Chapter 3
High-Frequency Data and Financial Econometrics: Outline

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Abstract/Overview

This chapter provides an integrated overview of financial econometrics and high-frequency econometrics, documenting how the availability of intraday trading data enriched the empirical analysis of asset prices, volatility, dependence, and market efficiency. The chapter begins by positioning high-frequency econometrics within the broader evolution of financial econometrics, outlining how early return-based modelling and stylised facts (fat tails, volatility clustering, leverage effects) shaped the development of benchmark econometric specifications for conditional means and variances. These include ARMA-type models for returns, ARCH/GARCH and asymmetric volatility models, and stochastic volatility frameworks, together with classical econometric questions surrounding predictability, risk premia, and efficiency. The chapter then highlights the availability of high-frequency driven by electronic trading and the availability of tick-by-tick transactions, quotes, and limit-order-book records. This transition motivates a shift from purely parametric modelling to measurement-based econometrics grounded in continuous-time theory. A core emphasis is market microstructure: the trading mechanism simultaneously generates economically informative variables—liquidity, bid–ask spreads, order flow, price impact, and price discovery—and statistical complications such as discreteness, irregular spacing, intraday seasonality, non-synchronous trading, and microstructure noise. Within this setting, the chapter surveys the central methods of high-frequency econometrics. It introduces realized measures of volatility and their interpretation via quadratic variation, discusses noise-robust estimation of integrated variance, and presents jump detection procedures and the decomposition of price dynamics into continuous and discontinuous components. The chapter then expands to multivariate

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high-frequency econometrics, reviewing realized covariances and correlations under asynchronous sampling, lead–lag effects, and extensions to connectedness and network-based dependence measures. It further highlights how high-frequency information improves forecasting and risk measurement, linking realized volatility and covariation to return-based forecasting models such as HAR-type specifications and to applications in portfolio risk management and systemic risk monitoring. The chapter concludes by revisiting market efficiency and predictability in light of high-frequency evidence, emphasising that predictability is horizon-dependent and tightly linked to liquidity and information flow. Overall, the chapter positions high-frequency econometrics as a methodological pillar of modern financial econometrics, unifying traditional return-based modelling with continuous-time measurement and microstructure-aware inference.

Finally, the chapter takes a deliberately retrospective stance. Beyond surveying the development of models and empirical tools, it asks which contributions of early financial econometrics have *aged well* (remaining central in modern data-rich settings) and which have *aged less well* once confronted with high-frequency evidence and microstructure frictions. This comparison is used to extract a set of *general lessons*: the importance of measurement and identification over specification, the fragility of certain stylised assumptions under temporal aggregation, the centrality of market microstructure to inference, and the need for robustness when moving from low-frequency to high-frequency empirical environments.

3.1 Introduction

From Low-Frequency to High-Frequency Econometrics

- Positions high-frequency (HF) data as a structural break in financial econometrics.
- Traces the intellectual lineage from early stochastic price models to modern data-rich, continuous-time econometrics.
- Frames HF econometrics as a shift from model-driven inference to measurement- and identification-driven analysis.

Main references: Bachelier (1900), Mandelbrot (1963), Samuelson (1965), Engle (1982)

3.2 Financial Econometrics before High-Frequency Data

- Describes the dominance of daily/monthly data and the resulting econometric constraints.
- Volatility treated as latent and inferred indirectly.
- Market microstructure largely theoretical, with limited empirical validation.
- Heavy reliance on Gaussianity, IID returns, and linear models.

Main references: Working (1934), Fama (1965, 1970), Roll (1984), French et al (1987)

3.3 Emergence of High-Frequency Financial Data

- Explains how electronic trading and digital record-keeping transformed the data-generating process.
- Introduces tick-by-tick prices, quotes, and order books.
- Identifies new econometric challenges: irregular spacing, intraday periodicity, and massive dimensionality.
- Establishes event time vs calendar time as a central distinction.

Main references: Hasbrouck (1991), Bollerslev and Domowitz (1993), Goodhart and O'Hara (1997), Madhavan (2000)

3.4 Market Microstructure and the Econometrics of Trading

- Shows how HF data made market microstructure empirically testable.
- Links order flow, bid–ask spreads, and price impact to information asymmetry.
- Distinguishes structural microstructure models from reduced-form econometric approaches.
- Establishes price discovery as a measurable object.

Main references: Kyle (1985), Glosten and Milgrom (1985), Easley and O'Hara (1992), Hasbrouck (1991, 1995)

3.5 Volatility as a Latent Process: The High-Frequency Breakthrough

- Reviews ARCH/GARCH and MGARCH as the dominant pre-HF paradigm.
- Introduces realized volatility as a model-free estimator of integrated variance.
- Marks the entry of continuous-time concepts into applied econometrics.
- Recasts volatility from a latent parameter to a measurable quantity.

Main references: Engle (1982, 2002), Bollerslev (1986), Andersen and Bollerslev (1998), Andersen et (2001, 2003), Barndorff-Nielsen and Shephard (2002)

3.6 Microstructure Noise and Econometric Identification

- Documents how HF prices are contaminated by market microstructure noise.
- Explains the bias–variance trade-off in sampling frequency.
- Frames HF econometrics as an identification problem under measurement error.
- Reviews noise-robust estimators of quadratic variation.

Main references: Zhou (1996), Aït-Sahalia, Mykland and Zhang (2005), Barndorff-Nielsen et al. (2008), Jacod et al. (2009)

3.7 Jumps, Discontinuities, and Intraday Price Dynamics

- Distinguishes continuous price variation from jumps.
- Shows how HF data enabled empirical jump detection.
- Links jumps to news, macro announcements, and systemic events.
- Alters the interpretation of information flow in asset prices.

Main references: Merton (1976), Barndorff-Nielsen and Shephard (2004, 2006), Andersen, Bollerslev and Diebold (2007), Lee and Mykland (2008)

3.8 Multivariate High-Frequency Econometrics

- Addresses correlation breakdown at very high frequencies (Epps effect).
- Introduces methods for asynchronous covariance estimation.
- Extends realized measures to multivariate systems.
- Lays foundations for network and connectedness analysis.

Main references: Epps (1979), Hayashi and Yoshida (2005), Barndorff-Nielsen and Shephard (2004), Diebold and Yilmaz (2012)

3.9 High-Frequency Econometrics and Financial Risk

- Integrates HF measures into risk management.
- Shows how realized volatility improves risk forecasting.
- Links HF econometrics to systemic risk and financial stability.
- Emphasises policy relevance and regulatory monitoring.

Main references: Andersen et al. (2003), Barndorff-Nielsen et al. (2010), Adrian and Brunnermeier (2016)

3.10 Forecasting with High-Frequency Data

- Demonstrates the forecasting gains from realized measures.
- Introduces heterogeneous volatility dynamics across horizons.
- Shows how mixed-frequency models exploit HF information.
- Connects HF econometrics to data-rich forecasting.

Main references: Corsi (2009), Ghysels et al (2006), Andersen et al. (2011)

3.11 Market Efficiency Revisited

- Reinterprets the Efficient Market Hypothesis using HF evidence.
- Documents short-horizon predictability and limits to arbitrage.
- Assesses the role of high-frequency trading in price discovery.
- Frames efficiency as horizon-dependent.

Main references: Fama (1970), Hasbrouck (2007), Brogaard, Hendershott and Riordan (2014)

3.12 Methodological Synergies in Financial Econometrics

- Highlights interaction between econometrics, probability, and finance.
- Emphasises semimartingale theory and continuous-time asymptotics.
- Notes growing links with statistics, computation, and machine learning.
- Positions HF econometrics as a catalyst for methodological renewal.

Main references: Duffie (3002), Jacod and Protter (2012)

3.13 High-Frequency Econometrics in Perspective

- Synthesises methodological lessons.
- Emphasises the transition from data scarcity to data abundance.
- Prioritises identification and measurement over specification.
- Assesses the enduring impact on econometrics as a discipline.

Main references: Cross-sectional synthesis of the HF literature

3.14 Conclusion: A Structural Break in Econometric History

- Argues that HF data constitute a structural break in econometric history.
- Summarises changes in theory, methods, and empirical practice.
- Positions HF econometrics as foundational for modern data-rich analysis such as LLMs