

# Managing Car Loan Portfolios

A State Space Approach

# Background

- Car financing is a relatively high-margin medium-term retail lending business.
- Loans are made against collateral that trades in an active market.
- Some aspects similar to real-estate financing, others resemble financing of durable consumer goods.
- Loan applications proceed through car dealers and credit approval is partly automated (e.g. a traffic lights approach).
- Common practice for the lender to hold the title to the collateral vehicle for the duration of the contract.
- Makes liquidation of collateral assets simpler upon violation of loan terms.

# Background

- Iceland ranks a world 4<sup>th</sup> by vehicle density ppt (658).
- Fueled by cheap credit, imports peaked in 2005 (import rate of 12% and growth of 6%).
- Forex denominated loans made car financing affordable (consumer carry-trade).
- Competition drove ever less safe lending practices.
- Significant losses recorded in 2008-2010.
- Eventually recorded as a legal risk event masking a more fundamental problem.

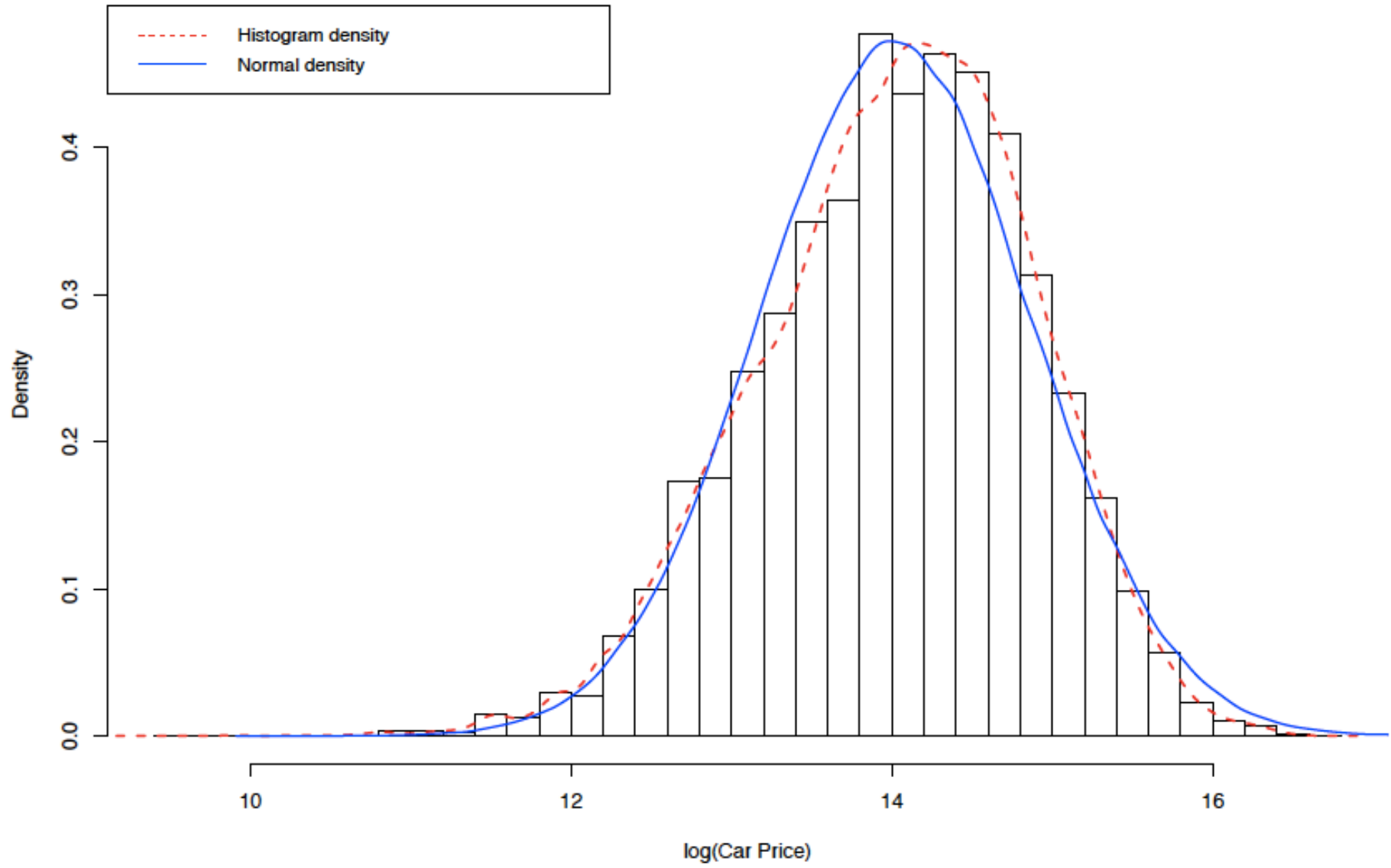
# Proposal

- More systematic lending practices are needed.
- If collateral value, variance and co-variance can be reliably monitored, optimal LTV ratios can be derived and applied.
- Risk of credit loss can be managed actively through an ongoing re-evaluation and rebalancing of the collateral portfolio.
- Usual caveats apply, cf. also securities portfolios. Normality, liquidity, etc.
- Needs to be complemented by coherent systematic stress tests

# Modeling the asset value process

- A data set of ca. 100.000 trades of pre-owned passenger vehicles.
- Modeled in a state-space framework, cf. Harvey (1989).
- Differences in value between cars within period driven by various characteristics.
- Evolution over time a Wiener process (random walk).
- Variable trend, driven by external market or macro variables, e.g. FX-rates, interest rates, inflation, etc.
- Useful feature for stress-testing purposes.

Histogram of log of car prices



# Estimation efficiency

- No rival statistical model available for benchmarking. Use car dealer sticker price (SP) for 8.500 trades. Markedly biased upward.

- Comparative results:

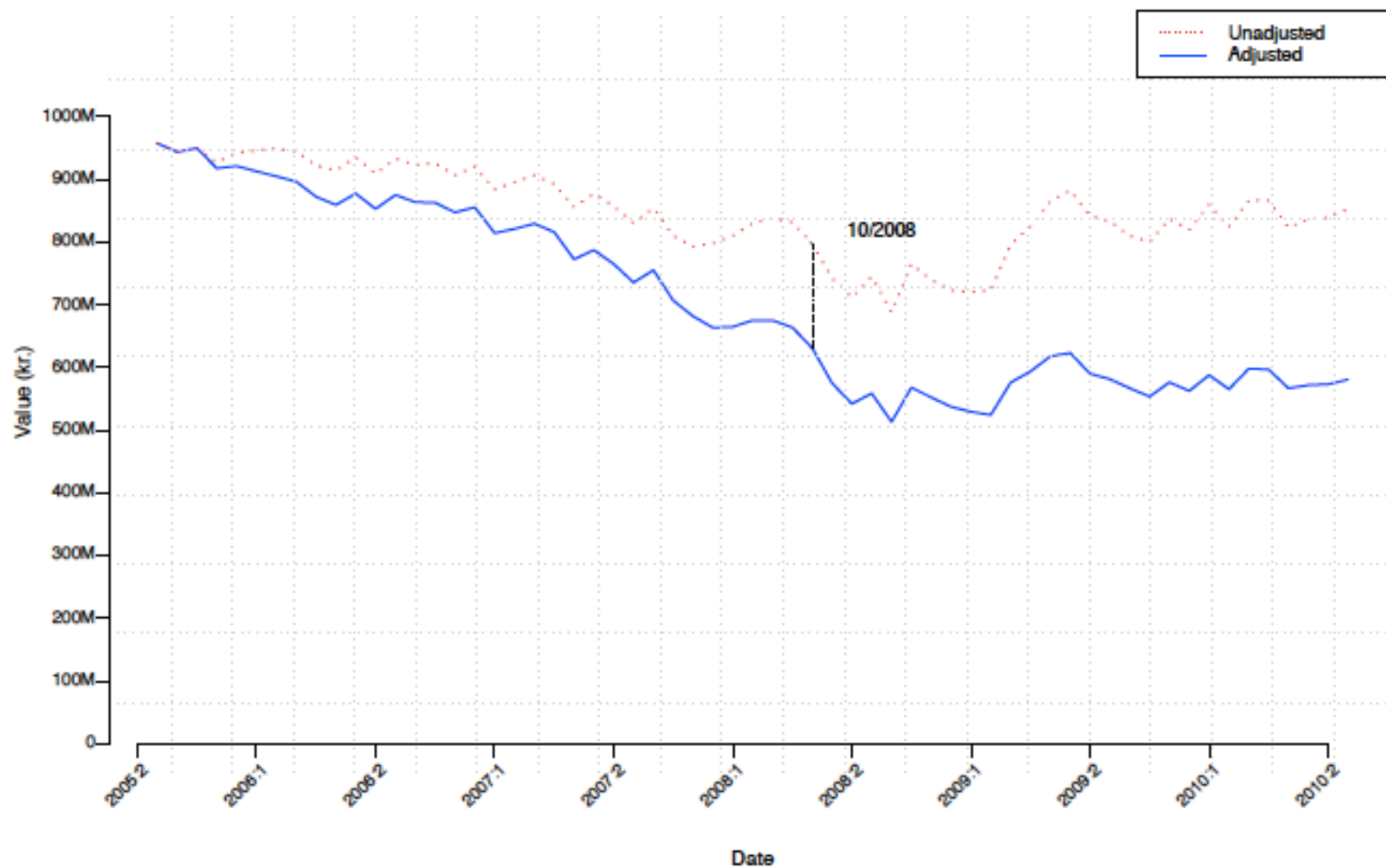
$$\text{Car price} = -15650 + 0.87 \times \text{Sticker price}$$

$$\text{Car price} = 51930 + 0.99 \times \text{Model estimate}$$

$$R_{SP}^2 = 0.96 \text{ and } R_{KF}^2 = 0.90$$

- Acceptable considering...

Evolution of portfolio value



# Significant advantages

- Allows LTV to be set individually, optimally and automatically at origination in the context of an overarching strategy.
- Potential problem assets can be addressed in a timely, proactive and preventive manner.
- A VaR approach or similar can be applied for optimisation at the portfolio level.
- A consistent risk-reporting framework can be developed for regulatory purposes, including coherent, model-based stress testing.

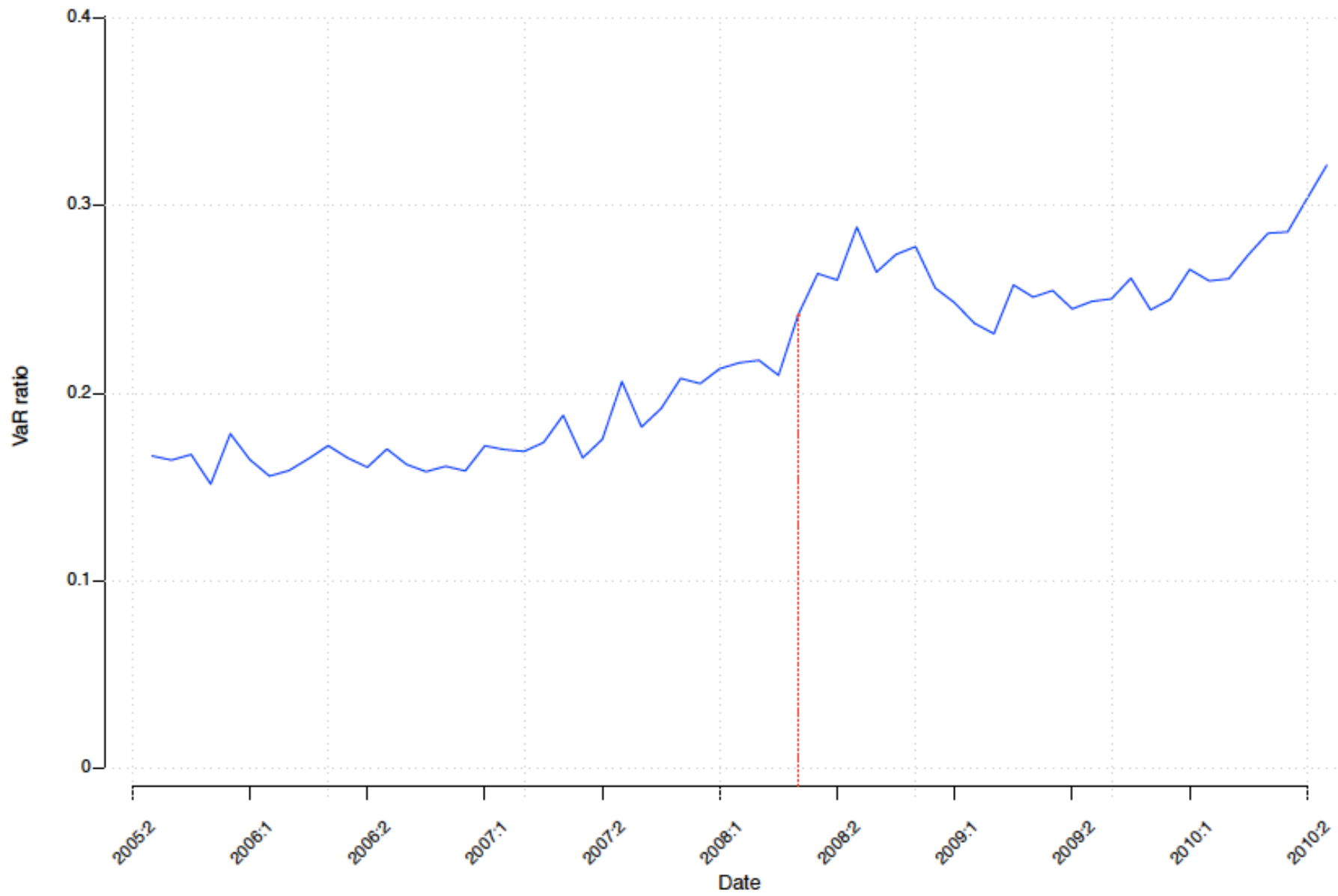
# Correlation matrix for a 10-car subset

$\hat{y}_t$	1	2	3	4	5	6	7	8	9	10
1	1.00	0.08	0.26	0.17	0.16	0.11	0.22	0.29	0.24	0.12
2	0.08	1.00	0.40	0.15	0.15	0.28	0.24	0.10	0.13	0.22
3	0.26	0.40	1.00	0.09	0.09	0.11	0.39	0.24	0.17	0.16
4	0.17	0.15	0.09	1.00	0.51	0.34	0.27	0.44	0.31	0.20
5	0.16	0.15	0.09	0.51	1.00	0.34	0.26	0.43	0.30	0.20
6	0.11	0.28	0.11	0.34	0.34	1.00	0.28	0.27	0.14	0.24
7	0.22	0.24	0.39	0.27	0.26	0.28	1.00	0.41	0.09	0.17
8	0.29	0.10	0.24	0.44	0.43	0.27	0.41	1.00	0.26	0.15
9	0.24	0.13	0.17	0.31	0.30	0.14	0.09	0.26	1.00	0.18
10	0.12	0.22	0.16	0.20	0.20	0.24	0.17	0.15	0.18	1.00
$\sigma$	0.3623	0.3523	0.3606	0.3280	0.3257	0.3494	0.3472	0.3482	0.3401	0.3396

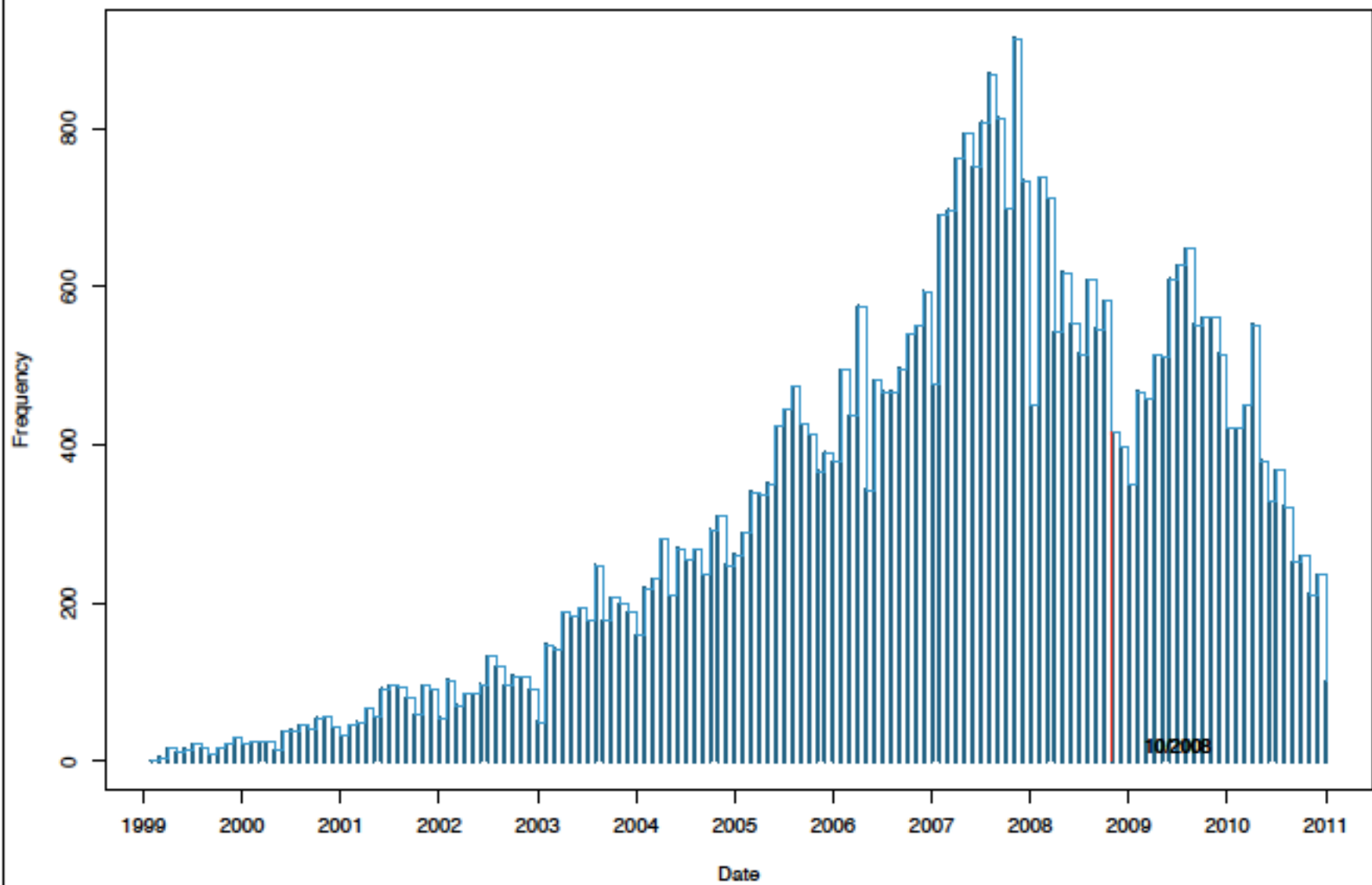
# 10-car subset

$X_t$	Est. price	Real price	Type	Mil. (km)	Yr	Engine	Date of sale
1	1315k	1380k	Octavia	39k	2003	2.0L	8/2005
2	670k	850k	Avensis	87k	1999	1.6L	7/2005
3	725k	720k	Avensis	97k	1999	1.6L	4/2005
4	1385k	1425k	Corolla	30k	2004	1.4L	10/2005
5	1335k	1200k	Corolla	41k	2004	1.4L	11/2005
6	700k	1200k	Corolla	108k	2001	1.6L	5/2005
7	585k	520k	Corolla	95k	1999	1.6L	12/2005
8	1530k	1490k	Corolla	26k	2004	1.6L	9/2005
9	1335k	1400k	Yaris	6k	2004	1.3L	3/2005
10	655k	940k	Golf	74k	2000	1.6L	3/2005

Evolution of VaR ratio



Frequency of car sales



# Discussion

- Some types of financing are more essentially “asset-backed” than others.
- Asset-based portfolio management techniques can usefully complement credit scoring.
- Methodology currently being tested in co-operation with financial intermediaries and local regulator.
- Corresponding real-estate lending model in alpha stage of development.
- Dedicated R&D company underway
- Partnership proposals welcomed 😊.