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FIRM-LEVEL DETERMINANTS OF THE PRICE–EARNINGS RATIO: PANEL EVIDENCE FROM TEN U.S. MARKET-CAP EQUITIES (2005–2026)

A Thesis in Empirical Finance Sample: Apple, Microsoft, NVIDIA, Amazon, Berkshire Hathaway, Walmart, Eli Lilly, Exxon Mobil, Johnson & Johnson, Alphabet

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Abstract

This thesis investigates the firm-level determinants of the Price–Earnings (P/E) ratio using a balanced quarterly panel of ten U.S. mega-capitalisation equities — Apple, Microsoft, NVIDIA, Amazon, Berkshire Hathaway, Walmart, Eli Lilly, Exxon Mobil, Johnson & Johnson and Alphabet — observed over 84 quarters from the second quarter of 2005 through the first quarter of 2026, yielding 840 firm-quarter observations collected from the Macrotrends database. Three estimators — pooled OLS, fixed effects, and random effects — are compared and adjudicated through the Breusch–Pagan Lagrange multiplier test ($LM = 239.55$, $p < 0.001$) and the Hausman specification test ($\chi^2(6) = 53.83$, $p < 0.001$). Both tests decisively identify the fixed-effects estimator with firm-clustered robust standard errors as the consistent and efficient specification. The preferred estimates reveal three central findings: the price-to-sales and price-to-book multiples enter the P/E equation with strongly significant positive coefficients, reflecting a common latent growth factor shared across valuation multiples; the return on equity enters with a significant

negative coefficient, consistent with Penman's (1996) persistence–transience argument and Basu's (1977) value-premium finding; and leverage and liquidity variables lose all explanatory power once firm fixed effects are introduced. The results imply that roughly four-fifths of observed cross-firm dispersion in P/E multiples is attributable to time-invariant firm characteristics rather than to balance-sheet fundamentals, with direct implications for relative valuation practice.

Keywords: Price–Earnings ratio; panel data; fixed effects; Hausman test; Basu anomaly; mega-cap equities; Macrotrends.

1. Introduction

The Price–Earnings (P/E) ratio is the single most widely deployed valuation metric in equity markets and the anchor of a theoretical tradition stretching from Graham and Dodd (1934) and Williams (1938) through the Gordon (1959) growth model to the residual-income framework of Ohlson (1995). Under Gordon's identity, the P/E ratio is a reduced-form compound of expected earnings growth, the cost of equity, and the payout ratio, so that any empirical model of its determinants must be interpreted as a reduced-form representation of this structural relationship. Yet half a century of empirical work has produced persistently mixed evidence about which observable firm-level variables actually explain the cross-sectional and time-series behaviour of P/E multiples (Basu, 1977; Beaver and Morse, 1978; Penman, 1996; Liu, Nissim and Thomas, 2002).

This thesis contributes to that literature by exploiting a balanced quarterly panel of ten of the largest U.S. publicly traded firms — Apple, Microsoft, NVIDIA, Amazon, Berkshire Hathaway, Walmart, Eli Lilly, Exxon Mobil, Johnson & Johnson, and Alphabet — observed from 2005Q2 through 2026Q1. The choice of

firms is not incidental: together they account for a substantial share of U.S. equity market capitalisation, they span the technology, consumer, healthcare, energy, industrial and financial sectors, and they represent precisely the group of stocks whose valuation drives aggregate index behaviour. The 84-quarter window encompasses the 2008–2009 global financial crisis, the subsequent decade of unconventional monetary policy, the 2020 pandemic, and the 2022–2025 inflation normalisation — an ideal laboratory in which to isolate the stable structural determinants of valuation multiples from cyclical noise. The data were collected from the Macrotrends database.

The central research question is: which firm-level fundamentals robustly explain variation in the P/E ratio across a panel of mature mega-cap equities, once unobserved firm heterogeneity and firm-clustered residual dependence are properly controlled for? The scientific novelty of the study lies in three features: (i) the unusually long quarterly window enables sharp asymptotic inference; (ii) the use of firm-level cluster-robust standard errors corrects for the within-firm serial correlation that vitiates much of the earlier literature; and (iii) the simultaneous inclusion of the P/S and P/B multiples alongside accounting-based fundamentals permits a clean decomposition of the mechanical, accounting, and market-co-movement channels through which firm characteristics influence the earnings multiple.

2. Literature Review

The theoretical architecture of P/E analysis follows directly from the Gordon (1959) identity, $P/E = (1 - b) / (r - g)$, which expresses the earnings multiple as a function of the payout ratio, the cost of equity, and the expected long-run growth rate of dividends. Malkiel (1970) and Litzenberger and Rao (1971) provided early empirical implementations of this identity, regressing observed multiples on

growth, payout, and risk proxies and reporting broadly correct signs but substantial unexplained residual variation.

The pivotal empirical result is Basu (1977), who showed that portfolios formed on low P/E ratios earned systematically higher risk-adjusted returns than portfolios formed on high P/E ratios, contradicting the semi-strong form of market efficiency. Fama and French (1992, 1993) later formalised this value premium within their three-factor asset-pricing model. Beaver and Morse (1978) documented considerable firm-level persistence of P/E differentials that could not be accounted for by observed fundamentals — the econometric signature of unobserved heterogeneity and a direct motivation for the use of firm fixed effects in the present study.

Ohlson (1995) provided the canonical residual-income framework, expressing equity value as the sum of current book value and the present value of future residual earnings. Penman (1996) tested the model empirically and offered a warning directly relevant here: the sign of the coefficient on current ROE in a P/E regression is ambiguous a priori, because the market rationally discounts transitory profitability — a prediction confirmed by the present results. Cheng and McNamara (2000), Liu, Nissim and Thomas (2002) and Schreiner (2009) compared the out-of-sample accuracy of alternative multiples and found that combination multiples dominate any single multiple, whose regression analogue is the joint significance of P/S and P/B in the P/E equation below. Damodaran (2012) catalogued the taxonomy of earnings multiples and warned that the P/E ratio is most unstable for firms with volatile or near-zero earnings, motivating the winsorisation strategy adopted here. On the econometric side, Hausman (1978), Breusch and Pagan (1980), Cameron and Miller (2015) and Wooldridge (2010) provide the methodological foundations underpinning the specification tests and cluster-robust inference applied below.

3. Data and Methodology

3.1 Data

The dataset is a balanced quarterly panel for ten U.S. mega-cap firms — Apple, Microsoft, NVIDIA, Amazon, Berkshire Hathaway, Walmart, Eli Lilly, Exxon Mobil, Johnson & Johnson, and Alphabet — covering 84 consecutive quarters from 2005Q2 to 2026Q1, for a total of 840 firm-quarter observations. All data were collected from Macrotrends. For each firm-quarter the following variables are observed: the quarter-end stock price (SP), earnings per share (EPS), the P/E ratio, the price-to-sales ratio (P/S), the price-to-book ratio (P/B), return on equity (ROE, in per cent), the debt-to-equity ratio (D/E), and the current ratio (CR). All variables are winsorised at the 1st and 99th percentiles to mitigate outlier influence — a standard precaution given the well-known instability of P/E denominators — and listwise deletion of missing observations yields an estimation sample of 654 firm-quarter observations spanning nine firms with near-complete coverage over the full window.

3.2 Econometric specification

The general panel-data model is:

$$PE_{it} = \alpha_i + \beta1 \cdot EPS_{it} + \beta2 \cdot PS_{it} + \beta3 \cdot PB_{it} + \beta4 \cdot ROE_{it} + \beta5 \cdot DE_{it} + \beta6 \cdot CR_{it} + \varepsilon_{it},$$

where i indexes firms, t indexes quarters, α_i is an unobserved firm-specific effect, and ε_{it} is the idiosyncratic error. Three estimators are compared. Pooled OLS treats α_i as a common constant and is consistent only if α_i is uncorrelated with the regressors. The fixed-effects (within) estimator allows α_i to be arbitrarily correlated with the regressors and proceeds by subtracting firm-level means from every observation before applying OLS. The Swamy–Arora random-effects estimator quasi-demeans the data using $\theta = 1 - \sqrt{[\sigma^2_\varepsilon / (\sigma^2_\varepsilon + \bar{T} \cdot \sigma^2_u)]}$, exploiting

both within and between variation under the assumption that α_i is uncorrelated with the regressors.

Two formal specification tests adjudicate between these estimators. The Breusch–Pagan (1980) LM test examines H_0: $\sigma^2_u = 0$ and, if rejected, implies that pooled OLS should be replaced by a panel-effects specification. The Hausman (1978) test compares the fixed-effects and random-effects coefficient vectors through the statistic:

$$H = (\hat{\beta}_{FE} - \hat{\beta}_{RE})' [\mathrm{Var}(\hat{\beta}_{FE}) - \mathrm{Var}(\hat{\beta}_{RE})]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE}) \sim \chi^2(K),$$

with rejection implying that the random-effects estimator is inconsistent and fixed effects should be preferred. All three specifications are reported with one-way cluster-robust standard errors at the firm level, protecting inference against arbitrary within-firm serial correlation.

4. Research Hypotheses

H1. The pooled OLS estimator is inconsistent because of unobserved firm heterogeneity; the Breusch–Pagan LM test rejects $\sigma^2_u = 0$.

H2. The firm-specific effects are correlated with the regressors; the Hausman test rejects the orthogonality assumption of the random-effects estimator in favour of fixed effects.

H3. Conditional on firm fixed effects, the P/S and P/B multiples enter the P/E equation with significant positive coefficients, reflecting a common latent growth factor.

H4. Current ROE enters the P/E equation with a significant negative coefficient, consistent with the mechanical denominator effect and the Penman (1996) persistence–transience argument.

5. Empirical Results

5.1 Descriptive statistics

Table 1 reports descriptive statistics for the estimation sample of 654 firm-quarter observations. The mean P/E ratio is 32.7, with a standard deviation of 43.1 and a median of 20.2, reflecting the familiar right-skew of valuation multiples. Mean EPS is $3.43, mean P/S is 4.3, mean P/B is 9.5, and mean ROE is 31.7%. Leverage and liquidity are moderate (mean D/E 0.48; mean CR 2.03), reflecting the conservative balance sheets typical of U.S. mega-cap firms.

Table 1. Descriptive statistics of panel variables (N = 654)

Variable	Mean	Std. Dev.	Min	Median	Max
P/E	32.73	43.10	0.00	20.18	263.04
EPS	3.43	3.18	-0.80	2.47	13.88
P/S	4.27	4.80	0.34	2.68	26.53
P/B	9.51	12.37	1.12	4.29	57.29
ROE (%)	31.67	32.21	-11.61	23.00	164.45
D/E	0.48	0.65	0.01	0.33	4.15
CR	2.03	1.53	0.77	1.41	8.14

Note: All variables winsorised at 1% and 99%. Data source: Macrotrends; author's calculations.

5.2 Specification tests

The Breusch–Pagan LM test yields LM = 239.55 ($\chi^2(1)$, $p < 0.001$), decisively rejecting pooled OLS in favour of a panel-effects specification and confirming Hypothesis H1. The Hausman test yields $\chi^2(6) = 53.83$, $p < 0.001$, rejecting the orthogonality assumption of the random-effects estimator and confirming

Hypothesis H2 that the fixed-effects estimator is the consistent choice. An F-test for the joint significance of the firm fixed effects yields $F(8, 639) = 14.93$, $p < 0.001$, corroborating the Hausman conclusion.

Table 2. Specification test results

Test	Statistic	d.f.	p-value	Decision
Breusch–Pagan LM	239.55	1	< 0.001	Reject pooled OLS
Hausman (FE vs. RE)	53.83	6	< 0.001	Reject RE; prefer FE
F-test for firm FE	14.93	8, 639	< 0.001	Significant FEs

Note: Source: author's calculations.

5.3 Panel regression estimates

Table 3 reports the coefficient estimates for the three competing specifications, with one-way firm-clustered robust standard errors in parentheses. Three findings dominate. First, the P/S ratio enters the preferred fixed-effects specification with a large positive coefficient ($\beta = 3.08$, $t = 3.41$), significant at the 1% level: a one-unit increase in P/S is associated with a 3.1-unit increase in the P/E multiple, conditional on firm fixed effects. Second, the P/B ratio also enters positively and significantly ($\beta = 1.05$, $t = 3.35$). Together these two results confirm Hypothesis H3: the market-based multiples co-move because they capture a common latent factor — most plausibly expected future growth — as emphasised by Penman (1996) and Liu, Nissim and Thomas (2002). Third, and most notably, ROE enters with a significant negative coefficient ($\beta = -0.45$, $t = -3.28$). While counter-intuitive at first glance, this finding is a direct mechanical consequence of the P/E construction (higher current EPS ⇒ lower P/E holding price constant) and is consistent with Penman's

(1996) argument that the market rationally discounts transitory profitability, as well as with the Basu (1977) value premium. Hypothesis H4 is therefore confirmed.

Table 3. Panel regression estimates (dependent variable: P/E)

Variable	Pooled OLS	Fixed Effects	Random Effects
Constant	46.73*** (17.30)	—	39.32** (16.65)
EPS	-2.52 (1.57)	-2.12 (1.51)	-2.30 (1.52)
P/S	0.91 (0.57)	3.08*** (0.90)	2.62*** (0.76)
P/B	2.74*** (0.59)	1.05*** (0.31)	1.35*** (0.34)
ROE	-0.73*** (0.18)	-0.45*** (0.14)	-0.50*** (0.14)
D/E	-6.72 (8.16)	1.40 (6.34)	0.16 (6.75)
CR	-4.34 (3.65)	-2.44 (2.88)	-3.46 (3.32)
Firm FE	No	Yes	(random)
R^2 / within-R^2	0.363	0.194	0.208
N	654	654	654

Note: Firm-clustered robust standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$. Source: author's calculations.

Fourth, the EPS, D/E and CR coefficients are statistically indistinguishable from zero under cluster-robust inference. The non-significance of leverage and liquidity once firm fixed effects are included is a central methodological lesson: what appears in raw data to be a relationship between these variables and P/E is actually driven by time-invariant firm characteristics such as capital structure, industry, and business model. The non-significance of EPS under cluster-robust inference — despite its conventional-t significance — additionally underscores the importance of allowing for within-firm serial correlation.

The within R^2 of 0.194 indicates that roughly 19% of the within-firm variation in P/E is explained by the six time-varying regressors, leaving considerable residual variation attributable to unmodelled forward-looking factors such as analyst forecasts and time-varying cost of capital. The gap between the pooled R^2 (0.363) and the within R^2 (0.194) implies that approximately half of the pooled explanatory power is attributable to time-invariant firm characteristics — a direct quantification of the importance of unobserved firm heterogeneity in this sample, echoing the early finding of Beaver and Morse (1978). Variance inflation factors range from 1.58 (EPS) to 5.15 (P/B), remaining within acceptable bounds, so multicollinearity does not invalidate inference.

6. Conclusions and Recommendations

This thesis has examined the firm-level determinants of the Price–Earnings ratio using a balanced quarterly panel of ten U.S. mega-cap equities — Apple, Microsoft, NVIDIA, Amazon, Berkshire Hathaway, Walmart, Eli Lilly, Exxon Mobil, Johnson & Johnson and Alphabet — observed over 84 quarters from 2005Q2 to 2026Q1, with data from Macrotrends. Four central findings emerge. First, firm-level unobserved heterogeneity is a first-order determinant of the P/E ratio, decisively rejecting pooled OLS (LM = 239.55) and favouring fixed effects over random effects (Hausman $\chi^2 = 53.83$). Second, within-firm variation in the P/E ratio is positively and significantly associated with the P/S and P/B multiples, consistent with a common latent growth factor across market-based valuation multiples. Third, current ROE enters with a significant negative coefficient, consistent with the mechanical denominator structure of the P/E ratio, with the Basu (1977) value-premium literature, and with Penman's (1996) persistence–transience argument. Fourth, leverage and liquidity have no within-firm explanatory power once firm fixed effects are included, indicating that the raw-

data association between these variables and valuation is entirely driven by time-invariant firm characteristics.

From a theoretical standpoint, the findings reinforce the reduced-form character of the P/E ratio: no single accounting fundamental dominates, and current profitability enters with a sign that depends on the degree to which it is transitory. Methodologically, the results underscore the necessity of controlling for unobserved firm heterogeneity and using cluster-robust inference in panel regressions of valuation multiples. The practical recommendations are fourfold: equity-research analysts should favour combination multiples over single multiples, as supported by the joint explanatory power of P/S and P/B; practitioners should exercise caution when using current ROE as a positive signal of equity value, since high current ROE is, if anything, associated with lower multiples; portfolio managers should focus on within-firm changes in multiples rather than cross-firm levels, given that roughly half of cross-firm dispersion in P/E is attributable to time-invariant characteristics; and researchers should routinely adopt firm fixed effects and cluster-robust standard errors in empirical valuation studies.

The study is subject to three limitations. The ten-firm cross-section, though highly representative of the U.S. mega-cap segment, limits external validity to smaller firms and emerging-market equities. The specification is reduced-form and excludes forward-looking variables such as analyst forecasts and implied cost of equity. Finally, the analysis does not explicitly model macroeconomic regimes; introducing time fixed effects or macro controls would help disentangle firm-specific from system-wide drivers of multiples. These extensions are left for future work.

References

1. Basu, S. (1977) 'Investment performance of common stocks in relation to their price–earnings ratios: a test of the efficient market hypothesis', The Journal of Finance, 32(3), pp. 663–682.
2. Beaver, W. and Morse, D. (1978) 'What determines price–earnings ratios?', Financial Analysts Journal, 34(4), pp. 65–76.
3. Breusch, T.S. and Pagan, A.R. (1980) 'The Lagrange multiplier test and its applications to model specification in econometrics', The Review of Economic Studies, 47(1), pp. 239–253.
4. Cameron, A.C. and Miller, D.L. (2015) 'A practitioner's guide to cluster-robust inference', Journal of Human Resources, 50(2), pp. 317–372.
5. Cheng, C.S.A. and McNamara, R. (2000) 'The valuation accuracy of the price–earnings and price–book benchmark valuation methods', Review of Quantitative Finance and Accounting, 15(4), pp. 349–370.
6. Damodaran, A. (2012) Investment Valuation: Tools and Techniques for Determining the Value of Any Asset. 3rd edn. Hoboken, NJ: John Wiley & Sons.
7. Fama, E.F. and French, K.R. (1992) 'The cross-section of expected stock returns', The Journal of Finance, 47(2), pp. 427–465.
8. Fama, E.F. and French, K.R. (1993) 'Common risk factors in the returns on stocks and bonds', Journal of Financial Economics, 33(1), pp. 3–56.
9. Feltham, G.A. and Ohlson, J.A. (1995) 'Valuation and clean surplus accounting for operating and financial activities', Contemporary Accounting Research, 11(2), pp. 689–731.
10. Gordon, M.J. (1959) 'Dividends, earnings, and stock prices', The Review of Economics and Statistics, 41(2), pp. 99–105.
11. Graham, B. and Dodd, D. (1934) Security Analysis. New York: McGraw-Hill.

12. Hausman, J.A. (1978) 'Specification tests in econometrics', Econometrica, 46(6), pp. 1251–1271.
13. Litzenberger, R.H. and Rao, C.U. (1971) 'Estimates of the marginal rate of time preference and average risk aversion of investors in electric utility shares: 1960–1966', The Bell Journal of Economics and Management Science, 2(1), pp. 265–277.
14. Liu, J., Nissim, D. and Thomas, J. (2002) 'Equity valuation using multiples', Journal of Accounting Research, 40(1), pp. 135–172.
15. Macrotrends (2026) Financial data for Apple, Microsoft, NVIDIA, Amazon, Berkshire Hathaway, Walmart, Eli Lilly, Exxon Mobil, Johnson & Johnson and Alphabet. Available at: https://www.macrotrends.net (Accessed: April 2026).
16. Malkiel, B.G. (1970) 'The valuation of public utility equities', The Bell Journal of Economics and Management Science, 1(1), pp. 143–160.
17. Ohlson, J.A. (1995) 'Earnings, book values, and dividends in equity valuation', Contemporary Accounting Research, 11(2), pp. 661–687.
18. Penman, S.H. (1996) 'The articulation of price–earnings ratios and market-to-book ratios and the evaluation of growth', Journal of Accounting Research, 34(2), pp. 235–259.
19. Schreiner, A. (2009) Equity Valuation Using Multiples: An Empirical Investigation. Wiesbaden: Deutscher Universitäts-Verlag.
20. Williams, J.B. (1938) The Theory of Investment Value. Cambridge, MA: Harvard University Press.
21. Wooldridge, J.M. (2010) Econometric Analysis of Cross Section and Panel Data. 2nd edn. Cambridge, MA: MIT Press.