

little or not at all over short periods, which thus precludes any attempt to resolve the "small farms are more productive" question by using fixed effect estimators. Fourth, and perhaps most serious, in the presence of white noise measurement error in the explanatory variables, demeaning or differencing of positively autocorrelated x 's will not only reduce the variability of the signal — variability in the true x 's — but it will inflate the ratio of noise to signal in the regressors. In the standard case where measurement error induces attenuation bias, the attenuation will be worse using the difference or within estimator. The combination of loss of precision and increased attenuation bias often erases in the difference or within estimates effects that were significant in the cross-section, even when the model is correctly specified and there is no heterogeneity bias. Such results provide no indication that heterogeneity bias is an issue in the cross-section. It clearly makes sense to use Hausman (1978) tests to check whether the estimates from the difference or within estimates are indeed significantly different from the cross-section estimates, although when significant differences are found, further information is needed to discriminate between measurement error or heterogeneity bias as an explanation.

2.1.7. Panel data in practice

Perhaps for the reasons given in the previous paragraph, it is difficult to use panel data — especially short panel data — to generate convincing conclusions and it is particularly difficult to disentangle measurement error from omitted heterogeneity. In particular, it is clear that panel data *are* no panacea, and that there is no guarantee that difference or within estimates will be preferable to OLS on a cross-section. Even so, panel data have allowed investigators to consider alternatives that could not otherwise have been explored, and to relax previously maintained assumptions.

The techniques that were originally developed for agricultural production functions have been widely applied to other sorts of "production", from the production of health in terms of health inputs — where exactly the same issues of simultaneity and heterogeneity arise — as well as to wage equations, where earnings are a function of schooling and heterogeneity arises because econometricians cannot control for unobserved ability. Such studies are extensively reviewed by Behrntart and Deolalikar (1987) and by Strauss and Thomas in this volume. At their best, these studies are sensitive to the difficulties, and much can be done to interpret results by using prior information about the likely size of measurement errors, so that changes between cross-section and within estimates can plausibly be explained. Investigators have also been creative in using the panel data idea, not just for differences over time, but in other applications. A number of studies, for example Behrman and Wolfe (1984, 1989) on education, and Rosenzweig and Wolpin (1988) on child health, use