Inflation Anchoring and Growth: The Role of Credit Constraints*

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Abstract

Can inflation anchoring foster growth? To answer this question, we use panel data on sectoral growth for 22 manufacturing industries from 39 advanced and emerging market economies over 1990–2014 and employ a difference-in-differences strategy based on the theoretical prediction that higher inflation uncertainty particularly depresses investment in industries that are more credit constrained. Industries characterized by high external financial dependence, liquidity needs, and R&D intensity, and low asset tangibility, tend to grow faster in countries with well-anchored inflation expectations. The results, based on an IV approach—using indicators of monetary policy transparency and central bank independence as instruments—confirm our findings.

Keywords: industry growth; inflation anchoring; inflation forecasts; credit constraints; difference-in-differences; central bank independence.

JEL codes: E52; E63; O11; O43; O47.

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"*The extent to which inflation expectations are anchored has first-order implications for the performance…of the economy.*" (Ben Bernanke, July 10, 2007)

"*To the extent that a monetary authority can build a reputation and gain credibility for low inflation, it…produces tangible economic benefits.*" (Charles Plosser, April 10, 2007)

I. INTRODUCTION

Central bankers often assert that low and stable inflation fosters macroeconomic stability and growth. Former Fed chair Paul Volcker stated, "Inflation feeds in part on itself, so part of the job of returning to a more stable and more productive economy must be to break the grip of inflationary expectations" (Paul Volcker, statement before the Joint Economic Committee of the U.S. Congress, October 17, 1979). The important role of inflation expectations has led many central banks worldwide to improve the transparency of their goals, often explicitly, by adopting an inflation target (IT) and better communication with the public.[1]

This view is underpinned by a large body of theoretical literature suggesting that inflation uncertainty makes it difficult for firms to plan (Fischer and Modigliani, 1978; Baldwin and Ruback, 1986; Huizinga, 1993). Thus, firms may reduce or delay investment when uncertainty about future prices is high.[2] While it is well established that heightened uncertainty can slow down the economy's long-run growth via credit constraints (Aghion et al., 2010, 2014), this distortion can be particularly acute in the case of inflation uncertainty.[3] To the extent that most financial contracts are written in nominal terms without effective hedging instruments

[1] For earlier discussions of the stabilizing effect of inflation targeting, see Bernanke et al. (1999) and Gonçalves and Salles (2008).

[2] For example, Baldwin and Ruback (1986) showed that higher uncertainty about future relative prices increases short-term investment relative to long-term investment, which is similar to the mechanism suggested in Aghion et al. (2010, 2014)

[3] Aghion et al. (2010) developed a theoretical framework that supports credit frictions as a key channel through which uncertainty affects long-run growth. In their theory, firms can invest either in short-term projects or in productivity-enhancing longer-term projects subject to liquidity risk. If credit constraints bind only during periods of contractions, reducing the volatility of aggregate shocks via countercyclical fiscal policy increases the likelihood that long-term projects survive liquidity shocks in the bad state without affecting what happens in the good state (when credit constraints are not binding).

available, inflation uncertainty can affect a firm's borrowing costs, thereby distorting optimal investment behavior.

Higher inflation uncertainty implies a higher likelihood of unexpected inflation in the future, which would arbitrarily redistribute the wealth between savers and borrowers who agree on nominal financial contracts, thereby preventing effective financial intermediation. This adverse effect is likely detrimental for firms that heavily rely on external finance (i.e., are credit-constrained).[4] We formalize this intuition by building a simple model, then test its theoretical predictions using a cross-country dataset on industry growth, a country-level proxy for inflation anchoring, and several industry-level measures of credit constraints.

Several authors have tried to demonstrate the benefits of low inflation or inflation volatility in promoting growth. For example, Fischer (1993) and Barro (1996) used cross-section and panel data for a large sample of countries to show that very high inflation was detrimental to growth, after controlling for other factors, over 1960–1990. However, other authors have found it difficult to demonstrate such impacts—particularly in more recent decades, when inflation rates have been lower than in the 1970s and 1980s—or have found the evidence to be fragile. For example, Levine and Renelt (1992) concluded that inflation variables are not robustly correlated with growth using an extreme bounds analysis. Judson and Orphanides (1999) concluded that "the empirical evidence documenting the benefits of low inflation is not very persuasive."

The main challenge in identifying a link between inflation and growth using aggregate data is that it is very difficult to control for all possible factors that are correlated with inflation (or inflation volatility) and that may, at the same time, affect growth. Moreover, to the extent to which a rise in inflation raises inflation uncertainty, which again feeds back into higher

[4] Inflation uncertainty can also reduce investment by increasing the firm's opportunity cost of holding cash. For example, Berentsen et al. (2012) explored the opportunity cost of holding cash, R&D investment, and growth, based on a money search model where liquidity is essential for investing in innovative investments. Chu and Cozzi (2014) analyzed the effect of price uncertainty on economic growth in a Schumpterian model with a cash-in-advance requirement on R&D investment. Recently, Evers et al. (2020) presented a model with financial frictions where inflation increases the cost of holding liquid assets to hedge risky production against expenditure shocks, and they tested this prediction using a large firm-level dataset from developing economies. However, Dotsey and Sarte (2000) showed that in a model where money is introduced via a cash-in-advance constraint, inflation uncertainty has a positive effect on growth via a precautionary savings motive, while the level of inflation reduces growth.

inflation, disentangling the effect of inflation level from inflation uncertainty is not a trivial task. The current paper tries to overcome this limitation by using cross-country sectoral (industry-level) data and applying a differences-in-differences (DID) strategy à la Rajan and Zingales (1998). Our theoretical prediction about which industries should benefit more from inflation anchoring (therefore reducing inflation uncertainty) is motivated by Aghion et al. (2010, 2014). Their work suggests that volatility in the economic environment is particularly harmful to growth for those firms and industries that are credit-constrained, as it pushes them toward short-term investment rather than long-term investment that boosts long-run growth.

We build a stylized model where firms borrow from banks to finance their investment, and the central bank tries to anchor inflation expectations. In our model, since the debt contract is written in nominal terms, inflation anchoring effectively lowers the nominal interest rate and the borrowing costs in the long run, thereby facilitating the provision of credit and the production of output. This positive effect on growth increases with the degree of financial frictions captured by the share of output that the firm can divert in case of default. In other words, credit constraints amplify the growth-enhancing effect of inflation anchoring.

We test this theoretical prediction by examining the sectoral output growth effect of the interaction between a country's measure of inflation anchoring and sector-specific measures of credit constraints after controlling for the unobserved country- and sector-specific characteristics. The framework is estimated for an unbalanced panel of 22 manufacturing industries in 39 advanced and emerging market economies over the period 1990–2014. As explained above, we expect and test the hypothesis that credit-constrained industries tend to achieve relatively faster growth in countries where inflation expectations are well anchored.

The advantages of a cross-industry analysis are twofold:

- First, we measure the degree of inflation anchoring by the sensitivity of inflation expectations to inflation surprises—a unique time-invariant parameter that varies only across countries. Since the country-fixed effect—designed to control for unobserved cross-country heterogeneity in a standard cross-country analysis—would absorb this country-specific inflation de-anchoring coefficient, a more disaggregated level of analysis is required to demonstrate the impact of anchoring on growth

- Second, it mitigates concerns about reverse causality. While it is difficult to identify causal effects using aggregate data, it is much more likely that inflation anchoring at the country level affects industry-level outcomes than the other way around. Since we control for country-fixed effects—and therefore for aggregate output—reverse causality in our setup would imply that differences in output growth across sectors influence inflation anchoring at the aggregate level—which seems implausible. Moreover, our main independent variable is the interaction between the degree of inflation anchoring and industry-specific credit constraints measured by U.S. firm-level data, which makes it even less plausible that causality runs from industry-level growth to this composite variable.[5]

The main finding of our paper is that inflation anchoring fosters growth in industries that are more credit-constrained. Figure 1 illustrates our key findings. We plot the average value-added growth of each manufacturing industry from 1990 to 2014 against the inflation de-anchoring coefficients after controlling for the initial share of each manufacturing industry.[6] The left panel in Figure 1 plots this relationship only for industries with the below-median level of external financial dependence (i.e., less credit-constrained industries), whereas the right panel plots the relationship only for industries with the above-median level of external financial dependence (i.e., more credit-constrained industries). Only in credit-constrained industries are larger de-anchoring coefficients (i.e., higher inflation uncertainty) negatively associated with average sectoral growth.[7]

The rest of the empirical analysis aims to establish the robustness of this main finding. First, we extend the measure of credit constraints to include liquidity needs, asset tangibility, and R&D intensity, in addition to external financial dependence. These characteristics are widely used as a proxy for credit constraints at the industry level (Braun and Larrain, 2005; Raddatz,

[5] Following Rajan and Zingales (1998) and many subsequent works, industry-level indicators capturing the degree of credit constraints are constructed from U.S. firm-level data because U.S. measures of industrial characteristics are assumed to represent technological characteristics in a relatively frictionless environment, thereby serving as a conceptual benchmark for our analysis.

[6] To be more specific, we regress the average value-added growth of an industry i in a country c on the measure of inflation anchoring, a set of industry dummies, and the initial share of the industry i in a country c.

[7] The slope coefficients of the left (right) panel are -6.56 and -23.07, and the associated t-statistics using robust standard errors are -1.17 and -3.70, respectively.

2006; Ilyina and Samaniego, 2011; Aghion et al., 2014). While we confirm the robustness of the key finding using these alternative measures, external financial dependence appears the most robust predictor of growth differentials.

Second, we disentangle the effect of inflation anchoring from various confounding factors, including the effect of inflation level, by explicitly controlling for the interaction between the level of inflation and industry-specific measures of credit constraints. While these two channels tend to be correlated—since low inflation is often achieved by better inflation anchoring (or a low-inflation environment fosters well-anchored inflation expectations as in Ball, 1992), our findings suggest that the degree of inflation anchoring and the level of inflation do not necessarily capture the same channel. In addition, we also rule out the possibility that our findings simply reflect the effect of nominal rigidities in amplifying the adverse impact of inflation uncertainty. Subsample analyses further indicate that our findings are not driven by the inclusion of euro-area countries with a common monetary policy framework during the second half of the sample period or extreme events such as the Global Financial Crisis and its aftermath.

Third, our main results are also robust to an instrumental variables (IV) approach, using monetary policy transparency and central bank independence as instruments. To the extent that inflation anchoring is likely achieved via the central bank's credibility while industry growth differentials are unlikely driven by central bank credibility itself, instrumenting the inflation anchoring measure using several central bank credibility proxies mitigates endogeneity issues and strengthens the structural interpretation of our findings.

Lastly, our conclusion about the role of credit constraints in determining the growth-enhancing effect of inflation anchoring still holds when we estimate a panel regression using annual industry growth as a dependent variable. To this end, we estimate time-varying inflation de-anchoring coefficients using a Kalman filter and include country, industry, and time-fixed effects to strengthen identification. This finding suggests that the interaction between inflation anchoring and credit constraints is not necessarily limited to a long-run perspective and can induce growth benefits even in the short run.

Our empirical analysis contributes to three streams of literature. The first is the long-standing literature on the link between inflation and growth (e.g., Dornbusch and Frenkel, 1973;

De Gregorio, 1993; Barro, 1996; Loungani and Sheets, 1997; Judson and Orphanides,1999).[8] The second is the more recent literature on the role of financial frictions in amplifying the effect of uncertainty on growth (e.g., Aghion et al., 2014; Alfaro et al., 2018; Choi et al., 2018; Arellano et al., 2019). The third is the literature documenting heterogeneity across industries regarding their interaction with monetary policy (e.g., Dedola and Lippi, 2005; Peersman and Smets, 2005; Aghion et al., 2015).[9]

The remainder of the paper is organized as follows. Section II illustrates the credit constraint channel through which inflation anchoring can affect growth. Section III discusses our DID methodology and describes various data used in the empirical analysis to test the model's theoretical predictions. Section IV presents the main results and the results from a battery of robustness exercises. Section V offers conclusions.

II. Inflation Anchoring and Growth: A Theoretical Argument

What are the channels through which inflation anchoring affects growth? In principle, inflation anchoring reduces uncertainty regarding the future level of inflation so that firms and households can make more informed decisions *ex-ante* regarding their investment and consumption (or saving). Moreover, to the extent that most financial contracts are offered in nominal terms (i.e., absence of indexed debts), uncertainty about future inflation translates into uncertainty about borrowing costs. In the presence of credit constraints, this form of uncertainty further distorts real decisions even if the agents are risk-neutral. This mechanism is distinct from the theoretical channels suggested in the literature to explain cross-country evidence on the negative link between growth and inflation, emphasizing the role of high realized inflation in amplifying the misallocation of resources.

This section summarizes key predictions of a simple theoretical model highlighting the role of inflation anchoring in reducing *ex-ante* inflation uncertainty, thereby promotes investment and growth and how this effect interacts with a firm's credit constraints. Since our

[8] See Judson and Orphanides (1999) and the references therein for a more comprehensive review of the literature.

[9] For example, Dedola and Lippi (2005) found that the sectoral output response to monetary policy shocks is systematically related to the degree of industry-level credit constraint, including external financial dependence. Aghion et al. (2015) formulated a theoretical framework where countercyclical short-term interest rates relax credit or liquidity constraints and test the theoretical prediction using a similar DID approach to ours.

model is highly stylized to formalize the well-known adverse effect of inflation uncertainty on effective financial intermediation in the absence of inflation-protected financial contracts, we only present the model's key features and main predictions here and relegate details of the model and the proof of propositions to Appendix A.

Suppose that each industry has a representative firm endowed with many investment projects that can increase output in the subsequent period. While firms should borrow from the bank to finance each project, a bank only provides a nominal debt contract to each project, which cannot be adjusted to inflation due to the absence of the complete asset market. Importantly, although the anchoring of inflation expectations is socially optimal (i.e., higher investment and growth) in this economy, the central bank may fail in anchoring inflation expectations because of its limited credibility. The degree of credit constraints—in the form of the costly state verification à la Townsend (1979)— is captured by an auditing cost that banks have to pay to identify the firm's output in case of default.

With the reasonable assumption of sufficiently large uncertainty about future inflation in the absence of inflation anchoring, expected inflation under successful anchoring would be lower than that in the economy under the failure of anchoring, an environment consistent with Ball (1992). He argues that inflation anchoring is more of a concern in the high-inflation economy because the public understands that policymakers do not face a dilemma in the low-inflation economy. In contrast, policymakers face a dilemma when inflation is high: they would prefer to have disinflation but fear the resulting recession. Since the public is aware of such a policy dilemma, the central bank announcement of inflation anchoring is not necessarily credible.

In the equilibrium of our model economy, the following proposition summarizes the extent to which inflation anchoring affects the growth of an economy:

Proposition 1. **Effect of inflation anchoring on growth.** *Under the sufficiently large uncertainty about future inflation (Assumption 1 in Appendix A), output growth will be higher in the economy with perfectly-anchored inflation expectations than without anchoring.*

The above proposition implies that there are growth benefits to inflation anchoring. This is because the bank sets a low nominal interest rate under inflation anchoring so that more firms can finance their investment, thereby increasing output. Turning our focus to the role of credit constraints, we obtain the following predictions:

Proposition 2. Role of credit constraints in shaping the effect of inflation anchoring growth. *Under the assumption that (i) credit constraints are not too excessive or (ii) there exists a sufficient number of productive firms in the economy (Assumption 2 in Appendix A), growth differentials achieved from inflation anchoring (Proposition 1) are greater for the industry that is more credit-constrained.*

While anchoring of inflation expectations is beneficial to all industries, the effect is heterogeneous, depending on the degree of credit constraints. For example, without much credit constraint, firms would have already taken sufficient projects, and thus marginal benefits in terms of financing more projects (i.e., producing more output) from inflation anchoring would be smaller. On the contrary, in the heavily credit-constrained industry, more high-productive projects have not yet been financed, and thus the marginal benefit is greater. We explain the technical detail of the above propositions as well as the environment of the model in Appendix A, but the main predictions of our model can be similarly derived from the existing models in the related literature (e.g., Aghion et al., 2014; Evers et al., 2020). In the remainder of the paper, we test the empirical relevance of Proposition 2 using international industry panel data.

III. Empirical Model and Data

Aghion et al. (2014) confirmed their theoretical prediction—that the higher the fraction of credit-constrained firms are, the larger the positive effect of the stabilization policy—by applying the DID strategy to international industry-level data from 15 OECD countries. We follow the same approach, but unlike Aghion et al. (2014), who used industry-level data from KLEMS, we use the United Nations Industrial Development Organization (UNIDO) database for both advanced and emerging market economies.

After illustrating an empirical framework, we introduce our measure of inflation anchoring at the country level, then discuss several intrinsic characteristics to measure credit constraints at the industry level. Our discussion draws largely from previous studies using similar data and methodology (e.g., Braun and Larrain, 2005; Raddatz, 2006; Kroszner et al., 2007; Ilyina and Samaniego, 2011; Samaniego and Sun, 2015).

A. Estimation Framework

To assess the effect of inflation anchoring on long-run growth and identify a relevant transmission channel, we closely follow the methodology proposed by Rajan and Zingales (1998). The following specification is estimated for an unbalanced panel of 39 countries and 22 manufacturing industries:

$$g_{i,c} = \alpha_i + \alpha_c + \delta const_i \times inf_c + \mu y_{i,c}^0 + \varepsilon_{i,c}, \tag{1}$$

where i denotes industries and c denotes countries. $g_{i,c}$ is a measure of industry growth, which is the average value-added growth from 1990 to 2014; $y_{i,c}^0$ is the initial share of each manufacturing sector i of country c's total manufacturing output in 1990; $const_i$ is a measure of credit constraints for industry i, such as external financial dependence; inf_c is our measure of inflation anchoring for country c;[10] α_i and α_c are industry and country fixed effects, respectively.

Following Dell'Ariccia et al. (2009), Equation (1) is estimated using Ordinary Least Squares (OLS)—and standard errors are clustered at the country level—as the inclusion of fixed effects is likely to address the endogeneity concern related to omitted variable bias. Also, reverse causality issues are unlikely. First, since we use the measures of industry characteristics constructed from U.S. firm-level data, it is hard to conceive that sectoral growth in other countries influences a particular industry's intrinsic characteristics. Second, it is also implausible that growth at the sectoral level can influence the aggregate measures of inflation anchoring. Moreover, since we are interested in the interaction effect of country-level inflation anchoring and U.S. industry-level variables, claiming reverse causality is equivalent to arguing that differences in growth across sectors lead to differences in the composite variable—which we believe to be highly unlikely.

A remaining possible concern in estimating Equation (1) with OLS is that other macroeconomic variables could affect industry growth when interacting with industries' credit constraints, and they are also correlated with our inflation anchoring measure. In this case, our estimates will suffer from an omitted variable bias. For example, this concern could be the case

[10] A higher sensitivity coefficient means a lower degree of inflation anchoring (i.e., de-anchoring).

for financial development—the original channel assessed by Rajan and Zingales (1998)—but also for the level of inflation itself or the stance of monetary policy. We address this issue in the subsection devoted to robustness checks.

In the following section, we introduce empirical proxies for the key variables in Equation (1) and discuss how to test the theoretical predictions of the model using these proxies. The model's key prediction hinges on the interaction between the degree of inflation anchoring at the macro level and the degree of credit constraints at the micro level. We measure inflation anchoring by how well inflation expectations are anchored in response to inflation surprises. We use four alternative measures of credit constraints (external financial dependence, liquidity needs, asset tangibility, and R&D intensity) to capture the comprehensive degree of credit constraints.

B. Measuring Inflation Anchoring

We measure the degree of inflation anchoring by estimating the sensitivity of long-term inflation expectations in response to short-term inflation surprises using data from 1990 to 2014 at a semi-annual frequency.[11] This sensitivity captures how well inflation expectations are anchored in the economy, thereby proxying the degree of inflation uncertainty. The idea is straightforward: if inflation expectations are well anchored due to credible monetary policy, long-term inflation expectations will not change swiftly in response to inflation surprises in the short run. We use survey-based measures of professional forecasters' inflation expectations from Consensus Economics available at different horizons for a large set of countries.

Though easily observable, we do not use the level of inflation or (realized) inflation volatility as a measure of inflation anchoring because they are an *ex-post* economic outcome, rather than *ex-ante* uncertainty surrounding the economic environment that matters to a firm's decisions. Such an *ex-post* measure of inflation anchoring is subject to an endogeneity concern since a higher level of (or volatility in) inflation can result from poor economic performance. Moreover, given that a firm's investment decision is forward-looking, what matters is the decision expectations about future inflation, not the current inflation level.

[11] Although the periodicity of Consensus Economics forecasts has enhanced since 2014 to include the July survey, they are only available at a semi-annual frequency (Spring and Fall) for the dominant part of our sample.

Specifically, we relate changes in future inflation expectations to current inflation forecast errors in order to estimate the degree of inflation anchoring. In particular, the following equation is estimated for each country c in the sample:

$$\Delta\pi^{e}_{c,t+h} = \alpha_c + \beta^{h}_{c}\pi^{news}_{c,t} + \varepsilon_{c,t+h}, \tag{2}$$

where $\Delta\pi^{e}_{c,t+h}$ denotes the first difference in expectations of inflation h years ahead in the future, and $\pi^{news}_{c,t}$ denotes current inflation forecast errors, defined as the difference between actual year-on-year inflation and short-term (one-year-ahead) inflation expectations from Consensus Economics formed in the previous period.

Since Consensus Economics forecasts are based on fixed-event rather than fixed-horizon (i.e., each survey refers to a specific calendar year, so the forecast horizon depends on the time in which the survey is collected), we adjust the raw series to obtain the fixed-horizon forecast following Dovern et al. (2012) and Buono and Formai (2018). In particular, we take the weighted average of the forecasts for the current calendar year and the next calendar year to compute one-year-ahead forecasts where the weight is determined by their share in the forecasting horizon. [12] The longer-term inflation expectations are adjusted similarly. Equation (2) is estimated with a time trend for each economy in the final sample, which consists of an unbalanced panel of 39 countries with consistent and sufficient data available for both Consensus Economics and UNIDO.

The coefficient β^{h}_{c} captures the degree of anchoring in h-years-ahead inflation expectations, a term usually referred to as "shock anchoring" (Ball and Mazumder, 2011), with a smaller coefficient denoting well-anchored inflation expectations or low uncertainty about future inflation. Our setup is similar to Levine et al. (2004), who estimated the sensitivity of inflation expectations to inflation shocks for measuring the effects of inflation targeting on inflation anchoring, except that we use inflation forecast errors on the right side, not changes in realized inflation. If a monetary policy is credible, the value of this parameter at a sufficiently far horizon should be close to zero. That is, inflation forecast errors should not lead to changes

[12] For some countries, surveys are not always conducted in April and October. See Appendix B for further details on how the raw Consensus Economics forecasts are adjusted and equation (2) is estimated.

in long-term expectations if agents believe that the central bank can counteract any short-term developments to bring inflation back to the target over the long term.

The forecast errors are used as a baseline measure of inflation surprises because it is less subject to reverse causality or measurement error than other measures, such as actual changes in inflation or deviations of inflation from its target. The baseline specification is estimated using five-year-ahead inflation expectations for three reasons: (i) inflation expectations at this horizon are a close proxy for central banks' inflation targets so that the parameter $\beta_c^{h=5}$ can be interpreted as the degree to which the headline inflation is linked to the central bank's target—a phenomenon typically referred to as "level anchoring" (Ball and Mazumder, 2011); (ii) long-term inflation expectations are less correlated with current and lagged inflation, and thus are less subject to problems of multicollinearity and reverse causality; and (iii) this corresponds to the average duration of corporate bond issuance, thereby capturing a relevant planning horizon firms in borrowing decisions. Nevertheless, we use inflation expectations at various horizons and check the sensitivity of the results to alternative horizons.

Table 1 summarizes the final country coverage and the number of industries used in the analysis per country. We do not include the United States in the final sample, as the industrial characteristics are measured from U.S. firm-level data. Given the possibility that inflation anchoring in the United States might systematically influence U.S. firms from different industries, the inclusion of the United States would bias the result.

In Figure C.1 in Appendix C, we first present the evolution of the left-side (top panel) and right-side (bottom panel) variables in Equation (2) for advanced and emerging market economies. Not surprisingly, changes in inflation expectations have been more volatile at shorter horizons for both groups of countries. Expectations were on a downward path throughout the 1990s in both advanced and emerging market economies. This trend was particularly strong in emerging market economies. Inflation expectations have been remarkably stable throughout the 2000s in advanced economies, especially at longer horizons, but recently their volatility has somewhat increased. In contrast, the volatility of expectations during 2010–14 has been lower than in the previous decade for emerging market economies.

Inflation forecast errors have been relatively modest in advanced economies, except for the global financial crisis period. These errors were mostly negative in the 1990s, suggesting that realized inflation was generally lower than expected, though it was close to zero in the 2000s. Since 2011, the median inflation forecast errors in advanced economies have become negative again. In emerging market economies, inflation errors were negative on average in the 1990s and early 2000s, but less so more recently.

In Figure 2, we plot the de-anchoring coefficient of long-term inflation expectations estimated in Equation (2) for the final sample of 39 countries used in the analysis.[13] Most coefficients are tightly estimated, and the statistically significant (at 10 percent) coefficients are denoted with a star. While the average of the sensitivity coefficients is 0.05, their standard deviation is 0.07, implying large variations across countries. As shown, there is considerable heterogeneity in the size of the sensitivity among countries, with advanced economies having stronger inflation anchoring than emerging market economies (i.e., smaller coefficients). We will exploit this cross-country variation to identify the link between inflation anchoring and sectoral growth.

C. Measuring Credit Constraints

Finance literature has long pursued a measure of firm-level financial constraints to analyze how they affect a firm's investment, R&D, or cash-holding decisions (e.g., Fazzari et al., 1988; Almeida and Campello, 2007). However, given our focus on the effect of inflation anchoring on industry growth, we employ several widely used measures of credit constraints that are readily available at an industry level. Following Lin and Ye (2018), we use four alternative measures of credit constraints (external financial dependence, liquidity needs, asset tangibility, and R&D intensity). To the extent to which these measures capture somewhat different aspects of credit constraints, considering multiple measures provides a more reliable result.

External financial dependence. As a baseline measure of credit constraints, we use external financial dependence, which has been widely used in the related literature (for example, Rajan and Zingales, 1998; Braun and Larrain, 2005; Ilyina and Samaniego, 2011). Recently, Aghion et al. (2014) also used external financial dependence as a proxy for industry-level credit constraints and found that industries with a relatively heavier reliance on external financing tend to grow faster in countries with more countercyclical fiscal policies. Testing whether inflation anchoring

[13] Table C.1 in Appendix C provides the estimates of β_c^h for all available horizons h and country c.

has a similar stabilizing effect through the credit constraint channel requires examining the role of external financial dependence.

Following Rajan and Zingales (1998), dependence on external financing in each industry is measured as the median of the ratio of total capital expenditures minus the current cash flow to total capital expenditures across all U.S. firms in each industry. We use an updated version of this indicator taken from Tong and Wei (2011).[14] Based on the suggestive empirical evidence and the prediction of our model, we expect a positive sign on the interaction term between the degree of external finance and the measure of inflation anchoring.

Liquidity needs. More recently, Raddatz (2006) proposed liquidity needs as a measure of credit constraints and found that financial system development led to a comparatively larger reduction in output volatility in sectors with high liquidity needs. While external financial dependence mainly captures a firm's reliance on external financing for fixed investment (i.e., long-term investment), liquidity needs capture the importance of financing working capital (i.e., short-term investment). Although neither our theoretical model nor the dataset employed in our analysis distinguishes long-term investment from short-term investment, one should note that, in principle, they capture quite different dimensions of credit constraints.

Liquidity needs are measured by the ratio of inventories to sales, capturing the fraction of inventory investment that can be typically financed with ongoing revenue. A higher value of this ratio means that a smaller fraction of inventory investment can be financed by ongoing revenue and represents a higher level of external liquidity needs. We take the liquidity needs indicator from Raddatz (2006), who built a measure of the liquidity needs of different industries using balance sheet data of U.S. public manufacturing firms from Compustat.

Asset tangibility. If inflation anchoring affects industry growth through the credit constraint channel, we should expect that inflation anchoring increases growth more in industries with lower asset tangibility. To the extent to which intangible assets are harder to use as collateral (Hart and Moore, 1994), an industry with less tangible capital tends to be more credit-constrained. In the presence of high inflation uncertainty, firms without sufficient collateral are more likely to lose their access to external financial markets than firms that have sufficient

[14] The updated data have been kindly provided by Hui Tong.

tangible assets to be collateralized. We take the asset tangibility indicator from Samaniego and Sun (2015), who updated the values in Braun and Larrain (2005) and Ilyina and Samaniego (2011) using the ratio of fixed assets to total assets from Compustat.

R&D intensity. R&D-intensive industries are comparatively likely to be credit-constrained for several reasons. First, while R&D typically requires large startup investments, the return on it comes with a significant lag. In the meantime, firms may find it difficult to finance their operational costs and be forced to rely on external financing. Second, R&D is an intangible asset that is difficult to collateralize, which also makes it difficult for R&D-intensive firms to raise external financing. This channel is also consistent with most of the empirical evidence suggesting a negative relationship between uncertainty and R&D investment (Goel and Ram, 2001; Czarnitzki and Toole, 2011; Furceri and Jalles, 2019). We adopt the R&D intensity indicator from Samaniego and Sun (2015), who measured R&D intensity as R&D expenditures over total capital expenditure using Compustat data.

We report these measures of credit constraints for 22 manufacturing industries using INDSTAT2 classifications. INDSTAT2 industry classification is similar to that of INDSTAT3 used in recent literature (Braun and Larrain, 2005; Ilyina and Samaniego, 2011) but is available for a longer period and fewer industries.[15] We make some adjustments to the industry measures based on the INDSTAT3 classification in the literature. For example, while "manufacture of food products and beverages" (ISIC 16) is the first industry in the INDSTAT2 dataset, the INDSTAT3 dataset disaggregates them into "manufacture of food products" (ISIC 311) and "manufacture of beverages" (ISIC 313). Following Choi et al. (forthcoming), we take the weighted average of each measure for ISIC 311 and ISIC 313 to obtain the value for ISIC 16 in this case, using the average share of value-added in the United States as a weight. If two datasets share the same industry, we simply use the values of INDSTAT3. Table C.2 in Appendix C compares the industry classification under INDSTAT2 and INDSTAT3.

Table C.3 in Appendix C reports the four industry-level measures of credit constraints. In the following analysis, these measures will be normalized (i.e., zero mean and unit variance) to facilitate comparing the size of coefficients across the models. Table C.4 shows the correlation

[15] There are 28 manufacturing industries in INDSTAT3.

matrix among these variables. The correlations among measures of industry credit constraints are intuitive and consistent with what existing theories would predict. For example, as described in Choi et al. (2018), an industry that relies more heavily on external financing also tends to have lower asset tangibility and higher R&D intensity, but the correlation between external financial dependence and asset tangibility is far from perfect. Consistent with Raddatz (2006), the correlation between external financial dependence on fixed investment and external dependence on working capital is low, suggesting that they capture quite different dimensions in credit constraints (long-term vs. short-term investment).

D. Sectoral Growth from the UNIDO Database

As explained earlier, industry-level outcome variables are taken from the UNIDO database. While many existing studies, including Aghion et al. (2014) and Choi et al. (2018), use the KLEMS database to analyze the effect of higher uncertainty on growth, the UNIDO database allows us to study not only advanced but emerging market and developing economies.[16] Extending the analysis to these economies is particularly meaningful for the econometric setup in our analysis.

Although our DID methodology mitigates endogeneity issues by controlling for unobserved heterogeneity and reducing the chance of reverse causality, as discussed in Aghion et al. (2014), successful identification hinges critically on variations in the degree of inflation anchoring across countries. To the extent that the conduct of monetary policy in many emerging market economies suffers from the lack of transparency or independence of their monetary authorities, a study of these economies provides an extra opportunity to study a causal link between inflation anchoring and long-run growth.

Following the practice in the literature, we measure sectoral growth by value-added growth, although similar results are obtained using gross output instead. All nominal variables are deflated by the country-level Consumer Price Index in local currency taken from the World Economic Outlook database. All these variables are reported for 22 manufacturing industries

[16] In addition to the increase in country coverage, UNIDO provides information on more disaggregated manufacturing industries compared to KLEMS.

based on the INDSTAT2 2021, ISIC Revision 3.[17] Some countries in UNIDO do not have sufficiently long industry-level data, which likely induces measurement errors. We restrict the sample to those industries with at least 15 years of data on value-added growth.

IV. Empirical Findings

A. Baseline Results

Table 2 presents the results obtained by estimating Equation (1). The results show the interaction effects of inflation anchoring and various industrial characteristics capturing the credit constraint channel on sectoral growth, together with the convergence coefficient on the initial share of the industry. The main findings are summarized as follows. First, convergence does exist, as the coefficient on the initial share is negative and statistically significant. Second, the signs of the interaction terms are consistent with the credit constraint channel.

We find that well-anchored inflation expectations—that is, the low de-anchoring coefficients—enhance growth more for industries with (i) higher external financial dependence, (ii) higher liquidity needs, (iii) lower asset tangibility, and (iv) higher R&D intensity than other industries. Effects through these four channels are statistically significant at the five percent level. To gauge the magnitude of each channel, we measure differential growth gains from a reduction in the de-anchoring coefficient from the 75th to the 25th percentile of the distribution for an industry at the 75th percentile of the distribution compared to the industry at the 25th percentile in their intrinsic characteristics.[18]

The magnitude of the interaction effects of inflation anchoring ranges from 0.67 percentage points for liquidity needs to 1.29 percentage points for external financial dependence. For example, the results suggest that the differential growth gains from improving the degree of inflation anchoring from the level of Peru to that of Norway for an industry with severe credit constraints, such as "rubber and plastic products" (i.e., the 75th percentile of external financial dependence), compared to an industry with mild credit constraints, such as "basic metals" (i.e.,

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[17] We exclude the "manufacture of recycling" industry from the original INDSTAT2 database due to insufficient observations.

[18] Since we normalized each of credit constraint indicators, the magnitude of each interaction term is directly comparable.

the 25th percentile of external financial dependence), are 1.29 percentage points (=1.441×(-0.067)×(-13.217). While these magnitudes seem large at first glance given the average industry growth of 0.73 percentage points (its standard deviation is 6.37 percentage points) during the sample period, moving from the 75th to the 25th percentile in the de-anchoring coefficient distribution implies a quite dramatic enhancement in the credibility of monetary policy.

As demonstrated in Aghion et al. (2014), there is a limitation of the industry-level analysis: despite the sharper identification of the relevant channel, it is difficult to map this DID estimate to the magnitude of the macroeconomic growth gain/loss achieved by inflation anchoring. For example, it is possible that inflation anchoring does not enhance aggregate growth because the gains for credit-constrained industries might be offset by the loss for those without credit constraints.

To provide an estimate of the aggregate growth-enhancing effect of inflation anchoring for an illustrative purpose, we perform a cross-country regression where the weighted average of industry value-added growth is regressed on the de-anchoring coefficients. Based on the estimates from this regression, improving the degree of inflation anchoring (moving from the 75th to the 25th percentile) translates into 0.35 percentage point aggregate growth gains. Given the average growth of 0.68 percentage points (corresponding standard deviation is 3.49 percentage points), the economic gain of inflation anchoring is non-trivial. However, one should note that this coefficient is imprecisely estimated due to the smaller sample size.

B. Robustness Checks and Additional Exercises

Alternative measure of the degree of inflation anchoring. Our baseline measure of inflation anchoring measure is based on the response of long-term inflation expectations to inflation forecast errors, defined as the difference between actual inflation and short-term inflation expectations. The reasons for using five-year-ahead expectations are that: (i) inflation expectations at this horizon are a close proxy for central banks' inflation targets so that the parameter β can be interpreted as the degree to which the headline inflation is linked to the central bank's target, a phenomenon typically referred to as "level anchoring" (Ball and Mazumder 2011), and (ii) long-term inflation expectations are less correlated with current and lagged inflation and thus are less subject to problems of multi-collinearity and reverse causality.

However, in practice, inflation five years ahead might react very little to any current shock (apart from inflation target shock), independent of whether the central bank is capable of anchoring inflation or not. To test the robustness of our findings, we use alternative measures of the degree of inflation anchoring by using: (i) the standard deviation of five-year-ahead inflation expectations themselves, (ii) alternative inflation shocks, defined as the change in actual inflation, (iii) the squared de-anchoring coefficients, and (iv) inflation expectations of the short-term horizon (one-year-ahead).

The first alternative is motivated by the fact that agents in a country with well-anchored inflation should expect inflation five years ahead to be equal to the central bank's inflation target with little variation over time. The second alternative guards against the possibility that agents perceive actual inflation changes differently from inflation forecast errors. The third alternative addresses the concern of how to treat a negative anchoring coefficient. For example, one cannot argue that inflation expectations are more anchored in a country with a negative anchoring coefficient than one with a zero coefficient. The last alternative concerns the relatively small variability in long-term expectations and uses short-term expectations instead. The correlation between the baseline measure of the degree of inflation anchoring with these alternative measures is 0.28, 0.84, 0.77, and 0.31, respectively.

The results obtained by re-estimating Equation (1) with these alternative measures of inflation anchoring are reported in Table 3. The coefficient on the initial share—which is always negative and statistically significant—and the magnitude of differential gains are omitted to conserve space. The results based on these specifications largely confirm a statistically significant effect of inflation anchoring on industry growth through credit constraints. Most of the interaction coefficients are statistically significant, except for liquidity needs that are statistically significant only in one case.[19] The fact the results on liquidity needs are the least robust among the four proxies is consistent with our empirical design of capturing long-term inflation uncertainty and growth because liquidity needs proxy working capital constraints, which is relevant in the short run.

[19] The results are robust when replacing one-year-ahead inflation expectations with two-, three-, and four-years-ahead inflation expectations. To save space, the results are available upon request.

Subsample analysis. We further test the robustness of our findings to four alternative subsample analyses. First, our findings might have been driven by the extreme event of the global financial crisis and the constrained monetary policy in many advanced economies in the recent period. A sequence of such unconventional events might have changed the role of inflation uncertainty in driving growth. Thus, we investigate the effect of inflation anchoring on industry growth from 1990 to 2007. For this exercise, we re-estimate the degree of inflation anchoring in Equation (2) but using the data from 1990 to 2007 only. The de-anchoring coefficients estimated from the pre-crisis sample are still tightly correlated with those from the full sample (0.85). Second, inflation expectations were on a downward path throughout the 1990s in both groups, as monetary frameworks improved and actual inflation was falling. This fact alone might have contributed to the findings of this paper. To guard against this possibility, we re-estimate Equation (1) using the post-2000 sample.[20]

Third, our findings might have been driven by a common monetary policy framework adopted in the euro area. Given the same degree of monetary policy credibility, heterogeneous inflation de-anchoring coefficients in the region might reflect a confounding factor that affects industry growth at the same time. To address this issue, we re-estimate Equation (1) after dropping ten euro-area countries from the sample. Lastly, to the extent to which firms in emerging market economies face more severe borrowing constraints, their growth will be lower regardless of the degree of inflation anchoring. To mitigate this concern, we restrict our analysis to the sample of emerging market economies, thereby exploiting the variation within only this group. As seen from Table 4, the key findings hardly change in each subsample analysis.

Confounding factors and omitted variable bias. A possible remaining concern in estimating Equation (1) is that the results could be biased due to the omission of macroeconomic variables affecting industry growth through the credit constraint that is, at the same time, correlated with our measure of inflation anchoring. Thus, we extend Equation (1) by interacting each of the country-specific confounding factors $other_c$ with our credit constraint measures to check whether the inclusion of these confounding factors alters the effect of inflation anchoring

[20] In this case, the correlation of the new de-anchoring coefficients with the original coefficients is 0.87. For this exercise, we include industries with more than 10, not 15, available observations on value-added growth due to the shorter sample period, which explains the increase in the sample size.

on industry growth. The parameter θ in Equation (3) aims to capture this additional interaction effect:

$$g_{i,c} = \alpha_i + \alpha_c + \delta const_i \times inf_c + \theta const_i \times other_c + \mu y_{i,c}^0 + \varepsilon_{i,c}. \tag{3}$$

The first obvious consideration is the level of financial development. To the extent that the lack of developed financial markets weakens the transmission channel of monetary policy, our measure of inflation anchoring might simply capture financial development. Acemoglu and Zilibotti (1997) also claim that low financial development could reduce long-run growth and increase the volatility of the economy. Following much of the literature, we use the average of bank credit to the private sector to GDP (the main variable used in Rajan and Zingales, 1998) between 1990 and 2014 to measure financial development.

The second potential variable is the level of inflation. Adding to the earlier literature on the negative relationship between inflation and growth, Evers et al. (2020) recently showed that inflation increases the cost of firms holding liquid assets to hedge risky production against expenditure shocks. They argued that inflation tilts firms' technology choice away from innovative activities toward safer but return-dominated ones and reduces long-run growth. To the extent to which high inflation can be both a source and an outcome of failed inflation anchoring, disentangling the effect of inflation anchoring from the effect of the level of inflation provides further insight into the underlying mechanism. Thus, we explicitly control the interaction between the level of inflation (the average annual CPI inflation between 1990 and 2014) and credit constraint measures.

Third, we control for the size of government, known to be correlated with fiscal policy cyclicality (Aghion et al., 2014; Choi et al., forthcoming), and governs the relationship between output volatility and growth (Fátas and Mihov, 2001; Debrun et al., 2008; Afonso and Furceri, 2010). We measure the government size by the average of government expenditure to GDP between 1990 and 2014.

The fourth candidate we consider is economy-wide growth. Suppose countries with a better monetary policy framework achieve faster economic growth overall. In that case, the interaction effect we found earlier might simply pick up different elasticities of industry growth to aggregate growth. To control for the effect of overall growth, we allow the interaction of the average of the annual real GDP growth between 1990 and 2014 with credit constraint measures.

Fifth, we control for output volatility, measured by the volatility of real GDP growth during the sample period. Given the well-known negative relationship between volatility and growth (Ramey and Ramey, 1995), controlling for output volatility is particularly important in identifying the effect of inflation anchoring through the credit constraint channel. Output volatility and inflation uncertainty could be systematically related via the Taylor rule. For example, suppose that a central bank is committed to keeping inflation at the target at the expense of any other objective. Then inflation expectations may well be perfectly anchored, but the real output would be more volatile. Such output volatility would reduce productive investment, especially in credit-constrained industries, through the mechanism described by Aghion et al. (2010, 14) and Choi et al. (2018).

Sixth, monetary policy stance—measured by the cyclicality of the real short-term interest rates—might also capture the stabilizing effect of monetary policy, similar to inflation anchoring. Using industry-level value-added growth from 15 OECD countries over the period 1995–2005, Aghion et al. (2015) found that industries relying heavily on external financing tend to grow faster in countries with a more procyclical real short-term interest rate (i.e., a countercyclical monetary policy). Following Aghion et al. (2015), we measure the cyclicality by the sensitivity of the real short-term interest rate to real GDP growth, controlling for the one-quarter-lagged real short-term interest rate.[21] Among the 39 countries in our sample, we obtain the cyclicality of the real short-term interest rates from 25 countries.

Lastly, we control for financial uncertainty, measured by stock market volatility during the sample period—taken by the updated dataset in Baker et al. (2020). Heightened uncertainty reduces growth via several channels, such as real option values theory and risk aversion (e.g., Bloom, 2014), and financial constraints tend to exacerbate the adverse effect of uncertainty on growth (e.g., Alfaro et al., 2018). To the extent that uncertainty about the future course of the

[21] We measure the short-term interest rate by the money market rate. Real interest rates are calculated by subtracting the annualized CPI inflation from nominal interest rates. To be comparable to our measure of inflation anchoring, we run the estimation over the period 1990–2014. For euro-zone countries with a common monetary policy since the introduction of the euro, the estimation is only conducted for the pre-euro period.

economy weakens the effectiveness of monetary policy (Aastveit et al., 2017), our findings might have been driven by the so-called finance-uncertainty multiplier (Alfaro et al., 2018; Caggiano et al., 2021).

Figure 3 provides correlations between the degree of inflation anchoring and macroeconomic variables that may affect industry growth. Indeed, they are correlated with the inflation de-anchoring coefficients with an expected sign. For example, a country with well-anchored inflation expectations, on average, tends to have a deeper credit market, a lower level of inflation, a larger government, higher overall growth, lower output volatility, a more countercyclical monetary policy, and lower financial uncertainty.[22] As expected, since the correlation is statistically significant for the level of inflation, we pay special attention to whether the inclusion of this confounding factor affects our findings.

Table 5 confirms that the significant interaction effects of inflation anchoring and credit constraint measures are robust to controlling for confounding factors.[23] While the coefficient of the interaction term between the average level of inflation and credit constraint measures is statistically significant with a correct sign for external financial dependence and R&D intensity, its presence hardly changes our key findings. This result is consistent with the theoretical prediction by Ball (1992) that the increased uncertainty in nominal contracts can be more costly than higher inflation itself. We take this as supporting evidence to distinguish the inflation anchoring channel from the traditional inflation channel.

All the aforementioned factors are likely associated with the income status of an economy, as emerging market economies are often characterized by faster but more volatile growth, underdeveloped financial markets, higher inflation, and more procyclical policies. As shown in Figure C.2 in Appendix C, it is not surprising that the inflation de-anchoring coefficients are larger in emerging market economies than in advanced economies. Thus, the role of inflation anchoring in explaining growth differentials when interacting with credit constraints might

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[22] The correlations between these seven variables and the inflation de-anchoring coefficients are -0.09 (0.56), 0.23 (0.14), -0.24 (-0.14), -0.14 (0.39), 0.14 (0.37), -0.09 (0.64), 0.39 (0.03), respectively. The numbers in parentheses are the associated p-values.

[23] Table D.1 in Appendix D summarizes the interaction effects of each confounding factor and credit constraint measures without the inflation anchoring variable.

simply capture some inherent characteristics of such economies. To guard against this possibility, we include an interaction variable of credit constraints and an indicator variable denoting whether a country belongs to the emerging market economy group. Although the statistical significance is somewhat reduced, the results in Column (VIII) of Table 5 confirm that our key findings still hold in this case.

Alternative growth measure. While value-added growth measures an industry's ability to generate income and contribute to GDP, gross output principally measures overall production at market prices. The difference between gross output and value-added of an industry is intermediate inputs. To the extent that the intensity of intermediate inputs varies across countries within the same industry, our growth measures, based on value-added, might not necessarily give us the same picture as a gross output measure. To check this possibility, we repeat our analysis using the average growth rate of the gross output. Gross output is also deflated using the CPI to obtain real values. Table D.2 in Appendix D confirms that the sign, size, and statistical significance of the interaction effects using gross output are largely similar to those using value-added growth, lending support to our baseline results.

Uncertainty in the estimates of the degree of inflation anchoring. A possible limitation of the analysis is that our measure of the degree of inflation anchoring is estimated and not directly observable, implying that the uncertainty about the inflation anchoring estimates is not properly considered. This is a crucial problem because some of the inflation anchoring coefficients are statistically insignificant, implying that they cannot be distinguished from zero. To address this concern, (i) we re-estimate Equation (1) using weighted least squares (WLS), with weights given by the reciprocal of the standard error of the estimated de-anchoring coefficients; (ii) assigning a value of zero to the insignificant estimates (at the 10 percent significance level); (iii) dropping the insignificant estimates. The results of this exercise are reported in Table D.3 in Appendix D. The estimated parameters are largely similar to those in Table 2 except for liquidity needs for cases (i) and (ii), suggesting that the inference in baseline results is unlikely contaminated from using a generated regressor.

Alternative measure of external financial dependence. As noted above, one of the concerns for using the industry-level indicators derived from U.S. firm-level data is that they might not necessarily be a good proxy for credit constraints for industries in emerging market economies.

However, searching for country-specific measures of these industry-level indicators would not necessarily resolve the problem. As emphasized in Rajan and Zingales (1998) and Raddatz (2006), (i) there are no comprehensive data to build a country-industry specific measure of credit constraints, especially in developing economies; (ii) even if such data were available, a firm's credit constraints will also be affected by the financial system or the conduct of monetary policy in which they operate, raising concerns for endogeneity. For example, it is still possible that the rapid growth of the textile industry in China relaxes its credit constraints over time, although it is unlikely to affect the credit constraints of the U.S. textile industry; (iii) although our industry measures of credit constraints are only imperfectly correlated across countries (i.e., noisy measure), the assumption that they are industry-specific would induce an attenuation bias in the main regression coefficient, thereby working against finding any significant results.

Indeed, these studies confirm that the ranking of industry characteristics using (partially) available firm-level data is stable across countries, validating their extrapolation of U.S. measures to the rest of the world. Nevertheless, we use an alternative proxy of credit constraints (external financial dependence) taken from Kroszner et al. (2007), which is derived from the firm-level data outside the United States as a robustness check.[24] The correlation between the two measures is 0.50, and Spearman's rank correlation coefficient is 0.58, both of which are highly statistically significant. Table D.4 in Appendix D shows that our results hold even when using the alternative measure.

Role of nominal rigidities. While the results in Table 5 have largely alleviated concerns for the omitted variable bias at the country level, there remains a concern for the bias at the industry level. For example, as demonstrated by Fernández-Villaverde et al. (2015) and Fernández-Villaverde and Guerrón-Quintana (2020), uncertainty can affect the aggregate economy via the markup channel, and nominal rigidities—often captured by the Calvo parameter—tend to amplify its adverse effect. To distinguish the credit constraint channel from this alternative explanation, we expand our baseline specification to include the interaction term between

[24] Kroszner et al. (2007) constructed a measure of external financial dependence similar to Rajan and Zingales but using the firm-level data from Worldscope for non-crisis countries during the period 1990–1999. The median value across the countries is used here.

industry-level measures of nominal rigidities and country-level inflation de-anchoring coefficients:[25]

$$g_{i,c} = \alpha_i + \alpha_c + \delta const_i \times inf_c + \theta rigidity_i \times inf_c + \mu y^0_{i,c} + \varepsilon_{i,c}. \quad (4)$$

We have obtained empirical measures of industry-level nominal rigidities from Roberts et al. (1994) and Leith and Malley (2007), who estimated the price adjustment speed parameter in the Rotemberg model and the Calvo parameter specific to the two-digit U.S. manufacturing industries, respectively. As shown in Table D.5 in Appendix D, we confirm the role of nominal rigidities, as inflation anchoring benefits more the industries with higher nominal rigidities.[26] However, Table 6 shows that our findings still hold, suggesting that credit constraints and nominal rigidities are independent channels.

Instrumental variables. We further address endogeneity concerns using an IV approach. Motivated by the theoretical argument in Section II, we use the following set of indicators regarding the institutional quality and credibility of central banks as instruments: (i) the central bank governor turnover index; (ii) the central bank independence index; and (iii) the central bank transparency index. These indicators are largely exogenous to our dependent variable of industry-level value-added growth, but they are likely correlated with the degree of inflation anchoring since inflation expectations tend to be better anchored in a country with an independent and transparent central bank (Loungani and Sheets, 1997; Crowe and Meade, 2007; Park, 2018).

We take the indicators from the dataset constructed by Crowe and Meade (2007), which extends the database of Cukierman et al. (1992). Seeking further exogeneity of our instrumental variables, we use the values of the central bank governor turnover index and the central bank independence index constructed from the institutional data between 1980 and 1989 only, which does not overlap with our main sample period of 1990–2014. Among the 39 countries in our sample, these indicators are jointly available for 29 countries.

[25] We appreciate the referee for suggesting this robustness check.

[26] A higher price adjustment speed parameter corresponds to a lower Calvo parameter. The correlation coefficients between credit constraint measures and nominal rigidity measures tend to be moderate, ranging from -0.19 to 0.33.

Figure 4 plots the correlation between our inflation anchoring coefficients and these measures of central bank institutional quality. Since the adoption of inflation targeting can enhance inflation anchoring, we also include a dummy variable indicating whether a country adopted an inflation-targeting framework by 2000. While the first three variables are strongly correlated with the anchoring coefficients, the inflation targeting dummy is not.[27] Thus, we use the first three variables as an instrument.

Each of the instruments that vary over countries also interacts with industry credit constraints before entering estimation. This interaction variable is the relevant instrument because the independent variables are themselves interaction variables (Wooldrige, 2010). We proceed with a two-stage least squares (2SLS) approach. In the first stage, we regress the inflation de-anchoring coefficients on the three instrumental variables, controlling for the industry- and country-fixed effects.

The results of the first stage in Table 7 confirm that these three instruments can be considered as "strong instruments"—that is, the Cragg-Donald Wald F-statistics are well above the Stock and Yogo (2005) critical values for weak instruments in all cases. Hansen's J statistics for valid instruments are also reported, which are not rejected in any cases. In the second stage, we re-estimate Equation (1) using the exogenous part of the degree of inflation anchoring driven by these three instruments—that is, the fitted value of the first stage. The results reported in Table 7 confirm that inflation anchoring enhances growth more for industries with heavier external financial dependence and higher R&D intensity.

Inflation anchoring and growth: panel evidence. Our analysis so far has focused on cross-country variation in long-run industry growth and the degree of inflation anchoring to identify the role of credit constraints in shaping the growth gains of inflation anchoring. While cross-country regression is conceptually aligned with our simple model describing a steady-state relationship, there is strong evidence that the degree of inflation anchoring has substantially changed over time within countries (e.g., Buono and Formai, 2018; Grishchenko et al., 2019).

[27] Perhaps these countries adopted inflation targeting because of poor inflation anchoring performance in the past. This possibility will weaken the causal channel from inflation targeting to inflation anchoring in the data. Even if inflation targeting improved inflation anchoring, it would be difficult to observe such a relationship during the sample period in our dataset because we took an average of the data for analysis.

To account for this change in inflation anchoring, we exploit the within-country variation in the degree of inflation anchoring in explaining annual industry growth while controlling for three-way fixed effects (country, industry, and time). Importantly, time-fixed effects absorb any common trend in changes in the degree of inflation anchoring shared by many countries, thereby sharpen the identification. To this end, we estimate the following equation:

$$g_{i,c,t} = \alpha_i + \alpha_c + \alpha_t + \rho g_{i,c,t-1} + \lambda inf_{c,t-1} + \delta const_i \times inf_{c,t-1} + \varepsilon_{i,c,t}, \tag{5}$$

where $g_{i,c,t}$ is annual industry growth; $inf_{c,t-1}$ is the time-varying inflation de-anchoring coefficient estimated by using a Kalman filter.[28] As in the baseline analysis, we measure the sensitivity of the long-term (five-year-ahead) inflation expectations to inflation forecast errors. Similar to the initial industry share in Equation (1), lagged industry growth is included to control for convergence effects, and the de-anchoring coefficient is included with a lag to mitigate reverse causality.[29]

Our main variable of interest is still δ. To minimize the influence of outliers, we winsorize annual value-added growth at one percent. However, our results are robust to how we treat the outliers. Following Abadie, Athey, Imbens, and Wooldridge (2017), we cluster standard errors at the treatment level, which is country-by-time. Table 8 presents the results from this exercise, which further corroborates the main finding of the paper.

V. Conclusions

Long-standing literature has demonstrated a beneficial impact of low inflation (and well-anchored inflation expectations) on growth, but establishing a causal link has proven difficult to do with aggregate data. Our paper establishes a relationship between inflation anchoring and industry-level growth. By applying a DID approach to large industry-level panel data for both advanced and emerging market economies, we have examined how the effect of inflation anchoring on growth depends on the industry's intrinsic characteristics capturing credit

[28] See Appendix B for a detailed explanation of how we estimate the time-varying de-anchoring coefficients and the evolution of the coefficients for selected countries.

[29] Although the lagged industry growth term is negative and highly statistically significant, its presence hardly affects our results. In the light of potential bias due to including the lagged dependent variable with fixed effects (Nickell, 1982), we also estimate Equation (5) without the lagged industry growth term and obtained very similar results.

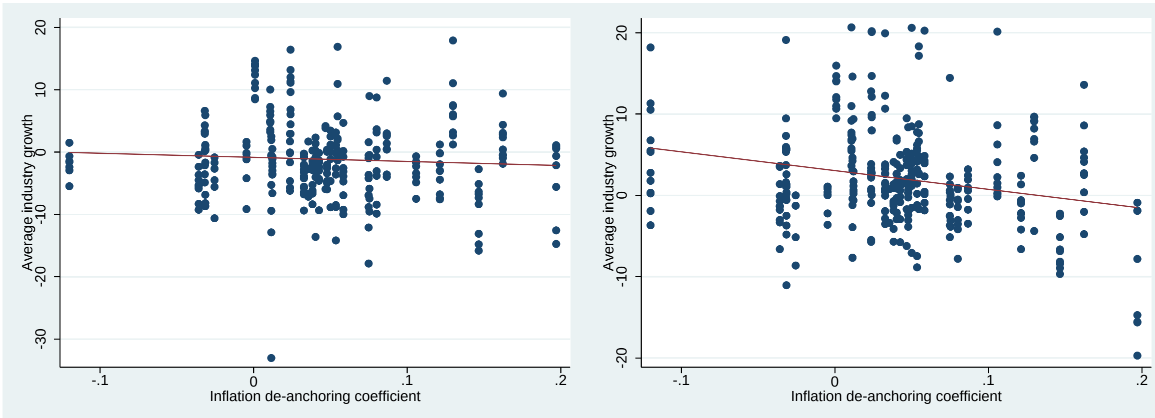
constraints. Consistent with the theoretical prediction of our model, we find that inflation anchoring fosters industry growth through the credit constraint channel.

Our results are robust to controlling for the interaction between credit constraints and a broad set of macroeconomic variables, such as financial development, the level of inflation, the size of government, overall economic growth, output volatility, monetary policy stance, and financial uncertainty. This provides reassurance that the credit constraint channel of inflation anchoring identified in the paper is unlikely to be confounded by other factors found to explain growth differentials in the literature. In addition, we also find suggestive evidence that countries with a higher degree of inflation anchoring tend to grow faster on average.

Our findings suggest that improving a monetary policy framework to anchor inflation expectations is expected to be growth-friendly, especially in an economy with a larger share of credit-constrained industries.

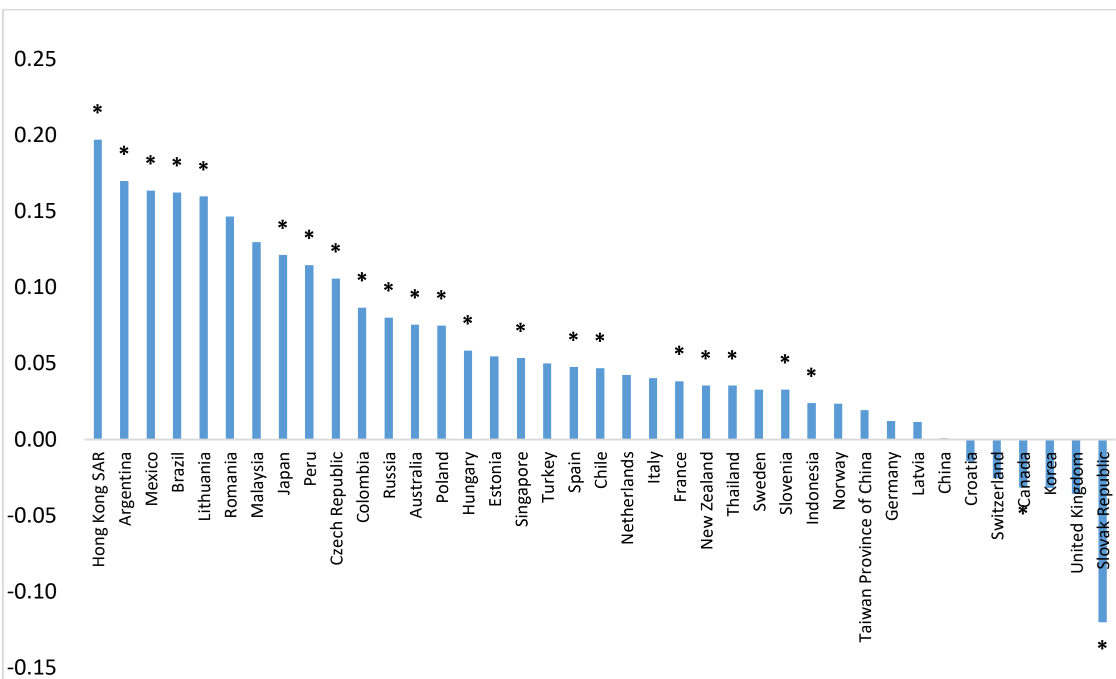
Figures and Tables

Figure 1. Inflation anchoring and industry growth: the role of credit constraints



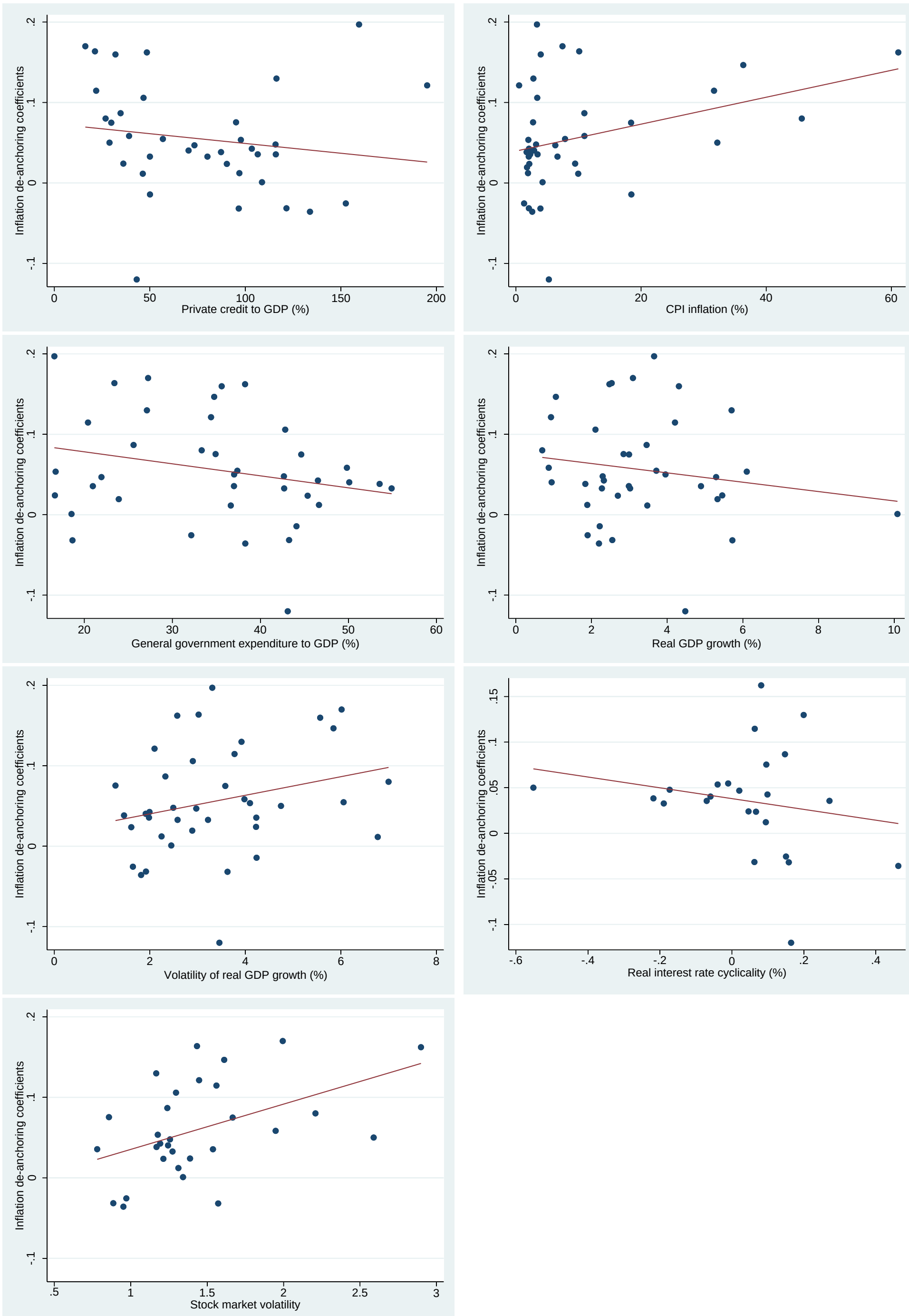
Note: The left (right) panel is the scatter plot of the average real value-added growth for industries with below (above) median external financial dependence against the sensitivity of the long-term (five-year) inflation expectations in response to inflation surprises, controlling for the initial share of each industry and industry-fixed effects. The slope coefficients of the left (right) panel are -6.56 and -23.07, and the associated t-statistics using robust standard errors are -1.17 and -3.70, respectively.

Figure 2. Inflation de-anchoring coefficients (five-year ahead inflation expectations)



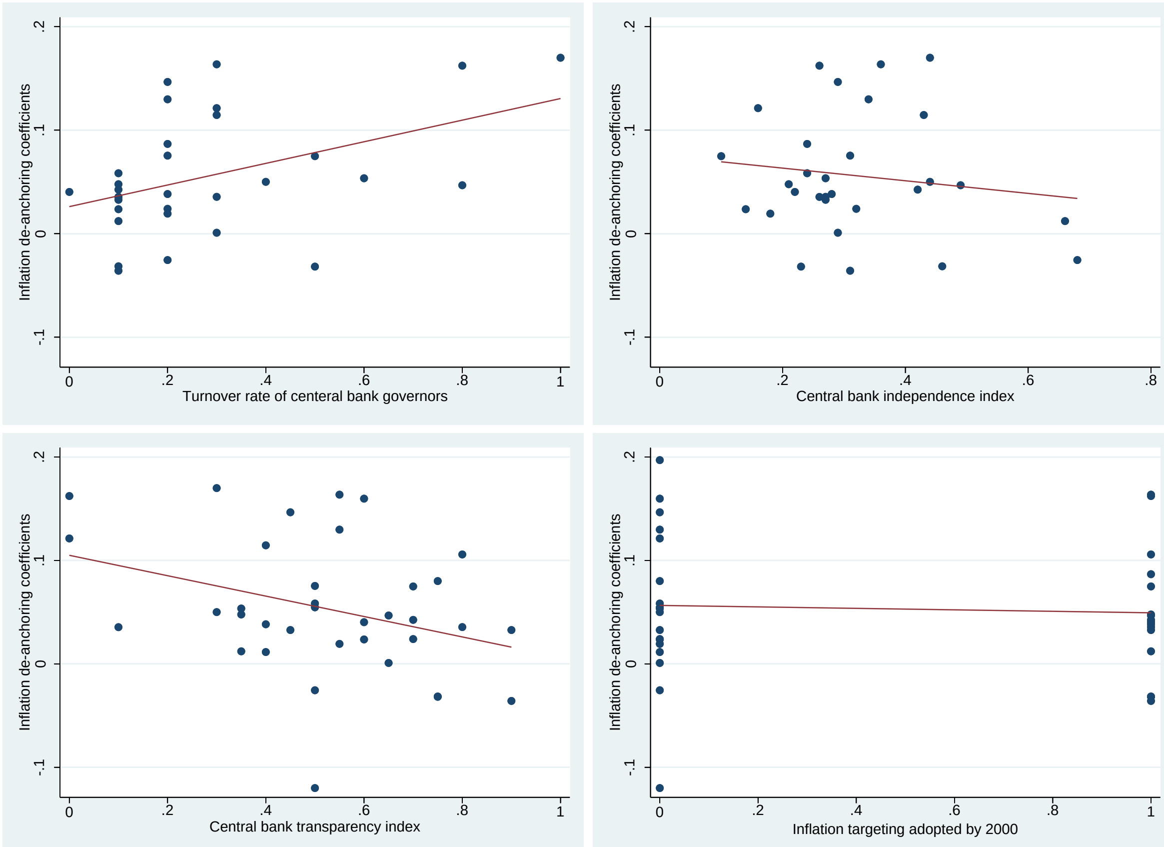
Note: The coefficients from estimating Equation (2) using five-year ahead inflation expectations. * indicates that the estimated coefficient is statistically significant at the 10% level.

Figure 3. Correlations between inflation anchoring and other factors



Note: The correlations between the inflation de-anchoring coefficients and the country average of i) private credit to GDP ratio, ii) CPI inflation, iii) general government expenditure to GDP ratio, iv) real GDP growth, v) volatility of real GDP growth, and vi) real interest rate cyclicality are -0.09 (0.56), 0.23 (0.14), -0.24 (-0.14), -0.14 (0.39), 0.14 (0.37), -0.09 (0.64), 0.39 (0.03), respectively. The numbers in parentheses are the associated p-values.

Figure 4. Correlations between inflation anchoring and other factors



Note: The correlations between the sensitivity of inflation expectations and i) turnover rate of central bank governors, ii) central bank independence index, iii) central bank transparency index, and iv) adoption of inflation targeting are 0.36 (0.05), -0.15 (0.40), -0.34 (0.04), -0.05 (0.77), respectively. The numbers in parentheses are the associated p-values.

Table 1. Country coverage and the number of industries used in the analysis

Country	Number of industries	Inflation targeting adoption	Country	Number of industries	Inflation targeting adoption
Argentina	22		Malaysia	21	
Australia	21	1993	Mexico	22	2001
Brazil	21	1999	Netherlands	20	1999
Canada	20	1991	New Zealand	13	1989
Chile	14	1999	Norway	20	2001
China	18		Peru	22	2002
Colombia	20	1999	Poland	22	1998
Croatia	12		Romania	21	2005
Czech Republic	19	1997	Russia	20	
Estonia	21	2011	Singapore	21	
France	21	1999	Slovak Republic	19	
Germany	20	1999	Slovenia	18	2007
Hong Kong SAR	16		Spain	22	1999
Hungary	22	2001	Sweden	22	1993
Indonesia	20	2005	Switzerland	17	
Italy	22	1999	Thailand	22	2000
Japan	21		Taiwan Province of China	19	
Korea	22	2001	Turkey	22	2006
Latvia	20		United Kingdom	20	1992
Lithuania	18				

Note: Only industries with more than 15 years of data are included in the analysis.

Table 2. The effect of inflation anchoring on industry growth: baseline

Explanatory variable	(I)	(II)	(III)	(IV)
Initial share	-0.879***	-0.804*	-0.813*	-0.816*
	(0.394)	(0.414)	(0.403)	(0.409)
External financial dependence *Inflation anchoring	-13.217***			
	(3.852)			
Liquidity needs *Inflation anchoring		-7.319**		
		(3.297)		
Asset tangibility *Inflation anchoring			8.540**	
			(2.612)	
R&D intensity *Inflation anchoring				-8.550**
				(3.579)
Magnitude of differential effects	1.29	0.67	-0.83	1.11
Observations	774	774	774	774
R-squared	0.48	0.46	0.47	0.47

Note: The dependent variable is the average annual growth rate in real value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (1). t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively. Differential effects are computed as the change in inflation anchoring from the 75^{th} percentile (i.e., larger de-anchoring coefficients) to the 25^{th} percentile (i.e., smaller de-anchoring coefficients) of the cross-country distribution between a sector with high credit constraints at the 75^{th} percentile of the distribution) and a sector with low credit constraints (at the 25^{th} percentile of the distribution).

Table 3. The effect of inflation anchoring on industry growth: using alternative measures of inflation anchoring

Explanatory variable	(I) Volatility of five-years-ahead inflation expectations	(II) Using actual changes in inflation	(III) Squared inflation anchoring coefficients	(IV) Using short-term inflation expectations
External financial dependence *Inflation anchoring	-0.206***	-9.079***	-82.221***	-3.751**
	(0.074)	(2.543)	(27.289)	(1.785)
Liquidity needs *Inflation anchoring	-0.058	-2.799	-39.655*	-1.057
	(0.041)	(2.610)	(22.192)	(1.066)
Asset tangibility *Inflation anchoring	0.069	5.376**	61.305***	1.996*
	(0.058)	(2.132)	(15.139)	(1.163)
R&D intensity *Inflation anchoring	-0.195***	-5.124***	-55.937**	-2.647**
	(0.058)	(1.694)	(23.593)	(1.134)
Observations	774	774	774	774

Note: The dependent variable is the average annual growth rate in real value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (1). t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 4. The effect of inflation anchoring on industry growth: subsample analysis

Explanatory variable	(I) Pre-GFC sample only	(II) Post-2000 sample only	(III) EME sample only	(IV) Non-euro area sample only
External financial dependence	-7.498***	-14.917**	-18.168**	-15.283***
*Inflation anchoring	(2.194)	(6.423)	(6.429)	(3.903)
Liquidity needs	-3.092	-8.329*	-10.446	-7.279*
*Inflation anchoring	(2.271)	(4.844)	(7.310)	(3.753)
Asset tangibility	4.696**	10.653***	16.610**	8.894**
*Inflation anchoring	(1.841)	(3.675)	(6.431)	(3.357)
R&D intensity	-4.236**	-13.382**	-15.338**	-12.144***
*Inflation anchoring	(1.593)	(6.197)	(6.889)	(3.731)
Observations	709	807	321	573

Note: The dependent variable is the average annual growth rate in real value-added during the corresponding subsample for each industry-country pair. Estimates are based on Equation (1). t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 5. The effect of inflation anchoring on industry growth: controlling for confounding factors

Explanatory variable	(I) Financial development	(II) Level of inflation	(III) Government size	(IV) Aggregate growth	(V) Aggregate volatility	(VI) Monetary policy stance	(VII) Stock market volatility	(VIII) Emerging markets
External financial dependence *Inflation anchoring	-11.652****	-9.590***	-12.041***	-13.125***	-13.122***	-16.132***	-13.701***	-9.889**
	(4.708)	(4.434)	(4.011)	(3.967)	(3.671)	(4.424)	(0.403)	(4.123)
Liquidity needs *Inflation anchoring	-6.205*	-5.524	-6.813**	-7.554**	-6.658*	-13.143***	-6.898	-6.361*
	(3.326)	(3.478)	(3.168)	(3.369)	(3.526)	(4.652)	(4.958)	(3.657)
Asset tangibility *Inflation anchoring	7.980***	7.529**	7.953***	8.810***	8.111***	11.040**	9.027*	8.014**
	(2.672)	(2.944)	(2.711)	(2.605)	(2.772)	(4.180)	(4.560)	(3.266)
R&D intensity *Inflation anchoring	-6.128**	-4.235*	-8.016**	-8.537**	-7.952**	-13.972*	-12.906**	-4.881
	(2.945)	(2.354)	(3.547)	(3.733)	(3.425)	(7.055)	(4.809)	(3.348)
External financial dependence *Confounding factor	-0.001	-0.046**	0.033	0.016	-0.016	0.162	-0.095	-1.045
	(0.005)	(0.020)	(0.021)	(0.144)	(0.178)	(0.695)	(0.497)	(0.758)
Liquidity needs * Confounding factor	0.002	-0.021	0.013	-0.044	-0.100	-0.263	-0.019	-0.300
	(0.005)	(0.014)	(0.019)	(0.077)	(0.106)	(0.528)	(0.352)	(0.471)
Asset tangibility * Confounding factor	-0.002	0.013	-0.016	0.051	0.066	0.348	-0.129	0.170
	(0.004)	(0.011)	(0.020)	(0.092)	(0.120)	(0.704)	(0.478)	(0.494)
R&D intensity * Confounding factor	0.010*	-0.059***	0.014	0.003	-0.104	0.293	-0.319	-1.270**
	(0.005)	(0.021)	(0.022)	(0.119)	(0.108)	(0.428)	(0.293)	(0.530)
Observations	734	774	774	774	774	502	617	774

Note: The dependent variable is the average annual growth rate in real value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (3). t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 6. The effect of inflation anchoring on industry growth: controlling for nominal rigidities

Explanatory variable	(I) External financial dependence	(II) Liquidity needs	(III) Asset tangibility	(IV) R&D intensity
	Price adjustment speed parameter estimates from Roberts et al. (1994)			
Credit constraints *Inflation anchoring	-12.968***	-6.857**	8.209***	-8.292**
	(3.777)	(3.079)	(2.389)	(3.489)
Nominal rigidities *Inflation anchoring	1.445	1.540	1.108	2.331
	(1.913)	(1.640)	(1.769)	(1.873)
Observations	774	774	774	774
R-squared	0.46	0.47	0.47	0.47
	Calvo parameter estimates from Leith and Malley (2007)			
Credit constraints *Inflation anchoring	-9.621**	-3.751	5.023**	-2.256
	(4.477)	(2.849)	(2.472)	(3.138)
Nominal rigidities *Inflation anchoring	-3.762	-4.259*	-3.888	-4.319
	(2.538)	(2.472)	(2.524)	(2.620)
Observations	686	686	686	686
R-squared	0.54	0.55	0.54	0.54

Note: The dependent variable is the average annual growth rate in real value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (4). t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively. A higher price adjustment speed parameter in the top panel corresponds to a lower Calvo parameter in the bottom panel.

Table 7. The effect of inflation anchoring on industry growth: IV regression

Explanatory variable	(I)	(II)	(III)	(IV)
Initial share	-0.619*	-0.508	-0.508	-0.554
	(0.358)	(0.378)	(0.365)	(0.378)
External financial dependence *Inflation anchoring	-14.045**			
	(6.320)			
Liquidity needs *Inflation anchoring		-3.646		
		(4.100)		
Asset tangibility *Inflation anchoring			2.992	
			(6.291)	
R&D intensity *Inflation anchoring				-9.723**
				(4.743)
Cragg-Donald Wald F-statistic	114.808	128.295	126.908	118.979
Stock-Yogo weak identification test 5% critical values	13.91	13.91	13.91	13.91
Hansen J-statistic p-value	0.144	0.454	0.500	0.228
Observations	591	591	591	591

Note: The dependent variable is the average annual growth rate in real value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (1). t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table 8. The effect of inflation anchoring on industry growth: panel regression

Explanatory variable	(I)	(II)	(III)	(IV)
Lagged value-added growth	-0.124***	-0.124***	-0.124***	-0.124***
	(0.013)	(0.013)	(0.013)	(0.013)
Lagged inflation anchoring	-0.367	-0.438	-0.395	-0.387
	(0.804)	(0.838)	(0.810)	(0.824)
External financial dependence *Lagged inflation anchoring	-2.534***			
	(0.949)			
Liquidity needs *Lagged inflation anchoring		-2.025**		
		(0.818)		
Asset tangibility *Lagged inflation anchoring			1.441**	
			(0.818)	
R&D intensity *Lagged inflation anchoring				-2.252**
				(3.967)
Observations	12,636	12,636	12,636	12,636
R-squared	0.09	0.09	0.09	0.09

Note: The dependent variable is the annual growth rate in real value-added for each industry-country pair. Estimates are based on Equation (5). t-statistics based on clustered standard errors at the country-time level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

References

Aastveit, Knut Are, Gisle James Natvik, and Sergio Sola. "Economic uncertainty and the influence of monetary policy." Journal of International Money and Finance 76 (2017): 50-67.

Abadie, Alberto, Susan Athey, Guido W. Imbens, and Jeffrey Wooldridge. "When should you adjust standard errors for clustering?" No. w24003. National Bureau of Economic Research, 2017.

Acemoglu, Daron, and Fabrizio Zilibotti. "Was Prometheus unbound by chance? Risk, diversification, and growth." Journal of Political Economy 105.4 (1997): 709-751.

Afonso, Antonio, and Davide Furceri. "Government size, composition, volatility and economic growth." European Journal of Political Economy 26.4 (2010): 517-532.

Aghion, Philippe, George-Marios Angeletos, Abhijit Banerjee, and Kalina Manova. "Volatility and growth: Credit constraints and the composition of investment." Journal of Monetary Economics 57, no. 3 (2010): 246-265.

Aghion, Philippe, David Hemous, and Enisse Kharroubi (2014), "Cyclical fiscal policy, credit constraints, and industry growth." Journal of Monetary Economics 62, 41-58.

Aghion, Philippe, Emmanuel Farhi, and Enisse Kharroubi. "Liquidity and growth: the role of counter-cyclical interest rates." Working Paper (2015).

Alfaro, Ivan, Nicholas Bloom, and Xiaoji Lin. "The finance uncertainty multiplier." NBER Working Paper, No. w24571. National Bureau of Economic Research, 2018.

Almeida, Heitor, and Murillo Campello. "Financial constraints, asset tangibility, and corporate investment." Review of Financial Studies 20, no. 5 (2007): 1429-1460.

Arellano, Cristina, Yan Bai, and Patrick J. Kehoe. "Financial frictions and fluctuations in volatility." Journal of Political Economy 127, no. 5 (2019): 2049-2103.

Baker, Scott R., Nicholas Bloom, and Stephen J. Terry. "Using disasters to estimate the impact of uncertainty." NBER Working Paper, No. w27167. National Bureau of Economic Research, 2020.

Baldwin, Carliss Y., and Richard S. Ruback. "Inflation, uncertainty, and investment." Journal of Finance 41.3 (1986): 657-668.

Ball, Laurence. "Why does high inflation raise inflation uncertainty?" Journal of Monetary Economics 29, no. 3 (1992): 371-388.

Ball, Laurence and Sandeep Mazumder. "Inflation Dynamics and the Great Recession." Brookings Papers on Economic Activity (2011): 337-405.

Barro, Robert J. "Inflation and growth." Review-Federal Reserve Bank of Saint Louis 78 (1996): 153-169.

Berentsen, A., M. Rojas Breu, and S. Shi (2012): "Liquidity, innovation and growth." Journal of Monetary Economics, 59(8), 721-737.

Bernanke, Ben S., Thomas Laubach, Frederic S. Mishkin, and Adam S. Posen. "Inflation targeting: lessons from the international experience" Princeton University Press, 1999.

Braun, Matias, and Borja Larrain (2005), "Finance and the business cycle: international, inter-industry evidence." Journal of Finance 60(3), 1097-1128.

Buono, Ines, and Sara Formai. "New evidence on the evolution of the anchoring of inflation expectations." Journal of Macroeconomics 57 (2018): 39-54.

Caggiano, Giovanni, Efrem Castelnuovo, Silvia Delrio, and Richard Kima. "Financial uncertainty and real activity: The good, the bad, and the ugly." European Economic Review 136 (2021): 103750.

Choi, Sangyup, Davide Furceri, and João Tovar Jalles. "Heterogeneous Gains from Countercyclical Fiscal Policy: New Evidence from International Industry-level Data." Oxford Economic Papers (forthcoming).

Choi, Sangyup, Davide Furceri, Yi Huang, and Prakash Loungani. "Aggregate uncertainty and sectoral productivity growth: The role of credit constraints." Journal of International Money and Finance 88 (2018): 314-330.

Chu, A. C., and G. Cozzi (2014): "R&D and Economic Growth in a Cash-in-Advance Economy," International Economic Review, 55, 507-524.

Crowe, Christopher, and Ellen E. Meade. "The evolution of central bank governance around the world." Journal of Economic Perspectives 21.4 (2007): 69-90.

Cukierman, Alex, Steven B. Web, and Bilin Neyapti. "Measuring the independence of central banks and its effect on policy outcomes." World Bank Economic Review 6, no. 3 (1992): 353-398.

Czarnitzki, Dirk, and Andrew A. Toole (2011), "Patent protection, market uncertainty, and R&D investment." Review of Economics and Statistics 93(1), 147-159.

De Gregorio, Jose. “Inflation, taxation, and long-run growth.” Journal of Monetary Economics 31.3 (1993): 271-298.

Debrun, Xavier, Jean Pisani-Ferry, and Andre Sapir. “Government Size and Output Volatility: Should We Forsake Automatic Stabilization?” IMF Working Paper (2008): 1-53.

Dedola, Luca, and Francesco Lippi. “The monetary transmission mechanism: evidence from the industries of five OECD countries.” European Economic Review 49.6 (2005): 1543-1569.

Dell'Ariccia, Giovanni, Enrica Detragiache, and Raghuram Rajan. “The real effect of banking crises.” Journal of Financial Intermediation 17.1 (2008): 89-112.

Dornbusch, Rudiger, and Jacob A. Frenkel. “Inflation and growth: alternative approaches.” Journal of Money, Credit and Banking 5.1 (1973): 141-156.

Dotsey, Michael and Pierre-Daniel Sarte, “Inflation Uncertainty and Growth in a Cash-in-Advance Economy.” Journal of Monetary Economics (2000), 45 (3), 631–655.

Dovern, Jonas, Ulrich Fritsche, and Jiri Slacalek. “Disagreement among forecasters in G7 countries.” Review of Economics and Statistics 94, no. 4 (2012): 1081-1096.

Evers, Michael, Stefan Niemann, and Marc Schiffbauer. “Inflation, liquidity and innovation.” European Economic Review 128 (2020): 103506.

Fatás, Antonio, and Ilian Mihov. “Government size and automatic stabilizers: international and intranational evidence.” Journal of International Economics 55.1 (2001): 3-28.

Fazzari, Steven M., R. Glenn Hubbard, and Bruce C. Petersen. “Financing Constraints and Corporate Investment.” Brookings Papers on Economic Activity 19, no. 1 (1988): 141-206.

Fernández-Villaverde, Jesús, Pablo Guerrón-Quintana, Keith Kuester, and Juan Rubio-Ramírez. “Fiscal volatility shocks and economic activity.” American Economic Review 105, no. 11 (2015): 3352-84.

Fernández-Villaverde, Jesús, and Pablo A. Guerrón-Quintana. “Uncertainty shocks and business cycle research.” Review of Economic Dynamics 37 (2020): S118-S146.

Fischer, Stanley. “The role of macroeconomic factors in growth.” Journal of Monetary Economics 32.3 (1993): 485-512.

Fischer, Stanley, and Franco Modigliani. “Towards an understanding of the real effects and costs of inflation.” Review of World Economics 114.4 (1978): 810-833.

Furceri Davide and Jalles João Tovar (2019). "Fiscal counter-cyclicality and productive investment: evidence from advanced economies." B.E. Journal of Macroeconomics, De Gruyter, vol. 19(1), pages 1-15, January.

Goel, Rajeev K., and Rati Ram (2001), "Irreversibility of R&D investment and the adverse effect of uncertainty: Evidence from the OECD countries." Economics Letters 71(2), 287-291.

Gonçalves, Carlos Eduardo S., and João M. Salles. "Inflation targeting in emerging economies: What do the data say?" Journal of Development Economics 85.1-2 (2008): 312-318.

Grishchenko, Olesya, Sarah Mouabbi, and Jean-Paul Renne. "Measuring inflation anchoring and uncertainty: A US and euro area comparison." Journal of Money, Credit and Banking 51, no. 5 (2019): 1053-1096.

Hart, Oliver, and John Moore (1994), "A theory of debt based on the inalienability of human capital." Quarterly Journal of Economics 109(4), 841-879.

Huizinga, John. "Inflation uncertainty, relative price uncertainty, and investment in US manufacturing." Journal of Money, Credit and Banking 25.3 (1993): 521-549.

Ilyina, Anna, and Roberto Samaniego. "Technology and financial development." Journal of Money, Credit and Banking 43.5 (2011): 899-921.

Judson, Ruth, and Athanasios Orphanides. "Inflation, volatility and growth." International Finance 2.1 (1999): 117-138.

Kroszner, Randall S., Luc Laeven, and Daniela Klingebiel. "Banking crises, financial dependence, and growth." Journal of Financial Economics 84, no. 1 (2007): 187-228.

Leith, Campbell, and Jim Malley. "A sectoral analysis of price-setting behavior in US manufacturing industries." Review of Economics and Statistics 89, no. 2 (2007): 335-342.

Levin, Andrew T., Fabio M. Natalucci, and Jeremy M. Piger. "The macroeconomic effects of inflation targeting." Review-Federal Reserve Bank of Saint Louis 86.4 (2004): 51-8.

Levine, Ross, and David Renelt. "A sensitivity analysis of cross-country growth regressions." American Economic Review (1992): 942-963.

Lin, Shu, and Haichun Ye. "The international credit channel of US monetary policy transmission to developing countries: Evidence from trade data." Journal of Development Economics 133 (2018): 33-41.

Loungani, Prakash, and Nathan Sheets. “Central bank independence, inflation, and growth in transition economies.” Journal of Money, Credit, and Banking (1997): 381-399.

Nickell, Stephen. “Biases in dynamic models with fixed effects.” Econometrica (1981): 1417-1426.

Park, Kwangyong. “Central bank credibility and monetary policy.” Bank of Korea Working Paper 45 (2018).

Peersman, Gert, and Frank Smets. “The industry effects of monetary policy in the euro area.” Economic Journal 115, no. 503 (2005): 319-342.

Raddatz, Claudio. “Liquidity needs and vulnerability to financial underdevelopment.” Journal of Financial Economics 80 (2006): 677-722.

Rajan, Raghuram and Luigi Zingales (1998), “Financial Dependence and Growth.” American Economic Review, 88 (3), 559-86

Ramey, Garey, and Valerie A. Ramey. “Cross-Country Evidence on the Link Between Volatility and Growth.” American Economic Review (1995): 1138-1151.

Roberts, John M., David J. Stockton, and Charles S. Struckmeyer. “Evidence on the Flexibility of Prices.” Review of Economics and Statistics (1994): 142-150.

Samaniego, Roberto M., and Juliana Y. Sun. “Technology and contractions: Evidence from manufacturing.” European Economic Review 79 (2015): 172-195.

Stock, James H., and Motohiro Yogo. “Testing for Weak Instruments in Linear IV Regression.” Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg (2005)

Tong, Hui, and Shang-Jin Wei (2011), “The composition matters: capital inflows and liquidity crunch during a global economic crisis.” Review of Financial Studies 24(6), 2023-2052.

Townsend, Robert M. “Optimal contracts and competitive markets with costly state verification.” Journal of Economic Theory 21, no. 2 (1979): 265-293.

Volcker, P., 1979, Statement before the Joint Economic Committee of the U.S. Congress. October 17, 1979. Reprinted in *Federal Reserve Bulletin* 65 (11): 888–90.

Wooldridge, Jeffrey M. “Econometric analysis of cross section and panel data.” MIT Press, 2010.

Appendix (for online publication only)

This online appendix includes A) the complete description of a theoretical model; B) details on how Consensus Economic forecasts are constructed and the inflation de-anchoring coefficients are estimated; C) additional figures and tables; D) additional robustness checks.

A. Theoretical model

We introduce a simple theoretical model that formally describes how inflation anchoring enhances growth in the absence of a complete market indexing nominal debt to real values and how this effect interacts with a firm's credit constraints when information asymmetry information exists between banks and firms. Our model shares some similarities with a recent study by Evers et al. (2020), who presented a model with financial frictions where inflation increases the cost of holding liquid assets to hedge risky production against expenditure shocks. As a result, firms are forced to shift their investment from long-term to short-term, resulting in lower productivity growth, similar to the mechanism suggested in Aghion et al. (2014). The major deviation of our model from theirs is the inflation information structure and the explicit role of the central bank, which we discuss below.

Model environments. We consider an environment where a representative firm operates in an industry.[30] We assume that there is no state-contingent contract (i.e., the incomplete asset market). In other words, due to the lack of indexed debt, only a nominal debt contract is offered; therefore, firms and banks cannot hedge risk stemming from unexpected inflation. A firm needs external funds to finance its investment projects with different (idiosyncratic) productivities, and banks provide a nominal debt contract to firms. To align with our empirical specification, we assume that the degree of credit constraints differs across industries due to their inherently different technological characteristics. We assume that depending on its credibility and reputation, the central bank's commitment to inflation anchoring that governs the agents' expectations of future inflation can be either credible or not.[31] Suppose agents in the economy

[30] One can alternatively consider an environment in which there are infinitely many firms distributed on a unit interval in each industry, and each firm has its own project with different productivities. Results are equivalent to the setup we consider here.

[31] It would be interesting to extend the model by endogenizing the credibility of the central bank and assuming that inflation anchoring is a function of credibility. However, as long as there is a one-to-one positive relationship between

believe that the central bank is credible, then inflation expectations are anchored to the level that the central bank announces. Otherwise, there still exists uncertainty about future inflation.

To highlight the role of inflation anchoring, we assume the following information structure: each firm is located on an island and does not have any (good) information on future inflation of the aggregate economy.[32] The central bank announces its target for future inflation and (i) is successful in inflation anchoring if its announcement is credible to the public or (ii) fails to anchor inflation expectations otherwise. As shown later, in our model, committing to perfect inflation anchoring is socially optimal because it maximizes aggregate output. While the central bank pursues such a goal, the lack of central bank credibility or instruments to achieve inflation targeting, political pressures, or constraint by central bank mandates other than price stability can lead to the de-anchoring of inflation expectations.

We consider a two-period model. Each firm in an industry $i \in [0,1]$ is ex-ante identical; a firm initially produces output by $Y_0 > 0$ in the first period and faces infinitely many investment projects that increase its output in the next period. Each project, indexed by j, requires a normalized cost in the first periods ($t = 0$), yielding additional output $y_j > 0$ in the next period ($t = 1$). We interpret y_j as value-added by the investment project j, which can also be interpreted as idiosyncratic productivity that the project can add to the firm's current productivity. The firm is assumed to have no internal funds to finance the project; thus, it should rely on external funds provided by banks.[33] We assume that the firm knows the productivity of its own investment project, but banks only know the distribution of y_j, denoted by $f(y)$ with a support $[\underline{y}, \infty)$ when it offers a nominal debt contract to the firm's project. Suppose that the firm can finance the project with a productivity level higher than the cut-off $\hat{y} \geq \underline{y}$. Then the net growth rate of output takes the following form: $g_Y = \frac{\int_{\hat{y}}^{\infty} y f(y) dy}{Y_0}$.

the two variables, the model's prediction will be preserved. To be consistent with an alternative consideration of the model, we use an instrumental variable approach where proxies of central bank credibility are used as an instrument.

[32] This assumption might be relaxed by allowing firms to possess partial information on future inflation. As long as there is an information gap between the firm and the central bank, the firm will rely more on public information provided by the central bank. For example, Svensson (2006) argues that it is more likely that public information (information disseminated by the central bank) is more accurate than private information. Thus, our assumption appears innocuous for our purpose—to highlight the relationship between inflation anchoring and growth.

[33] The model's predictions do not alter when we allow the firms to have a positive net worth to fund the project.

Thus, the growth rate is a decreasing function of the cut-off value, $\widehat{y}$. With a lower cut-off value, more investment projects can be financed, so the firm can produce more output. If no additional project is undertaken, $g_Y = 0$. As $\widehat{y}$ is a sufficient statistic for the growth rate of output, we mainly focus on $\widehat{y}$ in the subsequent analysis.

We assume that there is no time discounting for simplicity; therefore, the standard Fisher equation implies $I = R\Pi^e$ (the upper-case letter indicates the gross rate). We normalize the gross real interest rate, R, to one, which is exogenously determined from banks' perspective. Since there is no state-contingent contract, each firm faces the same gross nominal interest rate, $I = \Pi^e > 1$.[34] The firm is risk-neutral and maximizes dividend payout. Following Gertler and Kiyotaki (2015), we introduce a credit constraint to the economy by allowing the firm to default on the debt.

The dividend payout from the project j is $x^{nd} = y_j - I$ if the firm does not default on the debt and $x^d = \lambda y_j$ with $\lambda \in (0,1)$ if the firm declares default. λ denotes the share of output that the firm can divert from the investment in case of default, which measures the degree of credit constraints in our model economy. Thus, a larger value of λ implies a higher risk for banks in providing loans. One might interpret λ as an auditing cost borne by banks to identify the firm's output (costly state verification à la Townsend, 1979). It is straightforward to show the existence of a threshold level, $\widehat{y}$, so that projects with productivity above the threshold will be undertaken and contribute to the firm's growth.[35] Formally, $\widehat{y} - I = \lambda\widehat{y}$ or equivalently $\widehat{y} = \frac{I}{1-\lambda}$. Thus, changes in output would be determined by the following equation: $\Delta Y = \int_{\widehat{y}}^{\infty} y f(y) dy$.

The following remark immediately follows from the definition of $\widehat{y}$, which is the standard prediction of models with costly state verification:

Remark 1. *In the model economy, fewer investment projects can be undertaken when (i) banks set a high gross interest rate* (I) *or (ii) credit constraints* ($\lambda > 0$) *exist.*

[34] The assumption of a positive nominal interest rate is not crucial here. Our theoretical predictions hold even when we allow zero lower bound of the nominal interest rate.

[35] We further assume that for investment projects with y ≤ $\tilde{y}$, the diverted output cannot be added to the firm's final output since it should be hidden from the banks, which does not significantly affect our conclusion.

Given that high inflation leads to a high nominal interest rate in this economy, the above observation is consistent with the theoretical predictions of Evers et al. (2020) that inflation tilts firms' investment decisions away from innovative activities, which reduces long-run growth. One can interpret the firm's problem in our paper as an alternative modeling strategy to Evers et al. (2020) that allows the firm to choose between the basic technology (no investment, in our model) and the advanced technology (positive investment, in our model). As discussed below, we choose the simplest possible model to describe the theoretical channel, given the lack of industry-level data to distinguish basic and advanced technology.

We now turn to a bank's problem. We assume that a risk-neutral representative bank maximizes its expected profit from the loan contract offered to the firm's investment projects. Let $F(y)$ denote the cumulative density function of the project's productivity (value-added). From the firm's problem, the bank knows that only a fraction of investment projects with high productivity $1 - F(\hat{y})$ will be financed and thus produce output. Thus, the profit of the bank would be $\big(1 - F(\hat{y})\big)I$, and the bank's problem is to set I to maximize its profit.

Main predictions. Suppose that the rate of future inflation can take two values; $\Pi^e = \{\Pi^H, \Pi^L\}$ and without loss of generality, assume $\Pi^H > \Pi^L > 1$. To demonstrate the role of inflation anchoring clearly, we consider the following two scenarios:[36]

(i) No inflation anchoring: the central bank either provides no information on future inflation or provides its target for future inflation, but the public does not believe in the central bank signal. The bank knows that the future inflation rate will be either Π^H or Π^L, but does not know the probability of each state.
(ii) Perfect inflation anchoring: the central bank provides credible information on future inflation at $\Pi^L < \Pi^* < \Pi^H$ and banks form their expectations at Π^*, accordingly.

We first consider a benchmark case with perfect inflation anchoring. Given its inflation expectation at Π^*, the bank offers a nominal debt contract with the gross nominal interest rate $I = \Pi^*$, the only available option for the bank and the firm. Then $\hat{y}^* = \frac{\Pi^*}{1-\lambda}$ becomes the

[36] One might generalize our assumption here by allowing the intermediate case with loose inflation anchoring in which banks know the distribution of the future rate of inflation. We do not consider this scenario because it complicates the analysis without providing additional insights.

equilibrium threshold level, and the net increase in output of the firm under perfect inflation anchoring would be $\Delta Y^{*} = \int_{\hat{y}^{*}}^{\infty} y f(y) dy$, where $\hat{y}^{*} = \frac{\Pi^{*}}{1-\lambda}$.

On the other hand, in an economy without inflation anchoring, the bank sets either $I = \Pi^{H}$ or $I = \Pi^{L}$ after comparing the associated profit in each state. We make the following assumption on the future inflation rate in each state:

Assumption 1. Sufficient inflation uncertainty in the absence of inflation anchoring: $\Pi^{H} > \frac{1-F(\hat{y}^{L})+F(\underline{y})}{1-F(\hat{y}^{H})+F(\underline{y})} \Pi^{L}$.

The above assumption implies that future inflation rate in the high state (Π^{H}) is sufficiently higher than that in the low state (Π^{L}). In other words, there should be sufficient uncertainty about future inflation without inflation anchoring. This assumption is in line with the literature that inflation uncertainty is less of a concern in a low-inflation environment (e.g., Ball, 1992) because the public understands that policymakers do not face a dilemma.[37] We believe this condition is a reasonable description of the real-world economy. Suppose instead that inflation in the high state is only marginally higher than that in the low state: $\Pi^{H} \approx \Pi^{L}$. Then inflation anchoring is not of concern to the agents since uncertainty surrounding the inflation is very small. In such a case, the central bank would not face the dilemma as the inflation rate is already anchored to a low level. On the contrary, with $\Pi^{H} \gg \Pi^{L}$, anchoring inflation rate to a certain level between Π^{H} and Π^{L} would be important since it can substantially lower the inflation expectation. Under the above assumption, the following remark holds.

Remark 2. *In the model economy without inflation anchoring, banks always set a high nominal interest rate at the equilibrium.*

Proof. The profit of a bank is $(1 - F(\hat{y}))I = \left(1 - \int_{\underline{y}}^{\hat{y}} f(y) dy\right) I = (1 - F(\hat{y}^{H}) + F(\underline{y}))I$. Relacing I with inflation rate Π, we obtain $\frac{\Pi^{H}}{\Pi^{L}} > \frac{1-F(\hat{y}^{H})+F(\underline{y})}{1-F(\hat{y}^{L})+F(\underline{y})}$ as the condition for the profit

[37] In contrast, when inflation is high, policymakers face a dilemma: they would prefer to have disinflation but fear the resulting recession. Since the public is aware of such a policy dilemma, the central bank announcement of future monetary policy becomes less credible, which raises uncertainty about future inflation.

from setting a higher interest rate Π^H is larger than that from setting a lower interest rate Π^L, and the above assumption is a sufficient condition for this relationship.

The equilibrium level of additional output in this alternative economy would be $\Delta Y^* = \int_{\hat{y}^H}^{\infty} yf(y)dy$, where $\hat{y}^H = \frac{\Pi^H}{1-\lambda}$. We then present the first main prediction of the model.[38]

<u>Proposition 1.</u> Effect of inflation anchoring on growth. *Under the assumptions made above, output growth will be higher in the economy with perfectly-anchored inflation expectations than without anchoring.*

The above proposition implies that there are growth benefits to anchoring inflation. This is because the bank sets a lower interest rate under inflation anchoring so that more firms can finance their investment, thereby increasing the aggregate output. Turning our focus to the role of credit constraints, we obtain the following predictions:

<u>Proposition 2.</u> Role of credit constraints in shaping the effect of inflation anchoring on growth. *Under the assumptions made above, and let $\lambda_c > \lambda_{nc}$, then the following propositions hold.*

(i) When the central bank commits to full inflation anchoring, the share of investment projects that a firm can take increases more in the economy with higher λ.
(ii) Let $\hat{y}_j^*$ and $\hat{y}_j^H$ be the threshold levels in the economy with different degrees of credit constraints ($j = c, nc$). If $\int_{\hat{y}_{nc}^H}^{\hat{y}_c^H} yf(y)dy > \int_{\hat{y}_{nc}^*}^{\hat{y}_c^*} yf(y)dy$ holds, the effect on growth rate is always larger in the economy with higher λ.

The first part of Proposition 2 is straightforward. In the economy with higher λ (i.e., λ_c), the changes in the threshold level of productivity, from $\hat{y}^H$ to $\hat{y}^*$, are greater than those characterized by lower λ (i.e., λ_{nc}). With a decline in the nominal interest rate of the same magnitude, more projects will be financed, and thus more output will be produced. We need an additional assumption that $\int_{\hat{y}_{nc}^H}^{\hat{y}_c^H} yf(y)dy > \int_{\hat{y}_{nc}^*}^{\hat{y}_c^*} yf(y)dy$ to obtain the second part of the above proposition because more investments do not always translate into a higher output of the economy.

[38] Proofs for Propositions 1 and 2 are omitted since they are direct consequences of Remarks 1 and 2.

Assumption 2. Absence of excessive credit constraints or a sufficient number of productive firms: $\int_{\hat{y}_{nc}^{H}}^{\hat{y}_{c}^{H}} yf(y)dy > \int_{\hat{y}_{nc}^{*}}^{\hat{y}_{c}^{*}} yf(y)dy$.

This assumption requires the property that additional output from adding relatively high-productive projects ($\int_{\hat{y}_{nc}^{H}}^{\hat{y}_{c}^{H}} yf(y)dy$) dominates the additional output from adding relatively low-productive projects ($\int_{\hat{y}_{nc}^{*}}^{\hat{y}_{c}^{*}} yf(y)dy$). This assumption is not too restrictive, as it only avoids an environment where excessive credit constraints prevent mosts firms from financing their investment projects.

Note that we have two cases, depending on where the original threshold productivity level locates. For example, Figure A.1 considers the case in which more than half of the projects are already financed (i.e., the threshold exists on the left side of the productivity distribution). In this case, we do not need additional Assumption 2 because increases in aggregate output after inflation anchoring will always be larger for a more credit-constrained economy since the mass of additional projects is greater than that in a less credit-constrained economy. However, if less than half of the projects are only financed due to excessive credit constraints (i.e., the threshold exists on the left side of the productivity distribution), we need additional Assumption 2 to maintain Proposition 2. As shown in Figure A.2, it requires that there exists a sufficient mass on the right tail of the productivity distribution.

Discussion of the model. One might still question that our assumption of the productivity distribution is too restrictive. We present some evidence corroborating our assumption. First, the recent literature on firm size supports the view that there is granularity in firm size and profit distribution. For example, as is well surveyed by Gabaix (2016), empirical evidence supports the Pareto distribution of a firm's profit (and productivity).[39] Second, the well-known role of superstar firms (Rosen, 1981) is another piece of evidence supporting our assumption about a firm's productivity distribution, which requires sufficient mass on the right side of the distribution.

We further remark on the role of the net worth of the firm. While we are abstracting from the firm's net worth, it is straightforward that the extended model—where firms are

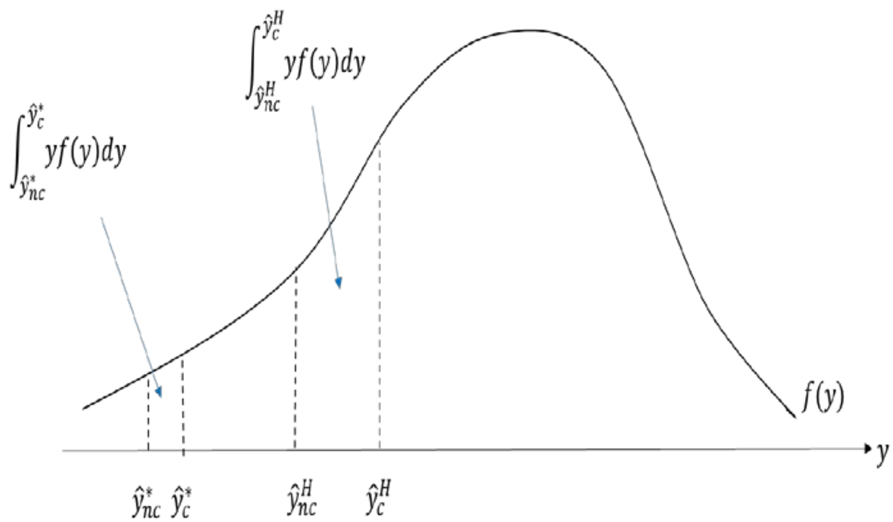
[39] About 25% of output is represented by the sales of the top-50 firms in the United States. In Korea, about 50% of GDP is produced by the ten biggest business groups.

allowed to hold a net worth—reaches the same prediction with the threshold productivity level decreasing with the level of net worth. This implies that, similar to Proposition 2, the effect of inflation anchoring on economic growth would be larger in an economy where firms have a lower net worth.

Lastly, we acknowledge that the model developed in this section does not aim to explain the behavior of economies whose prevailing level of inflation is below its target, which is the case studied in Ehrmann (2015). Our model describes a transition from a high-inflation environment with a lack of inflation anchoring to an environment where inflation expectations are well-anchored at a low level (e.g., inflation targeting by both advanced and emerging market economies in the 1990s and 2000s). Moreover, the recent phenomenon in advanced economies is instead described by relatively well-anchored inflation expectations, so falling inflation does not translate into a marked decline in inflation expectations anyway.[40]

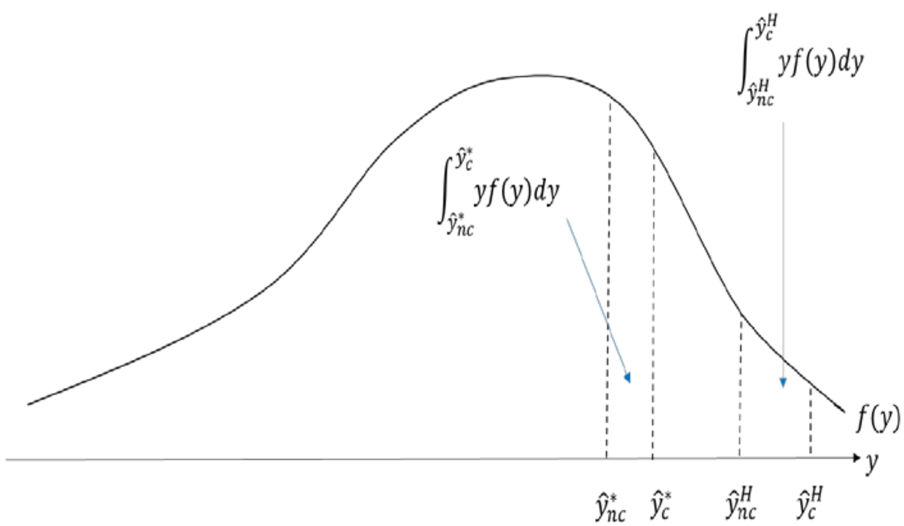
[40] In a low-inflation environment, firms' expectations of future inflation do not appear to be substantially affected by either monetary policy announcements or forward guidance (Coibion et al., 2020). Using micro-level data from professional forecasts of long-term inflation expectations, Dovern and Kenny (2020) do not find evidence of the central tendency of long-run distribution becoming unanchored.

Figure A.1. Productivity distribution without excessive credit constraints



Note: This figure illustrates an environment where sufficiently many firms have been already financed due to the lack of excessive credit constraints.

Figure A.2. Productivity distribution with excessive credit constraints



Note: This figure illustrates an environment where fewer firms have been already financed due to excessive credit constraints. Our assumption requires a sufficient mass of highly productive firms in the productivity distribution.

B. Inflation forecasts and time-varying inflation de-anchoring coefficients

This section provides details of how we adjust the raw series in Consensus Economics forecasts to obtain the fixed-horizon forecast. Following Dovern et al. (2012) and Buono and Formai (2018), we take the weighted average of the semi-annual forecasts for the current calendar year and the next calendar year to compute constant-horizon one-year-ahead forecasts where the weight is determined by their share in the following 12-months period:

$$\pi^e_{1Y} = \tfrac{12-m+1}{12}\pi^e_{CY} + \tfrac{m-1}{12}\pi^e_{NY},$$

where π^e_{CY} is the fixed-event inflation forecasts for this calendar year; π^e_{NY} is the fixed-event inflation forecasts for the next calendar year; and m is the current calendar month. The longer-term inflation expectations are adjusted in a similar manner (e.g., two-year-ahead inflation expectations in 2000 are computed by the weighted average of inflation expectations by the end of 2001 and those by 2002 with varying weights, and so on).

One should take caution in implementing this adjustment because not all Consensus surveys were conducted at the same time. Although most surveys took place in both April and October, there are many incidences that took place in March and September.[41] We collected those events in Table B.1 and made adjustments by changing the weight accordingly. Moreover, we do not use survey data from India because they report the change from the previous fiscal (not calendar) year, creating inconsistency with other countries.

Time-varying de-anchoring coefficients. In this section, we allow the sensitivity of expectations to inflation forecast errors to vary over time to assess whether inflation de-anchoring coefficients have changed over time. Inflation de-anchoring coefficients are likely to vary over time due to changes in monetary policy frameworks, adoption of inflation targeting regime, or constraints on the monetary policy such as the zero lower bound on the nominal interest rates. To this end, we estimate the version of Equation (2) for each country c and horizon h, allowing for time-varying coefficients $\beta^h_{c,t}$:

$$\Delta\pi^e_{c,t+h} = \beta^h_{c,t}\pi^{news}_{c,t} + \varepsilon_{c,t+h}, \tag{B.1}$$

[41] We appreciate the reviewer for pointing out this important issue.

where $\beta_{c,t}$ evolves as a random walk: $\beta_{c,t} = \beta_{c,t-1} + \eta^{\beta}_{c,t}$.

The model is estimated country-by-country using maximum likelihood, based on a constrained nonlinear Kalman filter. The model allows for time variation in all parameters to capture changes in the structure of each economy. This model has several advantages over rolling regressions: (i) it uses all observations in the sample to estimate the magnitude of the parameters in each period—which is not feasible in rolling regressions; (ii) it is consistent with gradually-changing economic structures where their changes depend on the immediate past; (iii) changes in the parameters in a given period come from shocks in the same period; and (iv) it also allows for possible nonlinearities.

Figure B.1 presents the time-varying de-anchoring coefficients using both one- and five-year-ahead inflation expectations ($h = 1, 5$) for six selected countries (three advanced economies: the United States,[42] Germany, and Hong Kong; three emerging market economies: Mexico, Poland, and Turkey). The pattern in the time-varying coefficients we estimated (i.e., steady improvement in inflation anchoring over time, which is temporarily disturbed by the global financial crisis) is largely consistent with that in advanced economies documented in the existing studies (e.g., Strohsal et al., 2016; Łyziak and Paloviita, 2017; Buono and Formai, 2018).

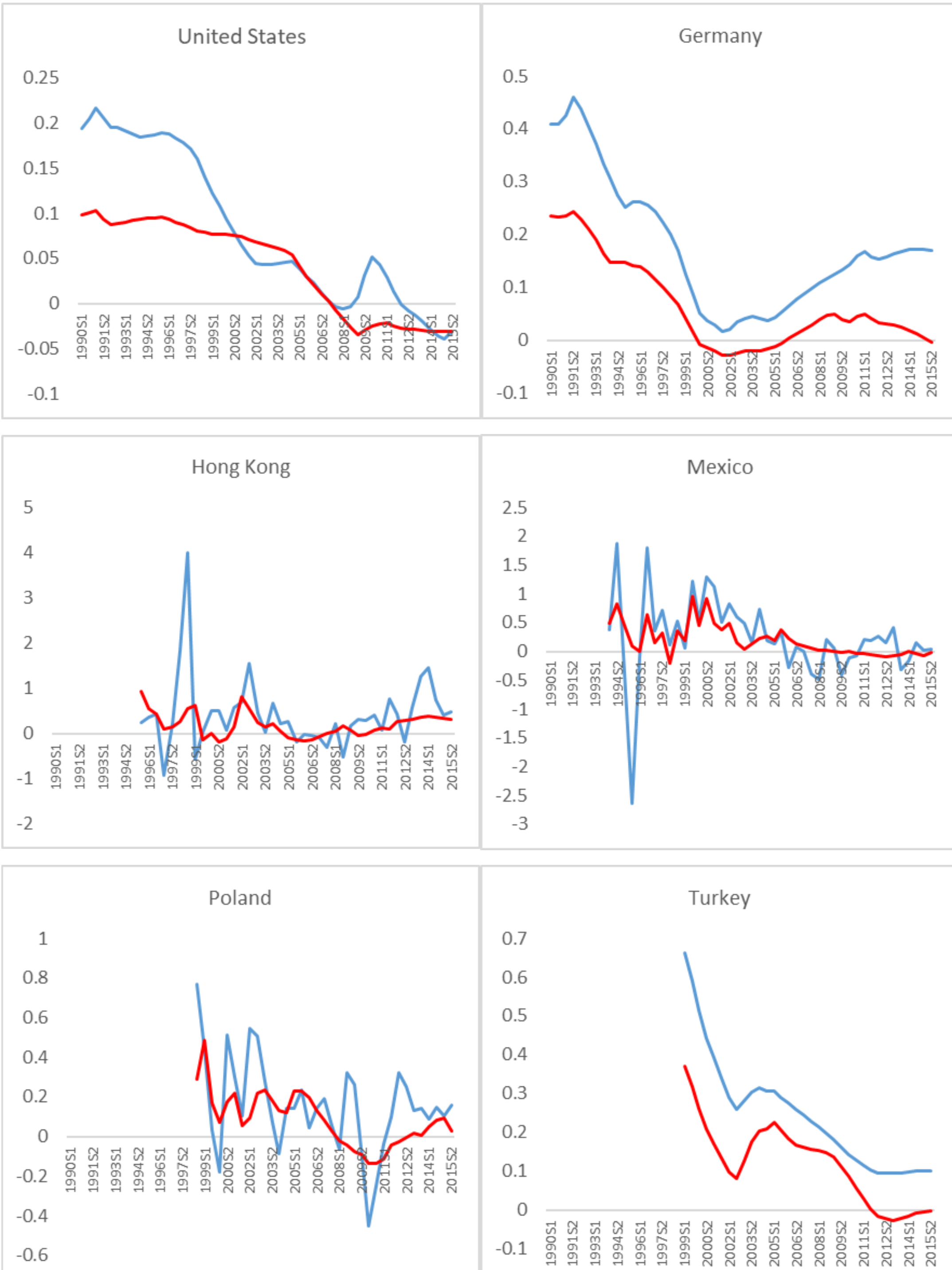
[42] Although the United States is not included in our main analysis, it is useful to compare its time-varying coefficient estimates with other studies.

Table B.1. List of countries where surveys were conducted in non-regular schedules

Country	Occasions
Croatia, Estonia, Latvia, Lithuania, Slovenia	Sep 17 2007, Mar 17 2008, Sep 15 2008, Mar 16 2009, Sep 21 2009, Mar 15 2010, Sep 20 2010, Mar 21 2011, Sep 19 2011, Mar 19 2012, Sep 17 2012, Mar 18 2013, Sep 16 2013, Mar 17 2014
Czech Republic, Hungary, Poland, Romania, Slovak Republic, Turkey	May 18 1998, Sep 21 1998, Mar 15 1999, Sep 20 1999, Mar 20 2000, Sep 18 2000, Mar 19 2001, Sep 17 2001, Mar 18 2002, Sep 16 2002, Mar 17 2003, Sep 15 2003, Mar 15 2004, Sep 20 2004, Mar 21 2005, Sep 19 2005, Mar 20 2006, Sep 18 2006, Mar 19 2007, Sep 17 2007, Mar 17 2008, Sep 15 2008, Mar 16 2009, Sep 21 2009, Mar 15 2010, Sep 20 2010, Mar 21 2011, Sep 19 2011, Mar 19 2012, Sep 17 2012, Mar 18 2013, Sep 16 2013, Mar 17 2014
Russia	May 18 1998, Sep 21 1998, Mar 15 1999, Sep 20 1999, Mar 20 2000, Sep 18 2000, Mar 19 2001, Sep 17 2001, Mar 18 2002, Sep 16 2002, Mar 17 2003, Sep 15 2003, Mar 15 2004, Sep 20 2004, Mar 21 2005, Sep 19 2005, Mar 20 2006, Sep 18 2006, Mar 19 2007, Sep 17 2007, Mar 17 2008, Sep 15 2008, Mar 16 2009, Sep 21 2009, Mar 15 2010, Sep 20 2010, Mar 21 2011, Sep 19 2011, Mar 19 2012, Sep 17 2012, Mar 18 2013, Sep 16 2013, Mar 17 2014

Note: They are the list of the sample countries where surveys were conducted in non-regular schedules (i.e., other than April-October cycles).

Figure B.1. Time-varying de-anchoring coefficients for selected countries



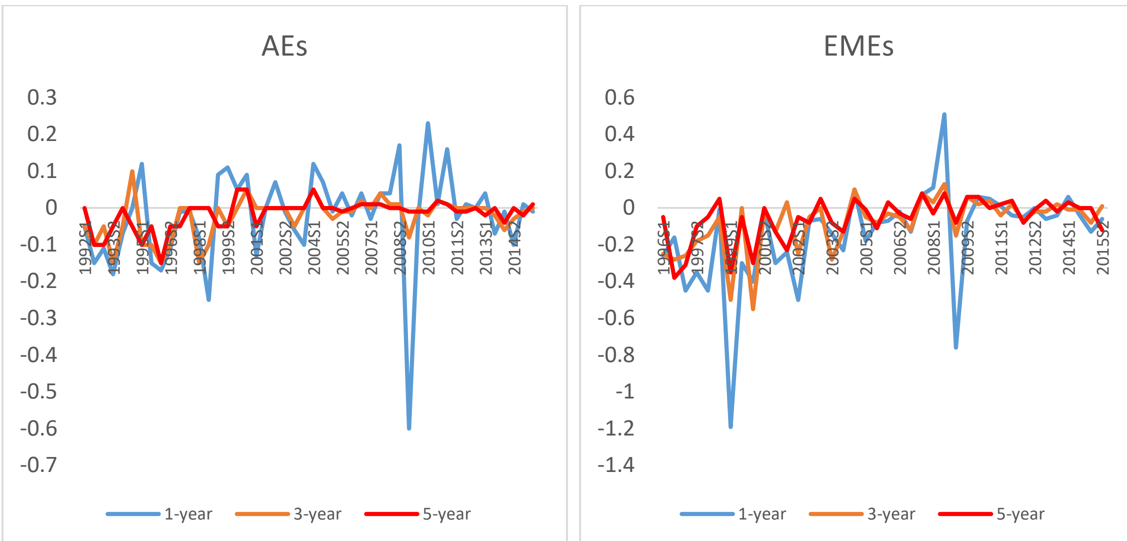
Note: Blue lines denote one-year-ahead inflation expectations, while red lines denote five-year-ahead inflation expectations that are used in estimating Equation (5) in the main text.

C. Additional figures and tables

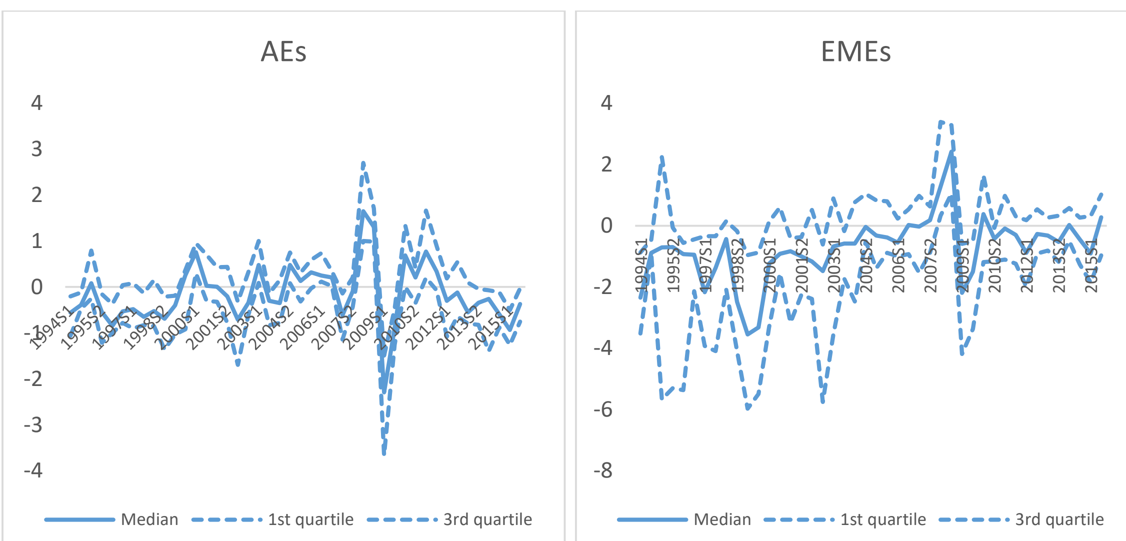
This section collects the additional figures and tables that are not presented in the main text to save space.

Figure C.1. Changes in inflation expectations and inflation surprises (percentage points)

A) Changes in inflation expectations

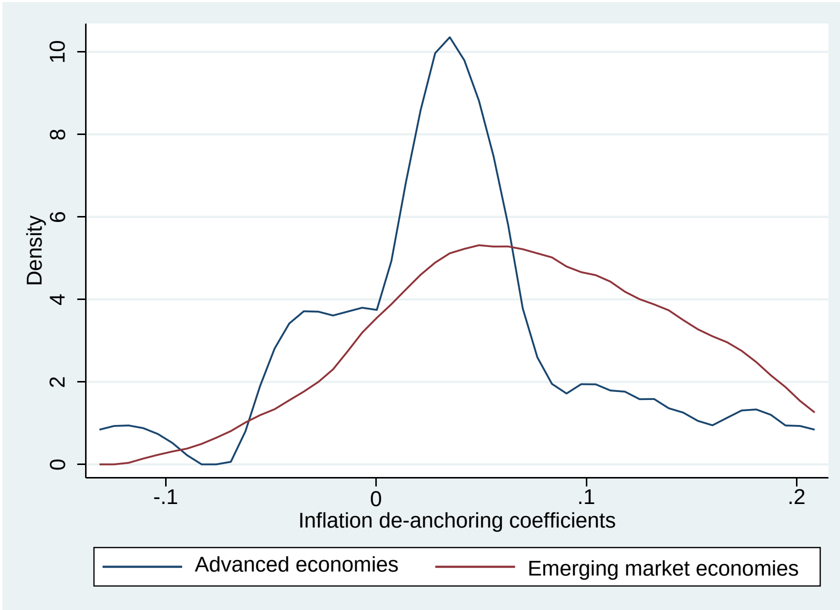


B) Changes in inflation surprises



Note: Data used in this figure are quarterly. In the first two panels, the blue, orange, and red lines denote changes in expectations at one-, three-, and five-year ahead in the future, respectively. In the last two panels, the solid lines denote the median of inflation surprises, and the dotted lines denote their interquartile ranges.

Figure C.2. Inflation anchoring coefficients: advanced vs. emerging market economies



Note: Distribution of the coefficients estimated from Equation (2) using five-year-ahead inflation expectations.

Table C.1. Degree of inflation anchoring coefficients

Country	(I) 1-year coef	1-year s.e.	(II) 2-year coef	2-year s.e.	(III) 3-year coef	3-year s.e.	(IV) 4-year coef	4-year s.e.	(V) 5-year coef	5-year s.e.
Argentina	1.336	0.277	0.593	0.168	0.372	0.096	0.181	0.077	0.170	0.060
Australia	0.296	0.065	0.055	0.042	0.066	0.027	0.081	0.022	0.075	0.036
Brazil	0.860	0.147	0.504	0.103	0.284	0.074	0.223	0.064	0.162	0.040
Canada	0.456	0.049	0.085	0.025	0.015	0.021	-0.006	0.018	-0.032	0.018
Chile	0.286	0.065	0.090	0.020	0.043	0.021	0.049	0.022	0.047	0.028
China	0.022	0.020	0.008	0.018	0.000	0.015	-0.001	0.014	0.001	0.014
Colombia	0.328	0.033	0.186	0.026	0.115	0.045	0.039	0.055	0.087	0.031
Croatia	0.355	0.085	0.077	0.043	-0.023	0.029	0.003	0.022	-0.014	0.023
Czech Republic	0.625	0.054	0.194	0.040	0.101	0.036	0.115	0.045	0.106	0.027
Estonia	0.537	0.061	0.188	0.034	0.031	0.040	0.014	0.047	0.055	0.034
France	0.387	0.067	0.134	0.029	0.030	0.014	0.050	0.015	0.038	0.016
Germany	0.381	0.074	0.186	0.030	0.033	0.022	0.040	0.022	0.012	0.019
Hong Kong SAR	0.533	0.090	0.323	0.138	0.117	0.091	0.153	0.064	0.197	0.087
Hungary	0.509	0.070	0.198	0.048	0.071	0.042	0.062	0.031	0.058	0.020
Indonesia	0.795	0.100	0.293	0.031	0.086	0.009	0.044	0.008	0.024	0.007
Italy	0.478	0.050	0.204	0.029	0.017	0.037	0.042	0.038	0.040	0.045
Japan	0.482	0.109	0.188	0.067	0.150	0.052	0.160	0.042	0.121	0.048
Korea	0.717	0.105	0.212	0.028	0.020	0.019	0.038	0.015	-0.032	0.032
Latvia	0.728	0.074	0.291	0.123	0.049	0.035	0.035	0.017	0.011	0.013

Lithuania	0.628	0.055	0.367	0.066	0.177	0.045	0.191	0.110	0.160	0.079
Malaysia	0.592	0.099	0.211	0.036	0.085	0.049	0.072	0.064	0.130	0.080
Mexico	0.816	0.030	0.357	0.007	0.182	0.012	0.150	0.009	0.164	0.005
Netherlands	0.256	0.070	0.109	0.045	0.066	0.033	0.044	0.039	0.043	0.053
New Zealand	0.384	0.067	0.043	0.029	0.007	0.023	0.037	0.021	0.036	0.020
Norway	0.453	0.055	-0.046	0.043	0.036	0.030	0.024	0.023	0.024	0.024
Peru	0.331	0.029	0.185	0.032	0.121	0.032	0.085	0.027	0.115	0.035
Poland	0.314	0.057	0.133	0.033	0.081	0.033	0.077	0.035	0.075	0.034
Romania	0.461	0.046	0.305	0.039	0.166	0.066	0.149	0.062	0.147	0.099
Russia	0.618	0.063	0.301	0.018	0.191	0.056	0.144	0.067	0.080	0.027
Singapore	0.424	0.067	0.177	0.028	0.083	0.022	0.054	0.021	0.054	0.022
Slovak Republic	0.408	0.066	0.035	0.055	-0.117	0.064	-0.110	0.059	-0.120	0.056
Slovenia	0.449	0.073	0.181	0.025	0.076	0.013	0.033	0.012	0.033	0.011
Spain	0.450	0.059	0.149	0.021	0.066	0.015	0.049	0.016	0.048	0.020
Sweden	0.497	0.065	0.216	0.035	0.056	0.022	0.023	0.019	0.033	0.021
Switzerland	0.567	0.078	0.190	0.043	0.026	0.032	-0.021	0.041	-0.025	0.039
Taiwan Province of China	0.327	0.115	0.125	0.038	0.055	0.031	0.027	0.037	0.019	0.030
Thailand	0.556	0.053	0.222	0.080	0.102	0.090	0.035	0.016	0.036	0.011
Turkey	0.846	0.116	0.540	0.097	0.186	0.102	0.095	0.042	0.050	0.033
United Kingdom	0.556	0.123	0.208	0.064	0.100	0.055	-0.010	0.075	-0.036	0.064

Note: This table summarizes the results from estimating Equation (2) country-by-country using inflation expectations at various horizons.

Table C.2. Industry classification: INDSTAT2 vs. INDSTAT3

INDSTAT2		INDSTAT3	
ISIC	Industry	ISIC	Industry
15	Food products and beverages	311	Food
16	Tobacco products	313	Beverages
17	Textiles	314	Tobacco
18	Wearing apparel; dressing and dyeing of fur	321	Textiles
19	Tanning and dressing of leather	322	Apparel
20	Wood and of products of wood and cork, except furniture	323	Leather
21	Paper and paper products	324	Footwear
22	Publishing, printing and reproduction of recorded media	331	Wood products
23	Coke, refined petroleum products and nuclear fuel	332	Furniture, except metal
24	Chemicals and chemical products	341	Paper and products
25	Rubber and plastics products	342	Printing and publishing
26	Other non-metallic mineral products	351	Industrial chemicals
27	Basic metals	352	Other chemicals
28	Fabricated metal products, except machinery and equipment	353	Petroleum refineries
29	Machinery and equipment n.e.c.	354	Misc. pet. And coal products
30	Office, accounting and computing machinery	355	Rubber products
31	Electrical machinery and apparatus n.e.c.	356	Plastic products
32	Radio, television and communication equipment and apparatus	361	Pottery, china, earthenware
33	Medical, precision and optical instruments, watches and clocks	362	Glass and products
34	Motor vehicles, trailers and semi-trailers	369	Other nonmetallic mineral products
35	Other transport equipment	371	Iron and steel
36	Furniture; manufacturing n.e.c.	372	Nonferrous metals
		381	Fabricated metal products
		382	Machinery, except electrical
		383	Machinery, electric
		384	Transport equipment
		385	Prof. and sci. equip.
		390	Other manufactured products

Note: This table summarizes industry codes in both INDSTAT2 and INDSTAT3 classifications.

Table C.3. Industry-specific intrinsic characteristics

ISIC code	Industry	External financial dependence	Liquidity needs	Asset tangibility	R&D intensity
15	Food products and beverages	0.11	0.10	0.37	0.07
16	Tobacco products	-0.45	0.28	0.19	0.22
17	Textiles	0.19	0.17	0.35	0.14
18	Wearing apparel; dressing and dyeing of fur	0.03	0.21	0.13	0.02
19	Tanning and dressing of leather	-0.14	0.23	0.14	0.18
20	Wood and of products of wood and cork, except furniture	0.28	0.11	0.31	0.03
21	Paper and paper products	0.17	0.13	0.47	0.08
22	Publishing, printing and reproduction of recorded media	0.20	0.07	0.26	0.10
23	Coke, refined petroleum products and nuclear fuel	0.04	0.08	0.55	0.08
24	Chemicals and chemical products	0.50	0.15	0.29	1.18
25	Rubber and plastics products	0.69	0.14	0.37	0.17
26	Other non-metallic mineral products	0.06	0.13	0.46	0.11
27	Basic metals	0.05	0.15	0.40	0.08
28	Fabricated metal products, except machinery and equipment	0.24	0.16	0.27	0.15
29	Machinery and equipment n.e.c.	0.60	0.17	0.20	0.93
30	Office, accounting and computing machinery	0.96	0.20	0.21	0.81
31	Electrical machinery and apparatus n.e.c.	0.95	0.20	0.21	0.81
32	Radio, television and communication equipment and apparatus	0.96	0.20	0.21	0.81
33	Medical, precision and optical instruments, watches and clocks	0.96	0.21	0.18	1.19
34	Motor vehicles, trailers and semi-trailers	0.36	0.18	0.26	0.32
35	Other transport equipment	0.36	0.18	0.26	0.32
36	Furniture; manufacturing n.e.c.	0.37	0.17	0.25	0.21

Note: The index for external financial dependence is taken from Tong and Wei (2011), the index for liquidity needs is taken from Raddatz (2006), and the indices for asset tangibility and R&D intensity are taken from Samaniego and Sun (2015).

Table C.4. Correlation matrix of industry-specific characteristics

	External financial dependence	Liquidity needs	Asset tangibility	R&D intensity
External financial dependence	1			
Liquidity needs	0.04 (0.86)	1		
Asset tangibility	-0.26 (0.24)	-0.68 (0.01)	1	
R&D intensity	0.74 (0.01)	0.33 (0.13)	-0.43 (0.04)	1

Note: The index for external financial dependence is taken from Tong and Wei (2011), the index for liquidity needs is taken from Raddatz (2006), and the indices for asset tangibility and R&D intensity are taken from Samaniego and Sun (2015). The numbers in parentheses are the associated p-values.

D. Additional robustness checks

Table D.1. The effect of confounding factors on industry growth

Explanatory variable	(I) Financial development	(II) Level of inflation	(III) Government size	(IV) Aggregate growth	(V) Aggregate volatility	(VI) Monetary policy stance	(VII) Stock market volatility	(VII) Emerging markets
External financial dependence	0.003	-0.062***	0.048*	0.111	-0.162	0.415	-0.811	-1.625**
*Confounding factor	(0.007)	(0.017)	(0.024)	(0.146)	(0.210)	(0.511)	(0.521)	(0.610)
Liquidity needs	0.004	-0.030**	0.022	0.002	-0.180*	-0.071	-0.391	-0.640
* Confounding factor	(0.005)	(0.014)	(0.021)	(0.081)	(0.098)	(0.431)	(0.286)	(0.447)
Asset tangibility	-0.005	0.025**	-0.025	-0.004	0.160	0.201	0.353	0.587
* Confounding factor	(0.005)	(0.011)	(0.020)	(0.093)	(0.121)	(0.616)	(0.480)	(0.441)
R&D intensity	0.011	-0.067***	0.025	0.060	-0.192	0.485*	-1.029***	-1.532**
* Confounding factor	(0.006)	(0.021)	(0.024)	(0.117)	(0.130)	(0.284)	(0.301)	(0.504)
Observations	734	774	774	774	774	502	617	774

Note: The dependent variable is the average annual growth rate in real value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (3), but the interaction term between credit constraints and inflation anchoring is dropped. t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table D.2. The effect of inflation anchoring on industry growth: using gross output

Explanatory variable	(I)	(II)	(III)	(IV)
Initial share	-0.537**	-0.475**	-0.484**	-0.490**
	(0.226)	(0.223)	(0.230)	(0.236)
External financial dependence *Inflation anchoring	-13.791***			
	(3.961)			
Liquidity needs *Inflation anchoring		-8.006**		
		(3.372)		
Asset tangibility *Inflation anchoring			9.257***	
			(2.899)	
R&D intensity *Inflation anchoring				-10.385***
				(2.527)
Magnitude of differential effects	1.35	0.73	-0.83	1.34
Observations	800	800	800	800
R-squared	0.49	0.48	0.48	0.49

Note: The dependent variable is the average annual growth rate in real gross output from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (1). t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively. Differential effects are computed as the change in inflation anchoring from the 75th percentile (i.e., larger de-anchoring coefficients) to the 25th percentile (i.e., smaller de-anchoring coefficients) of the cross-country distribution between a sector with high credit constraints at the 75th percentile of the distribution) and a sector with low credit constraints (at the 25th percentile of the distribution).

Table D.3. The effect of inflation anchoring on industry growth: accounting for uncertainty in inflation anchoring measures

Explanatory variable	(I) Weighted Least Squares	(II) Assigning zero to insignificant coefficients	(III) Dropping insignificant coefficients
External financial dependence *Inflation anchoring	-10.230*** (2.879)	-10.441*** (4.159)	-12.711*** (4.421)
Liquidity needs *Inflation anchoring	1.206 (4.806)	-3.874 (3.645)	-8.085* (4.455)
Asset tangibility *Inflation anchoring	4.549* (2.730)	6.031** (2.722)	10.276** (4.134)
R&D intensity *Inflation anchoring	-7.678** (2.911)	-5.484** (2.674)	-7.242* (4.023)
Observations	774	774	456

Note: The dependent variable is the average annual growth rate in real value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (1), but different ways of treating uncertainty in the estimated de-anchoring coefficients are considered: (i) using weighted least squares (WLS) with weights given by the reciprocal of the standard error of the estimated de-anchoring coefficients; (ii) assigning a value of zero to the insignificant estimates (at the 10 percent significance level); (iii) dropping the insignificant estimates. t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

Table D.4. The effect of inflation anchoring on industry growth: using an alternative measure of external financial dependence

Explanatory variable	(I)
Initial share	-0.750**
	(0.360)
External financial dependence *Inflation anchoring	-4.527**
	(2.220)
Magnitude of differential effects	0.43
Observations	774
R-squared	0.46

Note: The dependent variable is the average annual growth rate in real gross value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (1), but using an alternative proxy of credit constraints (external financial dependence) taken from Kroszner et al. (2007), which is derived from the firm-level data outside the United States. Kroszner et al. (2007) constructed a measure of external financial dependence similar to Rajan and Zingales but using the firm-level data from Worldscope for non-crisis countries during the period 1990–1999. The median value across the countries is used here. t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively. Differential effects are computed as the change in inflation anchoring from the 75^{th} percentile (i.e., larger de-anchoring coefficients) to the 25^{th} percentile (i.e., smaller de-anchoring coefficients) of the cross-country distribution between a sector with high credit constraints at the 75^{th} percentile of the distribution) and a sector with low credit constraints (at the 25^{th} percentile of the distribution).

Table D.5. The effect of inflation anchoring on industry growth: role of nominal rigidities

Explanatory variable	(I) Price adjustment speed parameter estimates from Roberts et al. (1994)	(II) Calvo parameter estimates from Leith and Malley (2007)
Initial share	-0.767*	-1.059**
	(0.413)	(0.456)
Nominal rigidities *Inflation anchoring	3.236*	-4.300*
	(1.904)	(2.526)
Magnitude of differential effects	0.38	0.40
Observations	774	686
R-squared	0.46	0.54

Note: The dependent variable is the average annual growth rate in real value-added from 1990 to 2014 for each industry-country pair. Estimates are based on Equation (1), but credit constraint measures are replaced by nominal rigidity measures. We have obtained empirical measures of industry-level nominal rigidities from Roberts et al. (1994) and Leith and Malley (2007). Roberts et al. (1994) estimated the price adjustment speed parameter in the model of quadratic costs of price adjustment (Rotemberg-style) specific to the two-digit U.S. manufacturing industries. The estimates are based on the time series of annual input-output tables from the Bureau of Labor Statistics and presented in Table 3 of Roberts et al. (1994, page 148). Leith and Malley (2007) estimated the Calvo parameter in the New Keynesian Phillips curve specific to the two-digit U.S. manufacturing industries using intermediate-good costs rather than labor costs as a measure of marginal costs (see Table 2 of Leith and Malley, 2007, page 338). A higher price adjustment speed parameter in Column (I) corresponds to a lower Calvo parameter in Column (II). t-statistics based on clustered standard errors at the country level are reported in parenthesis. *, **, *** denote significance at 10, 5, and 1 percent, respectively.

References

Coibion, Olivier, Yuriy Gorodnichenko, Saten Kumar, and Mathieu Pedemonte. “Inflation expectations as a policy tool?” Journal of International Economics (2020): 103297.

Dovern, Jonas, and Geoff Kenny. “Anchoring inflation expectations in unconventional times: Micro evidence for the euro area.” International Journal of Central Banking (2020), October.

Ehrmann, Michael. “Targeting Inflation from Below: How Do Inflation Expectations Behave?” International Journal of Central Banking 11, no. 4 (2015): 213-249.

Gabaix, Xavier. “Power laws in economics: An introduction.” Journal of Economic Perspectives 30, no. 1 (2016): 185-206.

Gertler, Mark, and Nobuhiro Kiyotaki. “Banking, liquidity, and bank runs in an infinite horizon economy.” American Economic Review 105, no. 7 (2015): 2011-43.

Łyziak, Tomasz, and Maritta Paloviita. “Anchoring of inflation expectations in the euro area: recent evidence based on survey data.” European Journal of Political Economy 46 (2017): 52-73.

Rosen, Sherwin. “The economics of superstars.” American Economic Review 71, no. 5 (1981): 845-858.

Svensson, Lars EO. “Social value of public information: Comment: Morris and shin (2002) is actually pro-transparency, not con.” American Economic Review 96, no. 1 (2006): 448-452.

Strohsal, Till, Rafi Melnick, and Dieter Nautz. “The time-varying degree of inflation expectations anchoring.” Journal of Macroeconomics 48 (2016): 62-71.