This paper considers the productivity impact on the US economy of the period of war mobilization and demobilization lasting from 1941 to 1948. Optimists have pointed to learning by doing in military production and spin-offs from military R&D as the basis for asserting a substantial positive effect of military conflict on potential output. Productivity data for the private non-farm economy are not consistent with this view, as they show slower total factor productivity (TFP) growth between 1941 and 1948 than before or after. The paper argues for adopting a less rosy perspective on the supply side effects of the war.

The historiography of the Great Depression in the United States has been overwhelmingly concerned with the sources of the deficiencies in aggregate demand responsible for more than a decade of double digit unemployment over the 12-year period 1929–41. The narrative has been infused with leitmotifs of failure and loss: of output, of employment, and of expenditure. In contrast, the macroeconomic history of the golden age (1948–73), the quarter century following the end of demobilization, has, on balance, radiated the bright glow of success. The emphasis has been on an American economic colossus standing astride the world in a position of dominance not realized before, or, in quite the same way, since.2

Awkwardly situated between Depression era ‘failure’ and postwar ‘success’ has been the Second World War, a disruption to the ‘normal’ path of economic development that is every bit as significant as the Depression, although in different ways. As a consequence of its temporal location, the conflict has acquired almost mythological significance in bridging these two storylines, although it has in fact received relatively little detailed examination from macroeconomists and economic historians. Conventional wisdom credits the war both with ‘bringing us out of the Depression’ and with ‘laying the foundations for postwar prosperity’.3

1 This paper has benefited from presentations at the Centre for Economic Policy Research workshop on ‘War and the Macroeconomy’ in Barcelona, Spain, 29–30 June 2005 and the Allied Social Science Association meetings in Boston, Mass., 7 Jan. 2006, as well as comments from seminar participants at Stanford University, Columbia University, Humboldt University (Berlin), Universidad Carlos III (Madrid), All Souls College (Oxford University), London School of Economics, and the University of California, Riverside.

2 Ferguson, Colossus, p. 18.

3 The demand side argument is widely understood, and not the main focus of this article; details of the magnitude of the fiscal and monetary stimulus can be found in Edelstein, ‘War and the American economy’. The supply side story is frequently more implicit, but equally common. Optimism about the supply side effects of war is reflected, for example, in Baumol’s comment in 1980 that ‘except in wartime, for the better part of a century, US productivity growth rates have been low’ (Baumol, ‘Productivity growth’, p. 1073). For a more recent illustration, see Ruttan, Is war necessary? Presumptions about the long-term economic benefits of war have, perhaps understandably, been somewhat less prevalent in Europe.
There can be little doubt that the war administered a huge demand shock to the economy, especially from 1942 onwards, the result of a massive increase in deficit spending and an expansionary monetary policy committed to pegging both short- and long-term rates at low levels.¹ The standard interpretation, however, couples the demand story, at least implicitly, with emphasis on a powerful supply shock, one resulting from learning by doing in military production and spin-offs from military research and development.⁵ That posited supply shock has to be a main underpinning of the claim that the war 'laid the foundations for postwar prosperity'.

My concern in this paper is principally with the second part of the conventional wisdom, that which credits much of the achieved level of potential output in 1948 to war-induced positive supply shocks. To what degree was the war responsible for establishing the technological, organizational, and infrastructural preconditions for what Rostow called the 'age of high mass consumption'?⁶ This paper follows upon a reconsideration of twentieth-century US economic growth that finds productivity advance between 1929 and 1941 far stronger than has been traditionally appreciated.⁷ A corollary is a greater scepticism about the rosy supply side picture typically painted of the impact of the war years.

The conventional productivity data for the private non-farm economy show that TFP, which had been growing very rapidly between 1929 and 1941, continued to increase from 1941 to 1948, but at a markedly slower rate.⁸ The conventional data do show TFP higher in 1948 than it had been in 1941, although as I show at the end of the paper, much of the gap is eliminated if one makes a cyclical adjustment to take account of the fact that the economy in 1941 had not yet fully re-attained potential output. The question I wish to pose is whether 1948 levels were higher than they would have been in the absence of the war. Alternately, one can ask whether these productivity levels might have been reached earlier in the absence of the conflict.

There is a strong case to be made, and this paper will attempt to make it, that any positive shocks that may have been associated with progress in the mass production of airframes, ships, penicillin, or munitions/fertilizer were largely counterbalanced by the negative shocks associated with the disruptions to the economy resulting from rapid mobilization and demobilization. Previous work has established that the period 1929–41 was marked by an exceptionally high rate of total factor productivity growth, with the consequence that a significant fraction of the productivity foundations of the postwar epoch were already in place by 1941,

¹ This demand shock was sufficient to end the Depression, in the sense that it drove unemployment from 9.9% in 1941 to under 2% within two years. But was it necessary? By the end of the 1930s (and certainly by 1941), the private economy was on the road to recovery, and might have continued in that direction, even in the absence of the growing stimulus from the government sector. Of all components of autonomous spending, residential construction took the longest to re-approach levels experienced during the 1920s (Field, 'Uncontrolled land development'). Nevertheless, after reaching a nadir in 1933, it climbed back steadily, and by 1941, before the war curtailed private house construction, it was approaching 1929 levels (see fig. 6; housing had actually peaked in 1926). Some of the recovery after 1939, one might argue, was in response to the stimulus provided by anticipatory rearmament spending. But, as shown below, only a small fraction of cumulative war spending had actually taken place at the time Pearl Harbor was attacked.

⁵ Searle, 'Productivity'; Alchian, 'Reliability'; Gemery and Hogendorn, 'Learning curves'; Ruttan, Is war necessary?
⁶ Rostow, 'Stages', pp. 10–11.
⁷ Field, 'Most technologically progressive decade'; idem, 'Technological change'.
before full-scale war mobilization. Thus the rate of increase of TFP between 1941 and 1948, even without a cyclical adjustment, is lower than is commonly realized.

Why? Mobilization/demobilization delivered a one-two punch, whipsawing the economy, as it force-fed very rapid expansion in a limited number of war-related sectors, such as other transport equipment, and then equally rapid contraction. The conflict diverted the cream of US scientific and engineering talent, who had not been experiencing high unemployment rates during the Depression, into military work, such as the Manhattan project. Mobilization required that managers and workers pay attention not only to the wrenching tasks of re-orienting production within and between sectors, but also to a panoply of regulations associated with government contracting and resource allocation in what, within the military and much of the civilian sector, approached a command economy. There was certainly some learning by doing in high profile sectors such as air-frames and shipbuilding, and some war-related R & D spin-offs, such as micro-waves and advances in electronics that benefited the nascent computer industry. But there were opportunity costs, and the overall effect of the Second World War was probably to slow the growth of TFP and potential output. The best way to describe the supply side effects of the war is that they represented, in the aggregate, a retardative supply shock, slowing down the breakneck pace of the advance of potential output that had been achieved during the Depression years, largely fuelled by advance of TFP.

II

The supply shocks associated with mobilization and demobilization were short, they were sharp, and whether they were positive or negative, they were experienced almost entirely after the US entered the war. The military build-up, which was only beginning when Pearl Harbor was attacked in December of 1941, led to a massive increase in military and naval construction in 1942, a surge in equipment and ordnance production that peaked in 1943, and an expansion of employment in the federal government, both civilian and military, that peaked in 1944. By 1948, with demobilization largely complete, non-military production revived, and unemployment at 3.8 per cent, these changes had been almost entirely unwound.

10 See Margo, ‘Depression unemployment’.
11 US Civilian Production Administration, Mobilization for war. Although the US did not resort to an industrial draft, as did Britain, where workers could be commanded (rather than enticed) to work in a war industry, the US did effectively socialize investment flows and direct them in ways dictated by the imperatives of war (see Higgs, ‘Wartime socialization’). As figs. 5, 6, and 7 show, private domestic investment, as well as non-war-related public investment, such as the construction of streets and highways, was crowded out during the conflict, and vast amounts of taxed or borrowed money were used by the government, through the instrument of the Defense Plant Corporation, to purchase new machine tools and construct plants in strategic sectors. Civilian automobile and appliance production was shut down, and critical raw material flows were allocated essentially by fiat, with some dual use inputs (gasoline and tyres, for example) subject to rationing.
12 Military spending and manpower tripled between 1940 and 1941, but it did so from a very low base, and only a small fraction of cumulative war expenditure had actually taken place at the time of the Japanese attack. As a consequence, war-related spillovers and learning by doing cannot have had much to do with achieved 1941 productivity levels.

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Either of these shocks alone would have imposed substantial transition costs on the economy. Together they represented something of a double whammy. The war put the economy through a wringer, not once, but twice. From this perspective, it is hardly surprising that total factor productivity grew much more slowly between 1941 and 1948 than it had between 1929 and 1941.

Although belief that the war had associated with it large positive productivity effects was common during the conflict and immediately thereafter, a more nuanced and pessimistic evaluation was shared by economists familiar with the effects of mobilization and demobilization. Fabricant is an exemplar of this group; his general pessimism is echoed by Backman and Gainsbrugh. In 1952, Fabricant wrote:

Despite beliefs frequently held to the contrary, little contribution to the defense effort may be expected from productivity . . . The composition and even the volume of output undergo radical transformation. Speed rather than cost is the criterion. And fundamental changes occur in the organization of the economy. In a word, attention is diverted from the mainsprings of progress.

In such a situation, the energy of businessmen is devoted not to new improvements and additions to knowledge, but to adapting standard mass production methods to the munitions industries. And they are under the necessity of learning new rules. Price, production, and other controls have to be studied and the very rapid and radical changes in them require attention. Little time or energy is left for improving efficiency.

[. . .] The new workers are inexperienced; and some are handicapped. Some of the new equipment brought into production is standby equipment, not worth operating in normal times, and the flow of new and up to date equipment is slowed to a trickle. The mines reopened are low grade or high cost mines . . . Inventories are inadequate, and delays in receiving materials hold up production lines. Ersatz materials frequently require more labor for processing. Long hours cut the strength of labor and management.

As a result, national output per man hour fails to rise at the peacetime rate.

Fabricant went on to note that railroads were an exception to this rule, because of their unusual cost structure, and that productivity declines in trade and services were sometimes disguised because they took the form of deterioration in quality. But ‘in most peacetime and manufacturing industries . . . actual and palpable declines occur. For skilled labor is pulled away, transport is choked, and materials come hesitatingly and in meager quantity’.

He concluded his analysis by acknowledging that some munitions manufacturing did experience rapid productivity gains. He referred to the famous case of shipbuilding, noting a doubling of output per hour in the three years following Pearl Harbor. But he also observed that these increases were from very low levels immediately following conversion, so that ‘even the wartime peak in productivity may be below the level of the industry’s peacetime productivity’.14

Some of Fabricant’s arguments address why one cannot expect, overall, a big contribution to wartime output growth from productivity advance. Many of the retardative forces, such as disruptions to production from erratic inventory control, would in principle disappear with the cessation of hostilities, with no

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permanent ill effects. But other factors help explain why war imposed a persisting
cost in terms of the trajectory of long-term productivity advance. Technical,
scientific, and managerial energies were diverted from commercial pursuits
towards the war effort. There was invention and learning by doing as a result, but
not all of it was relevant when peace returned. And there was an opportunity cost.
When scientists and engineers devote their time to building atomic bombs and
businessmen are preoccupied with learning new administrative rules, and when
success is measured by one’s ability to produce large quantities of ordnance
quickly in an environment of cost plus contracts, it is scarcely surprising that the
overall rate of commercially relevant innovative activity slows down.

Table 1 reports the rates of total factor and labour productivity growth before,
during, and after the period of war mobilization and demobilization, calculated
from the conventional data. The choice of 1941 as a breakpoint is critical, and
some discussion is warranted, since Kendrick and others who followed his
example used 1937. A local peak occurred in 1937 (when unemployment was
still 14.3 per cent), whereas in 1941 unemployment averaged less than 10 per cent
for the first time in a decade, and it is as close as we can get to a fully employed
peacetime economy before significant effects of war mobilization are experienced.
But while 1941 is far preferable to 1937, it is still not ideal, because unemployment
was higher (9.9 per cent) than it was in 1929 (3.2 per cent) or 1948 (3.8 per
cent). In any particular historical circumstance, productivity levels for an
economy operating below capacity might be higher or lower if the economy were
to operate at full employment. Theory can provide a rationale for a cyclical
adjustment in either direction. Discussion of what kind of an adjustment one
might make for the remaining cyclical effect, and how large it should be, can be
found in the penultimate section of this paper.

For the moment, the contrast between 2.31 per cent per year (1929–41) and
1.29 per cent per year (1941–8) is quite enough to motivate this article. We begin with
the striking observation that high TFP growth during the Depression years meant,
according to these numbers, that achieved productivity levels in 1941 were more
than 30 per cent higher than in 1929. Because of the absence of capital deepening
over this period, this was true for both labour productivity and TFP. Readers may

Table 1. Compound annual growth of total factor
and labour productivity, United States, 1919–2000

<table>
<thead>
<tr>
<th>Period</th>
<th>TFP</th>
<th>Output/hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1919–29</td>
<td>2.02</td>
<td>2.27</td>
</tr>
<tr>
<td>1929–41</td>
<td>2.31</td>
<td>2.35</td>
</tr>
<tr>
<td>1941–8</td>
<td>1.29</td>
<td>1.71</td>
</tr>
<tr>
<td>1948–73</td>
<td>1.90</td>
<td>2.88</td>
</tr>
<tr>
<td>1973–89</td>
<td>0.34</td>
<td>1.34</td>
</tr>
<tr>
<td>1989–2000</td>
<td>0.78</td>
<td>1.92</td>
</tr>
</tbody>
</table>

Notes: See also Field, ‘Most technologically progressive decade’, p. 1404. Data
are for the private non-farm economy.

15 Kendrick, Productivity trends.
16 For further discussion, see Field, ‘Most technologically progressive decade’; idem, ‘Technological change’.
have the impression that with Lend Lease and other expenditures in anticipation of war, the US was already on something like a full-scale war footing by the time of Pearl Harbor. If this were true, and if one were an ‘optimist’ about the effects of war on productivity, one might argue that some of the productivity levels in 1941 were attributable to the defence build-up that had already been underway for two years.

It is important to appreciate how small a share of total war spending had actually taken place at the time Pearl Harbor was attacked. The US departments of the Army and Navy spent $1.8 billion on military manpower, structures, equipment, and other ordnance in 1940, and $6.3 billion in 1941 (table 2, column 2; these figures exclude veterans’ benefits). If one wanted to emphasize the extent of the build-up in 1941, one could say that spending had more than tripled compared to the previous year. But this is clearly dwarfed by what followed. Combined army and navy spending in 1940 and 1941 represented just 3.2 per cent of the 1940–6 cumulative total.\textsuperscript{17} Adjusting for price changes makes virtually no difference in these calculations. Column 1 of table 2 reports the price index for national defence expenditures, rescaled so that 1940 = 100. This index rises 6.7 per cent in 1941, but then trends slightly downward, presumably reflecting some learning by doing and productivity improvement in the production of ordnance. The combined share of 1940 and 1941 spending in real terms (column 3) is still just 3.2 per cent of the cumulative 1940–6 total.\textsuperscript{18}

\begin{table}[h]
\centering
\caption{US military spending, nominal and real, 1940–6 (billion dollars)}
\begin{tabular}{cccccc}
\hline
& \multicolumn{2}{c}{Price index} & \multicolumn{2}{c}{Army and navy} & \multicolumn{2}{c}{All national defence} \\
\hline
& National defence & Nominal & Real & Nominal & Real & \\
1940 & 100.0 & 1.8 & 1.8 & 2.5 & 2.5 & \\
1941 & 106.7 & 6.3 & 5.9 & 14.3 & 13.4 & \\
1942 & 104.4 & 22.9 & 21.9 & 51.1 & 48.9 & \\
1943 & 105.5 & 63.4 & 60.1 & 84.2 & 79.8 & \\
1944 & 103.8 & 76.0 & 73.2 & 94.5 & 91.0 & \\
1945 & 104.5 & 80.5 & 77.0 & 82.0 & 78.5 & \\
Total & 250.9 & 240.0 & 328.6 & 314.2 & \\
\hline
\end{tabular}
\end{table}


\textsuperscript{17} Data for the Lend Lease programme itself show a similar pattern. The legislation was passed on 11 March 1941, and shipments did take place prior to Pearl Harbor; their rate of growth starting from a base of zero was, of course, astronomical. But 1941 shipments comprised only about 3.2\% of the cumulative total for the programme between 1941 and 1945; more than 96\% occurred after 1941 (see US Bureau of the Budget, \textit{United States at war}, chart 49, p. 412).

\textsuperscript{18} Although many of the institutional foundations for war and postwar military procurement were established between May 1940 and the declaration of war in Dec. 1941 (ibid.; Higgs, ‘Private profit, public risk’), the actual impact of government regulation and control on the economy was relatively minor prior to 1942. Effective control of retail prices, for example, did not begin until the General Maximum Price Regulation of May 1942 (Harris, \textit{Price and related controls}, p. 9).
The picture is slightly modified if one considers a broader measure of spending on national defence, including Lend Lease, and spending by the Defense Plant Corporation, a subsidiary of the Depression-era Reconstruction Finance Corporation. By this measure, a total of about 5 per cent of cumulative 1940–5 military spending had taken place prior to Pearl Harbor (table 2, columns 4 and 5).

Like total military spending, and not coincidentally, the average number of US military personnel also more than tripled, comparing the calendar year 1941 with 1940. But one needs to appreciate both how almost completely demilitarized the US economy had been during the Depression, and how much mobilization was still to come. Figure 1 makes this point vividly. The increase in military personnel in 1941 looks large in comparison with 1940, but is dwarfed by what followed. And the 1.8 million average military personnel in 1941 seems trivially small in comparison with the armed forces of Germany, Japan, and Italy, each of which already had more than 7 million men in uniform, including reserves, at the beginning of 1940.19

Figure 1. Military personnel and pay, 1936–50

19 Nelson, Arsenal of democracy, p. 30.
The pattern observed in military manpower is also evident in the time series for US military aircraft production (figure 2). Output of 19,455 planes in 1941 was more than three times the 6,028 produced in 1940, but barely a fifth of peak (1944) production of 95,272.

This pattern is even more pronounced for ship production (table 3), in part because of the country’s urgent need after 1941 to make good on the losses suffered at Pearl Harbor. Starting from low levels, production of combatant ships peaked in 1943, at more than 17 times 1941 levels. The surge in production of landing craft in 1944, however, pushes the peak in total ships produced to that year.

Finally, a consideration of the division of industrial production between war and non-war activity is necessary (figure 3). This chart, which is based on indexes compiled by the Federal Reserve Board, shows that in 1941 military production accounted for less than a fifth of the total, and civilian industrial
production was still increasing. In 1942, 1943, and 1944, on the other hand, civilian production declined and military production accounted for more than half of the total.  

Federal Reserve Board industrial production data (figure 4) also show that the wartime expansion of industrial production was almost exclusively a durable goods phenomenon. These data show industrial production, both total and war-related, peaking in 1943. Total industrial production peaked in October, when manufac-

Figure 3.  *Industrial production, United States, 1939–45*  

Figure 4.  *Industrial production indexes, 1935–51*  

turing accounted for a larger share of US value added than it ever had before or ever would again, and fell precipitously after February 1945.21

Individually, and in the aggregate, these data show that although the US may have been ‘gearing up for war’ prior to 1942, it was doing so from a very low base, and what had been accomplished by the end of 1941 was small compared to what would come subsequently. Achieved levels of production, total factor productivity, and output per hour in 1941 cannot have had much to do with learning by doing from military production or spillovers from military R & D.

III

The next section of the paper takes a broader look at the effects of mobilization and demobilization on the economy, in particular on its manpower requirements.22 In tables 4 and 5, the major sectors of the economy have been divided into those acquiring and those releasing workers between 1941 and 1943 (table 4) and between 1943 and 1948 (table 5). Although total military spending and military manpower continued to rise in 1944, 1943 represented the peak of industrial production and economic mobilization per se (see figure 4). For the sake of consistency, I have used it as the breakpoint for the analysis of both governmental and non-governmental employment.

In the case of non-governmental employment, we find the following major sectors releasing workers between 1941 and 1943: the motor vehicle industry, construction, wholesale trade, agriculture, and retail trade. Together, these five sectors account for 1.026 million of the total 1.580 million full-time equivalents (FTEs) contributed by releasing sectors over this two-year period.

It is possible to identify six major sectors acquiring workers, of which the largest by far is other transport equipment. This sector, which was producing the ships and planes already discussed, as well as a variety of other vehicles, acquired over a two-year period a mind-boggling 2.6 million FTEs, a 384 per cent increase over its 1941 employment of 675 thousand FTEs. The second biggest acquirer of labour was iron and steel and their products, including ordnance, followed by non-electric machinery, electric machinery, chemicals, and railroad transportation. Together these six sectors accounted for 88 per cent of the total increase of 5.302 million FTEs in the acquiring sectors.

It is striking that the sectors acquiring labour were so narrowly concentrated. Other transport equipment accounted for 49 per cent of the increase in FTEs in acquiring sectors. Adding in iron and steel products, including ordnance, takes the total to 64 per cent. In contrast, the two largest releasing sectors (motor vehicles and construction) accounted for barely 34 per cent of the total FTEs contributed by releasing sectors. FTE acquisitions were therefore much more highly concentrated than FTE releasers. Economic mobilization for war was very far from a balanced, across the board expansion of the economy.

21 Corroborative evidence for a peak in industrial production in late 1943 comes from data from the War Production Board, which show production of munitions alone peaking in the fourth quarter of 1943. Production of aluminum, magnesium, zinc, and chemicals all peaked in 1943, as did new merchant marine tonnage (US Bureau of the Budget, United States at war, chart 15, p. 137; chart 38, p. 300; chart 41, p. 319).

22 A somewhat analogous treatment of the disruptive effects of the war on capital accumulation (investment flows) can be found in Higgs, ‘Wartime socialization’.

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This methodology does not capture flows within sectors. For example, automobile production effectively ceased in February 1942, and workers remaining in the motor vehicles industry were producing military vehicles such as jeeps and trucks.

Turning now to the government sector, between 1941 and 1943, 1.317 million were released from work relief and 132,000 from state and local government employment. Between 1941 and 1943, the US military acquired 7.349 million FTEs and federal civilian employment another 1.553 million. Finally, government enterprises acquired 74,000.

Overall, adding the non-government sector net acquisition of 3.722 million and the government sector net acquisition of 7.527 million, there was a net inflow from the ranks of the unemployed or those not in the labour force of 11.249 million. Taken together, mobilization led to a rapid expansion of the economy, but one which represented a very sharp distortion of the ‘normal’ channels of such an expansion.

Although non-government FTEs peaked in 1943, total FTEs peaked in 1944 at 54.982 million (1.3 million above the 1943 total), largely because of an additional increment of 2.3 million military FTEs, which counterbalanced the declines.

---

**Table 4. Labour acquirers and labour releasers, United States, 1941–3**

<table>
<thead>
<tr>
<th>Non-government</th>
<th>(Full-time equivalents, thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour releasers:</td>
<td>FTEs acquired</td>
</tr>
<tr>
<td>Motor vehicles and equipment</td>
<td>(330)</td>
</tr>
<tr>
<td>Contract construction</td>
<td>(208)</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>(200)</td>
</tr>
<tr>
<td>Farms</td>
<td>(179)</td>
</tr>
<tr>
<td>Retail trade</td>
<td>(109)</td>
</tr>
<tr>
<td>Sum, above 5 sectors</td>
<td>(1,026)</td>
</tr>
<tr>
<td>Total labour releasers</td>
<td>(1,580)</td>
</tr>
<tr>
<td>Labour acquirers:</td>
<td></td>
</tr>
<tr>
<td>Other transportation equipment</td>
<td>2,596</td>
</tr>
<tr>
<td>Iron, steel, and their products, incl. ordnance</td>
<td>819</td>
</tr>
<tr>
<td>Machinery, except electrical</td>
<td>370</td>
</tr>
<tr>
<td>Electric and electronic equipment</td>
<td>353</td>
</tr>
<tr>
<td>Chemicals and allied products</td>
<td>269</td>
</tr>
<tr>
<td>Railroad transportation</td>
<td>249</td>
</tr>
<tr>
<td>Sum, above 6 sectors</td>
<td>4,656</td>
</tr>
<tr>
<td>Total labour acquirers</td>
<td>5,302</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Government</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour releasers:</td>
<td></td>
</tr>
<tr>
<td>Work relief</td>
<td>(1,317)</td>
</tr>
<tr>
<td>State and local</td>
<td>(132)</td>
</tr>
<tr>
<td>Labour acquirers:</td>
<td></td>
</tr>
<tr>
<td>Military</td>
<td>7,349</td>
</tr>
<tr>
<td>Federal civilian (not work relief)</td>
<td>1,553</td>
</tr>
<tr>
<td>Government enterprises</td>
<td>74</td>
</tr>
</tbody>
</table>

**SUMMARY**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-government net acquired</td>
<td>3,722</td>
</tr>
<tr>
<td>Government net acquired</td>
<td>7,527</td>
</tr>
<tr>
<td>TOTAL: Inflows from unemployed, NILF</td>
<td>11,249</td>
</tr>
</tbody>
</table>

*Note: NILF = not in labour force*

*Source: US Bureau of Economic Analysis, National income, tab. 6.7a, p. 275.*
beginning elsewhere. Military equipment had to be produced before it could be used. By the time of D-Day, the military goods production machine had already begun to wind down.

In the short span of two years, between 1941 and 1943, the US automobile industry shut down and reconverted to defence production. Non-defence construction largely ground to a halt, as military and naval construction soared. People streamed out of farms and wholesale and retail trade into defence factories and the military, and they were joined by hundreds of thousands, indeed millions more from the ranks of the unemployed and those not in the labour force. Billions of dollars were spent by the Defense Plant Corporation to build government-owned, privately operated plants and equip them with machine tools to jump-start the airframe and shipbuilding industries, produce aviation fuel and synthetic rubber, and aluminium. Then, before the economy could catch its breath, most of the ordnance was expended, the war was won, and full-scale demobilization was underway.

Table 5 uses the same methodology to study demobilization from 1943 to 1948. What we see here is a rough reversal of the trends associated with mobilization.

<table>
<thead>
<tr>
<th>Non-government</th>
<th>(Full-time equivalents, thousands)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour acquirers:</td>
<td>FTEs acquired</td>
</tr>
<tr>
<td>Retail trade</td>
<td>1,511</td>
</tr>
<tr>
<td>Services</td>
<td>756</td>
</tr>
<tr>
<td>Contract construction</td>
<td>712</td>
</tr>
<tr>
<td>Wholesale trade</td>
<td>676</td>
</tr>
<tr>
<td>Motor vehicles and equipment</td>
<td>441</td>
</tr>
<tr>
<td>Finance, insurance, and real estate</td>
<td>281</td>
</tr>
<tr>
<td>Telephone and telegraph</td>
<td>202</td>
</tr>
<tr>
<td>Total acquired</td>
<td>6,099</td>
</tr>
<tr>
<td>Labour releasers:</td>
<td></td>
</tr>
<tr>
<td>Other transportation equipment</td>
<td>(2,800)</td>
</tr>
<tr>
<td>Iron, steel, and their products, incl. ordnance</td>
<td>(588)</td>
</tr>
<tr>
<td>Chemicals and allied products</td>
<td>(126)</td>
</tr>
<tr>
<td>Electric and electronic equipment</td>
<td>(73)</td>
</tr>
<tr>
<td>Agriculture, forestry, and fisheries</td>
<td>(56)</td>
</tr>
<tr>
<td>Non-ferrous metals and their products</td>
<td>(32)</td>
</tr>
<tr>
<td>Railroad transportation</td>
<td>(31)</td>
</tr>
<tr>
<td>Total released</td>
<td>(3,709)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour acquirers:</td>
</tr>
<tr>
<td>State and local</td>
</tr>
<tr>
<td>Labour releasers:</td>
</tr>
<tr>
<td>Federal civilian (not work relief)</td>
</tr>
<tr>
<td>Government enterprises</td>
</tr>
<tr>
<td>Work relief</td>
</tr>
<tr>
<td>Military</td>
</tr>
<tr>
<td>Government net release</td>
</tr>
<tr>
<td>Non-government net acquire</td>
</tr>
<tr>
<td>TOTAL: Outflows to unemployed, NILF</td>
</tr>
</tbody>
</table>

Source: See tab. 4.
The two biggest acquirers of labour during mobilization, other transport equipment, and iron and steel and their products, including ordnance, were the two biggest releasers during demobilization, and the FTEs released by these two sectors (3.388 million) were almost exactly equivalent to those acquired during mobilization (3.415 million). Symmetrically, the biggest acquirers of labour during demobilization were largely the sectors that had released the most during mobilization, in particular motor vehicles, retail and wholesale trade, and construction. Another big acquirer was finance, insurance, and real estate. Home building and non-residential private construction as well as other forms of physical capital accumulation revived in the postwar period, finally surpassing 1929 rates after two decades in which investment had been depressed (the Depression years) or largely government-controlled (the war years). Employment in intermediation and brokering correspondingly increased. Agriculture, on the other hand, continued to lose FTEs, reflecting a long-term secular trend.

The analysis understates the impact of demobilization in the government sector, as government FTEs peaked in 1944. The military added an additional 2.336 million FTEs between 1943 and 1944, although other components of government FTEs were largely unchanged. Federal civilian FTEs went up 23,000, government enterprises went down 26,000, state and local lost another 79,000, and the remaining 47,000 on work relief left this category. The huge increase in the military would make the outflows from government larger in an analysis based on a 1944–8 transition.

The standard expenditure data (figure 5), expressed as proportions of gross national product, show that during the war rising proportions of government spending crowded out domestic private investment, net exports, and consumption (the current account went into deficit largely because of unilateral transfers, including Lend Lease). These numbers do show the absolute value of consumption rising in real terms throughout the war, except in 1942, although Higgs has argued that this is misleading because the price deflators used do not correctly measure the increasing real costs of goods in the context of rationing or simple unavailability. In other words, he would have the series for real personal consumption spending dip substantially during the war years before reviving.

Although the question of how much real consumption rose or dropped during the war is still contested, there is little dispute that government spending increased and that private investment in the country declined, not just as shares of GDP, but in absolute terms. There were also significant changes in the composition of public investment. Figures 6 and 7 show trends in public and private construction expenditures. Private residential construction spending is deflated by the residential structures index. All of the other series, both private and public, are deflated by the index for private non-residential structures. The indexes are rescaled so that 1929 = 100, and consequently for that date, real equals nominal.

Several conclusions are apparent from these figures. First, residential construction, the sick child of the US economy throughout much of the Depression, had by 1941 laboriously climbed back to within striking distance of its 1929 level. The

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23 Higgs, 'Wartime prosperity?'; idem, 'Regime uncertainty'; idem, 'Central planning'.
24 See Rockoff, 'Ploughshares to swords'; Edelstein, 'War and the American economy', p. 400.
25 See Field, 'Uncontrolled land development'.
war took the steam out of this forward movement, and by 1944, private housing construction was at an even lower level than it had been during the depths of the Depression in 1933. It was not until 1948 that residential construction surpassed its 1929 rate. Non-residential private construction was also depressed during the war, driven almost to the vanishing point in 1943. Other private construction, largely public utilities, was less dramatically affected by the war, principally because energy, especially electric power, was critical to the war effort.

If we look at public construction, we are first struck by the 1942 peak in military and naval construction and other public non-residential building. Mobilization for war can be thought of as consisting of three waves, each cresting respectively in the years 1942, 1943, and 1944: 1942 saw massive military construction, 1943 the peak in military industrial production, and 1944 the peak in military FTEs. Build the production facilities, produce the ordnance, and then let the military use it.

A second point to note, which I have stressed in earlier work, is the high rate of street and highway construction during the Depression years. This spending remained close to or above 1929 levels through 1941, creating a modern surface road infrastructure that was essentially complete by the outbreak of the war. War spending crowded out highway construction during the war, and this spending

**Figure 5. Changing shares in national output**

*Source: Council of Economic Advisors, Economic report, p. 56.*

came back more slowly than housing production immediately after the war. The public infrastructure spending of the 1930s had already begun to generate spillovers in transportation, distribution, and housing before the war. It continued to do so afterwards; thus the case that it was a combination of product and process innovation during the Depression, and Depression era infrastructure building, far more than the war, that was responsible for 1948 productivity levels.

Figure 7 also shows the impact of bridge, dam, tunnel, and other non-highway public infrastructure spending during the Depression. This too was crowded out during the war years, although the magnitude of the drop was lower, partly because recovery had been less dramatic.

IV

The purpose of this penultimate section is to consider a cyclical adjustment for 1941 productivity, and an adjustment to 1948 productivity based on inadequate accounting for government-owned, privately operated capital sold to the private sector after the war, and how such adjustments might affect the relative magnitude of productivity growth during the period of mobilization and demobilization.

The standard in measuring productivity change over time is, if possible, to calculate from peak to peak, in order to control for cyclical confounds. The year 1941, with its 9.9 per cent unemployment, is not ideal in this respect. The question

26 The evidence for this can be found in the very high rates of TFP growth in trucking and railroads, and to a lesser extent in wholesale and retail distribution (Field, ‘Technological change’). The build out of the surface road network created substantial spillover effects in both trucking and railroads. Trucking successfully substituted for rails for certain routes and commodities. But the two modes were also highly complementary, and the flexibility of trucking contributed to improved productivity in the railroad sector even in the presence of capital shallowing. One important mechanism was the smoothing of seasonal fluctuations in the demand for freight cars (see Field, ‘Origins’).
is whether productivity levels in 1941 would have been higher or lower had the economy been at full employment, and if so, by how much. Traditional economic models with constant returns to scale suggest that productivity should move counter-cyclically. The argument is that labour experiences diminishing returns as increasing doses are applied to a capital stock largely fixed in the short run. Correspondingly, when unemployment rates fall, so do capital labour ratios and, along with them, productivity levels.

The data, on balance, have not been kind to this hypothesis, in the sense that productivity, especially TFP, has tended to move with, rather than against, the cycle. This history, in turn, has led theorists to search for explanations of procyclicality. The most widely cited factor is labour hoarding, but it seems unlikely that this could have played an important role over a 12-year period, experiencing first a severe drop in employment and then a recovery of similar magnitude (hours for the private non-farm economy were essentially the same in 1941 as they had been in 1929). Other mechanisms, however, could account for procyclicality. These include network externalities and, in general, any factors that might conduce to short-run increasing returns to scale. Such conditions would be particularly prevalent where innovation and investment in infrastructure were important contributors to higher TFP.

The Depression years, in fact, were a period which evidenced strongly procyclical productivity, as figure 8 clearly shows. Table 6 provides the underlying data. The first column shows Kendrick’s index of total factor productivity for the private non-farm economy. Column 2 shows the continuously compounded rate of change in that index from one year to the next, column 3 the national civilian unemployment rate from Lebergott, and column 4 the change in percentage points in that rate.

Figure 7.  *Real public construction expenditures, 1929–50*

Sources: See fig. 6.
If we regress the change in TFP ($\Delta TFP$) on the change in the unemployment rate ($\Delta UR$), we get the following results:

$$\Delta TFP = 0.0283 - 0.0092 \times \Delta UR$$

$$R^2 = 0.647 \quad (3.02) \quad (-4.28)$$

(t statistics in parentheses; data are for 1929–41; n = 12)

The intercept term can be interpreted as showing that TFP had a trend growth rate of approximately 2.83 per cent per year over this 12-year period. The
coefficient on ΔUR suggests that every percentage point decrease in the unem-
ployment rate raised TFP growth by about 0.92 per cent, or close to a percentage
point, with every percentage point increase in the unemployment rate doing the
opposite. We can use this equation for two closely related exercises; first, to make
a cyclical adjustment to the 1941 productivity level, and second, to imagine what
one more year of peacetime growth and declining unemployment would have
meant for productivity in the US.

If one is a war productivity optimist, one thinks of 1948 as the first year in which
a demobilized peacetime economy benefited from all the new production knowl-
edge generated during the war, and this influences one’s interpretation of its
achieved productivity level. A better way to think of 1948, in my view, is that it is
1941 with full employment. The major new consumer product, television, had had
all of its development work done before the war, and had been rolled out to the
public at the New York World’s Fair in 1939, but had its commercial exploitation
delayed until after the war. One can tell a similar story about nylon, over which
women went wild when it was first introduced in 1939, before the war diverted its
use from stocking to parachute production and made it a scarce civilian commod-
ity. The 1948 surface transport infrastructure, which underlay productivity levels
in distribution, transportation, and housing, had been almost entirely completed
before 1942.

All of this suggests that if we imagine a world without the disruptions of the war,
with the economy continuing a rapid progression towards full employment in
1942, productivity levels in 1942 could well have approached those achieved in
1948. In a closely related exercise, we can ask what productivity levels would have
been in 1941 had unemployment been at 1948 levels (3.8 per cent).

Unemployment in 1948 was 6.1 percentage points lower than it had been in
1941. Using the estimated coefficient from the above regression, we can predict
that had unemployment in 1941 been as low as it was in 1948, TFP would
have been 5.61 per cent higher than it was (−0.0092 * −6.1 = 0.0561). TFP in 1948,
measured using natural logs, was 9 per cent higher than in 1941. So close to
two-thirds of the productivity gap between 1941 and 1948 would be eliminated if
we make a cyclical adjustment to the 1941 data.

Any positive cyclical adjustment to measured 1941 productivity to account for
the fact that the economy had not yet reached capacity would raise the estimated
TFP growth rate between 1929 and 1941, and lower it between 1941 and 1948.
Kendrick’s TFP index for the private non-farm economy stands at 132.0 for 1941.
If we make the 5.61 per cent adjustment implied by the above analysis, this creates
a cyclically adjusted 1941 level of 139.6. The level for 1948 is 144.5, implying
less than 0.5 per cent growth (0.49 per cent per year) between 1941 and 1948,
as compared with 2.78 per cent per year between 1929 and 1941.\textsuperscript{28} Table 7 revises
the numbers reported in table 1 to include rates of growth based on a cyclically
adjusted productivity level for 1941. It is notable, and quite remarkable, that the
calculated growth in output per hour between 1929 and 1941 is just short of that
registered during the golden age (1948–73), even in the complete absence of any

\textsuperscript{28} The 2.78% compound annual growth resulting from this exercise is very close to the 2.83% implied by the
intercept term on the regression using 1929–41 data.
private sector capital deepening during the earlier period. The revised numbers, including growth rates for output per hour, are in bold.

The 1941–8 growth rate would be further reduced were we to make an adjustment to 1948 TFP for the value of formerly GOPO (government-owned, privately operated) capital, much of which was already in the hands of the private sector by 1948 (the major exception being synthetic rubber, which was not completely de-accessioned until 1955). Gordon has argued that this capital was often sold off in sweetheart deals, and that its value has not been adequately included in the standard capital stock measures. If the capital stock input should be higher for 1948, the level of TFP in that year would have to be lower, and so, by definition, would its rate of growth between 1941 and 1948. It would not take a large nod in Gordon’s direction on this account to reach a cyclically adjusted rate of growth of TFP of close to 0 for the private non-farm economy between 1941 and 1948.

We can also ask, counterfactually, what might have happened had the Japanese attack been delayed for 12 months. Due to the disruptions associated with conversion and war mobilization, TFP in actuality grew hardly at all between 1941 and 1942 (132.5 from 132). But suppose the economy had experienced one more year of peacetime growth in which the economy benefited from the 1929–41 trend growth rate in TFP and the unemployment rate fell to 1948 levels. The regression results suggest that in this case, 1948 productivity levels would have been approached in 1942. This conjecture is based on adding the 2.83 intercept term from the equation, for one year of additional growth based on the peacetime trend growth rate, to the 5.61 per cent cyclical adjustment, the predicted increase in TFP from a drop in the unemployment rate of 6.1 percentage points. Adding these two terms leads to a predicted level of TFP in 1942 that is 8.4 per cent higher than 1941, just shy of the measured 1948 level.

Table 7. Compound annual growth of total factor and labour productivity, United States, 1919–2000, with cyclical adjustment for 1941

<table>
<thead>
<tr>
<th></th>
<th>TFP</th>
<th>Output/hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1919–29</td>
<td>2.02</td>
<td>2.27</td>
</tr>
<tr>
<td>1929–41</td>
<td>2.78</td>
<td>2.83</td>
</tr>
<tr>
<td>1941–8</td>
<td>0.49</td>
<td>0.91</td>
</tr>
<tr>
<td>1948–73</td>
<td>1.90</td>
<td>2.88</td>
</tr>
<tr>
<td>1973–89</td>
<td>0.34</td>
<td>1.34</td>
</tr>
<tr>
<td>1989–2000</td>
<td>0.78</td>
<td>1.92</td>
</tr>
</tbody>
</table>

Sources: See tab. 1 and text. Data are for the private non-farm economy. The bold numbers have changed relative to tab. 1 as a result of the cyclical correction for 1941.

30 On the other hand, the physical capital stock was used intensively during the war, and the depreciation allowances applied by government statisticians may not account adequately for the effects of wear and tear and deferred maintenance. This consideration could counterbalance an underestimate of the value of GOPO capital transferred to the private sector. See Higgs, ‘Wartime socialization’, pp. 515–17.
31 Although there is no way of knowing if peacetime advance would have continued at the same rate throughout the 1940s in the absence of the war, had TFP advance between 1941 and 1948 persisted at the rate of 2.78% per year rather than 0.49%, TFP in 1948 would have been 17.4% higher than it actually was.
On average, there were 5.560 million unemployed in 1941. Had the unemployment rate been at its 1948 level of 3.8 per cent, with higher employment in construction, motor vehicles, other manufacturing sectors, wholesale and retail trade, and finance, insurance, and real estate, roughly 3.547 million of them would have been at work. Unemployment was falling rapidly during 1941. In the fourth quarter, it was down to an average of 3.4 million, with a civilian labour force of 53.9 million, yielding an unemployment rate of 6.3 per cent.32

Had trends persisted in the absence of war, employment, TFP, and labour productivity would probably all have been higher in 1942. As figure 6 shows, housing construction was robust and growing in 1939, 1940, and 1941, and when the postwar housing boom emerged with full force in 1948, it took off from where it had been arrested in 1941. As the failure of residential construction to revive fully was one of the major contributors to the persistence of low private investment spending during the Depression, its signs of revival in the years immediately preceding the war suggest that had peace continued, investment, output, and employment growth would have continued as the economy re-approached capacity.

From this analysis, it can be concluded that the 1.29 per cent per year growth in TFP between 1941 and 1948 calculated from the standard data, a rate of growth already much lower than that recorded between 1929 and 1941, overstates productivity advance across the period of mobilization and demobilization. Both of the adjustments discussed strengthen the relative importance of productivity advance between 1929 and 1941, and weaken its probable magnitude between 1941 and 1948.

V

By 1948, the US economy had demobilized, the civilian economy was booming, and unemployment stood at the low peacetime rate of 3.8 per cent. Housing and private non-residential building had finally risen above their 1929 levels, as had automobile production. Between 1941 and 1948, TFP in the private non-farm economy, according to the standard measures, grew at a compound annual rate of 1.29 per cent of year, respectable in comparison with 1973–89, but far below the rapid advance before (1929–41) or after (1948–73). As the previous section suggests, the underlying rate of advance between 1941 and 1948 reflected in these numbers is probably overstated.

We come back to the question posed at the start of this essay. How much of the achieved productivity level of the 1948 civilian economy should reasonably be attributed to the war? The two main components of the ‘war stimulates productivity growth’ thesis involve learning by doing in military production and spin-offs from military research and development.

Much attention has been paid to the success stories in producing ships and airframes. There are several reasons, however, why one should be sceptical that this had much to do with how the economy performed in 1948. First, as Fabricant noted, the initial productivity levels immediately following conversion to military production were often low.33 Some of what one is seeing is improvement from this

33 US Bureau of the Budget, United States at war, p. 433.
base. Second, much of the success here involved the application to these military goods of mass production methods that had been pioneered in the 1920s and the 1930s in the civilian economy. In other words, organizational and technical advances prior to 1942 probably made a greater contribution to the success of economic mobilization than the latter made to postwar productivity levels. Even on the technical (as opposed to production) side, it is notable that there was not a single combat aircraft seeing major service produced during the Second World War that was not already on the drawing boards before it began.34

Finally, and most importantly, whatever commodity-specific learning by doing may have taken place between 1942 and VJ day in 1945 was largely irrelevant by 1948 because most of it applied to the other transport equipment sector, and that sector, having practically quadrupled in size between 1941 and 1943 (based on FTEs), was smaller in 1948 than it had been in 1941. Few of the ships and aircraft about which so much has been written (Liberty Ships or B-29s, for example)35 were produced after the war. Even those for which the production of civilian counterparts continued, such as the C-47/DC-3, had much smaller postwar production runs. Other dual use vehicles, such as trucks, had fewer units produced annually between 1942 and 1945 than had been the case in 1941 or even 1937.36 Here again, it is much more likely that success in producing these vehicles in volume derived from pre-war experience in civilian manufacturing, as opposed to the war contributing dramatically to postwar capabilities.

Where learning by doing took place in war industries, it involved innovations in workplace organization, materials flow, sequencing of tasks, and the acquisition of job- and product-specific human capital. Because of the shrinkage of the other transport goods sector and the disappearance of many of the wartime products from the postwar output mix, little of this learning would have had much influence on 1948 productivity levels.37

The second component of the thesis emphasizes spillovers from military research and development. Items often referenced include microwaves, advances in electronics benefiting the computing industry, atomic power, and techniques for mass-producing penicillin. Unlike learning by doing producing Sherman tanks, the penicillin experience clearly had more peacetime applicability, as did improved techniques learned on the battlefield for treating trauma. But with computers, microwaves, and atomic power, and many of the other putative spillover candidates, one has to ask how much the war accelerated a scientific and technological trajectory that was proceeding very well prior to it.

The scientific and engineering community, in cooperation with government officials, managers, and workers had, by all accounts, and based on our experience with war mobilization, done a superb job in helping to expand the potential output of the economy between 1929 and 1941. This community was then asked to drop much of what it was doing and focus on challenges central to the war effort. In the process, some discoveries and learning useful for civilian production took place.

34 'In World War II, no combat plane that had not been substantially designed before the outbreak of hostilities saw major service' (Galbraith, New industrial state, p. 18).
35 See Searle, 'Productivity'; or Alchian, 'Reliability', for detailed discussion.
37 Even with respect to general human capital formation, one must keep in mind that many of the war production workers, particularly women, left the labour force after the war.

But these were incidental to the war effort, and entailed opportunity costs in the form of disruptions to the trajectory of technical advance in the civilian economy. On balance, it is unlikely that the stock of economically relevant knowledge (both technical knowledge and production knowledge) was higher compared to what it would have been in the absence of war.

Employment of scientists and engineers in US manufacturing increased 74 per cent between 1927 and 1933, and then almost tripled between 1933 and 1940. Growing at a compound rate of 13.3 per cent per year, the number of scientists and engineers in US manufacturing increased from 10,918 to 27,777 over that seven-year period. The rate of increase between 1940 and 1946 slowed to 8.4 per cent per year, and both Schmookler and Mensch, in their enumerations of basic innovations, record sharp declines following the peak in the five-year period 1935–9. 38

There continues to be a popular perception that war is beneficial to an economy, particularly if it does not lead to much physical damage to the country prosecuting it. The US experience during the Second World War is the typical poster child for this point of view. The effect of detailed research into the effects of armed conflict, however, has usually been to produce more nuanced interpretations. For example, an earlier tradition saw the US Civil War as a tremendous stimulus to the northern US economy, whereas more systematic quantitative inquiry has led to an emphasis on its retardative effects on growth. 39 In that spirit, the research reported on in this paper represents a revisionist approach to the analysis of the Second World War, although one which is not entirely unanticipated. 40 As we become more comfortable in thinking of the latter half of the twentieth century as an appropriate venue for economic history research, it will be appropriate to delve more deeply as well into the Cold War’s impact on the growth of potential output in the United States.

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38 Mowery and Rosenberg, ‘Twentieth century’, p. 814; Schmookler, Invention; Mensch, Stalemate.
39 Hacker, Triumph of American capitalism; Goldin and Lewis, ‘Cost of the Civil War’.

Footnote references


