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Business cycle variation in the risk-return trade-off

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A B S T R A C T

In the United States and other Organisation for Economic Co-operation and Development (OECD) countries, the expected returns on stocks, adjusted for volatility, are much higher in recessions than in expansions. We consider feasible trading strategies that buy or sell shortly after business cycle turning points that are identifiable in real time and involve holding periods of up to 1 year. The observed business cycle changes in expected returns are not spuriously driven by changes in expected near-term dividend growth. Our findings imply that value-maximizing managers face much higher risk-adjusted costs of capital in their investment decisions during recessions than expansions.

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1. Introduction

The risk-adjusted cost of capital is a key input in any financial decision of rational managers. Its level affects the net present value of payoffs from any corporate investment project, from hiring decisions to capital expenditures, investment in inventories, advertising, and research and development. The risk-adjusted cost of capital of any firm depends on the firm's quantity of risk and its aggregate price. This paper focuses on the time-variation in the aggregate price of risk. We document regular shifts in the risk return trade-off over the course of 100 years of U.S. data and a half century of OECD data.

This paper provides new historical evidence from U.S. and foreign securities markets documenting large increases in the market price of aggregate risk during recessions. A U.S. equity investor, who buys securities 1–5 quarters into a recession or expansion – as defined by the National Bureau of Economic Research (NBER) – and holds them for 1 year, earns an average excess return of 11.3% in recessions, compared to only 5.3% in expansions, in the post-war sample examined (1945.1–2009.12). Sharpe ratios, which correspond to average excess returns divided by their standard deviations and thus represent a market compensation per unit of risk, are counter-cyclical: the post-war realized Sharpe ratio is on average 0.66 in recessions compared to 0.38 in expansions. In addition, the variation in the realized excess returns and Sharpe ratios during recessions (expansions) is equally substantial. Sharpe ratios reach a maximum of 0.82 four quarters into a recession and a minimum of 0.14 three quarters into an expansion.

The findings imply that, even in the absence of any other frictions in internal or external capital markets, unconstrained firms that maximize shareholder value have to use much higher risk-adjusted costs of capital when choosing investment projects during recessions, compared to expansions, if these projects are exposed to some aggregate risk. For a 1-year project with the same aggregate risk exposure as the U.S. stock market, the risk-adjusted cost of capital in the middle of an expansion would be at least nine percentage points lower than in the middle of a recession. As a result, financially

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unconstrained firms may reject lots of seemingly “good” projects in recessions to avoid destroying shareholder value. Conversely, in expansions, firms may accept lots of seemingly “bad” projects.

The findings are robust to different frequencies, different sub-samples, and different countries. Samples start either in 1854, 1925, or 1945, and end either in 1944 or 2009; estimates use either quarterly returns and quarterly recession dates, or monthly returns and monthly dates; and business cycles are dated thanks to the NBER or OECD economic turning points. In all time frames examined, equity Sharpe ratios increase during recessions and decrease during expansions. The findings pertain to a very limited number of observations: the NBER has identified only 32 cycles since 1854 in the USA. However, foreign countries offer additional observations. Using the OECD turning points to date peaks and troughs, similar business cycle variations in the conditional Sharpe ratio on equity appear in all G7 countries (Canada, France, Germany, Italy, Japan, UK, and USA). Again, the conditional equity Sharpe ratio increases during recessions and decreases during expansions.

In contrast to previous studies, financial variables are not used to predict asset returns. Instead, returns are only conditioned on the stage of the business cycle, determined exclusively by non-financial variables. Thus, the investment strategy described so far is not implementable because investors do not know NBER recession dates in real time. Hence, the question remains whether the variation in returns truly measures variation in expected returns, or whether it is a variation in expected cash flows mislabeled as discount rate variation. To answer this key question, four additional experiments are conducted.

First, evidence from newspaper articles and Internet searches shows that investors seem to learn about changes in the aggregate state of the U.S. economy rather quickly. The occurrence of the word “recession” in *The New York Times* and *The Washington Post* since 1980 is informative: it takes only 2 months for such an index to increase by one standard deviation above its expansion-implied mean. The number of Google Insight searches of the word “recession” is available on a shorter sample, but it shows a clear increase at the end of 2007, well before the NBER announcement of the start of the Great Recession.

Second, two different quasi real-time measures of business cycles lead to similar equity returns: the Chauvet and Piger’s (2008) real-time recession probabilities and the Chicago Fed National Activity Index (CFNAI). Investment strategies built on these quasi-real-time recession dates deliver substantial differences in average excess returns between recessions and expansions. In all cases, the average excess returns and the Sharpe ratios in the midst of recessions are larger than those measured in the midst of expansions.

Third, changes in expected returns during business cycle expansions and contractions are not related to changes in expected near-term dividend growth. The variance decomposition of the dividend yield offers a useful tool to assess cash flow predictability because the dividend yield is driven exclusively by news about either future returns or dividend growth. In the data, dividend-yield variation is more informative about returns in the subsequent year during recessions than during normal times: a 1% increase in the dividend yield raises the expected return by 56 basis points (bps) in recessions, compared to only 17 bps in expansions. This finding is consistent with a decrease in the persistence of risk premia during recessions. The dividend yield, however, is not more informative about future dividend growth during recessions. We find no empirical evidence that the simple investment strategy based on business cycle dates is really capturing cash flow variation.

Fourth, a set of simulations from a simple toy model shows that the investment strategy based on business cycle dates does not mechanically drive the results.¹ If excess returns and output or consumption growth are perfectly correlated and the NBER defines a peak as a period followed by low growth, then the methodology would suffer from a severe look-ahead bias: the simple investment strategy would automatically deliver low excess returns at the start of recessions. Excess returns, however, exhibit a low correlation with consumption growth. In this case, simulations show that the look-ahead bias is limited, even if consumption growth is persistent.

We show that expected returns to stocks, adjusted for volatilities, are higher in recessions than in expansions in the USA and other OECD countries under feasible trading strategies that start shortly after turning points and involve holding periods of up to 1 year. Such changes in expected returns during business cycle expansions and contractions are not explained away by changes in near-term dividend growth rates.

The rest of the paper is organized as follows. Section 2 presents some evidence that agents in the economy can detect changes in the business cycle environment rather quickly and defines “real-time” recession dates. Section 3 shows that realized and expected excess returns are higher on average during recessions than expansions. Section 4 focuses on the dynamics of excess returns and Sharpe ratios during recessions and expansions. Section 5 disentangles the cash flow and risk premium effects. Section 6 reviews the literature. Section 7 concludes. A detailed Appendix is available online on the Science Direct website.

2. How to identify recessions?

Recessions and expansions are commonly defined in the USA and other OECD countries using the NBER and OECD methodologies.

¹ A detailed description of the simulations is available in a separate Online Appendix, along with the published paper on Science Direct.

2.1. NBER and OECD business cycle dates

The NBER was founded in 1920 and published its first business cycle dates in 1929. During the period 1961–1978, the U.S. Department of Commerce embraced the NBER turning points as the official record of U.S. business cycle activity, but the NBER made no formal announcements when it determined the dates of turning points. The Business Cycle Dating Committee was created in 1978, and since then there has been a formal process of announcing the NBER determination of a peak or trough in economic activity.²

The NBER defines a recession as a significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real Gross Domestic Product (GDP), real income, employment, industrial production, and wholesale-retail sales. A recession begins just after the economy reaches a peak of activity and ends as the economy reaches its trough. Between trough and peak, the economy is in an expansion. Importantly, the NBER Business Cycle Dating Committee states that it does not consider financial variables when choosing peaks and troughs, even though its members have undeniably observed asset prices when choosing peaks and troughs and could have been influenced by these prices.

To determine peaks and troughs, the OECD built on the NBER approach. Bry and Boschan (1971) have formalized the guidelines used by the NBER and incorporated them into a computer program. This routine is used for each OECD country. Its main input is the Industrial Production index (IP) covering all industry sectors excluding construction. This series is used because of its cyclical sensitivity and monthly availability, while the broad-based GDP is used to supplement the IP series for identification of the final reference turning points in the growth cycle. The OECD does not consider financial variables when choosing peaks and troughs. Moreover, the mechanical nature of the OECD procedure precludes the possibility that these turning points are chosen to match asset price fluctuations.

Clearly, the NBER and the OECD announce peaks and troughs with a delay. But the media and Internet searches suggest that investors learn about the aggregate state of the economy before the NBER and OECD announcements.

2.2. Real-time information

The most obvious way to get a broad sense of the business cycle environment is by reading print and online offerings. The upper panel of Fig. 1 reports the occurrence of the word “recession” in *The New York Times* and *The Washington Post*, along with NBER business cycle dates, over the last 30 years. At the start of each recession, there is a marked increase in the recession index. These changes are large and obvious. It takes only 2 months for the index to increase by one standard deviation above its expansion-implied mean. The second spike tends to come toward the end of the recessions, presumably because there is a debate about the end of a recession. Moreover, the NBER announcement of the peak (and hence the start of the recession), denoted as black bars, sparks many articles with the word “recession,” and these announcements tend to occur up to 12 months after peaks. In addition, the recession index decreases dramatically in the first quarters after the trough, suggesting that agents realize rather quickly that the economy is no longer in a recession. As is clear from Fig. 1, the NBER announcement of a trough is typically preceded by a large drop in the recession index.

The number of Google Insight searches of the word “recession” points to the same conclusion. The lower panel of Fig. 1 reports how many searches have been done for the term “recession,” relative to the total number of searches done on Google over time. These numbers do not represent absolute search volume numbers, because the data are normalized and presented on a scale from 0 to 100. These counts are only available starting in 2004, but they illustrate clearly that recessions are common knowledge well before the NBER or OECD announcements. Fig. 1 shows a huge spike in the Google search of the word “recession” in the USA in the last weeks of December 2007 and first weeks of January 2008. It actually became one of the most common searches on Google, more than 1 year before the NBER officially announced that the U.S. recession started in December 2007.

As investors learn about incoming recessions, they should rebalance their portfolios out of equity and into bond assets. High-frequency and long-term data on portfolio holdings are not available, but recent data on mutual funds flows suggest that investors indeed sell equity at the start of recessions and buy bonds. The Online Appendix reports the monthly net flows into U.S. long-term equity and bond mutual funds, as collected by the Investment Company Institute since 1984. Massive net outflows out of equity mutual funds occur at the start of the 2007–2009 recession. Net inflows in fixed income funds drop in the fall of 2008 and then largely rebound. There is thus some evidence that investors learn progressively about the state of the economy. They are not the only ones trying to figure out business cycles.

2.3. Mechanical recession rules

Evaluating the state of the economy in real time is a challenge that has sparked the interest of investors, many academics, and central bankers. To address this challenge, a large literature tests the mechanical rules for real-time assessments of where the economy stands in relation to the business cycle. Some authors, building on the work of Hamilton (1989) (see Hamilton, 2011 for a recent survey), estimate Markov-switching models using a small set of

² Those announcement dates were: June 3, 1980 for the January 1980 peak; July 8, 1981 for the July 1980 trough; January 6, 1982 for the July 1981 peak; July 8, 1983 for the November 1982 trough; April 25, 1991 for the July 1990 peak; December 22, 1992 for the March 1991 trough; November 26, 2001 for the March 2001 peak; July 17, 2003 for the November 2001 trough; and December 1, 2008 for the December 2007 peak.

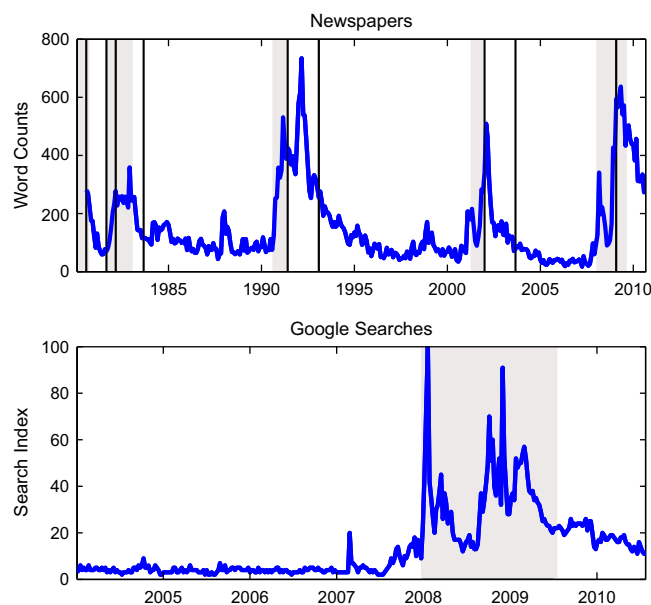


Fig. 1. "Recession" in the news. The upper panel reports the occurrence of the word "recession" in *The New York Times* and *The Washington Post* referring to the U.S., along with NBER business cycle dates. The source of word counts is Factiva and the sample is 1980.1–2010.6. Black bars correspond to NBER announcement dates. The lower panel reports the number of Google searches of the word "recession," along with NBER business cycle dates. These numbers do not represent absolute search volume numbers, because data are normalized and presented on a scale from 0 to 100. The source is Google Insights and the sample is 2004.1–2010.6.

macroeconomic variables. Others, building on the work of *Stock and Watson (1999)*, rely on large sets of macroeconomic and financial variables. We focus here on the two most successful attempts: *Chauvet and Piger's (2008)* real-time recession probabilities and the Chicago Fed index; both series are publicly available at a monthly frequency starting in 1967.

Real-time recession probabilities are available on the website of *Jeremy Piger* at the University of Oregon. They are obtained using a real-time dataset of coincident monthly variables and a parametric Markov-switching dynamic-factor model. The methodology is described in *Chauvet and Piger (2008)*, along with a detailed comparison of the implied business cycle dates and the NBER recession dates. Recession dates follow two simple rules: (1) a recession occurs when the recession probability is above 80% for three consecutive months, or (2) a recession occurs when the recession probability increases above 60% and lasts until the probability decreases below 30%. Both rules have been proposed in the literature.

The Chicago Fed index is a weighted average of 85 monthly indicators of national economic activity. The economic indicators are drawn from four broad categories of data: (1) production and income (23 series), (2) employment, unemployment, and hours (24 series), (3) personal consumption and housing (15 series), and (4) sales, orders, and inventories (23 series). None of the 85 components comes from equity or bond markets. Since January 2001, the Chicago Fed updates the index every month and sometimes re-estimates past values. Yet, vintage series, which are available on the Chicago Fed's website, are used in this paper to be as close as possible to real-time estimates. Recession dates as used by the Chicago Fed follow two simple rules: (1) a recession occurs when the index is below -0.7 and (2) a recession starts when the index falls below -0.7 and ends when the index increases above 0.2 . Finally, the information in the recession probabilities combined with the Chicago Fed index delivers another set of business cycle dates: a recession starts when the index is less than -0.7 and the probability above 60%; the recession ends when the index is above 0.2 and the probability below 30%. The Online Appendix reports the start and end of each recession according to these rules, along with NBER dates.

These rules are not perfectly "real-time" for three reasons. First, recession probabilities and indices were built after important econometric work that was certainly not known at the beginning of our sample. Second, in the case of the Chicago Fed index, the rule does not use vintage data prior to January 2001 (i.e., the first release of the index). Third, even if their estimation does not rely on NBER dates, these rules reflect the efforts of many researchers to propose business cycle dates that are as close as possible to the NBER dates. Nonetheless, the evidence from newspaper archives, Internet searches, portfolio rebalancing, and mechanical dates all point in the same direction: economic agents appear able to detect business cycle turning points that are close to the official dates and most of the time they do so before the actual NBER and OECD announcements. The behavior of asset prices across business cycles shows that knowing the state of the economy is key.

3. Measuring variation in returns from recessions to expansions

A simple description of average equity excess returns in each 3-month period following the NBER-defined recession and expansion dates already shows clear differences across business cycles; they become even stronger when the investment

horizon increases to 1 year. On average, realized excess returns are higher during recessions than during expansions. This is true when recessions are defined with NBER dates, as well as with real-time recession rules.

3.1. Quarterly realized returns across business cycles

Equity returns are obtained from the value-weighted index of the NYSE-AMEX-NASDAQ markets compiled by the Center for Research in Security Prices (CRSP), while risk-free rates correspond to returns on Treasury bill indices compiled by Global Financial Data. Table 1 describes the average realized returns across business cycles: it presents the average stock market excess returns in each 3-month period following the NBER peaks (left panel) and troughs (right panel), but does not include investments that start right at peaks or troughs. The table does not take into account the specific length of each recession or expansion: it simply reports excess returns in each of the five quarters that follow peaks and troughs. Data are monthly and the samples are 1925.12–2009.12, 1945.1–2009.12, and 1854.1–2009.12.

The standard errors are obtained by bootstrapping, using only the quarter under study (e.g., all first quarters after peaks): for each set of returns, 500 samples are built by drawing with replacement. This bootstrapping procedure thus takes as given the recession and expansion periods but captures the uncertainty stemming from the small samples of realized excess returns.

On average, excess returns are higher during recessions than expansions in the post-World War II samples, but not in the other samples. Excess returns tend to increase during recessions and decrease during expansions, but the short, one-quarter investment period implies lots of variation from one quarter to the next and no clear finding. A longer investment period of 1-year delivers much stronger results.

3.2. Average 1-year realized returns are higher in recessions

A 1-year investment exhibits clear business cycle frequencies. In expansions (recessions), 1-year investors buy the stock market index in the n th 3-month period after the NBER trough (peak) and sell it 1 year later. Table 2 reports summary statistics on the 1-year investments.

In the 1925.12–2009.12 sample, realized equity excess returns are equal to 9.1% during recessions and 5.7% during expansions. These averages are obtained by considering all the possible 1-year investments that follow peaks and troughs (i.e., $n=1, 2, \dots, \text{and } 5$). The difference between these two averages corresponds to approximately two standard errors.

Table 1

One-Quarter realized equity excess returns across business cycles: Monthly data.

The table reports moments of excess returns across business cycles: it presents the average stock market excess returns in each 3-month period following the NBER peaks (left panel) and troughs (right panel). Total return indices are compiled by CRSP. Risk-free rates correspond to returns on Treasury bill indices from Global Financial Data. Data are monthly. The samples are 1925.12–2009.12, 1945.1–2009.12, and 1854.1–2009.12. The table reports average excess returns (annualized, i.e., multiplied by 12), standard deviations (not annualized), and Sharpe ratios (annualized, i.e., multiplied by $\sqrt{12}$). Standard errors are obtained by bootstrapping.

	Recessions					Average	Expansions					Average
	<i>Buy in nth 3-month period after peak and sell one quarter later</i>						<i>Buy in nth 3-month period after trough and sell one quarter later</i>					
	1st	2nd	3rd	4th	5th		1st	2nd	3rd	4th	5th	
<i>Panel I: 1925.12–2009.12</i>												
Mean	–10.63	11.56	2.19	15.58	18.97	7.53	18.35	3.09	9.84	8.56	3.49	8.78
Standard error	[7.70]	[7.20]	[10.50]	[8.96]	[7.59]	[3.88]	[7.70]	[7.42]	[11.48]	[9.29]	[7.20]	[3.41]
Standard deviation	5.03	4.79	6.93	5.99	4.93	5.63	4.92	4.87	4.97	4.86	4.57	4.83
Standard error	[0.41]	[0.37]	[0.89]	[0.78]	[0.42]	[0.32]	[0.42]	[0.39]	[0.91]	[0.81]	[0.41]	[0.22]
Sharpe ratio	–0.61	0.70	0.09	0.75	1.11	0.39	1.08	0.18	0.57	0.51	0.22	0.52
Standard error	[0.43]	[0.48]	[0.45]	[0.43]	[0.47]	[0.21]	[0.43]	[0.50]	[0.50]	[0.44]	[0.45]	[0.21]
<i>Panel II: 1945.1–2009.12</i>												
Mean	–4.64	11.79	5.40	18.46	18.36	9.87	15.72	7.49	5.72	4.16	2.83	7.34
Standard error	[7.87]	[8.36]	[10.25]	[8.68]	[7.82]	[3.75]	[7.47]	[8.03]	[9.78]	[8.57]	[8.53]	[3.05]
Standard deviation	4.51	4.81	5.89	4.95	4.78	5.02	4.09	4.13	4.30	3.94	3.95	4.06
Standard error	[0.35]	[0.43]	[0.81]	[0.52]	[0.48]	[0.27]	[0.37]	[0.46]	[0.77]	[0.55]	[0.49]	[0.19]
Sharpe ratio	–0.30	0.71	0.26	1.08	1.11	0.57	1.11	0.52	0.38	0.30	0.21	0.52
Standard error	[0.52]	[0.57]	[0.54]	[0.55]	[0.51]	[0.22]	[0.49]	[0.55]	[0.52]	[0.53]	[0.56]	[0.22]
<i>Panel III: 1854.1–2009.12</i>												
Mean	–14.40	–2.21	1.30	10.56	11.76	1.40	19.10	7.27	9.75	11.64	10.61	11.71
Standard error	[5.79]	[10.79]	[5.69]	[4.89]	[4.44]	[2.99]	[5.86]	[10.17]	[5.94]	[4.85]	[4.15]	[2.04]
Standard deviation	5.35	10.09	5.56	4.80	4.06	6.37	4.32	4.06	4.23	3.98	3.94	4.11
Standard error	[0.58]	[3.83]	[0.56]	[0.51]	[0.27]	[1.13]	[0.56]	[3.71]	[0.58]	[0.53]	[0.28]	[0.15]
Sharpe ratio	–0.78	–0.06	0.07	0.64	0.84	0.06	1.28	0.52	0.66	0.84	0.78	0.82
Standard error	[0.29]	[0.39]	[0.30]	[0.28]	[0.32]	[0.15]	[0.30]	[0.36]	[0.31]	[0.28]	[0.30]	[0.15]

Table 2

One-year realized equity excess returns across business cycles: monthly data.

The table reports moments of excess returns obtained by the following investment strategy: in expansions (recessions), the investor buys the stock market index in the n th 3-month period ($n = 1, 2, \dots, 5$) after the NBER trough (peak) and sells 1 year later. Total return indices are compiled by CRSP. Risk-free rates correspond to returns on treasury bill indices from Global Financial Data. Data are monthly. The samples are 1925.12–2009.12, 1945.1–2009.12, and 1854.1–2009.12. The table reports average excess returns (annualized, i.e., multiplied by 12), standard deviations (not annualized), and Sharpe ratios (annualized, i.e., multiplied by $\sqrt{12}$). Standard errors are obtained by bootstrapping.

	Recessions					Average	Expansions					Average
	<i>Buy in nth 3-month period after peak and sell 1 year later</i>						<i>Buy in nth 3-month period after trough and sell 1 year later</i>					
	1st	2nd	3rd	4th	5th		1st	2nd	3rd	4th	5th	
<i>Panel I: 1925.12–2009.12</i>												
Mean	4.52	12.29	9.64	10.69	8.32	9.09	9.26	3.89	5.03	3.66	6.72	5.73
Standard error	[5.19]	[5.54]	[5.01]	[4.85]	[4.99]	[2.20]	[5.10]	[5.53]	[5.46]	[4.73]	[5.01]	[1.99]
Standard deviation	6.05	6.03	6.13	5.37	5.51	5.82	4.91	4.80	4.59	4.87	4.80	4.79
Standard error	[0.51]	[0.44]	[0.46]	[0.38]	[0.48]	[0.19]	[0.47]	[0.45]	[0.45]	[0.38]	[0.49]	[0.16]
Sharpe ratio	0.22	0.59	0.45	0.57	0.44	0.45	0.54	0.23	0.32	0.22	0.40	0.35
Standard error	[0.26]	[0.28]	[0.25]	[0.26]	[0.28]	[0.11]	[0.25]	[0.27]	[0.27]	[0.26]	[0.28]	[0.12]
<i>Panel II: 1945.1–2009.12</i>												
Mean	7.53	14.13	11.45	12.96	10.49	11.31	7.45	2.77	1.89	5.59	8.67	5.28
Standard error	[5.27]	[5.20]	[5.38]	[4.66]	[4.70]	[2.20]	[5.05]	[5.30]	[4.92]	[4.36]	[4.59]	[1.87]
Standard deviation	5.11	5.26	5.29	4.55	4.52	4.95	4.22	4.15	3.95	3.80	3.73	3.97
Standard error	[0.38]	[0.36]	[0.37]	[0.28]	[0.26]	[0.15]	[0.37]	[0.38]	[0.38]	[0.27]	[0.26]	[0.11]
Sharpe ratio	0.43	0.78	0.62	0.82	0.67	0.66	0.51	0.19	0.14	0.42	0.67	0.38
Standard error	[0.31]	[0.31]	[0.31]	[0.31]	[0.31]	[0.14]	[0.30]	[0.32]	[0.29]	[0.29]	[0.30]	[0.14]
<i>Panel III: 1854.1–2009.12</i>												
Mean	−2.86	4.31	7.27	8.35	8.24	5.06	10.96	8.46	8.39	6.45	5.72	8.00
Standard error	[4.51]	[4.13]	[3.00]	[2.90]	[2.67]	[1.54]	[4.46]	[4.31]	[2.96]	[2.55]	[2.68]	[1.11]
Standard deviation	7.39	7.16	4.95	4.46	4.53	5.85	4.22	4.13	4.06	4.23	4.34	4.19
Standard error	[1.70]	[1.69]	[0.29]	[0.24]	[0.30]	[0.60]	[1.72]	[1.84]	[0.28]	[0.24]	[0.31]	[0.10]
Sharpe ratio	−0.11	0.17	0.42	0.54	0.53	0.25	0.75	0.59	0.60	0.44	0.38	0.55
Standard error	[0.17]	[0.21]	[0.17]	[0.19]	[0.18]	[0.09]	[0.17]	[0.21]	[0.18]	[0.17]	[0.18]	[0.08]

However, realized equity returns are more volatile during recessions than expansions. This is consistent with previous results in the literature (see Schwert, 1989; Kandel and Stambaugh, 1990). But, despite this change in volatility, realized equity Sharpe ratios are higher during recessions: 0.45 vs. 0.35.

The 1945.1–2009.12 sample delivers similar results: during this period, the countercyclical nature of realized returns and Sharpe ratios is even stronger than in the previous sample. Realized equity excess returns are equal to 11.3% during recessions and 5.3% during expansions. The difference between these two averages corresponds to approximately three standard errors. Sharpe ratios are 0.66 during recessions and 0.38 during expansions.

Only the longest sample delivers excess returns that seem on average pro-cyclical. As shown in the next section, the pattern in Sharpe ratios inside each phase of the business cycle is similar in the long sample as in the others, and most of the difference is due to the length of recessions in each sample.

3.3. Sample selection bias

Overall, the first set of results shows a large difference between average realized excess returns during recessions and expansions. This variation, however, cannot be directly interpreted as time-varying risk premia (i.e., expected excess returns) because of a simple selection bias.

Investors do not perfectly know the state of the economy in real time. Instead, they assign a probability $p_{t,t+1}$ to the recession state of the world being realized at $t+1$: $p_{t,t+1}$ is thus the probability – estimated at date t – that the economy will be in a recession at date $t+1$. As new information becomes available, investors revise their estimates. During periods that are ex post identified as recessions, as new information becomes available, investors gradually learn that the economy is in a recession and $p_{t,t+1}$ converges to one. By conditioning on recessions, we focus only on those sample paths for which $p_{t,t+1}$ actually converges to one. This creates a sample selection bias.

Suppose that the recession risk premium is higher than the expansion risk premium. During the first quarters of periods that were ex-post identified as actual recessions, we expect to see price declines and hence negative realized equity returns, as $p_{t,t+1}$ increases to 1. However, we ignore those sample paths in which $p_{t,t+1}$ did not subsequently decrease. Hence, the sample averages of realized excess returns will understate the expected excess returns initially during recessions, provided that the true risk premium increases during recessions. Similarly, during the first quarters of periods that were ex post identified as actual expansions, we expect to see price increases and hence positive realized equity

returns, as $p_{t,t+1}$ increases to 0. Hence, the sample averages of realized equity excess returns will overstate the expected excess returns initially during expansions, provided that the true risk premium declines during expansion.

In the data, average realized equity excess returns are higher during recessions than expansions. The sample bias implies that realized equity excess returns will understate (overstate) the expected excess returns at the onset of recessions (expansions). As a result, the difference in expected excess returns between recessions and expansions is likely to be larger than the difference in average realized excess returns reported in Table 2.

3.4. What about expected returns?

Expected excess returns can actually be approximated with real-time recession dates in hand, computed from recession probabilities and the Chicago Fed index, and following the same investment strategy as above. The difference is that these returns are much closer to achievable; the investment strategy is almost implementable in real-time. Tables 3 and 4 report the results.

To establish a benchmark, Panel I of Table 3 summarizes the returns obtained with the NBER dates for the 1967.1–2009.12 period. Even on this short period, average returns are clearly higher during recessions than expansions: 4.9% vs. 2.1%. Due to the short sample size though, standard errors are quite large — up to 3.5%. But for all the dating procedures considered, equity excess returns are higher on average during recessions than during expansions, and for many of them, the difference in risk premia is actually larger than the difference in realized excess returns obtained with NBER dates.

Panels II and III of Table 3 report results using real-time recession probabilities. Using a simple rule with a single cutoff level, the average return is 11.4% in recessions compared to 4.8% in expansions. The difference is about two standard errors. Applying the two-cutoff rule, the average is 6.5% in recessions compared to 2.4% in expansions. In this case, the difference is only one standard error. Panels I and II of Table 4 report results using the Chicago Fed index. Using the one-cutoff rule, the average equity excess return is 7.0% in recessions compared to 4.5% in expansions. Using the two-cutoff

Table 3

One-year realized equity excess returns across business cycles: mechanical business cycle dates.

The table reports moments of excess returns obtained by the following investment strategy: in expansions (recessions), the investor buys the stock market index in the n th 3-month period ($n = 1, 2, \dots, 5$) after the trough (peak) and sells 1 year later. Six different sets of recession dates are used: the NBER dates, the Chauvet and Piger's (2008) probability-implied dates (using either one or two cutoff values to define recessions), the Chicago Fed index-implied dates (again using either one or two cutoff values to define recessions), and a combination of probability- and index-implied dates. Recessions are defined according to the following rules: (1) A recession starts when the recession probability stays above 80% for at least three consecutive months and ends when the recession probability falls below 80% (one cutoff); (2) a recession occurs when the recession probability increases above 60% and lasts until the probability decreases below 30% (two cutoffs); (3) a recession occurs when the Chicago Fed index falls below -0.7 for at least three consecutive months and ends when it climbs above -0.7 (one cutoff); (4) a recession starts when the Chicago Fed index falls below -0.7 and ends when it increases above 0.2 (two cutoffs); and (5) a recession starts and ends when both probability- and index-based criteria are satisfied (two cutoffs each). The data frequency is monthly. The sample runs from 1967.1 to 2009.12. The table reports the average excess return on this investment strategy (annualized, i.e., multiplied by 12), the standard deviation (not annualized), and the Sharpe ratio (annualized, i.e., multiplied by $\sqrt{12}$). Standard errors are obtained by bootstrapping.

	Recessions					Average	Expansions					Average
	<i>Buy in nth 3-month period after peak and sell 1 year later</i>						<i>Buy in nth 3-month period after trough and sell 1 year later</i>					
	1st	2nd	3rd	4th	5th		1st	2nd	3rd	4th	5th	
<i>Panel I: NBER dates, 1967.1–2009.12</i>												
Mean	–5.41	2.36	4.16	10.15	13.32	4.87	0.39	–1.96	1.14	2.30	8.63	2.07
Standard error	[7.57]	[8.37]	[8.49]	[6.67]	[6.14]	[3.40]	[7.38]	[8.17]	[8.40]	[6.72]	[6.40]	[2.47]
Standard deviation	5.94	6.25	6.19	5.14	4.88	5.71	4.48	4.20	4.02	3.62	3.54	3.98
Standard error	[0.49]	[0.49]	[0.50]	[0.34]	[0.35]	[0.23]	[0.51]	[0.49]	[0.50]	[0.37]	[0.33]	[0.17]
Sharpe ratio	–0.26	0.11	0.19	0.57	0.79	0.25	0.03	–0.13	0.08	0.18	0.70	0.15
Standard error	[0.38]	[0.39]	[0.41]	[0.38]	[0.37]	[0.17]	[0.36]	[0.38]	[0.40]	[0.38]	[0.39]	[0.18]
<i>Panel II: Chauvet and Piger's (2008): Probability-implied dates (one cutoff)</i>												
Mean	14.57	16.14	16.97	7.16	0.74	11.38	13.01	10.96	2.38	–1.90	–1.32	4.80
Standard error	[7.98]	[7.25]	[6.51]	[5.35]	[5.69]	[2.95]	[8.49]	[6.49]	[6.64]	[5.22]	[5.28]	[2.67]
Standard deviation	5.81	4.93	4.45	3.71	3.59	4.61	4.27	4.24	3.96	3.66	3.65	3.98
Standard error	[0.56]	[0.39]	[0.36]	[0.36]	[0.36]	[0.21]	[0.56]	[0.38]	[0.37]	[0.35]	[0.37]	[0.19]
Sharpe ratio	0.72	0.95	1.10	0.56	0.06	0.71	0.88	0.75	0.17	–0.15	–0.10	0.35
Standard error	[0.42]	[0.44]	[0.42]	[0.41]	[0.47]	[0.19]	[0.46]	[0.39]	[0.42]	[0.41]	[0.43]	[0.19]
<i>Panel III: Chauvet and Piger's (2008): Probability-implied dates (two cutoffs)</i>												
Mean	3.72	5.23	10.64	7.81	5.29	6.55	–0.82	–2.01	4.17	1.04	9.69	2.37
Standard error	[7.94]	[7.79]	[6.76]	[6.60]	[5.81]	[3.03]	[8.28]	[7.55]	[6.77]	[6.51]	[5.57]	[2.69]
Standard deviation	6.22	5.78	5.13	4.89	4.25	5.29	4.49	4.23	4.25	3.61	3.49	4.03
Standard error	[0.48]	[0.46]	[0.38]	[0.36]	[0.36]	[0.20]	[0.50]	[0.45]	[0.36]	[0.36]	[0.34]	[0.17]
Sharpe ratio	0.17	0.26	0.60	0.46	0.36	0.36	–0.05	–0.14	0.28	0.08	0.80	0.17
Standard error	[0.37]	[0.40]	[0.39]	[0.40]	[0.40]	[0.17]	[0.39]	[0.39]	[0.40]	[0.39]	[0.39]	[0.19]

Table 4

One-year realized equity excess returns across business cycles: mechanical business cycle dates, continued.

The table reports moments of excess returns obtained by the following investment strategy: in expansions (recessions), the investor buys the stock market index in the n th 3-month period ($n = 1, 2, \dots, 5$) after the trough (peak) and sells 1 year later. Six different sets of recession dates are used: the NBER dates, the Chauvet and Piger's (2008) probability-implied dates (using either one or two cutoff values to define recessions), the Chicago Fed index-implied dates (again using either one or two cutoff values to define recessions), and a combination of probability- and index-implied dates. Recessions are defined according to the following rules: (1) A recession starts when the recession probability stays above 80% for at least three consecutive months and ends when the recession probability falls below 80% (one cutoff); (2) a recession occurs when the recession probability increases above 60% and lasts until the probability decreases below 30% (two cutoffs); (3) a recession occurs when the Chicago Fed index falls below -0.7 for at least three consecutive months and ends when it climbs above -0.7 (one cutoff); (4) a recession starts when the Chicago Fed index falls below -0.7 and ends when it increases above 0.2 (two cutoffs); and (5) a recession starts and ends when both probability- and index-based criteria are satisfied (two cutoffs each). The data frequency is monthly. The sample runs from 1967:1 to 2009:12. The table reports the average excess return on this investment strategy (annualized, i.e., multiplied by 12), the standard deviation (not annualized), and the Sharpe ratio (annualized, i.e., multiplied by $\sqrt{12}$). Standard errors are obtained by bootstrapping.

	Recessions					Average	Expansions					Average
	Buy in n th 3-month period after peak and sell 1 year later						Buy in n th 3-month period after trough and sell 1 year later					
	1st	2nd	3rd	4th	5th		1st	2nd	3rd	4th	5th	
<i>Panel I: Chicago fed national activity index-implied dates (one cutoff)</i>												
Mean	8.62	5.80	10.93	7.60	1.66	6.98	3.40	1.54	4.04	3.98	9.45	4.48
Standard error	[6.52]	[6.53]	[5.80]	[5.42]	[4.91]	[2.52]	[6.68]	[6.50]	[5.86]	[5.18]	[4.73]	[2.32]
Standard deviation	5.36	5.42	4.74	4.30	3.80	4.76	4.34	4.07	3.70	3.56	3.62	3.86
Standard error	[0.42]	[0.44]	[0.33]	[0.32]	[0.29]	[0.18]	[0.47]	[0.43]	[0.35]	[0.34]	[0.29]	[0.14]
Sharpe ratio	0.46	0.31	0.67	0.51	0.13	0.42	0.23	0.11	0.32	0.32	0.75	0.33
Standard error	[0.36]	[0.36]	[0.35]	[0.37]	[0.38]	[0.16]	[0.38]	[0.36]	[0.36]	[0.35]	[0.36]	[0.17]
<i>Panel II: Chicago fed national activity index-implied dates (two cutoffs)</i>												
Mean	-5.92	3.55	8.41	10.42	6.16	4.49	3.00	1.75	0.83	4.80	6.24	3.33
Standard error	[8.15]	[8.14]	[7.09]	[6.99]	[5.98]	[3.37]	[8.39]	[8.21]	[6.71]	[7.17]	[5.85]	[2.26]
Standard deviation	6.38	6.18	5.35	5.10	4.49	5.55	3.64	3.40	3.40	3.54	3.59	3.50
Standard error	[0.49]	[0.51]	[0.35]	[0.37]	[0.30]	[0.20]	[0.50]	[0.49]	[0.35]	[0.33]	[0.32]	[0.15]
Sharpe ratio	-0.27	0.17	0.45	0.59	0.40	0.23	0.24	0.15	0.07	0.39	0.50	0.27
Standard error	[0.37]	[0.38]	[0.39]	[0.41]	[0.39]	[0.18]	[0.39]	[0.39]	[0.37]	[0.42]	[0.38]	[0.18]
<i>Panel III: Probability- and index-implied dates</i>												
Mean	9.03	7.53	9.99	3.07	2.05	6.43	-0.82	-2.01	4.17	1.04	9.69	2.37
Standard error	[7.40]	[6.67]	[6.33]	[5.63]	[5.69]	[3.01]	[7.19]	[6.36]	[6.61]	[5.60]	[5.72]	[2.50]
Standard deviation	5.54	5.05	4.79	4.31	4.13	4.79	4.49	4.23	4.25	3.61	3.49	4.03
Standard error	[0.48]	[0.35]	[0.36]	[0.32]	[0.34]	[0.18]	[0.50]	[0.36]	[0.37]	[0.36]	[0.34]	[0.16]
Sharpe ratio	0.47	0.43	0.60	0.21	0.14	0.39	-0.05	-0.14	0.28	0.08	0.80	0.17
Standard error	[0.41]	[0.39]	[0.39]	[0.38]	[0.41]	[0.18]	[0.40]	[0.37]	[0.41]	[0.38]	[0.41]	[0.18]

rule, it is 4.5% vs. 3.3%. When combining both recession probabilities and the Chicago Fed index (see Panel III in Table 4), average equity returns are equal to 6.4% during recessions vs. 2.4% during expansions. They translate into Sharpe ratios that are mildly countercyclical: high during recessions (0.39) and lower during expansions (0.17).

Recession probabilities and coincident indices suggest that agents are able to figure out the state of the economy well in advance of NBER announcements. If that is the case, then the realized excess returns are measures of *expected* excess returns, and thus risk premia. Such risk premia are clearly on average higher during recessions than expansions. We now show that these average returns hide some even larger dynamics along business cycles.

4. Investor returns during recessions and expansions

Realized and expected excess returns offer contrasted dynamics *inside* each phase of the business cycle.

4.1. Realized equity returns

Table 2 reports averages across recessions and expansions, as well as summary statistics on each investment that starts in the n th 3-month period after the NBER trough (peak) and ends 1 year later.

The right-hand side of Table 2 presents data on expansions. In the 1945.1–2009.12 (1925.12–2009.12) sample, the average returns, conditional on being in an expansion, decline from 7.5% (9.3%) in the first quarter after the trough to 1.9% (5.0%) in the third quarter after the trough. Standard errors on average excess returns are large (around 5%), and such changes are almost statistically significant. After three quarters, average returns tend to increase again.

The volatility of stock returns tends to decline slightly during expansions, from 4.2% (4.9%) in the first quarter to 3.7% in the last quarter (4.8%). Volatility is measured as the standard deviation of the monthly returns over the investment period

and is not annualized. It is admittedly a crude measure of stock return volatility, but higher frequency data deliver similar results.³

After three quarters, it seems fair to assume that investors know that the economy is in an expansion. The average return of 4.0% (5.0%) in the third quarter after a trough can thus be interpreted as a measure of the conditional expected excess return on U.S. equities in expansions.

The left-hand side of Table 2 reports data on recessions. In the 1945.1–2009.12 (1925.12–2009.12) sample, average realized returns conditional on being in a recession increase from 7.5% (4.5% in the whole sample) in the first quarter after a peak to 13.0% (10.7%) in the fourth quarter after a peak. The variation in the second moment of returns is much smaller.⁴ After four quarters, again, it seems fair to conclude that investors know that the economy is in a recession. The average return of 13.0% (10.7%) in the fourth quarter after a peak can thus be interpreted as a measure of the conditional expected excess return on U.S. equities in recessions.

Because of the dynamics of excess return during each phase of the business cycle, a large difference in the aggregate compensation per unit of risk appears: the Sharpe ratio is 0.14 (0.32 in the whole sample) in the midpoint of the expansions examined, compared to 0.82 (0.57) in the midpoint of a recession. Fig. 2 illustrates the substantial variation in realized Sharpe ratios in the post-WWII sample. The realized Sharpe ratio increases monotonically from one quarter into a recession to reach a maximum of 0.82 four quarters into a recession, and it declines during expansions from 0.51 in the first quarter into an expansion to reach a minimum of 0.14 three quarters into an expansion.

4.2. Robustness checks

The sample in the first two panels of Table 2 contains only 16 business cycles and thus offers a limited number of observations. Looking back to the nineteenth century or studying foreign countries extends the sample: those two robustness checks lead to consistent results.

There are 32 business cycles in the NBER data, which starts in 1854. Sixteen of these cycles took place before 1919. By including this earlier period, the number of observations double. However, using a longer period also adds structural breaks: since 1915, the nature of NBER business cycles has changed. The length of recessions has shortened dramatically. The average number of months from peak to trough decreased from 22 between 1854 and 1915, to 18 between 1919 and 1945, and to 10 months between 1945 and 2009. The average length of expansions has increased from 27 months in the first part of the sample, to 35 months in the interwar, and to 57 months in the post-war sample.

The 1854–1944 period delivers similar dynamics as in the previous, more recent samples. In the pre-WWII sample (not reported), the conditional Sharpe ratio decreases from 0.88 in the first quarter after the trough to 0.26 five quarters later. It increases from -0.29 in the first quarter after the peak to 0.44 five quarters later. In the whole sample (1854.1–2009.12), the same patterns emerge. Realized Sharpe ratios vary dramatically over the business cycle: one quarter after the turning points, Sharpe ratios are up to 0.75 during expansions and down to -0.11 during recessions. These differences are clearly significant as standard errors hover around 0.2. Sharpe ratios become close only four quarters after the turning points. It takes longer for Sharpe ratios to increase after peaks and to decrease after troughs in the pre-WWII than in the post-WWII sample. It would not be unreasonable to assume that it took longer for agents to learn about the state of the economy pre- than post-WWII.

Equity returns in G7 countries and OECD business cycle dates offer a second robustness check. The time-period (1955.1–2010.8) is defined by the availability of the OECD turning points. To save space, detailed results are reported in the Appendix. In all the G7 countries, the Sharpe ratios tend to increase during recessions and decrease during expansions. In all G7 countries except Germany, the Sharpe ratios in the middle of recessions (e.g., 12 months after peaks) are higher than in the middle of expansions. This is also true on average across all G7 countries.

4.3. Expected equity excess returns

Similar findings also emerge with real-time recession dates. As in the previous section, recessions are defined using monthly probabilities and the Chicago Fed index. Again, Tables 3 and 4 report averages across recessions and expansions along with the whole dynamics of returns and Sharpe ratios inside each phase of the business cycle.

As a comparison point, realized equity excess returns increase sharply during NBER recessions, from -5.4% at a peak to 13.3% five quarters later (see Panel I of Table 3). The standard errors obtained by bootstrapping are large because of the sample size. Yet, with an average around 8% , these standard errors still imply significant variation in equity excess returns

³ Daily returns are available from CRSP starting in 1925. Equity volatility can thus be obtained as the standard deviation of daily equity returns over each calendar month. The Online Appendix reports moments of this equity volatility measure across business cycles, along with moments of equity excess returns and Sharpe ratios over two samples: 1925.12–2009.12 and 1945.1–2009.12. In both samples, the same pattern as in Table 2 emerges.

⁴ The volatility of stock returns tends to increase initially during recessions, but then it declines slightly. Higher frequencies deliver a similar pattern, but this variation in volatility does not appear significant. However, there is a clear difference in volatilities between the mid-point of a recession and the mid-point of an expansion: 4.5% (5.4%) in a recession and 4.0% (4.6%) in an expansion.

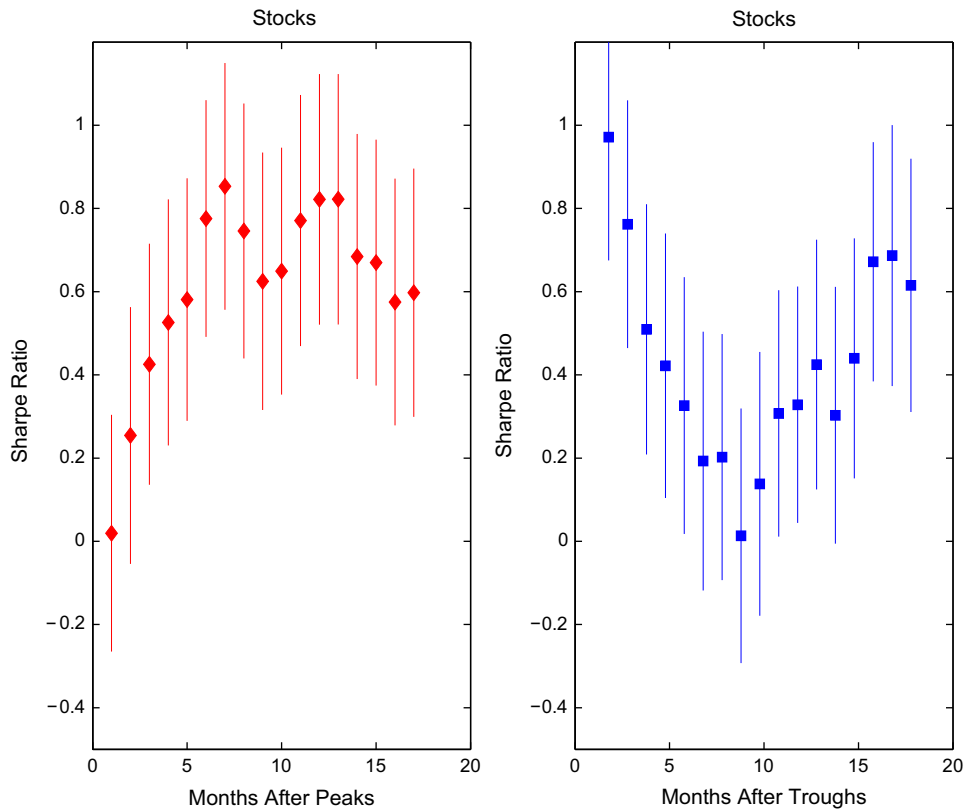


Fig. 2. One-Year realized U.S. equity Sharpe ratios across business cycles. This figure plots the conditional realized Sharpe ratio for 1-year excess returns on U.S. equity during NBER recessions and expansions. Investors buy m months after the start of an NBER recession (expansion) and hold for 1 year. The diamonds correspond to recessions (left panel) and the squares to expansions (right panel). The sample is 1945.1–2009.12. Vertical bars correspond to one standard error above and below point estimates.

along the business cycle. Realized equity excess returns increase slightly from 0.4% at a trough to 1.1% three quarters later, although this variation is not significant. Average returns increase again four and five quarters after the trough to reach 8.6%. This is similar to the findings in other samples. Four quarters into a recession, excess returns are on average equal to 10.1%, while they are equal to 1.1% three quarters into an expansion.

Panels II and III of Table 3 report results obtained with Chauvet and Piger (2008) probability-implied dates (using one and two cutoffs). As noted before, recession probabilities imply a clearly higher average excess returns in recessions than in expansions. Inside each phase of the business cycle, the dynamics, however, are less clear than in the longer sample. The one-cutoff rule delivers decreasing Sharpe ratios during expansions, but the two-cutoff rule does not. Inversely, the two-cutoff rule leads to increasing Sharpe ratios during recessions, but the one-cutoff rule does not, simply delivering very large Sharpe ratios in the first four quarters of recessions. These results are not surprising: the one-cutoff rule calls a recession after three consecutive months of high recession probabilities (above 0.8), while the one-cutoff rule signals it as soon as the probability increases above 0.6. As a result, the two-cutoff recession dates occur after their one-cutoff counterparts: later into a recession, risk premia are higher. But comparing again the midst of a recession to the midst of an expansion delivers clear results: excess returns are on average equal to 7.1% (7.8% with two cutoffs) four quarters into a recession, while they are equal to 2.4% (4.2%) three quarters into an expansion.

Panels I and II of Table 4 reports results obtained with the Chicago Fed-implied dates. Realized excess returns increase from -5.9% to 6.2% from the peak to five quarters later. They decrease from 3.0% at the trough to -0.8% three quarters later, and then increase back to 6.2% five quarters after the peak. For the same reason as above, the one-cutoff dates deliver large excess returns in the first quarters of recessions. And again, the midst of a recession leads to much higher excess returns than the midst of an expansion. Similar results appear when combining recession probabilities and the Chicago Fed index.

Overall, the patterns obtained with alternative real-time recession rules are quite similar to those obtained with benchmark NBER dates. As in longer samples, equity excess returns are clearly higher in the midst of recessions than in the midst of expansions. They tend to increase during recessions and decrease during expansions, although these higher frequency dynamics appear less clearly on a shorter sample.

5. Cash flows or discount rates?

The large difference between expected excess returns and Sharpe ratios in expansions vs. recessions points to time-varying risk premia as an important driver of equity prices. Yet, a second mechanism also drives changes in equity prices: revisions in expected future dividend growth rates.

5.1. Cash flow evidence

Expected future dividend growth rates also depend on the state of the business cycle. Table 5 reports the conditional moments of those future real dividends, using the same methodology as for excess returns in the previous sections. The dividend growth rate dated t corresponds to the percentage increase in aggregate dividends between t and $t + 12$. Averages are obtained on three samples (1925.12–2009.12 in Panel I, 1945.1–2009.12 in Panel II, and 1967.1–2009.12 in Panel III). Two findings emerge: average 12-month dividend growth rates are lower during recessions than expansions, and they tend to increase from the start to the end of recessions.

In the longer sample, the average 12-month real dividend growth rate is 2% during recessions vs. 6.8% during expansions. The same results appear in the shorter samples: 2.6% vs. 5.3% for the post-WWII sample and -1% vs. 4.5% for the post-1967 sample.

During recessions, growth rates increase from -2.7% (not reported) to 4.3% from the peak to five quarters later. Similar patterns appear on the shorter samples, with increases from -1.3% to 4.7% and from -5.9% to 2.7%. If investors revise their expectations according to the same schedule, stock prices should increase during recessions, delivering positive returns. Lower than expected cash flows at the start of recessions could explain the low excess returns measured in the previous section. Likewise, higher than expected future cash flows could deliver higher returns further away from the peak of the business cycle. Part of the variation on realized excess returns could thus correspond to cash flow effects, not risk premia.

During expansions, the patterns are less clear. Dividend growth rates are essentially flat in our entire sample, but increase in our post-WWII samples. They vary from 6.9% (at the peak, not reported) to 6.8% in the whole sample; increasing from 3.9% to 5.9% post-war, and from 0.6% to 6.4% post 1967. The increase is only significant in the shortest sample. Such increases should also lead to higher returns. Here, those cash flow effects reinforce the previous results (i.e., the decreases in realized equity excess returns during expansions). Such decreases are all the more surprising since they occur during periods when cash flow growth rates are revised upwards. As a result, these decreasing equity excess returns are accompanied by large decreases in equity risk premia during expansions.

5.2. Variance decomposition in recessions

The case of recessions deserves further scrutiny. Although expected returns increase during recessions, expected dividend growth rates also increase during recessions. As a result, these dynamics do not clearly indicate whether equity

Table 5

One-year realized dividend growth across business cycles.

This table reports the average annual dividend growth rates across different periods that start in the n th 3 months after NBER troughs (peaks) and end 1 year later. Annual nominal dividend growth rates are obtained from monthly CRSP equity return series including and excluding dividends. Consumer Price Index series from CRSP are used to obtain real dividend growth rates. Data are monthly and the three samples are 1925.12–2009.12 in Panel I, 1945.1–2009.12 in Panel II, and 1967.1–2009.12 in Panel III. Standard errors are obtained by bootstrapping.

	Recessions					Average	Expansions					Average
	Start in n th 3-month period after peak and ends 1 year later						Start in n th 3-month period after trough and ends 1 year later					
	1st	2nd	3rd	4th	5th		1st	2nd	3rd	4th	5th	
<i>Panel I: 1925.12–2009.12</i>												
Mean	−1.03	0.60	3.22	3.25	4.27	2.02	7.43	7.41	6.97	5.99	6.31	6.82
Standard error	[1.23]	[1.21]	[1.40]	[1.27]	[1.61]	[0.62]	[1.31]	[1.38]	[1.39]	[1.38]	[1.56]	[0.65]
Standard deviation	17.14	17.27	18.65	18.26	20.36	18.42	19.70	19.26	17.78	16.65	20.20	18.73
Standard error	[1.08]	[1.11]	[1.73]	[1.76]	[1.81]	[0.70]	[1.06]	[1.04]	[1.87]	[1.86]	[1.79]	[1.11]
<i>Panel II: 1945.1–2009.12</i>												
Mean	0.45	1.14	3.31	3.55	4.68	2.59	4.65	5.13	5.86	4.96	5.88	5.30
Standard error	[1.36]	[1.34]	[1.44]	[1.33]	[1.53]	[0.63]	[1.36]	[1.52]	[1.55]	[1.45]	[1.56]	[0.69]
Standard deviation	16.50	16.99	17.75	16.11	17.45	16.99	16.62	16.89	17.79	15.97	20.94	17.68
Standard error	[1.15]	[1.18]	[2.09]	[2.28]	[1.95]	[0.84]	[1.17]	[1.20]	[2.14]	[2.25]	[2.20]	[1.40]
<i>Panel III: 1967.1–2009.12</i>												
Mean	−3.62	−3.48	−1.04	1.05	2.73	−0.99	2.61	3.75	5.10	4.77	6.37	4.52
Standard error	[1.51]	[1.56]	[1.56]	[1.57]	[1.75]	[0.71]	[1.51]	[1.51]	[1.52]	[1.62]	[1.75]	[0.84]
Standard deviation	13.87	13.71	13.61	13.86	15.15	14.18	14.72	14.63	14.92	14.26	23.21	16.66
Standard error	[1.37]	[1.27]	[1.31]	[1.27]	[1.32]	[0.56]	[1.29]	[1.29]	[1.29]	[1.15]	[1.30]	[2.35]

Table 6

Return predictability in NBER recessions.

This table reports estimation results for the following pair of regressions:

$$r_{t+1} = a + (b_r + b_r^{rec} \times rec) \tilde{d}p_t + \varepsilon_{t+1},$$

$$\Delta d_{t+1} = a + (b_d + b_d^{rec} \times rec) \tilde{d}p_t + \varepsilon_{t+1},$$

where *rec* denotes NBER recession dummies, r_{t+1} denotes logs of the real return on the CRSP value-weighted index, Δd_{t+1} denotes real dividend growth, and $\tilde{d}p_t$ denotes the break-adjusted dividend yield. Columns (1) and (2) exclude the NBER recession dummies in the regression. Column (3) and (4) include the NBER recession dummies in the regression. Data are annual and the sample is 1927–2009. OLS *t*-stats are reported in brackets; White *t*-stats are reported in parenthesis. The last two rows of each panel report the R^2 s of these regressions and the infinite-horizon regression coefficient ($b/(1-\rho\phi)$) defined by Cochrane (2008), assuming that the dividend yield follows an AR(1). The mean ρ of the dividend yield is 0.9650 and its persistence ϕ is 0.7684.

	<i>r</i>	Δd	<i>r</i>	Δd
<i>Panel I: 1927–2009</i>				
	(1)	(2)	(3)	(4)
<i>b</i>	0.267 [3.118] (3.667)	0.039 [0.624] (0.736)	0.175 [1.827] (2.510)	0.034 [0.474] (0.583)
b^{rec}			0.411 [2.029] (2.067)	0.023 [0.151] (0.170)
R^2	0.107	0.005	0.151	0.005
$b/(1-\rho\phi)$	103%	–15%		
<i>Panel II: 1945–2009</i>				
<i>b</i>	0.300 [3.445] (3.959)	0.110 [1.707] (1.797)	0.219 [2.352] (3.005)	0.070 [0.993] (1.026)
b^{rec}			0.461 [2.092] (1.794)	0.229 [1.380] (1.823)
R^2	0.159	0.044	0.214	0.073
$b/(1-\rho\phi)$	116%	–0.42%		

prices are driven mostly by cash flow or discount rate news during recessions. There might be reasons to believe that cash flow news account for most of the variation in prices during recessions, while discount rates account for most of the variation in normal times. To the contrary, a classic variance decomposition of dividend yields shows that stock return predictability actually increases in recessions, while cash flow predictability does not.

This conclusion emerges from standard regressions of log real returns and log dividend growth on the log of the dividend yield, in which the slope coefficients depend on the state of the economy. The annual dividend yield (D_t/P_t) is obtained by dividing the cum dividend return by the ex dividend return. Lower cases denote logs.⁵ The recession dummy, denoted *rec*, is 1 if the U.S. economy is in an NBER recession in December of that same year. Table 6 reports regression results of returns or dividend growth in the following year (from January to December) on the dividend yield in December and the dividend yield interacted with the recession dummy in December. The results thus correspond to the following regressions:

$$r_{t+1} = a + (b_r + b_r^{rec} \times rec_t) \tilde{d}p_t + \varepsilon_{t+1}, \quad (1)$$

$$\Delta d_{t+1} = a + (b_d + b_d^{rec} \times rec_t) \tilde{d}p_t + \varepsilon_{t+1}. \quad (2)$$

The first panel of Table 6 pertains to the full sample (i.e., 1927–2009). The first two columns report results obtained when excluding the recession dummies. An increase in the dividend yield of 10% increases the expected return by 2.67 percentage points (pps) per annum (column 1). A one-standard deviation change in the log dividend yield increase is 27%. Put differently, an increase of 100 bps in the dividend yield increases the expected return by more than 700 bps, given that the mean log dividend yield is 3.75%. The adjusted dividend yield explains 10% of the variation in subsequent annual returns in the stock market. On the other hand, the dividend growth regression in column (2) shows very little cash flow predictability. An increase in the dividend yield of 10% increases expected dividend growth by 0.39 bps per annum. Hence, the slope coefficient does not have the expected sign. This is a classic result, derived from the log-linearization of the return equation around the mean log price/dividend ratio:

$$r_{t+1} = \Delta d_{t+1} + \rho p d_{t+1} + k - p d_t, \quad (3)$$

⁵ See the Online Appendix for historical times series of the dividend yield. The dividend yield drifts downward after 1990. Following Lettau and Van Nieuwerburgh (2008), the estimation thus allows for a break in the dividend yield in December 1991.

where ρ is a linearization coefficient that depends on the mean of the log price/dividend ratio pd : $\rho = (e^{pd}/e^{pd} + 1) < 1$. By iterating forward on the log-linearized expression for returns, the variance of the dividend yield equals:

$$\text{var}[dp_t] = \text{cov}\left(dp_t, \left[\sum_{j=1}^{\infty} \rho^{j-1} \Delta r_{t+j}\right]\right) - \text{cov}\left(dp_t, \left[\sum_{j=1}^{\infty} \rho^{j-1} \Delta d_{t+j}\right]\right). \quad (4)$$

Assuming, as in Cochrane (2008), that the dividend yield follows an AR(1), the equation above implies a cross-equation restriction in the estimated slope coefficients: $(b_r/1 - \rho\phi) - (b_d/1 - \rho\phi) = 1$. This cross-equation restriction is not imposed in the estimation of the return and dividend growth regressions, but its first component is 103%, implying that all of the variation in the dividend yield is accounted for by discount rates.

Regression results in column (3) of Table 6 allow the slope to shift with the state of the U.S. economy. The slope increases by 0.411 in recessions. Hence, a 10% increase in the dividend yield increases expected returns by 5.60 pps in a recession, compared to only 1.75 pps in an expansion. The slope coefficient triples in recessions. These estimates imply an expected return of 19.3% in December of 2008, almost two standard deviations above the sample mean of 8%.

Hence, the conditional covariance between the dividend yield and future returns

$$\text{cov}_t\left(dp_t, \left[\sum_{j=1}^{\infty} \rho^{j-1} \Delta r_{t+j}\right]\right)$$

increases during recessions to 220% of its value for the entire sample if one assumes that the same AR (1) parameter ρ applies. However, it seems reasonable that the persistence of the dividend yield is actually smaller when it comes to these cyclical variations in risk premia. If the persistence of the dividend yield ϕ drops from 0.77 to 0.46, then the ratio is still 100%. There is no evidence that cash flows become more important in recessions.

Panel II of Table 6 reports results for the 1945–2009 period. These results are stronger. The total effect on expected returns of a 10% increase in the dividend yield in recessions is 6.70 pps. The slope coefficient in the dividend growth predictability regression still has the wrong coefficient, and it increases in recessions. These post-war estimates imply an expected return of 23.1% in December of 2008, more than two standard deviations above the post-war sample mean of 6.44%.

Predictability regressions thus reinforce the prominent role of business cycle variation in risk premia reported in the paper. Cash flow news do not seem to be able to explain the whole variation in the risk-return tradeoff along the business cycle. Simulations from a simple toy model reinforces this point.

5.3. Simulations

Imagine the following mechanical link: assume (i) that excess returns and business cycles are correlated and (ii) that the NBER defines a peak as a period followed by low growth. Then, peaks would correspond to low excess returns and would be followed by higher excess returns. But this finding – driven by a look-ahead bias in the definition of peaks and troughs – would purely reflect changes in future cash flows, not risk premia. Simulations, however, show that the look-ahead bias is very limited if one takes into account the empirically low correlation between realized equity returns and consumption growth. In the interest of space, the simulations are described in the Online Appendix.

What is the bottom line? Assume that the Bry-Boschan algorithm (used to determine peaks and troughs) implies a two-quarter look ahead bias, then it would take a very large sample to convincingly show that the investment strategy implies two negative (positive) returns after peaks (troughs). Moreover, the look-ahead bias would not affect strategies that start more than two periods after the turning points. Yet, the empirical findings reported in this paper do not disappear after two periods and pertain to small samples. The largest difference between excess returns in recessions and expansions actually appears four quarters after the peaks and troughs.

The evidence reported here thus suggests a large role to time-varying risk premia in determining business cycle variation in equity prices. This finding relates to a large literature in macro-finance.

6. Literature review

A large literature explores the predictability of equity excess returns (see Lettau and Ludvigson, 2009 for a survey and recent evidence). The consensus is that excess returns appear somewhat predictable, especially at horizons equal to or above 1 year. Predictability results, however, depend on samples and predictors and they often rely on sophisticated econometric techniques. This paper takes a different, more simple approach. We study *realized* excess returns and show that they are on average a good measure of *expected* excess returns. The exercise is worth entertaining because of its focus on excess returns at precise points in business cycles: the quarters that follow the peak of a cycle and thus signal the start of a recession and the quarters that follow the trough of a cycle and thus signal the start of an expansion. As a result, the paper focuses on excess returns *conditional* on the state of the economy. These turning points are informative about marginal utility growth. Cochrane (2007) summarizes it very clearly, “The challenge is to find the right measure of “bad

times,” rises in the marginal value of wealth, so that we can understand high average returns or low prices as compensation for assets tendency to pay off poorly in bad times.” Our paper seeks to address this key challenge.

Building on the predictability literature, a few papers investigate the cyclicity of excess returns and the dynamics of the Sharpe ratio. Fama and French (1989) find that default spreads, a business conditions variable, predict equity and bond returns, as does the dividend yield, which they interpret as a proxy for long-term business conditions. They conclude that the implied variation in expected excess returns is largely common across securities and is negatively related to long- and short-term business conditions. Ferson and Harvey (1991) plot expected equity excess returns along with NBER recession dates and note that risk premia increase during recessions and peak near business cycle troughs. Harrison and Zhang (1999) report that non-parametric estimates of conditional mean excess returns are negatively correlated with proxies for the business cycle. Campbell and Diebold (2009) reach a similar conclusion using the Livingston business conditions survey data. Backus et al. (2010) report the correlation at different leads and lags between monthly equity returns and industrial production growth over the period from 1960 to 2008. They find that high excess returns are associated with high future growth. Lettau and Ludvigson (2009) measure the conditional Sharpe ratio on U.S. equities by forecasting stock market returns and realized volatility using different predictors. They obtain highly countercyclical and volatile Sharpe ratios and show that neither the external habit model of Campbell and Cochrane (1999) nor the long run risk model of Bansal and Yaron (2004) deliver volatile enough Sharpe ratios to match the data. Using a latent VAR process, Brandt and Kang (2004) also find a highly countercyclical Sharpe ratio. Ludvigson and Ng (2007) reach the same conclusion using a large number of predictors in a dynamic factor analysis. However, Goyal and Welch (2008) stress the poor out-of-sample performance of many of these predictors. They conclude that these predictors would have been of little help to actual investors using real-time data.

We do not use any predictors or high-powered econometrics but take a broad and long-term perspective, going back to the nineteenth century in the U.S. and studying several developed economies. By focusing on the turning points of each cycle, we recognize the limited number of recessions in any sample and favor a simple procedure that can be easily replicated. The results highlight strong links between business cycles characterized by real macro-economic variables and equity returns and thus depart from sentiment-based explanations of asset markets (see notably Long et al., 1990; Baker and Wurgler, 2006).

7. Conclusion

To study the cyclicity of expected returns without committing to one dynamic asset pricing model, we focus on realized excess returns conditional on NBER business cycle dates. Realized excess returns proxy well for their expected counterparts, since mechanical, real-time recession dates deliver similar results. Empirically, average equity excess returns are higher during recessions than during expansions, and averages hide much larger variation during each phase of the business cycle, implying large changes in Sharpe ratios. The findings imply that value-maximizing managers face much higher risk-adjusted cost of capital in their investment decisions during recessions than expansions.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.jmoneco.2012.11.003>.

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