

# ivpanel: IV estimation of panel-data models

Allin Cottrell

February 15, 2021

## 1 Introduction

This package estimates three variants of panel data models with instrumental variables, namely fixed-effects, the “between” model, and random effects (Generalized 2-Stage Least Squares or G2SLS). An extended discussion of these models can be found in chapter 7 of Baltagi (2005). The sample script provided with this package replicates results obtained by Baltagi using *Stata* for each of the three supported models.

The required arguments to the main public function `ivpanel()` are as follows:

1. *y* (series), the dependent variable
2. *X* (list), the regressors, both exogenous and endogenous
3. *Z* (list), the instruments, including any exogenous regressors

Note that exogenous variables in list *X* should be repeated in *Z*, as in *gretl*’s `tsls` command. The constant is automatically added to *X* and *Z* if it’s not already present.

An optional fourth argument, *case*, can be used to specify the type of model. The argument is an integer switch that takes values 1, 2 or 3 (this may be extended in future). A value of 1 means fixed effects, and is implicit if no fourth argument is given; a value of 2 means to use the between estimator; and a value of 3 means G2SLS. Leaving aside the constant, all the members of *X* and *Z* must be time-varying when the fixed effects case is selected.

An optional final boolean argument, *quiet*, controls the printing of output: if *quiet* is set to a non-zero value, printing is suppressed.

## 2 The ivpanel bundle

By way of return value, `ivpanel()` offers a *gretl* bundle containing the items shown in Table 1.

Some comments on the bundle members follow.

- The  $R^2$  value, `rsq`, is calculated as the square of the correlation between the dependent variable and the fitted values.
- The `dims` vector, if present, contains three elements holding, respectively, the number of groups used and the minimum and maximum time-series spans.
- The `Fpool` statistic for fixed effects is calculated as per Wooldridge (1990), adjusted for the panel case. The formula is

$$\frac{SSR_r - SSR_u}{SSR_f} \times \frac{dfd}{dfn}$$

where `SSRf` is the sum of squared residuals from the fixed-effects IV model and the other two `SSR` values are calculated thus:

<i>name</i>	<i>type</i>	<i>description</i>
<b>case</b>	scalar	the value of the <i>case</i> argument on input
<b>nobs</b>	scalar	the total number of observations used
<b>coeff</b>	matrix	column vector of coefficients
<b>stderr</b>	matrix	column vector of standard errors
<b>vcv</b>	matrix	the coefficient covariance matrix
<b>uhat</b>	matrix	the vector of residuals
<b>yhat</b>	matrix	the vector of fitted values
<b>SSR</b>	scalar	sum of squared residuals
<b>sigma</b>	scalar	standard error of the regression
<b>df</b>	scalar	degrees of the freedom for the regression
<b>rsq</b>	scalar	correlation-based $R^2$
<b>wald</b>	scalar	Wald joint $\chi^2$ test for all regressors
<b>modstr</b>	string	short description of the model
<b>ystr</b>	string	the name of the dependent variable
<b>Estr</b>	string	the names of the endogenous regressor(s)
<b>Istr</b>	string	the names of the (additional) instruments
<b>dims</b>	matrix	data dimensions (cases 1 and 3 only)
<b>Fpool</b>	scalar	$F$ -test for joint significance of fixed effects (case 1 only)

**Table 1:** Items in ivpanel bundle

1. We run the fixed-effects first-stage regressions and save the fitted values; we then use these to replace the endogenous regressors.
2. SSRr is then obtained via OLS, and SSRu from a fixed-effects regression. SSRu differs from SSRf in that it uses the “raw” residuals, without correction as one usually applies with two stage least squares (i.e. replacing the first-stage fitted values with the actual data for the endogenous regressors when computing the fitted values).

### 3 Sample script

The sample script estimates three models of the (log) crime rate across the counties of North Carolina over the years 1981 to 1987, using data from [Cornwell and Trumbull \(1994\)](#). The endogenous regressors are **lpolpc** (log of police per capita) and **lprbarr** (log of the estimated probability of arrest). The instruments (besides the exogenous regressors) are **ltaxpc** (log of tax revenue per capita), **lmix** (log of the offense “mix”, face-to-face versus other) and a set of year dummies.

It’s perhaps noteworthy that despite the IV approach, the coefficient on **lpolpc** is positive in all the models, the opposite of what would be expected if the estimator had succeeded in picking up a causal relationship. At least in the fixed effects specification the positive **lpolpc** coefficient is not statistically significant ( $P$ -value  $> 0.4$ ).

### 4 Graphical interface

An entry-point for **ivpanel** can be found under the **Panel** sub-menu of gretl’s **Model** menu: the label is “Panel IV model.” See [Figure 1](#). The specification of the endogenous regressors is implicit: any variables that appear in the “regressors” list and not in the “instruments” list are taken to be endogenous.



**Figure 1:** Specify arguments for ivpanel

## 5 Auxiliary printing function

The auxiliary public function `ivp\_print()` is provided to “pretty-print” the results contained in the bundle provided by `ivpanel()`; `ivp\_print()` takes a pointer to the bundle as its sole argument.

## 6 Change log

2021-02-15: add guard against excessive collinearity.

2020-09-22: avoid use of deprecated `isnull` function.

2015-10-17: first release as addon.

## References

Baltagi, B. H. (2005) *Econometric Analysis of Panel Data*, 3e, Chichester: Wiley.

Cornwell, C. and W. Trumbull (1994) ‘Estimating the economic model of crime with panel data’, *Review of Economics and Statistics* 76: 360–366.

Wooldridge, J. M. (1990) ‘A note on the Lagrange multiplier and F-statistics for two stage least squares regressions’, *Economics Letters* 34: 151–155.