Appendix: Property Prices

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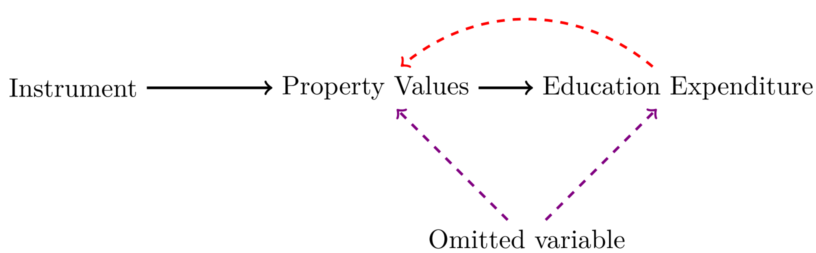
The structure of public financing (described in further detail in Section **??** of the Supplementary Materials) provides an avenue for a causal identification strategy. In brief, although revenue for public education comes from a combination of intergovernmental and local sources; revenue generated from local sources comes almost entirely from property taxes. Given this, we can isolate the channel through which our treatment (industry-specific wage growth) will affect our outcome variable using an instrumental variable approach. We outline the underlying path diagram of this econometric specification in Figure 1.

As seen in Figure 1, we hypothesize that property values have an effect on education expenditure. However, there is significant concern of a reverse causal effect as higher income families likely gravitate towards school districts with higher levels of expenditure per pupil, driving up property values (Could likely add sources here).

Figure 1: Instrumental Variable Path Diagram



Therefore, we adopt an identification strategy via a shift-share or Bartik instrument. A shift-share instrument interacts local industry shares with national industry-level growth rates to attain a plausibly exogenous local shock. In the context of this work, we construct the instrument by interacting a constant industrial employment share variable with a national industry-level wage.

We choose to employ the first of these options, assuming that industry shares are only exogenous at a given base period and that national level growth rates are exogenous and therefore allowed to vary with time.

Using data from the US Bureau of Labor Statistics' Quarterly Census of Employment and Wages (QCEW) and Bureau of Economic Analysis, we construct two types of shift-share Bartik instruments at the commuting zone level using local employment shares by industry and national changes in industry-specific wages and real value added. Equation Equation 1 demonstrates the Bartik instrument as outlined in Ferri (2022) and Goldsmith-Pinkham, Sorkin, and Swift (2020) and defined in Bartik (1991) . G_{njt} represents national-level changes in wages or value added in industry j in time t and $\frac{N_{ij\tau}}{N_{i\tau}}$ represents the 'sensitivity' of a CZ to these national shocks proxied by an initial share of local employment in industry j in a baseline time period τ. The product of these two values defines the shift-share indicator $\tilde{Z}_{i,t,s}$. In order to construct the share portion, we compute the total local share of employment in a particular industry j. Due to challenges with missing data, we compute an average share across 2001-2005 as our 'base year'.

[1]

$$\tilde{Z}_{ijt} = G_{njt} * \frac{N_{ij\tau}}{N_{i\tau}} \tag{1}$$

We compute the two relevant shift-share instruments across 19 two-digit NAICS industrial categories listed in Table X below. Given industry-level disaggregation of local employment and wage data requires data suppression for anonymity reasons, the plot immediately following displays the data coverage of our commuting zone level shift-share instruments. Given the high degree of missingness in the 3-digit categorisation we proceed with the 2-digit NAICS codes in the rest of the work.

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NAICS.Code	Industry
11	Agriculture, Forestry, Fishing, and Hunting
21	Mining
23	Construction
31-33	Manufacturing
42	Wholesale Trade
44-45	Retail Trade
48-49	Transportation and Warehousing
22	Utilities
51	Information
52	Finance and Insurance
53	Real Estate and Rental and Leasing
54	Professional, Scientific, and Technical Services
55	Management of Companies and Enterprises
56	Administrative and waste management services
61	Educational Services
62	Health Care and Social Assistance
71	Arts, Entertainment, and Recreation
72	Accommodation and Food Services
81	Other Services, except government
92	Public Administration

Before displaying the regression results using our shift-share instrument we discuss the plausibility of our identification strategy by exploring the relationships between wage and GDP on housing prices. We provide evidence of this relationship below.

0.0.1 Industry-level Wages

The two regression models show that wage levels and wage growth both play important roles in influencing house prices, but in different ways. The log-level model indicates that increases in average wages have a strong and persistent effect on the level of house prices, with significant positive effects extending up to four years. In contrast, the growth rate model suggests that house price growth responds primarily to contemporaneous wage growth, with little evidence of lagged effects. Together, these findings imply that while higher wages steadily raise housing values over time, short-term changes in wage growth do not affect the growth rate of house prices over time. Together, they suggest that housing markets are more responsive to trends than to transitory shocks in wages. I am unsure about this interpretation - given GR regressed on

[1]We explore the sensitivity of results to the choice of base period τ by constructing the instrument for various base periods as well as a rolling window. I have done this unsystematically so far (testing 2001, 2004, and 2005) but arrived at the decision to compute an average to deal with missing data. Will include a more systematic testing of this in the appendix.

GR is simply meant to handle non-stationarity issues...I worry that the GR results might just indicate that the level regression is meaningless?

Dependent Variables:	(log) House Price Index		(GR) House Price Index	
Model:	(1)	(2)	(3)	(4)
Variables				
(log) Annual Avg. Wkly. Wage	0.9365^{***}	0.7937^{***}		
	(0.0573)	(0.1106)		
(log, l1) Annual Avg. Wkly. Wage	0.0544	-0.0415		
	(0.0395)	(0.0447)		
(log, l2) Annual Avg. Wkly. Wage	0.0861^{**}	-0.0936^{*}		
	(0.0392)	(0.0486)		
(log, l3) Annual Avg. Wkly. Wage	0.0303	0.0374		
	(0.0398)	(0.0489)		
(log, l4) Annual Avg. Wkly. Wage	0.0863^{*}	-0.0269		
	(0.0448)	(0.0458)		
(log, l5) Annual Avg. Wkly. Wage	0.0261	0.0410		
	(0.0335)	(0.0485)		
(log, l6) Annual Avg. Wkly. Wage	0.0388	0.0060		
	(0.0388)	(0.0418)		
(log, l7) Annual Avg. Wkly. Wage	0.0222	0.0369		
	(0.0364)	(0.0454)		
(log) Real GDP Priv. Industry pc	0.0710^{***}	-0.0188		
	(0.0213)	(0.0347)		
(log) Population	0.4165^{***}	0.1001^{***}		
	(0.0537)	(0.0112)		
(GR) Annual Avg. Wkly. Wage			0.3164^{***}	0.3236^{***}
			(0.0396)	(0.0389)
(GR, l1) Annual Avg. Wkly. Wage			0.0040	0.0056
			(0.0201)	(0.0196)
(GR, l2) Annual Avg. Wkly. Wage			0.0242	0.0252
			(0.0179)	(0.0178)
(GR, l3) Annual Avg. Wkly. Wage			0.0035	0.0073
			(0.0166)	(0.0162)
(GR, l4) Annual Avg. Wkly. Wage			0.0263	0.0292
			(0.0214)	(0.0204)
(GR, l5) Annual Avg. Wkly. Wage			6.34×10^{-5}	0.0002
			(0.0222)	(0.0212)
(GR, l6) Annual Avg. Wkly. Wage			-0.0118	-0.0073
			(0.0191)	(0.0187)
(GR, l7) Annual Avg. Wkly. Wage			-0.0093	-0.0091
			(0.0201)	(0.0196)
(GR) Real GDP Priv. Industry pc			0.0078^{*}	0.0080^{*}
			(0.0043)	(0.0043)
(GR) Population			0.0063^{***}	0.0066^{***}
			(0.0016)	(0.0016)
Fixed-effects				
unit	Yes		Yes	
year	Yes	Yes	Yes	Yes
state		Yes		Yes
Fit statistics				
Observations	12,570	12,570	12,542	12,543
R^2	0.96815	0.76680	0.39690	0.38516
Within R^2	0.32132	0.49909	0.02349	0.02496

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Finally, we display the results for a 2SLS estimation using our wage-based shift-share instrument.

The instrumental variable estimates provide evidence of a robust causal relationship between national wage and GDP fluctuations and public education expenditure. Utilising our wage-based shift-share instrument we see highly significant and relevant first-stage relationships when the shift-share instrument is imposed both in levels and growth rates. Though the growth rate specification is only relevant with at least a 1-year lag and using state- instead of commuting zone-level fixed effects.

In each case in the first table, the first-stage regression yields a statistically significant and economically large coefficient. Varying the time-lag and inclusion of state or commuting zone fixed effects, we see that a 1% increase in the shift-share measure (which can be interpreted as a natural logarithm) is associated with a 0.05-0.5% increase in the local House Price Index ($p < 0.01$), with an F-statistic between 47-140 (all well above conventional weak instrument thresholds) confirming instrument relevance. The second-stage results are significant in all cases except the growth rate shocks with commuting zone level fixed effects.

In the level shift-share regressions, the instrumental variables estimates suggest that increases in house prices have a strong and statistically significant effect on education expenditure per pupil. Across specifications (columns 2, 4, 6, and 8), the estimated elasticity is close to one, implying that a 1% increase in house prices translates into nearly a 1% increase in elementary education spending. The instruments (intergovernmental revenue per capita and state wages) are highly relevant, as indicated by the very large first-stage F-statistics (well above the conventional threshold of 10), alleviating concerns about weak instruments. The Wu-Hausman tests reject the null of exogeneity, confirming that OLS estimates are biased and IV estimation is appropriate. Wald tests of joint significance further support the strength of the instruments. Taken together, these results provide robust evidence that higher property values causally increase local education spending, consistent with a mechanism in which rising property wealth expands the fiscal capacity of local governments. Furthermore, given the dependent variable measures per pupil expenditure, this result implies direct effects in experience per student.

Using wage shocks in levels yields strong instruments, high first-stage F-statistics, and stable second-stage estimates: higher house prices robustly increase education spending. In contrast, when shocks are measured in growth rates, the instruments lose predictive power (first-stage F-statistics ~1–2), resulting in weak identification. The second-stage coefficients become unstable and often insignificant, while Hausman tests fail to reject exogeneity. This suggests that the growth-rate specification is poorly identified and cannot provide reliable causal inference, whereas the level specification produces credible and consistent results.

The specification that uses wage shocks in levels provides the most credible identification strategy. The instruments are strong, as indicated by very large first-stage F-statistics well above conventional thresholds, and the second-stage results are both large and robust across specifications. The Wu–Hausman tests reject exogeneity, reinforcing the necessity of IV estimation over OLS. By contrast, when wage shocks are expressed in growth rates, the identifying variation is substantially reduced, resulting in weak first stages and unstable second-stage estimates. Since levels capture the cross-sectional fiscal variation that drives differences in property values and school spending, the level specification is more consistent with the economic mechanisms of interest and delivers more reliable causal estimates.

At the same time, the weakness of the growth-rate specification does raise concerns about the robustness of the results. If the relationship between wages, house prices, and education expenditure is driven by common non-stationary trends, then regressions in levels risk spurious correlation. In this sense, the fact that the IV design loses power when variables are differenced into growth rates may suggest that part of the strong level results reflect long-run trends rather than short-run causal shocks. While the large first-stage F-statistics and Hausman tests in the level specification support its validity, the weak performance of the growth-rate version cautions that the results could be sensitive to issues of persistence and trending in the data.

Taken together, these results suggest that while the level specification provides strong identification and compelling evidence of a positive causal effect of house prices on education spending, the weak performance of the growth-rate specification highlights the need for caution, as the strength of the findings may partly reflect long-run trending relationships rather than purely exogenous shocks.

However, examining the structure of the growth rate shock, the instability of the variable in growth rate is likely causing the poor identification in the growth rate regressions.

Dependent Variables:	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp
Stage	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
Wage SS (lvl)	0.3280^{***}		0.0450^{**}					
	(0.1085)		(0.0200)					
(l1, log) Elem.Ed.Exp.pp	0.1539^{***}	0.4720^{***}	0.2607^{***}	0.6882^{***}	0.1546^{***}	0.4518^{***}	0.2608^{***}	0.6878^{***}
	(0.0161)	(0.0328)	(0.0540)	(0.0423)	(0.0161)	(0.0438)	(0.0540)	(0.0425)
(log) IG Revenue pp	0.1352^{***}	0.1815^{***}	-0.2347^{***}	0.1607^{***}	0.1357^{***}	0.1637^{***}	-0.2347^{***}	0.1611^{***}
	(0.0191)	(0.0336)	(0.0483)	(0.0412)	(0.0191)	(0.0426)	(0.0483)	(0.0414)
(log) Real GDP Priv. Industry pc	0.2290^{***}	0.0138	0.0522^{*}	0.0316^{**}	0.2277^{***}	-0.0150	0.0522^{*}	0.0315^{**}
	(0.0284)	(0.0431)	(0.0295)	(0.0127)	(0.0283)	(0.0586)	(0.0295)	(0.0128)
(log) Enrollment	0.3028^{***}	-0.2977^{***}	0.1399^{***}	-0.0494^{**}	0.3062^{***}	-0.3387^{***}	0.1399^{***}	-0.0496^{**}
	(0.0341)	(0.0645)	(0.0091)	(0.0207)	(0.0339)	(0.0878)	(0.0091)	(0.0208)
% Black	-1.752^{***}	0.7467^{*}	-0.1156	0.0287	-1.760^{***}	0.9709^{*}	-0.1156	0.0288
	(0.5216)	(0.3828)	(0.0923)	(0.0290)	(0.5208)	(0.5085)	(0.0923)	(0.0292)
% Hispanic	0.2521	0.0154	0.1725^{*}	-0.0788^{**}	0.2626	-0.0270	0.1724^{*}	-0.0790^{**}
	(0.2577)	(0.1615)	(0.1005)	(0.0380)	(0.2581)	(0.1938)	(0.1005)	(0.0382)
(log) House Price Index		0.3840^{**}		0.2942^{**}		0.5133^{*}		0.2957^{**}
		(0.1905)		(0.1384)		(0.2640)		(0.1393)
Wage SS (lvl,l1)					0.2611^{**}		0.0451^{**}	
					(0.1027)		(0.0201)	
Fixed-effects								
unit	Yes	Yes			Yes	Yes		
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state			Yes	Yes			Yes	Yes
Fit statistics								
Observations	12,122	12,122	12,122	12,122	12,122	12,122	12,122	12,122
R2 (1st stage)	0.96574		0.74911		0.96569		0.74910	
Adj. R2 (1st stage)	0.96385		0.74776		0.96380		0.74775	
F-test (IV only)	56.278	12.481	98.573	74.850	38.479	15.272	98.136	75.291
F-test (IV only), p-value	6.73×10^{-14}	0.00041	3.84×10^{-23}	5.72×10^{-18}	5.71×10^{-10}	9.36×10^{-5}	4.78×10^{-23}	4.58×10^{-18}
Wu-Hausman		6.8728		58.363		9.8279		58.791
Wu-Hausman, p-value		0.00876		2.34×10^{-14}		0.00172		1.89×10^{-14}
Wald (IV only)	9.1433	4.0631	5.0650	4.5219	6.4677	3.7800	5.0419	4.5061
Wald (IV only), p-value	0.00250	0.04385	0.02443	0.03349	0.01100	0.05189	0.02476	0.03379

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Dependent Variables:	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp
IV stages	First	Second	First	Second	First	Second	First	Second
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
Wage SS (GR)	0.1913^{***}		0.8239^{***}					
	(0.0735)		(0.2690)					
(l1, log) Elem.Ed.Exp.pp	0.1560^{***}	0.5963^{***}	0.2866^{***}	0.7516^{***}	0.1563^{***}	0.4770^{***}	0.2876^{***}	0.6802^{***}
	(0.0162)	(0.0772)	(0.0545)	(0.0358)	(0.0162)	(0.0906)	(0.0545)	(0.0508)
(log) IG Revenue pp	0.1380^{***}	0.2914^{***}	-0.2495^{***}	0.1057^{***}	0.1381^{***}	0.1859^{**}	-0.2496^{***}	0.1677^{***}
	(0.0191)	(0.0671)	(0.0479)	(0.0309)	(0.0191)	(0.0876)	(0.0480)	(0.0467)
(log) Real GDP Priv. Industry pc	0.2230^{***}	0.1913^{*}	0.0584^{**}	0.0446^{***}	0.2229^{***}	0.0209	0.0586^{**}	0.0299^{**}
	(0.0278)	(0.1068)	(0.0290)	(0.0085)	(0.0278)	(0.1313)	(0.0290)	(0.0139)
(log) Enrollment	0.3168^{***}	-0.0452	0.1493^{***}	-0.0164	0.3172^{***}	-0.2876	0.1497^{***}	-0.0536^{**}
	(0.0337)	(0.1542)	(0.0080)	(0.0173)	(0.0337)	(0.1903)	(0.0080)	(0.0254)
% Black	-1.725^{***}	-0.6336	-0.1069	0.0054	-1.737^{***}	0.6915	-0.1065	0.0316
	(0.5078)	(0.8676)	(0.0922)	(0.0164)	(0.5084)	(1.044)	(0.0922)	(0.0332)
% Hispanic	0.3321	0.2769	0.1511	-0.0462^{**}	0.3267	0.0259	0.1507	-0.0829^{*}
	(0.2576)	(0.2246)	(0.0997)	(0.0224)	(0.2575)	(0.2325)	(0.0997)	(0.0440)
(log) House Price Index		-0.4120		0.0752		0.3522		0.3220^{*}
		(0.4762)		(0.1147)		(0.5862)		(0.1684)
Wage SS (GR,l1)					0.1345^{**}		0.6548^{***}	
					(0.0583)		(0.2412)	
Fixed-effects								
unit	Yes	Yes			Yes	Yes		
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state			Yes	Yes			Yes	Yes
Fit statistics								
Observations	12,122	12,122	12,122	12,122	12,122	12,122	12,122	12,122
R2 (1st stage)	0.96559		0.74731		0.96559		0.74724	
Adj. R2 (1st stage)	0.96369		0.74595		0.96369		0.74588	
F-test (IV only)	4.5662	1.1696	12.287	0.61069	2.5871	0.48426	8.8069	8.0264
F-test (IV only), p-value	0.03263	0.27950	0.00046	0.43454	0.10776	0.48651	0.00301	0.00462
Wu-Hausman		1.6999		0.16119		0.25023		6.3745
Wu-Hausman, p-value		0.19232		0.68807		0.61692		0.01159
Wald (IV only)	6.7752	0.74880	9.3808	0.43001	5.3212	0.36104	7.3671	3.6558
Wald (IV only), p-value	0.00925	0.38688	0.00220	0.51200	0.02108	0.54794	0.00665	0.05590

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

0.0.2 Industry-level GDP

We perform a similar combined baseline and causal IV estimation using the GDP-based shift-share instrument.

The estimates indicate that house prices are strongly correlated with local economic conditions. In the levels specification, both GDP per capita and population are positively associated with higher house prices, although the inclusion of state fixed effects alters the sign of lagged GDP coefficients, suggesting long-run mean reversion or heterogeneity across states. In the growth specification, contemporaneous GDP growth and short-run lags exert a positive effect on house price growth, while population growth also contributes significantly. Overall, these results imply that both the size and short-run dynamics of the local economy play a central role in shaping housing markets.

Overall, compared to wages, the relatively more sensitive stability of the relationship between GDP per capita and house prices indicates a weaker, and potentially more spurious link between real GDP and house prices. This conclusion logically aligns with the fact that the channel through which local economic activity links to house prices is through wages. Wages offer a more direct way of measuring the effect of local economic health on house prices than does real GDP. Nonetheless, the relationship still indicates a positive association between local economic health an dhousing prices, enough to warrant an investigation of our real value added shift-share instrument.

Dependent Variables:	(log) House Price Index		(GR) House Price Index	
Model:	(1)	(2)	(3)	(4)
Variables				
(log) Real GDP Priv. Industry pc	0.2411***	0.1438***		
	(0.0289)	(0.0274)		
(l1,log) Real GDP Priv. Industry pc	0.0276**	-0.0136		
	(0.0138)	(0.0198)		
(l2,log) Real GDP Priv. Industry pc	0.0204	-0.0256		
	(0.0141)	(0.0179)		
(l3,log) Real GDP Priv. Industry pc	0.0199	0.0373*		
	(0.0122)	(0.0208)		
(l4,log) Real GDP Priv. Industry pc	0.0045	-0.0078		
	(0.0166)	(0.0187)		
(l5,log) Real GDP Priv. Industry pc	0.0371***	-0.0061		
	(0.0131)	(0.0206)		
(l6,log) Real GDP Priv. Industry pc	0.0112	0.0212		
	(0.0136)	(0.0188)		
(l7,log) Real GDP Priv. Industry pc	0.0060	0.0146		
	(0.0124)	(0.0172)		
(log) Population	0.5459***	0.1524***		
	(0.0546)	(0.0079)		
(GR) Real GDP Priv. Industry pc			0.0161***	0.0169***
			(0.0048)	(0.0048)
(GR,l1) Real GDP Priv. Industry pc			0.0093**	0.0101***
			(0.0039)	(0.0039)
(GR,l2) Real GDP Priv. Industry pc			0.0062*	0.0063*
			(0.0034)	(0.0034)
(GR,l3) Real GDP Priv. Industry pc			-0.0009	-0.0010
			(0.0039)	(0.0039)
(GR,l4) Real GDP Priv. Industry pc			-0.0025	-0.0027
			(0.0037)	(0.0037)
(GR,l5) Real GDP Priv. Industry pc			0.0070*	0.0062
			(0.0041)	(0.0041)
(GR,l6) Real GDP Priv. Industry pc			8.67×10^{-5}	0.0010
			(0.0040)	(0.0040)
(GR,l7) Real GDP Priv. Industry pc			-0.0002	-3.7×10^{-5}
			(0.0038)	(0.0038)
(GR) Population			0.0060***	0.0064***
			(0.0016)	(0.0015)
Fixed-effects				
unit	Yes		Yes	
year	Yes	Yes	Yes	Yes
state		Yes		Yes
Fit statistics				
Observations	12,570	12,570	12,541	12,542
R^2	0.96261	0.74492	0.38587	0.37331
Within R^2	0.20336	0.45210	0.00564	0.00618

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Moving on to investigate the GDP-based shift-share instrument, we find a similar effect as with wages when estimating level shift-share shocks. The first-stage relationship between GDP shocks and house prices ranges from 0.1-0.7% increase in response to a 1% increase in the shift-share instrument (interpreted as wage levels) with an F-statistic between 100-400. These results hold after controlling for local revenues, GDP per capita, and enrollment, and the Wu-Hausman tests reject OLS in favor of IV, suggesting that naive estimates are biased. Overall, the evidence supports a causal channel from rising local housing wealth to increased investment in public education. However, we see an even weaker relationship when imposing the shift-share instrument as a growth rate shock where the first-stage relationship are spurious and statistically insignificant.

Together, these findings suggest that levels (rather than short-run changes) in GDP are more systematically and substantially associated with house price dynamics. The stronger fit and significant lag effects in the level regression underscore the longer-term influence of economic fundamentals on housing markets. It also indicates that wage growth is more important for house prices than the more general presence of industry-level GDP growth. This makes intuitive sense in that the link from industrial success (labour) to personal and community wealth creation is mediated via wage and not necessarily the total industrial output which might not be reflected in wages (especially given recent evidence of decoupling of wages from productivity).

Dependent Variables:	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp
IV stages	First	Second	First	Second	First	Second	First	Second
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
VA SS (Lvl)	0.6222***		0.0963***					
	(0.1541)		(0.0212)					
(l1, log) Elem.Ed.Exp.pp	0.1551***	0.4835***	0.2510***	0.7324***	0.1545***	0.4631***	0.2509***	0.7321***
	(0.0160)	(0.0246)	(0.0519)	(0.0180)	(0.0160)	(0.0263)	(0.0519)	(0.0181)
(log) IG Revenue pp	0.1333***	0.1917***	-0.2058***	0.1223***	0.1330***	0.1737***	-0.2058***	0.1226***
	(0.0189)	(0.0264)	(0.0469)	(0.0162)	(0.0189)	(0.0290)	(0.0470)	(0.0163)
(log) Real GDP Priv. Industry pc	0.2270***	0.0303	0.0410	0.0406***	0.2273***	0.0011	0.0411	0.0406***
	(0.0280)	(0.0315)	(0.0297)	(0.0066)	(0.0282)	(0.0356)	(0.0297)	(0.0066)
(log) Enrollment	0.2934***	-0.2742***	0.1239***	-0.0264***	0.2956***	-0.3158***	0.1239***	-0.0266***
	(0.0338)	(0.0440)	(0.0100)	(0.0060)	(0.0336)	(0.0502)	(0.0100)	(0.0060)
% Black	-1.876***	0.6185**	-0.0956	0.0124	-1.885***	0.8457**	-0.0955	0.0126
	(0.5182)	(0.2998)	(0.0902)	(0.0153)	(0.5169)	(0.3556)	(0.0902)	(0.0154)
% Hispanic	0.2465	0.0397	0.2065**	-0.0561***	0.2386	-0.0033	0.2065**	-0.0562***
	(0.2554)	(0.1443)	(0.1007)	(0.0197)	(0.2562)	(0.1640)	(0.1007)	(0.0198)
(log) House Price Index		0.3101**		0.1414***		0.4411***		0.1426***
		(0.1279)		(0.0392)		(0.1424)		(0.0394)
VA SS (lvl,l1)					0.6258***		0.0965***	
					(0.1529)		(0.0213)	
Fixed-effects								
unit	Yes	Yes			Yes	Yes		
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state			Yes	Yes			Yes	Yes
Fit statistics								
Observations	12,122	12,122	12,122	12,122	12,122	12,122	12,122	12,122
R2 (1st stage)	0.96591		0.75444		0.96591		0.75443	
Adj. R2 (1st stage)	0.96403		0.75311		0.96403		0.75311	
F-test (IV only)	117.27	16.879	362.21	62.091	117.77	34.349	362.12	63.157
F-test (IV only), p-value	3.35×10^{-27}	4.01×10^{-5}	1.36×10^{-79}	3.56×10^{-15}	2.6×10^{-27}	4.73×10^{-9}	1.42×10^{-79}	2.08×10^{-15}
Wu-Hausman		7.9479		35.314		20.630		36.135
Wu-Hausman, p-value		0.00482		2.88×10^{-9}		5.63×10^{-6}		1.89×10^{-9}
Wald (IV only)	16.300	5.8832	20.582	12.993	16.761	9.5999	20.574	13.066
Wald (IV only), p-value	5.44×10^{-5}	0.01530	5.77×10^{-6}	0.00031	4.27×10^{-5}	0.00195	5.79×10^{-6}	0.00030

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Dependent Variables:	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp	(log) House Price Index	(log) Elem.Ed.Exp.pp
IV stages	First	Second	First	Second	First	Second	First	Second
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Variables								
VA SS (GR)	0.0057		1.469***					
	(0.1181)		(0.3939)					
(l1, log) Elem.Ed.Exp.pp	0.1562***	13.10	0.2895***	0.8476***	0.1566***	0.1761	0.2909***	0.6249***
	(0.0162)	(259.8)	(0.0546)	(0.0436)	(0.0163)	(0.4958)	(0.0548)	(0.1074)
(log) IG Revenue pp	0.1380***	11.34	-0.2500***	0.0223	0.1380***	-0.0798	-0.2514***	0.2157**
	(0.0191)	(229.5)	(0.0479)	(0.0394)	(0.0191)	(0.4376)	(0.0480)	(0.0964)
(log) Real GDP Priv. Industry pc	0.2229***	18.04	0.0578**	0.0642***	0.2229***	-0.4085	0.0580**	0.0186
	(0.0278)	(371.4)	(0.0290)	(0.0126)	(0.0278)	(0.7105)	(0.0290)	(0.0272)
(log) Enrollment	0.3171***	25.34	0.1487***	0.0335	0.3170***	-0.8985	0.1497***	-0.0823
	(0.0337)	(527.7)	(0.0080)	(0.0226)	(0.0336)	(1.010)	(0.0080)	(0.0565)
% Black	-1.734***	-139.5	-0.1066	-0.0298	-1.732***	4.032	-0.1067	0.0519
	(0.5085)	(2,879.3)	(0.0920)	(0.0325)	(0.5084)	(5.721)	(0.0921)	(0.0597)
% Hispanic	0.3285	26.57	0.1511	0.0032	0.3287	-0.6067	0.1499	-0.1114
	(0.2576)	(544.3)	(0.0997)	(0.0337)	(0.2573)	(1.251)	(0.0998)	(0.0749)
(log) House Price Index		-80.47		-0.2565*		2.279		0.5131
		(1,663.4)		(0.1499)		(3.189)		(0.3742)
VA SS (GR,l1)					0.1221		0.7715	
					(0.1615)		(0.5047)	
Fixed-effects								
unit	Yes	Yes			Yes	Yes		
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
state			Yes	Yes			Yes	Yes
Fit statistics								
Observations	12,122	12,122	12,122	12,122	12,122	12,122	12,122	12,122
R2 (1st stage)	0.96558		0.74740		0.96558		0.74714	
Adj. R2 (1st stage)	0.96368		0.74604		0.96368		0.74577	
F-test (IV only)	0.00173	16.941	16.407	9.4817	0.64105	5.0243	3.7411	8.6593
F-test (IV only), p-value	0.96681	3.88×10^{-5}	5.14×10^{-5}	0.00208	0.42335	0.02501	0.05311	0.00326
Wu-Hausman		16.344		12.569		4.4447		7.5518
Wu-Hausman, p-value		5.32×10^{-5}		0.00039		0.03503		0.00600
Wald (IV only)	0.00235	0.00234	13.899	2.9295	0.57189	0.51055	2.3368	1.8797
Wald (IV only), p-value	0.96133	0.96141	0.00019	0.08700	0.44952	0.47492	0.12637	0.17039

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

0.0.3 Accounting for Heterogeneity

In order to make meaningful policy-related insights, we need to unmask the substantial heterogeneity obscured by the national-level average treatment effects described above. Barring design and data issues with our shift-share instrument, these national-level estimates are unlikley to apply uniformly across states and commuting zones. Therefore, this next section is dedicated to unpacking this heterogeneity. Below, we explore various metrics of local economic growth and decline to (1) partition our sample according to metrics of economic health, employ (2) industry-by-industry and (2) state-by-state uestimations sing our baseline descriptive models, wage- and GDP-based shift-share instruments.

0.0.3.1 Declining vs. Growing Regions

First, we identify declining and growing regions by estimating commuting-zone growth rates conditional on state and national level growth rates and partition our sample across this distribution.

In Figure X, we see that there is similar variability though the patterns do not consistently indicate the same high- and low-performing outliers across states indicating that GDP and wage growth are not consistently correlated across regions. We demonstrate this fact in Figure X (scatterplot with pink regression linear fit) where, although there is a positive correlation between commuting zone GDP and wage trend deviations, the wage trend deviation represents a nearly inelastic relationship to GDP growth.

0.0.3.2 Baseline Models

Table 1: Baseline Regression Applied to Declining GDP vs. Growing GDP Regions

Dependent Variable:	(log) Elem.Ed.Exp.pp											
		Declining			Hyper-Declining			Growing			Hyper-Growing	
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables												
(log) Real GDP Priv. Industry pc	0.0277			0.0214			0.0120			0.0022		
	(0.0359)			(0.0410)			(0.0222)			(0.0284)		
(log,l1) Real GDP Priv. Industry pc	0.0479			0.0524			0.0651^{***}			0.0616^{***}		
	(0.0313)			(0.0360)			(0.0160)			(0.0202)		
(log,l2) Real GDP Priv. Industry pc	0.1205^{***}			0.1191^{***}			0.1302^{***}			0.1647^{***}		
	(0.0303)			(0.0324)			(0.0291)			(0.0349)		
(log) IG Revenue pp	0.4154^{***}	0.4193^{***}	0.4114^{***}	0.3556^{***}	0.3651^{***}	0.3518^{***}	0.3671^{***}	0.3292^{***}	0.3462^{***}	0.3478^{***}	0.2888^{***}	0.2903^{***}
	(0.0605)	(0.0561)	(0.0603)	(0.0746)	(0.0700)	(0.0753)	(0.0352)	(0.0415)	(0.0386)	(0.0500)	(0.0588)	(0.0605)
(log) Annual Avg. Wkly. Wage		0.0394			0.0299			0.1855^{**}			0.1696	
		(0.0865)			(0.1070)			(0.0758)			(0.1191)	
(log, l1) Annual Avg. Wkly. Wage		0.1796^{*}			0.2173			0.1605^{***}			0.2229^{**}	
		(0.0977)			(0.1394)			(0.0544)			(0.0899)	
(log, l2) Annual Avg. Wkly. Wage		0.4072^{***}			0.4024^{***}			0.1573			0.1891	
		(0.1059)			(0.1402)			(0.1004)			(0.1518)	
(log) House Price Index			-0.0213			-0.0521			0.1053^{***}			0.1689^{***}
			(0.0354)			(0.0510)			(0.0324)			(0.0523)
(log, l1) House Price Index			0.1280^{***}			0.1933^{***}			0.0321			0.0468
			(0.0330)			(0.0377)			(0.0355)			(0.0547)
(log, l2) House Price Index			0.0232			0.0411			0.0447^{*}			0.0605
			(0.0308)			(0.0415)			(0.0262)			(0.0450)
(log, l3) House Price Index			0.0811^{**}			0.1080^{**}			0.0185			-0.0212
			(0.0384)			(0.0516)			(0.0254)			(0.0365)
(log, l4) House Price Index			-0.0407			-0.0958^{*}			-0.0286			-0.0912^{**}
			(0.0405)			(0.0524)			(0.0269)			(0.0450)
Fixed-effects												
unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics												
Observations	5,016	5,544	5,496	3,021	3,339	3,291	7,068	7,812	7,092	3,021	3,339	2,796
R^2	0.84183	0.84524	0.84205	0.83022	0.83653	0.83399	0.86135	0.85283	0.86232	0.79838	0.78135	0.77960
Within R^2	0.23941	0.27905	0.26129	0.19348	0.24973	0.23246	0.25046	0.21280	0.19813	0.26413	0.19167	0.15594

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

0.0.3.3 Wage SS Instrument

Result: The baseline estimate of an l-1 effect on public education expenditure is entirely dominated by declining regions. Interestingly, sample division by GDP growth rates isolates the wage-based SS instrument

Table 2: Baseline Regression Applied to Declining Wage vs. Growing Wage Regions

Dependent Variable:	(log) Elem.Ed.Exp.pp											
	Declining			Hyper-Declining			Growing			Hyper-Growing		
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Variables												
(log) Real GDP Priv. Industry pc	0.0124			0.0155			0.0165			-0.0074		
	(0.0577)			(0.0435)			(0.0201)			(0.0291)		
(log,l1) Real GDP Priv. Industry pc	0.1342***			0.1419***			0.0600***			0.0478**		
	(0.0414)			(0.0297)			(0.0148)			(0.0204)		
(log,l2) Real GDP Priv. Industry pc	0.0867*			0.0436			0.1448***			0.1680***		
	(0.0453)			(0.0415)			(0.0258)			(0.0348)		
(log) IG Revenue pp	0.3638***	0.3516***	0.3719***	0.4551***	0.4497***	0.4437***	0.3845***	0.3566***	0.3706***	0.3208***	0.2613***	0.2605***
	(0.0704)	(0.0643)	(0.0747)	(0.0570)	(0.0511)	(0.0540)	(0.0328)	(0.0368)	(0.0369)	(0.0490)	(0.0630)	(0.0537)
(log) Annual Avg. Wkly. Wage		-0.0397			0.0202			0.1911***			0.1556	
		(0.1478)			(0.0928)			(0.0660)			(0.1067)	
(log, l1) Annual Avg. Wkly. Wage		0.3092**			0.2210***			0.1709***			0.1649**	
		(0.1382)			(0.0813)			(0.0498)			(0.0761)	
(log, l2) Annual Avg. Wkly. Wage		0.4446***			0.3423***			0.2241**			0.2232	
		(0.1351)			(0.1090)			(0.0889)			(0.1418)	
(log) House Price Index			-0.0295			-0.0387			0.0947***			0.1485***
			(0.0608)			(0.0465)			(0.0299)			(0.0561)
(log, l1) House Price Index			0.1615**			0.1686***			0.0521*			0.0014
			(0.0668)			(0.0515)			(0.0294)			(0.0560)
(log, l2) House Price Index			0.0389			0.0030			0.0499**			0.0360
			(0.0564)			(0.0367)			(0.0235)			(0.0459)
(log, l3) House Price Index			-0.0167			0.0330			0.0471**			-0.0077
			(0.0618)			(0.0386)			(0.0237)			(0.0371)
(log, l4) House Price Index			0.0537			0.0014			-0.0260			0.0163
			(0.0506)			(0.0369)			(0.0242)			(0.0471)
Fixed-effects												
unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics												
Observations	1,520	1,680	1,593	3,021	3,339	3,203	10,564	11,676	10,995	3,021	3,339	2,867
R^2	0.89240	0.89101	0.88268	0.86591	0.86376	0.86041	0.84837	0.84083	0.84564	0.85678	0.83702	0.84799
Within R^2	0.23695	0.26609	0.23308	0.27288	0.28206	0.27358	0.26758	0.24564	0.23328	0.27774	0.19569	0.14548

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

effect almost entirely indicating that wage changes in declining regions matter most. Potentially an indicator of property price spirals.

Result: Whereas, in the case of the wage-based instrument when applied to growing and declining wage regions, the effect is more widespread across regions.

0.0.3.4 GDP SS Instrument

Result: In the case of the GDP-based instrument, the sub-sampling procedure indicates that GDP growth has an effect on public education expenditure in all but hyper-growing areas (as defined in both GDP and wage subsampling) indicating that GDP growth translates to changes in public expenditure more directly in all but non-superstar regions. This could indicate a spillover into private education...possible to investigate?

Table 3: Wage-based Shift-Share Instrument (l1) Applied to Declining GDP vs. Growing GDP Regions

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining (GDP)	Hyper-Declining (GDP)	Growing (GDP)	Hyper-Growing (GDP)
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.9707**	1.110***	0.9796***	0.7658	0.3677
	(0.3789)	(0.3718)	(0.3648)	(0.6049)	(0.8017)
(log) IG Revenue pp	0.4177***	0.4912***	0.4201***	0.4028***	0.2624***
	(0.0906)	(0.1084)	(0.1032)	(0.1272)	(0.0622)
(log) Real GDP Priv. Industry pc	0.0633	0.1163	0.1446*	0.0766	0.1156
	(0.0529)	(0.0744)	(0.0865)	(0.0685)	(0.1147)
(log) Enrollment	-0.1642***	-0.1711***	-0.1594***	-0.1450	-0.1249
	(0.0547)	(0.0488)	(0.0522)	(0.0950)	(0.1511)
Fixed-effects					
year	Yes	Yes	Yes	Yes	Yes
state	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,122	5,240	3,140	6,882	2,761
F-test (IV only)	461.61	537.75	298.28	80.036	3.6949
F-test (IV only), p-value	1.62×10^{-100}	2.87×10^{-113}	7.18×10^{-64}	4.67×10^{-19}	0.05468
Wu-Hausman	385.52	433.95	227.64	65.722	2.9286
Wu-Hausman, p-value	1.62×10^{-84}	1.29×10^{-92}	1.11×10^{-49}	6.11×10^{-16}	0.08714
Wald (IV only)	6.5624	8.9225	7.2100	1.6027	0.21038
Wald (IV only), p-value	0.01043	0.00283	0.00729	0.20556	0.64650

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 4: Wage-based Shift-Share Instrument (l1) Applied to Declining Wage vs. Growing Wage Regions

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining (Wage)	Hyper-Declining (Wage)	Growing (Wage)	Hyper-Growing (Wage)
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.9707**	0.7404	1.169*	0.8769**	0.4162
	(0.3789)	(0.4451)	(0.6305)	(0.3641)	(0.4671)
(log) IG Revenue pp	0.4177***	0.3630***	0.4551***	0.4119***	0.2829***
	(0.0906)	(0.1343)	(0.1654)	(0.0884)	(0.0621)
(log) Real GDP Priv. Industry pc	0.0633	-0.0124	-0.0335	0.0861**	0.1094**
	(0.0529)	(0.1669)	(0.1910)	(0.0436)	(0.0544)
(log) Enrollment	-0.1642***	-0.1246**	-0.1747**	-0.1502***	-0.1184
	(0.0547)	(0.0603)	(0.0778)	(0.0509)	(0.0747)
Fixed-effects					
year	Yes	Yes	Yes	Yes	Yes
state	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,122	1,520	3,060	10,602	2,822
F-test (IV only)	461.61	70.621	256.33	383.32	21.828
F-test (IV only), p-value	1.62×10^{-100}	1.01×10^{-16}	2×10^{-55}	7.19×10^{-84}	3.12×10^{-6}
Wu-Hausman	385.52	47.014	210.21	324.43	23.718
Wu-Hausman, p-value	1.62×10^{-84}	1.04×10^{-11}	4.31×10^{-46}	1.84×10^{-71}	1.18×10^{-6}
Wald (IV only)	6.5624	2.7674	3.4365	5.8010	0.79401
Wald (IV only), p-value	0.01043	0.09642	0.06387	0.01603	0.37297

Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 5: GDP-based Shift-Share Instrument (l1) Applied to Declining Wage vs. Growing Wage Regions

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining (Wage)	Hyper-Declining (Wage)	Growing (Wage)	Hyper-Growing (Wage)
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.4537***	0.4421**	0.6652***	0.3869***	-0.0710
	(0.1225)	(0.1987)	(0.2376)	(0.1208)	(0.1747)
(log) IG Revenue pp	0.3217***	0.2843***	0.3311***	0.3261***	0.2659***
	(0.0392)	(0.0832)	(0.0794)	(0.0402)	(0.0401)
(log) Real GDP Priv. Industry pc	0.1221***	0.0806	0.0835	0.1297***	0.1622***
	(0.0258)	(0.0891)	(0.0973)	(0.0239)	(0.0331)
(log) Enrollment	-0.0897***	-0.0838***	-0.1109***	-0.0822***	-0.0427
	(0.0180)	(0.0298)	(0.0286)	(0.0171)	(0.0317)
Fixed-effects					
year	Yes	Yes	Yes	Yes	Yes
state	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,122	1,520	3,060	10,602	2,822
F-test (IV only)	275.80	51.996	206.30	194.26	1.3917
F-test (IV only), p-value	2.95×10^{-61}	8.87×10^{-13}	2.7×10^{-45}	9.11×10^{-44}	0.23822
Wu-Hausman	176.29	23.467	135.86	126.44	0.91974
Wu-Hausman, p-value	5.98×10^{-40}	1.41×10^{-6}	9.74×10^{-31}	3.61×10^{-29}	0.33763
Wald (IV only)	13.718	4.9519	7.8373	10.253	0.16524
Wald (IV only), p-value	0.00021	0.02621	0.00515	0.00137	0.68441

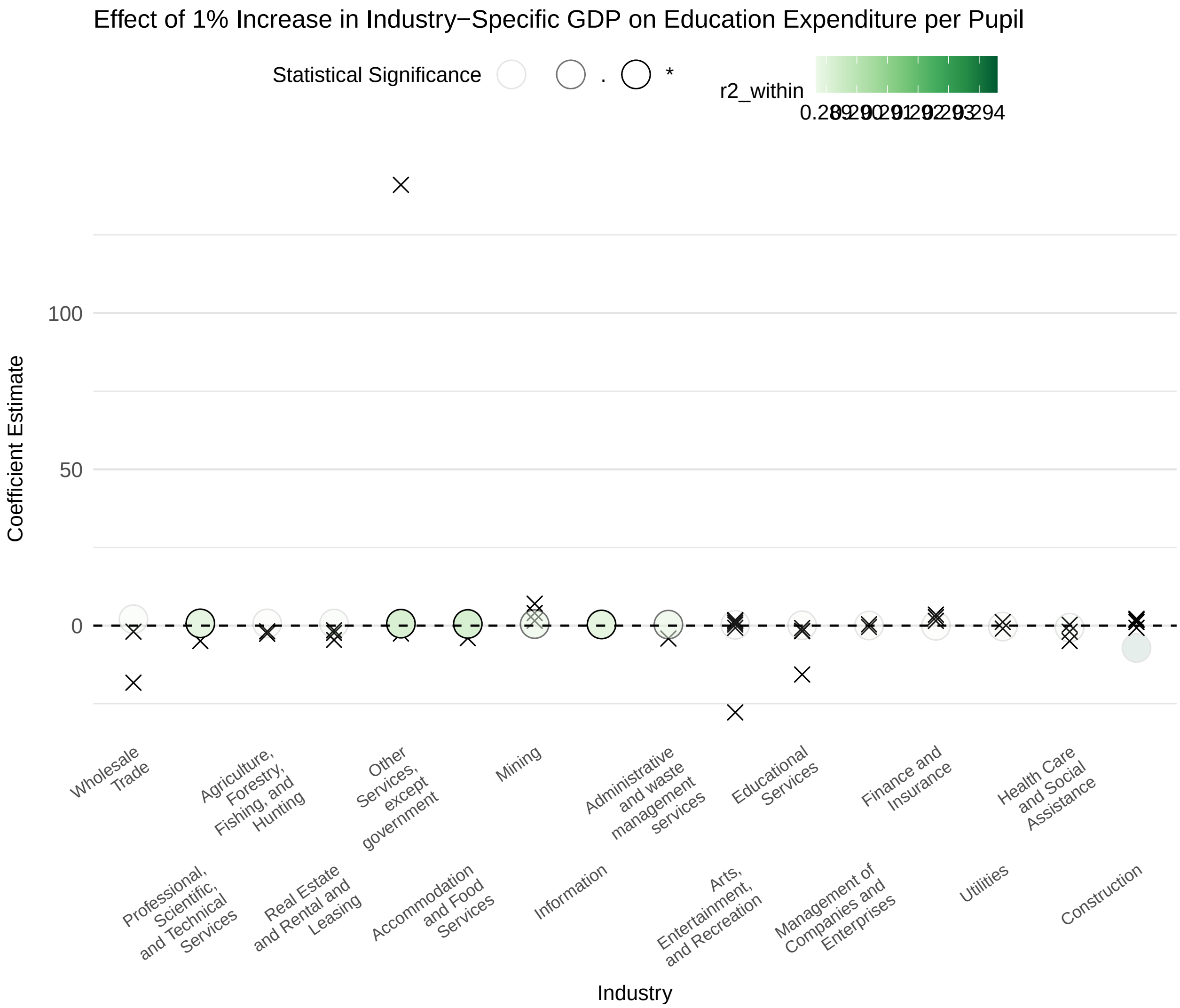
Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table 6: GDP-based Shift-Share Instrument (l1) Applied to Declining GDP vs. Growing GDP Regions

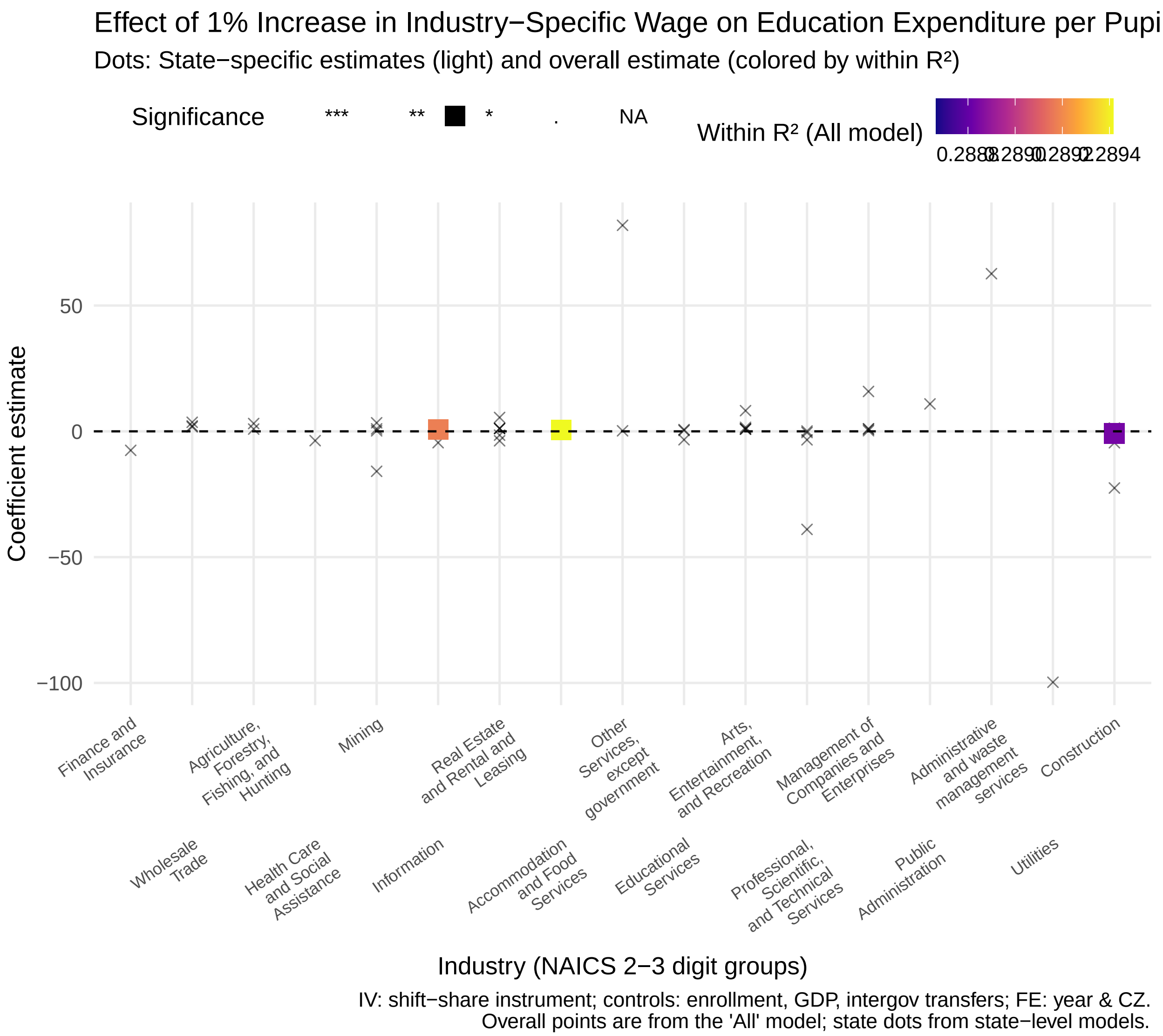
Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining (GDP)	Hyper-Declining (GDP)	Growing (GDP)	Hyper-Growing (GDP)
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.4537***	0.6799***	0.7473***	0.1898	-0.1220
	(0.1225)	(0.1706)	(0.2250)	(0.1388)	(0.2311)
(log) IG Revenue pp	0.3217***	0.3877***	0.3695***	0.2906***	0.2348***
	(0.0392)	(0.0589)	(0.0751)	(0.0463)	(0.0482)
(log) Real GDP Priv. Industry pc	0.1221***	0.1559***	0.1606**	0.1360***	0.1814***
	(0.0258)	(0.0507)	(0.0717)	(0.0267)	(0.0443)
(log) Enrollment	-0.0897***	-0.1158***	-0.1277***	-0.0555**	-0.0329
	(0.0180)	(0.0218)	(0.0318)	(0.0217)	(0.0442)
Fixed-effects					
year	Yes	Yes	Yes	Yes	Yes
state	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,122	5,240	3,140	6,882	2,761
F-test (IV only)	275.80	417.78	238.81	21.107	1.8623
F-test (IV only), p-value	2.95×10^{-61}	2.3×10^{-89}	6.04×10^{-52}	4.42×10^{-6}	0.17247
Wu-Hausman	176.29	279.33	163.43	7.2715	3.4328
Wu-Hausman, p-value	5.98×10^{-40}	4.09×10^{-61}	1.68×10^{-36}	0.00702	0.06402
Wald (IV only)	13.718	15.885	11.027	1.8703	0.27885
Wald (IV only), p-value	0.00021	6.82×10^{-5}	0.00091	0.17149	0.59750

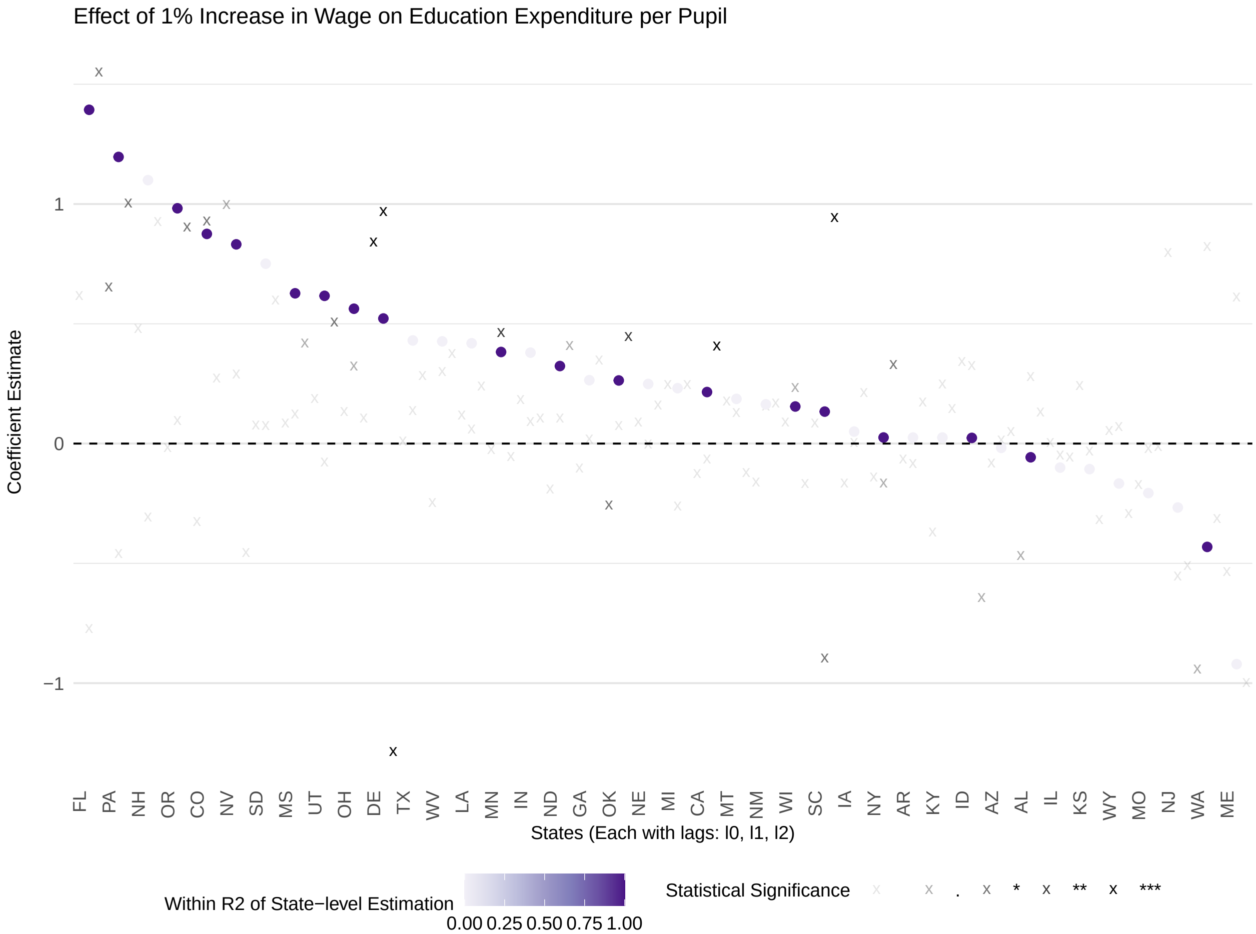
Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

0.0.3.5 State-by-state and industry-by-industry estimation

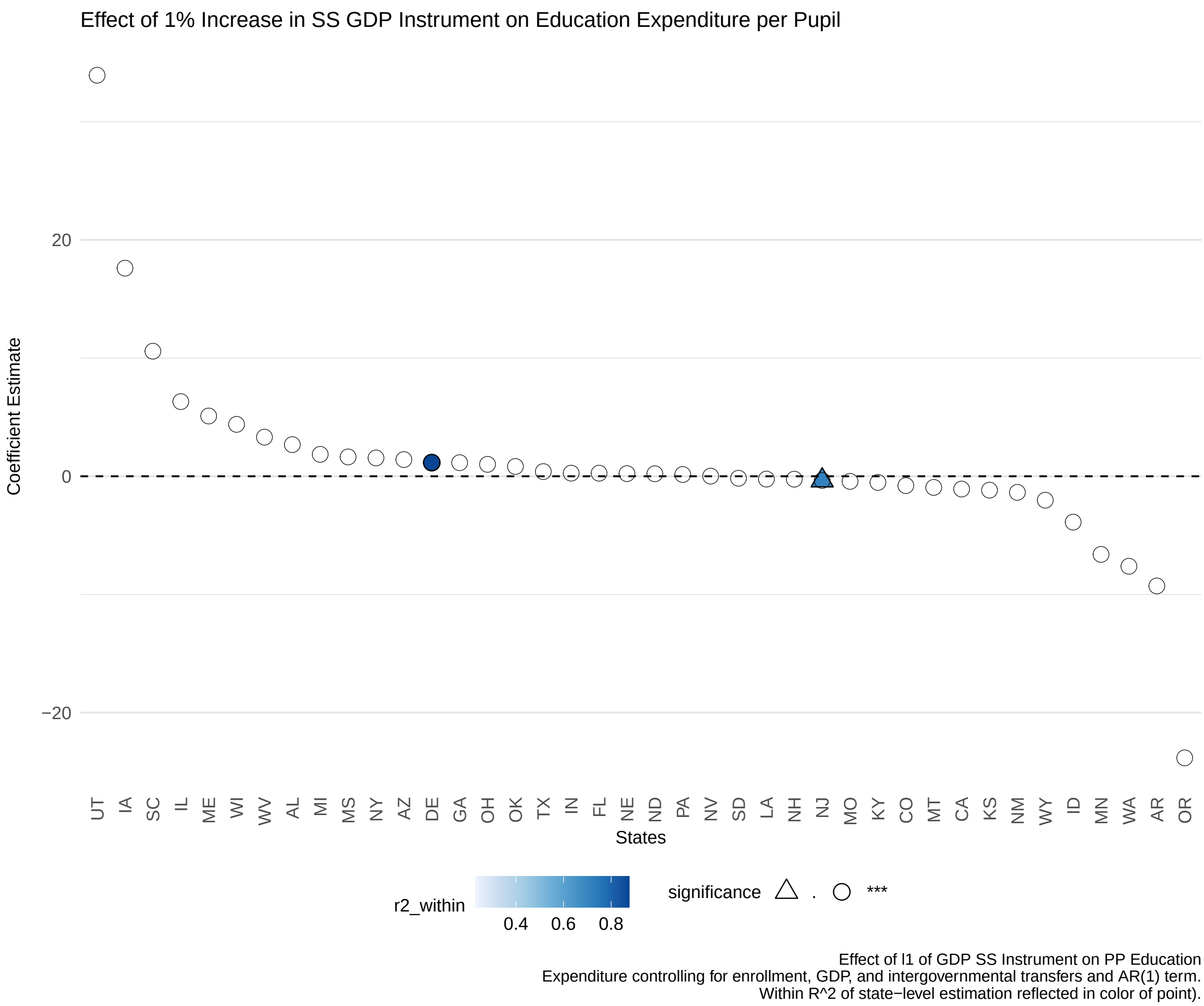


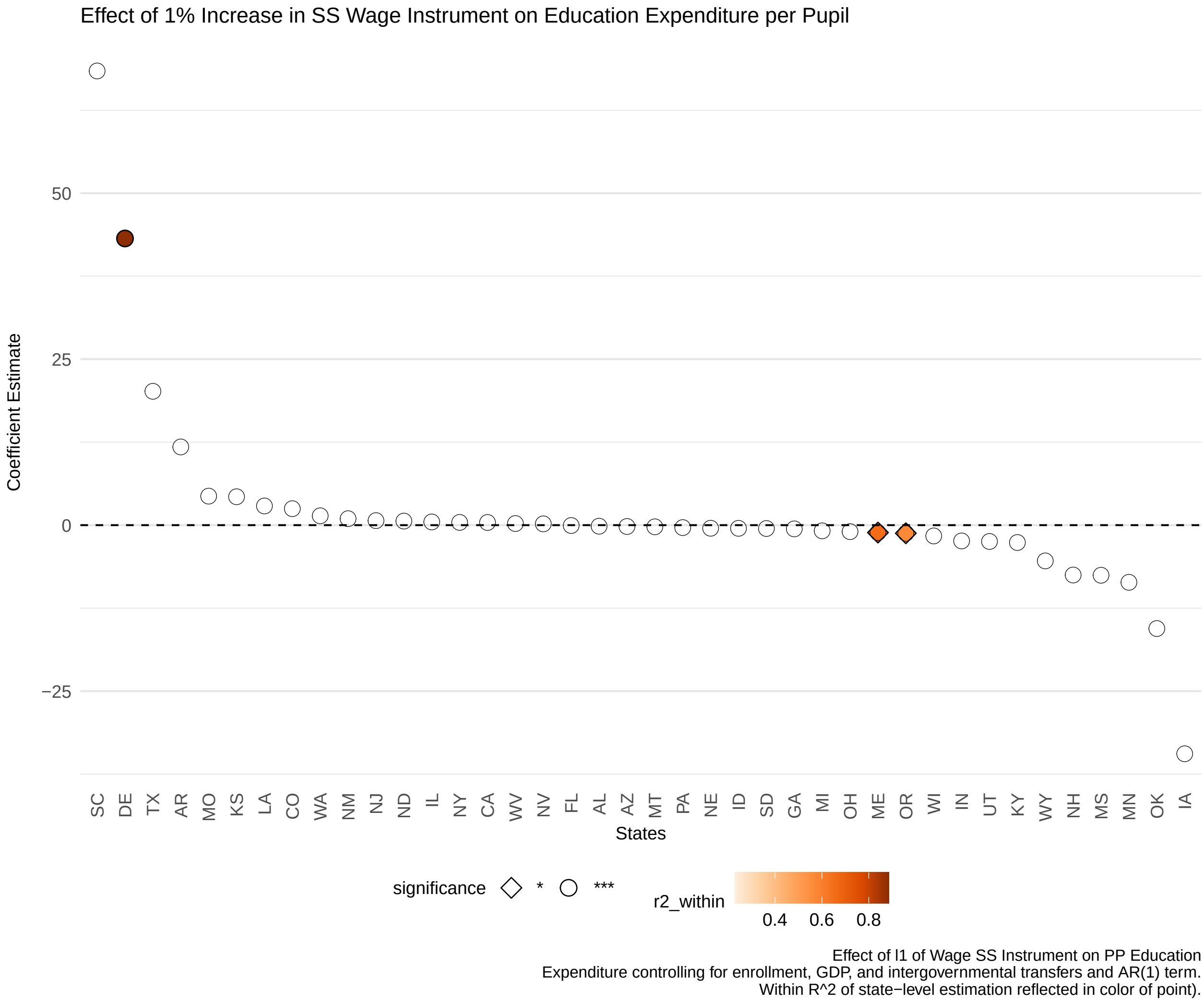
Effect of 1% increase in Industry−Specific GDP (shift−share). Controls: enrollment, GDP, intergov transfers, AR(1), year & state FE.
Within R^2 of 'All' estimation in point color.


Effect of 1% Increase in Industry−Specific Wage on Education Expenditure per Pupil
Dots: State−specific estimates (light) and overall estimate (colored by within R²)
Significance
***
**
*
.
NA
Within R² (All model)
0.2888
0.2890
0.2892
0.2894
Coefficient estimate
50
0
−50
−100
Finance and Insurance
Wholesale Trade
Agriculture, Forestry, Fishing, and Hunting
Health Care and Social Assistance
Mining
Information
Real Estate and Rental and Leasing
Accommodation and Food Services
Other Services, except government
Educational Services
Arts, Entertainment, and Recreation
Professional, Scientific, and Technical Services
Management of Companies and Enterprises
Public Administration
Administrative and waste management services
Utilities
Construction
Industry (NAICS 2−3 digit groups)
IV: shift−share instrument; controls: enrollment, GDP, intergov transfers; FE: year & CZ.
Overall points are from the 'All' model; state dots from state−level models.



Effect of contemporaneous, l1, l2 lag of avg weekly wage on PP Education Expenditure controlling for enrollment, GDP, and intergovernmental transfers.
Each state has 3 lagged wage coefficients (l0, l1, l2).
Blue dots show total effect across lags, plotted at the l1 position.
Within R^2 of state−level estimation reflected in color of point).


Effect of 1% Increase in SS GDP Instrument on Education Expenditure per Pupil
Coefficient Estimate
20
0
−20
UT IA SC IL ME WI WV AL MI MS NY AZ DE GA OH OK TX IN FL NE ND PA NV SD LA NH NJ MO KY CO MT CA KS NM WY ID MN WA AR OR
States
r2_within
0.4 0.6 0.8
significance . ***
Effect of l1 of GDP SS Instrument on PP Education
Expenditure controlling for enrollment, GDP, and intergovernmental transfers and AR(1) term.
Within R^2 of state−level estimation reflected in color of point).



Bartik, Timothy J. 1991. *Who Benefits from State and Local Economic Development Policies?* W.E. Upjohn Institute. https://www.jstor.org/stable/j.ctvh4zh1q.

Ferri, Benjamin. 2022. "Novel Shift-Share Instruments and Their Applications." *Boston College Working Papers in Economics*, Boston College Working Papers in Economics, September. https://ideas.repec.org//p/boc/bocoec/1053.html.

Goldsmith-Pinkham, Paul, Isaac Sorkin, and Henry Swift. 2020. "Bartik Instruments: What, When, Why, and How." *American Economic Review* 110 (8): 2586–2624. https://doi.org/10.1257/aer.20181047.