Did War Mobilization Cause Regional Development?

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1 Introduction

Did World War II spur regional development in the United States? The view that it did appears regularly in popular media accounts of what can be learned from this period of history. It is also a feature of the historical narrative that stretches from the post-World War I boom of the 1920s, the economic depression of the 1930s, and then rapid growth from the 1940s to the 1970s. A few of the standard measures of economic performance lend support to this narrative. Alternatively, the reallocation of resources to facilitate mobilization for war imposed costs that could not be recouped.

The tension in these two views regarding the potential benefits of war in spurring aggregate economic growth extends to other areas, including innovation (Gross and Sampat, 2022), business (Bianchi and Giorcelli, 2022), and institutions (Higgs, 2006). There is also an extensive literature on impact of war-related interventions locally. In particular, mobilization could have yielded benefits in the form of increased productivity or improved amenities, respectively, as government spending on supply contracts and new investment exposed workers and firms to new production techniques or residents gained access to better infrastructure.[1] However, costs may have arisen from the process of converting to wartime uses in the early 1940s and reconverting to a peacetime economy after 1945 or the benefits were only fleeting as capital installed and used for war production depreciated to be worth very little (White, 1980).

In this project we revisit the effects of World War II on the growth of US regions. A large literature addresses the regional implications of war mobilization. However, while recent work on the aggregate implications strikes a decidedly pessimistic tone regarding the war's impact covering the periods both during and after the war (e.g., Field, 2022), the assessement of the regional effects is more mixed: Jaworski (2017) and Fishback and Cullen (2013) find little effect in contrast with the positive aspects of the war emphasized by Wright (2017) and Garin and Rothbaum (2022). The goal of this project is to integrate the growing evidence on the link between mobilization for war and postwar aggregate economic performance with the more heterogeneous effects playing out

[1] Thornton and Thompson (2001) and Thompson (2001) consider the pace of learning, capital deepening, and their interaction in the shipbuilding industry during World War II.

across US regions.

As motivation, consider the changes in the average manufacturing wage depicted in Figure 1. Panel A shows the growth in the manufacturing wage by region between 1920 and 1987. In Panel B, the manufacturing wage by region is plotted with counties that did not receive a large plant appearing in gray and counties that did appearing in black. Across all regions, the manufacturing wage shows a clear structural break after 1940. However, the pace of change does not appear to be different across a commonly used World War II intervention. This suggests a need to develop a unified framework that can rationalize the actual time path of economic performance across spatially disaggregated locations, while maintaining the ability to relate the pattern at the local level to aggregate changes.

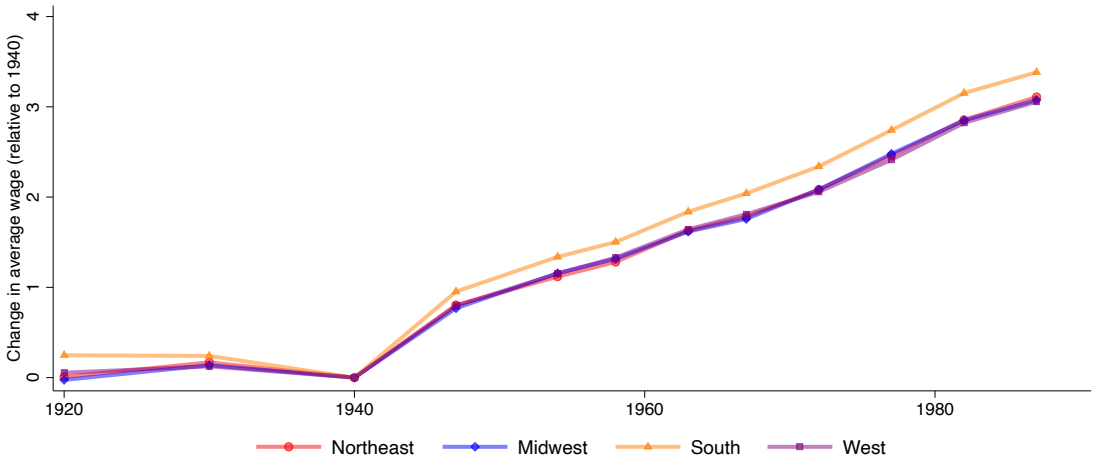
To do this, in Section 2 we sketch a theoretical framework that explicitly allows for dynamics between periods and provides guidance for how integrate one-time interventions at a spatially disaggregated level. This framework captures the potential for change to occur either due to long running factors that shape regional development ("persistence"), shocks that alter the path of local economies (i.e., due to World War II), or both. Then, in Section 3 we present preliminary results for the impact of World War II on productivity. The results partially hint at the source of the tension in the literature: statistical uncertainty around the magnitude of the effects within some regions and variation across regions in the effect of some variables. Section 4 provides an outline of work in progress.

2 Theory

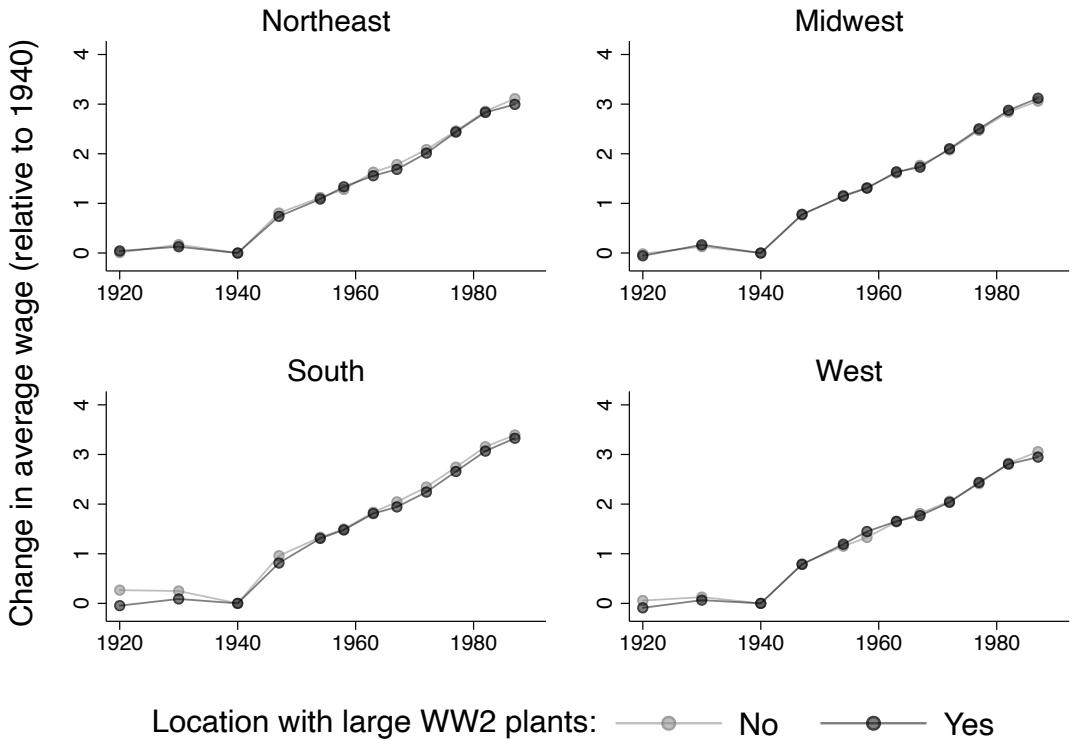
We use a dynamic quantitative model of economic geography that incorporates trade and migration. To do this, we build on the work of Caliendo, Dvorkin, and Parro (2019) and Allen and Donaldson (2022). In addition, to allow for the potential effect of World War II, we follow Rudik, Lyn, Tan, and Ortiz-Bobea (2022), Hollingsworth, Jaworski, Kitchens, and Rudik (2023), and Yang (2023) and model productivity and amenities as a reduced-form function of variables that capture the impact of war mobilization.

Setup. Locations are counties indexed by i and j, and time is indexed by t. At this point, the focus is on a single industry, manufacturing, although this is easily extended to several sectors (including agriculture and services) as well as non-employment. The

Figure 1: Average Wage in Manufacturing, 1920-1987



A. Average Manufacturing Wage by Region



B. Average Manufacturing Wage by World War II Large Plant Status

Notes: The figure shows the change in average wage in manufacturing from 1920 to 1987. Panel A gives the change in average wage each region relative to the region-specific value in 1940. Panel B gives the achange in average wage each region relative to the region-specific value in 1940 by locations with (in black) and without (in gray) a large World War II plant.

geographic fundamentals of the environment include location-specific productivity (A_{it}) and amenities (B_{it}). In addition, trade flows are governed by bilateral iceberg trade costs (τ_{ij}) and migration is subject to migration costs (δ_{ij}).

Preferences. Workers are forward-looking and decide where to live in each time period in order to maximize utility. First, flow utility is given by:

$$U(C_{jt}, B_{jt}) = \log(C_{jt} \times B_{jt})$$

where C_{jt} is composite consumption good and the local amenity can be written as function of exogenous and endogenous factors in the following way:

$$B_{jt} = \bar{B}_{jt} L_{jt}^{\rho_{B1}} L_{jt-1}^{\rho_{B2}} \exp\left(g(W_{jt}; \gamma_B)\right)$$

where ρ_{B1} and ρ_{B2} capture the influence of the current and previous number of local residents on amenities. In particular, these reflect the potential congestion from factors that are in fixed supply (e.g., land or housing). The function $g(\cdot)$ reflects the effect of war-specific investments on amenities (e.g., in hospitals or other services) or disamenities (e.g., more rapid deterioration of infrastructure). This function can take a flexible non-parametric form to capture potential interactions between different types of war-related investment or the differential, non-linear impact of receiving very little or substantial amount of spending.

In each period, workers maximize the sum of current flow utility and the expected present value of future utility with the expectation taken over potential locations.

$$v_{jt} = U(C_{jt}, B_{jt}) + \max_i \left\{ \beta \mathrm{E} v_{jt+1} - \delta_{ij} + \nu \epsilon_{it} \right\}$$

where C_{jt} is equal to real income, w_{jt}/P_{jt}, under the assumption that workers spend all income on consumption. Applying the assumption that idiosyncratic preference shocks, ϵ_{it}, follow a Type I extreme value distribution and taking expections gives a con-

venient expression for the migration share:

$$\mu_{ijt} = \frac{\exp\left(\beta \mathrm{E}(V_{it+1} - \delta_{ij})/\nu\right)}{\sum_{l=1}^{N} \exp\left(\beta \mathrm{E}(V_{lt+1} - \delta_{lj})/\nu\right)}$$

where term V_{it+1} captures the future real wage and value of local amenities, while $1/\nu$ can be interpreted as the migration elasticity. The migration share together with the initial distribution of workers determines the distribution of workers in the next period, i.e., $L_{it+1} = \sum_{i=1}^{N} \mu_{ijt} L_{it}$.

Production. A continuum of representative firms in each location, indexed by ζ, produce output for perfectly competitive markets using a constant returns scale production function and labor, L_{jt}, as the single factor of production.

$$q_{jt}(\zeta) = A_{jt}(\zeta) L_{jt}$$

where – as in the case of amenities – productivity can be written as function of exogenous and endogenous factors in the following way:

$$A_{jt} = z_{jt} L_{jt}^{\rho_{A1}} L_{jt-1}^{\rho_{A2}} \exp\left(f(W_{jt}; \gamma_A)\right)$$

The exogenous component, z_{jt}, is drawn from a Frechet distribution with location parameter Z_{jt} and shape parameter θ. The parameters ρ_{A1} and ρ_{A2} capture the influence of the current and previous employment on productivity via agglomeration-like forces. In particular, the parameter ρ_{A1} reflects contemporaneous agglomeration due to knowledge sharing, input-output linkages, or thick labor markets. A non-zero value for the parameter ρ_{A2} for historical agglomeration indicates persistent effects of employment across time periods. The function $f(\cdot)$ is (again) a flexible way of modelling the potential effects of war-specific investments on productivity.

Assuming cost minimization and applying the properties of the Frechet distribution

for productivity yields an expression for the trade share:

$$\pi_{ijt} = \frac{\left(w_{it}\tau_{ijt}/A_{it}\right)^{-\theta}}{\sum_{k=1}^{N}\left(w_{kt}\tau_{kjt}/A_{kt}\right)^{-\theta}}$$

where θ is interpreted as the trade elasticity. We can also obtain expressions for the location-specific price index (and market access) as well as the spatial distribution of output.

3 Results

Estimation of World War II productivity effect

The data for the estimation and quantitative analysis are drawn from several sources. County-level information on manufacturing is taken from Haines (2010). In particular, we make use of information on manufacturing wages as well as establishments, employment, and value-added from 1920 to 1987. In addition, we collect information on the new plants constructed as part of war mobilization from *War Industrial Facilities* (U.S. Civilian Production Administration, 1946). We use information on all capital investment including both facilities and equipment from *War Manufacturing Facilities* (U.S. War Production Board, 1945).

The estimating equation is derived by combining the gravity equation for trade flows with the expression for the fundamental determinants of productivity. In particular, we use the following expression:

$$\begin{aligned}\left(\frac{1+\theta}{\theta}\right)\left(\log w_{it} - \frac{1}{1+\theta}\log \Pi_{it}\right) &= \gamma \log \text{Investment}_i \times \text{After 1940}_t \\ &+ \left(\rho_{A1} - \frac{1}{\theta}\right)\log L_{it} + \rho_{A2}\log L_{it-1} + \log u_{it}\end{aligned}$$

The left-hand side of the equation is a function of the average manufacturing wage (w_{it}) and outward market access (Π_{it}) in county i and year t as well as the trade elasticity (θ). On the right-hand side, the first term $\text{Investment}_i \times \text{After 1940}_t$ captures the potential impact of war mobilization. We consider three alternative definitions, which include any new plant worth more than \$50 million, any new publicly-financed plant worth more than \$50 million, and the log of the total value of investment in facilities

Table 1: Results for Impact of Mobilization for World War II

	All	Northeast	Midwest	South	West
	(1)	(2)	(3)	(4)	(5)
Panel A. New World War II Plant Worth More Than $50 Million					
Plant > $50 Million × After 1940	0.0238	-0.0131	-0.0461	0.2384	0.1448
	(0.0689)	(0.0483)	(0.0358)	(0.1915)	(0.0227)
Panel B. New World War II Publicly-Financed Plant Worth More Than $50 Million					
Public Plant > $50 Million × After 1940	-0.1101	-0.0213	-0.1611	-0.1796	0.1042
	(0.0647)	(0.0395)	(0.1062)	(0.1097)	(0.0246)
Panel C. Value of World War II Facilities and Equipment Investment					
Log of Capital × After 1940	-0.0300	-0.0189	-0.0112	-0.0292	0.0056
	(0.0091)	(0.0101)	(0.0102)	(0.0087)	(0.0116)
Number of Counties	3,065	3,065	3,065	3,065	3,065

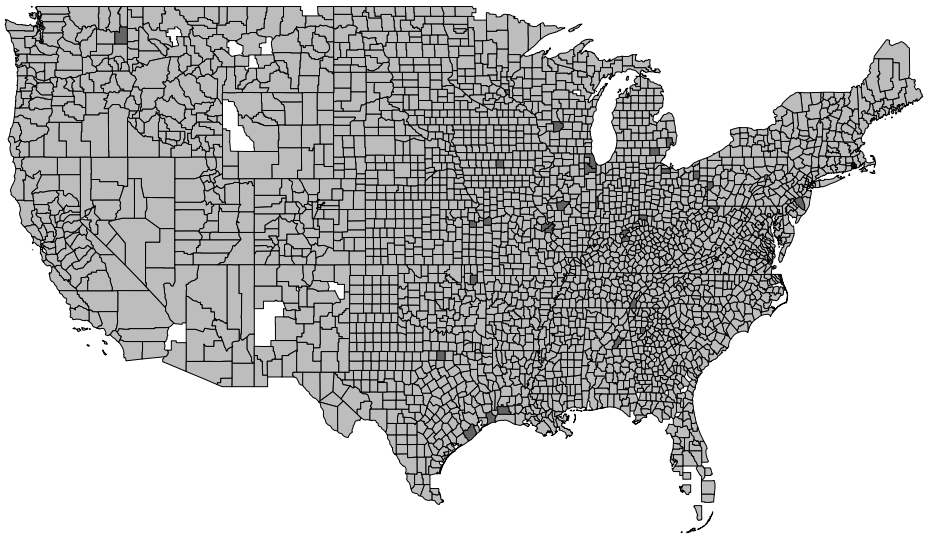
Notes: The dependent variable is the average manufacturing wage. The sample in column 1 is all US counties, and the sample in columns 2, 3, 4, and 5 are counties in Northeast, Midwest, South, or West regions, respectively. The panels use three alternatives to capture the potential impact of World War II: any new plant worth more than $50 million (Panel A), any new publicly-financed plant worth more than $50 million (Panel B), and the log of the total value of investment in facilities (Panel C). All specifications include county and year fixed effects, and are weighted by the number of manufacturing workers. Robust standard errors in parentheses are clustered on county.

(including structures and equipment). The remaining terms capture the impact of the contemporaneous and historical agglomeration as well as the unobserved productivity.

In our preliminary analysis, we fix the trade elasticity as well as the parameters associated with contemporaneous and historical agglomeration at the values in Allen and Donaldson (2022). Specifically, we set the trade elasticity $\theta = 13$, contemporaneous agglomeration $\rho_{A1} = 0.142$, and historical agglomeration $\rho_{A2} = 0.025$. In addition, we include county and year fixed effects to proxy for county- and year-specific components of unobserved productivity. Finally, we calculate outward market access using the trade costs based on the highway network in each decade from 1920 to 1990; in cases where the year of the manufacturing data and market access do not overlap we use the closest year available.

The results of estimating the above producitivity specification are shown in Table 1. Column 1 reports results for all counites in the United States, while columns 2 through 5 report results for counties in the Northeast, Midwest, South, or West regions, respec-

Figure 2: Locations of World War II Plants Worth More Than $50 Million



Notes: The figure shows the counties that received more than $50 million in World War II plant investment (in dark gray). Counties in white are not in the sample.

tively. Panel A uses any new plant worth more than $50 million to capture the effect of World War II, Panel B uses any new publicly-financed plant worth more than $50 million, and Panel C uses the log of capital investment in facilities and equipment. The preliminary results are consistent across the different specifications. In general, for the entire United States the estimated cofficients are small and not statistically significant or negative (Column 1). For the Northeast and Midwest, the estimated coefficients are small and not statistically significant; for the South, the estimated coefficients are imprecisely estimated; for the West, the estimated coefficients for large plants in panels A and B are consistently positive and statistically significant.

The map in Figure 2 shows the location of the plants worth more than $50 million that were built as part of mobilization for World War II, and also the plants used to estimate the effects reported in Panel A of Table 1. The main goal of the paper is to combine the estimates for the productivity effects of industrialization mobilization with the economic geography model described above to quantify the aggregate impact of the various aspects of the mobilization effort. Figure 2 indicates that relatively few locations were treated with new plants and, therefore, the scope for aggregate effects is quite small. Future work will quantify the aggregate productivity effects as well as consider the po-

tential amenity effects of mobilization.

4 Work in Progress

The final version of the paper will provide quantitative estimates for the aggregate impact of World War II. This will include effects that work through both the productivity and amenities channels articulated in the model above. More specifically, the next steps are (1) to estimate the amenity effect using data on migration flows and (2) to carry out counterfactuals using the model to understand the aggregate impact and regional implications of industrial mobilization for World War II.

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