Do Asset Price Drops Foreshadow Recessions?

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The views expressed in this presentation are those of the authors and do not necessarily represent those of the IMF.
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  - Early 1990s asset price collapse and recession in Japan
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- Asset prices affect current and future aggregate demand.
- Negative wealth effect on households, dampening consumption.
- Negative effect on firms' and banks' balance sheets, reducing investment and lending.
- Asset prices are forward-looking, reflecting future economic conditions. Changes in asset prices contain information about future growth.
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Questions and findings

Key questions and our findings:

- Are asset price drops associated with the beginning of recessions in the G-7? Are the effects of equity prices on the conditional probability of beginning a new recession asymmetric?

  - Yes. Equity price drops and oil price rises are significantly associated with new recessions. However, house price drops are not.

  - Yes. Equity price drops have larger effects (in absolute terms) than equivalent equity price rises on the chances of a new recession.

  - Does the nature of the relationship between asset price drops and downturns change with the severity of recessions?

    - Yes. Equity price drops are even more strongly associated with severe recessions.
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  • Focus on association with new recessions.
  • Consider robustness to the rare events problem.
  • Explore non-linearities in the relationship between equity prices and recessions.
• Core data include:
  • Cyclical peaks and troughs of seasonally-adjusted real GDP, identified by the Bry-Boschan/Harding-Pagan algorithm.
  • Real equity price growth, term spread, real oil price, real house price growth.
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- Other data considered:
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  - implied S&P volatility, net fall in real equity prices, real equity growth elsewhere, and others
Asset Prices and Recessions

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Motivation

Questions and Contributions

Data and Model

Empirical Results

Baseline

Robustness

One-step ahead classification

Conclusion

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• Data are based on quarterly averages unless otherwise indicated.
• Cyclical peaks (binary) conditional on being in expansion.
Model

- Cyclical peaks (binary) conditional on being in expansion.
- Panel logit

\[
P(r_{i,t}|x_{i,t-1}) = \frac{\exp(x_{i,t-1}'\beta)}{1 + \exp(x_{i,t-1}'\beta)}
\]

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A first look at the data

Frequency Distribution of Real Equity Price Growth
Conditional on Business Cycle Phase

Note: The conditioning variable is once-lagged. Growth rates are expressed as changes in log levels of the series times 100. The expansion period density excludes the year before a peak. Year before a peak includes the peak. The p-value of the Kolmogorov–Smirnov test of the equality of densities is 0.002.
A first look at the data

Frequency Distribution of Term Spread
Conditional on Business Cycle Phase

Note: The conditioning variable is once-lagged. Growth rates are expressed as changes in log levels of the series times 100. The expansion period density excludes the year before a peak. Year before a peak includes the peak. The p-value of the Kolmogorov–Smirnov test of the equality of densities is 0.000.
A first look at the data

Frequency Distribution of Log Real Oil Price
Conditional on Business Cycle Phase

Note: The conditioning variable is once-lagged. Growth rates are expressed as changes in log levels of the series times 100. The expansion period density excludes the year before a peak. Year before a peak includes the peak. The p-value of the Kolmogorov–Smirnov test of the equality of densities is 0.001.
A first look at the data

Note: The conditioning variable is once-lagged. Growth rates are expressed as changes in log levels of the series times 100. The expansion period density excludes the year before a peak. Year before a peak includes the peak. The p-value of the Kolmogorov–Smirnov test of the equality of densities is 0.575.
A first look at the data

**Frequency Distribution of Negative Real Equity Price Growth**

Conditional on Business Cycle Phase

Note: The conditioning variable is once-lagged. Growth rates are expressed as changes in log levels of the series times 100. The expansion period density excludes the year before a peak. Year before a peak includes the peak. The p-value of the Kolmogorov–Smirnov test of the equality of densities is 0.002.
Predicting Recessions in the G-7
Baseline Results, 1970:Q1-2011:Q4

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
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<td>Log Real Oil Price</td>
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<td>(0.2510)</td>
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<td>Real House Price Growth</td>
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<td>0.003</td>
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<td>(0.0416)</td>
<td>(0.0408)</td>
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<tr>
<td>Negative Real Equity Price Growth</td>
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<td>-0.0792**</td>
<td>0.301***</td>
<td>0.281***</td>
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<td>(0.0323)</td>
<td>(0.1140)</td>
<td>(0.1040)</td>
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<td>948</td>
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<tr>
<td>AUC</td>
<td>0.787</td>
<td>0.77</td>
<td>0.733</td>
<td>0.703</td>
<td>0.749</td>
<td>0.799</td>
<td>0.844</td>
</tr>
</tbody>
</table>
Asset Prices and Recessions

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Motivation
Questions and Contributions
Data and Model
Empirical Results
Baseline
Robustness
One-step ahead classification
Conclusion

Baseline model

Receiver Operating Characteristic Curve

Area under ROC curve = 0.8438
Note: The underlying logit model contains explanatory variable set 7.
Marginal effects of equity prices

Effect of Real Equity Price Growth
Predicted Probabilities

Covariate Contribution

1st Quintile
Median
4th Quintile
Marginal effects of equity prices

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Median
4th Quintile
## Predicting Recessions in the G-7

Robustness to Estimation Method, 1970:Q1-2011:Q4

<table>
<thead>
<tr>
<th>Explanatory Variable</th>
<th>Baseline</th>
<th>Firth's Bias Correction</th>
<th>Complementary Log-Log</th>
<th>King and Zeng's Correction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real Equity</td>
<td>-0.312***</td>
<td>-0.278***</td>
<td>-0.308***</td>
<td>-0.277***</td>
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<tr>
<td>Price Growth</td>
<td>(0.0998)</td>
<td>(0.1010)</td>
<td>(0.0985)</td>
<td>(0.0930)</td>
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<tr>
<td>Term Spread</td>
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<td>-0.440***</td>
<td>-0.412***</td>
<td>-0.439***</td>
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<tr>
<td></td>
<td>(0.1770)</td>
<td>(0.0983)</td>
<td>(0.1580)</td>
<td>(0.1140)</td>
</tr>
<tr>
<td>Log Real Oil Price</td>
<td>0.948***</td>
<td>0.902***</td>
<td>0.951***</td>
<td>0.903***</td>
</tr>
<tr>
<td></td>
<td>(0.2560)</td>
<td>(0.3180)</td>
<td>(0.2310)</td>
<td>(0.3130)</td>
</tr>
<tr>
<td>Real House Price Growth</td>
<td>0.003</td>
<td>0.000548</td>
<td>0.0114</td>
<td>-0.000181</td>
</tr>
<tr>
<td></td>
<td>(0.0408)</td>
<td>(0.0679)</td>
<td>(0.0388)</td>
<td>(0.0712)</td>
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<tr>
<td>Negative Real Equity Price Growth</td>
<td>0.281***</td>
<td>0.245**</td>
<td>0.290***</td>
<td>0.244**</td>
</tr>
<tr>
<td></td>
<td>(0.1040)</td>
<td>(0.1150)</td>
<td>(0.0991)</td>
<td>(0.1100)</td>
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<td>No. of Obs.</td>
<td>948</td>
<td>948</td>
<td>948</td>
<td>948</td>
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<tr>
<td>AUC</td>
<td>0.844</td>
<td>0.844</td>
<td>0.84</td>
<td>0.844</td>
</tr>
</tbody>
</table>
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- Most contributed little (insignificant and no change in AUC):
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- Only rate of exchange rate depreciation versus the USD was significant.
- Estimated coefficients on the baseline variables were roughly unchanged across all models.
- Baseline also robust to inclusion of additional lags (4 total).
We also looked at how the model performed in predicting severe recessions (deep in terms of output fall).

### Predicting Severe Recessions in the G-7

Baseline Results, 1970:Q1-2011:Q4

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<th>(6)</th>
<th>(7)</th>
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<tbody>
<tr>
<td>Real Equity Price Growth</td>
<td>-0.102***</td>
<td>-0.602***</td>
<td>-0.571***</td>
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<tr>
<td></td>
<td>(0.0240)</td>
<td>(0.1680)</td>
<td>(0.2030)</td>
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<tr>
<td>Term Spread</td>
<td>-0.714***</td>
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<td>-0.645***</td>
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<tr>
<td></td>
<td>(0.2000)</td>
<td></td>
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<td>(0.2030)</td>
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<tr>
<td>Log Real Oil Price</td>
<td></td>
<td>1.365***</td>
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<td>1.653***</td>
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<td></td>
<td></td>
<td>(0.3930)</td>
<td></td>
<td>(0.4970)</td>
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<tr>
<td>Real House Price Growth</td>
<td></td>
<td>0.076</td>
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<td>0.0626**</td>
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<td></td>
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<td>(0.1020)</td>
<td></td>
<td>(0.0314)</td>
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<tr>
<td>Negative Real Equity Price Growth</td>
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<td></td>
<td>-0.0928***</td>
<td>0.516**</td>
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<tr>
<td>AUC</td>
<td>0.801</td>
<td>0.811</td>
<td>0.739</td>
<td>0.702</td>
<td>0.756</td>
<td>0.823</td>
<td>0.901</td>
</tr>
</tbody>
</table>
Overall performance out-of-sample

Receiver Operating Characteristic Curve
One-Step Ahead Recession Start Predictions

Area under ROC curve = 0.8867

Note: The underlying logit model contains the change in the log real equity price, the negative changes in the log real equity price, the term spread, and the log real oil price. Initiating sample starts in 1970:Q1.
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Great Recession Starts

One-Step Ahead Classifier
Baseline Model at Start of Great Recession

Note: Red line indicates optimal threshold (Youden’s J-statistic) to achieve a false positive rate < 12%.
• Predictions are generally too low to merit interpretation as probabilities.
• When viewed as a classification problem, then the model does well for France, Germany, Italy, Japan, and the United Kingdom.
• However, it performs poorly for Canada and the United States.
• More work needed to inspect country-by-country.
• Focus on identifying new recessions with simple model centered on a few financial variables.

• Equity price growth, term spread, and oil price are significantly associated with new recessions, while house prices are not.

• Non-linearities evident in the effect of equity prices, with equity price drops showing larger effects (in absolute terms) than rises.

• Next steps . . .
  • more in-depth, out-of-sample analysis
  • country-by-country investigation ⇒ the rare events problem can be acute in these cases, likely necessitating the use of one of the alternative estimation methods.