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Sentiment, Productivity, and Economic Growth

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ABSTRACT

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Sentiment, productivity, and economic growth[†]

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Abstract

Previous research finds correlation between sentiment and future economic growth, but disagrees on the channel that explains this result. In this paper, we shed new light on this issue by exploiting cross-country variation in sentiment and market efficiency. We find that sentiment shocks in G7 countries increase economic activity, but only temporarily and without affecting productivity. By contrast, sentiment shocks in non-G7 countries predict prolonged economic growth and a corresponding increase in productivity. The results suggest that sentiment can indeed create economic booms, but only in less advanced economies where noisy asset prices make sentiment and fundamentals harder to disentangle.

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1. Introduction

A growing body of evidence shows that business cycles are mainly driven by expectations (see, e.g., Beaudry and Portier (2014) for an excellent review). The underlying idea is intuitive and actually rather old. For example, Pigou (1927) suggests that economic fluctuations are directly caused by businessmen's beliefs, so that booms and busts are related to bouts of optimism and pessimism. Similarly, Keynes (1936) proposes the notion that "animal spirits" lie at the core of economic activity. However, the exact channel through which expectations affect the macroeconomy is not entirely clear.

In this respect, previous literature has proposed three competing hypotheses. First, optimism is the result of a positive signal (or "news") over future fundamentals, so that positive sentiment anticipates economic growth but does not cause it (see, e.g., Beaudry and Portier (2004, 2006, 2014); Barsky and Sims (2012)). Second, macroeconomic mood swings have no relation with economic fundamentals and, therefore,

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only create short-lived economic fluctuations (see, e.g., Akerlof and Shiller (2009)). Third, sentiment has a direct effect on future fundamentals through a self-fulfilling feedback loop, thus creating immediate and lasting economic growth (see, e.g., Benhabib and Farmer (1994); Benhabib et al. (2015); Benhabib et al. (2016); Shiller (2017)). To a large extent, these hypotheses are difficult to disentangle empirically (see, e.g., Beaudry et al. (2011)).

In this paper, we propose a novel solution to this problem. Benhabib et al. (2016) develop a theoretical model where stock market prices represent a noisy signal for future economic prospects. In the presence of high noise, sentiment and fundamentals become harder to tease out. As a result, sentiment-driven fluctuations in asset prices lead to self-fulfilling business cycles. In our analysis, we test these predictions in a cross-country setting. We hypothesize that countries that are less advanced also feature less efficient financial markets. Therefore, for economic agents in these countries, it is harder to distinguish purely psychological mood swings in sentiment from rational expectations. As a result, the effect of sentiment on economic growth should be more pronounced.

Using data for a sample of sixteen OECD countries over the period 1975-2019, we find strong support for our predictions. In large and advanced economies which we identify as G7 countries (see, e.g., Colacito et al. (2018)), we find that sentiment shocks increase consumption, employment, and income, but only in the short run and without affecting future productivity. In non-G7 countries on the other hand, sentiment shocks lead to prolonged economic booms and correspondingly predict an increase in productivity. The results suggest that less advanced economies are indeed more likely to mistake sentiment for genuine information, which leads to a large increase in economic growth.

We also shed light on the economic channel that underlies our results. First, we test the prediction that a wave of sentiment should be followed by a subsequent mispricing correction (see, e.g., Baker and Wurgler (2006)). Consistent with this channel, we find that sentiment shocks are negative predictors of future equity returns. Interestingly, stock markets in G7 countries exhibit a much faster mispricing correction which lends support to our conjecture that such markets are indeed more efficient than their non-G7 counterparts. Second, we test the prediction that rational managers exploit mispricing by engaging in market timing (see, e.g., Baker et al. (2003)). Consistent with this hypothesis, we find that sentiment shocks create a short-term increase in capital investments and their associated internal rate of return.

Beaudry et al. (2011) find that consumer confidence shocks predict economic growth in the U.S. and suggest that further research is needed to understand whether the effect is driven by economic news or genuine sentiment. Benhabib and Spiegel (2019) propose a novel strategy to address this issue. While previous literature analyzes individual countries or blocks of countries (see, e.g., Beaudry and Portier (2014); Dees (2017)), they exploit cross-sectional variation in local sentiment across U.S. states and find that exogenous shocks to state-level sentiment are followed by higher short-run economic growth.

In a similar vein, we exploit cross-country variation in sentiment in our analysis. This strategy grants us two important advantages. First, it allows us to test a specific channel through which sentiment affects

economic growth, i.e., a decrease in the local cost of capital due to the overpricing of stocks. Second, we study how differences in market efficiency across countries affect the speed (and magnitude) of mispricing correction and the extent to which economic agents mistake sentiment for economic fundamentals. Our focus on the unique cross-sectional predictions of the sentiment story is in line with previous sentiment literature (see, e.g., Baker and Wurgler (2006, 2007); Baker et al. (2012)) and addresses the concern that sentiment may capture unobserved economic shocks (Cochrane (1994)).

Previous studies find that the impact of sentiment shocks on economic growth is only temporary (Starr (2012); Benhabib and Spiegel (2019)) and small (Ludvigson (2004); Barsky and Sims (2012)). To the best of our knowledge, our paper is the first to show that sentiment can create long-lasting economic booms, as predicted by theory (see, e.g., Benhabib et al. (2016); Acharya et al. (2021)). The key difference between our results and theirs is that we consider cross-country differences in sentiment and market efficiency instead of focusing on individual countries. Our findings also suggest that sentiment affects the real economy through equity markets, which lends novel support to the idea that the financial sector can influence economic growth (see, e.g., Levine (2005)).

Since stock prices contain information about future productivity (Beaudry and Portier (2006)), it is possible to identify short- and long-run shocks by regressing the growth rate of productivity on lagged country-specific price-dividend ratios (Colacito and Croce (2011); Bansal et al. (2016)). Colacito et al. (2018) interpret the residuals from this regression as shocks to the unanticipated component of productivity and innovations to the price-dividend ratio as shocks to the expected component of productivity. As in Beaudry and Portier (2006), the latter represents pure long-run news shocks because asset prices shocks do not immediately affect the growth rate of productivity.

In this paper, we extend this framework to incorporate the idea that stock prices partly reflect investor sentiment in financial markets (see, e.g., Hirshleifer (2001); Baker and Wurgler (2006, 2007); Baker et al. (2012)). In the absence of sentiment, stock prices bring about an efficient allocation of economic resources by signaling relevant information to economic agents (see, e.g., Hayek (1945); Grossman and Stiglitz (1980)). When sentiment is present, however, the informational role of financial markets in allocating resources can become impaired, creating distortions in corporate financing and investment (Lamont and Stein (2006)). Theory predicts that this channel should ultimately affect economic growth (Benhabib et al. (2016)).

To test this hypothesis, we augment the model from Colacito et al. (2018) by proposing a decomposition of the country-level price-dividend ratio into a sentiment and a fundamental component. Specifically, we define the former as the fitted values of a regression of the price-dividend ratio on local sentiment. The residuals from this regression, on the other hand, represent the fundamental component, i.e., the part of the price-dividend ratio that reflects long-run economic news. Overall, then, we identify a productivity shock, a sentiment shock, and a news shock.[1]

[1]The analysis of Colacito et al. (2018) focuses on two major economic blocks, namely, the US and G7 countries (considered as a whole). By contrast, we consider several individual countries from the OECD (including, but not limited to, the U.S. and

To identify sentiment in the analysis, we consider the country-specific consumer confidence index from the OECD. This measure is based on surveys and captures short-term economic expectations among the households of a given country. As such, it represents the cross-country counterpart to the U.S. consumer confidence index from the Conference Board. Both the U.S. and the international version of this index have been used extensively in the finance literature as a proxy for biases in investor expectations (see, e.g., Lemmon and Portniaguina (2006); McLean and Zhao (2014); Montone and Zwinkels (2020)).[2] The advantage of using the consumer confidence index is that it is the only widely-recognized measure of sentiment that is available at the country-level for a large set of countries.

The main hurdle in this empirical exercise is the distinction between sentiment, i.e., a genuine bias in economic expectations, and news over future fundamentals (see, e.g., Beaudry et al. (2011)). To address this point, our procedure is threefold. First, we orthogonalize sentiment to income, consumption, and employment shocks to purge the index from a potential business cycle component (see, e.g., Baker and Wurgler (2006)). Second, we acknowledge that if sentiment exerts a causal effect on growth, it should predict an immediate and long-lasting increase in economic growth and productivity (Barsky and Sims (2012)). Third, we run our empirical tests using a panel of countries to exploit cross-sectional variation in local sentiment and market efficiency.

Another potential issue is that local sentiment may partly reflect the level of sentiment of U.S. or global investors (Baker et al. (2012); Montone and Zwinkels (2020)). This is a particularly pressing concern in light of the positive correlation between global sentiment and economic growth in a number of advanced economies (Dees (2017)). While this issue is hard to tackle in a single-country setting, our panel analysis enables us to purge the local (and orthogonalized) consumer confidence index from the effect of either U.S. or global sentiment by simply using year fixed effects.[3] In addition, we also introduce country fixed effects to capture the potential impact of time-invariant country characteristics on our estimates.

We begin the empirical analysis by estimating the test equation for productivity growth from Colacito et al. (2018), augmented with the aforementioned price-dividend decomposition into a sentiment and a fundamental component. The results reveal a clear picture. In the subsample of G7 countries, the fundamental component of the price-dividend ratio has strong predictive power over future productivity growth. Among non-G7 countries, it is the sentiment component that predicts future productivity. The latter result suggests that sentiment may generate endogenous growth in less advanced economies.

To shed further light on this issue, we acknowledge that sentiment-driven endogenous growth requires immediate and protracted economic booms (Barsky and Sims (2012)). We find evidence consistent with this prediction. Sentiment shocks predict large growth in consumption, employment, and income among non-G7

G7 countries). Therefore, we estimate country-level idiosyncratic shocks.

[2]From a theoretical perspective, the intuition is that the representative agent is simultaneously both a consumer and an investor, which implies an overlap between consumer and investor sentiment. As a result, either measure represents a proxy for the distortion of the marginal investor's beliefs about the future payoffs of financial assets (see, e.g., Shefrin (2008)).

[3]This specification also captures the potential confounding effect of U.S. or global business cycles.

countries for up to four years into the future. For G7 countries, on the other hand, the effect is smaller and vanishes within two years. Taken together, the results suggest that sentiment shocks are uncorrelated with economic fundamentals in G7 countries, as they only create short-term fluctuations unrelated to productivity. Conversely, sentiment seems to generate self-fulfilling feedback loops in non-G7 countries.

In the last part of the paper, we analyze the economic channel that underlies our results. To this end, we test two specific predictions of the sentiment story. First, a wave of positive sentiment should create overpricing and then be followed by a subsequent price correction (see, e.g., Baker and Wurgler (2006)). Consistent with this hypothesis, we find that sentiment shocks predict negative equity returns. We also find that mispricing correction is faster and smaller in G7 countries, which indicates the presence of stronger arbitrage forces and lower initial mispricing. These results provide further support to our conjecture that G7 markets are indeed more efficient.

Second, we test the prediction that rational managers carry out their capital investments during waves of high sentiment in an attempt to exploit the lower cost of capital generated by stock overpricing (see, e.g., Baker et al. (2003)). Consistent with this view, we find that sentiment shocks are indeed followed by an increase in capital growth and its associated internal rate of return. The effect takes place within one year, which lends support to the idea that managers rationally exploit the mispricing as soon as it arises. The results are stronger for non-G7 countries, which is in line with our findings that stock prices in these markets include a larger mispricing component.

Our findings make several contributions to the literature. Barsky and Sims (2012) show that sentiment-driven growth should be characterized by a fast and substantial increase in economic activity and a corresponding increase in productivity through learning-by-doing or some similar endogenous growth channel. In their empirical analysis, they find that this channel is not operational in the US. In our paper, we obtain a similar result for G7 countries. However, we find that sentiment shocks are followed by a substantial and prolonged increase in economic activity as well as productivity in non-G7 countries. For the latter subsample, then, sentiment seems to generate endogenous growth.

Previous research shows that the financial sector can affect the real economy through the financing of capital (see, e.g., Bernanke and Gertler (1989); Kiyotaki and Moore (1997)) and the production of information about investment opportunities (see, e.g., Levine (2005)). Our findings suggest that sentiment operates through both channels. First, we show that sentiment shocks affect capital financing by decreasing the local cost of equity. Second, we find evidence that sentiment shocks hinder the production of information in less advanced capital markets, where economic agents seem to mistake genuine sentiment for a signal about better investment opportunities.

The findings also speak to the relation between sentiment and managerial market timing. When investor optimism boosts company valuations in financial markets, corporate managers rationally take advantage of the lower cost of equity by timing their investments or issuing new shares (see, e.g., Morck et al. (1990); Stein (1996); Baker and Wurgler (2000, 2002); Baker et al. (2003); Polk and Sapienza (2009), McLean and

Zhao (2014)). Arif and Lee (2014) show that high sentiment also increases aggregate investment in the US. In this paper, we find that this channel is also operational in a large sample of OECD countries.

Finally, we acknowledge that models of trade for non-informational reasons make similar predictions to sentiment models. For example, Campbell et al. (1993) show that changes in the level of risk aversion for a large subset of investors can affect short-term equity returns and then the cost of capital for firms. This alternative interpretation of investor behavior is closer in nature to the idea of animal spirits, but also partly overlaps with the modern concept of investor sentiment (see, e.g., Baker and Wurgler (2006)). Overall, the difference between changes in risk aversion and shifts in sentiment appears to be more philosophical than economic (Tetlock (2007)), and, therefore, does not substantially alter the interpretation of our results.

The paper proceeds as follows. We introduce the data and methodology in Section 2, present the empirical results in Section 3, and offer some concluding remarks in Section 4.

2. Data and methodology

The sample includes data for sixteen OECD countries over the period 1975-2019.[4] The macroeconomic variables are from the Penn World Table V.10. The price-dividend ratio is retrieved from Kenneth French's website for foreign countries and Robert Shiller's website for the US. Consumer sentiment data is from the OECD.

Previous research warns that sentiment measures may partly reflect economic fundamentals and should then be orthogonalized to macroeconomic indicators (Baker and Wurgler (2006, 2007); Baker et al. (2012)). In this paper, we follow the same strategy. We also purge our local sentiment measures from the effect of time-invariant country-specific characteristics through country fixed effects, as well as a variety of global patterns (e.g., global business cycles and/or sentiment) through year fixed effects.

We start with the following sentiment decomposition:

$$S_{c,t} = S^{E}_{c,t} + S^{\perp}_{c,t}, \tag{1}$$

where $S_{c,t}$ is sentiment in country c at time t, $S^{E}_{c,t}$ is the sentiment component explained by economic fundamentals, and $S^{\perp}_{c,t}$ is the sentiment component that is orthogonal to fundamentals. Specifically, the two components come from the following panel regression:

$$S_{c,t} = \alpha_c + \alpha_t + \delta' Z_{c,t} + \epsilon_{c,t}, \tag{2}$$

where $Z_{c,t}$ is a vector that includes innovations in local real GDP, consumption, and employment, whereas α_c and α_t respectively represent country and year fixed effects. The fitted values from this regression constitute the explained sentiment component ($S^{E}_{c,t} \equiv \widehat{S}_{c,t}$), whereas the residuals are the unexplained component ($S^{\perp}_{c,t} \equiv S_{c,t} - \widehat{S}_{c,t}$). In the analysis that follows, we simply refer to the latter as "sentiment".

Table 1 presents some summary statistics. On average, we find that non-G7 countries exhibit slightly

[4]The countries are Australia, Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, New Zealand, Spain, Sweden, Switzerland, United Kingdom, and United States.

higher sentiment than G7 countries, along with higher values of the price-dividend ratio and total factor productivity growth. They also exhibit higher rates of growth for real GDP, consumption, and employment. The empirical pattern is similar when considering medians instead of means, which suggests that these estimates are not driven by outliers. In the analysis that follows, we shed more light on these relations.

[Table 1 here]

To identify the aforementioned productivity, news, and sentiment shocks, we proceed as follows. As in previous literature, we model future country-level productivity growth as a function of lagged price-dividend ratios (Colacito and Croce (2011); Bansal et al. (2016); Colacito et al. (2018); Constantinides and Ghosh (2021)):

$$\Delta a_{c,t+h} = \alpha_c + \alpha_t + \beta_a PD_{c,t} + \epsilon^a_{c,t+h}, \tag{3}$$

where $h = 1, 2, 3, 4$, i.e., we measure productivity one, two, three, and four years ahead. The residuals from this regression represent shocks to the unanticipated component of productivity. Since we consider individual economies rather than blocks of countries, we also include country and year fixed effects.

Previous literature defines long-run news shocks as innovations to the price-dividend ratio (Beaudry and Portier, 2006), expressed as an AR(1) process (Colacito et al. (2018)). These are shocks to the expected component of productivity growth. In our paper, we refine this measure to incorporate the idea that stock prices partly reflect investor sentiment in financial markets (see, e.g., Hirshleifer (2001); Baker and Wurgler (2006, 2007); Baker et al. (2012)). We propose a decomposition of the country-level price-dividend ratio into a sentiment and a fundamental component:

$$PD_{c,t} = PD^s_{c,t} + PD^f_{c,t}, \tag{4}$$

which we estimate through the following panel regression of the price-dividend ratio on sentiment:

$$PD_{c,t} = \alpha_c + \alpha_t + \beta_p S^{\perp}_{c,t} + \epsilon^p_{c,t}, \tag{5}$$

where the sentiment component of the price-dividend ratio is defined as the fitted values from the regression ($PD^s_{c,t} \equiv \widehat{PD}_{c,t}$), whereas the residuals are the fundamental component ($PD^f_{c,t} \equiv PD_{c,t} - \widehat{PD}_{c,t}$), i.e., the part of the price-dividend ratio that reflects long-run economic news.

As with the raw price-dividend ratio, we assume that both its sentiment and its fundamental component also follow an AR(1) process:

$$PD^s_{c,t} = \alpha_c + \alpha_t + \rho_s PD^s_{c,t-1} + \epsilon^s_{c,t}, \tag{6}$$

$$PD^f_{c,t} = \alpha_c + \alpha_t + \rho_f PD^f_{c,t-1} + \epsilon^f_{c,t}. \tag{7}$$

The residuals from these regressions represent a sentiment shock ($\epsilon^s_{c,t}$), and a news shock ($\epsilon^f_{c,t}$), respectively.

Overall, then, we derive two test equations. The first one is a regression of productivity growth on the sentiment and fundamental components of the price-to-dividend ratio:

$$\Delta a_{c,t+h} = \alpha_c + \alpha_t + \beta^s_a PD^s_{c,t} + \beta^f_a PD^f_{c,t} + \epsilon^a_{c,t+h}, \tag{8}$$

where $h = 1, 2, 3, 4$. It is easy to see that the decomposition of the price-dividend ratio from Eq. 4 is equivalent to a decomposition into its lagged value and lagged country-level sentiment (see Appendix A for details). Therefore, Eq. 8 can alternatively be rearranged as:

$$\Delta a_{c,t+h} = \alpha_c + \alpha_t + \beta_1 PD_{c,t-1} + \beta_2 S^{\perp}_{c,t-1} + \epsilon^a_{c,t+h}. \tag{9}$$

The second test equation is a regression of macroeconomic outcomes on productivity, long-run news, and sentiment shocks:

$$g_{c,t+h} = \alpha_c + \alpha_t + \beta^a_g \epsilon^a_{c,t} + \beta^f_g \epsilon^f_{c,t} + \beta^s_g \epsilon^s_{c,t} + u_{c,t+h}, \tag{10}$$

where $g_{c,t+h}$ represents the growth rate of real GDP, consumption, or employment, and again $h = 1, 2, 3, 4$. In less advanced economies, we expect sentiment to exert a positive effect on productivity ($\beta^s_a > 0$), as well as economic growth ($\beta^s_g > 0$). Conversely, the effect of sentiment on growth should be limited in advanced economies, as efficient financial markets exhibit a superior ability to disentangle sentiment from genuine economic news.

In the analysis that follows, we take these predictions to the data.

3. Empirical analysis

We present our empirical findings as follows. In Section 3.1, we estimate the relation between price-dividend ratios and future productivity. In Section 3.2, we study how the estimated shocks lead to economic growth. Finally, we test two specific predictions of the sentiment hypothesis in Section 3.3.

3.1. Price-dividend ratios and future productivity

Original model

We start the empirical analysis by estimating Eq. 3, i.e., the original test equation from Colacito et al. (2018) that includes the raw price-dividend ratio. The estimates are in Table 2. Consistent with their results, we find a positive relation between the lagged price-dividend ratio and productivity growth among advanced economies. To get a sense of the magnitude, a one-standard-deviation increase in the price-dividend ratio is associated with an increase in productivity growth, although marginally significant, of 5.85% over the subsequent year (t-stat 1.93).

[Table 2 here]

The estimates becomes statistically stronger when we estimate productivity farther into the future. They are equal to 5.98% two years ahead (t-stat 2.11), 6.12% three years ahead (t-stat 2.27), and 6.01% four years ahead (t-stat 2.32). This empirical pattern is consistent with the idea that the price-dividend ratio indeed contains long-run news over productivity growth. Interestingly, the coefficient of the raw price-dividend ratio is not significant for non-G7 countries at any maturity. This result suggests that capital markets are less efficient in the latter subsample, as hypothesized.

In untabulated tests, we also find similar estimates when using the growth rate of welfare-relevant total factor productivity which is calculated using prices that are more relevant to consumers rather than firms (see, e.g., Basu et al. (2012)).

Model with sentiment

To look further into the hypothesis that non-G7 markets are less efficient, we perform the sentiment decomposition of the price-dividend ratio into a fundamental and a sentiment component from Eq. 4. Therefore, we estimate Eq. 8. The results are in Table 3. For G7 countries, we find that the coefficient of the fundamental component of the price-dividend ratio is similar in magnitude and statistical significance to that of the raw price-dividend ratio from Table 2. Specifically, a one-standard-deviation increase in the fundamental component of the price-dividend ratio is associated with an increase in productivity of 4.52% over the subsequent year (t-stat 1.95). On the other hand, the coefficient of the sentiment component is close to zero.

[Table 3 here]

In non-G7 countries, the empirical pattern is reversed. The coefficient of the fundamental component of the price-to-dividend ratio is close to zero in both magnitude and significance, whereas the coefficient of the sentiment component is large, positive, and highly significant. Specifically, a one-standard-deviation increase in the sentiment component is associated with an increase in productivity of 18.84% over the subsequent year (t-stat 3.43).

The analysis of future productivity at farther horizons reveals another interesting empirical pattern. The estimates become again statistically stronger over time for G7 countries. A one-standard-deviation increase in the fundamental component of the price-dividend ratio is followed by an increase in productivity growth of 4.62% two years ahead (t-stat 2.14), 4.71% three years ahead (t-stat 2.31), and 4.63% four years ahead (t-stat 2.38). Conversely, the effect of the sentiment component of the price-dividend ratio becomes progressively weaker for non-G7 countries and equal to 17.37% two years ahead (t-stat 2.83), 16.00% three years ahead (t-stat 2.34), and 13.84%, although marginally significant four years ahead (t-stat 1.70).

The results are consistent with our theoretical arguments in two ways. First, the fundamental component of stock prices incorporates relevant information on long-run productivity growth in more advanced economies. Second, sentiment in less advanced economies predicts an increase in productivity, as expected. This lends support to the prediction that sentiment constitutes an important catalyst for economic growth among less advanced economies due to their less efficient financial markets. The large magnitude of the coefficient is also consistent with the prediction that sentiment-driven economic growth is characterized by a large short-run jump (see, e.g., Barsky and Sims (2012)). Importantly, the effect seems to vanish rather than strengthen over time, which is in line with the volatile nature of sentiment.

Next, we estimate Eq. 9 which includes the alternative decomposition of the price-dividend ratio into its

lagged value and lagged country-level sentiment. The results are in Table 4. Attesting to the validity of the decomposition, we obtain an analogous empirical pattern. The coefficient of lagged sentiment only explains future productivity in non-G7 countries and its effect decreases over time. For these countries, then, the results suggest that $\rho_s > \rho_f$ (see Appendix A). This seems to reflect two facts that characterize less efficient financial markets. First, they are slower to incorporate fundamental information into the price-dividend ratio, which lowers ρ_f. Second, and somewhat related, they are slower to arbitrage sentiment away, which increases ρ_s.

[Table 4 here]

Overall, the predictive power of sentiment over future productivity, along with its decreasing magnitude over time, suggests that sentiment in less advanced economies may affect future fundamentals by generating endogenous growth. If so, however, we should also observe immediate and lasting economic booms following sentiment shocks (Barsky and Sims (2012)). We test this prediction in the analysis of economic growth, in Section 3.2 below.

Additional tests

One potential concern with these results is that the U.S. may partly drive the estimates for the G7 subsample, due to its highly-efficient financial market (see, e.g., Rajan and Zingales (1998)), and leading role in the world economy (Harvey (1991); Campbell and Hamao (1992); Kwark (1999); Kim (2001)); Lumsdaine and Prasad (2003)) and financial markets (Albuquerque et al. (2009); Baker et al. (2012); Rapach et al. (2013)). Also, the calculation of total factor productivity uses the U.S. as the reference country.

To address these issues, we repeat the analysis by excluding the U.S. from the sample. The results are in Table 5. Reassuringly, we find that the estimates are similar in both magnitude and statistical significance. For non-U.S. G7 countries, a one-standard-deviation increase in the fundamental component of the price-dividend ratio is followed by an increase in productivity growth of 4.56% (t-stat 1.95), 4.66% (t-stat 2.14), 4.75% (t-stat 2.31), and 4.66% (t-stat 2.38) for time horizons of one, two, three, and four years ahead, respectively. The coefficient of the sentiment component, on the other hand, is insignificant.

[Table 5 here]

For non-G7 countries, the pattern is again reversed. The sentiment component of the price-dividend ratio predicts an increase in future productivity of 14.44% (t-stat 3.47), 13.30% (t-stat 2.87), 12.24 (t-stat 2.36), and 10.59% (t-stat 1.72) for each of the four years ahead, respectively. The pattern is also decreasing over time, consistent with the sentiment story. By contrast, the fundamental component of the price-dividend ratio has no explanatory power over future productivity.

The absence of an empirical relation between fundamentals and future productivity in non-G7 countries

deserves further attention. Since these countries are relatively smaller and less advanced economies, they rely comparatively more on foreign investments to thrive (see, e.g., Albuquerque et al. (2005)) and acquire know-how (see, e.g., Hummels et al. (2001)). As a result, their country-specific economic fundamentals might be less relevant to productivity than the fundamentals of more advanced economies. To test this conjecture, we repeat the analysis by adding a regressor that represents the average (and standardized) fundamental component of the price-dividend ratio across G7 countries. Since this is a pure time-series variable, we need to drop year fixed effects from this analysis.

The results are in Table 6. We find that the country-specific fundamental component of the price-dividend ratio continues to have no predictive power over future productivity in non-G7 countries. Conversely, the coefficient of the average fundamental component of the price-dividend ratio for G7 countries is positive and highly significant for all time horizons. Interestingly, this effect has a similar economic magnitude to the one we find for G7 countries in our previous analyses. The results lend support to our conjecture that it is aggregate economic fundamentals from G7 countries that affect productivity in non-G7 countries rather than country-specific fundamentals.

[Table 6 here]

Financial development

Another concern is that the groups of G7 and non-G7 countries might be heterogeneous to some extent, which blurs the distinction between more and less advanced economies. To address this issue, we perform an additional test of our hypothesized mechanism using the full sample without any breakdown into country groups. Our theoretical arguments imply that sentiment should be easier to distinguish from fundamentals in financially developed economies. Therefore, the effect of sentiment on future productivity should decrease with a country's degree of financial development.

To test this conjecture, we estimate an augmented version of Eq. 8, introducing an interaction term between our independent variables and country-level financial development. To identify the latter, we follow the methodology from Rajan and Zingales (1998). Among the measures they propose, we choose stock turnover over GDP and GDP per capita as they are the ones for which we have the most observations in our sample. We take their country-level averages at the beginning of the sample period (1975-1990), and re-estimate our augmented test equation in the subsequent period (1991-2019).

The results are in Table 7. We find strong evidence for our predictions. In Panel A, a one-standard-deviation increase in a country's ratio between stock turnover and GDP is associated with a decrease in the effect of the sentiment component of the price-dividend ratio on future productivity of 0.60% (t-stat -3.16), 0.54% (t-stat -3.12), 0.43% (t-stat -3.07), and 0.35% (t-stat -2.84) for each of the four years ahead, respectively. The pattern is again decreasing over time, consistent with the transient nature of sentiment.

[Table 7 here]

In Panel B, we obtain a similar empirical pattern when we define a country's degree of financial development as GDP per capita. Interestingly, the magnitude of the effect is similar across the two financial development measures and also mirrors the estimates for the non-G7 subsample from Table 3, which suggests that it is less advanced economies that drive these results.

Eurozone

Finally, we attempt to identify a shock to market efficiency by considering the introduction of the euro for the European Monetary Union, also known as "Eurozone". The adoption of a common currency implied a common monetary policy for all the participating countries, managed by the European Central Bank, and a lengthy and onerous process of preparation where signatories "have to bring their national legislation in line with relevant EU law and meet specific conditions designed to ensure economic convergence." [5]

The creation of the euro as a single currency officially took place on January 1, 1999, after a seven-year convergence effort started with the 1992 Maastricht Treaty. The euro has since improved financial development within the Eurozone (Bris et al. (2006, 2009)), with a corresponding increase in trade, output, and income per capita (Frankel and Rose (2002)). Eurozone countries have then become larger and more financially developed. In our setup, this implies that their productivity should become less sensitive to sentiment and more sensitive to fundamentals after 1999.

To test this conjecture, we estimate another augmented version of Eq. 8, where we include two additional explanatory variables. First, we introduce a dummy variable that takes on value one for countries that are among the original signatories to the Eurozone agreement, and zero otherwise.[6] Second, we include a dummy variable that takes on value one for the period that follows the official launch of the euro on January 1, 1999, and zero otherwise.

The results are in Table 8. We include G7 countries in Panel A, and non-G7 countries in Panel B. For the relatively less advanced Eurozone countries (non-G7), we find strong evidence consistent with our conjecture. After the introduction of the euro, the productivity of these Eurozone members exhibits a weaker relation with the sentiment component of the price-dividend ratio and a stronger relation with the fundamental component. On the other hand, neither of these two effects is present among the more advanced Eurozone economies (G7).

[Table 8 here]

These additional results mirror those from the analysis of financial development in Table 7, thereby providing further support to the mechanism we hypothesize.

[5] See https://economy-finance.ec.europa.eu/euro/enlargement-euro-area/convergence-criteria-joining_en.

[6] The countries in our sample that are original members of the Eurozone are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, and Spain. Conversely, none of the countries that entered the Eurozone after 1999 are in our sample.

3.2. Sentiment shocks and economic growth

To study the effect of sentiment shocks on economic growth, we estimate Eq. 10. We start from the analysis of consumption growth. The results, reported in Table 9, indicate that sentiment shocks are positively associated with future consumption growth. When measuring consumption one year ahead, the effect is similar across G7 and non-G7 countries. Following a one-standard-deviation sentiment shock, consumption growth increases by 0.52% among the former (t-stat 2.88) and 0.46% among the latter (t-stat 2.75).

[Table 9 here]

At longer horizons, however, the sentiment effect is much stronger for less advanced economies. Among G7 countries, a one-standard-deviation sentiment shock is followed by an increase in consumption growth of 0.37% two years ahead (t-stat 8.50), whereas the effect becomes insignificant and close to zero three and four years ahead. Among non-G7 countries, the magnitude of the effect is 0.71% two years ahead (t-stat 6.14) and, therefore, almost twice as large as that from G7 countries. Also, the effect is still large and highly significant three years ahead and equal to 0.45% (t-stat 4.79). Four years ahead, the effect drops to 0.16% and loses its statistical significance (t-stat 1.40).

In Table 10, we repeat the analysis for employment growth. We find a similar empirical pattern, although the difference in estimates between G7 and non-G7 countries becomes even more pronounced. Following a one-standard-deviation sentiment shock, employment growth increases by 0.16% among G7 countries (t-stat 2.45). Among non-G7 countries, the effect is almost four times as large and equal to 0.59% (t-stat 4.72).

[Table 10 here]

The effect is again stronger for less advanced economies at longer horizons. Among G7 countries, a one-standard-deviation sentiment shock is followed by an increase in employment growth of 0.13% two years ahead (t-stat 3.13), whereas the effect becomes effectively zero in both magnitude and significance three and four years ahead. Among non-G7 countries, the effect is significant all throughout. The magnitude is 0.50% two years ahead (t-stat 4.81), 0.35% three years ahead (t-stat 3.61), and 0.13%, although marginally significant, four years ahead (t-stat 1.92).

Among the other coefficients of interest, we find that productivity shocks consistently predict higher employment growth. The effect, however, is more persistent for advanced economies, as the coefficient is highly significant up to four years ahead. For less advanced economies, the effect vanishes after two years. The results are consistent with our previous findings that productivity in non-G7 countries also largely depends on sentiment, so that the explanatory power of pure productivity shocks on future growth is relatively limited in these economies.

The coefficient of long-run news shocks also exhibits an interesting pattern. Among G7 countries, a one-standard-deviation news shock is associated with an immediate and highly significant decrease in employment

growth of 0.25% (t-stat -2.27). Among non-G7 countries, the effect of long-run news shocks on employment growth is close to zero in both magnitude and significance at all maturities. It seems then that positive long-run news shocks make it optimal for companies in advanced economies to hire less domestically, a finding consistent with the analysis of capital outflows from Colacito et al. (2018).

Finally, we study the relation between sentiment shocks and real GDP growth, which represents one of the most comprehensive indicators of a country's economic performance. The results are in Table 11. We find again a similar empirical pattern. Following a one-standard-deviation sentiment shock, one-year-ahead GDP growth increases by 0.32% among G7 countries (t-stat 7.78). The effect is almost twice as large among non-G7 countries and equal to 0.62% (t-stat 6.75). At longer horizons, the estimates are not significant and close to zero for G7 countries. For non-G7 countries, the estimates are significant and equal to 0.36% two years ahead (t-stat 3.96), 0.24% three years ahead (t-stat 1.72), and 0.15% four years ahead (t-stat 2.30).

[Table 11 here]

As for the other regressors, we find that productivity shocks predict higher one-year-ahead real GDP growth, but only for G7 countries and not for longer time horizons. These estimates seem to reflect the presence of strong global comovements across productivity shocks, especially among G7 countries (Gregory and Head (1999); Kose et al. (2008); Colacito et al. (2018)). In keeping with these findings, our analysis shows that country-specific productivity shocks play a relatively minor role compared with global ones which, in our analysis, are absorbed by year fixed effects. On the other hand, long-run news shocks predict higher real GDP growth three and four years ahead, which is consistent with the idea that they capture long-term fundamentals (Colacito et al. (2018)).

Overall, sentiment shocks predict large growth in consumption, employment, and income. Importantly, the results differ across G7 and non-G7 countries. The effect is smaller and vanishes within two years in advanced economies, whereas it is large and lasts for up to four years in less advanced economies. Taken together, the results suggest that sentiment shocks are uncorrelated with economic fundamentals in G7 countries, as they only create short-term fluctuations that do not affect productivity. Conversely, sentiment seems to generate self-fulfilling feedback loops in non-G7 countries that leads to prolonged economic growth and higher productivity.

3.3. Testing the channel

In the last part of the paper, we shed light on the economic channel through which sentiment may affect growth. To this end, we test two predictions that are specific to the sentiment story.

Future stock returns

First, periods of high sentiment should be characterized by stock overpricing and followed by lower stock returns (see, e.g., Baker and Wurgler (2006, 2007) for U.S. evidence and Baker et al. (2012) for international

evidence). To test this channel, we analyze the relation between future country-level stock returns, defined as the first difference of the log price-dividend ratio, and the two sentiment components, i.e., explained and orthogonalized sentiment.

The results are in Table 12. Consistent with the hypothesized channel, we find that sentiment predicts negative one-year-ahead equity returns. The effect is concentrated in G7 countries, which indicates the presence of stronger arbitrage forces. Specifically, a one-standard-deviation increase in orthogonalized sentiment is followed by a decrease in stock returns of 1.73% (t-stat -2.20). For non-G7 countries, the effect is close to zero in both magnitude and significance.

[Table 12 here]

As an alternative test, we look into the effect of individual macroeconomic variables on stock returns. To this end, we regress one-year-ahead stock returns on the raw consumer sentiment index and its three macroeconomic predictors introduced above. This specification allows us to interpret the coefficient of the raw sentiment index as the effect of orthogonalized sentiment. We find again similar results. A one-standard-deviation increase in sentiment is followed by a decrease in stock returns of 1.90% (t-stat -2.73). For non-G7 countries, the effect is again close to zero. Among the other coefficients of interest, innovations in employment predict higher stock returns, but only among G7 countries, which again lends support to our conjecture that stock prices in these markets more closely reflect economic fundamentals.

We also analyze stock returns at longer horizons. An interesting empirical pattern emerges. For G7 countries, the effect of orthogonalized sentiment on stock returns is insignificant two and three years ahead and becomes effectively zero four years ahead. For non-G7 countries, the coefficient is negative and significant for two- and three-year-ahead stock returns and becomes zero in year four. To get a sense of the magnitude, a one standard deviation increase in orthogonalized sentiment is followed by a decrease in stock returns of 2.68% two years ahead (t-stat -2.86) and 1.75% three years ahead (t-stat -1.66).

The results lend support to our conjecture that advanced economies exhibit more advanced financial markets. Mispricing correction is fast in G7 countries, as it takes place within one year only, and small, which indicates the presence of lower initial mispricing. Conversely, mispricing correction is slow in non-G7 countries, as it only takes place two and three years ahead, and larger, which attests to the presence of higher mispricing. Markets in less advanced economies then seem characterized by weaker arbitrage forces.

Capital formation and internal rate of return

Second, we test the prediction that rational managers should bring forward capital investments when they observe waves of high sentiment. The idea behind this market timing strategy is to exploit the lower cost of capital that is generated by stock overpricing (see, e.g., Baker et al. (2003)). To test this conjecture, we analyze the relation between sentiment shocks and capital formation growth.

The estimates are in Table 13. We find that sentiment shocks indeed predict an increase in one-year-ahead capital formation growth. In particular, the results support the sentiment hypothesis in two ways. First, the effect vanishes within one year, which is consistent with the idea that managers rationally and immediately exploit mispricing when it arises. Second, the magnitude of the effect is much larger for non-G7 countries, where mispricing is larger (see Table 12). A one-standard-deviation sentiment shock is followed by a 1.01% increase in one-year-ahead capital growth in G7 countries, whereas the effect is equal to 2.49% for non-G7 countries (t-stat 6.62).

[Table 13 here]

The results lend support to the prediction that aggregate corporate investment should peak during periods of positive sentiment because high sentiment reduces the cost of capital (e.g., Arif and Lee (2014)). However, high sentiment may have two opposite effects on the internal rate of return on capital (IRR).[7] On the one hand, investment becomes more profitable other things being equal due to a lower discount rate and a boost in consumer demand for goods and services. As a result, the IRR may increase. On the other hand, managers may accept projects with even lower IRR than before. If so, high sentiment may actually decrease the average IRR in the economy.

We find evidence in support of the first prediction, in Table 14. A one-standard-deviation sentiment shock is associated with an increase in the one-year-ahead internal rate of return of 0.14% for G7 countries (t-stat 2.98), and 0.20% for non-G7 countries (t-stat 2.40). The effect becomes marginally significant two years ahead and concentrated in non-G7 countries (0.10%, t-stat 1.76), whereas it becomes effectively zero for all countries at a three- and four-year horizon.

[Table 14 here]

These results match those for capital formation growth in both sign and timing. Therefore, they provide further support to the idea that the effect of sentiment on investment is concentrated in the short run.

4. Conclusion

A growing body of evidence shows that business cycles are positively related to sentiment. Previous literature has proposed three competing channels to explain this result. First, optimism captures positive signals over future fundamentals so that positive sentiment anticipates changes in fundamentals but does not cause them. Second, sentiment merely represents a psychological factor that has no effect on economic fundamentals and therefore only creates short-term economic fluctuations. Third, sentiment has a direct

[7] Following Jorgenson and Nishimizu (1978), the Penn World Table defines the IRR as the required rate of return on capital that exhausts the income left after subtracting labor income from GDP under the assumption of perfect competition (see, e.g., https://www.rug.nl/ggdc/docs/pwt91_whatsnew.pdf).

effect on future fundamentals through a self-fulfilling feedback loop. To a large extent, these stories are difficult to disentangle empirically.

In this paper, we propose a novel solution to this problem. Building on the idea that stock market prices represent a noisy signal for future economic prospects, we analyze how cross-country variation in market efficiency affects the relation between sentiment and economic activity. We hypothesize that it is harder for economic agents in less advanced economies to distinguish mispricing from rational expectations. As a result, the effect of sentiment on economic growth should be more pronounced.

Using a large sample of OECD countries, we find evidence consistent with our theoretical predictions. In non-G7 countries, we find that sentiment shocks are associated with immediate and prolonged economic booms and a corresponding increase in total factor productivity. By contrast, the real effects of sentiment in G7 countries are confined to the short run and do not affect productivity. Correspondingly, we show that the latter economies are quicker to identify sentiment as a noise component in asset prices.

Altogether, these findings explain the apparent discrepancy between the theoretical literature of sentiment-driven business cycles and its empirical applications. Most empirical studies so far have focused on highly-advanced individual countries (e.g., the U.S.) or blocks of countries (e.g., the G7) and, therefore, find scarce evidence that sentiment affects future fundamentals. In this paper, we show that this result is specific to advanced economies with efficient financial markets. On the other hand, we find that the theoretical predictions of sentiment-driven business-cycle models apply to less advanced economies where sentiment shocks seem indeed to drive future fundamentals.

Appendix A

Price-dividend ratio decomposition

The sentiment component of the price-dividend ratio is a function of country-level sentiment $S^{\perp}_{c,t}$:

$$PD^{s}_{c,t} = bS^{\perp}_{c,t} + e^{s}_{c,t}, \tag{A.1}$$

where $b > 0$. Using this relation and exploiting the autoregressive nature of the price-dividend ratio, we obtain a new decomposition for the raw price-dividend ratio:

$$\begin{aligned}
PD_{c,t} &= PD^{f}_{c,t} + PD^{s}_{c,t} = \\
&= \underbrace{\rho_f PD^{f}_{c,t-1} + \epsilon^{f}_{c,t}}_{\equiv PD^{f}_{c,t}} + \underbrace{\rho_s PD^{s}_{c,t-1} + \epsilon^{s}_{c,t}}_{\equiv PD^{s}_{c,t}} = \\
&= \rho_f \underbrace{(PD_{c,t-1} - PD^{s}_{c,t-1})}_{\equiv PD^{f}_{c,t-1}} + \epsilon^{f}_{c,t} + \rho_s \underbrace{(bS^{\perp}_{c,t-1} + e^{s}_{c,t-1})}_{\equiv PD^{s}_{c,t-1}} + \epsilon^{s}_{c,t} = \\
&= \rho_f (PD_{c,t-1} - (bS^{\perp}_{c,t-1} + e^{s}_{c,t-1})) + \epsilon^{f}_{c,t} + \rho_s (bS^{\perp}_{c,t-1} + e^{s}_{c,t-1}) + \epsilon^{s}_{c,t} = \\
&= \rho_f PD_{c,t-1} + b(\rho_s - \rho_f) S^{\perp}_{c,t-1} + e_{c,t},
\end{aligned} \tag{A.2}$$

where:

$$e_{c,t} = \epsilon^f_{c,t} + \epsilon^s_{c,t} + (\rho_s - \rho_f) e^s_{c,t-1}. \tag{A.3}$$

To the degree that the error term $e_{c,t}$ is i.i.d., the raw price-dividend ratio can be statistically decomposed into its lagged value and the lagged value of country-level sentiment. We use this fact in Eq. 9.

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Table 1. Summary statistics

Summary statistics for the main variables in our sample. We consider the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. The variables are total factor productivity growth (TFP), which is expressed at constant national prices, calculated using U.S. as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time; the price-dividend ratio (PD); the consumer sentiment index, orthogonalized to country-level shocks to real GDP, consumption, and employment, and country and year fixed effects; and the rate of growth of real GDP, consumption, and employment. The sample includes sixteen OECD countries over the period 1975-2019 and all variables are annual. The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. All countries

Variable	Mean	Std. Deviation	P25	Median	P75
TFP	0.9375	0.1141	0.8728	0.9612	1.0000
PD	35.2522	18.3558	22.4719	30.5344	43.6681
Sentiment	0.0000	1.9618	-1.0480	0.1716	1.2598
Real GDP	0.0266	0.0298	0.0134	0.0277	0.0416
Consumption	0.0239	0.0365	0.0067	0.0244	0.0430
Employment	0.0093	0.0188	0.0011	0.0104	0.0195

Panel B. G7 countries

Variable	Mean	Std. Deviation	P25	Median	P75
TFP	0.9227	0.1153	0.8403	0.9338	0.9971
PD	32.7940	13.6808	22.8516	29.8507	39.9280
Sentiment	-0.2927	1.6770	-1.5411	-0.3229	0.9224
Real GDP	0.0210	0.0204	0.0104	0.0218	0.0337
Consumption	0.0215	0.0232	0.0077	0.0229	0.0372
Employment	0.0068	0.0113	0.0011	0.0079	0.0133

Panel C. Non-G7 countries

Variable	Mean	Std. Deviation	P25	Median	P75
TFP	0.9418	0.1135	0.8788	0.9665	1.0029
PD	36.7420	20.5551	22.2718	31.1043	46.6203
Sentiment	0.0858	2.0306	-0.8971	0.2926	1.3092
Real GDP	0.0282	0.0318	0.0147	0.0298	0.0432
Consumption	0.0246	0.0395	0.0061	0.0250	0.0455
Employment	0.0101	0.0204	0.0012	0.0117	0.0212

Table 2. Total factor productivity and the price-dividend ratio

Panel regressions of country-level annual total factor productivity growth, estimated one, two, three, or four years ahead, on the price-dividend ratio (PD). Total factor productivity growth is expressed at constant national prices, calculated using U.S. as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. We consider the raw price-dividend ratio in this analysis and thus estimate Eq. 3. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10. The price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites.

Panel A. Short run

	Productivity $t+1$			Productivity $t+2$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
PD	0.0112	0.0585*	0.0023	0.0103	0.0598**	0.0006
	1.09	1.93	0.23	1.06	2.11	0.07
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	620	235	385	604	230	374
R-squared	0.7821	0.8539	0.7258	0.7796	0.8543	0.7223

Panel B. Long run

	Productivity $t+3$			Productivity $t+4$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
PD	0.0103	0.0612**	0.0002	0.0106	0.0601**	-0.0001
	1.07	2.27	0.02	1.11	2.32	-0.02
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	588	225	363	572	220	352
R-squared	0.7788	0.8557	0.7211	0.7796	0.8539	0.7232

Table 3. Total factor productivity and the price-dividend ratio: Sentiment decomposition

Panel regressions of country-level annual total factor productivity growth, estimated one, two, three, or four years ahead, on the price-dividend ratio (PD). Total factor productivity growth is expressed at constant national prices, calculated using U.S. as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. In this analysis, we decompose the price-dividend ratio into a fundamental (F) and a sentiment (S) component and thus estimate Eq. 8. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Productivity $t+1$			Productivity $t+2$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
PD(F)	0.0085	0.0452*	0.0007	0.0079	0.0462**	-0.0005
	1.04	1.95	0.09	1.01	2.14	-0.07
PD(S)	0.0707	-0.0351	0.1884***	0.0589	-0.0382	0.1737***
	1.27	-0.56	3.43	1.07	-0.58	2.83
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	620	235	385	604	230	374
R-squared	0.7833	0.8547	0.7436	0.7805	0.8553	0.7392

Panel B. Long run

	Productivity $t+3$			Productivity $t+4$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
PD(F)	0.0080	0.0471**	-0.0008	0.0082	0.0463**	-0.0008
	1.03	2.31	-0.12	1.08	2.38	-0.13
PD(S)	0.0426	-0.0592	0.1600**	0.0370	-0.0581	0.1384*
	0.72	-0.71	2.34	0.60	-0.59	1.70
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	588	225	363	572	220	352
R-squared	0.7793	0.8574	0.7370	0.7800	0.8556	0.7366

Table 4. Total factor productivity and the price-dividend ratio: Alternative sentiment decomposition

Panel regressions of country-level annual total factor productivity growth, estimated one, two, three, or four years ahead, on the price-dividend ratio (PD). Total factor productivity growth is expressed at constant national prices, calculated using U.S. as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. In this analysis, we estimate an alternative decomposition of the price-dividend ratio into its lagged value and lagged country-level consumer sentiment and thus estimate Eq. 9. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Productivity $t+1$			Productivity $t+2$		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full	G7	Non-G7	Full	G7	Non-G7
PD (-1)	0.0101	0.0591**	-0.0007	0.0102	0.0603**	-0.0010
	1.01	2.14	-0.07	1.03	2.31	-0.11
Sentiment (-1)	0.0031	-0.0043	0.0102***	0.0021	-0.0056	0.0094**
	0.91	-0.94	2.71	0.58	-1.00	2.25
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	604	230	374	588	225	363
R-squared	0.7805	0.8553	0.7392	0.7793	0.8574	0.7370

Panel B. Long run

	Productivity $t+3$			Productivity $t+4$		
	(1)	(2)	(3)	(4)	(5)	(6)
	Full	G7	Non-G7	Full	G7	Non-G7
PD (-1)	0.0105	0.0592**	-0.0010	0.0100	0.0588**	-0.0017
	1.08	2.38	-0.13	1.06	2.47	-0.34
Sentiment (-1)	0.0018	-0.0055	0.0082	0.0011	-0.0049	0.0063
	0.47	-0.85	1.64	0.27	-0.73	1.06
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	572	220	352	556	215	341
R-squared	0.7800	0.8556	0.7366	0.7813	0.8574	0.7349

Table 5. Total factor productivity and the price-dividend ratio: Sentiment decomposition excluding the U.S.
Panel regressions of country-level annual total factor productivity growth for non-U.S. countries, estimated one, two, three, or four years ahead, on the price-dividend ratio (PD). Total factor productivity growth is expressed at constant national prices, calculated using U.S. as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. In this analysis, we decompose the price-dividend ratio into a fundamental (F) and a sentiment (S) component and thus estimate Eq. 8. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes fifteen non-U.S. OECD countries over the period 1975-2019. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Productivity $t+1$			Productivity $t+2$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
PD (F)	0.0086	0.0456*	0.0007	0.0080	0.0466**	-0.0005
	1.04	1.95	0.09	1.01	2.14	-0.07
PD (S)	0.0557	-0.0189	0.1444***	0.0465	-0.0212	0.1330***
	1.32	-0.41	3.47	1.12	-0.44	2.87
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	620	235	385	604	230	374
R-squared	0.7833	0.8547	0.7436	0.7805	0.8553	0.7392

Panel B. Long run

	Productivity $t+3$			Productivity $t+4$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
PD (F)	0.0080	0.0475**	-0.0008	0.0083	0.0466**	-0.0008
	1.03	2.31	-0.12	1.08	2.38	-0.13
PD (S)	0.0340	-0.0371	0.1224**	0.0298	-0.0364	0.1059*
	0.76	-0.60	2.36	0.64	-0.49	1.72
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	588	225	363	572	220	352
R-squared	0.7793	0.8574	0.7370	0.7800	0.8556	0.7366

Table 6. Total factor productivity in non-G7 countries and the price-dividend ratio: Effect of G7 fundamentals
Panel regressions of country-level annual total factor productivity growth for non-G7 countries, estimated one, two, three, or four years ahead, on the price-dividend ratio (PD). Total factor productivity growth is expressed at constant national prices, calculated using U.S. as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. In this analysis, we decompose the price-dividend ratio into a fundamental (F) and a sentiment (S) component and thus estimate Eq. 8. We also include the average fundamental component of the price-dividend ratio for G7 countries as an additional regressor. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. All specifications include country fixed effects and standard errors are robust to heteroskedasticity. The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Productivity $t+1$			Productivity $t+2$		
	(1)	(2)	(3)	(4)	(5)	(6)
PD (F)	-0.0012		0.0016	-0.0022		0.0002
	-0.09		0.12	-0.18		0.02
PD (F) G7		0.0659***	0.0664***		0.0571***	0.0572***
		4.72	4.08		4.39	3.92
PD (S)	0.0130**	0.0207***	0.0207***	0.0136***	0.0204***	0.0204***
	2.51	3.82	3.79	2.68	3.68	3.68
Country FE	Y	Y	Y	Y	Y	Y
Observations	385	385	385	374	374	374
R-squared	0.2804	0.3731	0.3735	0.2895	0.3648	0.3648

Panel B. Long run

	Productivity $t+3$			Productivity $t+4$		
	(1)	(2)	(3)	(4)	(5)	(6)
PD (F)	-0.0022		-0.0001	-0.0023		-0.0002
	-0.20		-0.01	-0.25		-0.02
PD (F) G7		0.0496***	0.0496***		0.0456***	0.0455***
		4.27	3.85		4.21	4.02
PD (S)	0.0150***	0.0207***	0.0207***	0.0149***	0.0201***	0.0201***
	3.01	3.79	3.79	3.05	3.74	3.74
Country FE	Y	Y	Y	Y	Y	Y
Observations	363	363	363	352	352	352
R-squared	0.3074	0.3703	0.3703	0.3188	0.3787	0.3787

Table 7. Total factor productivity and the price-dividend ratio: Financial development

Panel regressions of country-level annual total factor productivity growth estimated one, two, three, or four years ahead, on the price-dividend ratio (PD), and an interaction term with the degree of financial development (FD). The sample includes sixteen OECD countries over the period 1975-2019. Total factor productivity growth is expressed at constant national prices, calculated using U.S. as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. In this analysis, we decompose the price-dividend ratio into a fundamental (F) and a sentiment (S) component, thus estimating an augmented version of Eq. 8. We identify a country's degree of financial development following the methodology from Rajan and Zingales (1998). Among the measures they propose, we choose stock turnover over GDP (Panel A) and GDP per capita (Panel B) as they are the measures for which we have the most observations in our sample. Then we take their country-level averages at the beginning of the sample period (1975-1990), and re-estimate our test equation (augmented with interaction terms) in the subsequent period (1991-2019). All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. All specifications include country fixed effects and standard errors are robust to heteroskedasticity. The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, the financial development meaasures are from the World Bank, and sentiment data is from the OECD.

Panel A. Stock turnover over GDP

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	$t+1$	$t+2$	$t+3$	$t+4$
PD (F)	-0.0056	-0.0044	-0.0031	-0.0016
	-1.10	-0.86	-0.61	-0.35
PD (S)	0.2030***	0.2032***	0.1930***	0.1998***
	2.69	2.64	2.65	2.77
PD (F) × FD	-0.0014	-0.0016	-0.0019	-0.0024
	-0.35	-0.38	-0.42	-0.56
PD (S) × FD	-0.0060***	-0.0054***	-0.0043***	-0.0035***
	-3.16	-3.12	-3.07	-2.84
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	416	401	386	371
R-squared	0.6877	0.6750	0.6539	0.6468

Panel B. GDP per capita

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	$t+1$	$t+2$	$t+3$	$t+4$
PD (F)	0.0055	0.0049	0.0050	0.0052
	0.66	0.65	0.72	0.80
PD (S)	0.1714***	0.1655***	0.1522***	0.1422**
	2.94	2.83	2.63	2.12
PD (F) × FD	-0.0053	-0.0046	-0.0046	-0.0043
	-0.71	-0.60	-0.61	-0.57
PD (S) × FD	-0.0059***	-0.0053***	-0.0041**	-0.0034*
	-2.92	-2.76	-2.15	-1.77
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	444	428	412	396
R-squared	0.7038	0.6905	0.6717	0.6597

Table 8. Total factor productivity and the price-dividend ratio: Eurozone

Panel regressions of country-level annual total factor productivity growth estimated one, two, three, or four years ahead, on the price-dividend ratio (PD), and interaction terms with a dummy variable that takes on value one for countries that are among the original signatories to the European Monetary Union (or "Eurozone"), and zero otherwise, and a dummy variable that takes on value one for the period that follows the official launch of the euro on January 1, 1999, and zero otherwise. The sample includes sixteen OECD countries over the period 1975-2019. The countries in our sample that are original signatories to the Eurozone are Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, and Spain. We include G7 countries in Panel A, and non-G7 countries in Panel B. Total factor productivity growth is expressed at constant national prices, calculated using U.S. as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. In this analysis, we decompose the price-dividend ratio into a fundamental (F) and a sentiment (S) component, thus estimating an augmented version of Eq. 8. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. All specifications include country fixed effects and standard errors are robust to heteroskedasticity. The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	$t+1$	$t+2$	$t+3$	$t+4$
PD (F)	0.0108**	0.0148***	0.0184***	0.0191***
	2.19	2.64	3.02	2.97
PD (S)	-0.0206	-0.0246	-0.0442	-0.0415
	-0.34	-0.38	-0.55	-0.45
PD (F) × Eurozone	0.0585***	0.0515***	0.0475***	0.0440***
	10.63	11.34	9.24	7.05
PD (S) × Eurozone	-0.0045	-0.0062	-0.0073	-0.0110
	-0.10	-0.14	-0.18	-0.27
PD (F) × Eurozone × Post-99	-0.0004	0.0050	0.0024	0.0037
	-0.02	0.21	0.12	0.18
PD (S) × Eurozone × Post-99	0.0199	0.0190	0.0148	0.0130
	0.38	0.37	0.32	0.29
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	235	230	225	220
R-squared	0.8696	0.8681	0.8683	0.8662

Panel B. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	$t+1$	$t+2$	$t+3$	$t+4$
PD (F)	-0.0098	-0.0101	-0.0105	-0.0095
	-1.48	-1.51	-1.53	-1.40
PD (S)	0.1893***	0.1756***	0.1644**	0.1467*
	3.76	3.00	2.47	1.85
PD (F) × Eurozone	-0.0135	-0.0126	-0.0108	-0.0089
	-0.93	-0.92	-0.85	-0.73
PD (S) × Eurozone	0.0291***	0.0277**	0.0237**	0.0189*
	2.64	2.54	2.32	1.69
PD (F) × Eurozone × Post-99	0.0381**	0.0352**	0.0332**	0.0301**
	2.24	2.27	2.42	2.36
PD (S) × Eurozone × Post-99	-0.0227**	-0.0226**	-0.0204**	-0.0172*
	-2.36	-2.51	-2.57	-1.92
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.7958	0.7884	0.7847	0.7784

Table 9. Economic growth: Consumption

Panel regressions of the annual growth rate of country-level consumption one, two, three, and four years ahead on productivity shocks, long-run news shocks, and sentiment shocks from Eq. 10. Productivity shocks are defined as the residuals from a regression of total factor productivity growth on the price-dividend ratio, decomposed into a sentiment and a fundamental component, and news (sentiment) shocks are defined as the residuals of a regression of the fundamental (sentiment) component of the price-dividend ratio on its first lag. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Consumption growth $t+1$			Consumption growth $t+2$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	0.0023	0.0035***	0.0025	0.0016	0.0028	0.0027
	1.61	3.52	1.03	1.03	1.24	0.94
Long-run news shocks	-0.0013	-0.0009	-0.0016	0.0000	-0.0036	0.0003
	-0.97	-1.17	-1.06	0.02	-1.30	0.37
Sentiment shocks	0.0051***	0.0052***	0.0046***	0.0059***	0.0037***	0.0071***
	4.03	2.88	2.75	6.27	8.50	6.14
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	604	230	374	588	225	363
R-squared	0.4354	0.5921	0.4149	0.4421	0.5757	0.4397

Panel B. Long run

	Consumption growth $t+3$			Consumption growth $t+4$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	0.0017	0.0012	0.0029	-0.0008	-0.0003	-0.0012
	0.86	0.55	0.92	-0.38	-0.11	-0.30
Long-run news shocks	-0.0008	0.0009	-0.0009	0.0008	0.0031	0.0003
	-0.60	0.72	-0.63	1.17	1.49	0.39
Sentiment shocks	0.0018	-0.0015	0.0045***	0.0006	-0.0007	0.0016
	1.33	-1.00	4.79	0.54	-0.47	1.40
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	572	220	352	556	215	341
R-squared	0.3976	0.5449	0.4070	0.3987	0.5457	0.3866

Table 10. Economic growth: Employment

Panel regressions of the annual growth rate of country-level employment one, two, three, and four years ahead on productivity shocks, long-run news shocks, and sentiment shocks from Eq. 10. Productivity shocks are defined as the residuals from a regression of total factor productivity growth on the price-dividend ratio, decomposed into a sentiment and a fundamental component, and news (sentiment) shocks are defined as the residuals of a regression of the fundamental (sentiment) component of the price-dividend ratio on its first lag. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Employment growth $t+1$			Employment growth $t+2$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	0.0036***	0.0028***	0.0059***	0.0029**	0.0027***	0.0044**
	2.67	2.96	2.81	2.53	3.99	2.35
Long-run news shocks	-0.0007	-0.0025**	-0.0004	-0.0004	-0.0024	-0.0001
	-1.09	-2.27	-0.54	-1.02	-1.33	-0.29
Sentiment shocks	0.0043***	0.0016**	0.0059***	0.0034***	0.0013***	0.0050***
	4.27	2.45	4.72	3.64	3.13	4.81
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	604	230	374	588	225	363
R-squared	0.5674	0.6119	0.6102	0.5429	0.6160	0.5733

Panel B. Long run

	Employment growth $t+3$			Employment growth $t+4$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	0.0022**	0.0025***	0.0027	0.0015	0.0018***	0.0012
	2.21	6.91	1.35	1.14	5.14	0.42
Long-run news shocks	-0.0004	-0.0022	-0.0002	-0.0003	-0.0002	-0.0001
	-0.82	-1.33	-0.34	-0.73	-0.25	-0.14
Sentiment shocks	0.0020*	0.0001	0.0035***	0.0005	-0.0005	0.0013*
	1.93	0.09	3.61	0.58	-0.39	1.92
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	572	220	352	556	215	341
R-squared	0.5179	0.6197	0.5328	0.4992	0.6100	0.4938

Table 11. Economic growth: Real GDP

Panel regressions of the annual growth rate of country-level real GDP one, two, three, and four years ahead on productivity shocks, long-run news shocks, and sentiment shocks from Eq. 10. Productivity shocks are defined as the residuals from a regression of total factor productivity growth on the price-dividend ratio, decomposed into a sentiment and a fundamental component, and news (sentiment) shocks are defined as the residuals of a regression of the fundamental (sentiment) component of the price-dividend ratio on its first lag. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Real GDP growth $t+1$			Real GDP growth $t+2$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	0.0009	0.0029**	0.0008	-0.0000	0.0020	-0.0016
	0.65	2.15	0.53	-0.02	0.87	-0.76
Long-run news shocks	0.0031	-0.0013	0.0037	-0.0003	-0.0004	-0.0005
	1.26	-0.96	1.31	-0.58	-0.24	-0.72
Sentiment shocks	0.0050***	0.0032***	0.0062***	0.0021**	0.0008	0.0036***
	6.27	7.78	6.75	2.37	1.12	3.96
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	604	230	374	588	225	363
R-squared	0.6237	0.7648	0.6192	0.5787	0.7328	0.5673

Panel B. Long run

	Real GDP growth $t+3$			Real GDP growth $t+4$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	-0.0007	0.0016	-0.0027	-0.0014	0.0012	-0.0044
	-0.35	0.73	-1.24	-0.65	0.65	-1.40
Long-run news shocks	0.0014*	0.0009	0.0013	0.0005	0.0017**	0.0001
	1.86	1.62	1.52	0.91	2.50	0.19
Sentiment shocks	0.0009	-0.0008	0.0024*	0.0008	-0.0002	0.0015**
	0.76	-0.55	1.72	1.36	-0.13	2.30
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	572	220	352	556	215	341
R-squared	0.5847	0.7293	0.5703	0.5846	0.7272	0.5645

Table 12. Future stock returns

Panel regressions of country-level one-year-ahead stock returns (Panel A), and two-, three-, and four-year-ahead stock returns (Panel B), on orthogonalized and explained consumer sentiment (Panel A, columns (1) to (3), and Panel B), and on raw consumer sentiment and innovations in real GDP, consumption, and employment (Panel A, columns (4) to (6)). Stock returns are defined as the first difference of the country-level log price-dividend ratio. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw consumer sentiment on changes in real GDP, consumption, and employment, and country and year fixed effects. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. In Panel A, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). In Panel B, we include the subsample of G7 countries in columns (1) to (3), and the subsample of non-G7 countries in columns (4) to (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. One year ahead

Dep. variable: Returns $t+1$	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Orthogonalized sentiment	-0.0120	-0.0173**	-0.0020			
	-1.40	-2.20	-0.11			
Explained sentiment	0.0239	0.0496**	-0.1256***			
	1.09	2.05	-3.12			
Sentiment				-0.0129	-0.0190***	-0.0009
				-1.41	-2.73	-0.04
Δ Real GDP				0.1057	0.2307	-0.4943
				0.62	0.80	-0.40
Δ Consumption				-0.1412	-0.0729	-2.0018
				-0.53	-0.16	-1.07
Δ Employment				0.0282**	0.0312***	0.0589
				2.19	2.70	0.64
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	620	235	385	620	235	385
R-squared	0.6545	0.6742	0.6805	0.6554	0.6784	0.6808

Panel A. Two, three, and four years ahead

	G7 countries			Non-G7 countries		
Dep. variable: Returns $t+s$	(1) $t+2$	(2) $t+3$	(3) $t+4$	(4) $t+2$	(5) $t+3$	(6) $t+4$
Orthogonalized sentiment	-0.0110	-0.0018	-0.0005	-0.0268***	-0.0175*	-0.0018
	-1.27	-0.10	-0.03	-2.86	-1.66	-0.16
Explained sentiment	0.0202**	-0.0048	0.0112	0.1705***	-0.1880***	-0.2174***
	2.05	-0.32	0.98	2.75	-2.90	-2.85
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	230	225	220	374	363	352
R-squared	0.6821	0.6767	0.6828	0.6886	0.6927	0.6980

Table 13. Capital formation growth

Panel regressions of the annual growth rate of country-level capital formation growth one, two, three, and four years ahead on productivity shocks, long-run news shocks, and sentiment shocks from Eq. 10. Productivity shocks are defined as the residuals from a regression of total factor productivity growth on the price-dividend ratio, decomposed into a sentiment and a fundamental component, and news (sentiment) shocks are defined as the residuals of a regression of the fundamental (sentiment) component of the price-dividend ratio on its first lag. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Capital formation growth $t+1$			Capital formation growth $t+2$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	0.0096**	0.0059	0.0176***	0.0021	0.0047	0.0031
	2.33	1.39	3.03	0.57	0.80	0.53
Long-run news shocks	0.0020	-0.0070	0.0033	0.0014	-0.0078***	0.0038
	0.87	-1.28	1.22	0.51	-2.75	1.28
Sentiment shocks	0.0194***	0.0101***	0.0249***	-0.0014	-0.0049	0.0003
	6.29	4.59	6.62	-0.40	-1.27	0.07
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	604	230	374	588	225	363
R-squared	0.4144	0.5171	0.4371	0.3504	0.5060	0.3500

Panel B. Long run

	Capital formation growth $t+3$			Capital formation growth $t+4$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	-0.0001	0.0032	-0.0031	0.0050	0.0033	0.0046
	-0.03	0.64	-0.48	1.49	1.01	1.36
Long-run news shocks	0.0028	0.0013	0.0024	-0.0028	0.0039	-0.0041
	0.69	0.34	0.43	-0.57	0.73	-0.69
Sentiment shocks	0.0002	-0.0035	0.0030	0.0008	-0.0028	0.0036
	0.05	-0.45	0.62	0.26	-0.38	0.90
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	572	220	352	556	215	341
R-squared	0.3510	0.5057	0.3441	0.3540	0.5025	0.3483

Table 14. Internal rate of return

Panel regressions of the annual growth rate of country-level internal rate of return on capital one, two, three, and four years ahead on productivity shocks, long-run news shocks, and sentiment shocks from Eq. 10. Productivity shocks are defined as the residuals from a regression of total factor productivity growth on the price-dividend ratio, decomposed into a sentiment and a fundamental component, and news (sentiment) shocks are defined as the residuals of a regression of the fundamental (sentiment) component of the price-dividend ratio on its first lag. All specifications include country and year fixed effects and standard errors are robust to heteroskedasticity. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen OECD countries over the period 1975-2019. In both Panels, we include the full sample in columns (1) and (4), the subsample of G7 countries in columns (2) and (5), and the subsample of non-G7 countries in columns (3) and (6). The macroeconomic variables are from the Penn World Table V.10, the price-to-dividend ratios are from Kenneth French's and Robert Shiller's websites, and sentiment data is from the OECD.

Panel A. Short run

	Internal rate of return $t+1$			Internal rate of return $t+2$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	0.0035*	0.0029**	0.0045	0.0023	0.0026*	0.0019
	1.87	2.45	1.40	1.31	1.79	0.86
Long-run news shocks	0.0009	-0.0013	0.0016	0.0007	-0.0007	0.0010
	0.76	-1.40	1.19	0.76	-0.68	1.08
Sentiment shocks	0.0017***	0.0014***	0.0020**	0.0009**	0.0008	0.0010*
	3.32	2.98	2.40	2.41	1.36	1.76
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	604	230	374	588	225	363
R-squared	0.9082	0.9076	0.9207	0.9033	0.9031	0.9142

Panel B. Long run

	Internal rate of return $t+3$			Internal rate of return $t+4$		
	(1) Full	(2) G7	(3) Non-G7	(4) Full	(5) G7	(6) Non-G7
Productivity shocks	0.0014	0.0025	-0.0001	0.0005	0.0026	-0.0020
	0.76	1.52	-0.06	0.27	1.56	-1.63
Long-run news shocks	0.0009	-0.0001	0.0011	0.0010	0.0004	0.0011
	0.88	-0.07	1.00	0.93	0.60	0.90
Sentiment shocks	0.0006	0.0003	0.0009	0.0003	0.0002	0.0004
	1.09	0.34	1.03	0.78	0.38	0.63
Country FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	572	220	352	556	215	341
R-squared	0.9042	0.9006	0.9163	0.9047	0.9009	0.9181