# Robust Standard Errors in Small Samples

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The package `ShiftShareSE` implements confidence intervals proposed by Adão et al. [2019] for inference in shift-share least squares and instrumental variables regressions, in which the regressor of interest (or the instrument) has a shift-share structure, as in Bartik [1991]. A shift-share variable has the structure $X_i = \sum_{s=1}^{S} w_{is} X_s$, where $i$ indexes regions, $s$ indexes sectors, $X_s$ are sectoral shifters (or shocks), and $w_{is}$ are shares, such as initial share of region $i$'s employment in sector $s$.

This vignette illustrates the use of the package using a dataset from Autor et al. [2013] (ADH hereafter). The dataset is included in the package as the list `ADH`. The first element of the list, `ADH$reg` is a data-frame with regional variables, the second element, `ADH$sic` is a vector of SIC codes for the sectors, and `ADH$W` is a matrix of shares. See `?ADH` for a description of the dataset.

We now replicate column (1) of Table V in Adão et al. [2019]. First we load the package, define the vector of controls, and define a vector of 3-digit SIC codes:

```
library("ShiftShareSE")
ctrls <- "t2 + l_shind_manuf_cbp + l_sh_popedu_c + l_sh_popfborn +
          l_sh_empl_f + l_sh_routine33 + l_task_outsource + division"
sic <- floor(ADH$sic/10)
```

We cluster the standard errors at the 3-digit SIC code (using the option `sector_cvar`), and, following ADH, weight the data using the weights `ADH$reg$weights`. See `?reg_ss` and `?ivreg_ss` for full description of the options.

The first-stage regression:

```
reg_ss(as.formula(paste("shock ~ ", ctrls)), W = ADH$W,
    X = IV, data = ADH$reg, weights = weights, region_cvar = statefip,
    sector_cvar = sic, method = "all")
#> Estimate: 0.6310409
#>
#> Inference:
#>                Std. Error      p-value  Lower CI  Upper CI
#> Homoscedastic 0.02732516 0.000000e+00 0.5774846 0.6845973
#> EHW           0.08700719 4.083400e-13 0.4605100 0.8015719
#> Reg. cluster  0.09142372 5.113909e-12 0.4518537 0.8102281
#> AKM           0.05296055 0.000000e+00 0.5272402 0.7348417
#> AKM0          0.07671358 1.282891e-03 0.5375710 0.8382827
```

Note that for `"AKM0"`, `"Std. Error"` corresponds to the normalized standard error, i.e. the length of the confidence interval divided by $2z_{1-\alpha/2}$.

The reduced-form and IV regressions:

```
reg_ss(as.formula(paste("d_sh_empl ~", ctrls)), W = ADH$W,
    X = IV, data = ADH$reg, region_cvar = statefip, weights = weights,
```

```
    sector_cvar = sic, method = "all")
#> Estimate: -0.4885687
#>
#> Inference:
#>                Std. Error      p-value   Lower CI   Upper CI
#> Homoscedastic 0.06332778 1.221245e-14 -0.6126889 -0.3644485
#> EHW           0.11244360 1.392685e-05 -0.7089541 -0.2681833
#> Reg. cluster  0.07578147 1.140306e-10 -0.6370977 -0.3400398
#> AKM           0.16419445 2.924641e-03 -0.8103839 -0.1667535
#> AKM0          0.25437489 4.218033e-04 -1.2368853 -0.2397541
ivreg_ss(as.formula(paste("d_sh_empl ~", ctrls, "| shock")),
    W = ADH$W, X = IV, data = ADH$reg, region_cvar = statefip,
    weights = weights, sector_cvar = sic, method = "all")
#> Estimate: -0.7742267
#>
#> Inference:
#>                Std. Error      p-value   Lower CI   Upper CI
#> Homoscedastic  0.1069532 4.523049e-13 -0.9838511 -0.5646022
#> EHW            0.1647892 2.623532e-06 -1.0972075 -0.4512459
#> Reg. cluster   0.1758096 1.063809e-05 -1.1188071 -0.4296462
#> AKM            0.2403730 1.277718e-03 -1.2453492 -0.3031041
#> AKM0           0.3318966 4.218033e-04 -1.6903240 -0.3893132
```

## References


Rodrigo Adão, Michal Kolesár, and Eduardo Morales. Inference in shift-share designs: Theory and inference. *Quarterly Journal of Economics*, forthcoming, August 2019. doi: 10.1093/qje/qjz025.

David H. Autor, David Dorn, and Gordon H. Hanson. The China syndrome: Local labor market effects of import competition in the United States. *American Economic Review*, 103(6):2121–2168, October 2013. doi: 10.1257/aer.103.6.2121.

Timothy J. Bartik. *Who Benefits from State and Local Economic Development Policies?* W.E. Upjohn Institute for Employment Research, Kalamazoo, MI, 1991.