Financial Econometrics | Lecture 9

Dynamic Causal Effects: Multipliers, HAC and the Cumulative Test

In Class Group Activity

· SJTU, Summer School 2026 · Fatih Kansoy

Lesson of the day. A shock acts along a path, so you read its dynamic multipliers period by period and sum them into a cumulative multiplier. Because the lagged regressors are collinear and the errors are serially correlated, you test the cumulative effect with a linear combination and report HAC standard errors, never reading the lag coefficients one at a time.

Phase 1 – Concept checks

ANSWERS

ConcepTest 1. **Answer.** Option **(b)**. The cumulative effect at horizon 3 is the running sum $0.014 + 0.009 + 0.002 + 0.005 = 0.030$. The dynamic multiplier at horizon 2 is the coefficient on the *second* lag, $b_3 = 0.002$ (horizon 0 is the impact b_1). Option (a) reads a single coefficient as the cumulative; (c) treats the impact as the total; (d) is off by one on the lag index.

Horizon h means the coefficient on the h-th lag. The cumulative is the running sum.

ConcepTest 2. **Answer.** Option **(c)**. The residual autocorrelations $0.56, 0.46, 0.39$ are large and decay slowly, so the errors are serially correlated: robust SEs (b) fix only heteroskedasticity, not autocorrelation, and ordinary SEs (a) are worse. You need HAC, with truncation m from the sample size: $0.75 \times 749^{1/3} \approx 7$. Option (d) confuses the lag length $r = 6$ (the reach of the cause) with the HAC truncation m (the memory of the error). On the lab data the same coefficient 0.0139 has $t = 10.2$ (ordinary), 9.2 (robust), 6.8 (HAC).

ConcepTest 3. **Answer.** Option **(b)**. The 18 lags are highly collinear, so each coefficient is individually noisy and even the joint F misses the effect, but their estimation errors offset, so the *sum* is precisely estimated and the cumulative multiplier is significant ($t = -3.6$). Option (a) reads the t's and F one at a time and stops; (c) denies the paradox; (d) misapplies the ADL trick, which whitens the errors for inference but does not make individual X-lags significant. You must test the cumulative effect with a *lincom*.

Phase 2 – The desk problem

WORKED SOLUTIONS

(b) Cumulative multipliers (running sums): 0.20; $0.20 + 0.15 = 0.35$; $+0.10 = 0.45$; $+0.08 = 0.53$; $+0.07 = \mathbf{0.60}$. The long-run cumulative multiplier is 0.60: a permanent one-point rise in the policy rate eventually raises import-price inflation by 0.60 points in total, once the full response has played out.

(c) (i) ordinary $t = 0.20/0.040 = \mathbf{5.0}$; HAC $t = 0.20/0.080 = \mathbf{2.5}$. (ii) HAC ($t = 2.5$) is honest: a distributed lag has no lagged Y, so its errors are serially correlated; the ordinary SE assumes independence and is too small, overstating precision. The coefficient is unchanged; only the SE grows. (iii) $343^{1/3} = 7.0$, so $m = 0.75 \times 7 = 5.25$, round to $\mathbf{m = 5}$ (from T, not from the 4 lags of X).

(d) (i) the individual t's are $1.50, 1.27, 1.10, 1.00$, all below 1.96: none significant. (ii) cumulative $= 0.18 + 0.14 + 0.11 + 0.09 = 0.52$; cumulative $t = 0.52/0.16 = \mathbf{3.25} > 1.96$, so the cumulative effect *is* significant. (iii) Reading the individual t's you would conclude "no pass-through", which is wrong. Adding the four SEs gives 0.42 and a t of $0.52/0.42 = 1.24$, which also misses it. The *lincom* SE of 0.16 is far smaller because it carries the lags' (negative) covariances, which the sum of SEs ignores. The collinear coefficients are individually imprecise, but their sum is pinned down.

Phase 3 – The case

REVEAL AND ANSWERS

1. Her reading is *not* defensible. $F(19, 676) = 1.42$, $p = 0.11$ says only that no single lag, and no combination tested that way, is distinguishable from zero. It says nothing about the *total* effect, which is a different quantity.

2. The *cumulative* multiplier, the running sum of the 19 dynamic multipliers, computed with *lincom*. Its standard error cannot be the sum of the individual SEs because the collinear lags have large (negative) covariances; the proper combination carries those covariances and is far smaller, so the sum is precisely estimated even though each term is not.

3. (b) negative and significant. Oil is a tax on a petroleum-importing economy, and the effect should accumulate slowly rather than hit in one month.

4. Demand-driven simultaneity: a booming world economy raises oil demand *and* output together (the 2004 and 2008 spikes were largely demand-driven), so the shock is partly correlated with the error. That biases the estimate *towards zero*; the true damage from a clean supply shock is likely larger.

Instructor reveal. The cumulative multiplier is -0.054 ($t = -1.8$) at six months, -0.124 ($t = -2.8$) at twelve, and -0.165 ($t = -3.6$) at eighteen. A 10% surprise oil spike lowers the level of industrial production by about 1.7% after eighteen months. The effect is real, negative and slow, building over more than a year. The memo was wrong: oil does hit output, but the damage is cumulative. No single month is distinguishable from zero, and even the joint F misses it, because the 18 lags are highly collinear. The head of research read the column of t's and the F one at a time; she never summed the multipliers. And even -0.165 is probably an underestimate, biased towards zero by demand-driven simultaneity, which no standard error can fix.

Reserve alternate (long and variable lags). A central bank's rate hike has tiny, insignificant short-run multipliers, but the cumulative multiplier turns clearly significant only after 18 to 24 months. Reading the short-horizon multipliers alone says "the hike is not working"; the cumulative says it works, just slowly.

End of worked solutions.