Duration-Driven Returns

Niels Joachim Gormsen\textsuperscript{1} \quad Eben Lazarus\textsuperscript{2}

\textsuperscript{1}University of Chicago, Booth School of Business

\textsuperscript{2}MIT Sloan School of Management

January, 2020
Motivation: Understanding Equity Risk Factors

We want to understand the major equity risk factors:

<table>
<thead>
<tr>
<th>Value</th>
<th>Profit</th>
<th>Low investment</th>
<th>Low risk</th>
<th>Payout</th>
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- Key factors in leading factor models
- Highly persistent, implying price importance

Challenge for understanding these risk factors:

- Hard to relate to fundamental economics
- Hard to relate to one another
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Challenge for understanding these risk factors:
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- Hard to relate to one another

New facts about the major risk factors:
- The major risk factors are long short-duration stocks
- New data to pin down duration as key driver of cross-section
Duration is the PV-weighted time to maturity of expected cash flows:

\[
\text{Duration} = \sum_{i=1}^{\infty} i \times w_i, \quad \text{where} \quad w_i = \frac{PV(CF_i)}{\sum PV(CF_i)}
\]
Cash-Flow Duration of Risk Factors

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\]

- Used to measure interest-rate sensitivity for bonds, but applicable here as simple measure of cash-flow timing
- For equities, growth rates are key determining for duration (high growth = long duration)
Cash-Flow Duration of Risk Factors

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Firms in the long leg have shorter duration based on combination of risk factors. But holds as well for individual risk factors.

Niels Joachim Gormsen, Eben Lazarus · Duration-Driven Returns · A1 A2 A3 A4 A5 A6 A7 A8
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  \]

Firms in the long leg have shorter duration
- Based on combination of risk factors
- But holds as well for individual risk factors
Duration-Driven Returns

Hypothesis: the risk-factors are driven by premium on near-future cash flows

Recall,

\[ E_t[r_{t+1}] = \sum_{m=1}^{\infty} w_t^m E_t[r_t^{m+1}] \]  \hspace{1cm} (1)

where \( r_t^{m+1} \) is one-period excess return on the \( t + m \) cash flow and \( w_t^m \) is its relative present value.

We argue that \( E_t[r_t^{m+1}] \)

- is the same across firms
- but decrease in \( m \)

\( \Rightarrow \) Firms with higher weight on near-future cash-flows have higher returns.
Duration-Driven Returns: Evidence from Dividend Strips

New dataset of **single-stock** dividend futures
- Claims on individual dividends on individual firms
Duration-Driven Returns: Evidence from Dividend Strips

New dataset of **single-stock** dividend futures

- Claims on individual dividends on individual firms

![CAPM Alpha for portfolios of dividend strips](image)

- The alpha decrease in maturity
- But it is the same across firms

⇒ Duration-driven returns
The Economics: Why might near-future cash flows have high returns?

Multiple economic mechanisms give duration-driven returns:

   ■ Distant-future cash flows more exposed to discount-rate risk (low risk premium)
   ■ Near-future cash flows more exposed to cash-flow risk (high risk-premium)

2. Near future cash-flows *perceived* as riskier

3. See Binsbergen and Koijen (2017) for more

Our contribution:

■ Organize the risk factors into a single fact

■ Illustrate that they can be explained by a model where near-future cash flows content...
Related Literature

Duration and the cross-section of stocks:
- Dechow, Sloan, and Soliman (2004) studies the relation between duration and stock returns
- Goncalves (2018) and Chen and Li (2018) use duration factor to explain return

We contribute by:
1. Explaining payout, beta and volatility anomalies
2. Directly linking the different anomalies to expected growth rates and duration
3. Studying a novel dataset of dividend futures
4. Studying the equity yield curve
5. Theoretical model
6. Global evidence

The factor zoo:
- Recent literature on taming the factor zoo based on statistical methods
  → Feng, Giglio, and Xiu (2017); Giglio, Liao, and Xiu (2018); Harvey and Liu (2017); Harvey, Liu, and Zhu (2016); Freyberger, Neuhierl, and Weber (2017); Kozak, Nagel, and Santosh (2017)
- We differ by using basic economics and intuition to shrink the cross-section
Part 1: The Major Risk Factors Invest in Short-Duration Firms
Measuring Expected Growth Rates
Two Different Approaches

1. Realized growth rates

2. Long term growth forecast (LTG) from I/B/E/S database
Measuring Expected Growth Rates
Two Different Approaches

1. **Realized growth rates**

2. **Long term growth forecast (LTG) from I/B/E/S database**
   - Ex ante analyst expectations of growth rate of next business cycle
   - Available for a subset of firms from 1982
Measuring Expected Growth Rates
Two Different Approaches

1. Realized growth rates
2. Long term growth forecast (LTG) from I/B/E/S database
   - Ex ante analyst expectations of growth rate of next business cycle
   - Available for a subset of firms from 1982

We run the following firm-level panel regression:

\[ \text{LTG}_{i,t} = X'_{i,t} \Gamma + e_{i,t} \]  

(2)

where

- \( \text{LTG}_{i,t} \) is the median LTG for firm \( i \) at time \( t \)
- \( X'_{i,t} \) is a vector of firm \( i \) characteristics at time \( t \)
- LTG and firm characteristics are measured as cross-sectional percentiles
Expected Growth Rates and Characteristics

Results of the following panel regression:

\[ \text{LTG}_{i,t} = X'_{i,t} \Gamma + e_{i,t} \]  \hspace{1cm} (3)

<table>
<thead>
<tr>
<th>Dependent variable: LTG</th>
</tr>
</thead>
<tbody>
<tr>
<td>High BM</td>
</tr>
<tr>
<td>High profit</td>
</tr>
<tr>
<td>Low investment</td>
</tr>
<tr>
<td>Low beta</td>
</tr>
<tr>
<td>High payout</td>
</tr>
<tr>
<td>Fixed effect</td>
</tr>
<tr>
<td>Cluster</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Sample</td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>R-squared</td>
</tr>
</tbody>
</table>
Expected Growth Rates and Characteristics

Results of the following panel regression:

\[
\text{LTG}_{i,t} = X'_{i,t} \Gamma + e_{i,t}
\]  \hspace{1cm} (4)

<table>
<thead>
<tr>
<th></th>
<th>US</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>High BM</td>
<td>-0.493</td>
<td>-0.544</td>
</tr>
<tr>
<td></td>
<td>(-52.86)</td>
<td>(-22.31)</td>
</tr>
<tr>
<td>High profit</td>
<td>-0.191</td>
<td>-0.240</td>
</tr>
<tr>
<td></td>
<td>(-21.62)</td>
<td>(-10.25)</td>
</tr>
<tr>
<td>Low investment</td>
<td>-0.093</td>
<td>-0.090</td>
</tr>
<tr>
<td></td>
<td>(-16.07)</td>
<td>(-4.71)</td>
</tr>
<tr>
<td>Low beta</td>
<td>-0.174</td>
<td>-0.277</td>
</tr>
<tr>
<td></td>
<td>(-18.22)</td>
<td>(-12.40)</td>
</tr>
<tr>
<td>High payout</td>
<td>-0.262</td>
<td>-0.203</td>
</tr>
<tr>
<td></td>
<td>(-33.21)</td>
<td>(-7.85)</td>
</tr>
</tbody>
</table>

Fixed effect: Firm/Date
Cluster: Firm/Date
Weight: Analysts Full
Sample: Market Cap Full
Observations: 539,297  539,297
R-squared: 0.48  0.44
### Expected Growth Rates and Characteristics

Results of the following panel regression:

\[
\text{LTG}_{i,t} = X'_{i,t} \Gamma + e_{i,t}
\]

(5)

<table>
<thead>
<tr>
<th>Dependent variable: LTG</th>
<th>US</th>
<th>US</th>
<th>INT</th>
<th>INT</th>
</tr>
</thead>
<tbody>
<tr>
<td>High BM</td>
<td>-0.485</td>
<td>-0.530</td>
<td>-0.167</td>
<td>-0.202</td>
</tr>
<tr>
<td></td>
<td>(-54.81)</td>
<td>(-23.81)</td>
<td>(-15.77)</td>
<td>(-9.52)</td>
</tr>
<tr>
<td>High profit</td>
<td>-0.172</td>
<td>-0.230</td>
<td>-0.078</td>
<td>-0.092</td>
</tr>
<tr>
<td></td>
<td>(-20.42)</td>
<td>(-10.37)</td>
<td>(-7.28)</td>
<td>(-3.62)</td>
</tr>
<tr>
<td>Low investment</td>
<td>-0.092</td>
<td>-0.090</td>
<td>-0.027</td>
<td>-0.007</td>
</tr>
<tr>
<td></td>
<td>(-16.37)</td>
<td>(-4.874)</td>
<td>(-3.55)</td>
<td>(-0.50)</td>
</tr>
<tr>
<td>Low beta</td>
<td>-0.112</td>
<td>-0.230</td>
<td>-0.058</td>
<td>-0.126</td>
</tr>
<tr>
<td></td>
<td>(-12.30)</td>
<td>(-10.44)</td>
<td>(-5.41)</td>
<td>(-7.16)</td>
</tr>
<tr>
<td>High payout</td>
<td>-0.229</td>
<td>-0.183</td>
<td>-0.144</td>
<td>-0.134</td>
</tr>
<tr>
<td></td>
<td>(-30.15)</td>
<td>(-7.655)</td>
<td>(-15.08)</td>
<td>(-7.86)</td>
</tr>
<tr>
<td>Fixed effect</td>
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<td>Analysts Full</td>
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</tr>
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<td>Observations: 539,290</td>
<td>539,290</td>
<td>290,418</td>
<td>290,418</td>
</tr>
<tr>
<td></td>
<td>R-squared: 0.50</td>
<td>0.46</td>
<td>0.06</td>
<td>0.10</td>
</tr>
</tbody>
</table>
Part 1: The Major Risk Factors Invest in Short-Duration Firms

Growth Rates and Characteristics
G7-countries

[Bar chart showing growth rates and characteristics for G7 countries, with categories for High BM, High Profit, Low INV, Low beta, and High Payout]
Growth Rates and Characteristics
Country-level evidence
Equity Risk Factors & Duration: Intuition

Equity risk factors are intuitively related to duration:

- **Low investment**: Low investment in generating future cash flows
- **High profit**: High profit firms are in the profitable part of their life cycle
- **High payout**: High payout because of low future growth prospects
- **Low valuation**: Low valuations arise partly because of low future growth rates
- **Low beta/low volatility**: Firms with a short cash-flow duration are less sensitive to discount rate shocks and growth rate shocks, meaning they have lower betas and volatility
Part 2: Explaining Returns with a Duration Factor
Explaining Risk Factors with the Duration Factor

Fama and French-type Duration factor:
- Factor sorted on predicted LTG in (5)

We introduce new three-factor model:

\[ r_{t+1}^i = \alpha_t + \beta_{MKT} (r_{t+1}^{MKT} - r_{t}^f) + \beta_{SMB} r_{t+1}^{SMB} + \beta_{DUR} r_{t+1}^{DUR} + \epsilon_{t+1} \]

<table>
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<tr>
<th>Factor</th>
<th>CAPM model</th>
<th>Three-factor model</th>
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<td>( \alpha_{CAPM} )</td>
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<td>HML</td>
<td>0.32 (2.82)</td>
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Part 3: Duration-Driven Returns: Evidence From Dividend-Futures and Corporate Bonds
Understanding the Driver of Expected Returns

So far:

- Major equity risk factors are all long short-duration stocks
- Their return can be summarized by a duration factor
Understanding the Driver of Expected Returns

So far:
- Major equity risk factors are all long short-duration stocks
- Their return can be summarized by a duration factor

Next:
- Are the high returns due to the short cash-flow duration?
- Or some other firm level characteristic correlated with duration?

Recall,

\[ E_t[r_{t+1}] = \sum_{m=1}^{\infty} w_t^m E_t[r_{t+1}^m] \]

We argue that risk-adjusted returns on cash-flows
- Are the same across firms (i.e., not firm specific drivers)
- Decrease in maturity

⇒ Duration-driven returns
Single Stock Dividend Futures

- Single stock dividend futures are claims to a given year’s dividend on a firm
- Exchange traded products that allow you to buy a single year’s dividend
- Similar to zero-coupon bonds, only the outcome is stochastic
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- Exchange traded on EuroStoxx
- Prices available on Bloomberg
- Maturity: 1 to 4 years
- Period: 2010 - 2018
- Notional outstanding: USD 6 billion
Duration versus Firm Effects

Calculate annualized expected returns based on expected dividends among analysts:

\[ E_t[r_{t+m}^m] = \frac{E_t[D_{t+m}]}{P_t^m} - 1 \]  \hspace{1cm} (6)

Average Alpha to Dividend Futures with Different Maturity for Different Firms

<table>
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<tr>
<th>Maturity of Strip</th>
<th>1 year</th>
<th>2 year</th>
<th>3 year</th>
<th>4 year</th>
<th>Average</th>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
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(Average Alpha to Dividend Futures with Different Maturity for Different Firms)

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<th></th>
<th></th>
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<td>2 year</td>
<td>3 year</td>
<td>4 year</td>
<td>Average</td>
<td></td>
</tr>
<tr>
<td>Short-duration firms</td>
<td>0.072</td>
<td>0.062</td>
<td>0.033</td>
<td>-0.005</td>
<td>0.041</td>
<td></td>
</tr>
<tr>
<td>Long-duration firms</td>
<td>0.087</td>
<td>0.061</td>
<td>0.023</td>
<td>0.006</td>
<td>0.044</td>
<td></td>
</tr>
<tr>
<td>Average across firms</td>
<td>0.080</td>
<td>0.062</td>
<td>0.028</td>
<td>0.000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Takeaways:

- Returns are the same across firms (i.e., not firm specific drivers)
- Returns decrease in maturity
Maturity versus Firm-Level Effects

Panel regressions with annual CAPM alpha on LHS for firm $i$, maturity $m$:

$$\alpha_{i,t+m} = \beta_0 + \beta_1 FIRM_{i,t} + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + FE_t + \varepsilon_{i,m,t}$$
Maturity versus Firm-Level Effects

Panel regressions with annual CAPM alpha on LHS for firm $i$, maturity $m$:

$$\alpha_{i,t+m} = \beta_0 + \beta_1 FIRM_{i,t} + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 + FE_t + \varepsilon_{i,m,t}$$

<table>
<thead>
<tr>
<th>Panel B: CAPM alpha</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent variable</td>
<td>CAPM alpha</td>
<td>CAPM alpha</td>
<td>CAPM alpha</td>
<td>CAPM alpha</td>
<td>CAPM alpha</td>
</tr>
<tr>
<td>2-year maturity dummy</td>
<td>-0.0109</td>
<td>-0.0503***</td>
<td>-0.0503***</td>
<td>-0.0573**</td>
<td>-0.0545***</td>
</tr>
<tr>
<td></td>
<td>(-1.083)</td>
<td>(-3.774)</td>
<td>(-3.926)</td>
<td>(-3.209)</td>
<td>(-3.646)</td>
</tr>
<tr>
<td>3-year maturity dummy</td>
<td>-0.0415***</td>
<td>-0.0755***</td>
<td>-0.0755***</td>
<td>-0.0854***</td>
<td>-0.0814***</td>
</tr>
<tr>
<td></td>
<td>(-3.353)</td>
<td>(-4.448)</td>
<td>(-4.968)</td>
<td>(-3.930)</td>
<td>(-4.798)</td>
</tr>
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<td>4-year maturity dummy</td>
<td>-0.0754***</td>
<td>-0.0748***</td>
<td>-0.0748**</td>
<td>-0.0707**</td>
<td>-0.0707**</td>
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<tr>
<td></td>
<td>(-3.815)</td>
<td>(-4.072)</td>
<td>(-3.373)</td>
<td>(-3.124)</td>
<td>(-2.509)</td>
</tr>
<tr>
<td>Low LTG</td>
<td></td>
<td></td>
<td></td>
<td>-0.00018**</td>
<td>-0.000990</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(-2.619)</td>
<td>(-1.507)</td>
</tr>
<tr>
<td>Short duration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>675</td>
<td>667</td>
<td>667</td>
<td>615</td>
<td>615</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.094</td>
<td>0.636</td>
<td>0.636</td>
<td>0.358</td>
<td>0.358</td>
</tr>
<tr>
<td>Fixed effect</td>
<td>Date/cur</td>
<td>Date/cur</td>
<td>Date/cur</td>
<td>Date/cur</td>
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</tr>
<tr>
<td>Cluster</td>
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<td>Firm</td>
<td>Firm/date</td>
<td>Firm/date</td>
<td>Firm/date</td>
</tr>
<tr>
<td>Weight</td>
<td>None</td>
<td>Notional</td>
<td>Notional</td>
<td>Notional</td>
<td>Notional</td>
</tr>
</tbody>
</table>

Niels Joachim Gormsen, Eben Lazarus  •  Duration-Driven Returns
Conclusion: Duration-Driven Returns

Major equity risk factors
- Invest in short-duration firms
- Can be explained by a new duration factor in a three-factor model

Evidence from single-stock dividend futures:
- Suggests risk factors arise from premium on near-future cash flows
- Inconsistent with other firm-level drivers of returns

Future research
- Structural model for duration-driven returns
- Explicit links to risk or behavioral biases
Appendix
Appendix

References


Feng, Guanhao, Stefano Giglio, and Dacheng Xiu, 2017, Taming the factor zoo.


Giglio, Stefano, Yuan Liao, and Dacheng Xiu, 2018, Thousands of alpha tests.

Goncalves, Andrei Salem, 2018, Essays in financial economics, Ph.D. thesis The Ohio State University.

Harvey, Campbell, and Yan Liu, 2017, Lucky factors.


### Univariate Correlation

Panel B: Univariate Correlation Between LTG and Characteristics

*Panel B: Firm-level univariate correlations between characteristics and survey expectations of growth rates*

<table>
<thead>
<tr>
<th>Survey growth rates</th>
<th>High BM</th>
<th>High profit</th>
<th>Low inv</th>
<th>Low beta</th>
<th>Low IV</th>
<th>High pay</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.40</td>
<td>-0.12</td>
<td>-0.26</td>
<td>-0.30</td>
<td>-0.37</td>
<td>-0.37</td>
</tr>
</tbody>
</table>
Figure 4: Cumulative Alpha for the Duration Factor
Single Stock Dividend Futures

Some facts about dividend futures:

- Dividend futures arise from hedging demand for financial institutions
- Most trade takes place off the order book
- Daily volume 2018: 20,000 contracts (each contract is on 1,000 shares)
Estimating Expected Return and Sharpe Ratios

- Use I/B/E/S estimates of expected dividends to estimate expected returns on dividend strips:

\[ E_t[r_{t+1}^{i,m}] = \left( \frac{E_t[d_{t+m}^i]}{f_{t}^{i,m}} \right)^{1/m} \]  

(8)

where \( f_{t}^{i,m} \) is the futures price at time \( t \) for the \( t + m \) dividend on firm \( i \).

- Estimate CAPM alpha as

\[ \alpha_t^{i,m} = E_t[r_{t+1}^{i,m}] - \beta_t^{i,m} E_t[r_{t+1}^{mkt}] \]  

(9)