Demand Stimulus as Social Policy

By Auerbach, Gorodnichenko, and Murphy

ONLINE APPENDIX

Appendix A. Discussion of IV from AGM20

For the reader's convenience, we present here modified language from AGM20 related to the advantage of the Bartik-type DOD instrument.

Our objective is to assess the effect of new DOD spending on production of goods and services that would not have occurred in the absence of new spending. For example, during the Iraq war build-up, the DOD increased total orders for fighter jets relative to what had been anticipated before the war. Many DOD contracts, however, represent payment for production that would have occurred anyway, either because the contract was anticipated or because firms smooth production over lumpy contracts. For example, assume that Lockheed accurately forecasts average orders for fighter jets over the next three years. The timing of a contract simply indicates when DOD receives cash but does not correspond to actual new production demand.

More formally, consider $\Delta G_{\ell,t} \equiv G_{\ell,t} - G_{\ell,t-1} = \Delta G_{\ell,t}^{W} + \Delta G_{\ell,t}^{P}$, where $\Delta G_{\ell,t}^{P}$ is an outlay that induces new production and $\Delta G_{\ell,t}^{W}$ are contracts that that are not associated with new production but rather only contain information on the timing of outlays (e.g., because they were anticipated). By mixing $\Delta G_{\ell,t}^{W}$ and $\Delta G_{\ell,t}^{P}$, we are likely to have a downward bias in the size of the multiplier to government spending shocks. Our strategy is to find a variable that is correlated with $\Delta G_{\ell,t}^{P}$ and uncorrelated with $\Delta G_{\ell,t}^{W}$ and use this variable as an instrument for $\Delta G_{\ell,t}$.

The Bartik instrument effectively provides such a filter: aggregate DOD spending represents new production of goods and services and thus $\frac{s_{\ell} \times (G_t - G_{t-1})}{Y_{\ell,t-1}}$ picks up only spending-related changes in $\frac{G_{\ell,t} - G_{\ell,t-1}}{Y_{\ell,t-1}}$ and filters out the cash transfers (including anticipated contracts). In other words, the Bartik instrument helps us to isolate the component of contracts that corresponds to new production by relating location-specific contracts to changes in aggregate production/spending.

Our DOD Bartik instrument exploits changes in national production ($G_t - G_{t-1}$) rather than changes in total contract obligations, ΔO_t. This is because the timing of contract obligations does not correspond to the timing of outlays or new production, and many contracts specify production and outlays over horizons of over five years. One might expect that aggregating across contract obligations would yield an aggregate measure that smoothly tracks DOD production. However, Appendix Figure 2 demonstrates that aggregate obligations are lumpy, whereas our measure of DOD spending smoothly tracks the shape of DOD production. For comparison, Appendix Figure 2 also reports NIPA national defense production, modified to follow the recommended approach from Cox let al. (2024). Despite level differences between our aggregate spending measure and NIPA production, the trends are highly related (correlation 0.99).

Recent evidence has raised concerns that NIPA-based DOD measures do not accurately reflect the timing of production. For example, Brunet (2022) and Briganti and Sellemi (2023) show that government spending is often recorded at delivery, which occurs after production. We are less concerned about a potential timing mismatch in our study for several reasons. First, Brunet's Budget Authority measure (which corrects for timing mismatch) closely tracks NIPA measures of

production post-2000. Relatedly, the timing mismatch emphasized in Briganti and Sellemi (2023) is highly relevant at the quarterly frequency but is less likely to be relevant at the two-year horizon in this study. Our results are similar over even longer (five-year) horizons, which further mitigates concerns about high-frequency timing mismatch. Finally, as emphasized by Briganti and Sellemi, any remaining timing mismatch will tend to bias the estimated effects of DOD shocks toward zero, which would imply that our results provide a lower bound for the benefits of DOD spending.

Appendix Table A1. Average DOD Spending Shares by Cities.

CBSA/City	Share of National DOD Spending	Spending as a Fraction of Local Labor Earnings
Panel A: Cities with highest share of National DOD Spending		
Washington-Arlington-Alexandria, DC-VA-MD-WV	0.133	0.150
Dallas-Fort Worth-Arlington, TX	0.054	0.071
Los Angeles-Long Beach-Santa Ana, CA	0.052	0.040
Boston-Cambridge-Newton, MA-NH	0.041	0.055
Virginia Beach-Norfolk-Newport News, VA-NC	0.030	0.233
Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	0.030	0.044
New York-Newark-Jersey City, NY-NJ-PA	0.028	0.019
Baltimore-Columbia-Towson, MD	0.027	0.087
San Diego-Carlsbad, CA	0.026	0.083
St. Louis, MO-IL	0.022	0.068
Phoenix-Mesa-Scottsdale, AZ	0.022	0.056
Panel B: Cities with highest DOD Spending Fraction of Earnings		
Lexington Park, MD	0.008	0.743
Fort Polk South, LA	0.001	0.596
Enterprise, AL	0.003	0.532
Fort Leonard Wood, MO	0.001	0.530
Norwich-New London, CT	0.016	0.489
Huntsville, AL	0.019	0.396
Camden, AR	0.001	0.386
Oshkosh-Neenah, WI	0.007	0.385
Hinesville, GA	0.001	0.366
Jacksonville, NC	0.002	0.350
Charleston-North Charleston, SC	0.004	0.342

Source: AGM20.

Appendix B. Comparing Effects on Mortality with Those in Ruhm (2000)

Ruhm (2000) considers the impact of a change in the state unemployment rate, controlling for income in some specifications. As the main impact works through the unemployment rate, consider his results for his specification excluding income as an explanatory variable. For a 1 percentage point increase in the state unemployment rate, the change in the number of deaths per 100,000 are:

All	-4.57	presented in Table II; also computable from the effect on log deaths in Table II, -.0052, multiplied by the number of deaths per 100,000 in Table I, 879.8
20-44	-3.36	Effect on log deaths in Table III, -.0203, multiplied by the number of deaths per 100,000 in Table I, 165.4
45-64	+0.28	+.0003 x 934.2 (same approach as above)
>65	-16.77	-.0032 x 5240.0 (same approach as above)

where the value for all deaths is provided in his Table II, and those for specific age ranges computed by multiplying the effect on log deaths per 100,000 in his Table III by the number of deaths per 100,000 in his Table I.

In our results above, we consider the effects of a change in DOD spending or a general demand (Bartik) income shock on mortality. In each case, a unit change is an increase in defense spending or income equal in magnitude to the level of local income, rather than a percentage point of defense spending or income, so we need to divide the coefficients in Table 6 by 100 and multiply them by -1 to make them of a comparable scale and sign to Ruhm's. Also, to convert these effects of a percentage point change in DOD spending or income to those of a change in the unemployment rate, we divide them by the employment-rate responses in the last two columns of Table 8 (0.214 and 0.125 respectively, for DOD shocks and general demand shocks). The results for effects on mortality (for all CBSAs, based on the first and third columns of Table 6) are:

	DOD demand shock	General demand shock
All	+2.20	-8.76
25-44	-1.27	-3.06
45-64	+11.26	-7.33
>65	+35.50	-42.54

(Note that we have ages 25-44 whereas Ruhm has 20-44.)

Our results for the general demand shock are generally of the same sign and order of magnitude as Ruhm's, whereas those of the DOD shock are of the opposite sign.

Appendix C. Additional tables and figures.

Appendix Table 1. Labor Force Responses by Demographic Group: 5-year outcomes in response to shocks measured over 5 years

Labor Market Outcomes:	Total ACS Earnings		Average ACS Earnings		Employment Rate	
Shock:	DOD	General Demand	DOD	General Demand	DOD	General Demand
	(1)	(2)	(3)	(4)	(5)	(6)
All	0.776***	0.602***	0.512**	0.407***	0.202***	0.171***
	(0.260)	(0.062)	(0.198)	(0.057)	(0.069)	(0.038)
Education						
No Bachelors	0.559***	0.438***	0.737***	0.564***	0.218***	0.194***
	(0.177)	(0.051)	(0.233)	(0.062)	(0.078)	(0.043)
Bachelors	0.201*	0.177**	0.153	0.154	0.093**	0.098***
	(0.117)	(0.066)	(0.195)	(0.147)	(0.043)	(0.030)
N	1684	1684	1684	1684	1684	1684
First-Stage F statistic	21.718	95.244	21.718	95.244	21.718	95.244

Note: This table reports the effect of increases in DOD spending over a five-year time span (instrumented by the DOD Bartik shock) and earnings over a five-year time span (instrumented by the traditional Bartick shock) on labor market outcomes over a five-year time span. Fixed effects for CBSA and year are included but not reported. Standard errors clustered by state are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 2. 5-year outcomes in response to shocks measured over 5 years

Panel A Social Outcomes:	Poverty	Food Stamp Receipt	Welfare Income	Medicaid Receipt	Health Insurance	Disabled	Occupational Prestige	Transportation Time to Work
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
DOD shock	-0.099**	-0.112*	-0.002	0.170	0.951*	-0.097***	2.146	-6.263**
	(0.041)	(0.064)	(0.002)	(0.442)	(0.537)	(0.036)	(1.561)	(2.343)
General Demand shock	-0.105***	-0.142***	-0.003**	0.007	0.113**	0.035	0.042	2.632
	(0.024)	(0.037)	(0.001)	(0.034)	(0.048)	(0.027)	(0.579)	(2.479)

Panel B Social Outcomes:	Multi-Family Home	Homeowner	Married	Divorced	Single Parent	Mortality age 45-65	Mortality age 65-99	Median AQI
DOD shock	-0.015	0.108**	0.053	-0.029	-0.013	-137.4**	-689.0***	-3.812
	(0.038)	(0.050)	(0.058)	(0.030)	(0.025)	(60.1)	(235.4)	(6.592)
General Demand shock	-0.010	0.021	-0.053**	-0.006	0.015	144.2***	365.6**	3.206
	(0.025)	(0.028)	(0.022)	(0.020)	(0.011)	(40.6)	(158.4)	(7.093)

Note: This table reports the effect of increases in DOD spending over a five-year time span (instrumented by the DOD Bartik shock) and earnings over a five-year time span (instrumented by the traditional Bartick shock) on social outcomes over a five-year time span. The coefficients on each shock are estimated from separate regressions. Fixed effects for CBSA and year are included but not reported. Standard errors clustered by state are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 3. Effects of DOD Shocks: Difference between Bachelor's and non-Bachelors' Households

	Difference (bachelor's -no-bachelor's)	p-value
Outcome	(1)	(2)
Total Earnings	-0.513***	(0.002)
Average Earnings	-0.437	(0.146)
Employment Rate	-0.175*	(0.053)
Labor Force Participation Rate	0.122	(0.176)
Population	-0.511*	(0.084)
Poverty	0.120*	(0.068)
Food Stamp Receipt	0.085	(0.189)
Disabled	0.110***	(0.009)
Multi-family home	0.069	(0.382)
Homeowner	0.101	(0.391)
Married	-0.148	(0.387)
Divorced	0.011	(0.871)
Single parent	-0.015	(0.793)

Note: This table reports the differential effect of DOD shocks on outcomes for non-bachelor's households and bachelor's households (column 1). Column 2 reports the statistical significance (p-value) of the difference.

Appendix Table 4. Effects of DOD Shocks: Differences by Demographic Group, QWI Data

	Total Earnings	Average Earnings	Employment Rate
	(1)	(2)	(3)
Black compared to White	-0.297***	0.358*	0.159
	(0.001)	(0.057)	(0.201)
Hispanic compared to White	-0.337***	0.458***	0.175***
	(0.000)	(0.010)	(0.003)
Male compared to Female	0.220***	0.398***	0.116***
	(0.001)	(0.000)	(0.000)
Young compared to Middle-aged	0.071*	0.153*	0.106***
	(0.079)	(0.083)	(0.001)

Note: This table reports the differential effect of DOD shocks on labor market outcomes by demographic category. P-values of the differences between demographic groups are reported in parentheses. Young refers to ages 22 to 44, and middle-aged refers to ages 45 to 64.*** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 5. Effect of DOD shock on Transportation Method and Density

	Drive	Public Transportation	Walk or Bike	Work From Home	Employment-weighted Density
	(1)	(2)	(3)	(4)	(5)
DOD shock	-0.068*	0.022	0.009	0.022	0.748**
	(0.036)	(0.017)	(0.018)	(0.025)	(0.336)
N	2541	2541	2541	2541	2541
First-Stage F statistic	28.576	28.576	28.576	28.576	28.576

Note: This table reports the differential effect of DOD shocks on changes in the share of workers driving to work (column 1), taking public transportation to work (column 2), walking/biking to work (column 3), and working from home (column 4); and employment-weighted density (column 5). Employment-weighted density is employment-weighted average of employment density across zip codes in a CBSA. Standard errors clustered at the state level are reported in parentheses.*** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 6. Top Five Industry Responses to General Demand Shock

	Mining	Manufacturing	Construction	Wholesale Trade	Professional Services
	(1)	(2)	(3)	(4)	(5)
General Demand	0.209***	0.192***	0.129***	0.073***	0.071***
	(0.055)	(0.041)	(0.014)	(0.016)	(0.010)
N	2460	2502	2502	2502	2502
First-Stage F statistic	147.47	151.10	151.10	151.10	151.10

Note: This table reports the response of industry-level earnings to changes in CBSA-level earnings (instrumented with the general demand shock) for industries with the strongest response. All variables are winsorized at the 1% and 99% levels. Fixed effects for CBSA and year are included but not reported. Standard errors clustered by state are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 7. Social Outcomes by Demographic Group, General Demand Shock

Social Outcomes (rates):	Transportation time to work	Multi-family home	Homeowner	Home Value (growth)	Married	Divorced	Single parent
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Demographic Group							
All	4.298**	0.009	-0.017	0.377*	0.005	-0.022	-0.027
	(1.991)	(0.022)	(0.026)	(0.202)	(0.030)	(0.020)	(0.027)
Education							
No Bachelors	3.418	-0.003	0.016	0.507**	0.016	-0.018	-0.029
	(2.101)	(0.024)	(0.033)	(0.206)	(0.036)	(0.021)	(0.033)
Bachelors	6.537*	0.042	-0.147***	0.252	-0.088*	-0.035	-0.025
	(3.299)	(0.036)	(0.044)	(0.209)	(0.048)	(0.029)	(0.017)
Race							
White	4.140*	-0.009	-0.020	0.272	-0.016	-0.025	-0.031
	(2.312)	(0.022)	(0.028)	(0.181)	(0.040)	(0.031)	(0.028)
Black	16.361**	0.126	-0.160	0.372	0.040	-0.034	0.088
	(7.448)	(0.123)	(0.147)	(0.468)	(0.206)	(0.083)	(0.105)
Hispanic	11.925*	-0.080	-0.226	-0.226	-0.072	0.045	0.035
	(6.004)	(0.110)	(0.179)	(0.179)	(0.093)	(0.057)	(0.103)
Age							
20-40	3.931	0.020	-0.021	0.268	0.007	-0.034	-0.031
	(3.174)	(0.040)	(0.037)	(0.242)	(0.052)	(0.033)	(0.061)
41-61	4.937	-0.003	-0.012	0.555**	0.010	-0.034	-0.027
	(2.967)	(0.037)	(0.030)	(0.212)	(0.031)	(0.025)	(0.018)
62-70	4.504	0.065**	-0.073	0.202	-0.120*	0.014	0.003
	(5.376)	(0.025)	(0.062)	(0.197)	(0.068)	(0.033)	(0.032)
Sex							
Male	5.296*	0.028	-0.024	0.379*	-0.024	-0.018	-0.009
	(3.110)	(0.026)	(0.034)	(0.194)	(0.032)	(0.034)	(0.017)
Female	1.937	-0.007	-0.006	0.389*	0.022	-0.026	-0.046
	(1.869)	(0.025)	(0.033)	(0.209)	(0.032)	(0.020)	(0.045)
N	2542	2542	2542	2542	2542	2542	2542
First-Stage F statistic	160.1	160.1	160.1	160.1	160.1	160.1	160.1

Note: This table reports the effect of a percent increase in earnings (instrumented by a general demand shock) by demographic category over a two-year time span. CBSA-level earnings growth is instrumented with a traditional Bartik shock. All variables except the Bartik shock are winsorized at the 1% and 99% levels. Fixed effects for CBSA and year are included but not reported. Standard errors clustered by state are in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix Table 1. Savings from General Demand Shocks.

	Estimate	Population share	Required Spending	Value per person	Benefits per dollar
	(1)	(2)	(3)	(4)	(5)
Safety Net Savings					
Food Stamp Receipt	-0.108	1	$157,407	$1,500	$0.010
Welfare Payments (direct savings)	-0.002				$0.002
Medicaid Receipt Bachelor's	0.08	0.27	-$787,037	$8,436	-$0.011
Medicaid Receipt 6-10	-0.258	0.104	$633,572	$3,556	$0.006
Medicaid Receipt 16-20	-0.184	0.121	$763,564	$3,556	$0.005
Health Insurance White (net)	0.217	0.71	$110,339	$817	$0.007
Subtotal					**$0.018**
Other Social Benefits					
Transportation Time (hours per year)	35.8	1	-$474	$10	-$0.021
Child Poverty age 6-10	-0.19	0.104	$860,304	$50,000	$0.058
Child Poverty age 11-15	-0.33	0.106	$485,992	$50,000	$0.103
Child Poverty age 11-15	-0.18	0.121	$780,533	$50,000	$0.064
Mortality (per 100k)	109.5	1	-$15,525,114	$369,000	-$0.024
Vehicle Theft (per 100k)	-121.6	1	$13,980,263	$10,000	-$0.001
Subtotal					**$0.179**
Total					**$0.198**

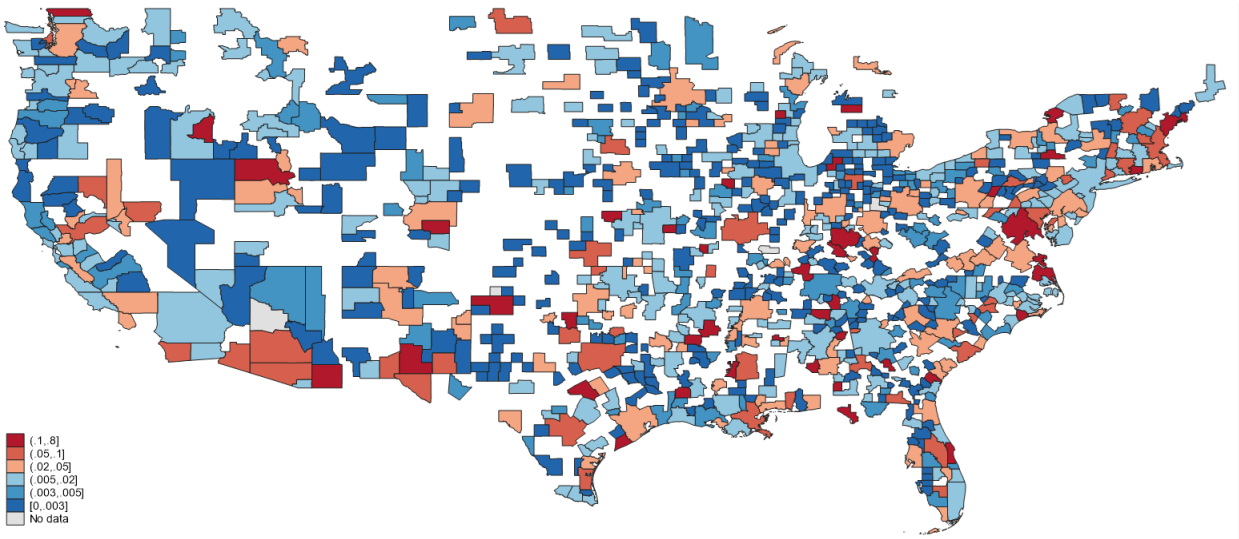
This table derives social benefits per dollar of spending from a general demand shock. Unless otherwise specified, outcomes are changes in rates in response to DOD spending equal to local earnings. The method for determining the value of benefits is analogous to the method used to determine the benefits of DOD spending in Table 8. When there are statistically significant effects across overlapping subgroups, we compute value based on the larger subgroup. Benefits per dollar (column 5) is the value per person of the value of the outcome (column 4) divided by the amount the DOD must spend to produce that outcome (column 3). The amount in column 3 is average QCEW earnings (17k) divided by the (negative of the) estimate from column 1 and the population share from column (2).

Appendix Table 9. Correlations between Demand Shocks and CBSA Characteristics

	Shock:	
	General Demand	DOD Spending
	(1)	(2)
log(population)	0.297	0.072
Saiz (2010) housing supply elasticity	-0.134	-0.051
Bachelor's share	0.182	0.082
White share	-0.297	-0.091
Poverty	0.031	-0.126
Employment rate	0.152	0.081
Average home value	0.209	0.052
Average wage earnings	0.192	0.135

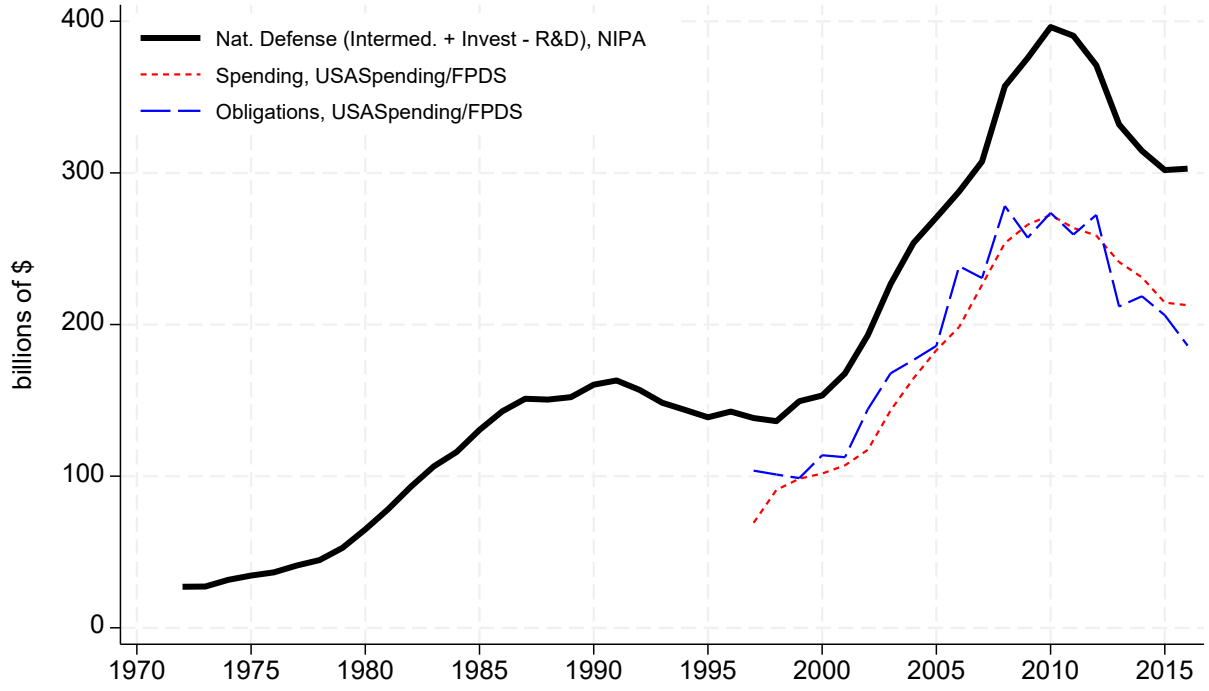
Note: This table reports correlation coefficients between the demand shocks and CBSA covariates. Column (1) reports correlations with the general demand shock, and column (2) reports correlations with the DOD spending shock. The shocks are based on national growth rates between 2005 and 2007, and with the exceptions of the Saiz (2010) housing supply elasticity and population (based on 2000 Census), the CBSA covariates are based on estimates from the 2005 ACS.

Appendix Figure 1. Cross-Sectional Variation in DOD Spending.



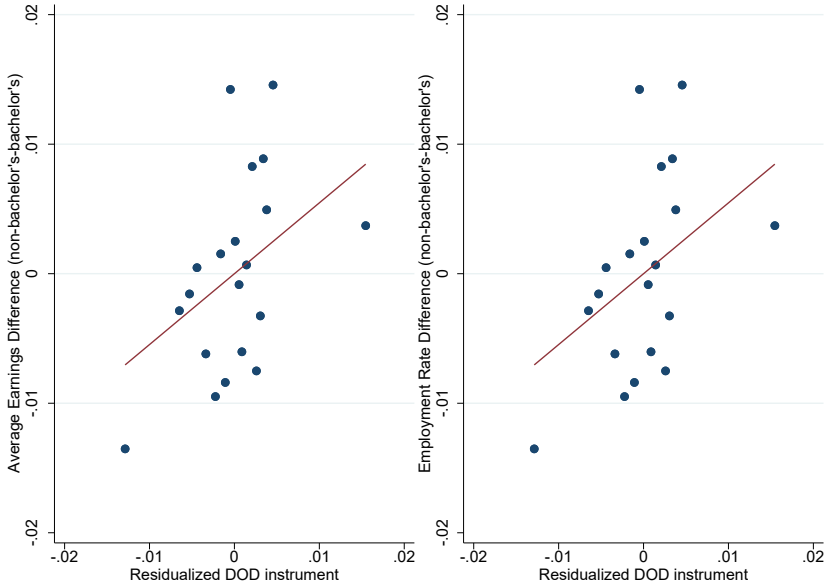
Note: this figure shows variation in $s_\ell \times \left(G_{2005}/Y_{\ell,2005}\right)$, that is, the CBSA share of national spending scaled by national spending relative to CBSA-level labor earnings.

Appendix Figure 2. Time-Series Variation in National DOD Spending.



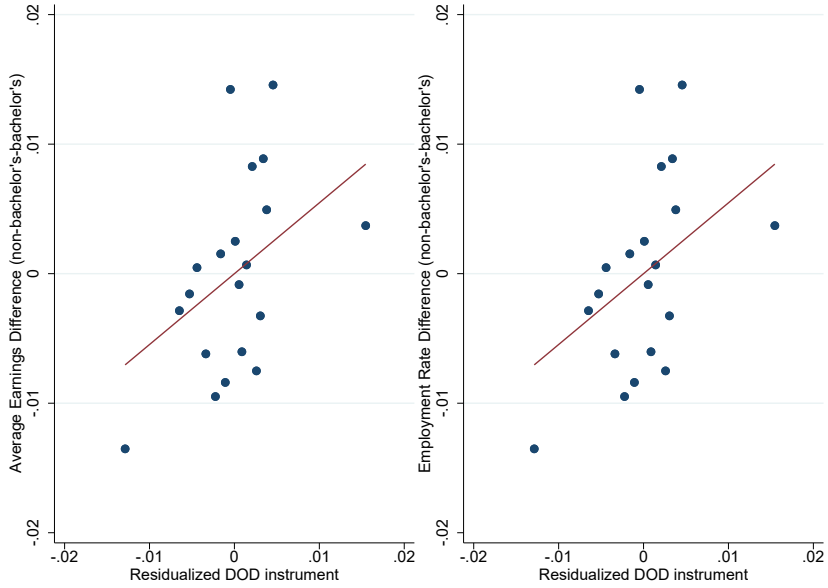
Notes: The level difference between NIPA and our contract-based DOD spending stems from several sources. First, we use contracts awarded only by the Department of Defense while national defense spending covers other agencies responsible for national defense (e.g., Department of Energy, CIA, U.S. Coast Guard, etc.). Second, we use only contacts with the place of performance in the U.S. This means we exclude military spending in overseas bases and operations (this is about 10-15% of DOD contracts). Third, there is a collection of smaller issues (e.g., missing zip codes for the place of contract performance) that contribute to the difference between the NIPA statistics and our aggregate spending.

Appendix Figure 3. Visual Evidence of Relationship between DOD shock and Differential Labor Market Effects (non-bachelor's versus bachelor's), Full Panel.



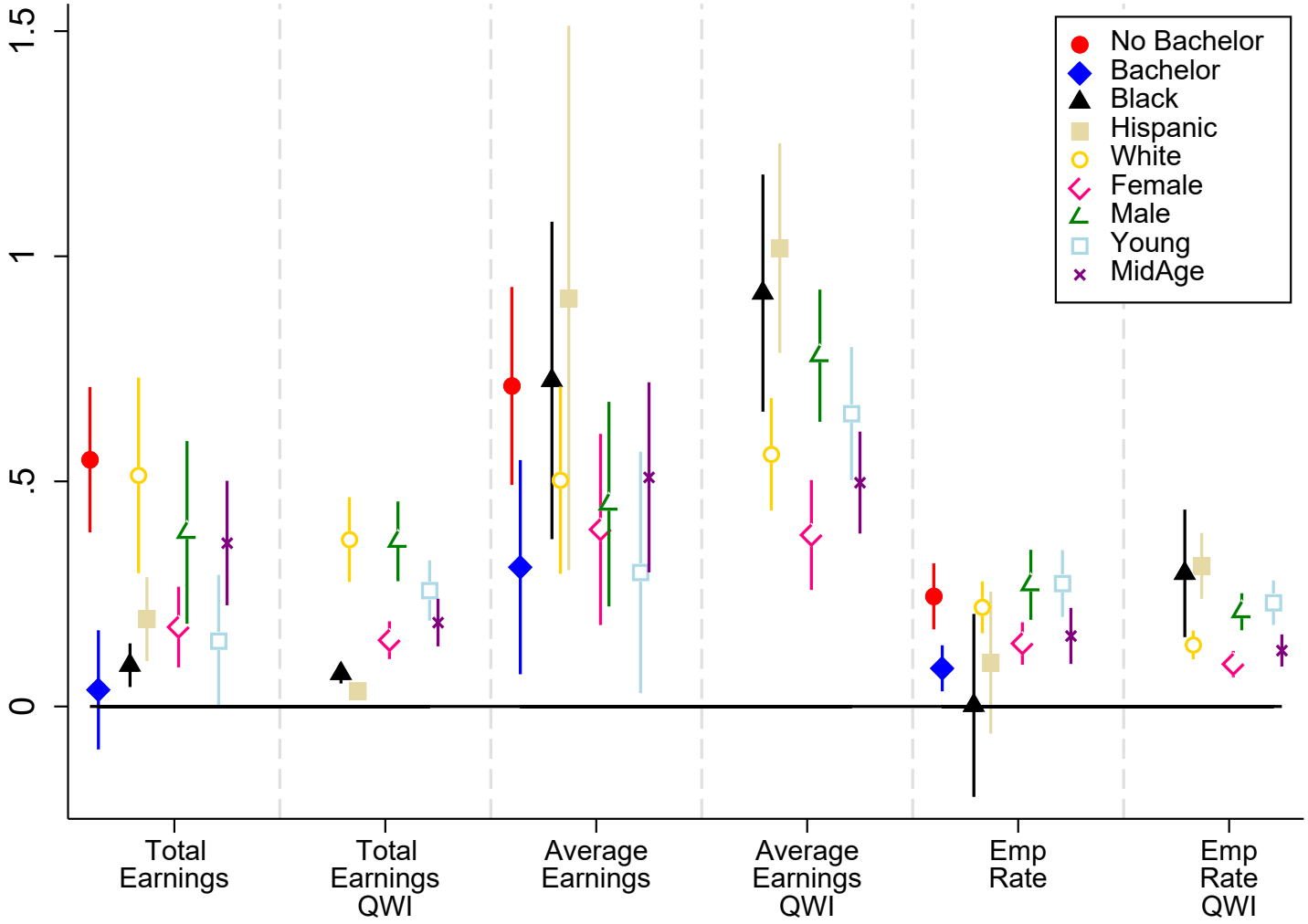
Note: This figure plots the binscatter of the difference (between non-bachelor's and bachelor's) households in Average earnings growth (left panel; employment rates, right panel) and the residuals from a regression of the DOD instrument $\frac{s_{\ell} \times (G_t - G_{t-2})}{Y_{\ell,t-2}}$ on time and CBSA fixed effects.

Appendix Figure 4. Visual Evidence of Relationship between DOD shock and Differential Labor Market Effects (non-bachelor's versus bachelor's), Cross-Sectional Variation.



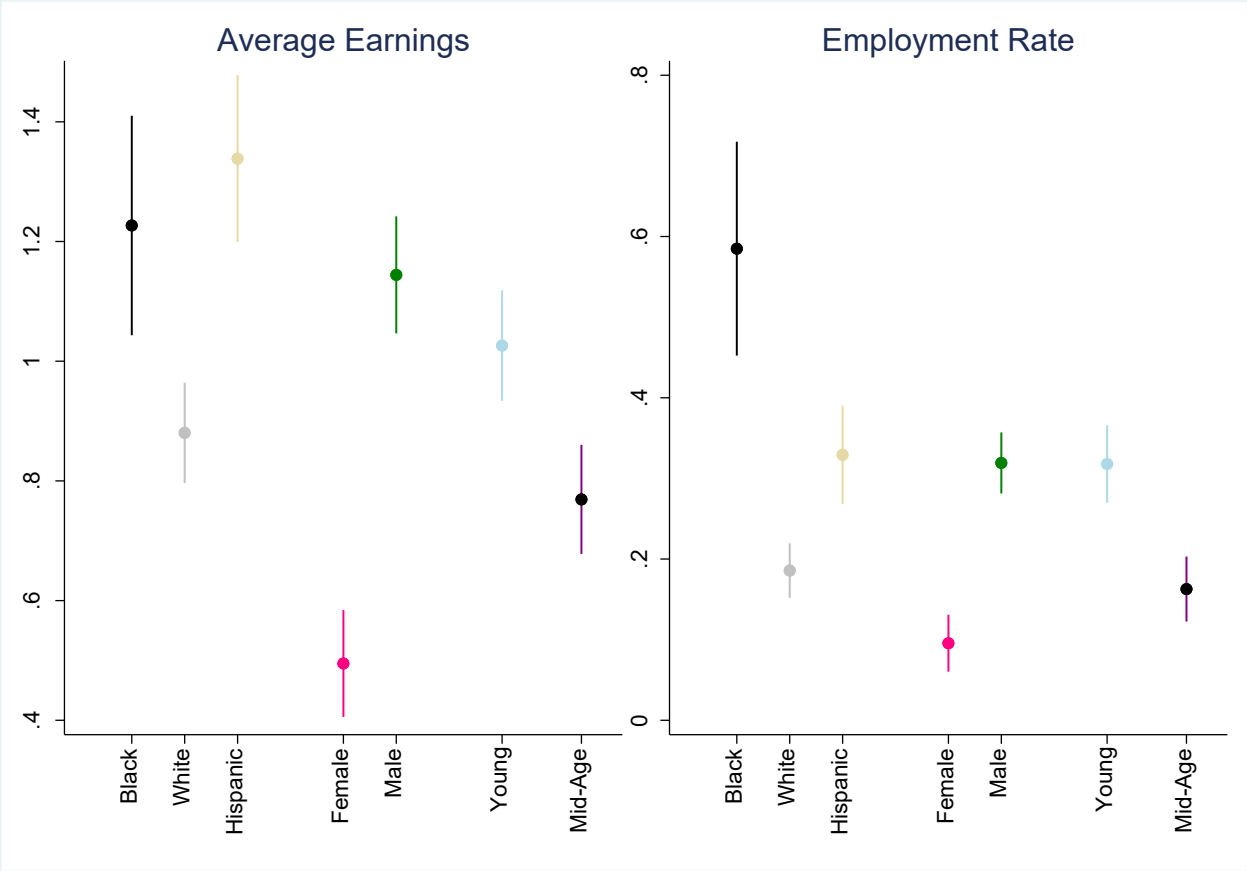
Note: This figure is similar to Appendix Figure 3 but exploits only cross-sectional variation. Specifically, we examine changes in DOD spending and labor market outcomes between 2005/06 and 2009/10. We obtain residuals from a regression of the DOD instrument on the CBSA covariates from Demyanyk at al (2019). We then plot the binscatter of the differential labor market outcomes and these residuals.

Appendix Figure 5. Labor Market Effects of DOD Spending by Demographic Group, ACS and QWI.



Note: This figure plots the regression coefficients plus and minus one standard error from regressions of labor market outcomes (by demographic group) on DOD spending. The first-stage F-statistic for the QWI-based regressions is 143.4 (N=11911).

Appendix Figure 6. Distributional Effects of General Demand Shocks by Demographic Group, QWI.



Note: This figure plots the regression coefficients plus and minus one standard error from regressions of labor market outcomes (by demographic group) on DOD spending. The first-stage F-statistic for the QWI-based regressions is 189.3 (N=12567).