor, capital, and land—in wartime conditions and the disruptive effects of the ensuing inflation.

One particular way that severe wars may disrupt long-term economic growth is through sudden increases in national debt. Rasler and Thompson (1983:500) find that increases in real national debt for the countries they consider winners of global wars[27] are relatively permanent following those wars. Using Box-Tiao statistical procedures (to test the effects of an "intervention" on a time series), global wars are shown as statistically significant, "abrupt, permanent interventions" on U.S. and British debt levels (p. 507). Such debt increases might contribute to the disruption of stable, long-term economic growth following severe wars.

At least three countereffects can be postulated, nonetheless, in which war exerts a *positive* effect on production. While these are weaker than the negative effects, they deserve mention.

First, in the short term, war can effectively "squeeze" maximum production out of a national economy.[28] Pigou (1940:32) reasons that productive power can increase in wartime "by the direct action of patriotic sentiment. Volunteers flow into the army and munition-makers readily accept long hours, just as a family would do which suddenly discovered its house burning and in crying need of salvage." These effects are augmented by direct and indirect coercion (conscription and taxation).

Second, war seems sometimes to "shock" a national economy into a reorganized mode based on a new "technological style."[29] After a sharp drop in production during the war, production may resume growth at a more rapid rate than before the war—as was the case for French national production discussed above (fig. 12.4). Organski and Kugler (1980) refer to the "phoenix factor" in which a country that has been decimated by losing a major war recovers economically and within fifteen to twenty years restores its capabilities to levels competitive with the other leading powers (the distribution of power that would have ensued had the war not taken place).[30] West Germany and Japan are the two most recent and most striking such cases. But John Stuart Mill refers to the same kind of phenomenon centuries earlier:

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27. The leadership cycle school's definition.

28. Economists distinguish actual GNP from potential GNP, which would be achieved at 100% capacity utilization. War, while reducing potential GNP, may in the short-term increase actual GNP by increasing capacity utilization.

29. To use the language of the innovation school.

30. Government reorganizations brought about by losing a war may play a role in this renewal process. Beer (1981:174) notes that war played a major role at least in recent centuries in causing domestic regime changes in the losing countries. He categorizes 10 countries as winners and 9 as losers in the Franco-Prussian War, Russo-Japanese War, and World Wars I and II (countries are listed once for each war they participated in). All 9 losers had changes of domestic regime as a result of losing the war, while none of the 10 winners had such changes.

The great rapidity with which countries recover from a state of devastation . . . has so often excited wonder. . . . An enemy lays waste a country by fire and sword, and destroys or carries away nearly all the moveable wealth existing in it: all the inhabitants are ruined, and yet in a few years after, everything is much as it was before.[31]

A third possible positive effect of war on production, although beyond the scope of this book to explore, is war's role in shaping the formation of the nation-state itself and hence the overall context of production. As Tilly (1975:42) puts it, "war made the state, and the state made war."

These three positive effects of war on growth operate on different time scales. The squeezing of higher production can be sustained only over the short-term (a few years); the "phoenix effect" is relevant to a period of decades following a major war;[32] and the role of war in state-making operates on an even longer time-scale more relevant to hegemony cycles than long waves.

The Effect of War on Prices

In my theory, prices are not crucial but are mainly a reflection of the more crucial elements production and war. They are a good indicator by which to date long wave phases, because of the availability of high-quality data. The link from war to inflation has been strongly corroborated in my empirical work (chapter 11) and that of other scholars (chapters 2 and 5). As the war school argued, major wars increase demand, interrupt supply, and hence lead to strong inflation.

Thompson and Zuk (1982:622) write: "Most observers are prepared to accept the idea that wars tend to be inflationary. . . . It is much less commonly accepted that the relationship between war and war-induced inflation may have functioned as a continuous historical process with some regularity over the past two centuries." In light of the evidence discussed in previous chapters, the past two centuries would seem to be the "tip of the iceberg" in a much longer historical continuity. Indeed, the Chinese military strategist Sun Tzu wrote some 2,400 years ago: "Where the army is, prices are high; when prices rise the wealth of the people is exhausted" (p. 74).[33]

The Effect of Production on Prices

While prices certainly are affected by war, they may also respond to production, with a ten-to-fifteen-year lag. The relationship of production and prices is not easy to unravel historically. Long wave scholars have widely presumed that the long-term fluctuations of prices and production are synchronous.[34] But my analysis (see chapter

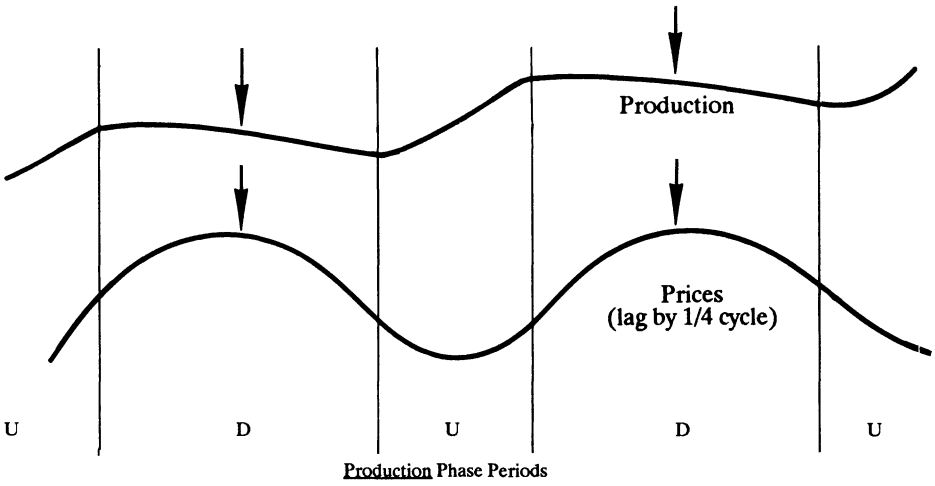
31. Quoted in Rasler and Thompson (1985b). While this has been historically true, we may assume it has changed in the case of nuclear war at least potentially.

32. And may thus play a role in the production upswing that follows the downturn in war by about 15 years.

33. In fig. 12.2, above, this statement maps directly onto a positive arrow from war to prices and a negative arrow from prices to real wages.

34. This theory may owe its popularity in part to the fact that what can be empirically measured most readily is prices, while what is of greatest interest to long wave scholars theoretically is production. So one measures prices and makes claims about production.

Figure 12.6. Timing of Production Growth and Price Levels



Lowest growth rate of production corresponds with highest price level (arrows).

10) suggests that prices lag production. Since the difference between measuring trends and measuring levels corresponds to a shift of about one-fourth of a cycle in the timing of the long wave (see chapter 8), it follows that the *level* of prices (rather than the rate of inflation) is *inversely* correlated with the *rate* of production. Figure 12.6 illustrates this relationship. The period of lowest production growth coincides with the highest level of prices, and the highest production growth coincides with the lowest price levels.[35] These relationships, however, seem only to supplement the primary relationship that connects production to prices through war.[36]

Production, War, and Real Wages

The empirical analysis in chapter 10 showed strong evidence that real wages correlated inversely with the long wave (although the data covered only Britain). When prices rise, money wages do not keep pace, and so real wages fall. In price downswings, the reverse occurs and real wages rise.

This timing of real wages in the long wave makes sense theoretically for two reasons: First, real wages appear to be inversely correlated with capital investment (capital investment leads by about ten years). This suggests that, on the long wave upswing, as more resources are funneled into capital investment (a necessary aspect of increasing production growth), fewer resources go into real wages. There is a trade

35. It is in that period of most rapid growth that prices begin to rise again.

36. It should also be noted that prices seem to respond to money supply as well, at least since World War II. Fusfeld (1979:8), for instance, shows data linking the increase in inflation after 1967 with the fact that money supply (M1 and M2) began increasing faster than the potential GNP growth rate. I have no theory that ties in money supply, however, except as it is used to finance wars.

off, in real terms, between capital and labor. Thus sustained growth late in the production upswing may be subsidized in part by workers' standards of living.[37]

Second, and more important, real wages are affected by taxes, which are affected by war. Inflation and taxes combine to redistribute income away from real wages and toward the government in time of war.[38] Tilly (1975:23) notes that "taxation was the chief means by which the builders of states in the sixteenth century and later supported their expanding armies. . . . Conversely, military needs were in those first centuries the main incentive for the imposition of new taxes and the regularization of old ones." Taxation and the military fed on each other, since military forces were required to overcome resistance to taxation and taxation was required to support military forces. In 1787, Thomas Paine wrote: "War involves in its progress such a train of unforeseen and unsupposed circumstances that no human wisdom can calculate the end. It has but one thing certain, and that is to increase taxes."

But direct taxation is not the only way to redistribute income away from real wages to finance wars. Hamilton (1977:17–18) sees inflation itself as a tax to pay for war and a way to avoid paying from current taxation. "Of all forms of de facto taxation, inflation is the easiest to levy, the quickest to materialize, and the hardest to evade."[39] Hamilton argues that "wars . . . without taxation to cover the cost have been the principal causes of hyperinflation in industrial countries in the last two centuries."[40] He blames the high inflation of the 1970s on the Vietnam war and "the unwillingness of our political leaders in both parties to attempt to pay the cost of the war through taxation. For this method of payment would have revealed the true cost, and thus ended the war."

The main causal links involving prices have been drawn *from* war and production *to* prices. But there may also be a "feedback loop" (though perhaps of lesser importance) from prices to production, perhaps through the intermediate variables of real wages and "class struggle."[41] This dynamic, consistent with the mainstream of the capitalist crisis school, would entail higher production growth leading (through inflation and with a decade's delay) to lower real wages, which in turn would lead to

37. This is not to deny, of course, that over the long term the secular growth of production contributes to higher standards of living for workers in the core of the world system.

38. On this subject, see also Rasler and Thompson (1985b).

39. In the unlikely event that governments did try to pay for wars from current taxation, Hamilton predicts that the people would see that "the cost of the war was too great and the probable benefits entirely too small . . . and would clamor for peace." Consequently, "if only one side resolved to pay as it went, it would be one of the surest possible ways to lose the war."

40. He cites inflation figures from World War I (1913–20) of 120% in the United States, 145% in Canada, 200% in Britain, and 400% in France. The "hyperinflation which reduced the value of money in Germany to zero from 1919 to 1923 would have been inconceivable without World War I and its aftermath." U.S. inflation following the War of 1812 and the Civil War ran at similar levels to that following World War I. And World War II, according to Hamilton, "again forced commodity prices sharply upward in virtually all countries throughout the civilized world, whether industrial or agricultural, belligerent or neutral."

41. Regarding the direct effects of prices on production, Kaldor (1978:257) argues that "*any* large change in commodity prices . . . retards industrial growth." But these effects seem relatively minor in the overall long wave dynamic.

an upsurge of "worker militancy" late in the price upswing phase (see chapters 2 and 3), which would dampen the growth of production. Heightened worker demands resulting from low real wages might help explain the downturn of capital investment in the last ten years of the price upswing phase.[42] And the increases in real wages in the first decade of the price downswing phase could contribute, with a delay, to a reduced worker militancy (and a buildup of demand) that helps spark the production upturn ten to fifteen years into that phase.

Other Elements in the Theory

In this long wave theory I try to synthesize the most consistent and plausible long wave hypotheses in a way that makes them compatible both with each other and with the empirical evidence uncovered by myself and others. Figure 12.7 is a schematic diagram of an expanded model incorporating the dynamics of innovation, capital investment, the memory of war, and the distribution of national capabilities among nations.[43]

The model as a whole is consistent internally, consistent with my empirical findings, and consistent with the main conclusions of the schools of long wave research discussed in Part One. Note that the three negative feedback loops connecting with production in the "economic" half of the diagram correspond with the respective theories of the three long wave research schools. The two negative feedback loops connecting with war on the "political" half of the diagram contain the main causal elements of the three war/hegemony schools in their reading of long waves.[44] Some elements of this "full" model may turn out to be unnecessary at a later time, but for now all add something and none are ruled out.

Innovation

First consider the innovation cycle (fig. 12.7, lower left). My tentative conclusion (chapter 10), resonant with the main line of thinking in the innovation school, was that innovation is inversely correlated with production, lagging production by about ten years. Secondary relationships may also exist between innovation and war and between innovation and national capabilities.

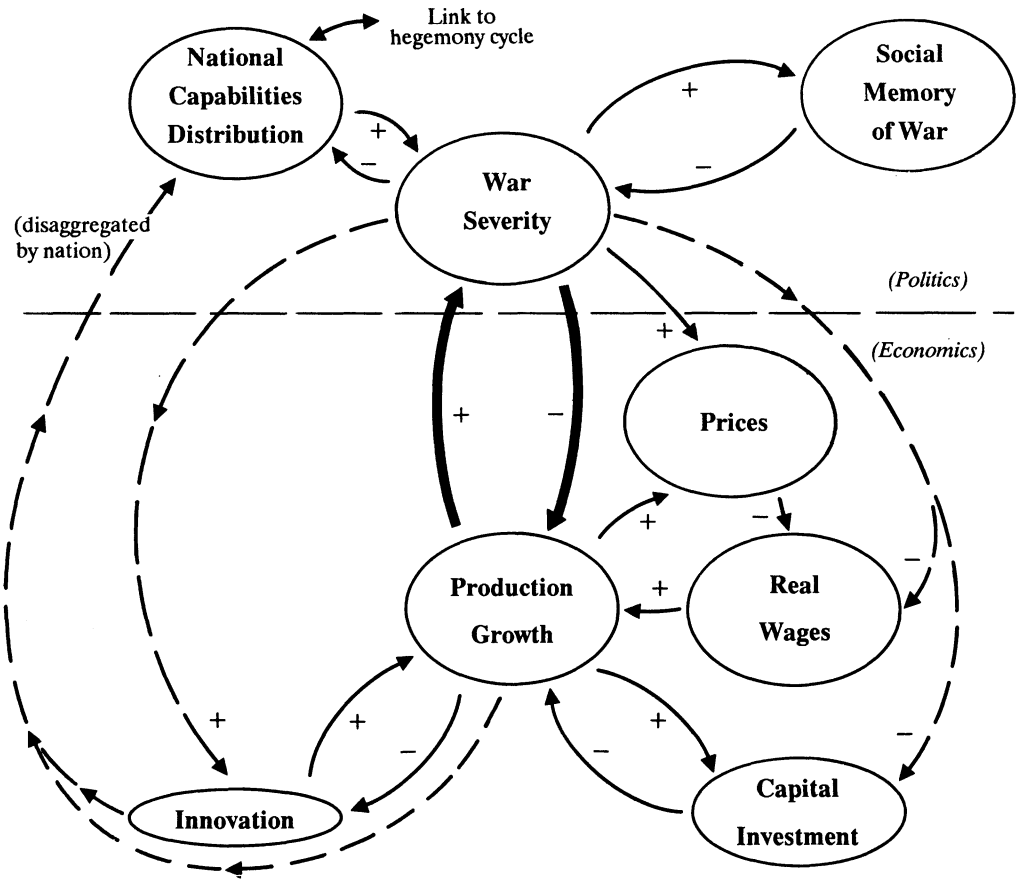
The relationship of innovation and production somewhat parallels that between war and production in that the lagged negative feedback between the two variables gives rise to a long cyclical pattern. Increased growth of production leads to decreased innovation, but decreased innovation leads to decreased growth of production. Conversely, decreased production growth stimulates renewed innovation,

42. This would be consistent with the argument of Screpanti (1984) that higher worker militancy discourages investment (see chap. 3).

43. Social memory of war refers to Toynbee's generation cycle (see chap. 5). National capabilities distribution refers to the international distribution of capabilities, their differential growths, and the conditions of hegemony or competition in the core (linking to the longer hegemony cycle), which are central to Modelski and Organski (chap. 6).

44. The national capabilities distribution loop resonates with Organski, but he does not address long waves. It also resonates with Modelski, but he would apply that dynamic only to longer hegemony cycles. The social memory of war loop embodies Toynbee's explanation for 50-year war cycles.

Figure 12.7. Theoretical Model of Long Wave Dynamics



which triggers faster growth. This innovation cycle theory was discussed in detail in chapters 2 and 3.

War's effect on innovation is indicated by a dashed line on the figure. Does war stimulate or depress innovations? Many basic innovations have come about under the exigencies of war conditions. World War II, for example, spurred innovations that helped develop the electronics sector in the United States. Van Duijn ([1981] 1983:25) states that "war conditions . . . have historically been a major force in bringing about innovations." He argues that in the "innovation-rich decades" of the 1930s and 1940s, the innovations did not cluster around the Great Depression but around the war.[45] Kleinknecht (1981b:297) indicates that 37 of his list of 120 innovations were connected with a "war armament strategy."

45. "If a specific cause of basic innovations in the 1930s and 1940s has to be singled out, it would have to be rearmament and war-related demand" ([1981] 1983:29).

But is the experience of World War II generally applicable or (as in some other respects) unique? I cannot answer this question, but if war does stimulate innovation, this does not fit the timing of lagged relationships adduced at the beginning of this chapter. In that timing sequence, the upturn of war severity comes nearly synchronously with the downturn of innovation. If innovation is stimulated by war, this is a weak countervailing force relative to the stronger production-war and production-innovation cycles.[46] But this area remains something of a puzzle for future research.

Capital Investment

The relationship between capital investment and production—like that between innovation and production or between war and production—may be seen as a negative feedback loop with time lags. The upturn in production is closely followed by an upturn in capital investment. But this surge of investment overshoots the equilibrium level and eventually causes a downturn in production and investment. This is the theory of the capital investment school discussed in chapters 2 and 3.

As with innovation, we must also assume a connection between war and capital investment. The net effect of war (although varying from country to country) is to disrupt capital investment—indeed, war devastation constitutes negative capital investment. In the long wave sequence adduced above, the downturn in investment comes just as wars are approaching their peak and production is turning downward. Like the war-innovation link, the war-investment connection seems to be secondary, largely following the war-production dynamic.[47]

War and Social Memory

Toynbee's theory (chapter 5) that the social memory of war causes cycles in war may also be integrated into this framework. The memory of recent severe war works against its recurrence. But as that memory fades over the decades, the chances of war recurrence increase. While I am not sure that social memory can be shown to play a role in the long wave,[48] and while I have not done empirical research in this area, a role for social memory in the long wave has a certain theoretical appeal and should not be ruled out.

Such a theory is consistent with the finding, in chapter 11, that war severity is more "periodic" than other elements in the long wave with respect to calendar time.[49] Thus the social memory element of the long wave theory could serve to stabilize and give greater regularity to the recurrence of major wars, which in turn would stabilize the entire long wave.

46. Note the production-war-innovation cycle is a positive feedback loop, in contrast to the other negative loops.

47. As with innovation, I cannot elaborate in any detail the connections of war and capital investment but consider this an area of potentially fruitful future research.

48. And recent empirical analyses do not support hypotheses of "war-weariness" (Levy and Morgan 1985).

49. The relatively fixed length of a generation becomes a clock that links long waves to calendar time.

War and National Capabilities Distribution

Finally, the element of national capability dynamics, including the differentials in the growth of capabilities in different countries, may also be integrated into this theoretical model. This element of the theory links long waves to hegemony cycles.

The most important connection here, in my view, is a negative loop between war severity and the distribution of national capabilities. If the "power transition" approach (see chapter 5) were applied to long waves, severe wars might be seen as resulting from a shift toward more equal distribution of national capabilities ("challengers" try to "catch up" with the leading economic and military power). But a severe war in turn unequalizes the distribution of capabilities again.

Thus, after a war peak, the winners emerge with a predominant position in terms of national capabilities (this almost has to be the case since they have just defeated the other side). This advantage in relative economic and military capabilities then erodes over the following decades, as new (and renewed) challengers come forward. Capabilities again begin to equalize, and a new escalation of war follows.

In addition to this war-capabilities loop, I adduce two other possible elements affecting the distribution of national capabilities—the relative national changes in production and innovation (disaggregated at the national level). These are indicated on the figure by the dashed line at the left connecting innovation and production with capabilities.

The growth rate of each country's production affects its prospects for increasing or decreasing its share of world capabilities. To incorporate this element in the model, production should be broken out into its national components, each of which affects a corresponding national capability component (which together determine the systemic distribution of capabilities).[50]

Likewise, the theoretical model could incorporate the effects of relative rates of innovation on relative national capabilities (again, ultimately affecting the systemic-level distribution of capabilities) by disaggregating innovations by country. A country in which an innovative new leading sector develops gains an advantage in war (by translating the new "technological style" into military innovations). Military innovations allow a nation's overall economic potential to be leveraged into greater effective military capabilities.[51] In addition, innovations in one country will also increase that country's relative capabilities indirectly by stimulating production.

The Theoretical Model as a Whole

To summarize, the theoretical model as illustrated in figure 12.7 contains eight variables. There are six basic two-way causality relationships, which I have portrayed as negative feedback loops with time delays. The primary relationship is between production and war. Of secondary importance are three

50. This level of detail is not shown in fig. 12.7 but would be necessary in a formalization of the model.
51. But military technology diffuses to competing powers, so the technological edge tends to erode.

feedback relationships involving production (innovation, investment, and real wages) and two involving war (social memory and national capabilities). As noted earlier, these encompass most major causal theories of the long wave, which are seen not as competing explanations but as pieces of a larger dynamic.

A further set of possible relationships, less well articulated and of lesser importance, were sketched into the long wave model. These include the effects of war on innovation and on investment and the effects of production and innovation on the distribution of capabilities.[52]

This long wave theory integrates elements normally considered political with those considered economic. A horizontal line through figure 12.7 separates the disciplinary spheres of politics and economics. Many of the relationships in the theoretical model—including the primary war-production relationship—cross this disciplinary divide. Indeed, if this model at all closely approximates the dynamics of the long wave, those dynamics could not be understood while remaining on just one side of this disciplinary border.

Conclusion to Part Two

Part Two has addressed some of the outstanding issues of the long wave debate (from Part One) through empirical analysis and theoretical reformulation. I have by no means answered all questions, and I have explicitly noted a number of anomalies or puzzles for future research. Nonetheless, in Part Two I have largely succeeded in building an integrative theoretical framework within which the alternative hypotheses of different theoretical schools have been sorted, translated into common terms, and partially tested.

The implications of the results for other research efforts in the long wave field are clear. More attention should be paid to the role of war than most long wave theories have given it. Those approaches that have emphasized war (for example, Imbert 1959) should be reexamined and built on. Studies that have developed theoretical accounts of the economic aspects of the long wave *without* giving adequate attention to the role of war (for example, Forrester, Mass, and Ryan 1976; Mensch 1979; Van Duijn 1983) should be extended to include war. Schumpeterian innovation theorists should look more closely at the effects of war on innovation (Rose 1941). Theorists of capital investment, likewise, should consider the role of war in the destruction of existing capital plant and its subsequent rebuilding. The "capitalist crisis" theorists should consider the effects of war on production, distribution, and class struggle. At the same time, those who have studied war only in the context of longer (hegemony) cycles should not ignore the fifty-year cycle.

In Parts One and Two I have moved from theoretical debate to empirical analysis to theoretical synthesis in the long wave debate. In Part Three I will take up the longer hegemony cycle. In this context the long wave is an intermediate unit of time within a larger unfolding of world history.

52. My empirical data analysis, and the timing sequence it suggested, formed the starting point for the model, but the theory far exceeds the bounds of what can be induced directly from data.