Capital Accounting for Rapidly Obsolescing One-Hoss Shay Individuals in Geometric Cohorts

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Paper Abstract: The twin problems of properly accounting for, and measuring the productivity contributions of, used computers, when quality-adjusted prices of new computers decline rapidly and persistently, remain unsolved and controversial. This paper contributes to a resolution by decomposing a geometrically-depreciating asset cohort into a proper weighted sum of its individual-asset members. (Geometric cohorts are sufficient but not necessary for a geometrically-depreciating stock.) The individuals are "one-hoss shay" (i.e., light-bulb) assets, though with a common rate of obsolescence. Weights as a function of service-lives are inferred by a variational exercise, and are exactly appropriate for correcting for survivor-bias in age-price regressions. By contrast, the Feldstein-Rothschild mortality distribution, often cited for the case of one-hoss shay individuals in geometric cohorts, is shown to be mistaken.

One-hoss shay individual computers are key to the exercise, for the individual-level resale-price profile is sensitive to the own-discount rate. That sensitivity feeds into the derived survival distribution, which then prevents the geometric cohort from allowing complete pass-through of an increase in the persistent rate of obsolescence to the overall depreciation rate. The mechanism is straightforward: an increase in the persistent rate of obsolescence would transmit one-for-one to the depreciation rate, except for the accompanying increase in the own-discount rate, which partly inhibits pass-through. For rates typical of computers (cf. Diewert and Wei, 2015), the inhibition reduces the contribution of obsolescence toward depreciation by about a fourth. (By contrast, straightline individual-level resale-price profiles, which do not feature discounting, would allow perfect cohort-level pass-through.)

The model is extended by the introduction of a positive alternative-use / floor / scrap price, so that increases in obsolescence might induce premature retirements. These turn out to affect the cohort depreciation rate only slightly (since the floor price is treated as a refundable deposit), yet they knock cohort-level efficiency profiles away from simple geometric forms. Fortunately, the resulting non-geometric efficiency profiles are readily approximated as constant-weighted sums of a few geometric processes, which are fairly easy to handle at the cohort and stock levels.