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A Simple Measure of Price Adjustment Coefficients: A Correction

NEIL BRISLEY and MICHAEL THEOBALD*

DAMODARAN (1993) DEVELOPS AN ESTIMATOR for price adjustment coefficients as a function of variances at varying differencing intervals and autocovariances. However, the estimator generated in Damodaran (1993), equation (7), would appear to contain an error. Damodaran correctly demonstrates that by defining a period k such that $g(k) = 1$, it is possible to estimate both the noise and intrinsic variances of the returns process. Knowing these variances, an estimate of the speed of adjustment for a differencing interval j , $g(j)$, can be developed which is a function of observable variance and covariance terms. However, the relationship that is derived by Damodran is incorrect. The correct formulation is

$$g(j) = \frac{2 \operatorname{var}\{R(j, t)\}/j + 2 \operatorname{cov}\{R(k, t), R(k, t-1)\}/j}{\operatorname{var}\{R(j, t)\}/j + \operatorname{var}\{R(k, t)\}/k + 2 \operatorname{cov}\{R(k, t), R(k, t-1)\}/k} \quad (1)$$

where var and cov are the variance and covariance operators, respectively.

The estimator developed in equation (1) differs from that in Damodaran (1993), equation (7), by a $2(j-1)\operatorname{var}\{R(k, t)\}/k$ term in both the numerator and the denominator. The relationship between the corrected $g(j)$ (denoted by $g(C)$) and the Damodaran price adjustment coefficient (denoted by $g(D)$) for a differencing interval j can be expressed as

$$\frac{g(D)}{g(C)} - 1 = \frac{(j-1)}{jk} \frac{1}{(VR + p)} \frac{[(1/k) - (VR/j) + 2p[(1/k) - (1/j)]]}{[(VR/j) + (2j-1)/k + 2p/k]} \quad (2)$$

where $VR = \operatorname{var}\{R(j, t)\}/\operatorname{var}\{R(k, t)\}$ and $p = \operatorname{cov}\{R(k, t), R(k, t-1)\}/\operatorname{var}\{R(k, t)\}$. The expression in equation (2) will be equal to zero when $j = 1$. As $j \rightarrow k$, $VR \rightarrow 1$, so that when $j = k$, the above expression will again be equal to zero. Intermediate values in the range $\{1, k\}$ will, however, not have zero errors in estimated price adjustment coefficients and will be biased towards one.

That is,

$$(g(C) < g(D) < 1 | g(C) < 1) \quad \text{and} \quad (g(C) > g(D) > 1 | g(C) > 1) \quad (3)$$

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Table I
Empirical Error Magnitudes for the Median Firm

Differencing Interval	Damodaran's Partial Adjustment Coefficient	Corrected Partial Adjustment Coefficient	Percentage Error in Damodaran's Estimator
1	0.6408	0.6408	0.0
2	0.8687	0.7336	+18.4
5	0.9900	0.9503	+4.2
10	1.0005	1.0050	-0.4
15	1.0006	1.0080	-0.7
20	1.0000	1.0000	0.0

Effectively, as $j \rightarrow k$, the error term appearing in the numerator and denominator will increasingly dominate the other terms in the expression, thereby forcing the Damodaran price adjustment coefficient towards one.

Insights into the empirical magnitude of the error in Damodaran's estimator for the median firm can be obtained from the "All Firms" sample in Table II of Damodaran's paper. Given the intrinsic variance and noise estimates at the 20-day differencing interval contained in Table II, the variances for 1 day, 2 day, etc. return intervals may be deduced. Using this data in the corrected formula, the following results, reported in Table I, are obtained.

As the analytics imply, the Damodaran estimator will be above (below) the corrected estimator when the corrected partial adjustment estimator is below (above) one. The magnitude of the error difference is proportionately greater for the shorter differencing intervals with an over-estimation of 18.4 percent at the two day return interval declining to below one percent at longer differencing intervals.

The main impact that derives from the error in the estimator formulation is that the Damodaran estimator of the price adjustment coefficient will be biased towards one; the greater empirical impact is at shorter differencing intervals. Irrespective of the period assumed to have a unit price adjustment coefficient, the measured price reaction towards intrinsic values will be overstated by the Damodaran estimator when the actual price adjustment is incomplete. However, the correction does not change the basic conclusion of Damodaran's work; that is, there are price adjustment delays of several days.

REFERENCE

- Damodaran, Aswath, 1993, A simple measure of price adjustment coefficients, *Journal of Finance* 48, 387-400.