Chapter F

Research Limitations and Extensions

F.1 Purpose

The empirical analysis developed in this book is intended as a first implementation of the Accounting Bias Framework rather than as a complete measurement system for the latent quantity

$$AB_{it} = A_{it} - E_{it}.$$

The analysis provides evidence about observable accounting structures associated with Recognition, Measurement, Timing, and Estimation mechanisms.

It does not directly observe the economic state

$$E_{it}.$$

This appendix summarizes the principal limitations of the present empirical design and identifies directions in which the framework can be extended.

The objective is not to weaken the empirical contribution.

It is to define clearly what the evidence can and cannot establish.

F.2 The Central Identification Limitation

The most important limitation follows directly from the theoretical definition of Accounting Bias.

Accounting information is observable:

$$A_{it}.$$

The corresponding economic state is generally latent:

$$E_{it}.$$

Therefore,

$$AB_{it} = A_{it} - E_{it}$$

cannot usually be observed directly.

The empirical proxies used in this book instead identify exposure to mechanisms that can create such divergence.

Thus,

$$X_{j,it} \neq AB_{it}.$$

More accurately,

$$X_{j,it} \rightarrow \text{Accounting Mechanism Exposure.}$$

The empirical variables should therefore be interpreted as indicators of the structure through which Accounting Bias may arise.

This distinction remains the central limitation of the empirical framework.

F.3 Exposure, Magnitude, and Direction

The empirical design distinguishes three concepts:

Exposure,

Magnitude,

and

Direction.

Exposure identifies the importance of an accounting mechanism within the firm.

Magnitude refers to the absolute size of the divergence

$$|A - E|.$$

Direction refers to the sign:

$$A - E > 0$$

or

$$A - E < 0.$$

The present proxies primarily identify exposure.

For example,

$$PPEINT \uparrow$$

indicates greater importance of tangible assets and therefore greater exposure to historical-cost measurement, depreciation, and impairment.

It does not establish whether the carrying amount of those assets is above or below their economic value.

Similarly,

$$GWINT \uparrow$$

does not determine whether goodwill is economically overstated or understated.

The empirical framework therefore does not produce a signed firm-level estimate of Accounting Bias.

F.4 Sample Size

The empirical study uses

$$50$$

predetermined firms observed over

$$5$$

principal analysis years.

The maximum balanced panel therefore contains

$$N = 250$$

firm-year observations.

This sample is sufficient for the structural and hypothesis-testing exercises performed in the book.

However, it is small relative to the full population of U.S. listed

corporations.

The results should therefore not be interpreted as population estimates for all public firms.

A larger sample would improve

- statistical power;
- industry coverage;
- representation of smaller firms;
- estimation of heterogeneous effects;
- generalizability.

F.5 Predetermined but Non-Random Sampling

The sample is predetermined, but it is not a random probability sample.

The firms were deliberately selected across five economically different industry groups.

This improves the ability to study variation in Accounting Bias mechanisms.

However, it limits statements about population prevalence.

The present research can test whether observed proxies differ systematically across industries.

It cannot estimate quantities such as

$$P\left(GWINT > x\right)$$

for the entire U.S. corporate population without stronger sampling assumptions.

F.6 Short Time Dimension

The principal analysis period is

2021–2025.

This produces five annual observations per firm.

The panel is sufficient to distinguish some persistent and dynamic patterns.

For example, the empirical analysis clearly shows that goodwill intensity is much more persistent than accrual intensity.

Nevertheless, five years remain a relatively short horizon for studying long-term accounting structure.

A longer panel could better identify

- structural changes in business models;
- major acquisition cycles;
- long-lived asset replacement;
- impairment cycles;
- tax-regime changes;
- changes in accounting standards.

F.7 XBRL Standardization Is Incomplete

XBRL makes large-scale automated accounting research possible, but standardized reporting remains imperfect.

Economically similar quantities can be reported using different taxonomy elements.

Firms can also use custom extensions.

As a result, concept extraction requires a hierarchy of preferred and fallback tags.

The empirical pipeline addresses this problem explicitly, but no automated mapping can guarantee perfect economic comparability across all issuers.

Thus,

$$\text{same economic concept} \not\Rightarrow \text{same XBRL tag}.$$

Conversely,

$$\text{same XBRL tag}$$

does not always imply complete economic equivalence across firms.

This is an inherent limitation of standardized filing data.

F.8 Disclosure-Based Missingness

Missing observations are preserved rather than mechanically replaced.

This improves measurement integrity but creates unequal sample sizes across variables.

The missingness is also not necessarily random.

For example,

$$P(RDINT\ observed)$$

is related to business model and industry.

Consequently, complete-case restrictions can alter the economic composition of the sample.

This issue is particularly important in the six-proxy multivariate model, whose sample falls to

$$N = 103$$

firm-year observations across

$$23$$

firms.

The model is therefore treated as a robustness specification rather than as the principal analysis.

F.9 The Estimation Dimension

The Estimation dimension is theoretically important but empirically the least developed in the current implementation.

Accounting quantities such as

- provisions;
- expected credit losses;
- allowances;
- impairment estimates;
- pension obligations;
- contingent liabilities;
- fair-value estimates;

are direct examples of accounting representations that depend on uncertain future outcomes.

However, standardized XBRL coverage for many of these variables is substantially lower than for the core Recognition, Measurement, and Timing variables.

The current study therefore avoids forcing a poorly observed Estimation dimension into the main statistical tests.

This should be interpreted as a data limitation rather than a theoretical rejection of Estimation Bias.

F.10 Firm Fixed Effects and Limited Within-Firm Variation

Firm-fixed-effect models remove persistent time-invariant firm characteristics.

This is useful for distinguishing structural from dynamic relationships.

However, fixed-effect estimation requires sufficient variation within each firm.

Highly persistent variables may provide relatively little within-firm information over a five-year period.

Thus, the disappearance of a pooled relationship under fixed effects can have two interpretations:

1. the relationship is genuinely predominantly structural;
2. the short panel provides insufficient within-firm variation to estimate the relationship precisely.

The empirical interpretation therefore considers the fixed-effect results jointly with persistence and within-between diagnostics.

F.11 Associational Rather Than Causal Regression

The regression models in the book are not based on an exogenous causal identification strategy.

The general profitability model is

$$ROA_{it} = \alpha + \beta X_{it} + Controls + Industry + Year + \varepsilon_{it}.$$

A significant coefficient implies conditional association.

It does not establish

$$X_{it} \rightarrow ROA_{it}.$$

Accounting structure, business model, investment, acquisition activity, profitability, and financing decisions can be jointly determined.

Accordingly, the empirical language used in the book emphasizes

association

rather than

causal effect.

F.12 Mechanical Relationships Between Accounting Variables

Some empirical variables share accounting components.

For example,

$$ROA = \frac{NI}{Average\ Assets},$$

while

$$ACCRUALINT = \frac{|NI - CFO|}{Average\ Assets}.$$

Net income therefore appears in both variables.

This creates a mechanical relationship that must be considered when interpreting regressions involving accrual intensity and ROA.

The strong multivariate accrual result is therefore informative but should not be interpreted as an independent causal estimate of the economic effect of accruals.

Future research could use outcomes less mechanically connected to the proxy definitions.

F.13 No Universal Composite Index

The current implementation does not construct a universal Accounting Bias Index.

This is a deliberate consequence of the empirical results.

A scalar index of the form

$$ABI_{it} = \sum_{j} w_j X_{j,it}$$

would require theoretically defensible weights.

The observed variables also differ in sign, persistence, within-firm behavior, and economic interpretation.

The absence of a composite index therefore limits simple firm rankings.

At the same time, it avoids imposing an empirical structure that the data do not support.

Future research may nevertheless investigate aggregation if better theoretical or empirical weighting schemes become available.

F.14 Accounting Bias Profiles

The current evidence instead favors a profile representation:

$$\mathbf{B}_{it} = [Recognition_{it}, Measurement_{it}, Timing_{it}, Estimation_{it}] .$$

This approach preserves the economic meaning of each mechanism.

However, profiles create their own analytical challenge.

Comparisons become multidimensional.

Two firms can have different configurations without one firm being unambiguously more biased than the other.

Future research may therefore require techniques for comparing multidimensional Accounting Bias profiles without collapsing them prematurely into one number.

F.15 Potential Extension: Larger Firm Universe

The most direct extension is to apply the pipeline to a much larger population of SEC registrants.

The existing data architecture is scalable in principle.

A larger sample would allow

- finer industry classifications;
- size-based subsamples;
- value versus growth comparisons;

- domestic versus multinational comparisons;
- broader robustness analysis.

The principal challenge would be expanding the XBRL concept-resolution system without sacrificing comparability.

F.16 Potential Extension: Longer Time Series

Extending the panel backward would allow Accounting Bias exposures to be studied through multiple economic regimes.

A longer dataset could investigate periods involving

- recessions;
- inflation shocks;
- interest-rate cycles;
- major accounting-standard changes;
- tax reforms;
- pandemic-related disruptions.

The decomposition

$$X_{it} = S_i + D_{it}$$

could then be refined further.

For example, structural components may themselves change slowly through time:

$$S_{it} = S_{i,t-1} + \eta_{it}.$$

This would allow gradual transformations of business models to be distinguished from short-term accounting fluctuations.

F.17 Potential Extension: Market-Based Outcomes

The present study focuses primarily on accounting structure and reported ROA.

A natural extension would connect Accounting Bias profiles to market outcomes.

Possible dependent variables include

$$Market\text{-}to\text{-}Book,$$

$$Tobin's\ Q,$$

$$Price\text{-}to\text{-}Earnings,$$

$$Enterprise\ Value\ Multiples,$$

$$Stock\ Returns,$$

and

$$Cost\ of\ Capital.$$

Such tests could investigate whether capital markets price different Accounting Bias exposures differently.

F.18 Potential Extension: Analyst Forecasts

Another extension concerns analyst expectations.

If accounting representation obscures economically important information, some Accounting Bias exposures may be associated with greater forecasting difficulty.

Possible outcomes include

$$ForecastError,$$

$$ForecastDispersion,$$

and

$$ForecastRevision.$$

A generic specification could be

$$ForecastError_{it} = \alpha + \beta X_{it}^{AB} + Controls + \varepsilon_{it}.$$

This would provide evidence about the informational consequences of Accounting Bias rather than only its accounting structure.

F.19 Potential Extension: Acquisition Events

Recognition Bias could be studied more directly around business combinations.

Suppose a firm acquires another company at time t.

The transaction can cause previously unrecognized intangible resources to enter the accounting system.

An event-based design could compare

$$PreAcquisition\ AccountingStructure$$

with

$$PostAcquisition\ AccountingStructure.$$

This could provide sharper evidence on the transaction-dependent recognition mechanism developed in the theoretical framework.

F.20 Potential Extension: Impairment Events

Goodwill and asset impairments provide another natural research setting.

An impairment represents an explicit accounting revision of a previously recognized carrying amount.

One could study

$$PreImpairment\ Exposure$$

and

$$PostImpairment\ Outcomes.$$

Questions include whether firms with particular Accounting Bias profiles are more likely to recognize impairments and whether impairment timing is associated with prior profitability or market performance.

F.21 Potential Extension: Textual Footnote Analysis

Many important accounting estimates are explained in financial-statement footnotes rather than captured fully by standardized XBRL concepts.

Natural-language processing could therefore extend the empirical framework.

Potential targets include disclosures concerning

- impairment assumptions;
- discount rates;
- useful lives;
- litigation provisions;
- pension assumptions;
- expected credit losses;
- revenue recognition judgments;
- tax valuation allowances.

This could materially improve measurement of the Estimation dimension.

F.22 Potential Extension: Fair-Value Hierarchy

Fair-value accounting provides a particularly useful setting for studying measurement uncertainty.

Assets measured using Level 1 inputs differ fundamentally from those measured using Level 3 assumptions.

A future Accounting Bias proxy could therefore incorporate the proportion of fair-value measurements based on less observable inputs.

Conceptually,

$$FVUNCERTAINTY_{it} = \frac{Level3Assets_{it}}{FairValueAssets_{it}}.$$

Such a variable would connect Measurement and Estimation more directly.

F.23 Potential Extension: International Comparison

The current empirical design focuses on SEC-reporting U.S. listed companies.

The framework could be extended internationally.

Possible comparisons include firms reporting under

$$US\ GAAP$$

and

$$IFRS.$$

Different accounting systems may produce different transformations of similar economic structures.

A comparative design could therefore investigate

$$AccountingSystem \times EconomicStructure.$$

This would test whether the same type of firm exhibits different Accounting Bias profiles under different reporting regimes.

F.24 Potential Extension: Accounting Standard Changes

Changes in accounting standards can provide quasi-experimental variation.

Suppose a new standard changes the recognition or measurement treatment of a particular transaction.

Then one can compare

$$PreStandard$$

and

$$PostStandard$$

accounting structures.

A difference-in-differences design could potentially be written as

$$Y_{it} = \alpha + \beta_1 Treated_i + \beta_2 Post_t + \beta_3 \left(Treated_i \times Post_t\right) + \varepsilon_{it}.$$

The interaction coefficient

$$\beta_3$$

could provide stronger evidence about the effect of a specific accounting rule than the purely observational regressions used in the present study.

F.25 Potential Extension: Predictive Analysis

The current empirical framework is explanatory and structural.

Future research could also examine predictive questions.

For example:

$$FutureImpairment_{i,t+1} = f\left(\mathbf{X}_{it}^{AB}\right),$$

or

$$FutureROA_{i,t+1} = f\left(\mathbf{X}_{it}^{AB}\right).$$

Predictive performance should be evaluated using out-of-sample procedures rather than in-sample fit.

Possible techniques include

- rolling-window validation;
- cross-validation;
- penalized regression;
- tree-based models.

Such methods should supplement rather than replace the accounting-theoretical interpretation of the variables.

F.26 Potential Extension: Nonlinear Effects

The current regression models are primarily linear.

However, Accounting Bias mechanisms may operate nonlinearly.

For example, moderate goodwill intensity may have little economic implication, while extremely high goodwill intensity could signal a materially different balance-sheet structure.

A nonlinear model could include

$$GWINT^2$$

or spline functions.

Similarly, interactions may matter:

$$RDINT \times GWINT,$$

$$PPEINT \times ACCDEPINT,$$

or

$$ACCRUALINT \times DTINT.$$

These specifications could test whether the economic relevance of one mechanism depends on another.

F.27 Potential Extension: Latent-Class Analysis

If firms naturally cluster into different Accounting Bias profiles, latent-class or mixture models may be more appropriate than a single continuous index.

For example, firms might be classified into groups such as

- research-intensive Recognition profiles;
- acquisition-intensive Recognition profiles;
- capital-intensive Measurement profiles;
- high-Timing-exposure profiles.

This could preserve multidimensionality while still providing interpretable firm classifications.

F.28 Potential Extension: Direct Economic-Value Benchmarks

The strongest possible empirical extension would introduce independent information about economic value. Such benchmark construction would connect the framework more directly to established financial-statement and valuation methods (Penman, 2013; Damodaran, 2012).

Examples might include

- transaction prices;
- external appraisals;
- observable market values for individual assets;
- liquidation values;
- acquisition purchase-price allocations;
- impairment recoverable-value estimates.

Where both accounting and economic benchmarks are available, one could estimate

$$AB^{Observed} = A - E^{Benchmark}.$$

Such observations would provide a more direct empirical test of the theoretical definition.

The challenge is that these economic benchmarks are rarely available consistently across firms and years.

F.29 Potential Extension: Directional Accounting Bias

The present proxy framework primarily identifies exposure.

Future research could attempt to distinguish directional effects.

For mechanism j, define

$$DIRECTION_{j,it} \in \{-1, 0, +1\},$$

where

$$-1$$

represents accounting representation below an economic benchmark,

$$+1$$

represents accounting representation above it, and

$$0$$

represents approximate alignment.

Such a framework would move the empirical analysis from

$$\text{Exposure}$$

toward

$$\text{Exposure} + \text{Magnitude} + \text{Direction}.$$

This would represent an important development of the Accounting Bias research program.

F.30 Potential Extension: Cross-Dimensional Interaction

The present analysis provides evidence that Accounting Bias mechanisms should not be treated as independent additive components.

A more general model is

$$AB_{it} = f\left(R_{it}, M_{it}, T_{it}, S_{it}, Interactions\right).$$

For example,

$$R_{it} \times M_{it}$$

could capture the interaction between recognition structure and asset measurement.

Likewise,

$$M_{it} \times T_{it}$$

could represent interactions between measurement conventions and timing effects.

Understanding these interactions may ultimately be more informative than constructing separate univariate rankings.

F.31 Potential Extension: Dynamic Accounting Bias

The current structural-dynamic decomposition is

$$X_{it}^d = S_i^d + D_{it}^d.$$

A richer dynamic model could allow both components to evolve:

$$S_{it}^d = \rho_d S_{i,t-1}^d + \eta_{it}^d,$$

and

$$D_{it}^d = \phi_d D_{i,t-1}^d + u_{it}^d.$$

This would make it possible to estimate different persistence processes for different Accounting Bias dimensions.

Such models would require longer time series than are available in the present study.

F.32 Potential Extension: Accounting Bias and Firm Life Cycle

Accounting mechanisms may also vary systematically over the corporate life cycle.

Young firms may exhibit

$$RDINT \uparrow,$$

while mature firms may exhibit greater tangible capital or goodwill.

Acquisition phases, restructuring phases, and decline phases may generate different Accounting Bias profiles.

A future framework could therefore model

$$\mathbf{X}_{it}^{AB} = f\left(LifeCycle_{it}\right).$$

This could provide a richer economic interpretation of structural differences currently captured partly by industry and firm fixed effects.

F.33 Potential Extension: Reproducible Open Research

The present project is designed to be reproducible.

A natural next step is to make the empirical code, sample definition, and variable documentation publicly available.

A reproducibility package could contain

- the Python scripts;
- the predetermined ticker list;
- configuration files;
- environment requirements;
- documentation of XBRL fallback tags;
- generated tables and figures;
- instructions for reproducing the analysis.

Because SEC data can be redownloaded from the original public source, the research can in principle be reconstructed without relying on proprietary financial databases.

F.34 A Research Program Rather Than a Final Metric

The main limitation of the current framework is also one of its strengths.

The empirical work does not produce one final immutable Accounting Bias number.

Instead, it produces a research architecture.

That architecture begins with

$$\textit{Economic Reality}$$

and asks how it is transformed by

$$\textit{Recognition},$$

$$\textit{Measurement},$$

$$Timing,$$

and

$$Estimation.$$

The resulting accounting representation is

$$A = \mathcal{A}(E).$$

Accounting Bias is

$$AB = \mathcal{A}(E) - E.$$

The empirical research program therefore focuses on understanding the transformation

$$\mathcal{A},$$

rather than pretending that E can always be recovered perfectly.

F.35 Conclusion

The present empirical implementation provides evidence that Accounting Bias exposure is systematic, multidimensional, industry-dependent, and frequently persistent.

At the same time, important limitations remain.

The sample is relatively small.

The panel is short.

XBRL standardization is incomplete.

Missingness is economically structured.

The Estimation dimension remains difficult to observe.

The profitability regressions are associational rather than causal.

Most importantly, the economic state E remains latent.

These limitations define the current frontier of the empirical framework.

They also identify a clear research agenda.

Future work can extend the analysis through

- larger samples;
- longer panels;

- market outcomes;
- analyst forecasts;
- accounting events;
- textual disclosure analysis;
- international comparison;
- accounting-standard changes;
- direct economic-value benchmarks;
- dynamic and nonlinear models.

The objective is therefore not to defend the current empirical implementation as final.

It is to establish a transparent framework that can be progressively tested, criticized, expanded, and improved.

In this sense, the principal contribution of the Accounting Bias Framework is not a single empirical coefficient.

It is the research question:

How does the accounting system transform economic reality into reported numbers?

The empirical program developed in this book provides one reproducible way of beginning to answer that question.