ECONOMICS 6002 CLASS 12
INSTRUMENTAL VARIABLES ESTIMATION

1.   Motivation for OLS
      a.   OLS is Best Linear Unbiased Estimator (BLUE) - Gauss-Markov Theorem
      b.   Implies $E[X\varepsilon]=0$ (errors orthogonal to regressors)

2.   Implications of the Exogenous X assumption
      a.   Counterexamples
            i.   Simultaneous equations (e.g., consumption function)
            ii.   Omitted variables (correlated with included variables)
            iii.   Measurement error (in independent variables)

3.   Characteristics of Instrumental variables Z
      a.   Uncorrelated with disturbances: $E[Z'\varepsilon]=0$
      b.   Correlated with independent variables: Z'X is rank K
      c.   There can be overlap between Z and X, in the case of any X variable that is itself
            exogenous
      d.   IV's act as filters to remove from the independent variables any variations that are
            correlated with the disturbances (and are therefore causing OLS bias)
      e.   There must be at least as many IV's as independent variables – otherwise, there are
            not enough filters to filter the independent variables that need to be filtered

4.   Instrumental variables estimation - the just identified case (rank(Z)=K)
      a. $\beta^{IV} = (Z'X)^{-1} Z'y$
      b. β^{IV} is consistent, but there is a loss of efficiency due to the filtering action of the
            instrumental variables.

5.   Two-stage least squares estimation - the overidentified case (rank(Z)>K)
      a.   Stage 1: Regress X on Z.. This gives us the combinations of Z that best explain X,
            and so are the most efficient.
      b.   Stage 2: Use the values of X predicted in Stage 1, which are the most efficient
            combinations of Z, as the instrumental variables.
      c. β^{2SLS} is consistent, and asymptotically efficient. It makes full use of the available
            instruments.

6.   Testing for exogeneity - the Hausman test

7.   Panel data models: the Hausman-Taylor Instrumental Variable estimator
      a.   The main limitation of the FE estimator (other than its inefficiency relative to the
            RE estimator) is that it cannot estimate the effect of independent variables that
            vary with i but not t, because there is no within-group variation for such variables.
      b.   The H-T estimator estimates the effect of independent variables that vary with i
            but not t, through the use of the group means of independent variables $\mathbf{x}_{it}$ that are
            uncorrelated with the individual effect u_i, as instrumental variables.

                                                            Updated October 20, 2008