Uneven Wage Growth and Public Goods:

The Case of US Public Education

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1 Introduction

The following document summarises the progress made thus far on Chapter 1: Local Fiscal Risks of Decarbonisation of my DPhil. The work aims to pursue a better understanding of how industrial transformation impacts local well-being. From an original interest in looking at all aspects of local public finance, the project has narrowed to focus on expenditure on public education and its connection to industrial prosperity and transformation.

Current strategy/research plan: 1. Outcome: Educational Expenditure 2. Treatment (endogenous): Wages, Economic Growth, Property Values, Property Taxes 3. Instrument: Industry Shares of Employment in high vs. low wage growth industries/sectors - plausible exogeneity comes from industrial shares. Need to justify the choice of base-year for the shift-share instrument such that industries were "present" but still nascent (this is important because there are likely to be certain industries that "cropped up" post-baseline completely unrelated to the industrial composition before right?)

Recall the work from the previous meeting:

1. After reading more work on US economic geography, it became clear that aggregating counties up to commuting zones was the better choice for analysis at sub-state level as these areas more accurately represent local labour markets/economies/commuting zones (Fowler et al. 2024, David Dorn's Resource Page).
2. Below, I provide some baseline regressions to demonstrate the relationships between key variables in the dataset.
3. Next, I turn to an instrumental variable application in which I use coal mine counts and production volumes as an instrument for property taxes. Coal mine counts do not serve as good instruments but coal production passes relevance and exogeneity restrictions. I believe a strong argument can be made for the exclusion restriction to be satisfied. I provide supporting statistical tests for all that demonstrate the unfitness of coal mine counts but fitness of coal production. Along this line, we can hopefully discuss other sources of variation in industrial/economic productivity that might lead to property value spirals (positive or negative) to test the property tax channel.
4. I identify declining vs. growing regions by estimating commuting-zone growth rates conditional on state and national level growth rates. Using this distinction (on both a per capita and total gdp bases and a lenient vs. stringent magnitude threshold), I rerun the key regressions identified in steps 2 and 3 on the subgroups (declining and growing regions).

Note: Any warnings about "missing observations" or "NA being removed" relates to the lags incorporated, except in the Bartik estimations.

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[1] "Running analysis on CZs (cz_id)."
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2 Data

All data used is reported annually at the commuting zone level. Therefore, no time-invariant variables are included (apart from the State in which a commuting zone is in, which is made time-variant through the inclusion of a state-level trend in various models). 636 commuting zones in 40 states between 2001-2021.

Expenditure and Revenue: The dependent variables of interest come from Willamette University's Government Finance Database. The data includes commuting-zone level revenue and expenditure on public education including disaggregated values by revenue source (federal, state, or other intergovernmental revenue) and expenditure item (lunches, wages, debt). All values are reported in real US dollars. The data for property taxes collected used in regressions below also come from this dataset. Expenditure on vocational training and from Educational Service Agencies (ESAs) are also sourced from this dataset.

GDP Controls: US Bureau of Economic Analysis. Values are also reported in current US dollars (real GDP values exist). The controls used in the below are total, private industry, and oil, gas, mining & quarrying commuting zone-level GDP.

Population controls: US Census Bureau.

Coal mine activity and production levels: Mine Safety and Health Administration

2.1 Summary statistics

All dollar values are reported in real 2017-chained thousands.

% Table created by stargazer v.5.2.3 by Marek Hlavac, Social Policy Institute. E-mail: marek.hlavac at gmail.com % Date and time: Thu, Jun 05, 2025 - 02:03:56

Table 1

Statistic	N	Mean	St. Dev.	Min	Max
Enrollment	13,356	62,385	169,905	126	3,169,733
Population	13,356	405,180	1,077,994	884	18,732,544
Elem. Expenditure per pupil	13,356	11	3	6	58
Property Tax per pupil	13,356	4	2	0	33
IG Revenue per pupil	13,356	7	2	1	28
Federal IG Revenue per pupil	13,356	0	1	0	10
State IG Revenue per pupil	13,356	7	2	1	26
GDP per capita	13,356	45	25	15	389
GDP pc - Private Industry	13,356	38	25	6	383
GDP pc - Oil, gas, mining	13,356	5	22	0	358
Elem. Expenditure	13,356	721,660	2,041,665	1,743	36,821,354
Property Tax	13,356	269,965	869,323	134	13,122,389
IG Revenue	13,356	407,826	1,221,577	628	29,281,493
Federal IG Revenue	13,356	4,494	11,734	0	188,059
State IG Revenue	13,356	394,483	1,186,265	473	28,049,628
GDP	13,356	20,460,822	63,264,224	23,844	1,170,864,108
GDP - Private Industry	13,356	17,966,608	56,867,704	18,518	1,058,221,358
GDP - Oil, gas, mining	13,356	533,297	2,247,582	0	69,778,502
Active Coal Mines	13,356	1	8	0	220
Coal Produced (k short tons)	13,356	1,448	13,930	0	415,924

3 Modelling

3.1 Baseline TWFE Model

3.1.1 Incorporating time lags

Education expenditure has a highly relevant time dependence. The effect of increases in GDP two years prior has the greatest effect on current education expenditure, implying a delayed effect of commuting zone-level economic growth on public education expenditure. First 6 do not include state time trends; second 6 do.

Dependent Variable:	(log) Elem.Ed.Exp.pp						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
(log) Real GDP Priv. Industry pc	0.0094	-0.0144	-0.0095	0.0171			
	(0.0203)	(0.0204)	(0.0199)	(0.0198)			
(log,l1) Real GDP Priv. Industry pc	0.0612***	0.0400***	0.0241	0.0344**			
	(0.0145)	(0.0153)	(0.0178)	(0.0169)			
(log,l2) Real GDP Priv. Industry pc	0.1325***	0.1073***	0.0944***	0.1092***			
	(0.0225)	(0.0232)	(0.0234)	(0.0197)			
(log) Annual Avg. Wkly. Wage		0.1998***	0.1319*	0.0483	0.2645***	0.1592**	0.1283*
		(0.0668)	(0.0699)	(0.0732)	(0.0632)	(0.0655)	(0.0679)
(log, l1) Annual Avg. Wkly. Wage		0.1779***	0.1339**	0.1417**	0.2201***	0.1621***	0.1619***
		(0.0525)	(0.0578)	(0.0571)	(0.0484)	(0.0549)	(0.0540)
(log, l2) Annual Avg. Wkly. Wage		0.0215	0.0090	0.0079	0.1945***	0.1674***	0.1963***
		(0.0637)	(0.0647)	(0.0637)	(0.0678)	(0.0541)	(0.0530)
(log) House Price Index			0.0186	-0.0310		0.0386	0.0003
			(0.0299)	(0.0271)		(0.0273)	(0.0245)
(log, l1) House Price Index			0.0726**	0.0573*		0.0657**	0.0532**
			(0.0327)	(0.0315)		(0.0272)	(0.0259)
(log, l2) House Price Index			0.0776***	0.0498**		0.0614***	0.0306
			(0.0259)	(0.0245)		(0.0228)	(0.0211)
(log, l3) House Price Index			0.0158	0.0235		0.0295	0.0338
			(0.0237)	(0.0231)		(0.0220)	(0.0209)
(log, l4) House Price Index			-0.0118	0.0109		-0.0051	0.0185
			(0.0260)	(0.0230)		(0.0221)	(0.0195)
(log, l5) House Price Index			-0.0799***	-0.0588***		-0.0897***	-0.0669***
			(0.0243)	(0.0207)		(0.0219)	(0.0190)
(log) State IG Rev pp				0.3600***			0.3480***
				(0.0334)			(0.0330)
(log) Fed IG Rev. pp				0.0056**			0.0055**
				(0.0025)			(0.0022)
Fixed-effects							
unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics							
Observations	12,084	12,084	11,420	11,420	13,356	12,536	12,536
R^2	0.82088	0.82430	0.83203	0.86309	0.81776	0.82710	0.85772
Within R^2	0.07806	0.09567	0.10150	0.26763	0.08329	0.09465	0.25497

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

Dependent Variable:	(log) Elem.Ed.Exp.pp				
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
state_share	0.3807	0.4409	-0.4090	0.1497	-0.6038
	(0.6027)	(0.6279)	(0.6709)	(0.4649)	(0.4585)
(log) Real GDP Priv. Industry pc	-0.2444***	-0.2447***	-0.1677**		
	(0.0775)	(0.0814)	(0.0778)		
(log,l1) Real GDP Priv. Industry pc	0.1036*	0.0778	-0.0283		
	(0.0614)	(0.0630)	(0.0684)		
(log,l2) Real GDP Priv. Industry pc	0.3252***	0.2954***	0.2816***		
	(0.0801)	(0.0785)	(0.0724)		
state_share × (log) Real GDP Priv. Industry pc	0.4415***	0.3919***	0.2482**		
	(0.1274)	(0.1335)	(0.1258)		
state_share × (log,l1) Real GDP Priv. Industry pc	-0.1160	-0.1056	0.0551		
	(0.0996)	(0.1014)	(0.1082)		
state_share × (log,l2) Real GDP Priv. Industry pc	-0.4256***	-0.4044***	-0.3903***		
	(0.1235)	(0.1222)	(0.1031)		
(log) Annual Avg. Wkly. Wage		-0.0579	-0.0523	-0.0169	-0.0695
		(0.1949)	(0.1995)	(0.2152)	(0.2062)
(log, l1) Annual Avg. Wkly. Wage		0.2640*	0.1269	0.2405	0.1220
		(0.1551)	(0.2255)	(0.1549)	(0.2182)
(log, l2) Annual Avg. Wkly. Wage		0.1513	0.0969	0.3747*	0.3149*
		(0.1657)	(0.1791)	(0.1979)	(0.1706)
state_share × (log) Annual Avg. Wkly. Wage		0.5684*	0.4082	0.5184	0.3950
		(0.3118)	(0.3189)	(0.3406)	(0.3260)
state_share × (log, l1) Annual Avg. Wkly. Wage		-0.1879	-0.0520	-0.0884	0.0042
		(0.2504)	(0.3474)	(0.2472)	(0.3352)
state_share × (log, l2) Annual Avg. Wkly. Wage		-0.3645	-0.2613	-0.5583*	-0.4675*
		(0.2823)	(0.2785)	(0.3234)	(0.2708)
(log) House Price Index			-0.1954		-0.2105*
			(0.1300)		(0.1219)
(log, l1) House Price Index			0.1465		0.1385
			(0.1673)		(0.1373)
(log, l2) House Price Index			0.4083***		0.3942***
			(0.1190)		(0.0990)
(log, l3) House Price Index			-0.0575		-0.0163
			(0.0980)		(0.1096)
(log, l4) House Price Index			-0.1427		-0.1251
			(0.1095)		(0.0925)
(log, l5) House Price Index			-0.0397		-0.1044
			(0.0831)		(0.0851)
state_share × (log) House Price Index			0.4394**		0.4690**
			(0.1983)		(0.1870)
state_share × (log, l1) House Price Index			-0.1329		-0.1294
			(0.2474)		(0.2050)
state_share × (log, l2) House Price Index			-0.5463***		-0.5355***
			(0.1807)		(0.1493)
state_share × (log, l3) House Price Index			0.0967		0.0493
			(0.1542)		(0.1707)
state_share × (log, l4) House Price Index			0.1836		0.1638
			(0.1668)		(0.1428)
state_share × (log, l5) House Price Index			-0.0457		0.0454
			(0.1276)		(0.1327)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,084	12,084	11,420	13,356	12,536

3.1.2 Incorporating state-level trends

The below take the Education Expenditure ~ GDP models and incorporate deterministic state time trends.

Dependent Variable:	(log) Elem.Ed.Exp.pp						
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Variables							
(log) Real GDP Priv. Industry pc	0.0152	0.0021	0.0054	0.0253			
	(0.0192)	(0.0195)	(0.0203)	(0.0200)			
(log,l1) Real GDP Priv. Industry pc	0.0550***	0.0405***	0.0256	0.0355**			
	(0.0150)	(0.0154)	(0.0179)	(0.0170)			
(log,l2) Real GDP Priv. Industry pc	0.1044***	0.0917***	0.0815***	0.1110***			
	(0.0249)	(0.0245)	(0.0243)	(0.0213)			
(log) Annual Avg. Wkly. Wage		0.0902	-0.0291	-0.0329	0.2033***	0.0758	0.1010
		(0.0652)	(0.0678)	(0.0708)	(0.0595)	(0.0626)	(0.0655)
(log, l1) Annual Avg. Wkly. Wage		0.1676***	0.1200**	0.1276**	0.1840***	0.1355**	0.1370**
		(0.0518)	(0.0560)	(0.0567)	(0.0481)	(0.0543)	(0.0547)
(log, l2) Annual Avg. Wkly. Wage		0.0289	0.0803	0.0650	0.1607**	0.2098***	0.2432***
		(0.0629)	(0.0638)	(0.0593)	(0.0758)	(0.0571)	(0.0544)
(log) House Price Index			0.0628**	0.0272		0.0676***	0.0466*
			(0.0280)	(0.0261)		(0.0248)	(0.0238)
(log, l1) House Price Index			0.0522	0.0407		0.0466*	0.0385
			(0.0321)	(0.0309)		(0.0272)	(0.0260)
(log, l2) House Price Index			0.0712***	0.0409*		0.0550**	0.0276
			(0.0254)	(0.0248)		(0.0223)	(0.0211)
(log, l3) House Price Index			0.0262	0.0244		0.0281	0.0273
			(0.0237)	(0.0228)		(0.0216)	(0.0210)
(log, l4) House Price Index			-0.0032	0.0160		-0.0037	0.0180
			(0.0260)	(0.0227)		(0.0220)	(0.0190)
(log, l5) House Price Index			-0.1303***	-0.0601***		-0.1301***	-0.0627***
			(0.0239)	(0.0212)		(0.0217)	(0.0196)
(log) State IG Rev pp				0.3695***			0.3498***
				(0.0388)			(0.0380)
(log) Fed IG Rev. pp				0.0049**			0.0033
				(0.0023)			(0.0021)
Fixed-effects							
unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fit statistics							
Observations	12,084	12,084	11,420	11,420	13,356	12,536	12,536
R^2	0.83997	0.84139	0.85220	0.87704	0.83621	0.84900	0.87219
Within R^2	0.17635	0.18364	0.20940	0.34226	0.17607	0.20933	0.33076

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

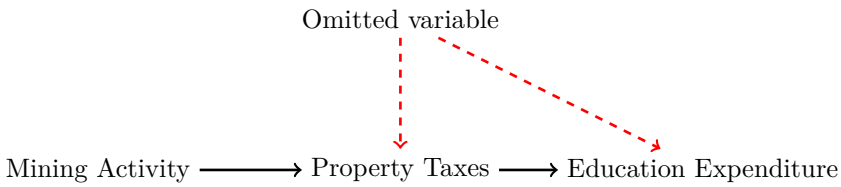
3.2 Instrumental Variable Approach

There is a significant endogeneity concern in using total active production and active mines as the treatment variable. Therefore, I have tried two instrumental variable approaches below and aim to add results using production- and employment-based Bartik instruments.

We consider using XX as an instrument affecting education expenditure through property taxes or GDP. We know that property taxes have an endogenous relationship with education expenditure, however, in theory, XX is unlikely to affect education expenditure, except via property taxes. We test this hypothesis below.

As a reminder, the intuition behind the idea is:

Figure 1: Instrumental Variable Path Diagram



A more commonly used identification strategy is via a shift-share or Bartik instrument. A shift-share instrument interacts local industry shares with nationa industry-level growth rates to attain a plausibly exogenous local shock. In the context of this work, we intend to create a unit-specific time-varying treatment variable by interacting a unit-specific, time-invariant industrial employment share variable with a national-level time-varying wage growth rate.

The literature on Bartik instruments derives plausible exogeneity from two sources. First, authors argue that local industry shares are exogenous by imposing that shares be fixed to a particular base year and are therefore unable to adapt to changes in national-level growth rates. Such a shift-share instrument would look as follows:

$$Z_{it} = \sum_{j=1}^{k} S_{ij\tau} G_{njt} \tag{1}$$

where S_{ij0} is the local share of unit i's economy (potentially measured by metrics like employment, wages, revenue) in industry j at a fixed base year τ and G_{njt} is the growth rate of industry j at a national level n at time t.

Alternatively, authors may argue that the national-level growth rates are exogenous allowing the shares to vary over time, constructing the shift-share instrument as follows:

$$Z_{it} = \sum_{j=1}^{k} S_{ijt} G_{njt} \tag{2}$$

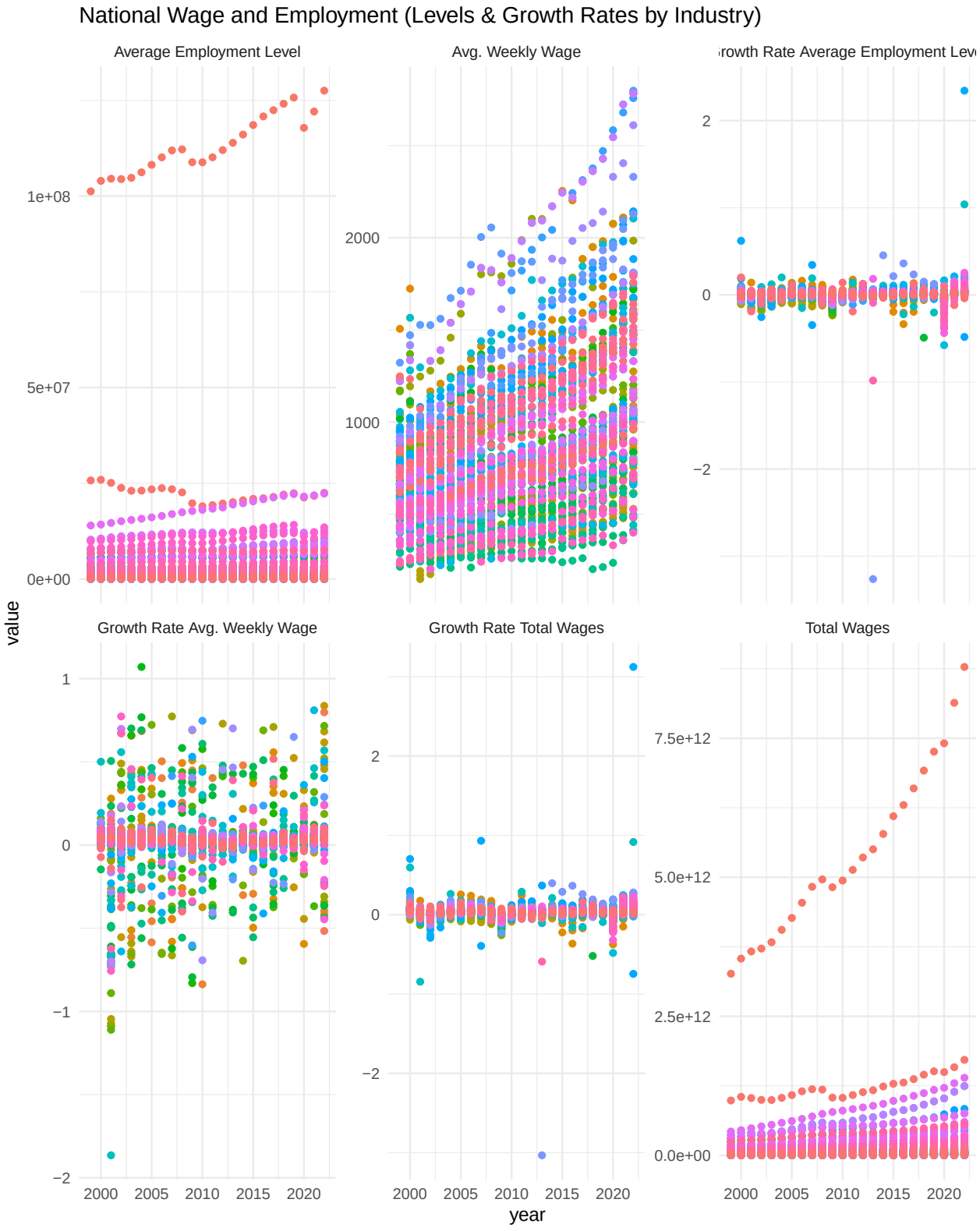
Finally, authors might be concerned about the implausible exogeneity of both shares and national-level growth rates in which case they could construct the instrument as follows where the local shares are fixed at a common base year and industry-specific growth rates G are derived from data on other similar regions o rather than national-level changes that are inherently comprised of local-level shifts. This approach likely comes at significant expense to instrument relevance.

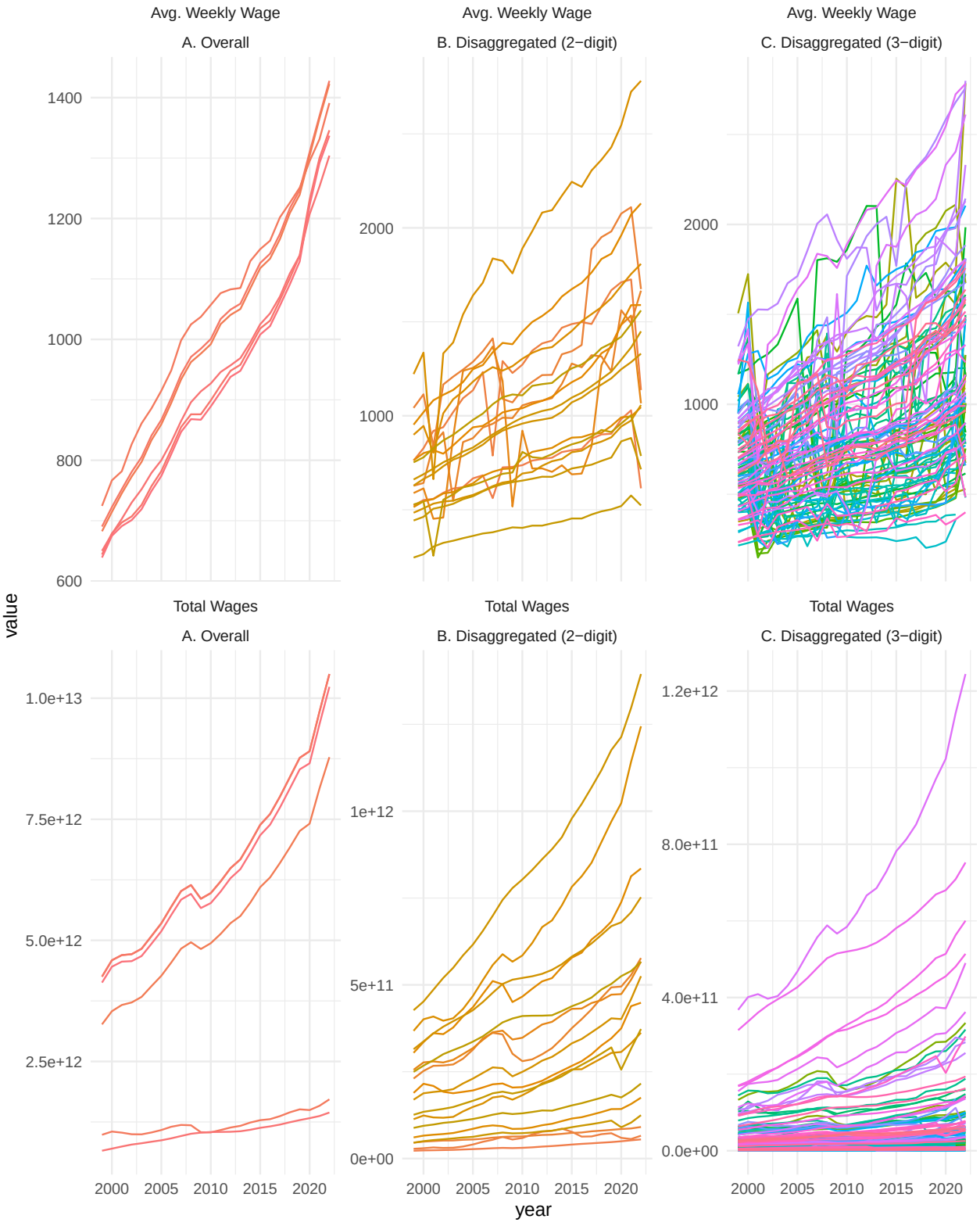
$$Z_{it} = \sum_{j=1}^{k} S_{0jt} G_{ojt} \tag{3}$$

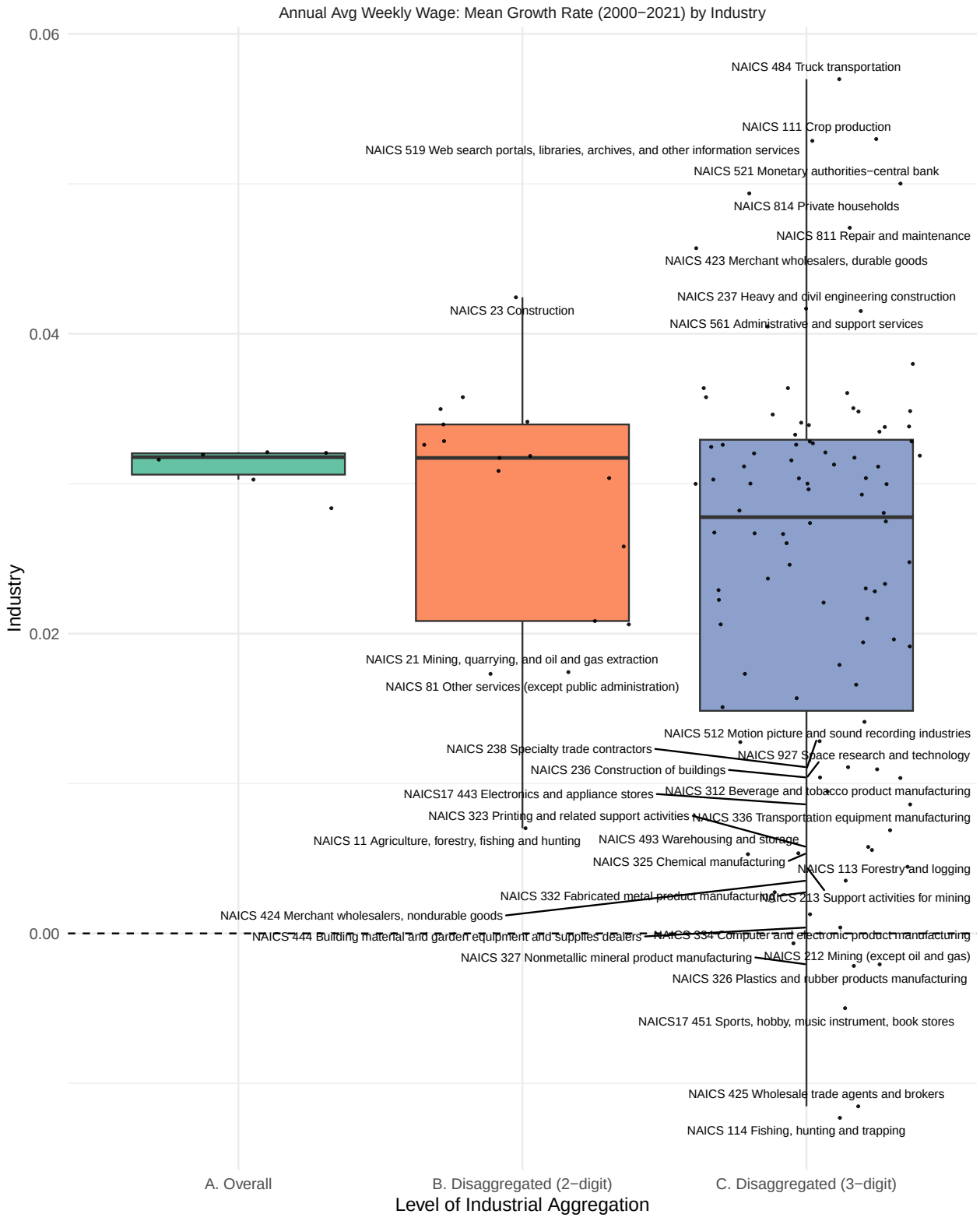
Finally, the authors can make an additional design choice about whether the effect of these instruments should be assumed common to an aggregate local-level wage growth indicator or allowed to vary by industry. In other words, whether to construct the first-stage relationship of the 2SLS as:

$$X_{it} = \alpha_i + \beta \sum_{j=1}^{k} S_j G_j + \epsilon_{it} \tag{4}$$

$$X_{it} = \alpha_i + \sum_{j=1}^{k} \beta_j S_{\star j \star} G_{\star jt} + \epsilon_{it} \tag{5}$$


National Wage and Employment (Levels & Growth Rates by Industry)
Average Employment Level
Avg. Weekly Wage
rowth Rate Average Employment Lev
Growth Rate Avg. Weekly Wage
Growth Rate Total Wages
Total Wages
value
year
1e+08
5e+07
0e+00
2000
1000
2
0
−2
1
−1
7.5e+12
5.0e+12
2.5e+12
0.0e+00
2000
2005
2010
2015
2020


Avg. Weekly Wage
A. Overall
B. Disaggregated (2−digit)
C. Disaggregated (3−digit)
Total Wages
A. Overall
B. Disaggregated (2−digit)
C. Disaggregated (3−digit)
value
year
1400
1200
1000
800
600
2000
1000
1.0e+13
7.5e+12
5.0e+12
2.5e+12
1e+12
5e+11
0e+00
1.2e+12
8.0e+11
4.0e+11
0.0e+00
2000
2005
2010
2015
2020

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[1] "Appended national shock variables."
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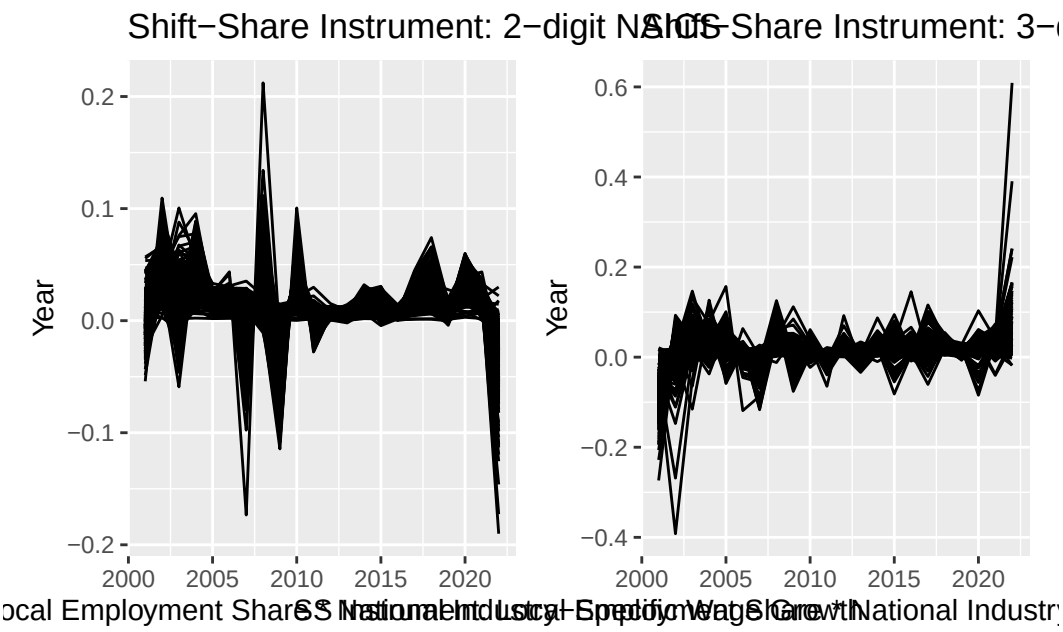

Dependent Var.:	iv_model_2d (log) Elem.Ed.Exp.pp	iv_model_3d (log) Elem.Ed.Exp.pp
(log) House Price Index	-0.4439	-37.53
	(0.4627)	(9,952.7)
(log) IG Revenue pp	0.4556***	5.598
	(0.0729)	(1,380.1)
(log) Real GDP pc	0.3259*	10.60
	(0.1328)	(2,756.1)
Fixed-Effects:	----------	----------
unit	Yes	Yes
year	Yes	Yes
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S.E.: Clustered	by: unit	by: unit
Observations	12,717	12,717
R2	0.80887	-224.75
Within R2	0.00596	-1,173.1
F-test (1st stage), (log) House Price Index	4.0809	1.02e-5
F-test (1st stage), p-value, (log) House Price Index	0.04339	0.99745
F-test (2nd stage)	0.89356	0.01603
F-test (2nd stage), p-value	0.34453	0.89926
Wu-Hausman	1.3791	0.01559
Wu-Hausman, p-value	0.24028	0.90064
Wald (IV only)	0.92057	1.42e-5
Wald (IV only), p-value	0.33734	0.99699

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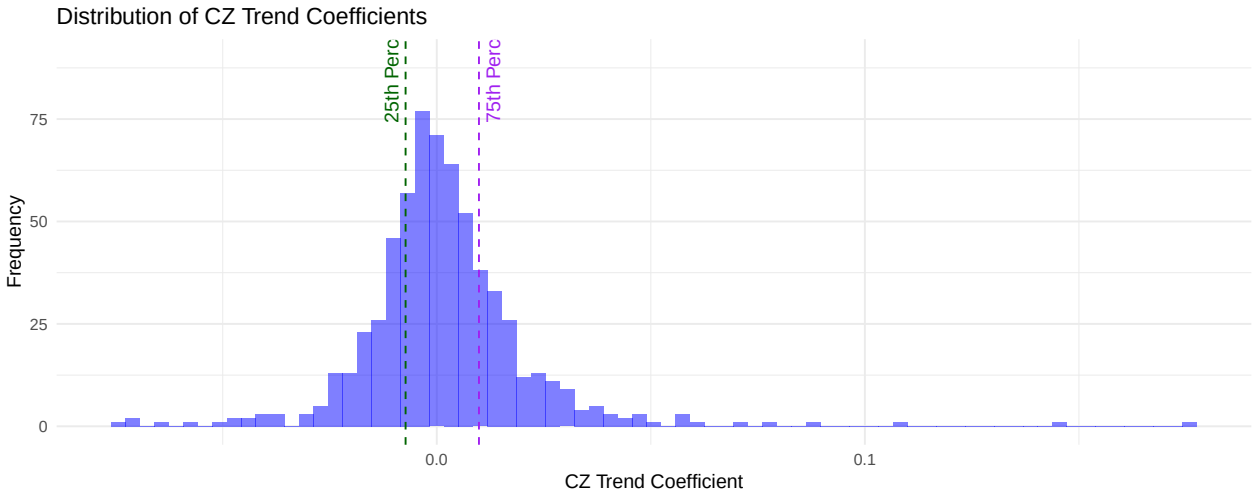
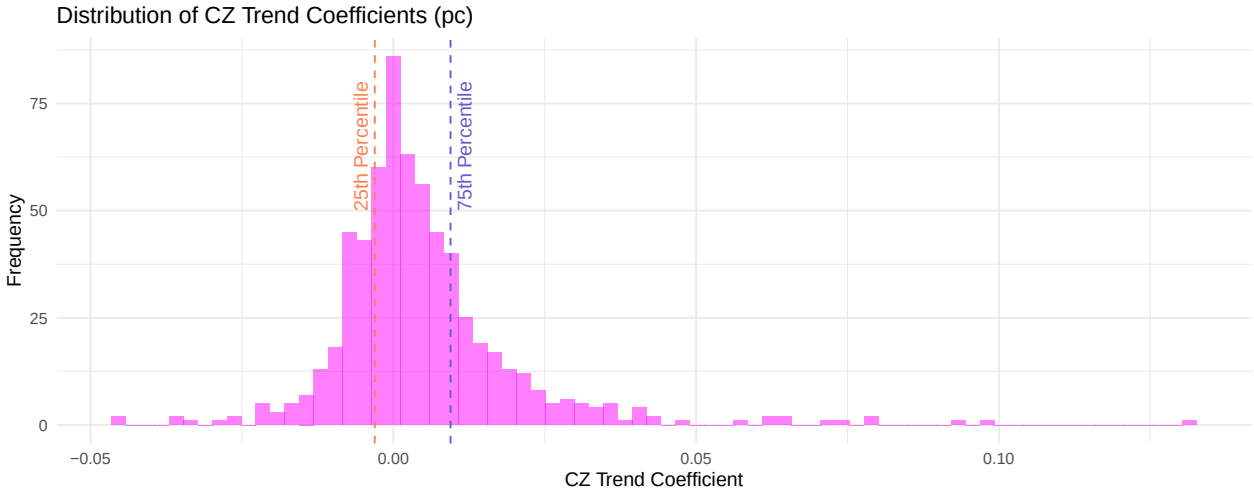
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

3.2.1 Declining vs. Growing Regions

What would be great is to be able to econometrically test when a commuting zone is "declining." In the first step, it would be good to identify when a commuting zone is declining overall (GDP, poverty, etc) but ideally eventually apply this to the education outcome. My hope is that being able to identify counties that are "declining" we can either use this variable as a covariate or as a central point of analysis. The below analysis looks at state-level variables as a first step (mainly to aid in visual comparison and plotting). Ideally, once a method is decided on this would be applied to commuting zone-level data which would need to be summarise/collated in some way for plotting.

3.2.2 CZ GDP growth conditional on state and national level



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[1] 0.2154088
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[1] 0.1540881
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[1] 0.1194969
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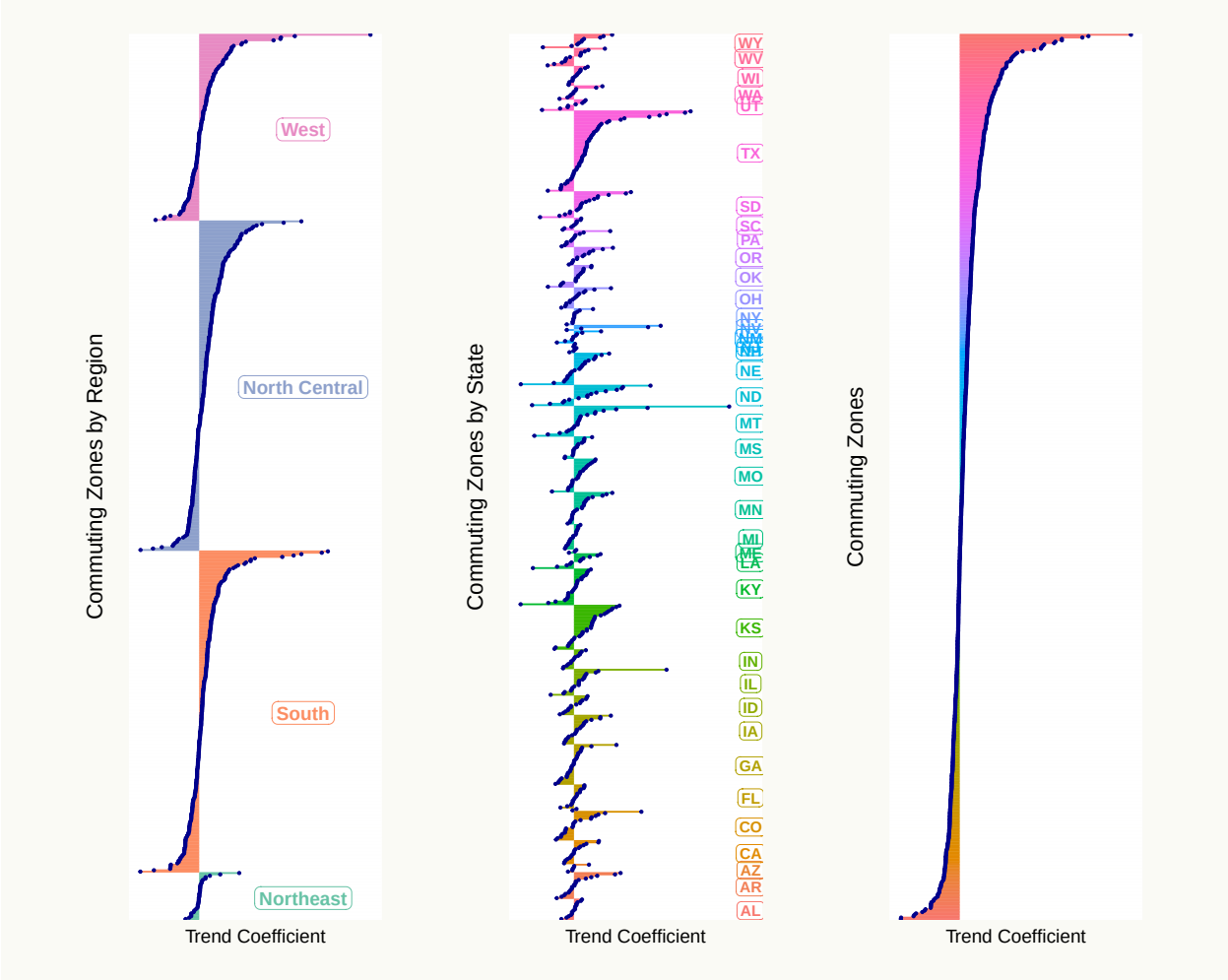


3.2.3 Running IV models on declining vs. growing sub-groups

The following implements an employment based Bartik instrument for various industries available from the Quarterly Census of Employment and Wages.

3.2.4 Running base models on declining vs. growing sub-groups

Dependent Variable:	(log) Elem.Ed.Exp.pp		
Model:	(1)	(2)	(3)
Variables			
(log) Annual Avg. Wkly. Wage	0.2546**	0.1022	0.0183
	(0.1037)	(0.0984)	(0.0993)
(log, l1) Annual Avg. Wkly. Wage	0.2197***	0.1966**	0.1754**
	(0.0813)	(0.0801)	(0.0816)
(log, l2) Annual Avg. Wkly. Wage	0.1611*	0.1269	0.1897**
	(0.0839)	(0.0833)	(0.0781)
(log) House Price Index		0.0281	-0.0257
		(0.0477)	(0.0395)
(log, l1) House Price Index		0.0579	0.0565*
		(0.0390)	(0.0309)
(log, l2) House Price Index		0.0632	0.0282
		(0.0383)	(0.0337)
(log, l3) House Price Index		0.0820**	0.0801**
		(0.0326)	(0.0329)
(log, l4) House Price Index		-0.0341	-0.0156
		(0.0337)	(0.0317)
(log, l5) House Price Index		-0.1047***	-0.0813**
		(0.0361)	(0.0328)
(log) State IG Rev pp			0.3306***
			(0.0575)
(log) Fed IG Rev. pp			0.0077**
			(0.0030)
Fixed-effects			
unit	Yes	Yes	Yes
year	Yes	Yes	Yes
Fit statistics			
Observations	5,418	5,214	5,214
R^2	0.82524	0.83229	0.86103
Within R^2	0.07186	0.09335	0.24874

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

Dependent Variable:	(log) Elem.Ed.Exp.pp		
Model:	(1)	(2)	(3)
Variables			
(log) Annual Avg. Wkly. Wage	0.2736***	0.2033**	0.2075**
	(0.0814)	(0.0883)	(0.0944)
(log, l1) Annual Avg. Wkly. Wage	0.2204***	0.1400*	0.1524**
	(0.0599)	(0.0737)	(0.0720)
(log, l2) Annual Avg. Wkly. Wage	0.2138**	0.1888**	0.1923***
	(0.0955)	(0.0730)	(0.0693)
(log) House Price Index		0.0488	0.0218
		(0.0327)	(0.0299)
(log, l1) House Price Index		0.0694*	0.0520
		(0.0357)	(0.0352)
(log, l2) House Price Index		0.0548**	0.0252
		(0.0275)	(0.0260)
(log, l3) House Price Index		0.0014	0.0080
		(0.0277)	(0.0262)
(log, l4) House Price Index		0.0064	0.0332
		(0.0284)	(0.0240)
(log, l5) House Price Index		-0.0744***	-0.0512**
		(0.0280)	(0.0230)
(log) State IG Rev pp			0.3685***
			(0.0366)
(log) Fed IG Rev. pp			0.0036
			(0.0030)
Fixed-effects			
unit	Yes	Yes	Yes
year	Yes	Yes	Yes
Fit statistics			
Observations	7,938	7,322	7,322
R^2	0.81346	0.82416	0.85704
Within R^2	0.08664	0.09190	0.26172

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

Dependent Variable:	(log) Elem.Ed.Exp.pp		
Model:	(1)	(2)	(3)
Variables			
(log) Annual Avg. Wkly. Wage	0.2511**	-0.0216	-0.1060
	(0.1257)	(0.1148)	(0.1176)
(log, l1) Annual Avg. Wkly. Wage	0.2186**	0.1857*	0.1967*
	(0.1095)	(0.1063)	(0.1022)
(log, l2) Annual Avg. Wkly. Wage	0.1205	0.1423	0.1922**
	(0.1019)	(0.1123)	(0.0945)
(log) House Price Index		0.1490***	0.0638
		(0.0507)	(0.0434)
(log, l1) House Price Index		0.0091	0.0372
		(0.0537)	(0.0432)
(log, l2) House Price Index		0.0282	-5.94×10^{-5}
		(0.0460)	(0.0418)
(log, l3) House Price Index		0.0855*	0.0836*
		(0.0449)	(0.0443)
(log, l4) House Price Index		0.0005	0.0075
		(0.0389)	(0.0393)
(log, l5) House Price Index		-0.1609***	-0.1413***
		(0.0434)	(0.0406)
(log) State IG Rev pp			0.2686***
			(0.0659)
(log) Fed IG Rev. pp			0.0075*
			(0.0039)
Fixed-effects			
unit	Yes	Yes	Yes
year	Yes	Yes	Yes
Fit statistics			
Observations	3,339	3,164	3,164
R^2	0.78745	0.80094	0.82736
Within R^2	0.07134	0.10056	0.21994

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

Dependent Variable:	(log) Elem.Ed.Exp.pp		
Model:	(1)	(2)	(3)
Variables			
(log) Annual Avg. Wkly. Wage	0.1987*	0.1783	0.1768
	(0.1152)	(0.1330)	(0.1471)
(log, l1) Annual Avg. Wkly. Wage	0.2616***	0.1725	0.2381**
	(0.0962)	(0.1157)	(0.1127)
(log, l2) Annual Avg. Wkly. Wage	0.2471*	0.2193*	0.2152**
	(0.1388)	(0.1114)	(0.1011)
(log) House Price Index		0.0764*	0.0721*
		(0.0455)	(0.0412)
(log, l1) House Price Index		0.0719	0.0594
		(0.0512)	(0.0524)
(log, l2) House Price Index		0.0406	0.0073
		(0.0387)	(0.0380)
(log, l3) House Price Index		-0.0151	-0.0279
		(0.0374)	(0.0348)
(log, l4) House Price Index		-0.0251	-0.0142
		(0.0483)	(0.0418)
(log, l5) House Price Index		-0.1272***	-0.0912**
		(0.0459)	(0.0379)
(log) State IG Rev pp			0.2994***
			(0.0604)
(log) Fed IG Rev. pp			0.0060
			(0.0060)
Fixed-effects			
unit	Yes	Yes	Yes
year	Yes	Yes	Yes
Fit statistics			
Observations	3,339	2,812	2,812
R^2	0.74176	0.76891	0.79942
Within R^2	0.08470	0.08674	0.20732

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

3.2.5 Removing outliers - really high-income commuting zones!

As you can see in the scatterplot below, there is a somewhat non-linear relationship between property taxes and elementary expenditure as property taxes collected rise. This happens largely as a result of very high-income commuting zones. Therefore, I exclude any commuting zone that spends more than 28k per pupil to avoid any distorting effects. This removes 12 counties (~2% of the sample) This could benefit from more robust outlier detection. This outlier exclusion weakens our results (and the validity of our instrument choice) in the production-based IV regression. Worth noting and thinking about!!

Table 2: ss_2d

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growin
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	-0.4439	-0.2132	-0.0100	-0.8526	-4.522
	(0.4627)	(0.4195)	(0.8952)	(1.346)	(10.57)
(log) IG Revenue pp	0.4556***	0.4197***	0.3343**	0.5005***	0.8133
	(0.0729)	(0.0898)	(0.1584)	(0.1647)	(1.103)
(log) Real GDP pc	0.3259**	0.2620	0.1735	0.4165	0.8739
	(0.1328)	(0.1670)	(0.3304)	(0.3272)	(1.600)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,717	5,256	3,199	7,461	2,927
R^2	0.80887	0.84523	0.82662	0.70557	-3.1332
Within R^2	0.00596	0.15580	0.20156	-0.49613	-15.045
F-test (1st stage), (log) House Price Index	4.0809	4.2583	0.92469	0.68864	0.08357
F-test (1st stage), p-value, (log) House Price Index	0.04339	0.03911	0.33632	0.40665	0.77253
F-test (2nd stage)	0.89356	0.20955	8.89×10^{-5}	0.55491	1.5620
F-test (2nd stage), p-value	0.34453	0.64714	0.99248	0.45634	0.21148
Wu-Hausman	1.3791	0.47475	0.02098	0.70290	1.5954
Wu-Hausman, p-value	0.24028	0.49084	0.88483	0.40184	0.20666
Wald (IV only)	0.92057	0.25839	0.00012	0.40120	0.18312
Wald (IV only), p-value	0.33734	0.61125	0.99110	0.52649	0.66874

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

Table 3: ss_3d

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Grow
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	-37.53	0.8015	0.1925	-1.947	0.2253
	(9,952.7)	(0.9135)	(0.4254)	(17.62)	(0.9478)
(log) IG Revenue pp	5.598	0.2553	0.2998***	0.6279	0.3371***
	(1,380.1)	(0.1653)	(0.1071)	(2.046)	(0.1025)
(log) Real GDP pc	10.60	-0.1164	0.1021	0.6804	0.1653
	(2,756.1)	(0.3329)	(0.1461)	(4.255)	(0.1410)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,717	5,256	3,199	7,461	2,927
R^2	-224.75	0.78939	0.83030	0.17168	0.80204
Within R^2	-1,173.1	-0.14881	0.21847	-3.2091	0.23150
F-test (1st stage), (log) House Price Index	1.02×10^{-5}	0.92868	3.3704	0.01541	0.88195
F-test (1st stage), p-value, (log) House Price Index	0.99745	0.33525	0.06647	0.90120	0.34775
F-test (2nd stage)	0.01603	0.64605	0.12024	0.06479	0.04089
F-test (2nd stage), p-value	0.89926	0.42156	0.72880	0.79909	0.83977
Wu-Hausman	0.01559	0.45994	0.00692	0.07087	0.00728
Wu-Hausman, p-value	0.90064	0.49768	0.93372	0.79009	0.93199
Wald (IV only)	1.42×10^{-5}	0.76971	0.20478	0.01221	0.05652
Wald (IV only), p-value	0.99699	0.38035	0.65092	0.91202	0.81210

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

Table 4: 10

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	2.841***	2.377***	1.952***	3.448***	3.587**
	(0.4100)	(0.4495)	(0.4426)	(0.7419)	(1.432)
(log) Real GDP pc	-0.5838***	-0.7041***	-0.5189**	-0.6206***	-0.3364
	(0.1547)	(0.2253)	(0.2045)	(0.2318)	(0.2451)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,717	5,256	3,199	7,461	2,927
R^2	-0.32272	0.08143	0.28727	-0.91331	-1.3731
Within R^2	-5.8793	-4.0104	-2.2823	-8.7225	-8.2123
F-test (2nd stage)	-2.52×10^{-11}	-6.54×10^{-12}	1.96×10^{-12}	7.19×10^{-12}	2.35×10^{-12}
F-test (2nd stage), p-value	1	1	1.0000	1.0000	1.0000
Wald (IV only)	48.028	27.967	19.439	21.596	6.2779
Wald (IV only), p-value	4.4×10^{-12}	1.28×10^{-7}	1.07×10^{-5}	3.42×10^{-6}	0.01228

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

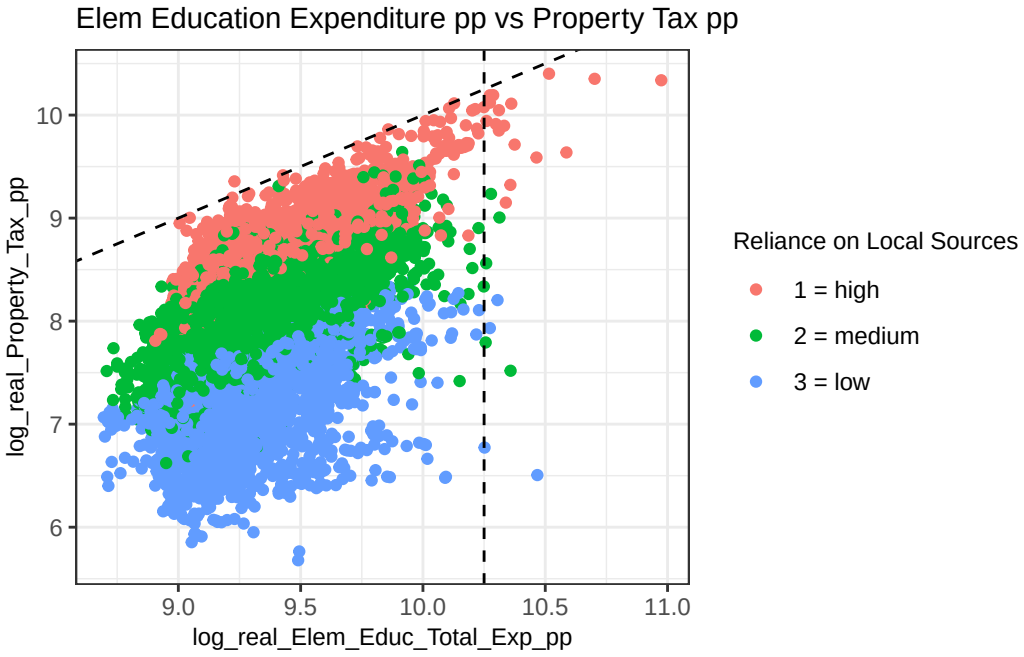


Table 5: 11

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	1.809	-3.645	-2.784	1.068	4.607
	(2.091)	(2.589)	(1.852)	(1.541)	(24.53)
(log) Real GDP pc	-0.2881	1.562	1.186*	-0.0375	-0.4860
	(0.5766)	(1.006)	(0.7081)	(0.3685)	(3.723)
(log) IG Revenue pp	0.1700	0.9535**	0.8156***	0.2940*	-0.0420
	(0.2591)	(0.4001)	(0.3116)	(0.1600)	(2.157)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	11,278	4,656	2,766	6,622	2,592
R^2	0.41322	-1.3408	-0.63193	0.72252	-2.8559
Within R^2	-2.1888	-12.572	-6.5177	-0.45913	-13.800
F-test (1st stage), (log) House Price Index	0.30560	0.23892	0.23461	0.32420	0.01095
F-test (1st stage), p-value, (log) House Price Index	0.58041	0.62501	0.62816	0.56911	0.91668
F-test (2nd stage)	1.1507	3.7550	1.8010	0.40945	0.21136
F-test (2nd stage), p-value	0.28342	0.05271	0.17970	0.52227	0.64574
Wu-Hausman	0.98018	3.8777	1.9665	0.31864	0.19351
Wu-Hausman, p-value	0.32218	0.04899	0.16094	0.57244	0.66005
Wald (IV only)	0.74854	1.9832	2.2587	0.48041	0.03526
Wald (IV only), p-value	0.38696	0.15912	0.13298	0.48826	0.85107

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

Table 6: 21

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	1.127*	0.0379	-0.2259	1.673*	0.6924
	(0.6470)	(0.8004)	(0.8289)	(0.9556)	(0.7798)
(log) Real GDP pc	-0.1012	0.1391	0.2308	-0.1769	0.1108
	(0.1815)	(0.3134)	(0.3038)	(0.2491)	(0.1312)
(log) IG Revenue pp	0.2338**	0.3957***	0.3985***	0.1934*	0.2589***
	(0.0914)	(0.1177)	(0.1405)	(0.1160)	(0.0822)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	8,751	3,948	2,373	4,803	1,802
R^2	0.71928	0.86853	0.80333	0.51982	0.74091
Within R^2	-0.61027	0.23797	0.10619	-1.7562	-0.00277
F-test (1st stage), (log) House Price Index	1.0725	0.44594	0.46258	0.91147	1.0517
F-test (1st stage), p-value, (log) House Price Index	0.30040	0.50431	0.49649	0.33977	0.30526
F-test (2nd stage)	1.5720	0.00073	0.02189	2.9189	0.45162
F-test (2nd stage), p-value	0.20995	0.97843	0.88240	0.08761	0.50165
Wu-Hausman	1.2167	0.00482	0.07333	2.4485	0.29455
Wu-Hausman, p-value	0.27005	0.94463	0.78657	0.11770	0.58739
Wald (IV only)	3.0332	0.00224	0.07424	3.0663	0.78828
Wald (IV only), p-value	0.08161	0.96225	0.78528	0.07999	0.37474

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

Table 7: 22

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	-0.0630	-0.0591	-0.1613	-0.2689	-6.855
	(0.5798)	(0.4410)	(0.4877)	(1.868)	(26.93)
(log) Real GDP pc	0.2362	0.1905	0.2131	0.3074	1.289
	(0.1615)	(0.1811)	(0.1865)	(0.4319)	(4.157)
(log) IG Revenue pp	0.4291***	0.4069***	0.3704***	0.4751**	1.154
	(0.0874)	(0.0910)	(0.1046)	(0.2063)	(2.825)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	10,804	4,758	2,827	6,046	2,329
R^2	0.85888	0.85601	0.80805	0.84417	-7.3700
Within R^2	0.26229	0.23102	0.15688	0.19442	-33.287
F-test (1st stage), (log) House Price Index	1.7854	2.9843	2.0870	0.19470	0.03019
F-test (1st stage), p-value, (log) House Price Index	0.18152	0.08414	0.14867	0.65905	0.86208
F-test (2nd stage)	0.00819	0.01148	0.05317	0.01649	1.3905
F-test (2nd stage), p-value	0.92789	0.91468	0.81765	0.89783	0.23844
Wu-Hausman	0.05817	0.09728	0.19673	0.03215	1.3782
Wu-Hausman, p-value	0.80941	0.75513	0.65741	0.85771	0.24054
Wald (IV only)	0.01182	0.01797	0.10939	0.02072	0.06482
Wald (IV only), p-value	0.91341	0.89336	0.74086	0.88556	0.79905

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

Table 8: 23

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growin
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.4400	1.267	1.093	-0.2225	0.4563
	(0.5942)	(1.797)	(4.665)	(0.8464)	(0.6528)
(log) Real GDP pc	0.0820	-0.2981	-0.2245	0.2656	0.1291
	(0.1650)	(0.6760)	(1.683)	(0.2070)	(0.1008)
(log) IG Revenue pp	0.3262***	0.1692	0.1298	0.4225***	0.3015***
	(0.0895)	(0.3002)	(0.8203)	(0.1046)	(0.0872)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,661	5,235	3,178	7,426	2,892
R^2	0.84250	0.65055	0.66639	0.84145	0.79097
Within R^2	0.17540	-0.88888	-0.49748	0.17995	0.16014
F-test (1st stage), (log) House Price Index	1.4196	0.24301	0.03655	0.87450	0.78716
F-test (1st stage), p-value, (log) House Price Index	0.23349	0.62206	0.84840	0.34974	0.37503
F-test (2nd stage)	0.31019	0.42347	0.04226	0.04905	0.15599
F-test (2nd stage), p-value	0.57757	0.51524	0.83715	0.82472	0.69291
Wu-Hausman	0.16224	0.33997	0.03092	0.11464	0.07694
Wu-Hausman, p-value	0.68711	0.55987	0.86043	0.73493	0.78151
Wald (IV only)	0.54831	0.49722	0.05488	0.06908	0.48857
Wald (IV only), p-value	0.45902	0.48075	0.81480	0.79269	0.48462

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

Table 9: 42

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growin
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	-0.2900	-0.1810	-0.1489	-0.4472	-1.450
	(0.2902)	(0.2848)	(0.4846)	(0.5837)	(1.221)
(log) Real GDP pc	0.2861***	0.2526**	0.2247	0.3231**	0.4254**
	(0.0837)	(0.1207)	(0.1837)	(0.1417)	(0.1973)
(log) IG Revenue pp	0.4340***	0.4311***	0.3779***	0.4409***	0.5024***
	(0.0481)	(0.0670)	(0.0918)	(0.0741)	(0.1603)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,426	5,173	3,136	7,253	2,864
R^2	0.83025	0.85225	0.82341	0.79810	0.33880
Within R^2	0.13146	0.18409	0.16687	0.01279	-1.5021
F-test (1st stage), (log) House Price Index	10.530	11.118	4.4144	2.7081	1.2559
F-test (1st stage), p-value, (log) House Price Index	0.00118	0.00086	0.03572	0.09989	0.26252
F-test (2nd stage)	0.97673	0.39420	0.09390	0.59297	2.4060
F-test (2nd stage), p-value	0.32303	0.53013	0.75930	0.44130	0.12098
Wu-Hausman	1.8616	1.0499	0.38868	0.91855	2.7254
Wu-Hausman, p-value	0.17247	0.30558	0.53304	0.33789	0.09888
Wald (IV only)	0.99862	0.40402	0.09444	0.58696	1.4112
Wald (IV only), p-value	0.31766	0.52505	0.75862	0.44362	0.23496

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

Table 10: 51

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Gro
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.2379	0.4313**	1.308	0.0850	0.467
	(0.1707)	(0.2084)	(1.022)	(0.4377)	(1.164
(log) Real GDP pc	0.1338**	0.0062	-0.3100	0.1896	0.130
	(0.0604)	(0.1042)	(0.3910)	(0.1190)	(0.163
(log) IG Revenue pp	0.3760***	0.3219***	0.1144	0.4158***	0.3484
	(0.0409)	(0.0714)	(0.1994)	(0.0651)	(0.150
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,583	5,240	3,183	7,343	2,830
R^2	0.85894	0.84576	0.60222	0.86269	0.7902
Within R^2	0.26462	0.16369	-0.80778	0.29684	0.1772
F-test (1st stage), (log) House Price Index	43.461	37.295	4.5029	5.7012	1.117
F-test (1st stage), p-value, (log) House Price Index	4.5×10^{-11}	1.09×10^{-9}	0.03392	0.01698	0.2906
F-test (2nd stage)	2.7847	7.4950	7.4464	0.04736	0.2367
F-test (2nd stage), p-value	0.09519	0.00621	0.00639	0.82772	0.6266
Wu-Hausman	0.78233	3.9226	5.6966	0.00427	0.1395
Wu-Hausman, p-value	0.37645	0.04770	0.01706	0.94789	0.7087
Wald (IV only)	1.9420	4.2826	1.6365	0.03771	0.1610
Wald (IV only), p-value	0.16348	0.03855	0.20090	0.84603	0.6882

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

Table 11: 52

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.6668	0.8212**	1.154	0.9599	-0.5227
	(0.4989)	(0.4084)	(1.090)	(3.355)	(3.782)
(log) Real GDP pc	0.0192	-0.1238	-0.2375	-0.0186	0.2740
	(0.1438)	(0.1702)	(0.3988)	(0.8040)	(0.5548)
(log) IG Revenue pp	0.3030***	0.2521***	0.1359	0.2937	0.4056
	(0.0729)	(0.0848)	(0.1944)	(0.3738)	(0.3441)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,698	5,256	3,199	7,442	2,908
R^2	0.81081	0.78519	0.66110	0.74595	0.72586
Within R^2	0.01515	-0.17169	-0.56070	-0.29254	-0.06394
F-test (1st stage), (log) House Price Index	2.1267	3.2081	0.63189	0.06840	0.04489
F-test (1st stage), p-value, (log) House Price Index	0.14477	0.07333	0.42672	0.79369	0.83223
F-test (2nd stage)	1.0489	2.3428	0.81173	0.06963	0.01110
F-test (2nd stage), p-value	0.30578	0.12592	0.36768	0.79189	0.91611
Wu-Hausman	0.68913	1.6817	0.60233	0.05120	0.01669
Wu-Hausman, p-value	0.40648	0.19475	0.43775	0.82100	0.89722
Wald (IV only)	1.7863	4.0429	1.1211	0.08188	0.01910
Wald (IV only), p-value	0.18140	0.04441	0.28975	0.77477	0.89009

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

Table 12: 53

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	5.594	-2.481	-6.794	1.189	-1.298
	(14.54)	(3.211)	(12.42)	(1.481)	(6.496)
(log) Real GDP pc	-1.345	1.103	2.579	-0.0739	0.3934
	(4.054)	(1.212)	(4.432)	(0.3653)	(0.9564)
(log) IG Revenue pp	-0.3745	0.7970	1.513	0.2670*	0.4764
	(1.994)	(0.5082)	(2.181)	(0.1609)	(0.6213)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,638	5,240	3,183	7,398	2,864
R^2	-3.9380	-0.17030	-7.3056	0.67526	0.43022
Within R^2	-24.648	-5.3457	-36.746	-0.65273	-1.2018
F-test (1st stage), (log) House Price Index	0.15673	0.53433	0.19268	1.3801	0.08976
F-test (1st stage), p-value, (log) House Price Index	0.69219	0.46483	0.66073	0.24013	0.76450
F-test (2nd stage)	5.4746	3.5743	8.6151	2.1727	0.13883
F-test (2nd stage), p-value	0.01931	0.05874	0.00336	0.14053	0.70947
Wu-Hausman	5.0746	3.7802	8.7514	1.6954	0.16139
Wu-Hausman, p-value	0.02430	0.05192	0.00312	0.19293	0.68791
Wald (IV only)	0.14801	0.59668	0.29903	0.64431	0.03995
Wald (IV only), p-value	0.70045	0.43988	0.58453	0.42218	0.84159

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

Table 13: 54

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growin
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.4892***	0.3669*	0.3687	0.6189**	1.336*
	(0.1678)	(0.2198)	(0.4209)	(0.2856)	(0.7428)
(log) Real GDP pc	0.0443	0.0378	0.0311	0.0323	-0.0604
	(0.0550)	(0.1063)	(0.1710)	(0.0762)	(0.1310)
(log) IG Revenue pp	0.3337***	0.3307***	0.2727***	0.3382***	0.2140**
	(0.0388)	(0.0653)	(0.0984)	(0.0486)	(0.0920)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,327	5,130	3,094	7,197	2,745
R^2	0.84137	0.85319	0.82336	0.82453	0.53306
Within R^2	0.15212	0.19446	0.18551	0.07185	-0.95644
F-test (1st stage), (log) House Price Index	11.947	4.9831	1.4714	5.5815	1.0731
F-test (1st stage), p-value, (log) House Price Index	0.00055	0.02564	0.22521	0.01818	0.30034
F-test (2nd stage)	3.3069	0.73814	0.19498	2.5158	2.0322
F-test (2nd stage), p-value	0.06901	0.39030	0.65883	0.11275	0.15411
Wu-Hausman	1.8855	0.35122	0.07039	1.5920	1.6411
Wu-Hausman, p-value	0.16973	0.55345	0.79080	0.20708	0.20029
Wald (IV only)	8.4950	2.7859	0.76719	4.6950	3.2350
Wald (IV only), p-value	0.00357	0.09516	0.38116	0.03028	0.07219

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

Table 14: 55

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growin
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.6313	1.803	0.5705	0.4239	1.074
	(0.5188)	(8.018)	(0.5764)	(0.3485)	(0.7374)
(log) Real GDP pc	-0.0183	-0.4096	-0.0244	0.0772	-0.1212
	(0.1840)	(2.478)	(0.1604)	(0.1401)	(0.2122)
(log) IG Revenue pp	0.3352***	0.1307	0.2832**	0.3684***	0.2971***
	(0.0707)	(1.305)	(0.1124)	(0.0487)	(0.0859)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	8,589	4,116	2,352	4,473	1,155
R^2	0.84334	0.41749	0.80753	0.87445	0.54895
Within R^2	0.02150	-2.5654	0.09743	0.19860	-0.64712
F-test (1st stage), (log) House Price Index	0.97641	0.04142	0.37371	1.4839	0.31378
F-test (1st stage), p-value, (log) House Price Index	0.32311	0.83874	0.54105	0.22323	0.57548
F-test (2nd stage)	0.50522	0.17657	0.13555	0.34015	0.41941
F-test (2nd stage), p-value	0.47723	0.67436	0.71278	0.55977	0.51736
Wu-Hausman	0.30635	0.14969	0.06647	0.14342	0.28485
Wu-Hausman, p-value	0.57995	0.69886	0.79658	0.70492	0.59365
Wald (IV only)	1.4811	0.05057	0.97961	1.4794	2.1216
Wald (IV only), p-value	0.22363	0.82208	0.32240	0.22394	0.14551

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

Table 15: 56

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	-2.052	-1.596	-7.210	-2.567	1.134
	(1.496)	(2.139)	(37.06)	(2.785)	(2.034)
(log) Real GDP pc	0.7479*	0.7832	2.738	0.7996	0.0292
	(0.4009)	(0.8108)	(13.17)	(0.6352)	(0.3193)
(log) IG Revenue pp	0.7043***	0.6449*	1.587	0.7415**	0.2378
	(0.2252)	(0.3339)	(6.421)	(0.3739)	(0.2530)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,071	5,174	3,137	6,897	2,529
R^2	0.10835	0.40997	-8.4588	-0.29784	0.60859
Within R^2	-3.6433	-2.1866	-41.841	-5.6326	-0.51011
F-test (1st stage), (log) House Price Index	0.91156	0.32329	0.01306	0.36175	0.18493
F-test (1st stage), p-value, (log) House Price Index	0.33972	0.56966	0.90904	0.54756	0.66721
F-test (2nd stage)	4.3340	0.89254	0.66069	2.7129	0.23240
F-test (2nd stage), p-value	0.03738	0.34483	0.41638	0.09959	0.62980
Wu-Hausman	4.6493	0.98703	0.66864	2.8611	0.18120
Wu-Hausman, p-value	0.03109	0.32052	0.41359	0.09079	0.67038
Wald (IV only)	1.8816	0.55664	0.03786	0.84967	0.31105
Wald (IV only), p-value	0.17018	0.45565	0.84574	0.35668	0.57709

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

Table 16: 61

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.9095	29.72	0.0020	0.5539	-1.183
	(1.276)	(1,598.9)	(1.122)	(0.9353)	(3.236)
(log) Real GDP pc	-0.0851	-10.10	0.2079	0.0216	0.3510
	(0.3785)	(554.8)	(0.3462)	(0.2618)	(0.5589)
(log) IG Revenue pp	0.2680	-4.460	0.3134	0.3378***	0.4617
	(0.1721)	(260.1)	(0.2174)	(0.1078)	(0.3501)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	11,482	4,822	2,848	6,660	2,378
R^2	0.76716	-141.61	0.81817	0.84303	0.47014
Within R^2	-0.26927	-757.86	0.18951	0.12444	-1.2489
F-test (1st stage), (log) House Price Index	1.7785	0.00113	1.9103	2.3602	0.67975
F-test (1st stage), p-value, (log) House Price Index	0.18236	0.97317	0.16704	0.12451	0.40976
F-test (2nd stage)	1.7196	1.1142	7.29×10^{-6}	0.86295	1.0223
F-test (2nd stage), p-value	0.18977	0.29121	0.99785	0.35295	0.31209
Wu-Hausman	1.2182	1.0707	0.05758	0.47380	1.2430
Wu-Hausman, p-value	0.26975	0.30084	0.81038	0.49127	0.26501
Wald (IV only)	0.50792	0.00035	3.05×10^{-6}	0.35070	0.13364
Wald (IV only), p-value	0.47605	0.98517	0.99861	0.55374	0.71472

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

Table 17: 62

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growi
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.6481	-2.100	-0.1129	0.4238	-0.3378
	(0.5085)	(7.810)	(1.051)	(0.3456)	(0.9564)
(log) Real GDP pc	0.0466	0.8926	0.2520	0.1161	0.2504
	(0.1381)	(2.461)	(0.2992)	(0.0930)	(0.1598)
(log) IG Revenue pp	0.2995***	0.7093	0.3548*	0.3356***	0.3610***
	(0.0727)	(1.197)	(0.1802)	(0.0498)	(0.1198)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,034	4,954	2,960	7,080	2,714
R^2	0.81751	0.06562	0.80665	0.84961	0.76420
Within R^2	0.04535	-3.9153	0.16634	0.20945	0.05809
F-test (1st stage), (log) House Price Index	10.468	0.32810	2.5489	17.950	1.7623
F-test (1st stage), p-value, (log) House Price Index	0.00122	0.56681	0.11048	2.3×10^{-5}	0.18445
F-test (2nd stage)	4.9604	1.5745	0.03102	3.6612	0.19307
F-test (2nd stage), p-value	0.02595	0.20961	0.86022	0.05573	0.66041
Wu-Hausman	3.0638	1.7277	0.20015	1.6962	0.38229
Wu-Hausman, p-value	0.08008	0.18877	0.65463	0.19282	0.53644
Wald (IV only)	1.6244	0.07232	0.01154	1.5034	0.12473
Wald (IV only), p-value	0.20250	0.78800	0.91447	0.22020	0.72399

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

Table 18: 71

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growing
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	-2.467	-0.8106	-0.3742	3.340	2.270
	(3.743)	(1.984)	(1.577)	(7.544)	(3.246)
(log) Real GDP pc	0.9397	0.4743	0.2855	-0.6212	-0.1695
	(1.099)	(0.7823)	(0.5898)	(1.943)	(0.5608)
(log) IG Revenue pp	0.7621	0.5357*	0.4162	0.0826	0.2105
	(0.5137)	(0.3040)	(0.2548)	(0.8216)	(0.3257)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,320	5,156	3,099	7,164	2,691
R^2	-0.18758	0.73154	0.78436	-0.75648	-0.01216
Within R^2	-5.1765	-0.46653	0.01606	-7.9194	-2.8929
F-test (1st stage), (log) House Price Index	0.70971	0.84064	0.69071	0.23404	0.51283
F-test (1st stage), p-value, (log) House Price Index	0.39956	0.35926	0.40599	0.62856	0.47398
F-test (2nd stage)	4.9335	0.61130	0.09556	3.0066	2.5951
F-test (2nd stage), p-value	0.02636	0.43433	0.75725	0.08297	0.10731
Wu-Hausman	5.2351	0.77670	0.18816	2.7024	2.2319
Wu-Hausman, p-value	0.02215	0.37820	0.66449	0.10025	0.13531
Wald (IV only)	0.43454	0.16702	0.05633	0.19601	0.48916
Wald (IV only), p-value	0.50978	0.68279	0.81241	0.65797	0.48436

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

Table 19: 72

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-G
Model:	(1)	(2)	(3)	(4)	(5
Variables					
(log) House Price Index	0.4226	0.6362	-0.5621	0.3165*	-0.18
	(0.2640)	(1.658)	(1.934)	(0.1881)	(0.34
(log) Real GDP pc	0.0967	-0.0700	0.3585	0.1608***	0.259
	(0.0837)	(0.6351)	(0.6837)	(0.0614)	(0.07
(log) IG Revenue pp	0.3463***	0.2871	0.4363	0.3813***	0.397
	(0.0490)	(0.2836)	(0.3632)	(0.0374)	(0.06
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Ye
year	Yes	Yes	Yes	Yes	Ye
Fit statistics					
Observations	12,433	5,219	3,162	7,214	2,7
R^2	0.84578	0.81955	0.74388	0.85589	0.79
Within R^2	0.19781	0.02014	-0.16605	0.26594	0.20
F-test (1st stage), (log) House Price Index	32.174	1.1715	0.68593	46.889	15.8
F-test (1st stage), p-value, (log) House Price Index	1.44×10^{-8}	0.27914	0.40762	8.13×10^{-12}	$7.14 \times$
F-test (2nd stage)	6.4061	0.51608	0.20998	5.2378	0.508
F-test (2nd stage), p-value	0.01138	0.47255	0.64681	0.02213	0.475
Wu-Hausman	3.3787	0.33520	0.32633	2.0878	1.26
Wu-Hausman, p-value	0.06607	0.56264	0.56787	0.14852	0.259
Wald (IV only)	2.5617	0.14717	0.08452	2.8302	0.288
Wald (IV only), p-value	0.10951	0.70127	0.77129	0.09255	0.591

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

Table 20: 81

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Growin
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.3253	0.1878	6.304	0.3482	0.1881
	(0.2567)	(0.6646)	(37.18)	(0.3124)	(0.7167)
(log) Real GDP pc	0.1129	0.1124	-2.055	0.1269	0.1709
	(0.0785)	(0.2641)	(13.03)	(0.0839)	(0.1178)
(log) IG Revenue pp	0.3489***	0.3548***	-0.7418	0.3608***	0.3409***
	(0.0438)	(0.1071)	(6.330)	(0.0495)	(0.0905)
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,717	5,256	3,199	7,461	2,927
R^2	0.85202	0.86061	-5.4881	0.84977	0.80309
Within R^2	0.23038	0.23968	-28.879	0.23658	0.23561
F-test (1st stage), (log) House Price Index	3.2758	0.53239	0.00710	2.3081	0.46294
F-test (1st stage), p-value, (log) House Price Index	0.07033	0.46564	0.93285	0.12875	0.49631
F-test (2nd stage)	0.38519	0.02034	0.27201	0.31021	0.01497
F-test (2nd stage), p-value	0.53485	0.88659	0.60203	0.57757	0.90264
Wu-Hausman	0.15289	0.00309	0.25223	0.12606	0.00145
Wu-Hausman, p-value	0.69579	0.95564	0.61555	0.72257	0.96963
Wald (IV only)	1.6062	0.07989	0.02875	1.2425	0.06891
Wald (IV only), p-value	0.20506	0.77746	0.86538	0.26503	0.79295

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

Table 21: 92

Dependent Variable:	(log) Elem.Ed.Exp.pp				
	All	Declining	Hyper-Declining	Growing	Hyper-Gr
Model:	(1)	(2)	(3)	(4)	(5)
Variables					
(log) House Price Index	0.1142	1.133	0.5544	-0.1278	-0.038
	(0.2741)	(1.174)	(3.005)	(0.2868)	(0.977
(log) Real GDP pc	0.1714**	-0.2400	-0.0257	0.2417***	0.204
	(0.0819)	(0.4517)	(1.065)	(0.0787)	(0.151
(log) IG Revenue pp	0.3782***	0.2016	0.2381	0.4162***	0.3636
	(0.0469)	(0.1910)	(0.5150)	(0.0479)	(0.108
Fixed-effects					
unit	Yes	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes	Yes
Fit statistics					
Observations	12,717	5,256	3,199	7,461	2,92
R^2	0.85894	0.70325	0.80283	0.84787	0.798
Within R^2	0.26634	-0.61862	0.09197	0.22693	0.218
F-test (1st stage), (log) House Price Index	23.185	2.1330	0.26900	25.101	1.207
F-test (1st stage), p-value, (log) House Price Index	1.49×10^{-6}	0.14422	0.60404	5.57×10^{-7}	0.272
F-test (2nd stage)	0.33565	2.9654	0.07968	0.45333	0.001
F-test (2nd stage), p-value	0.56236	0.08512	0.77775	0.50078	0.967
Wu-Hausman	0.00018	2.3198	0.04208	1.6906	0.029
Wu-Hausman, p-value	0.98944	0.12780	0.83747	0.19357	0.863
Wald (IV only)	0.17374	0.93074	0.03403	0.19864	0.001
Wald (IV only), p-value	0.67681	0.33472	0.85365	0.65583	0.968

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

3.3 Panel VAR Specification

$$Y_{it} = \alpha_i + \sum_{k=1}^{4} \gamma_k A_{i,t-k} + \beta X_{it} + \varepsilon_{it}$$

Where we approach a level and per capita value expression of the relationship between total educaiton expenditure, intergovernmental revenue, house prices conditioned on GDP and wage levels.

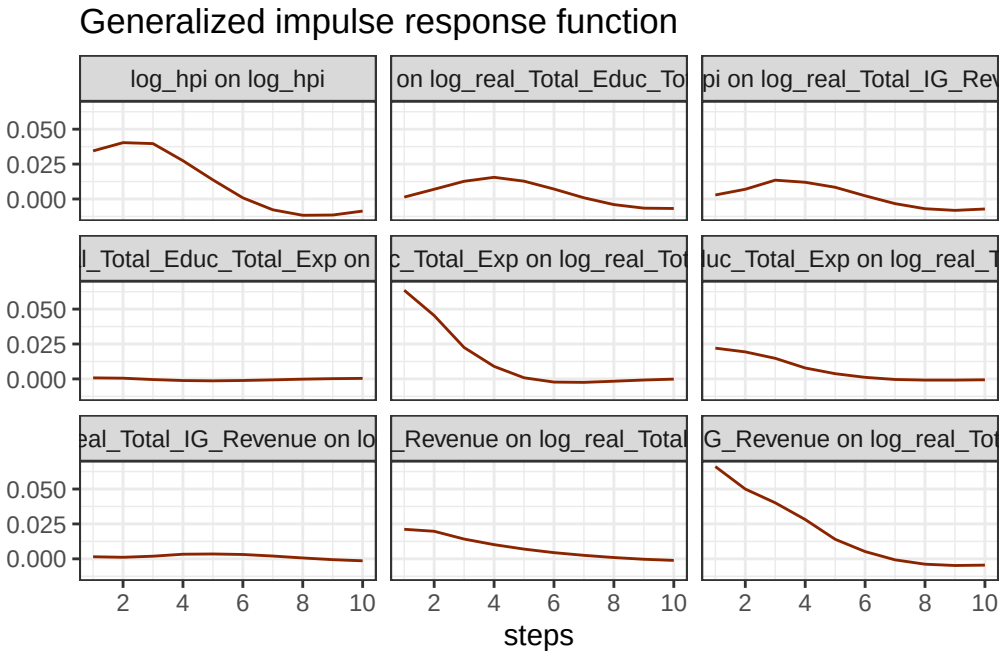
$$Y_{it} = \begin{bmatrix} \log(\text{real Total Educ. Exp.})_{it} \\ \log(\text{real Total IG Revenue})_{it} \\ \log(\text{HPI})_{it} \end{bmatrix}, \quad X_{it} = \begin{bmatrix} \log(\text{real GDP})_{it} \\ \log(\text{wage})_{it} \end{bmatrix}$$

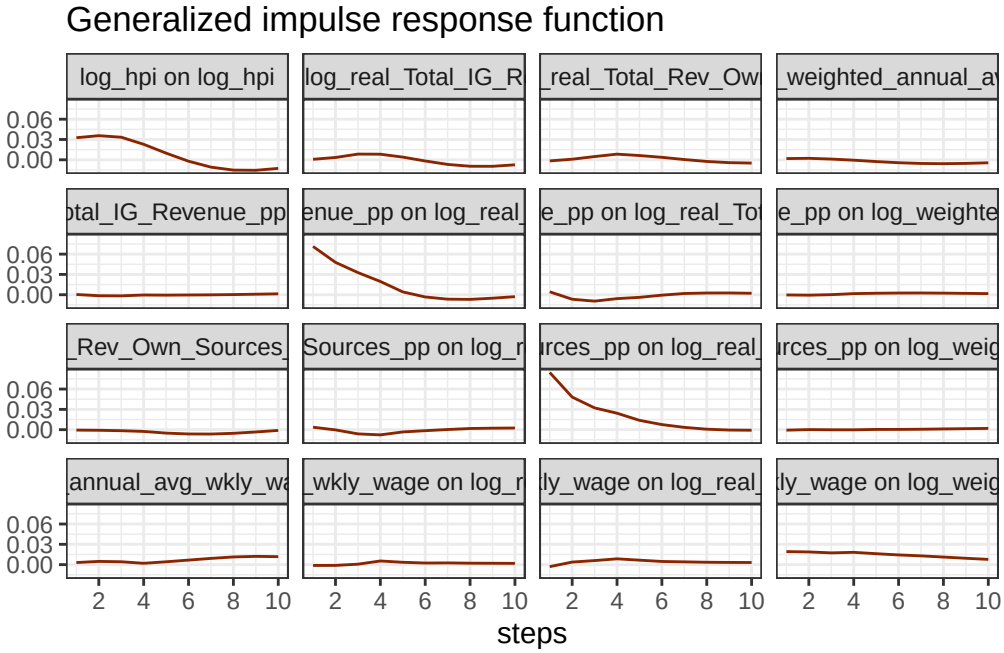
- A_1, A_2, A_3, A_4 are 3×3 coefficient matrices
- β is a 3×2 matrix of coefficients on the exogenous variables
- α_i is a vector of unit fixed effects
- ε_{it} is the error term

Where:

$$Y_{it} = \begin{bmatrix} \log(\text{real Own Source Rev. per person})_{it} \\ \log(\text{real IG Revenue per person})_{it} \\ \log(\text{wage})_{it} \\ \log(\text{HPI})_{it} \end{bmatrix}, \quad X_{it} = [\log(\text{real GDP per capita})_{it}]$$

- A_1, A_2, A_3, A_4 are 4×4 coefficient matrices
- B is a 4×1 coefficient matrix
- α_i: unit fixed effects
- ε_{it}: error term


Generalized impulse response function
log_hpi on log_hpi
on log_real_Total_Educ_To
pi on log_real_Total_IG_Rev
l_Total_Educ_Total_Exp on
c_Total_Exp on log_real_Tot
uc_Total_Exp on log_real_T
eal_Total_IG_Revenue on lo
_Revenue on log_real_Total
G_Revenue on log_real_Tot
0.050
0.025
0.000
2
4
6
8
10
steps


Generalized impulse response function
log_hpi on log_hpi
log_real_Total_IG_R
_real_Total_Rev_Ow
_weighted_annual_a
otal_IG_Revenue_pp
enue_pp on log_real_
e_pp on log_real_Tot
e_pp on log_weighte
_Rev_Own_Sources_
Sources_pp on log_r
urces_pp on log_real_
urces_pp on log_weig
annual_avg_wkly_wa
_wkly_wage on log_r
ly_wage on log_real_
ly_wage on log_weig
0.06
0.03
0.00
2
4
6
8
10
steps

4 Property Prices

Dependent Variables:	(log) House Price Index	gr_hpi	log_real_Elem_Educ_Total_Exp	di
Model:	(1)	(2)	(3)	
Variables				
(log) Annual Avg. Wkly. Wage	0.5110***		0.1302*	
	(0.0662)		(0.0727)	
(log, l1) Annual Avg. Wkly. Wage	0.2052***		0.1796***	
	(0.0376)		(0.0550)	
(log, l2) Annual Avg. Wkly. Wage	0.2789***		0.1149	
	(0.0885)		(0.0759)	
(log) Real GDP	0.1368***		0.0305	
	(0.0308)		(0.0251)	
gr_weighted_annual_avg_wkly_wage		0.3141***		
		(0.0332)		
l1_gr_weighted_annual_avg_wkly_wage		0.3308***		
		(0.0319)		
l2_gr_weighted_annual_avg_wkly_wage		0.2514***		
		(0.0253)		
l1_log_real_gdp_total			0.0612***	
			(0.0171)	
l2_log_real_gdp_total			0.1589***	
			(0.0297)	
diff_log_real_gdp_total				
l1_diff_log_real_gdp_total				
l2_diff_log_real_gdp_total				
(log) Real GDP pc				
l1_log_real_gdp_total_pc				
l2_log_real_gdp_total_pc				
diff_log_real_gdp_total_pc				
l1_diff_log_real_gdp_total_pc				
l2_diff_log_real_gdp_total_pc				
Fixed-effects				
unit	Yes	Yes	Yes	
year	Yes	Yes	Yes	
Fit statistics				
Observations	12,612	12,585	11,856	
R^2	0.96755	0.41767	0.99644	
Within R^2	0.30497	0.05311	0.17113	

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

Dependent Variable:	(log) Elem.Ed.Exp.pp
Model:	(1)
Variables	
(log) Annual Avg. Wkly. Wage	0.1704***
	(0.0610)
l2_log_real_gdp_total_pc	0.0729**
	(0.0301)
(log) Prop Taxpp	0.1932***
	(0.0156)
(log) House Price Index	0.1642***
	(0.0198)
Fixed-effects	
unit	Yes
year	Yes
Fit statistics	
Observations	11,521
R^2	0.84827
Within R^2	0.19025

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

Dependent Variable:	(log) Elem.Ed.Exp.pp
Model:	(1)
Variables	
(log) Annual Avg. Wkly. Wage × share_own_discrete = 1=high	0.1589**
	(0.0666)
(log) Annual Avg. Wkly. Wage × share_own_discrete = 2=medium	0.1803***
	(0.0615)
(log) Annual Avg. Wkly. Wage × share_own_discrete = 3=low	0.1376**
	(0.0663)
l2_log_real_gdp_total_pc	0.0713**
	(0.0304)
(log) Prop Taxpp	0.1952***
	(0.0159)
(log) House Price Index	0.1645***
	(0.0200)
Fixed-effects	
unit	Yes
year	Yes
Fit statistics	
Observations	11,521
R^2	0.84841
Within R^2	0.19101

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

Appendix

A Descriptive Regression Results

In the following set of results, I report descriptive regressions to establish relationships between property taxes, education expenditure, GDP (total, private industry, O&G&mining), etc. All regression models that follow include TWFE (CZ- and year- fixed effects) and standard errors clustered by commuting zone. All functional forms in the feols() functions below are of the form Y ~ X In the cases in which multiple estimations are included via sw(Xa, Xb, Xc + Xd), the function will return results for Y~Xa, Y~Xb, Y ~ Xc + Xd.

A.1 Property Tax ~ GDP

GDP has a highly relevant relationship to property taxes. A 1% increase in GDP (per capita) leads to a 0.38% (0.32%) increase in property taxes collected (per capita).

Dependent Variables:	log_real_Property_Tax		(log) Prop Taxpp	
Model:	(1)	(2)	(3)	(4)
Variables				
(log) Real GDP	0.3854***	0.1226***		
	(0.0480)	(0.0325)		
l(log_real_gdp_total,1)		0.1193***		
		(0.0274)		
l(log_real_gdp_total,2)		0.0697**		
		(0.0285)		
l(log_real_gdp_total,3)		0.0790***		
		(0.0183)		
l(log_real_gdp_total,4)		0.1198***		
		(0.0384)		
(log) Real GDP pc			0.3151***	0.1212***
			(0.0616)	(0.0366)
l(log_real_gdp_total_pc,1)				0.0929***
				(0.0271)
l(log_real_gdp_total_pc,2)				0.0677**
				(0.0328)
l(log_real_gdp_total_pc,3)				0.0731***
				(0.0229)
l(log_real_gdp_total_pc,4)				0.0624*
				(0.0351)
Fixed-effects				
unit	Yes	Yes	Yes	Yes
year	Yes	Yes	Yes	Yes
Fit statistics				
Observations	13,356	10,812	13,356	10,812
R^2	0.99175	0.99329	0.93467	0.94256
Within R^2	0.10787	0.15702	0.06308	0.08956

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

A.2 Education Expenditure ~ Revenue Sources

The below regressions are included to establish the relationship between education expenditure and its component parts. These regressions simply corroborate what is displayed in the section on Key Relationships in LINK (ie. that the largest form of IG revenue is state funding and Own Source revenue is largely sourced from Property Taxes).

Dependent Variables:	(log) Elem.Ed.Exp.pp				log_real_Elem_Educ_Total_E			
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
Variables								
(log) Rev. Own Sources pp	0.3604***							
	(0.0190)							
(log) IG Revenue pp	0.4469***		0.4532***					
	(0.0244)		(0.0265)					
(log) Prop Taxpp		0.2266***	0.2871***	0.2897***				
		(0.0180)	(0.0185)	(0.0181)				
(log) Fed IG Rev. pp				0.0019				
				(0.0019)				
(log) State IG Rev pp				0.4307***				
				(0.0283)				
log_real_Property_Tax					0.2565***	0.3014***	0.3070***	
					(0.0195)	(0.0194)	(0.0192)	
log_real_Total_IG_Revenue						0.5020***		0.
						(0.0252)		(0
log_real_Total_Fed_IG_Revenue							0.0005	
							(0.0007)	
log_real_Total_State_IG_Revenue							0.4823***	
							(0.0269)	
log_real_Total_Rev_Own_Sources								0.
								(0
Fixed-effects								
unit	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Fit statistics								
Observations	13,356	13,356	13,356	13,356	13,356	13,356	13,356	1
R^2	0.89075	0.82859	0.88016	0.87791	0.99566	0.99738	0.99732	0
Within R^2	0.45044	0.13778	0.39717	0.38586	0.14427	0.48315	0.47095	0

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

A.3 Education Expenditure ~ GDP

A 1% increase in GDP pc is associated with a 0.19% increase in education expenditure per pupil, dominated by the effect of GDP from private industry (0.16%). I include here also the GDP generated from the oil, gas, mining, and quarrying sector. The effect is small and statistically insignificant.

Dependent Variable:	(log) Elem.Ed.Exp.pp		
Model:	(1)	(2)	(3)
Variables			
(log) Real GDP pc	0.1926***		
	(0.0210)		
(log) Real GDP Priv. Industry pc		0.1674***	
		(0.0182)	
log_real_gdp_o_g_mining_quarr_21_pc			0.0155***
			(0.0032)
Fixed-effects			
unit	Yes	Yes	Yes
year	Yes	Yes	Yes
Fit statistics			
Observations	13,356	13,356	13,356
R^2	0.81378	0.81283	0.80330
Within R^2	0.06328	0.05847	0.01055

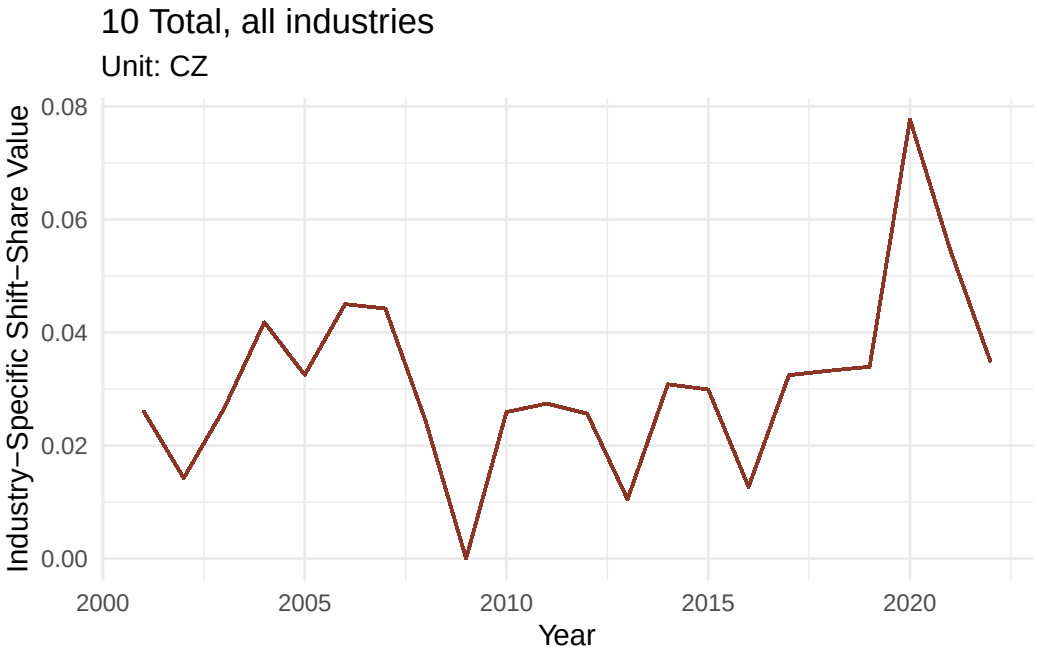
Clustered (unit) standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

A.4 Groups

Industry-level shift-share_instrument

[1] "Downloaded QCEW data for 2004." [1] "Cleaned temp file." [1] "Created employment share values." [1] "Appended national shock variables." % latex table generated in R 4.5.0 by xtable 1.8-4 package % Thu Jun 5 02:06:51 2025

industry_title
10 Total, all industries
NAICS 11 Agriculture, forestry, fishing and hunting
NAICS 21 Mining, quarrying, and oil and gas extraction
NAICS 22 Utilities
NAICS 23 Construction
NAICS 42 Wholesale trade
NAICS 51 Information
NAICS 52 Finance and insurance
NAICS 53 Real estate and rental and leasing
NAICS 54 Professional, scientific, and technical services
NAICS 55 Management of companies and enterprises
NAICS 56 Administrative and support and waste management and remediation services
NAICS 61 Educational services
NAICS 62 Health care and social assistance
NAICS 71 Arts, entertainment, and recreation
NAICS 72 Accommodation and food services
NAICS 81 Other services (except public administration)
NAICS 92 Public administration

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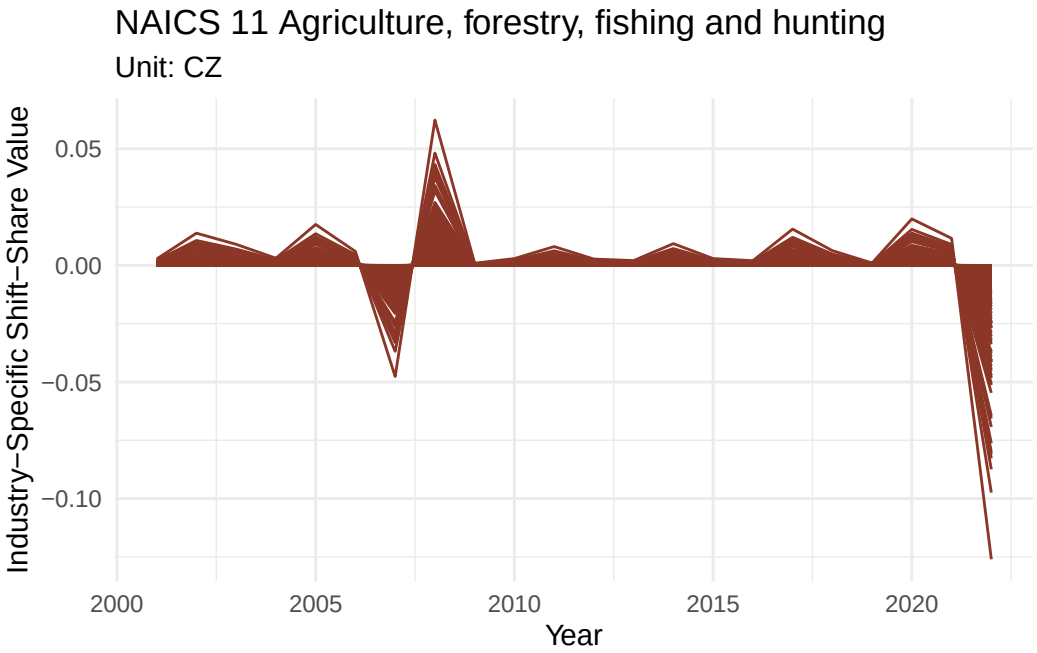


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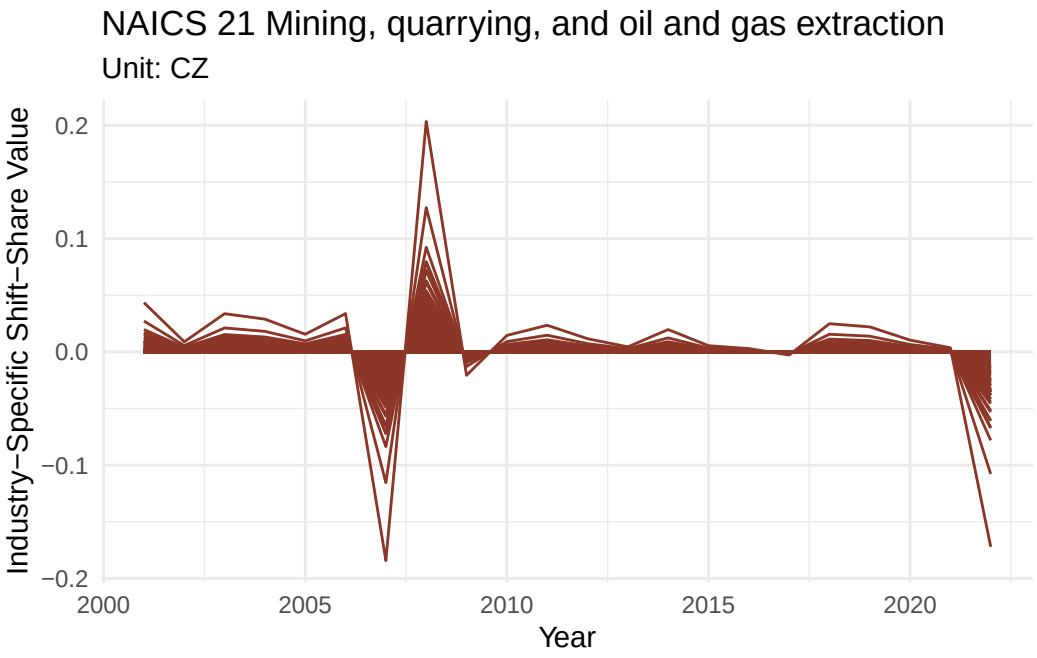


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Warning: Removed 2992 rows containing missing values or values outside the scale range (`geom_line()`).
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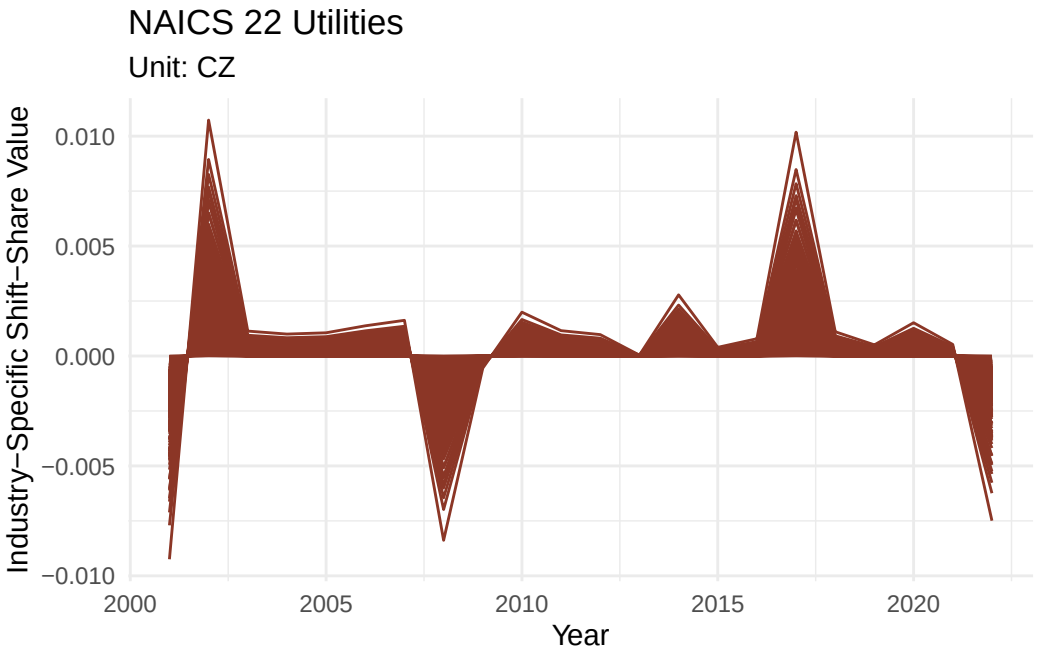


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Warning: Removed 308 rows containing missing values or values outside the scale range (`geom_line()`).
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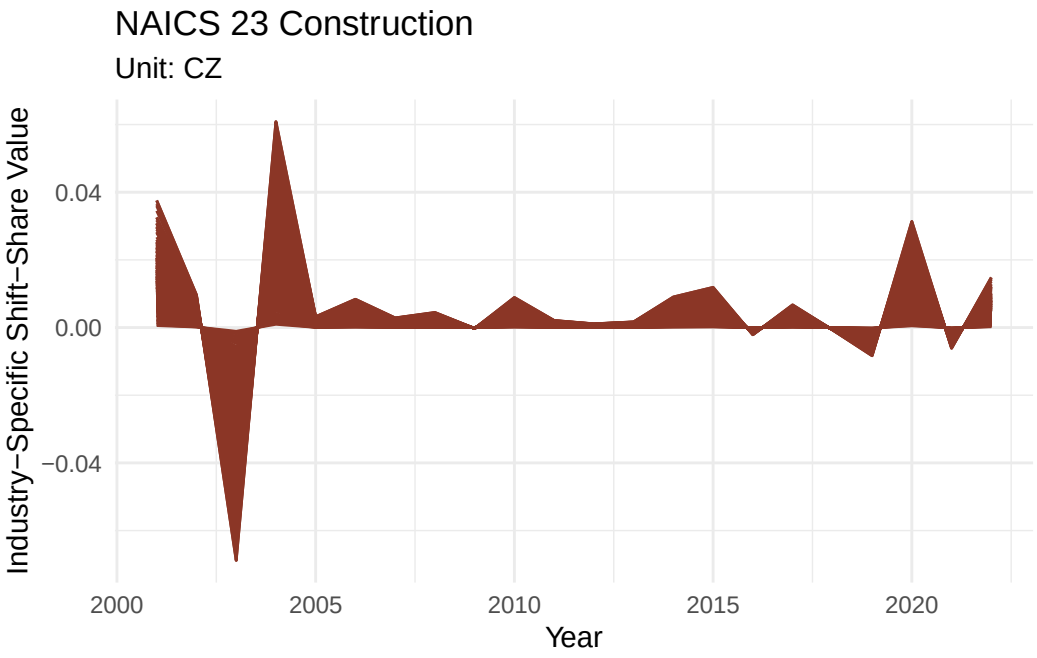
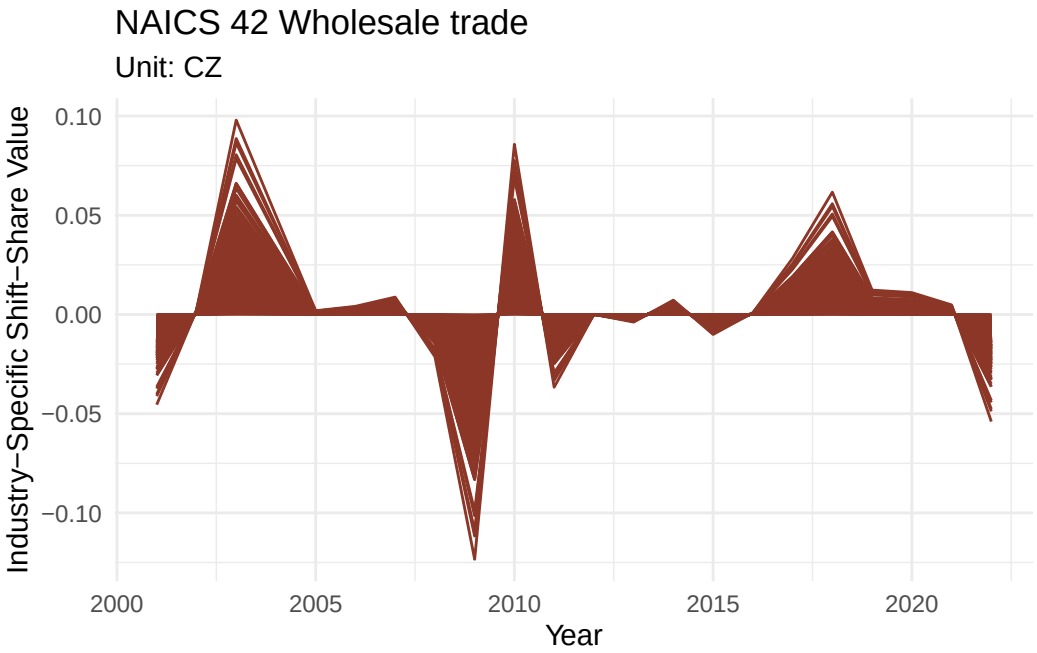



```
Warning: Removed 858 rows containing missing values or values outside the scale range (`geom_line()`).
```

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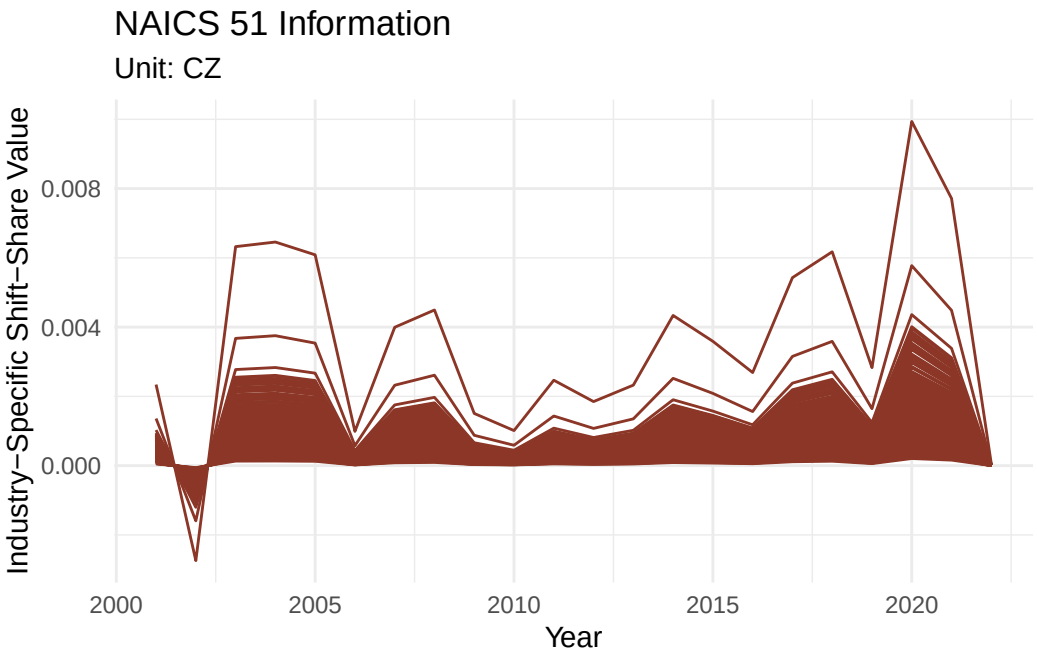


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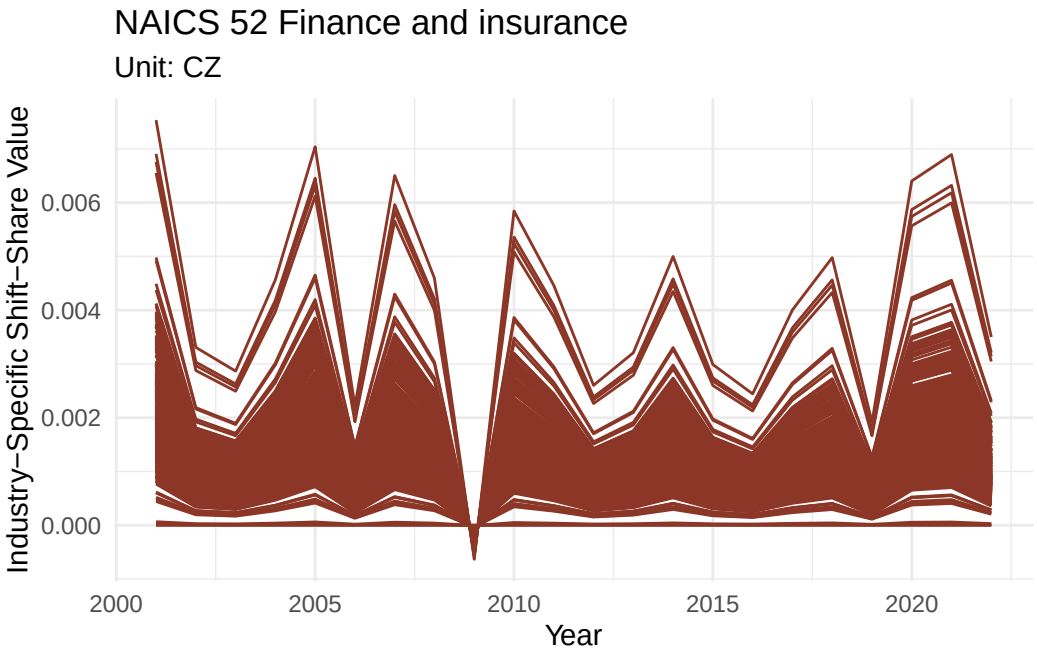


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Warning: Removed 726 rows containing missing values or values outside the scale range (`geom_line()`).
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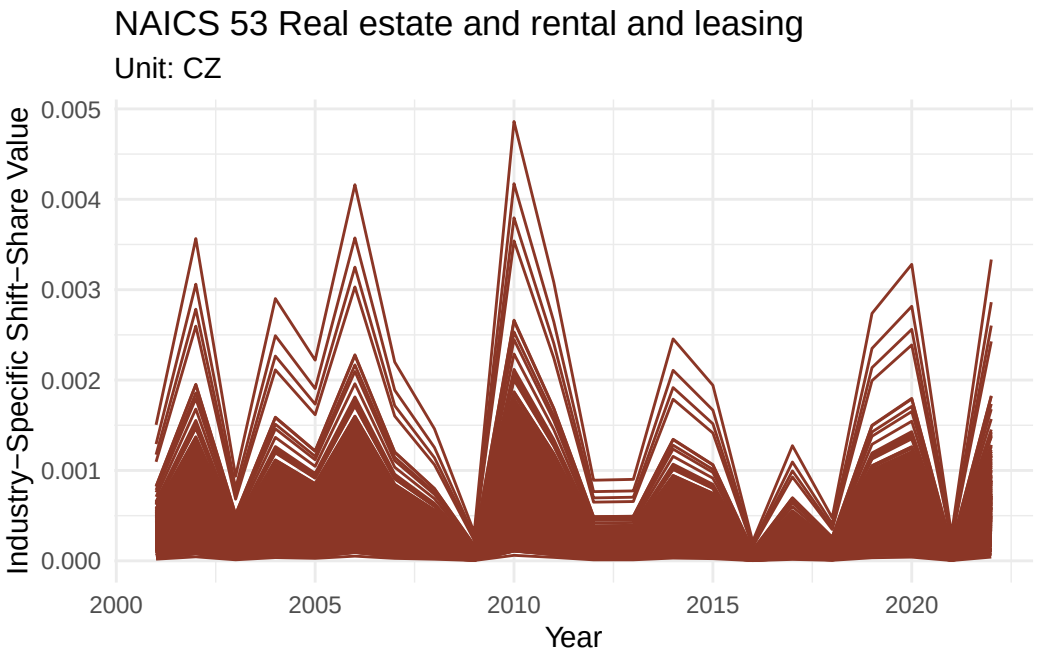


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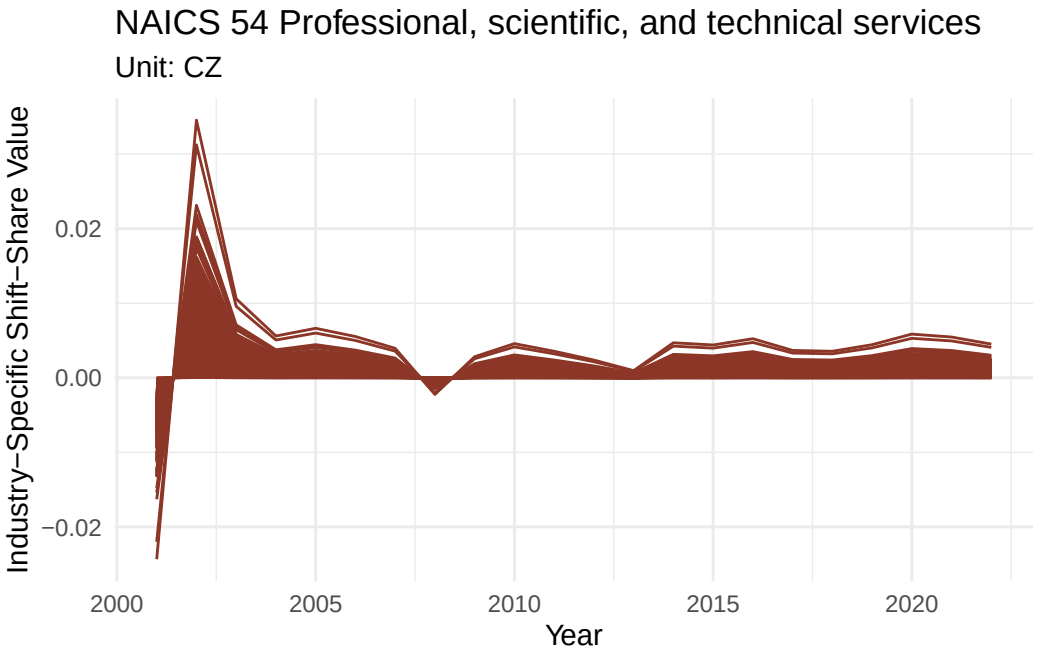


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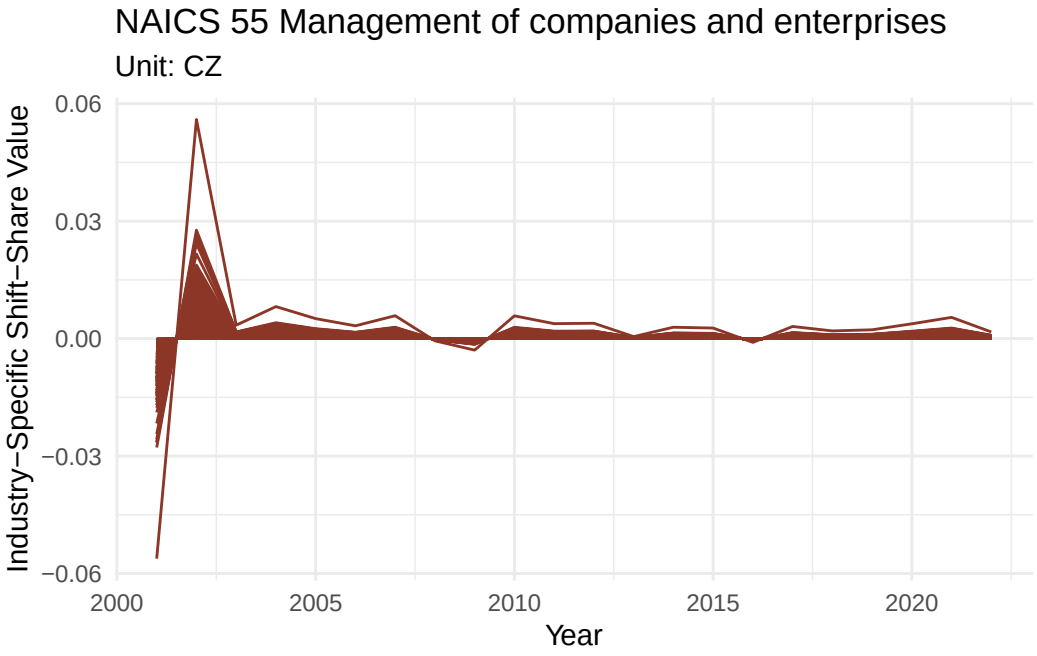


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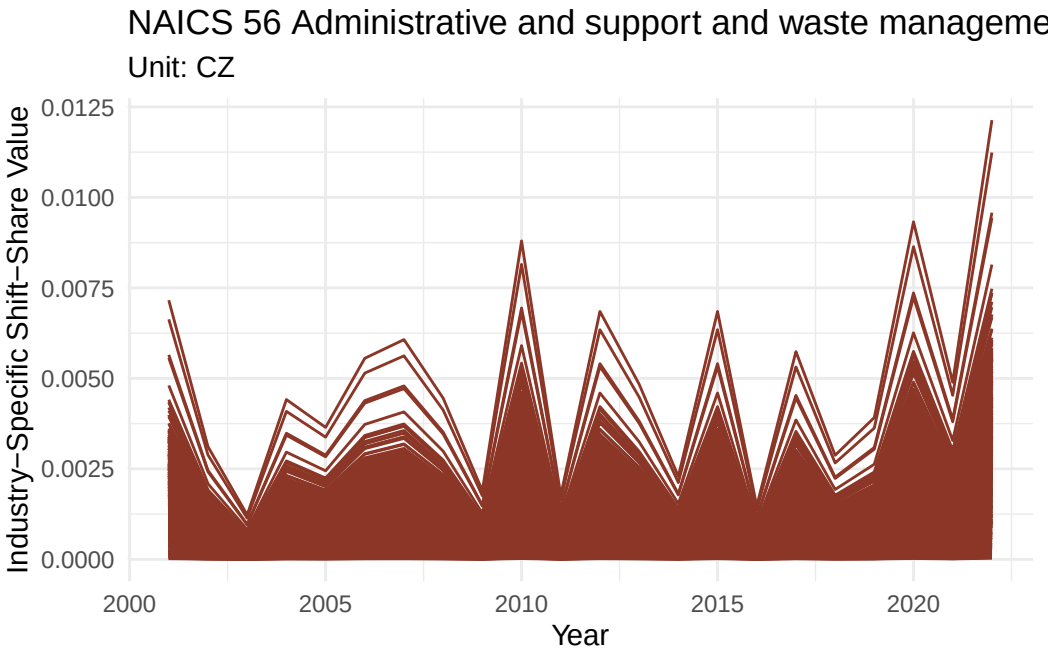


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Warning: Removed 2068 rows containing missing values or values outside the scale range (`geom_line()`).
```
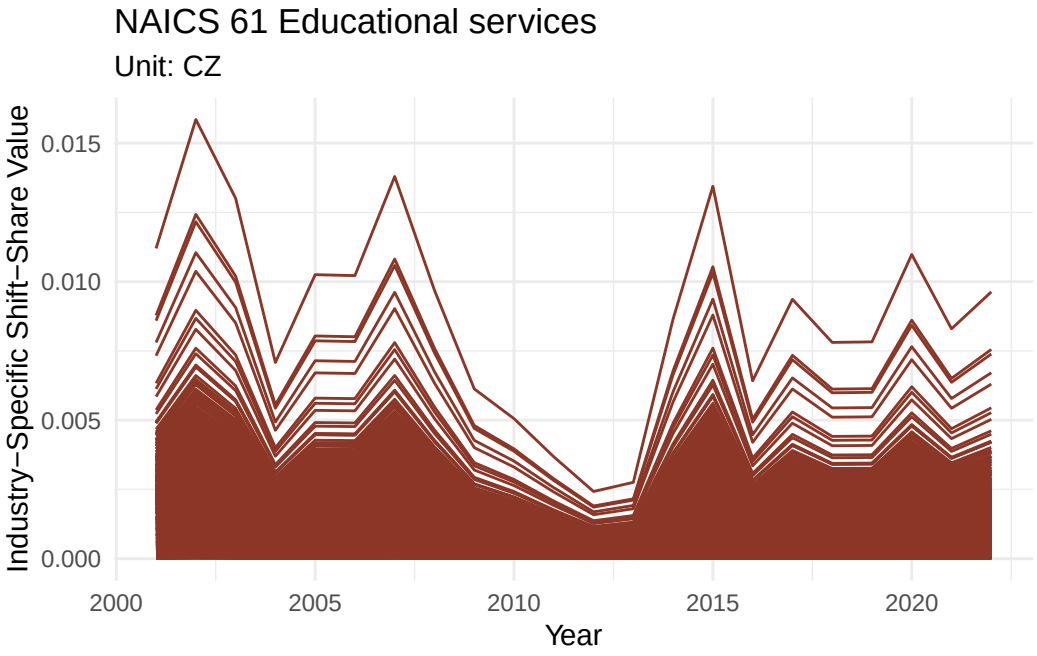
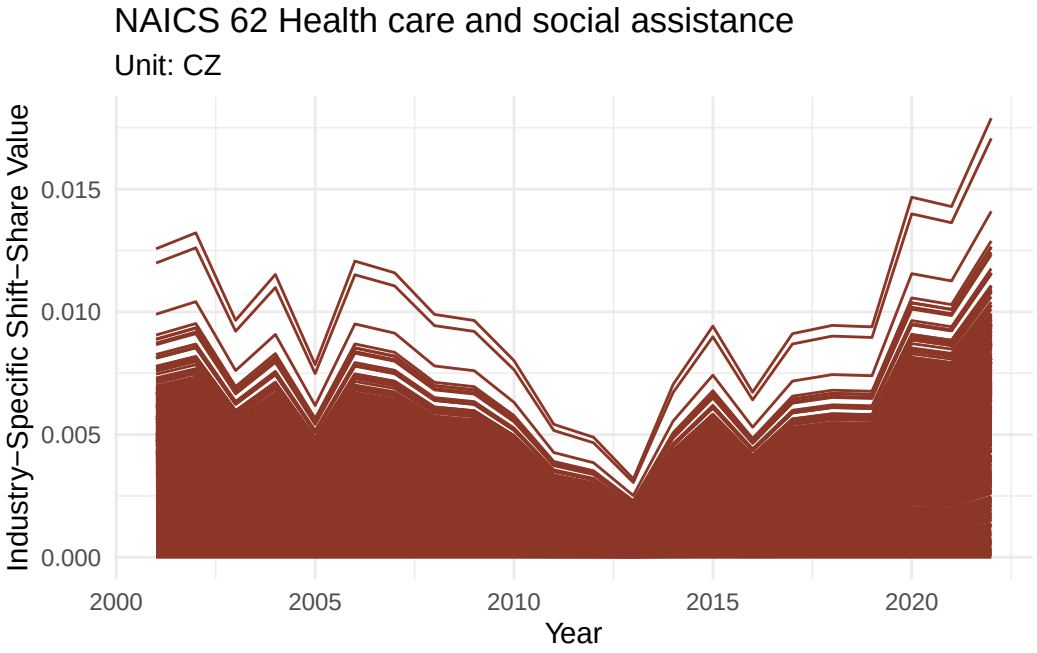
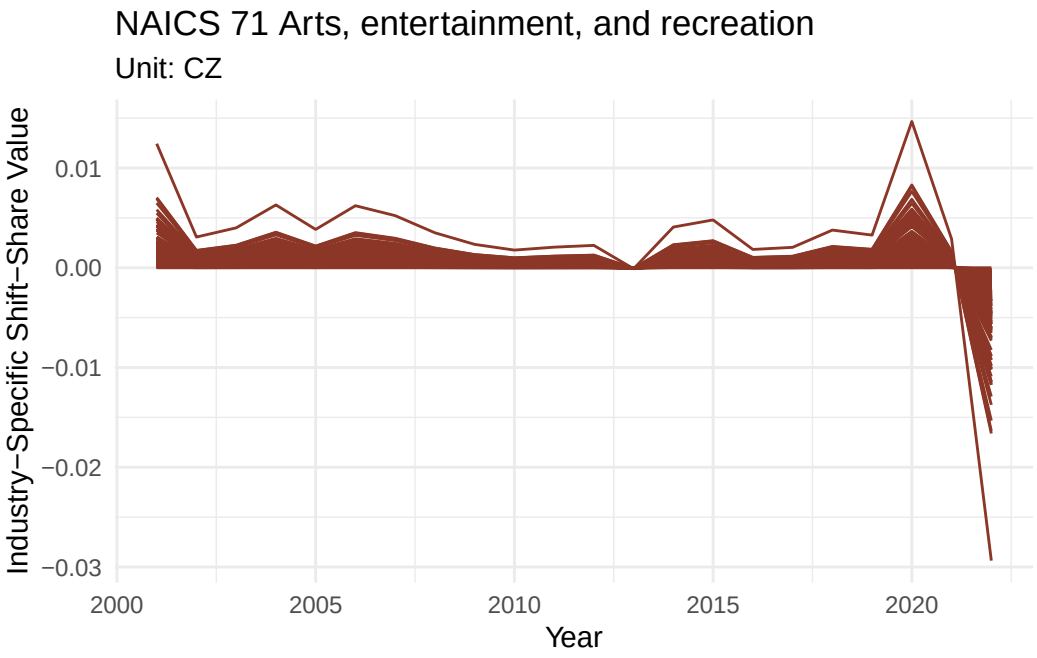



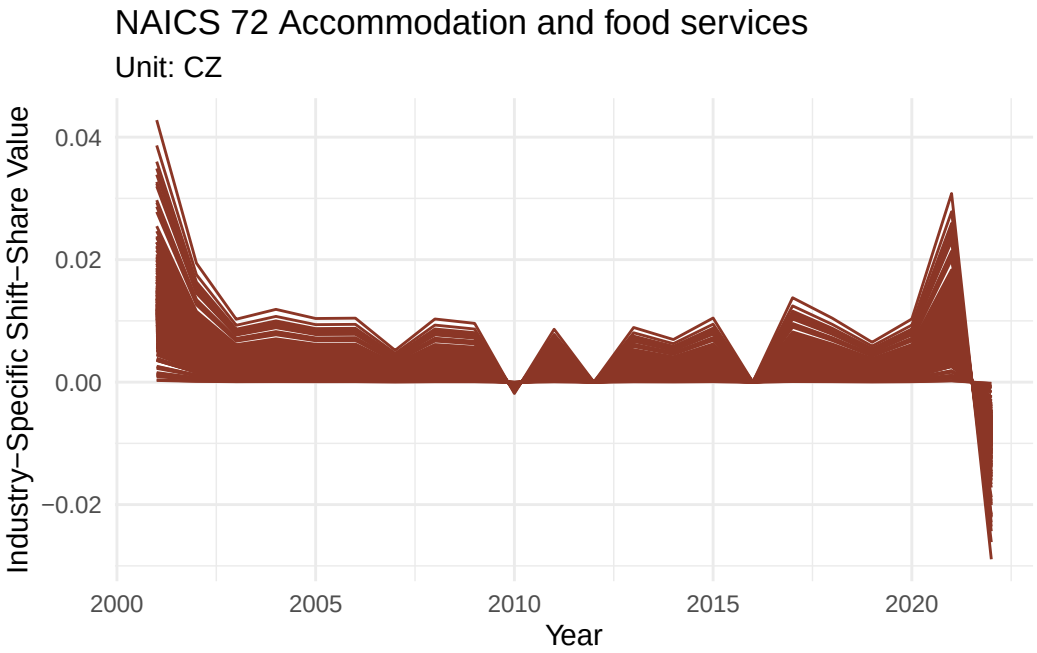

```
Warning: Removed 1078 rows containing missing values or values outside the scale range (`geom_line()`).
```



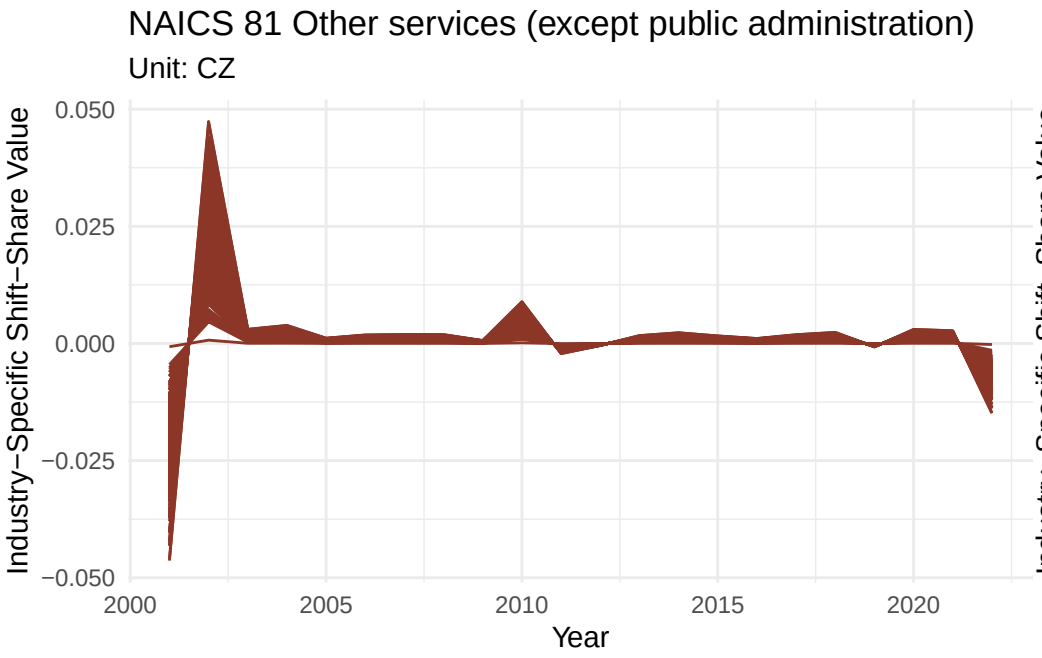

```
Warning: Removed 990 rows containing missing values or values outside the scale range (`geom_line()`).
```

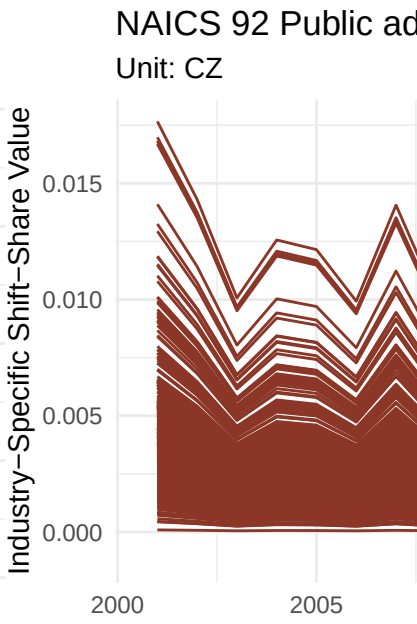



```
Warning: Removed 748 rows containing missing values or values outside the scale range (`geom_line()`).
```




```
Warning: Removed 176 rows containing missing values or values outside the scale range (`geom_line()`).
```


NAICS 81 Other services (except public administration)
Unit: CZ
Industry−Specific Shift−Share Value
0.050
0.025
0.000
−0.025
−0.050
2000
2005
2010
2015
2020
Year


NAICS 92 Public ad
Unit: CZ
Industry−Specific Shift−Share Value
0.015
0.010
0.005
0.000
2000
2005