Sentiment, productivity, and economic growth[†]

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Abstract

Earlier research finds correlation between sentiment and future economic growth, but disagrees on the channel that explains this result. 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 countries with less developed financial markets 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

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of a positive signal (or "news") over future fundamentals, so that positive sentiment anticipates economic growth but does not cause it (e.g., Beaudry and Portier (2004, 2006, 2014); Barsky and Sims (2012)). Second, macroeconomic mood swings have no relation with economic fundamentals and, therefore, only create short-lived economic fluctuations (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 (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 (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 disentangle. 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. Correspondingly, the effect of sentiment on economic growth should be more pronounced.

Using data for a sample of seventeen OECD countries over the period 1975-2019, we find strong support for our predictions. Following previous literature, we identify advanced economies as G7 countries (e.g., Colacito et al. (2018); Huo et al. (2023)).[1] In these countries, we find that sentiment shocks increase consumption, employment, and income, but only in the short run and without affecting future productivity. Conversely, sentiment shocks in non-G7 countries 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.

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 (e.g., Beaudry et al. (2011)). Consistent with our interpretation of sentiment as a genuine distortion of investor beliefs, we find that a wave of high sentiment is followed by a subsequent mispricing correction (e.g., Baker and Wurgler (2006)), a shift from credit to equity markets (e.g., Baker and Wurgler (2000)), and a short-term increase in capital investments (e.g., Baker et al. (2003)). All three empirical patterns are largely confined to non-G7 countries, which lends further support to our conjecture that their financial markets are relatively less efficient.

Beaudry et al. (2011) find that consumer confidence shocks predict economic growth in the US, suggesting 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 (e.g., Beaudry and Portier (2014); Dees (2017)),

[1]The goal of the G7 block is to create a forum for the world's most industrialized countries. The strength of this group of countries is that G7 summits address a number of socio-economic problems, thus creating grounds for greater social and economic development with respect to other (non-G7) countries.

they exploit cross-sectional variation in local sentiment across US 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 hypothesis is in line with previous sentiment literature (e.g., Baker and Wurgler (2006, 2007); Baker et al. (2012)) and addresses the concern that sentiment may capture unobserved economic shocks (Cochrane (1994); L'Huillier et al. (2022)).

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 (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 the equity markets, which lends novel support to the idea that the financial sector can influence economic growth (e.g., Levine (2005)).

We identify sentiment with the country-specific consumer confidence index from the OECD. This measure is based on surveys and captures economic expectations among the households of a given country for the short term (12 months ahead). As such, it represents the cross-country counterpart to the US consumer confidence index from the Conference Board. Both the US and the international version of this index have been used extensively in the finance literature as a proxy for biases in investor expectations (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.

We acknowledge that local sentiment may partly reflect the level of sentiment of US 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 consumer confidence index from the effect of either US 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. Finally, we control for a number of macroeconomic

[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 (e.g., Shefrin (2008)).

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

variables to purge the index from a potential business cycle component (e.g., Baker and Wurgler (2006)).

In a preliminary analysis, we study the lead-lag relation between productivity and raw sentiment. To this end, we estimate a panel vector autoregression (VAR) model. Although this specification does not distinguish between different sentiment components, it allows us to test our basic conjecture in a unified approach while controlling for several lags of our two key variables of interest. We find that a sentiment shock predicts a significant increase in future productivity. Consistent with the transient nature of sentiment, the effect monotonically tails off to zero within five years. Further tests indicate that the results are driven by less advanced economies, as expected.

In subsequent panel regressions, we further study whether this empirical pattern is driven by the component of sentiment that merely reflects economic fundamentals or rather a residual component that picks up genuine optimism. To this end, we estimate panel regressions controlling for the aforementioned set of macroeconomic factors and fixed effects. We find that the coefficient of sentiment is again positive and significant, suggesting that the results are driven by the unexplained sentiment component. Consistent with our theoretical predictions, the results are again confined to less advanced economies. An increase in sentiment predicts a prolonged increase in productivity among non-G7 countries, whereas the effect is absent among G7 countries.

Despite our effort to control for lead-lag effects and macroeconomic indicators, the results may still possibly suffer from endogeneity issues such as an omitted variable bias or reverse causality. Blanchard et al. (2013) argue that structural VARs typically cannot separately recover news and noise shocks because, if agents face a signal extraction problem and are unable to separate news from noise, then the econometrician, faced with either the same data as the agents or a subset of these data, cannot do it either. We address this issue by identifying exogenous variation in sentiment by exploiting the well-known positive effect of sunshine on investor mood and behavior (Hirshleifer and Shumway (2003); Cortés et al. (2016); Dong and Tremblay (2022)). Consistent with our overall results, we find that an increase in weather-related sentiment is associated with a positive and highly significant increase in productivity growth up to four years ahead in non-G7 countries. By contrast, we find an insignificant increase in productivity in G7 countries. These results provide support to the validity to our identification of sentiment.

Previous research argues that if sentiment has a causal effect on productivity, rather than merely reflect long-run fundamental information, then it should also generate immediate and protracted economic booms through a mechanism of endogenous growth.[4] We find that this is indeed the case among non-G7 countries, where an increase in sentiment predicts a short-run increase in real consumption, employment, and income which lasts for up to three years into the future. Among G7 countries, the effect is short-lived and weaker in both magnitude and significance.

We further validate our identification of sentiment by testing three predictions that are specific to the

[4]See, e.g., Barsky and Sims (2012), pp. 1363-1364, for an excellent discussion on this point.

sentiment hypothesis, which would not otherwise hold if sentiment actually reflects unobservable long-run economic fundamentals (news). First, a wave of positive sentiment should create overpricing and then be followed by a price correction (e.g., Baker and Wurgler (2006, 2007); Baker et al. (2012); Stambaugh et al. (2012)). Consistent with this hypothesis, we find that the unexplained component of sentiment is a negative predictor of equity returns. Conversely, the explained component of sentiment is a positive predictor of equity returns, consistent with our interpretation of this measure as a reflection of economic fundamentals. We also find that the 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 the view that G7 markets are indeed more efficient, as hypothesized.

Second, high sentiment and its associated lower cost of equity should make equity markets relatively more attractive than credit markets (e.g., Baker and Wurgler (2000, 2002)). Consistent with this mechanism, we find that an increase in the unexplained component of sentiment predicts a temporary increase in the size of local equity markets relative to that of credit markets. The results are confined to non-G7 countries, which is in line with our finding that such markets are characterized by greater and more prolonged overpricing.

Third, 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 (e.g., Baker et al. (2003)). Consistent with this view, we find that an increase in the unexplained component of sentiment is followed by an increase in capital formation growth. The effect occurs within one year, which lends support to the hypothesis that sentiment indeed represents a temporary distortion of beliefs rather than a signal for future economic growth. Furthermore, it only occurs among non-G7 countries, which is in line with our findings that stock prices in these markets include a larger mispricing component. In additional tests, we find a similar empirical pattern for investment in research and development, which suggests that the sentiment-driven increase in productivity from earlier tests partly reflects an increase in innovation. Altogether, these additional findings are hard to reconcile with the alternative hypothesis that sentiment merely reflects long-run economic news.

In the last part of the paper, we repeat our main empirical tests through an analysis of country-level price-dividend ratios. 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 (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 sig-

naling relevant information to economic agents (e.g., Hayek (1945); Grossman and Stiglitz (1980)). When sentiment is present, however, the informational role of financial markets in allocating resources is 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 decomposing the country-level price-dividend ratio into a sentiment and a fundamental component. Specifically, we define the former as the fitted value of a regression of the price-dividend ratio on local sentiment. The residual from this regression represents the fundamental component, i.e., the part of the price-dividend ratio that reflects economic news. This decomposition is important because it allows us to tease out two different types of information embedded in the price-dividend ratio, namely one for the short run (sentiment) and the other for the long run (news), thereby addressing the concern that sentiment may reflect unobservable economic news that is not included in current or past fundamentals (L'Huillier et al. (2022)). Overall, we identify a productivity shock, a sentiment shock, and a news shock.[5]

The results reveal a clear picture. The sentiment component of the price-dividend ratio has predictive power over future productivity growth only among non-G7 countries. Similarly, we find that sentiment shocks predict large growth in consumption, employment, and income among non-G7 countries for up to four years into the future. For G7 countries, the effect is smaller and vanishes within two years. Taken together, the findings are in line with our earlier results. Sentiment shocks are uncorrelated with economic fundamentals in G7 countries, as they only create short-term fluctuations unrelated to productivity. Conversely, sentiment generates self-fulfilling feedback loops in non-G7 countries.

The paper proceeds as follows. In Section 2, we discuss some related literature and further highlight our contribution. In Section 3, we introduce the data and methodology. In Section 4, we present our main empirical findings. In Section 5, we explore the channel underlying our results. In Section 6, we relate our findings to previous literature on the price-dividend ratio. In Section 7, we offer some concluding remarks.

2. Related literature

Our paper makes several contributions to the literature. Barsky and Sims (2012) propose a model with exogenous technology growth, where the relationship between sentiment and subsequent economic activity is not causal but rather reflects advance knowledge of future productivity developments. Using US data, they provide empirical evidence for their prediction. They also point out that if technology growth were in fact endogenous, sentiment should cause a short-run jump increase in economic activity, thereby leading to a rise in productivity through learning-by-doing. We speak to their paper in two ways. First, we find similar empirical evidence for the United States and the G7 countries more broadly. Second, we find that

[5]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 US and G7 countries). Therefore, we estimate country-level idiosyncratic shocks.

sentiment-driven endogenous growth actually seems to be operational for non-G7 countries.

A recent strand of research analyzes macroeconomic outcomes more broadly by looking at international comovement, either through production networks (Huo et al. (2023)) or non-technological business shocks (Levchenko and Pandalai-Nayar (2020)). Furthermore, these studies are centered on the US because this is the only country for which a wide collection of identified shocks is available. Our paper complements this literature by looking at the effect of sentiment on local business cycles rather than cross-country transmission. In doing so, we significantly expand the number of countries in the analysis by using a sentiment decomposition from the asset pricing literature (Baker and Wurgler (2006, 2007); Baker et al. (2012)).

More generally, our paper contributes to a burgeoning literature on expectations not grounded on macroeconomic fundamentals. Previous research shows that such expectations can be extrapolative (Bacchetta et al. (2009); Amromin and Sharpe (2014); Greenwood and Shleifer (2014); Barberis et al. (2015, 2018); Giglio et al. (2021)), sensitive to extreme events (Kozlowski et al. (2019, 2020)), or characterized by rational inattention and frictions (Angeletos and Lian (2016, 2022, 2023); Gabaix (2019)). More recent studies provide evidence for overreactive expectations (Bianchi et al. (2023); Bordalo et al. (2023); L'Huillier et al. (2023); and Maxted (2023)). The role of sentiment we identify in our paper is similar in spirit to the one proposed in this latter strand of research.

In particular, Bordalo et al. (2023) also connect financial markets to economic fluctuations. Using a mechanism of overreacting expectations in a setup à la Angeletos et al. (2020), they show that waves of optimism among US analysts are followed by a short-term increase in US macroeconomic activity. Our paper is complementary to theirs in two ways. First, we show that their findings apply not only to the US but to advanced economies in general. Second, we show that sentiment generates a stronger and more persistent overreaction among less advanced economies, both in financial markets and real economic activity, which ultimately translates into an increase in productivity. Our findings then highlight the importance of country-level development in mediating the real effects of sentiment.

Previous research shows that the financial sector can affect the real economy through the financing of capital (e.g., Bernanke and Gertler (1989); Kiyotaki and Moore (1997)) and the production of information about investment opportunities (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 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 (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 based on 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 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 (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.

3. Data and methodology

We retrieve macroeconomic variables from the Penn World Table V.10, consumer confidence data from the OECD, and the price-dividend ratio from Kenneth French's website for foreign countries and Robert Shiller's website for the US. Overall, the sample includes data for seventeen OECD countries over the period 1975-2019, of which six are G7 countries (Canada, France, Germany, Italy, United Kingdom, and United States) and eleven are non-G7 countries (Australia, Austria, Belgium, Denmark, Finland, Ireland, Netherlands, New Zealand, Spain, Sweden, and Switzerland).[6]

We start with the following test equation:

$$y_{c,t+h} = \beta_1 S_{c,t} + \delta' Z_{c,t} + \epsilon_{c,t+h}, \tag{1}$$

where the dependent variable is alternatively defined as productivity growth or economic growth in country c measured from one to four years ahead ($h = 1, 2, 3, 4$); $Z_{c,t}$ is a vector that includes innovations in local real GDP, real consumption, employment, labor share in GDP, and inflation, the eight principal components of 132 US macroeconomic variables from Ludvigson and Ng (2009), and country fixed effects.

Previous research warns that sentiment measures may partly reflect economic fundamentals and should then be purged from the effect of macroeconomic indicators (Baker and Wurgler (2006, 2007); Baker et al. (2012)). We follow the same strategy. The presence of US fundamentals in the test equation is important to capture potentially omitted fundamentals also at the local level, as the US plays a leading role in the world economy (e.g., Harvey (1991), Campbell and Hamao (1992), Kwark (1999), Kim (2001), and Lumsdaine and Prasad (2003)). The use of country fixed effects also helps us purge our local sentiment measures from the effect of time-invariant country-specific characteristics.

Following Baker and Wurgler (2006), we further identify two sentiment components:

$$S_{c,t} = S^{E}_{c,t} + S^{\perp}_{c,t}, \tag{2}$$

[6] We exclude Japan from the analysis due to the highly unusual distribution of its price-dividend ratio, which lies three standard deviations to the right of the distribution for the other countries in the sample. Although the OECD also provides consumer confidence data for some non-OECD countries (Brazil, China, and Russia, among others), we are unable to include them in our main analyses as we do not have data for their price-dividend ratios.

where $S_{c,t}$ is sentiment in country c in year t, calculated as an annual average across calendar months, $S^E_{c,t}$ 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:

$$S_{c,t} = \delta' Z_{c,t} + \epsilon_{c,t}, \tag{3}$$

where the vector of explanatory variables is defined as above but replaces the US macroeconomic variables with year fixed effects, so as to capture the potential confounding effect of global sentiment or business cycles. 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, or orthogonalized, component ($S^{\perp}_{c,t} \equiv S_{c,t} - \widehat{S}_{c,t}$).

Although consumer confidence captures forward-looking economic expectations, one potential issue with this identification strategy is that the macroeconomic variables themselves may be contemporaneously affected by sentiment to some extent. To address this concern, we alternatively estimate sentiment in a given year using the monthly value for December instead of considering the average across all calendar months. The latter approach grants the advantage of smoothing out variation in sentiment over the year, thereby decreasing the impact of potential outliers, whereas the former approach effectively identifies end-of-year expectations for the subsequent year, thereby decreasing the likelihood that the right-hand side variables are spuriously affected by sentiment. Reassuringly, the two measures of sentiment are highly correlated (around 90%) and yield similar results in the analysis that follows.

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

In the last part of the analysis, we repeat our main empirical tests using country-level price-dividend ratios. We proceed as follows. As in previous literature, we model future productivity growth as a function of lagged price-dividend ratios (Beaudry and Portier (2006); Colacito and Croce (2011); Bansal et al. (2016); Colacito et al. (2018); Constantinides and Ghosh (2021)):

$$\Delta a_{c,t+h} = \alpha_c + \alpha_t + \beta_a PD_{c,t} + \epsilon^a_{c,t+h}, \tag{4}$$

where we again measure productivity from one to four years ahead ($h = 1, 2, 3, 4$) and use country and year fixed effects as additional regressors. To incorporate the idea that stock prices partly reflect investor sentiment in financial markets (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:

$$PD_{c,t} = PD^s_{c,t} + PD^f_{c,t}, \tag{5}$$

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

$$PD_{c,t} = \alpha_c + \alpha_t + \beta_p S^{\perp}_{c,t} + \epsilon^p_{c,t}, \tag{6}$$

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 economic news.[7]

This decomposition allows us to separate out two different types of information embedded in the price-dividend ratio. The sentiment component represents a signal for short-run economic dynamics (Starr (2012); Benhabib and Spiegel (2019)), whereas the fundamental component represents an economic signal for the long run (Bryzgalova and Julliard (2021); Constantinides and Ghosh (2021); L'Huillier et al. (2022)).

As a result, we estimate a refined version of Eq. 4 by regressing productivity growth on the sentiment and fundamental components of the price-to-dividend ratio:

$$\Delta a_{c,t+h} = \alpha_c + \alpha_t + \beta^s_a PD^s_{c,t} + \beta^f_a PD^f_{c,t} + \epsilon^a_{c,t+h}, \tag{7}$$

where $h = 1, 2, 3, 4$.

The residuals from Eq. 4 represent shocks to the unanticipated component of productivity, whereas the residuals from a regression of the price-dividend ratio onto its lagged value represent shocks to the expected component of productivity (Colacito and Croce (2011); Bansal et al. (2016); Colacito et al. (2018)). These two shocks are referred to as productivity and long-run news shocks, respectively. In our paper, we further decompose long-run news shocks into a fundamental and a sentiment component following Eq. 5:

$$PD^s_{c,t} = \alpha_c + \alpha_t + \rho_s PD^s_{c,t-1} + \epsilon^s_{c,t}, \tag{8}$$

$$PD^f_{c,t} = \alpha_c + \alpha_t + \rho_f PD^f_{c,t-1} + \epsilon^f_{c,t}. \tag{9}$$

The residuals from Eq. 8 represent a sentiment shock ($\epsilon^s_{c,t}$), defined as a shock to investors' expectations of future productivity unrelated to economic fundamentals. Conversely, the residuals from Eq. 9 represent an economic news shock ($\epsilon^f_{c,t}$).[8]

In the empirical analysis, we use productivity, long-run news, and sentiment shocks to predict macroeconomic outcomes:

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

where $g_{c,t+h}$ represents the growth rate of real GDP, real consumption, or employment, and again $h = 1, 2, 3, 4$.[9] In less advanced economies, we expect sentiment to exert a positive effect on productivity ($\beta^s_a > 0$),

[7] The inclusion of labor and inflation variables to orthogonalize sentiment is particularly important in this respect, because they exhibit a strong relation with aggregate stock prices (Constantinides and Ghosh (2021)).

[8] In related work, L'Huillier et al. (2022) propose a decomposition of consumer confidence into a component explained by current and past fundamentals and another that includes agents' information (news) on future fundamentals. Our approach differs from theirs in two important ways. First, they focus on economic news shocks whereas we also attempt to identify productivity and sentiment shocks. Second, we use a larger number of macroeconomic variables to include known predictors of aggregate asset prices.

[9] The results that follow are similar when we alternatively identify news and sentiment shocks as changes in the two components of the price-dividend ratio, rather than estimate an autoregressive model.

as well as economic growth ($\beta_g^s > 0$). 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.

We acknowledge that some of our test equations make use of generated regressors, which implies a potential downward-bias in the standard errors of the coefficients of interest. To address this issue, we follow Engelberg et al. (2018) and correct standard errors using a block bootstrap with 200 repetitions. Since blocks correspond to the unit of observation (countries in our case), this methodology performs bootstrapping at the country-level instead of using the entire sample indiscriminately. As a result, we are able to impose a more precise autocorrelation structure in our standard errors.[10]

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

4. The unexplained sentiment

We begin our empirical analysis by identifying the effect of "unexplained" sentiment, defined as the sentiment component that does not reflect economic fundamentals, on total factor productivity. To this end, we study a potential lead-lag relation between sentiment and productivity (subsection 4.1), control for a wide array of macroeconomic fundamentals (subsection 4.2), identify exogenous variation in sentiment using weather patterns (subsection 4.3), and propose a sentiment decomposition in the spirit of Baker and Wurgler (2006) based on economic fundamentals (subsection 4.4).

4.1. VAR model

As a preliminary test, we estimate a panel VAR model to study the lead-lag relation between productivity and raw sentiment. Although this is a coarse specification that does not distinguish between explained and orthogonalized sentiment, it is nonetheless useful because it allows us to test our basic conjecture through a more unified approach while controlling for several lags of our two key variables of interest.

The model includes four lags and uses forward orthogonal deviation from the Helmert transformation to remove panel-specific fixed effects. As customary, we estimate an orthogonalized impulse-response function based on the Cholesky decomposition. As our identifying assumption, we impose the coefficient restriction that sentiment has no contemporaneous effect on productivity. The intuition is that it takes time for the impulse of sentiment to propagate through the economy, ultimately affecting productivity.[11]

The results, reported in Figure 1, provide evidence consistent with our expectations in two ways. First, we find that a sentiment shock predicts an increase in future productivity. Second, the magnitude of the effect is monotonically decreasing and effectively becomes zero by year five, which seems to reflect the fleeting

[10] E.g., Greene (2018) for a theoretical discussion. We find similar estimates when using "naive" bootstrapping (i.e., without country-level clustering) or replacing bootstrapping altogether with raw standard errors clustered by country.

[11] Previous studies show that asset prices do not immediately affect productivity (Beaudry and Portier (2006); Colacito et al. (2018)). In our framework, sentiment is a short-term component of asset prices (Hirshleifer (2001); Baker and Wurgler (2006)).

nature of sentiment. The importance of this test is that sentiment shocks can be thought of as exogenous, in the sense that they do not spuriously reflect past productivity shocks.

[Figure 1 here]

We also repeat the analysis separately for relatively more advanced economies (G7 countries) and less advanced ones (non-G7). The results are plotted in Figures 2and 3, respectively. Consistent with our theoretical predictions, we find that the results from the full sample are largely driven by non-G7 countries, where we hypothesize that sentiment is harder to disentangle from economic fundamentals. We shed further light on this empirical pattern in the panel analyses that follow.

[Figure 2 here]

[Figure 3 here]

4.2. Macroeconomic fundamentals

Next, we analyze whether these results are driven by the explained or the unexplained sentiment component. To this end, we run panel regressions of future productivity on sentiment, controlling for the five country-level macroeconomic variables introduced above, the US macroeconomic variables from Ludvigson and Ng (2009), and country fixed effects (see Eq. 3). Thanks to the Frisch–Waugh–Lovell theorem, the coefficient of sentiment in this type of regression can be interpreted as the effect of orthogonalized sentiment without performing the associated decomposition, because we are purging the results from the potential confounding effect of other explanatory variables by including them on the right-hand side of the test equation.

In Table 2, we report the results for the full sample. We find that a one-standard-deviation increase in sentiment is associated with a positive and highly significant increase in one-year-ahead productivity growth of 0.90% (t-stat 2.84). Consistent with the transient nature of sentiment, we find that the magnitude of the effect decreases monotonically over time. A one-standard-deviation increase in sentiment is followed by an increase in productivity growth of 0.71% (t-stat 2.25), 0.68% (t-stat 2.20), and 0.62% (t-stat 2.12) for horizons of two, three, and four years ahead respectively.

[Table 2 here]

In Tables 3 and 4, we repeat the analysis for the subsamples of G7 and non-G7 countries, respectively. Consistent with our conjecture that less advanced economies should be more sensitive to sentiment, we find that the coefficient is near-zero and not significant for G7 countries whereas it is positive and highly

significant for non-G7 countries. In the latter subsample, the estimates are respectively equal to 0.99% (t-stat 3.04), 0.86% (t-stat 2.46), 0.82% (t-stat 2.50), and 0.77% (t-stat 2.45) for each of the four time horizons under consideration. The results from the full sample are therefore entirely driven by the non-G7 subsample, where the coefficient of interest is stronger in both magnitude and significance.

[Table 3 here]

[Table 4 here]

4.3. Weather-related sentiment

Despite our effort to control for lead-lag effects and macroeconomic indicators, the relation between sentiment and productivity may still suffer from endogeneity issues due for example to omitted variable bias or reverse causality. To address this concern, we identify exogenous variation in sentiment by exploiting the well-known positive effect of sunshine on investor mood and behavior (e.g., Cortés et al. (2016)). Specifically, we expect a decrease in local rainfall in a given year to boost local sentiment. In our setup, this effect should translate into an increase in future productivity.

To test this conjecture, we proceed as follows. We collect weather data from the Global Historical Climatology Network's Global Summary of the Year database. Following previous literature, we select the weather stations that are closest to the cities where stock exchanges are located (Hirshleifer and Shumway (2003); ;Dong and Tremblay (2022)). Then we create a dummy variable that takes on the value one if local rainfall has decreased in a given year, and zero otherwise. This specification allows us to compare rainfall patterns across countries that exhibit different baseline amounts of precipitation.

In the first stage, we regress our sentiment measure on the rainfall dummy with country and year fixed effects. Consistent with our conjecture, we find that a decrease in annual rainfall in a given country is indeed associated with an increase in sentiment of approximately one-fifth of a standard deviation. Although the magnitude is small, it is nonetheless statistically significant (t-stat 2.45). We define the fitted values from this regression as "weather-related" sentiment. In the second stage, we re-estimate Eq. 3 by replacing sentiment with its weather-related and residual components.

The results, reported in Table 5, follow a similar empirical pattern to that from our previous tests. In the full sample (Panel A), a one-standard-deviation increase in weather-related sentiment is associated with a positive and highly significant increase in productivity growth up to four years ahead. The estimates are equal to of 1.19% (t-stat 2.67), 0.91% (t-stat 2.11), 1.11% (t-stat 2.32), and 1.08% (t-stat 2.30), for one, two, three, and four years ahead, respectively.[12] In the subsample of G7 countries (Panel B), none of the

[12]The point estimates need to be interpreted with caution here, due to the magnitude of the first-stage coefficient.

coefficients of weather-related sentiment are significant. By contrast, the estimates are positive and highly significant in the subsample of non-G7 countries (Panel C). A one-standard-deviation increase in weather-related sentiment is associated with an increase in future productivity of 1.12% (t-stat 2.77), 0.86% (t-stat 2.26), 1.01% (t-stat 3.38), and 0.97% (t-stat 3.34) for each of the four years under consideration, respectively.

[Table 5 here]

We recognize that extreme precipitation may have a negative effect on productivity through a channel other than sentiment, for example through reduced agricultural output or disruption in the service industry. To allay this concern, we purge the data from this potential confounding effect as follows. The Global Summary of the Year database reports the number of days per year with extreme precipitation, defined as instances of daily rainfall above 1.00 inch. We subtract this count variable from the total number of precipitation days in a year and repeat our analysis with this adjusted variable. The estimates, reported in Table A1, are virtually unchanged in both magnitude and significance.

Overall, these results provide support to the validity to our identification of sentiment.

4.4. Explained and unexplained sentiment

Finally, we propose decomposition of the sentiment into an explained and an unexplained component based on Eq. 2. This approach allows us to potentially identify multiple sources of sentiment, also not weather-related. The presence of year fixed effects also allows us to capture the potential confounding effect of any variables that are global in nature, such as the level of sentiment of global investors (Baker et al. (2012); Montone and Zwinkels (2020)), which may drive economic growth in its own right (Dees (2017)).

[Table 6 here]

The results are in Table 6. Despite this more conservative setup, we obtain similar estimates. Among non-G7 countries, the coefficient of orthogonalized sentiment is equal to 1.11% (t-stat 3.94), 0.98% (t-stat 3.30), 0.92% (t-stat 2.89), and 0.80% (t-stat 2.34) for each of the four time horizons under consideration. By contrast, the coefficient is close to zero and insignificant for the subsample of G7 countries. In additional tests, we find similar results when measuring sentiment in December (see Table A2).

Altogether, our empirical analysis shows that sentiment has a positive and monotonically decreasing effect on future productivity growth. The effect is confined to the subsample of relatively less advanced economies and seems to be driven by the unexplained component of sentiment.

5. Testing the channel

In this section, we explore the channel that underlies our results. We propose two sets of tests. First, we study the relation between sentiment and economic growth (subsection 5.1). Second, we test three specific predictions of the sentiment hypothesis (subsection 5.2).

5.1. Future economic growth

Barsky and Sims (2012) show that sentiment-driven increases in productivity should take place through a mechanism of endogenous economic growth, which is characterized by a fast and substantial increase in economic activity. We test this prediction next.

To study the effect of sentiment on future economic growth, we start with real consumption growth. The results are in Table 7. We find that orthogonalized sentiment is a positive predictor of future real consumption growth, but again the results are largely driven by non-G7 economies. Among G7 countries, a one-standard-deviation increase in sentiment is followed by a 0.57% increase in one-year-ahead real consumption growth (t-stat 2.76), and a marginally significant 0.23% increase at a two-year horizons. For three and four years ahead, the coefficient is insignificant.

For non-G7 countries, the coefficient of orthogonalized sentiment is positive and highly significant for up to three years ahead. The magnitude is equal to 0.91% (t-stat 8.42), 0.64% (t-stat 6.80), and 0.41% (t-stat 3.27), respectively. In year four, the effect vanishes (0.05%, t-stat 0.40). The coefficient of interest again follows a monotonically decreasing pattern, tailing off to zero.

[Table 7 here]

Next, we repeat the analysis for employment growth. The results are reported in Table 8. We find a similar empirical pattern. A one-standard-deviation increase in orthogonalized sentiment is followed by a 0.28% increase in one-year-ahead employment growth in G7 countries (t-stat 3.71). In years two and three, the coefficient is small and insignificant. In year four, the coefficient becomes negative although marginally significant (0.11%, t-stat -1.70), indicating a reversal of the sentiment effect on employment growth. For non-G7 countries, the coefficient is again positive and significant for up to three years ahead, with magnitude equal to 0.88% (t-stat 7.78), 0.65% (t-stat 5.72), and 0.35% (t-stat 2.81), respectively. In year four, the effect vanishes (0.09%, t-stat 0.57).

[Table 8 here]

In unreported analyses, we find that the coefficient is not significant at longer horizons of five to eight years ahead. The absence of reversals suggests that these real effects of sentiment on consumption and employment growth are permanent. Also, the absence of a sentiment effect in the very long run further supports our interpretation of sentiment as a bias in expectations rather than long-run economic news. However, these additional results need to be interpreted with caution due to the smaller sample size.

Finally, we study the relation between sentiment and future real GDP growth, which represents one of the most comprehensive indicators of a country's economic performance. The results are in Table 9. We find again a similar empirical pattern. Following a one-standard-deviation increase in orthogonalized sentiment, one-year-ahead GDP growth increases by a 0.27% among G7 countries (t-stat 2.11). The effect

is insignificant and close to zero in year two, whereas it becomes negative although marginally significant in year three (0.23%, t-stat -1.79), thereby implying a reversal of the sentiment effect from year one. In year four, the coefficient is again insignificant.

For non-G7 countries, the coefficient of orthogonalized sentiment is highly significant in years one and two. The magnitude is equal to 0.78% (t-stat 7.41) and 0.37% (t-stat 3.48), respectively. Notably, the one-year effect is almost three times as large as that for G7 countries. At longer horizons, the estimates are insignificant.

[Table 9 here]

Overall, unexplained sentiment is a positive predictor of future growth in consumption, employment, and income. Importantly, the results differ across G7 and non-G7 countries. The effect is smaller and shorter-lived in advanced economies, whereas it is large and lasts for up to three years in less advanced economies. Taken together, the estimates suggest that sentiment shocks do not affect 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.

5.2. Sentiment-specific predictions

Previous literature cautions that sentiment may reflect news on future fundamentals that is not included in current and past fundamentals (L'Huillier et al. (2022)). Although the analysis of weather-related sentiment in subsection 4.3 already speaks to this concern, we further address this point by testing three predictions that are specific to the sentiment story and would not otherwise hold if our measure of sentiment captures unobservable future fundamentals. Following previous literature, we expect a wave of high sentiment to be followed by a mispricing correction, an aggregate shift from credit to equity markets, and a short-term increase in capital investments through managerial market timing.

Mispricing correction

Periods of high sentiment should be characterized by stock overpricing and a subsequent correction, where prices revert back to fundamentals. As a result, high sentiment should be followed by lower stock returns (e.g., Baker and Wurgler (2006, 2007) for US 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, explained and orthogonalized sentiment.

The results are in Table 10. Consistent with the hypothesized mechanism, we find that orthogonalized sentiment predicts negative one-year-ahead equity returns. The effect is concentrated in G7 countries, which indicates the presence of more effective arbitrage forces. Specifically, a one-standard-deviation increase in

orthogonalized sentiment is followed by a decrease in stock returns of 1.91% (t-stat -2.74). By contrast, explained sentiment is a positive predictor of one-year-ahead equity returns, as expected from a measure of economic fundamentals. For non-G7 countries, these two effects have the right signs but are close to zero and insignificant.

[Table 10 here]

In additional tests, we find that the results for explained sentiment are driven by innovations in inflation and employment (see Table A3). These seem to represent the two driving forces behind the positive relation between explained sentiment and subsequent equity returns, which is consistent with previous research showing that these variables are important to explain aggregate equity prices (Constantinides and Ghosh (2021)). The results again only hold among G7 countries, which lends further 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 mispricing correction fully occurs within one year, which matches the findings of previous studies on mispricing correction in advanced economies (e.g., Baker et al. (2012)). Conversely, the coefficient is negative and significant for two- and three-year-ahead stock returns among non-G7 countries and becomes insignificant 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 1.98% two years ahead (t-stat -2.14) and 2.70% three years ahead (t-stat -3.36).[13]

A large literature shows that unsophisticated investors tend to leave the market when they hold pessimistic beliefs (e.g., Chen et al. (2002); Stambaugh et al. (2012); Hong and Sraer (2013); Antoniou et al. (2016)). Therefore, sentiment tends to have an asymmetric effect on stock prices. When sentiment is high, the high demand by unsophisticated traders inflates stock prices, thereby causing overpricing. When sentiment is low, unsophisticated traders tend to exit the market. As a result, the distortionary effect of sentiment on stock prices mostly occurs when sentiment is high. In additional tests, we find evidence in support of this mechanism (see Table A4). Mispricing correction only takes place in the high-sentiment subsample (i.e., above-median), but not in the low-sentiment one (i.e., below-median).[14]

Overall, these results present a clear picture. The orthogonalized component of sentiment is a negative predictor of future stock returns, consistent with mispricing correction. The explained component of sentiment, on the other hand, is a positive predictor of future stock returns, consistent with the well-known positive relation between economic fundamentals and stock prices. The opposite signs of these two effects lend support to the validity of our identification strategy, suggesting that the measure of orthogonalized

[13]Mutual funds and ETFs, such as the Fidelity Emerging Markets Fund, may take advantage of this predictability by increasing the investment weight in countries with predicted high market return.

[14]Unfortunately, the relatively small number of observations in these two subsamples does not allow us to perform a further breakdown into G7 and non-G7 countries.

sentiment is correctly identified.

More generally, the results lend support to our conjecture that advanced economies have more advanced financial markets. Mispricing correction is faster in G7 countries, as it fully occurs within one year and smaller, which indicates the presence of lower initial mispricing. Conversely, mispricing correction is slower in non-G7 countries as it takes place two and three years ahead and larger, which attests to the presence of greater mispricing. Markets in less advanced economies then seem to be characterized by weaker arbitrage forces.

Equity and credit markets

The high stock valuations that characterize periods of high sentiment decrease the cost of equity for companies (e.g., Baker et al. (2003)), thereby generating an aggregate shift from credit to equity markets (e.g., Baker and Wurgler (2000, 2002)). In light of this, our measure of orthogonalized sentiment should predict an increase in the size of local equity markets relative to the size of credit markets. To test this conjecture, we identify these two measures as the country-level total stock trading and total bank lending from the World Bank, and express them as a ratio. Then we study the relation between this ratio and the two sentiment components introduced above.

The results are in Table 11. Consistent with the sentiment story, we find that an increase in orthogonalized sentiment predicts an increase in the size of the local equity market relative to the credit market. The magnitude monotonically decreases over time and the results are confined to non-G7 countries, which is consistent with our previous finding that such markets are characterized by greater and more prolonged overpricing. Note that the sign of this effect is different from that of a hypothetical credit channel. Given the positive relation between the supply of credit and the state of the economy (e.g., Mian et al. (2017)), if orthogonalized sentiment captured some omitted fundamentals then it should be a negative predictor of the equity-credit ratio.

[Table 11 here]

Market timing

The shift towards equity that follows periods of high sentiment should be driven by rational managers, who bring forward capital investments to exploit the lower cost of capital (e.g., McLean and Zhao (2014)). This strategy represents an instance of market timing and takes place both at the micro and the macro level (Arif and Lee (2014)). In light of this mechanism, we expect sentiment shocks to predict a short-term increase in capital investment.

The estimates are in Table 12. Consistent with our conjecture, we find that orthogonalized sentiment predicts an increase in capital growth and the effect is entirely confined to non-G7 countries over a one-year horizon. A one-standard-deviation increase in orthogonalized sentiment is followed by a large and highly

significant 2.27% increase in the one-year-ahead capital growth in non-G7 countries (t-stat 6.72), whereas the effect is much smaller and largely insignificant for G7 countries. Conversely, the explained component of sentiment is a negative predictor of future capital growth. This result seems to reflect the fact that the stock of capital is high during good economic times, which in turn decreases the subsequent rate of growth of capital.

[Table 12 here]

It is also interesting to compare these results to those of the employment growth tests (Table 8). The magnitude of the sentiment shock coefficient is much larger for capital than it is for employment. Correspondingly, in additional tests we also find that a sentiment shock leads to a persistent increase in capital intensity, defined as the logarithm of the ratio between physical capital and labor, and the effect is again entirely concentrated among non-G7 countries (see Table A5). Finally, we also find a similar empirical pattern for investment not only in physical capital but also in research and development (see Table A6).[15] This is further confirmation of the mechanism we hypothesize, namely that high equity prices make it optimal to bring forward long-term investment, and also suggests that the corresponding increase in productivity partly comes from an innovation channel.

Overall, these results from the analysis of capital formation support the sentiment hypothesis in two ways. First, the very short-term nature of the effect suggests that our measure of sentiment represents a distortion of short-term beliefs rather than a signal for long-term economic growth. Second, the concentration of the effect among non-G7 countries matches the findings from the analysis of equity returns, which shows that mispricing is much larger and more persistent in these countries (see Table 10). Specifically, mispricing is not corrected yet one year ahead, which is exactly when managers seem to engage in market timing to exploit the lower cost of capital.

6. Price-dividend ratio

In this final section, we relate our results to the earlier literature on the price-dividend ratio. We first study the relation between future productivity and the price-dividend ratio in our sample (subsection 6.1), then we test how shocks to productivity and the two components of the price-dividend ratio affect future economic growth (subsection 6.2).

6.1. Model with sentiment

In a preliminary test, we begin to analyze the relation between price-dividend ratios and future productivity by estimating Eq. 4, i.e., the original test equation from Colacito et al. (2018) that includes the raw

[15] Unfortunately, we are unable to carry out this test separately for G7 and non-G7 countries due to low data coverage.

price-dividend ratio. The estimates are in Table A7. Consistent with their results, we find that the price-dividend ratio is a positive predictor of future productivity growth among G7 countries up to four years into the future. Conversely, the effect is absent among non-G7 countries at any horizon. These results indicate that the price-dividend ratio indeed contains long-run news over productivity growth, but only among more advanced economies.[16]

To look further into these findings, we perform the sentiment decomposition of the price-dividend ratio into a fundamental and a sentiment component from Eq. 5. Therefore, we estimate Eq. 7. The results are in Table 13. 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 A7. Specifically, a one-standard-deviation increase in the fundamental component of the price-dividend ratio is associated with an increase in productivity of 4.01% over the subsequent year (t-stat 2.13). On the other hand, the coefficient of the sentiment component is small and insignificant.

[Table 13 here]

In non-G7 countries, the empirical pattern is reversed. The coefficient of the fundamental component of the price-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 of the price-dividend ratio is associated with an increase in productivity of 15.78% over the subsequent year (t-stat 3.87).

The analysis of future productivity at farther horizons reveals another interesting empirical pattern. The estimates become 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 4.07% two years ahead (t-stat 2.23), 4.14% three years ahead (t-stat 2.35), and 4.08% four years ahead (t-stat 2.31). Conversely, the effect of the sentiment component of the price-dividend ratio becomes progressively weaker for non-G7 countries. The coefficient is 14.21% two years ahead (t-stat 3.20), 13.23% three years ahead (t-stat 2.81), and 11.52% four years ahead (t-stat 2.28).

One potential concern with these results is that the inclusion of the US may partly distort the estimates. The reason is twofold. First, the US is one of the driving forces not only for the world economy but also for international financial markets (Albuquerque et al. (2009); Baker et al. (2012); Rapach et al. (2013); Montone and Zwinkels (2020)). Second, the calculation of total factor productivity uses the US as the reference country. Reassuringly, we obtain similar estimates when we exclude the US from the sample (see Table A8). In additional tests, we repeat the analysis using the growth rate of welfare-relevant total factor productivity as dependent variable, which is calculated using prices that are more relevant to consumers

[16] A possible explanation for this finding is that non-G7 economies rely comparatively more on foreign investments to thrive (e.g., Albuquerque et al. (2005)) and acquire know-how (e.g., Hummels et al. (2001)). As a result, their country-specific economic fundamentals may be less relevant to productivity than the fundamentals of more advanced economies.

rather than firms (e.g., Basu et al. (2012)). The estimates are virtually identical (see Table A9). We also find similar results when measuring sentiment in December (see Table A10).

Overall, the findings are consistent with our theoretical arguments in two ways. First, the fundamental component of the price-dividend ratio 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 (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.

6.2. Sentiment shocks and future economic growth

Overall, the predictive power of the sentiment component of the price-dividend ratio over future productivity, along with its decreasing magnitude over time, suggests again that sentiment shocks in less advanced economies may affect future fundamentals by generating endogenous growth. To test this hypothesis, we estimate Eq. 10, where we can study the effect of sentiment shocks on future growth controlling for economic news and productivity shocks.

We start from the analysis of real consumption growth. The results, reported in Table 14, indicate that sentiment shocks are positively associated with future real 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, real consumption growth increases by 0.47% among the former (t-stat 3.04) and 0.59% among the latter (t-stat 4.27).

[Table 14 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 real consumption growth of 0.38% two years ahead (t-stat 3.68), whereas the effect becomes insignificant and close to zero three and four years ahead. Among non-G7 countries, the magnitude of the effect is 0.59% two years ahead (t-stat 6.54) 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 0.51% (t-stat 4.08). Four years ahead, the effect drops to 0.25% although it keeps its statistical significance (t-stat 2.79).

In Table 15, we repeat the analysis for employment growth. We find a similar empirical pattern and 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 0.22% among G7 countries (t-stat 3.51). Among non-G7 countries, the effect is almost three times as large and equal to 0.55% (t-stat 4.70).

[Table 15 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 0.14% two years ahead (t-stat 3.50), 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 and again decreases monotonically over time. The magnitude is 0.55% two years ahead (t-stat 7.84), 0.41% three years ahead (t-stat 5.04), and 0.19% four years ahead (t-stat 2.18).

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.

Finally, we study the relation between sentiment shocks and real GDP growth. The results, reported in Table 16, reveal again a similar empirical pattern. Following a one-standard-deviation sentiment shock, one-year-ahead GDP growth increases by 0.41% among G7 countries (t-stat 4.96). The effect is larger among non-G7 countries and equal to 0.68% (t-stat 8.02). 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 0.39% two years ahead (t-stat 3.72), 0.26% three years ahead (t-stat 2.00), and 0.17% four years ahead (t-stat 2.18).

[Table 16 here]

As for the other regressors, we find that productivity shocks are unrelated to future real GDP growth. These estimates seem to reflect the presence of strong global comovements across productivity shocks (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 four years ahead among G7 countries, which is consistent with the idea that such shocks capture long-term fundamentals (Colacito et al. (2018)).

Overall, sentiment shocks predict large growth in consumption, employment, and income. As in our preliminary analysis of sentiment, the results differ substantially between countries from the G7 and non-G7 cohorts. The effect is smaller and tails off within two years in advanced economies, whereas it is large and persists for up to four years in less advanced economies. The results then lend further support to our previous finding that sentiment is uncorrelated with economic fundamentals in G7 countries, whereas it seems to create self-fulfilling feedback loops in non-G7 countries.

Importantly, the results from the price-dividend ratio analysis address the concern that sentiment might

reflect long-run economic news that is uncorrelated with current or future fundamentals. In our setup, this effect is captured by the fundamental component of the price-dividend ratio. Furthermore, we also control for productivity shocks thus showing that our sentiment results do not merely (and spuriously) reflect future productivity news. Finally, another advantage of using our price-dividend ratio decomposition is that the price-dividend ratio is a forward-looking measure. Correspondingly, our estimated shocks have stronger explanatory power over longer horizons than the simple sentiment measure used in Section 4.

7. 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 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 cross-country data from the OECD, 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 stock prices.

One of the main hurdles of this empirical exercise is the correct identification of sentiment. The difficulty lies in the fact that sentiment partly reflects the state of the economy and potentially includes unobservable news on future economic fundamentals. Although we cannot completely exclude this possibility, we do provide some evidence that points to the contrary. Weather-related sentiment, for example, exhibits a strong relation with future productivity despite being arguably exogenous in nature. We also find that sentiment predicts a decrease in local stock returns, an aggregate shift from credit to equity, and a short-term increase in capital investment. Crucially, these relations are stronger for economies that are expected to be more sensitive to sentiment – the less advanced ones. These empirical patterns are hard to reconcile with the alternative story that our measure of sentiment might just reflect some omitted fundamentals.

Altogether, these findings provide an explanation for 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 US) 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.

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Figure 1. Panel VAR between total factor productivity and sentiment: Full sample

Graph of the impulse-response function from the panel vector autoregression model of country-level annual total factor productivity growth and sentiment. Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. Sentiment is defined as the country-level consumer confidence index. The model includes four lags and the Choleski decomposition assumes that sentiment cannot have a contemporaneous effect on productivity. The sample includes seventeen countries over the period 1975-2019. Country-level productivity data is from the Penn World Table V.10, and country-level consumer confidence data is from the OECD.

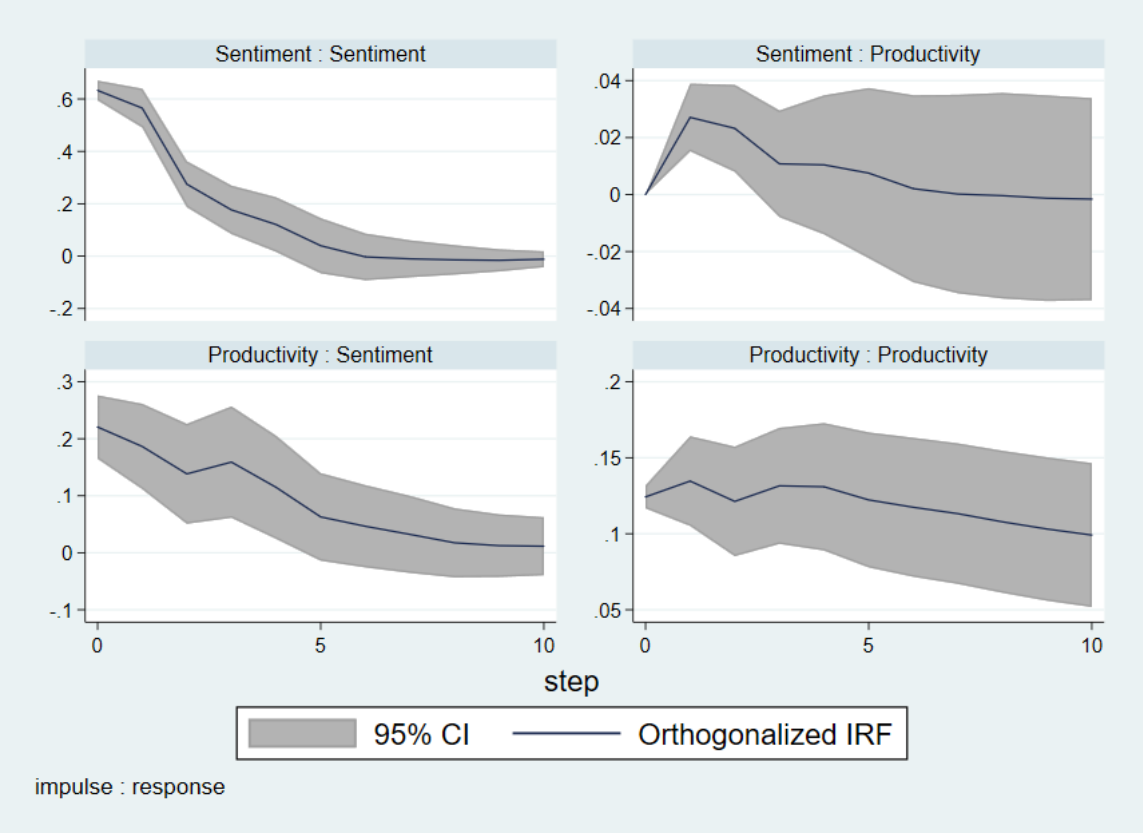

Figure 2. Panel VAR between total factor productivity and sentiment: G7 countries

Graph of the impulse-response function from the panel vector autoregression model of country-level annual total factor productivity growth and sentiment. Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. Sentiment is defined as the country-level consumer confidence index. The model includes four lags and the Choleski decomposition assumes that sentiment cannot have a contemporaneous effect on productivity. The sample includes six G7 countries over the period 1975-2019. Country-level productivity data is from the Penn World Table V.10, and country-level consumer confidence data is from the OECD.

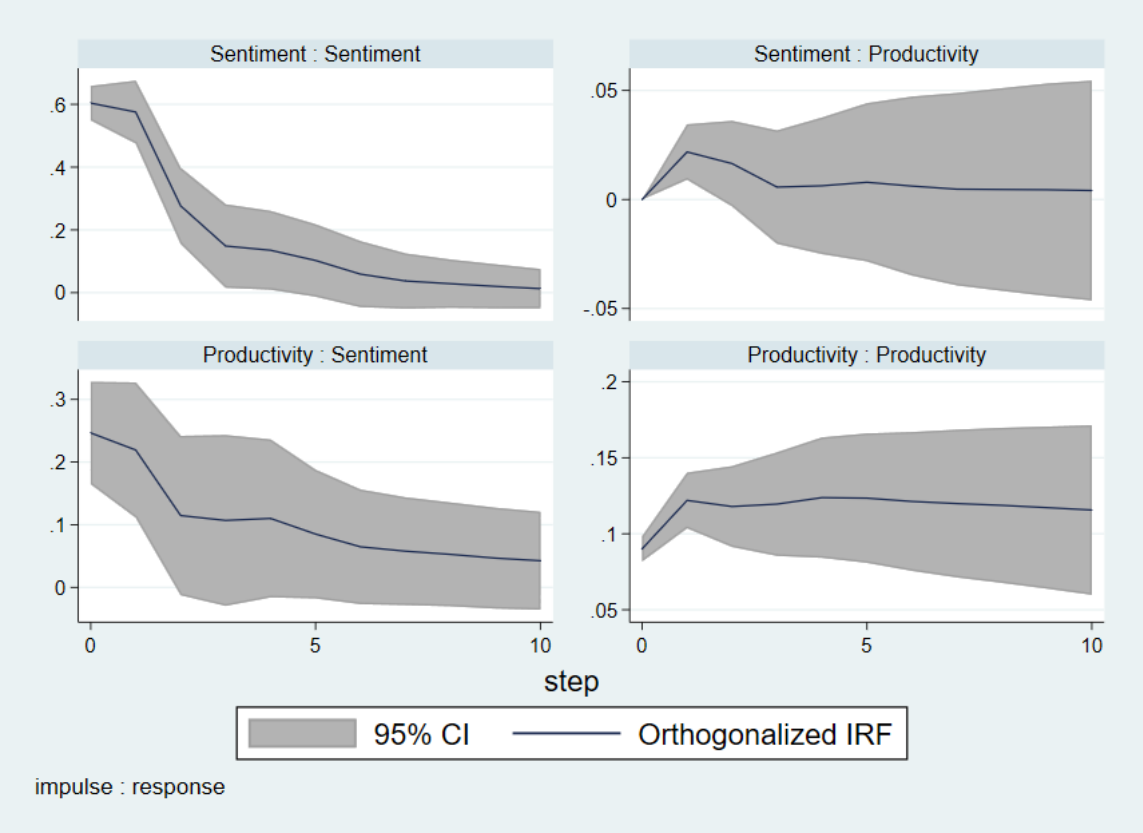

Figure 3. Panel VAR between total factor productivity and sentiment: non-G7 countries

Graph of the impulse-response function from the panel vector autoregression model of country-level annual total factor productivity growth and sentiment. Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. Sentiment is defined as the country-level consumer confidence index. The model includes four lags and the Choleski decomposition assumes that sentiment cannot have a contemporaneous effect on productivity. The sample includes eleven G7 countries over the period 1975-2019. Country-level productivity data is from the Penn World Table V.10, and country-level consumer confidence data is from the OECD.

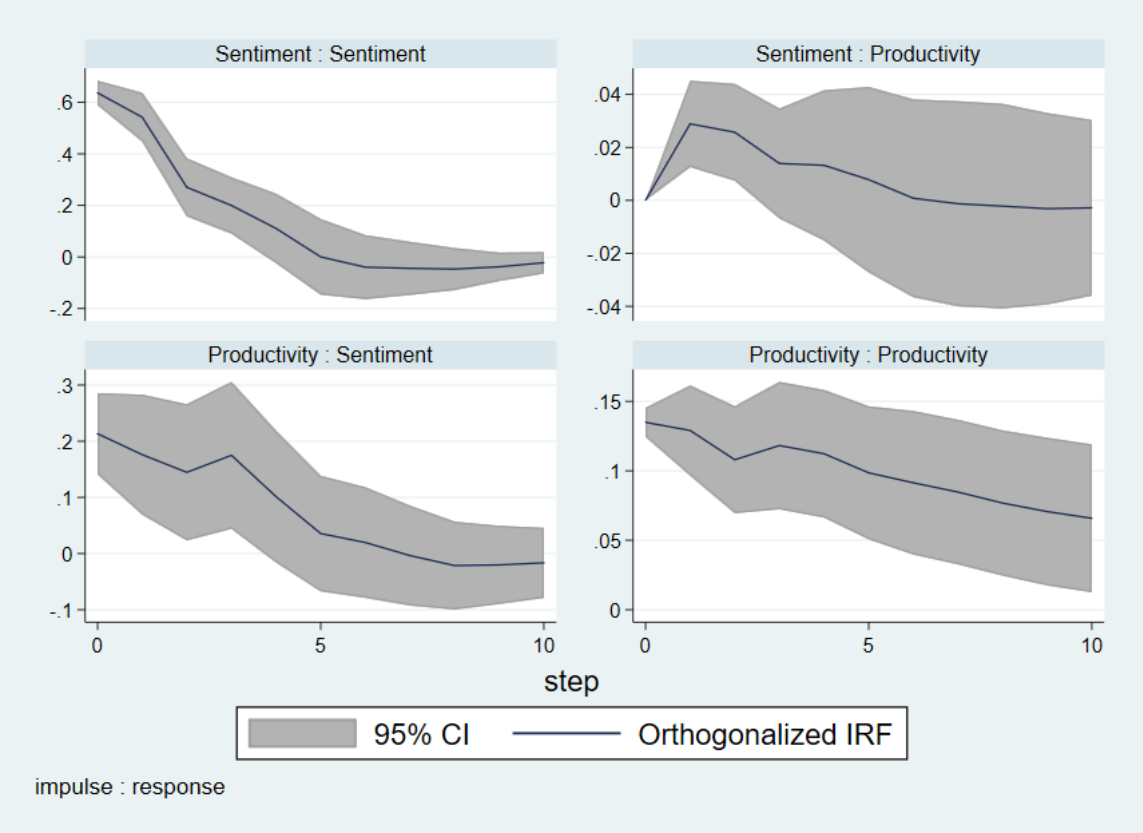

Table 1. Summary statistics

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 the US 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, real consumption, and employment, and country and year fixed effects; and the rate of growth of real GDP, real consumption, and employment. The sample includes seventeen 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	0.9388	0.1137	0.8746	0.9635	1.0013
PD	35.4332	18.0821	22.8777	31.0078	43.7639
Sentiment	0.0000	1.8399	-1.0041	0.1590	1.1517
Real GDP	0.0270	0.0297	0.0140	0.0280	0.0418
Real consumption	0.0243	0.0365	0.0068	0.0248	0.0433
Employment	0.0096	0.0189	0.0016	0.0108	0.0199

Panel B. G7 countries

Variable	Mean	Std. Deviation	P25	Median	P75
TFP	0.9285	0.1154	0.8481	0.9563	0.9989
PD	33.5821	13.6745	24.0674	30.7238	41.4966
Sentiment	-0.2056	1.4915	-1.3030	-0.3531	0.8444
Real GDP	0.0218	0.0200	0.0117	0.0230	0.0340
Real consumption	0.0216	0.0222	0.0090	0.0234	0.0367
Employment	0.0083	0.0123	0.0024	0.0096	0.0159

Panel C. Non-G7 countries

Variable	Mean	Std. Deviation	P25	Median	P75
TFP	0.9419	0.1131	0.8788	0.9665	1.0029
PD	36.7420	20.5551	22.2718	31.1043	46.6203
Sentiment	0.0602	1.9265	-0.9063	0.2635	1.2184
Real GDP	0.0285	0.0319	0.0151	0.0300	0.0439
Real consumption	0.0251	0.0397	0.0065	0.0254	0.0464
Employment	0.0100	0.0204	0.0010	0.0116	0.0211

Table 2. Total factor productivity and sentiment: Full sample

Panel regressions of country-level annual total factor productivity growth one, two, three, or four years ahead on sentiment, defined as the country-level consumer confidence index, a vector of country-level macroeconomic variables, which includes innovations in local real GDP, real consumption, employment, labor share in GDP, and inflation, and the eight principal components of 132 US macroeconomic variables from Ludvigson and Ng (2009). Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen countries over the period 1975-2019. All specifications include country fixed effects and standard errors clustered by year. The country-level macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Dependent variable: Productivity growth	(1) t+1	(2) t+2	(3) t+3	(4) t+4
Sentiment	0.0090***	0.0071**	0.0068**	0.0062**
	2.84	2.25	2.20	2.12
Δ RGDP	0.0094**	0.0088**	0.0075*	0.0089**
	2.22	1.98	1.73	2.04
Δ Employment	-0.0194***	-0.0206***	-0.0189***	-0.0193***
	-3.34	-4.14	-3.75	-4.00
Δ Consumption	0.0046	0.0053	0.0063	0.0049
	1.11	1.27	1.51	1.29
Δ Labor share	-0.0033	-0.0015	-0.0024	-0.0034
	-0.98	-0.49	-0.78	-1.25
Δ Inflation	-0.0330***	-0.0297***	-0.0299***	-0.0283***
	-3.73	-3.21	-3.20	-3.01
F1	0.0403***	0.0401***	0.0409***	0.0372***
	5.56	5.94	5.78	4.89
F2	-0.0210	-0.0193	-0.0304**	-0.0320**
	-1.38	-1.31	-2.04	-2.19
F3	0.0126	0.0123	0.0285*	0.0337**
	0.72	0.72	1.70	2.18
F4	-0.0053	-0.0046	-0.0087	-0.0108
	-0.67	-0.58	-1.20	-1.58
F5	-0.0376***	-0.0389***	-0.0332***	-0.0251***
	-5.08	-5.23	-4.76	-3.85
F6	-0.0219***	-0.0203***	-0.0198***	-0.0195***
	-3.26	-3.10	-3.23	-3.42
F7	0.0155***	0.0142***	0.0165***	0.0149***
	3.33	3.21	3.49	2.82
F8	0.0259***	0.0218***	0.0244***	0.0260***
	4.16	3.68	4.12	4.30
Country FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.6655	0.6592	0.6550	0.6492

Table 3. Total factor productivity and sentiment: G7 countries

Panel regressions of country-level annual total factor productivity growth one, two, three, or four years ahead on sentiment, defined as the country-level consumer confidence index, a vector of country-level macroeconomic variables, which includes innovations in local real GDP, real consumption, employment, labor share in GDP, and inflation, and the eight principal components of 132 US macroeconomic variables from Ludvigson and Ng (2009). Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes six G7 countries over the period 1975-2019. All specifications include country fixed effects and standard errors clustered by year. The country-level macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Sentiment	-0.0001	-0.0017	-0.0021	-0.0022
	-0.01	-0.34	-0.43	-0.48
Δ RGDP	0.0095**	0.0094*	0.0080*	0.0108**
	2.08	1.95	1.67	2.43
Δ Employment	-0.0137*	-0.0163**	-0.0156**	-0.0175***
	-1.86	-2.54	-2.36	-2.74
Δ Consumption	0.0056	0.0060	0.0074	0.0049
	1.21	1.27	1.52	1.16
Δ Labor share	-0.0130**	-0.0101*	-0.0101*	-0.0087
	-2.17	-1.73	-1.75	-1.54
Δ Inflation	-0.0424***	-0.0434***	-0.0413***	-0.0384**
	-2.75	-2.89	-2.67	-2.43
F1	0.0444***	0.0441***	0.0448***	0.0422***
	5.43	5.65	5.65	5.07
F2	-0.0232	-0.0236	-0.0331*	-0.0316*
	-1.38	-1.43	-1.89	-1.77
F3	0.0182	0.0200	0.0328*	0.0335*
	0.98	1.09	1.73	1.75
F4	-0.0069	-0.0081	-0.0115	-0.0122
	-0.80	-0.92	-1.39	-1.51
F5	-0.0360***	-0.0354***	-0.0305***	-0.0252***
	-4.45	-4.50	-4.05	-3.31
F6	-0.0187**	-0.0180**	-0.0184***	-0.0170**
	-2.49	-2.43	-2.67	-2.56
F7	0.0159***	0.0148***	0.0167***	0.0158***
	3.14	3.02	3.23	2.75
F8	0.0319***	0.0295***	0.0310***	0.0306***
	5.18	5.17	5.26	4.86
Country FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.7228	0.7194	0.7159	0.7077

Table 4. Total factor productivity and sentiment: Non-G7 countries

Panel regressions of country-level annual total factor productivity growth one, two, three, or four years ahead on sentiment, defined as the country-level consumer confidence index, a vector of country-level macroeconomic variables, which includes innovations in local real GDP, real consumption, employment, labor share in GDP, and inflation, and the eight principal components of 132 US macroeconomic variables from Ludvigson and Ng (2009). Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes eleven non-G7 countries over the period 1975-2019. All specifications include country fixed effects and standard errors clustered by year. The country-level macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Sentiment	0.0099***	0.0086**	0.0082**	0.0077**
	3.04	2.46	2.50	2.45
Δ RGDP	0.0857***	0.0613***	0.0689***	0.0604**
	3.43	2.64	3.25	2.55
Δ Employment	-0.0811**	-0.0624*	-0.0542	-0.0347
	-2.30	-1.72	-1.52	-1.00
Δ Consumption	0.0013	0.0114	0.0006	-0.0060
	0.06	0.55	0.03	-0.26
Δ Labor share	0.0072*	0.0061	0.0056	0.0031
	1.73	1.62	1.65	0.93
Δ Inflation	-0.0260***	-0.0210**	-0.0218***	-0.0210**
	-3.37	-2.50	-2.61	-2.41
F1	0.0361***	0.0360***	0.0365***	0.0320***
	5.21	5.63	5.76	4.71
F2	-0.0111	-0.0093	-0.0209	-0.0223*
	-0.78	-0.69	-1.59	-1.65
F3	0.0037	0.0031	0.0218	0.0270*
	0.21	0.19	1.41	1.82
F4	-0.0035	-0.0017	-0.0063	-0.0089
	-0.43	-0.21	-0.88	-1.38
F5	-0.0374***	-0.0402***	-0.0339***	-0.0254***
	-5.06	-5.33	-4.87	-3.81
F6	-0.0222***	-0.0201***	-0.0185***	-0.0194***
	-3.05	-2.87	-2.85	-3.37
F7	0.0134***	0.0123***	0.0147***	0.0123**
	2.85	2.78	3.27	2.42
F8	0.0198***	0.0143**	0.0176***	0.0199***
	3.13	2.34	2.95	3.05
Country FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.6080	0.5885	0.5808	0.5678

Table 5. Total factor productivity and sentiment: Rainfall decomposition

Panel regressions of country-level annual total factor productivity growth one, two, three, or four years ahead on sentiment, defined as the country-level consumer confidence index, a vector of country-level macroeconomic variables, which includes innovations in local real GDP, real consumption, employment, labor share in GDP, and inflation, and the eight principal components of 132 US macroeconomic variables from Ludvigson and Ng (2009) Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. Sentiment is divided into a component explained by country-level annual rainfall and a residual component. Rainfall is defined as a dummy variable that takes on value one if country-level precipitation has decreased in a given year and zero otherwise. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Sentiment (Weather)	0.0119***	0.0091**	0.0111**	0.0108**
	2.67	2.11	2.32	2.30
Sentiment (Residual)	0.0048	0.0040	0.0031	0.0025
	1.30	1.09	0.83	0.70
Controls	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.4307	0.4117	0.4019	0.3857

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Sentiment (Weather)	0.0085	0.0064	0.0088	0.0092
	1.29	1.00	1.36	1.34
Sentiment (Residual)	-0.0036	-0.0044	-0.0057	-0.0060
	-0.67	-0.87	-1.15	-1.15
Controls	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.4495	0.4365	0.4316	0.4148

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Sentiment (Weather)	0.0112***	0.0086**	0.0101***	0.0097***
	2.77	2.26	3.38	3.34
Sentiment (Residual)	0.0064	0.0059	0.0052	0.0047
	1.54	1.37	1.20	1.13
Controls	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.4868	0.4582	0.4493	0.4289

Table 6. Total factor productivity and sentiment: Economic decomposition

Panel regressions of country-level annual total factor productivity one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0058**	0.0047*	0.0036	0.0028
	2.03	1.65	1.18	0.90
Explained sentiment	0.0027	0.0050	0.0055	0.0061
	0.59	1.07	1.08	1.16
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.6131	0.6052	0.5981	0.5943

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	-0.0018	-0.0028	-0.0048	-0.0053
	-0.33	-0.56	-0.89	-0.94
Explained sentiment	0.0019	0.0010	0.0029	0.0046
	0.30	0.19	0.58	0.92
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.6094	0.6021	0.5972	0.5941

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0111***	0.0098***	0.0092***	0.0080**
	3.94	3.30	2.89	2.34
Explained sentiment	0.0021	0.0085	0.0063	0.0043
	0.35	1.41	0.75	0.47
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.6662	0.6601	0.6560	0.6525

Table 7. Real consumption growth and sentiment

Panel regressions of country-level annual real consumption growth one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Consumption growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0079***	0.0049***	0.0016	-0.0001
	6.31	3.99	1.06	-0.12
Explained sentiment	0.0042***	0.0045***	-0.0011	0.0006
	2.96	2.70	-0.76	0.25
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.4183	0.3699	0.3330	0.3234

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Consumption growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0057***	0.0023*	-0.0015	-0.0007
	2.76	1.85	-0.92	-0.36
Explained sentiment	0.0047***	0.0007	-0.0009	-0.0004
	2.62	0.67	-0.38	-0.14
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.4496	0.4047	0.4033	0.3990

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Consumption growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0091***	0.0064***	0.0041***	0.0005
	8.42	6.80	3.27	0.40
Explained sentiment	0.0019	0.0110***	-0.0061	-0.0023
	0.57	3.20	-1.34	-0.42
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.4516	0.4227	0.3787	0.3532

Table 8. Employment growth and sentiment

Panel regressions of country-level annual employment growth one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Employment growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0063***	0.0040***	0.0016	-0.0002
	4.67	3.07	1.41	-0.20
Explained sentiment	0.0012	-0.0038***	-0.0055***	-0.0043***
	1.19	-4.01	-5.67	-3.67
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.5426	0.4888	0.4552	0.4447

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Employment growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0028***	0.0010	-0.0004	-0.0011*
	3.71	1.48	-0.50	-1.70
Explained sentiment	0.0012	-0.0027***	-0.0052***	-0.0041***
	1.16	-4.88	-5.75	-3.56
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.5546	0.5456	0.5763	0.5868

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Employment growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0088***	0.0065***	0.0035***	0.0009
	7.78	5.72	2.81	0.57
Explained sentiment	0.0040*	-0.0058***	-0.0076***	-0.0073*
	1.95	-2.75	-2.80	-1.92
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.6248	0.5487	0.4824	0.4552

Table 9. Real GDP growth and sentiment

Panel regressions of country-level annual real GDP growth one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Real GDP growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0056***	0.0017	0.0001	-0.0008
	4.10	1.48	0.06	-0.88
Explained sentiment	-0.0015	-0.0007	-0.0027	-0.0029
	-1.16	-0.46	-1.58	-1.48
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.5485	0.5083	0.5055	0.5132

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Real GDP growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0027**	-0.0008	-0.0023*	-0.0017
	2.11	-0.64	-1.79	-1.06
Explained sentiment	-0.0002	-0.0005	-0.0009	-0.0004
	-0.30	-0.51	-0.64	-0.36
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.6985	0.6859	0.6983	0.6895

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Real GDP growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0078***	0.0037***	0.0016	-0.0002
	7.41	3.48	1.59	-0.14
Explained sentiment	-0.0027	-0.0004	-0.0061	-0.0088
	-0.73	-0.09	-1.12	-1.42
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.5432	0.4878	0.4792	0.4874

Table 10. Future stock returns

Panel regressions of country-level annual stock returns one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10, stock market data is from Kenneth French's and Robert Shiller's websites, and country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Stock returns	t+1	t+2	t+3	t+4
Orthogonalized sentiment	-0.0120	-0.0171***	-0.0176***	-0.0048
	-1.48	-3.45	-3.21	-0.75
Explained sentiment	0.0334*	0.0082	0.0257**	0.0010
	1.74	0.63	2.03	0.07
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.6549	0.6625	0.6643	0.6680

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Stock returns	t+1	t+2	t+3	t+4
Orthogonalized sentiment	-0.0191***	-0.0129	-0.0091	0.0012
	-2.74	-1.54	-0.66	0.08
Explained sentiment	0.0607***	0.0159	0.0052	0.0193
	4.99	1.47	0.37	1.43
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.6754	0.6795	0.6755	0.6810

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Stock returns	t+1	t+2	t+3	t+4
Orthogonalized sentiment	-0.0078	-0.0198**	-0.0270***	-0.0103
	-0.58	-2.14	-3.36	-1.33
Explained sentiment	0.0367	-0.0134	0.0528	-0.0056
	0.77	-0.29	1.29	-0.14
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.6800	0.6874	0.6928	0.6956

Table 11. Equity and credit markets

Panel regressions of the annual growth rate of the relative size of the country-level equity and credit markets one, two, three, and four years ahead on orthogonalized and explained sentiment. The size of the equity market is defined as total stock trading, whereas the size of the credit market is defined as total bank lending. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Equity/credit ratio	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0094	0.0040	-0.0009	-0.0061
	0.83	0.36	-0.08	-0.56
Explained sentiment	-0.0091	-0.0087	-0.0183	-0.0019
	-0.46	-0.50	-0.82	-0.12
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	362	355	348	341
R-squared	0.4940	0.4889	0.4751	0.4626

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Equity/credit ratio	t+1	t+2	t+3	t+4
Orthogonalized sentiment	-0.0105	-0.0152	-0.0196	-0.0216
	-0.44	-0.61	-1.02	-1.19
Explained sentiment	-0.0254	-0.0276	-0.0340	-0.0268
	-0.84	-1.18	-1.11	-1.36
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	138	136	134	132
R-squared	0.8689	0.8678	0.8657	0.8593

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Equity/credit ratio	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0278**	0.0224**	0.0127	-0.0031
	2.51	2.48	1.39	-0.26
Explained sentiment	0.0329	0.0102	-0.0359	0.0021
	0.82	0.27	-0.87	0.08
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	224	219	214	209
R-squared	0.4605	0.4493	0.4291	0.3986

Table 12. Capital formation growth

Panel regressions of the country-level annual growth rate of country-level capital formation one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Capital formation growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0157***	-0.0004	-0.0029	-0.0028
	4.16	-0.09	-0.94	-0.84
Explained sentiment	-0.0187***	-0.0069	-0.0001	-0.0188*
	-3.23	-1.51	-0.02	-1.89
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.3598	0.3207	0.3173	0.3261

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Capital formation growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0061	-0.0061	-0.0044	-0.0026
	1.25	-0.91	-0.84	-0.50
Explained sentiment	-0.0074**	-0.0095*	-0.0082	-0.0044
	-2.10	-1.66	-1.51	-1.29
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.4697	0.4679	0.4870	0.4878

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Capital formation growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0227***	0.0037	-0.0021	-0.0019
	6.72	0.68	-0.42	-0.35
Explained sentiment	-0.0390***	-0.0100	0.0084	-0.0499*
	-3.45	-0.50	0.50	-1.71
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.3890	0.3157	0.3088	0.3302

Table 13. Total factor productivity and the price-dividend ratio: Sentiment decomposition

Panel regressions of country-level annual total factor productivity growth 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 the US 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. 7. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. 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 consumer confidence database.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0079	0.0073	0.0073	0.0075
	1.03	1.00	1.01	1.05
PD (S)	0.0825**	0.0667*	0.0507	0.0408
	2.12	1.74	1.24	0.99
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.6210	0.6120	0.6052	0.6018

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0401**	0.0407**	0.0414**	0.0408**
	2.13	2.23	2.35	2.31
PD (S)	0.0183	0.0039	-0.0225	-0.0300
	0.35	0.08	-0.47	-0.56
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.6768	0.6761	0.6784	0.6763

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0005	-0.0006	-0.0009	-0.0009
	0.07	-0.10	-0.15	-0.18
PD (S)	0.1578***	0.1421***	0.1323***	0.1152**
	3.87	3.20	2.81	2.28
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.6661	0.6587	0.6552	0.6523

Table 14. Real consumption growth and productivity, news, and sentiment shocks

Panel regressions of the annual growth rate of country-level real 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 the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. 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 consumer confidence database.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Real consumption growth	t+1	t+2	t+3	t+4
Productivity shock	0.0015	0.0011	0.0013	-0.0010
	0.85	0.58	0.62	-0.43
PD (F) shock	-0.0010	-0.0000	-0.0006	0.0008
	-0.70	-0.02	-0.44	1.19
PD (S) shock	0.0055***	0.0052***	0.0022	0.0006
	5.55	6.41	1.46	0.59
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	642	625	608	591
R-squared	0.3824	0.3703	0.3322	0.3234

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Real consumption growth	t+1	t+2	t+3	t+4
Productivity shock	0.0014	0.0019	0.0008	-0.0007
	0.31	0.42	0.19	-0.22
PD (F) shock	0.0025	-0.0036**	0.0008	0.0030*
	1.07	-2.37	0.67	1.76
PD (S) shock	0.0047***	0.0038***	-0.0011	-0.0014
	3.04	3.68	-0.73	-1.59
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	268	262	256	250
R-squared	0.4449	0.4405	0.4017	0.4032

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Real consumption growth	t+1	t+2	t+3	t+4
Productivity shock	0.0018	0.0023	0.0026	-0.0012
	0.62	0.69	0.75	-0.30
PD (F) shock	-0.0016	0.0005	-0.0009	0.0003
	-1.12	0.60	-0.63	0.31
PD (S) shock	0.0059***	0.0059***	0.0051***	0.0025***
	4.27	6.54	4.08	2.79
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	374	363	352	341
R-squared	0.4078	0.4004	0.3873	0.3569

Table 15. Employment growth and productivity, news, and sentiment shocks

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 the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. 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 consumer confidence database.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Employment growth	t+1	t+2	t+3	t+4
Productivity shock	0.0030***	0.0027**	0.0022**	0.0016
	2.66	2.56	2.22	1.13
PD (F) shock	-0.0005	-0.0002	-0.0004	-0.0002
	-0.85	-0.50	-0.87	-0.72
PD (S) shock	0.0042***	0.0037***	0.0022**	0.0005
	4.63	4.24	2.07	0.56
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	642	625	608	591
R-squared	0.5109	0.4961	0.4638	0.4407

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Employment growth	t+1	t+2	t+3	t+4
Productivity shock	0.0023	0.0026*	0.0027***	0.0021*
	1.55	1.80	2.70	1.80
PD (F) shock	-0.0017**	-0.0013	-0.0021***	-0.0002
	-2.21	-1.03	-2.66	-0.47
PD (S) shock	0.0022***	0.0014***	0.0002	-0.0009
	3.51	3.50	0.18	-1.16
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	268	262	256	250
R-squared	0.5830	0.5821	0.5891	0.5819

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Employment growth	t+1	t+2	t+3	t+4
Productivity shock	0.0053**	0.0039**	0.0024	0.0011
	2.55	2.04	1.14	0.37
PD (F) shock	-0.0003	-0.0001	-0.0002	-0.0001
	-0.38	-0.21	-0.32	-0.21
PD (S) shock	0.0055***	0.0055***	0.0041***	0.0019**
	4.70	7.84	5.04	2.18
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	374	363	352	341
R-squared	0.5485	0.5391	0.4969	0.4502

Table 16. Real GDP growth and productivity, news, and sentiment shocks

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 the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. 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 consumer confidence database.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Real GDP growth	t+1	t+2	t+3	t+4
Productivity shock	0.0004	-0.0002	-0.0007	-0.0015
	0.28	-0.08	-0.34	-0.65
PD (F) shock	0.0031	-0.0001	0.0013*	0.0005
	1.33	-0.24	1.82	1.09
PD (S) shock	0.0056***	0.0022**	0.0008	0.0004
	6.88	2.31	0.64	0.64
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	642	625	608	591
R-squared	0.5806	0.5133	0.5146	0.5159

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Real GDP growth	t+1	t+2	t+3	t+4
Productivity shock	0.0017	0.0014	0.0012	0.0004
	0.54	0.43	0.37	0.14
PD (F) shock	-0.0001	0.0003	0.0009**	0.0018***
	-0.07	0.26	2.04	2.59
PD (S) shock	0.0041***	0.0009	-0.0014	-0.0011
	4.96	0.87	-1.35	-1.24
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	268	262	256	250
R-squared	0.7314	0.6917	0.6911	0.6860

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Real GDP growth	t+1	t+2	t+3	t+4
Productivity shock	0.0003	-0.0019	-0.0028	-0.0044
	0.19	-0.89	-1.18	-1.32
PD (F) shock	0.0036	-0.0005	0.0013	0.0001
	1.28	-0.83	1.43	0.18
PD (S) shock	0.0068***	0.0039***	0.0026**	0.0017**
	8.02	3.72	2.00	2.18
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	374	363	352	341
R-squared	0.5646	0.4944	0.4949	0.4923

Appendix A. Additional tables

Table A1. Total factor productivity and sentiment: Alternative rainfall decomposition

Panel regressions of country-level annual total factor productivity growth one, two, three, or four years ahead on sentiment, defined as the country-level consumer confidence index, a vector of country-level macroeconomic variables, which includes innovations in local real GDP, real consumption, employment, labor share in GDP, and inflation, and the eight principal components of 132 US macroeconomic variables from Ludvigson and Ng (2009) Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. Sentiment is divided into a component explained by country-level annual rainfall and a residual component. Rainfall is defined as a dummy variable that takes on value one if country-level precipitation has decreased in a given year and zero otherwise, excluding days of extreme precipitation (1.00 inch or higher). All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Sentiment (Weather)	0.0122***	0.0094**	0.0113**	0.0111**
	2.85	2.29	2.45	2.43
Sentiment (Residual)	0.0047	0.0039	0.0030	0.0024
	1.27	1.06	0.80	0.67
Controls	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.4313	0.4122	0.4024	0.3863

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Sentiment (Weather)	0.0091	0.0070	0.0093	0.0096
	1.48	1.18	1.50	1.47
Sentiment (Residual)	-0.0039	-0.0046	-0.0059	-0.0062
	-0.72	-0.92	-1.18	-1.18
Controls	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.4509	0.4377	0.4329	0.4161

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Sentiment (Weather)	0.0112***	0.0086**	0.0102***	0.0098***
	2.77	2.28	3.41	3.36
Sentiment (Residual)	0.0064	0.0059	0.0052	0.0047
	1.55	1.36	1.20	1.12
Controls	Y	Y	Y	Y
Country FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.4868	0.4582	0.4494	0.4290

Table A2. Total factor productivity and December sentiment: Economic decomposition

Panel regressions of country-level annual total factor productivity one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence, measured in December of each year, on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. Total factor productivity growth is expressed at constant national prices, calculated using the US as the base country, and accounts for variation in both the share of labor income and capital depreciation across countries and over time. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0053**	0.0048**	0.0039	0.0031
	2.18	1.99	1.60	1.19
Explained sentiment	0.0045	0.0073	0.0084	0.0093
	0.70	1.14	1.23	1.35
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.6125	0.6058	0.5991	0.5952

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	-0.0002	-0.0007	-0.0021	-0.0034
	-0.04	-0.16	-0.51	-0.74
Explained sentiment	0.0040	0.0031	0.0055	0.0071
	0.43	0.38	0.73	0.97
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.6092	0.6013	0.5951	0.5921

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0096***	0.0087***	0.0083***	0.0075***
	4.13	3.77	3.41	2.87
Explained sentiment	0.0059	0.0148*	0.0119	0.0090
	0.68	1.73	1.00	0.70
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.6603	0.6567	0.6534	0.6516

Table A3. Future stock returns, sentiment, and local macroeconomic variables

Panel regressions of country-level annual stock returns one year ahead on local sentiment, defined as country-level consumer confidence, and a vector of local macroeconomic variables, which includes changes in real GDP, real consumption, employment, labor share in GDP, inflation. All variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in column (1), the subsample of G7 countries in column (2), and the subsample of non-G7 countries in column (3). All specifications include country and year fixed effects and standard errors are clustered by year. The macroeconomic variables are from the Penn World Table V.10, stock market data is from Kenneth French's and Robert Shiller's websites, and country-level consumer confidence data is from the OECD.

Dependent variable: Stock returns t+1	(1) Full	(2) G7	(3) Non-G7
Sentiment	-0.0153	-0.0223***	-0.0015
	-1.61	-4.27	-0.07
Δ RGDP	0.0080	0.0125	-0.0185
	0.78	0.74	-0.19
Δ Employment	0.0323**	0.0401***	0.0810
	1.99	2.96	0.85
Δ Consumption	-0.0086	-0.0069	-0.1008
	-0.77	-0.39	-1.40
Δ Labor share	-0.0146	-0.0236	-0.0011
	-0.75	-1.12	-0.04
Δ Inflation	0.1025**	0.1754***	0.0890
	2.30	4.32	1.36
Country FE	Y	Y	Y
Year FE	Y	Y	Y
Observations	659	274	385
R-squared	0.0164	0.0715	0.0099

Table A4. Future stock returns: High v. low sentiment breakdown

Panel regressions of country-level annual stock returns one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. In Panels A and B, we respectively include the subsample of years in which sentiment takes on above- and below-median values. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10, stock market data is from Kenneth French's and Robert Shiller's websites, and country-level consumer confidence data is from the OECD.

Panel A. High sentiment

Dependent variable:	(1)	(2)	(3)	(4)
Stock returns	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0036	-0.0438**	0.0122	-0.0042
	0.15	-2.17	0.74	-0.30
Explained sentiment	0.0129	-0.0118	0.0192	-0.0132
	0.27	-0.34	0.52	-0.28
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	330	323	313	304
R-squared	0.6720	0.6801	0.7233	0.7328

Panel B. Low sentiment

Dependent variable:	(1)	(2)	(3)	(4)
Stock returns	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0031	-0.0128	0.0008	0.0004
	0.11	-0.68	0.06	0.02
Explained sentiment	0.0375	-0.0038	0.0379	-0.0160
	1.26	-0.17	1.50	-1.02
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	329	319	312	304
R-squared	0.6997	0.7047	0.6569	0.6553

Table A5. Capital intensity

Panel regressions of the country-level capital intensity one, two, three, and four years ahead on orthogonalized and explained sentiment. Capital intensity is defined as the logarithm of the ratio between physical capital and labor. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Capital intensity	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0334***	0.0283***	0.0223**	0.0182*
	3.94	3.12	2.31	1.81
Explained sentiment	0.0245	0.0208	0.0271**	0.0093
	1.54	1.33	2.04	0.39
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.6123	0.5947	0.5756	0.5582

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Capital intensity	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0191	0.0132	0.0092	0.0074
	1.64	0.96	0.63	0.60
Explained sentiment	0.0508***	0.0449***	0.0433***	0.0446***
	6.90	5.85	4.67	4.20
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.7911	0.7771	0.7579	0.7421

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Capital intensity	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0451***	0.0403***	0.0326**	0.0276*
	4.01	4.02	2.46	1.65
Explained sentiment	-0.0043	-0.0140	0.0017	-0.0538
	-0.12	-0.40	0.04	-0.80
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.5389	0.5221	0.5015	0.4924

Table A6. Investment in R&D

Panel regressions of the country-level growth in investment in research and development (R&D) one, two, three, and four years ahead on orthogonalized and explained sentiment. Orthogonalized and explained sentiment are respectively defined as the fitted values and the residuals from a regression of raw country-level consumer confidence on changes in real GDP, real consumption, employment, labor share in GDP, inflation, and country and year fixed effects. The sentiment variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1982-2019. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. The macroeconomic variables are from the Penn World Table V.10. Country-level consumer confidence data is from the OECD.

Dependent variable:	(1)	(2)	(3)	(4)
R&D growth	t+1	t+2	t+3	t+4
Orthogonalized sentiment	0.0073***	0.0044	0.0005	0.0011
	2.87	1.33	0.16	0.40
Explained sentiment	0.0127	0.0010	0.0029	-0.0026
	1.39	0.18	0.38	-0.42
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	481	490	484	477
R-squared	0.2321	0.2093	0.2080	0.2135

Table A7. Total factor productivity and the price-dividend ratio

Panel regressions of country-level annual total factor productivity growth 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 the US 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. 4. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year 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.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD	0.0107	0.0098	0.0098	0.0099
	1.09	1.06	1.06	1.09
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.7767	0.7745	0.7739	0.7749

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD	0.0519**	0.0528**	0.0539***	0.0531***
	2.33	2.47	2.62	2.61
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.8396	0.8403	0.8418	0.8410

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD	0.0023	0.0006	0.0002	-0.0001
	0.23	0.07	0.02	-0.02
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.7258	0.7223	0.7211	0.7232

Table A8. Total factor productivity and the price-dividend ratio: Sentiment decomposition excluding the US
Panel regressions of country-level annual total factor productivity growth for non-US countries 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 the US 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. 7. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes sixteen non-US OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. 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 consumer confidence database.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0072	0.0063	0.0061	0.0062
	0.83	0.77	0.76	0.80
PD (S)	0.0711*	0.0577	0.0444	0.0366
	1.94	1.58	1.15	0.91
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	600	584	568	552
R-squared	0.5607	0.5480	0.5370	0.5298

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0516**	0.0507**	0.0498**	0.0482**
	2.21	2.13	2.08	1.96
PD (S)	0.0181	0.0049	-0.0191	-0.0239
	0.21	0.06	-0.25	-0.31
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	215	210	205	200
R-squared	0.6035	0.5949	0.5893	0.5817

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0005	-0.0006	-0.0009	-0.0009
	0.07	-0.10	-0.15	-0.18
PD (S)	0.1338***	0.1203***	0.1119***	0.0975**
	3.84	3.17	2.79	2.28
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.6659	0.6584	0.6550	0.6521

Table A9. Welfare-relevant total factor productivity and the price-dividend ratio: Sentiment decomposition
Panel regressions of country-level annual welfare-relevant total factor productivity growth 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 the US 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. 7. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. 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 consumer confidence database.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0057	0.0066	0.0070	0.0060
	0.88	1.02	1.00	0.79
PD (S)	0.1159**	0.1197***	0.1114**	0.1121*
	2.56	2.62	2.14	1.90
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.7756	0.7714	0.7650	0.7598

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0374**	0.0382**	0.0405**	0.0425**
	1.98	2.12	2.28	2.40
PD (S)	0.0446	0.0374	0.0133	0.0078
	0.84	0.83	0.25	0.11
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.8296	0.8300	0.8310	0.8318

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	-0.0022	-0.0013	-0.0016	-0.0040
	-0.44	-0.24	-0.28	-0.86
PD (S)	0.2069***	0.2163***	0.2230***	0.2291***
	5.43	5.06	3.93	3.33
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.7491	0.7426	0.7359	0.7342

Table A10. Total factor productivity and the price-dividend ratio: December sentiment decomposition

Panel regressions of country-level annual total factor productivity growth 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 the US 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. 7. In the first-stage regression, sentiment is defined as country-level consumer confidence measured in December of each year. All the explanatory variables are standardized by subtracting their mean and dividing by their standard deviation. The sample includes seventeen OECD countries over the period 1975-2019. We include the full sample in Panel A, the subsample of G7 countries in Panel B, and the subsample of non-G7 countries in Panel C. All specifications include country and year fixed effects. Standard errors are block bootstrapped at the country-level with 200 repetitions. 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 consumer confidence database.

Panel A. Full sample

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0079	0.0073	0.0073	0.0074
	1.03	0.99	1.00	1.04
PD (S)	0.0695**	0.0626**	0.0510*	0.0403
	2.34	2.16	1.72	1.31
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	659	642	625	608
R-squared	0.6203	0.6123	0.6057	0.6020

Panel B. G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0403**	0.0409**	0.0416**	0.0408**
	2.13	2.23	2.34	2.30
PD (S)	0.0518	0.0455	0.0267	0.0103
	1.11	1.06	0.73	0.28
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	274	268	262	256
R-squared	0.6770	0.6757	0.6763	0.6740

Panel C. Non-G7 countries

Dependent variable:	(1)	(2)	(3)	(4)
Productivity growth	t+1	t+2	t+3	t+4
PD (F)	0.0005	-0.0007	-0.0010	-0.0012
	0.06	-0.11	-0.17	-0.23
PD (S)	0.1255***	0.1164***	0.1104***	0.0999***
	4.03	3.60	3.23	2.72
Country FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
Observations	385	374	363	352
R-squared	0.6600	0.6545	0.6520	0.6509