Investment, Inflation, and the Role of Internal Information Systems as a Transmission Channel*

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Abstract

We examine whether the quality of firms' internal information systems influences the relation between inflation shocks and corporate investment, as posited by imperfect information models. We first document a positive relation between inflation shocks and investment, consistent with nominal rigidity breaking the classical dichotomy, i.e., the prediction that nominal variables, such as inflation, do not affect real variables, such as corporate investment. Next, we use responses to the World Management Survey to directly measure firms' internal information system quality and find that higher internal information system quality mitigates the positive relation between inflation shocks and investment. This result suggests that internal accounting quality serves as a transmission channel through which aggregate nominal variables affect real variables at the firm level. Our findings are robust to using import competition, inheritance tax levels, education levels and the 8th EU Company Law Directive as instruments for internal information quality.

JEL Classification: E22, E52, M41
Key words: Investment, Inflation, Accounting Quality

1. Introduction

In April 2021 inflation expectations (as measured by the 10-Year Breakeven Rate) reached their highest levels since 2008, and inflation overtook COVID-19 as fund managers' main concern (Bank of America 2021).[1] This surge in inflation expectations derives from three recent developments. First, central banks have dramatically expanded their balance sheets and thereby the money supply through security purchases to support financial aid extended by governments in response to the COVID-19 crisis.[2,3] Second, central banks have increasingly shifted their focus away from price stability. Specifically, in summer 2020 the Fed announced a policy change by now targeting an average rather than a maximum inflation of 2%. Similarly, the ECB has promoted the fight against climate change as a new tenet of ECB policy.[4] Third, changing demographics create upward pressure on prices. For example, Goodhart and Pradhan (2020) argue that ageing across the globe will lead to shortages in labor supply, leading to increases in labors' bargaining power and wage markups. The current threat of rising inflation has therefore revived the academic and non-academic debate on how inflation affects economic agents' decision making. We contribute to this debate by studying how inflation shocks affect corporate investment and whether the quality of the firm's internal information system mitigates this relation.

[1] The 10-Year Breakeven Rate is an inflation expectation measure imputed from the yield difference between 10-Year Constant Maturity and 10-Year Inflation-Indexed Constant Maturity Treasury Bonds.

[2] For example, the Fed approximately doubled its security holdings over the September, 2019 to June, 2021 period. See e.g., https://www.federalreserve.gov/monetarypolicy/bst_recenttrends.htm.

[3] Some have criticized these fiscal policy measures. For example, former Vice President of Development Economics and Chief Economist of the World Bank Larry Summers has characterized the measures taken by the Biden Administrations as the "least responsible fiscal policy in 40 years" in an interview with Bloomberg. See https://www.bloomberg.com/news/articles/2021-03-20/summers-says-u-s-facing-worst-macroeconomic-policy-in-40-years.

[4] See e.g., https://www.ecb.europa.eu/ecb/orga/climate/html/index.en.html. Other central banks started to incorporate the fight against climate change in their policy frameworks as well. On March 3rd 2021, the Bank of England announced that it will add a climate remit to monetary policy in its annual budget statement to "support the government's ambition of a greener industry, using innovation and finance to protect our environment and tackle climate change."

Prior literature links inflation to real decisions through the channel of nominal rigidity, i.e., the tendency of prices to be "sticky". Under imperfect competition, nominal rigidity arises in New Keynesian (NK) models under some restriction on the costliness or the frequency of firms' price adjustments (Rotemberg 1982; Calvo 1983). As a result, Real Business Cycle (RBC) models' prediction that nominal variables cannot affect real variables, also known as the classical dichotomy, breaks down and gives rise to the Dynamic Income-Savings (IS) Equation and the NK Phillips Curve. Under this NK paradigm, adopted routinely both by central banks and academic researchers (Galí 2015), real variables such as investment respond to monetary shocks.

While most prominent, the standard NK model's sticky price channel is not the only possible transmission mechanism through which nominal variables can affect real variables. In this paper, we examine an alternative transmission mechanism which to date has received relatively little attention and which highlights the role of the quality of the firm's internal information system. Specifically, we interpret the role of the firm's internal information system through the lens of an RBC model featuring perfect competition and imperfect information (Lucas 1972, 1975). In this model, information frictions rather than costly or infrequent price updating lead to a breakdown of the classical dichotomy. Firms are subject to firm-level real and aggregate-level nominal shocks that managers cannot perfectly disentangle because they observe each type of shock with noise. As a result, firms partially respond to real as well as to nominal shocks, giving rise to a relation between inflation and investment that resembles the NK Philips Curve. Within this imperfect information framework, we predict that higher quality of internal information raises the precision of the real signals, thereby allowing managers to filter real firm-level shocks more effectively from inflation shocks (the so-called 'filtering hypothesis'). As a consequence, this

higher internal information quality will lead managers to respond less to nominal shocks and thus mitigate the relation between aggregate nominal shocks and firm investment decisions.[5]

To examine the empirical validity of the described transmission mechanisms, we use a sample of international firms that responded to the World Management Survey (WSM) during the 2001 to 2015 period. The World Management Survey provides us with a composite proxy for the quality of firms' internal information systems, derived from five proxies for different internal information system quality dimensions (documentation, tracking, review, dialogue, and consequences). As such, the WMS allows us to overcome one of the main difficulties in studying internal information systems, i.e., its unobservability to outsiders.

Using this sample, we first evaluate the base-line prediction from standard NK models that firms adjust their investment decisions in response to inflation shocks. We measure inflation shocks as the difference between realized and forecasted Consumer Price Index (CPI) at the country-level and find support for this prediction. We document a large and statistically significant effect, namely a 1% change in inflation shock is associated with a 0.743% change in investment of the same sign.

Next, we evaluate the prediction from the imperfect information models that internal information quality attenuates the relation between inflation and investment. In support of this prediction, we document that the positive association between investment and inflation shocks weakens for firms with higher internal information quality. The magnitude of the effect is economically meaningful: a one-standard-deviation change in internal information quality offsets nearly a third of inflation's positive effect on investment. This finding suggests that internal

[5] The empirically documented delay in the inflation response to monetary expansion arises naturally in imperfect information models (Christiano, Eichenbaum, and Evans 1999, 2005). A recent example is the delayed inflation response to the unprecedented degree of economic stimulus released by many governments around the world following the COVID-19 crisis.

information quality is an important channel for the transmission of aggregate nominal shocks into real firm-level variables.

We further exploit the richness of our data set to examine which aspects of internal information drive our results. Specifically, we repeat our main tests using each of the composite internal information quality score's five components and find that our results hold for all five components individually. In other words, all dimensions of firms' internal information systems quality appear to affect managers' decisions.

If investments in response to inflation shocks lead to misallocation of capital, the mitigating effect of internal information system quality on the investment-inflation relation should increase investment efficiency. To test this prediction, we follow prior studies and examine the effect of internal information quality on the relation between inflation expectations and future profitability (Chen, Goldstein, and Jiang 2007; Jayaraman and Wu 2019). Consistent with inflation shocks misleading managers in their investment decision making, we document a negative relation between year-ahead profitability and inflation shocks. Importantly, we also find that this effect decreases in the quality of internal information quality, which suggests that higher internal information system quality reduces the misleading effect of inflation signals on managers' investment decision making.

While inflation shocks are likely exogenous to an individual firm, the degree of investment in its internal information system is a choice by the firm that partially derives from its exposure to macroeconomic fluctuations. To address this endogeneity concern and to enhance the internal validity of our inferences, we implement two additional tests. In the first test, we rely on an instrumental variable strategy, in which we instrument for internal information quality using country-level variables that 1) prior literature identifies as important determinants of managerial

practices, and that 2) are unlikely to mitigate the effect of inflation on investment through other channels than internal information quality. Specifically, we instrument for internal information system quality using the degree of import competition, the level of inheritance taxes, and the level of educational attainment in the country where the firm is located (Van Reenen, Bloom, Sadun, Lemos, and Scur 2014). The results confirm the main inference in the paper, namely that, while the association between investment and inflation continues to be positive, the magnitude of the association declines for firms with higher quality internal information systems.

In our second test, we rely on a difference-in-differences analysis based on the 8th EU Company Law Directive. Enacted on March 17, 2006, the Directive requires *public* firms to provide assurance to the board of directors and the audit committee that adequate and effective controls to monitor and manage critical risks exist, and also that a process to adequately report on this monitoring is in place. We find that in countries that adopted the Directive, this adoption induced public firms to increase the quality of their internal information system more than both private firms that are not subject to the Directive or public firms in countries that did not adopt it. Further, as in our prior tests, we find that this exogenous increase in internal information system quality mitigates the positive relation between inflation and investment, consistent with the filtering hypothesis forwarded by imperfect information models.

Our paper contributes to three streams of literature. First, we contribute to the literature that relates information quality to investment decisions (for a review see Roychowdhury, Shroff, and Verdi 2019). In a paper closely related to ours, Armstrong, Glaeser, and Kepler (2019) document that low *external* corporate reporting quality and unexpected Federal Funds Rate changes during Federal Open Market Committee (FOMC) meetings jointly have a negative interactive effect on firms' stock returns and investment. Armstrong et al. (2019) explain their

findings via the balance sheet channel hypothesis (Bernanke and Gertler 1989), whereby information asymmetry paired with declining firm earnings exacerbates moral hazard and adverse selection problems for the firm (Jensen and Meckling 1976). While Armstrong et al. (2019) interpret their findings to underline the role of *external* accounting quality in the presence of information asymmetry and the effects of the balance sheet channel (Dechow, Ge, and Schrand 2010), subsequent research has challenged this view (e.g., Gallo and Kothari (2019), Binz, Joos, and Kubic (2021)).[6] Instead, we forward a novel, alternative explanation for the negative interactive effect between nominal shocks and reporting quality derived from imperfect information models. While both explanations could be at play, our explanation does not require the underlying assumptions of the balance sheet channel and emphasizes the importance of *internal* information quality rather than external accounting quality (Lucas 1972; Woodford 2003). We also document a direct as well as an indirect internal information quality effect of nominal variables on corporate investment decisions, a result that is important as both theoretical and empirical evidence suggests that higher internal information quality is associated with higher external information quality (e.g., Hemmer and Labro (2008), Gong, Li, and Xie (2009)).[7]

Second, we add to research on the implications of the internal information environment for managerial decision making. Decision theory and empirical work suggest that higher quality

[6] Gallo and Kothari (2019) point out that the documented effect only holds for rate decreases but not increases, which gives rise to the puzzling implication "that low [accounting quality] firms are not worse off when there are surprise increases in interest rates but are, in fact, 'rewarded' by the market when there is a surprise decrease in interest rates (p. 4)." Binz et al. (2021) document that, inconsistent with the predictions of the balance sheet channel, absolute net income *increases* in response to monetary policy shocks as managers cut cost more than consumers cut purchases in response to a rate shock, which leads to a larger decline in expenses than revenues.

[7] Supporting our choice of inflation as the causal variable of interest, the imperfect information channel posits that money affects real decisions (here investment) through monetary variables that are measured with noise (here inflation). There is no "right" inflation measure. Commonly used measures such as CPI and PPI are based on the constellation of a representative basket of goods chosen by the Bureau of Economic Analysis. However, the constellation of this representative basket might be very different of the specific basket that is relevant to the manager's decision making. Alternative monetary variables (such as Federal Funds Rate changes) that are observed with no or little noise only have indirect effects insofar as they reflect some of the variation in noisy monetary variables.

internal information facilitates various managerial decisions such as tax planning, mergers and acquisitions, and hiring (Gallemore and Labro 2015; Ferracuti 2021). We show that higher quality internal information systems lead to better managerial decisions by facilitating the separation of firm-specific real and aggregate nominal shocks. Our finding that firms' internal information systems influence the transmission of monetary shocks into corporate investment decisions could therefore partially explain differences in total factor productivity across countries, industries, or firms (e.g., Van Reenen et al. 2014). To our knowledge, we are also among the first to examine the effects of the 8th EU Company Law Directive, that introduced audit regulation similar to Sarbanes-Oxley across countries in the EU. We show that the Directive led to increased internal information quality and that this increase in quality reduced firms' sensitivity to inflation shocks.

Third, we contribute to the literature examining the effects of inflation on accounting numbers. While this literature generally focuses on whether external accounting users such as investors understand the confounding effect of inflation on historical cost accounting numbers (Chordia and Shivakumar 2005; Basu, Markov, and Shivakumar 2010; Konchitchki 2011), we take a different approach and investigate whether the design of internal accounting systems can influence managers' ability to disentangle firm-level productivity shocks from aggregate monetary shocks, thereby improving investment decision making.

2. Hypotheses Development

Standard business cycle models such as the RBC model proposed by Kydland and Prescott (1982) predict that under conditions of perfect competition and full price flexibility nominal variables cannot affect real variables. Money serves merely as a unit of account and does not affect agents' decision making. However, the empirical literature consistently shows that nominal variables produce real effects (for a survey see Taylor 1999). For this reason, since the 1990s, the

NK model has developed into the standard tool for analyzing the relation between real variables, such as investment, and nominal variables, such as inflation (Galí 2018).

The NK model extends the RBC model by relaxing the two assumptions of perfect competition and full price flexibility (Rotemberg 1982; Calvo 1983). Under conditions of imperfect competition, firms can change the prices of their goods and services without experiencing an immediate collapse in demand. However, they will do so infrequently because of price adjustment frictions, leading to nominal rigidity, i.e., "stickiness" of prices. Solutions of the NK model yield the NK Phillips Curve, which relates corporate investment decisions to inflation shocks. Shocks to money supply, inflation expectations ("animal spirits"), or input costs deriving from divergences between the efficient and natural levels of output ("cost-push inflation") directly drive inflation. In the presence of nominal rigidity, firms' nominal cost of capital adjusts slowly to changes in inflation. In conjunction with the Fisher Equation, which states that the nominal cost of capital equals the real cost of capital plus inflation, fluctuations in inflation paired with a slow-moving nominal cost of capital induce fluctuation in the real cost of capital and thereby managers' incentivizes to invest (Roberts 1995; Clarida, Galí, and Gertler 1999). This discussion gives rise to our first hypothesis:

Hypothesis 1. Corporate investment is positively associated with inflation shocks.

The NK model is not the only model predicting that nominal shocks affect firms' real actions. In particular, Lucas (1972, 1975) proposes a model that preserves the assumption of perfect competition but introduces imperfect information as an alternative to the price adjustment frictions assumed in standard NK models. In Lucas' model, firms are subject to firm-level productivity shocks and aggregate-level money supply shocks, but managers cannot perfectly disentangle the effects of these shocks as they observe them with noise. As in the NK model, this

structure gives rise to nominal rigidity and a positive relation between corporate investment and inflation that resembles the NK Phillips Curve.

The assumption that managers cannot perfectly disentangle real firm-level from nominal aggregate-level shocks introduces the possibility that the quality of a firm's internal information system mediates the association between nominal shocks and corporate investment. Corporate internal information systems acquire, process, and communicate data to produce knowledge that supports managerial decision-making. Models of internal information design suggest that higher quality internal information systems, while costlier, increase the quality of managerial decisions (Feltham and Demski 1970). Recent empirical evidence supports this conjecture and shows that higher quality internal information systems facilitate information acquisition and integration (Hodge, Kennedy, and Maines 2004; Brazel and Dang 2008), leading to superior managerial decisions (Gallemore and Labro 2015; Ferracuti 2021). Thus, to the extent that a higher quality internal information system provides managers with less noisy signals about *firm-level* productivity shocks, higher quality internal information aid managers to disentangle real firm-level from nominal aggregate-level shocks. As a result, managers with access to a higher quality internal information system will be less likely to adjust their investment decisions in response to nominal aggregate shocks and therefore behave in a way more akin to the frictionless case of perfect information. It follows that higher quality internal information systems mitigate the positive relation between corporate investment and inflation, stated in our second hypothesis:

Hypothesis 2. The positive association between corporate investment and inflation shocks decreases in the quality of the firm's internal information system.

Figure 1 illustrates our hypotheses development schematically. Firms are exposed to noisy real firm-level productivity shocks and noisy nominal aggregate shocks. Firms' internal

information systems filter these shocks and convey the resulting productivity signals to managers who use these signals to make investment decisions. The higher the quality of firms' internal information systems, the more precise the productivity signal and the weaker the association between nominal aggregate shocks and investment.

3. Research Design

We test the hypotheses developed in the previous section by estimating the following regression model:

$$Investment_{i,t} = \beta_1 Inflation\ Shock_t + \beta_2 Internal\ Information_{i,t} + \beta_3 Internal\ Information_{i,t} \times Inflation\ Shock_t + Controls_{i,t} + \Gamma_j + \varepsilon_{i,t}. \quad (1)$$

Investment denotes the change in fixed assets scaled by average total assets, *Inflation Shock* denotes the difference between realized and forecasted inflation measured as the change in the firm's home country's CPI, and *Internal Information* denotes the firm's internal information system quality as measured by the World Management Survey described in more detail below. Hypothesis 1 predicts a positive β_1 coefficient and Hypothesis 2 predicts a negative β_3 coefficient. *Controls* denotes a set of investment and management practice controls proposed in prior literature including cash flow scaled by average total assets (*Cash Flow*); change cash flow scaled by average total assets (Δ*Cash Flow*); the natural logarithm of total assets (*Size*); long-term debt scaled by total assets (*Leverage*); the change in operating revenue scaled by average total assets (Δ*Sales*); and the firm's operating quality (*Operating Quality*), target focus (*Target Focus*), and people management (*People Management*) as measured by the World Management Survey. Γ denotes an industry fixed effect based on the NACE Revision 2 one-digit industry code.

Lastly, to control for potentially confounding macroeconomic movements, we estimate an alternative specification of Equation (1) which includes Θ, a country-year fixed effect that absorbs all time-constant variables:[8]

$$Investment_{i,t} = \beta_2 Internal\ Information_{i,t} + \beta_3 Internal\ Information_{i,t} \times Inflation\ Shock_t + Controls_{i,t} + \Gamma_j + \Theta_t + \varepsilon_{i,t}. \quad (2)$$

Given that one of our variables of interest, namely the interaction between *Internal Information* and *Inflation Shock*, varies within country-year, we can use different combinations of industry and country-year fixed effects to control for potential other macroeconomic movements influencing our results. However, since country-year fixed effects are perfectly collinear with country-level inflation, we drop the main effect of *Inflation Shock* from this model.

4. Data Measurement & Sample

4.1 Measures of Internal Information Quality

To estimate Equations (1) and (2), we need to establish a measure for the quality of the firm's internal information system, a difficult task given the unobservable nature of firms' internal information systems. We overcome this challenge by relying on the World Management Survey Database to identify proxies that offer several advantages over proxies employed in the literature.[9]

The World Management Survey [WMS] is a project developed with the purpose of measuring a number of management practices, thereby allowing researchers to identify the impact of those practices on corporate outcomes. The project scores firms' managerial practices on a scale ranging from 1 ("worst practice") to 5 ("best practice") for a set of randomly sampled medium-sized firms from multiple countries around the world. More specifically, interviewers conduct 45-

[8] Our results are robust to using year fixed effects instead of country-year fixed effects.
[9] We thank the World Management Survey team for sharing their data with us. Details about the World Management Survey are available at https://worldmanagementsurvey.org/.

minute double-blind (i.e., the manager does not know that their firm is being scored and the interviewer does not have any information about the firm's financial performance) phone interviews with senior managers. After the interview, the interviewers score the firms employing these managers based on a grid that comprises 18 questions, classified into four broad categories: operating quality (*Operating Quality*), monitoring (*Monitoring*), target focus (*Target Focus*), and people management (*People Management*).[10] Importantly, one of these categories, monitoring, aims to measure how organizations monitor, i.e., assess in a structured way, what goes on inside the firm, and how they use this derived information for decision making. In this paper, we use the monitoring score as our proxy for internal information system quality because firms with superior internal information systems track external and internal influences on the firm's operations and transaction more closely and with greater precision.

The WMS also provides us with the five underlying components underlying the monitoring score, which allow us to assess the differential impact of various dimensions of internal information system quality: 1) information documentation ("Are process improvements made only when problems arise, or are they actively sought out for continuous improvement as part of normal business processes?"); 2) information tracking ("Is tracking ad hoc and incomplete, or is performance continually tracked and communicated to all staff?"); 3) information review ("Is performance reviewed infrequently and only on a success/failure scale, or is performance reviewed continually with an expectation of continuous improvement?"); 4) information dialogue ("In review/performance conversations, to what extent are the purpose, data, agenda, and follow-up steps (like coaching) clear to all parties?"); and 5) information consequences ("To what extent

[10] For more details on the WMS data see Van Reenen et al. (2014).

does failure to achieve agreed objectives carry consequences, which can include retraining or reassignment to other jobs?").

These proxies present several advantages relative to measures relied upon in previous research. First, the monitoring score directly measures the quality of firms' internal information systems and thus avoids using the quality of *external* financial reporting as an indirect proxy. This use of a direct measure reduces both noise and bias induced by other determinants of external reporting quality. Second, rather than simply asking managers to score their own firms, the WMS interviewers score firms based on answers to a set of open-ended (as opposed to closed) questions. This is important because people tend to not tell the complete truth in open surveys (Schwarz 1999; Bertrand and Mullainathan 2001). Third, the availability of information about medium-sized firms from multiple countries reduces generalizability concerns that apply to hand-collected proxies of internal information quality, such as information about a firm's adoption of enterprise resource planning (ERP) systems. Fourth, the survey-methodology and the resulting scores have been both validated extensively by the original authors (Van Reenen et al. 2014), and used in published research in economics and management (e.g., Bloom, Sadun, and Van Reenen 2012).

4.2 Sample Construction and Description

We test our hypotheses using a sample of firms from 21 countries that participated to the WMS during the 2004 to 2015. This sample, which includes 4,891 firm-year observations distributed over 3,613 firms, represents the intersection of three different databases: (1) the WMS database described in the previous section providing firm-year level survey data about internal information systems; (2) Bureau van Dijk's Orbis database providing annual financial statements information for a broad set of international firms; and (3) the Organization for Economic Co-

operation and Development's (OECD) Economic Outlook database providing annual aggregate country-year-level variables including inflation forecasts and realizations.

Table 1 presents information about our sample's geographic composition. The UK (22.96%), Italy (11.63%), Greece (9.83%), and China (8.87%) provide the largest contributions to the sample, while Canada and New Zealand are the countries with the fewest observations. Table 2 presents descriptive statistics for the variables used in the study.[11] Investment comprises on average 1% of total assets and exhibits substantial heterogeneity, with a standard deviation of 11% an interquartile range of 9% of total assets. Inflation shocks have a zero mean and median, indicating that the OECD's inflation forecast are unbiased and approximately symmetrically distributed. Figure 2 presents a histogram of the inflation shock distribution. While most shocks are close to zero, there are three notable clusters of outliers.[12] First, Chile's inflation was forecasted to be 8.72% but only reached 0.35% in advent of the financial crisis. Second, similar to Chile, Australia experienced lower than expected inflation in 2010 with forecasted inflation of 4.35% and realized inflation of 1.77%. Third, China experienced higher than expected inflation in 2010 with forecasted deflation of 0.73% and realized inflation of 4.03%.

Our proxies for internal information quality; i.e., *Internal Information* and its components *Documentation*, *Tracking*, *Review*, *Dialogue*, and *Consequences*, have mean values of 3.26, 3.19, 3.35, 3.41, and 3.21, respectively, suggesting that the WMS interviewers consider the internal information systems of our sample firms to be better than average (corresponding to a value of 3.00). These variables exhibit considerable variation though, with some firms at the bottom (top) of the distribution ranging from 1.00 to 5.00 (1st and 99th percentile) for each score. The histograms

[11] We winsorize all continuous firm-level variables at the 1st and 99th percentiles.
[12] Our results are robust to excluding these outlier observations.

in Figure 3 Panels A and E show that each score exhibits left skewness, with few firms receiving a score of 1 and relatively more firms receiving a score of 5.

Table 3 presents the Pearson and Spearman correlation matrix. Consistent with Hypothesis 1, investment exhibits a significantly positive univariate correlation with inflation shocks. We also observe that *Documentation, Tracking, Review, Dialogue*, and *Consequences* are highly positively correlated, which suggests that different aspects of internal information system quality go hand in hand and therefore supports the decision to combine them in a single internal information quality score, *Internal Information*. Aggregate growth expectations (macroeconomic uncertainty) are positively and (negatively) related to investment (Bloom, Floetotto, Jaimovich, Saporta-Eksten, and Terry 2018; Binz 2021). Better target focus is positively related to investment, but operating quality and people management do not relate significantly to investment. As in prior research, cash flow, changes in cash flow, and changes in sales (a proxy for Tobin's Q for private firms; see Badertscher, Shroff, and White (2013)) relate positively to investment (Fazzari, Hubbard, and Petersen 1988).

5. Main Results

5.1 Baseline Analysis

Table 4 presents coefficient estimates for Equations (1) and (2) that regress investment on the interaction between inflation shocks and internal information system quality, their main effects, and different combinations of controls, industry fixed effects, and country-year fixed effects. We cluster standard errors by industry.[13] Consistent with Hypothesis 1, inflation shocks relate significantly positively to investment before and after controls and industry fixed effects. This effect is also economically significant: according to the full model in column (6), a 1% inflation

[13] We cluster by industry rather than by firm because most firms appear only once in our sample.

shock is associated with a 0.743% change in investment. This evidence suggests that, as previously documented in the literature and contrary to the classical dichotomy, firms' investment decisions respond to aggregate inflation shocks.

Next, we test whether internal information system quality allows managers to filter real firm-level shocks from nominal inflation shocks, thereby mitigating the positive association between inflation shocks and investment. As predicted by Hypothesis 2, the coefficient on the interaction between *Inflation Shock* and *Internal Information* is negative in all columns. This is consistent with internal information system quality mitigating the positive association between inflation and investment. This effect is economically meaningful as well: according to the estimates in column (6) a one-standard-deviation increase in internal information quality offsets approximately 27.82% (= 0.78 × 0.265/0.743) of inflation shocks' positive effect on investment.

Together, the findings in Table 4 are consistent with two observations. First, per the information quality channel posited by imperfect information managers adjust their investment decisions to inflation because they cannot perfectly distinguish inflation from productivity shocks. Second, higher quality internal information systems help managers to differentiate between these two shocks and as a result, managers' investment decisions become less sensitive to inflation.

5.2 Internal Information System Quality Components

Next, we examine which aspects of internal information system quality drive our results by repeating the analysis reported in Table 4 using each of the five components of the internal information system quality score separately. The results in Table 5 show that the positive relation between inflation shocks and corporate investment is consistently positive for the information documentation and dialogue dimensions of internal information system quality. For the other dimensions of internal information system quality, the evidence is either mixed or insignificant.

Further, the coefficients on the interaction between inflation shocks and the information documentation, tracking, dialogue, and consequences dimensions are all negative and significant. The interaction between inflation shocks and information review (i.e., the assessment of the frequency of performance evaluation) is not significant, suggesting that performance evaluation frequency is not important for the filtration of nominal aggregate from real firm-level shocks.

5.3 Investment Efficiency

Our base line results show that firms with higher internal information quality respond less strongly to inflation shocks. If these investment decision responses to inflation shocks are inefficient because inflation shocks are nominal without implications for the firm's real business environment, then our findings would additionally lead to two predictions. First, larger inflation shocks will be associated with lower future profitability as the firm's investment response to these shocks will not be sustained by real future demand. Second, this negative effect on future profitability following inflation shocks will be attenuated for firms with higher internal information quality as these firms will adjust their investments less in response to the monetary shocks (Chen et al. 2007; Jayaraman and Wu 2019).

We test these predictions in Table 6 that reports coefficients from estimating Equation (1) with next year's return on assets as dependent variable. We find two results consistent with the discussion above. First, future profitability decreases following inflation shocks, consistent with the quality of firms' investment decisions in response to monetary shocks being worse. Second, this decrease in future profitability following inflation shocks is muted for firms with higher internal information quality. This result provides further evidence to support our hypothesis that higher internal information quality allows firms to better distinguish between inflation and productivity shocks leading to better investment decisions.

6. Additional Tests

Next, we address the endogeneity concern that the extent of firm exposure to macroeconomic fluctuations influences managers' choice of how much to invest in the firm's internal information systems. If this is the case, then the observed mediating effect of internal information quality could result from the firm's exposure to these fluctuations and not from the filtering mechanism posited by imperfect information models. We address this endogeneity concern using two alternative identification strategies: 1) an instrumental variable approach, and 2) a staggered difference-in-differences analysis.

6.1 Instrumental Variable Approach

In our first identification strategy, we instrument both internal information quality and the interaction between internal information quality and inflation shocks using three instruments for managerial practice recommended in prior literature (Van Reenen et al. 2014). First, Bloom, Draca, and Van Reenen (2016) find that stronger competition in the product market is associated with superior managerial practices in both the cross-sectional and panel dimensions (Bloom, Draca, and Van Reenen 2016). Hence, we use the openness of an economy, as measured by the ratio of imports to production of the firm's country of location, as our instrument for the level of competition in the firm's product market. Second, based on the findings by Bloom and Van Reenen (2007), who show that family firms tend to follow worse management practices, and the result in Tsoutsoura (2015) that higher inheritance taxes increase the likelihood that family firms are sold outside of the family, we use cross-country variation in the level of inheritance taxes as our second instrument, as this level will affect the likelihood that family firms persist within an economy. Third, Feng (2013) documents that access to higher quality human capital is associated with superior management practices. We therefore use population's education level, as measured by the

proportion of a country's population with below upper-secondary education and with tertiary education, as our instrument for the firm's access to higher quality human capital. Further, we follow the recommendations in Gormley and Matsa (2014) and not only instrument the main effect of the endogenous regressor (internal information system quality) but also its interaction with inflation shocks by employing both each instrument's main effect and each instrument's interaction with inflation shocks as instrumental variables.

Table 7 shows that our results are robust to the use of this instrumental variable approach. We observe that, consistent with H1, inflation shocks continue to be positively associated with investment. More importantly, we observe that internal information quality continues to mitigate that relation after accounting for the endogenous nature of internal information quality. Furthermore, the magnitude of the economic effect is consistent with the one documented using OLS, reducing concerns over the validity of our instruments (Jiang 2017).

To mitigate endogeneity concerns our instruments must satisfy the relevance criterion, i.e., have an effect on the quality of firms' internal information systems while at the same time satisfy the exclusion restriction and be uncorrelated with the relation between investment and inflation. Our first-stage estimation confirms the relevance of the instruments, as evidenced by an F-statistics of excluded instruments between 7.34 and 17.72, depending on the fixed-effect structure adopted. Furthermore, the instruments do not appear weak, as documented by Craig-Donald Wald F-statistics between 6.83 and 13.76, depending on the fixed-effect structure adopted.

Second, the instruments likely meet the (untestable) exclusion restriction for two reasons. First, we calculate the instruments at the country level making them beyond each individual firm's control. Second, while the instruments could have a direct impact on investment (e.g., see Tsoutsoura (2015) for evidence on the effect of inheritance taxes on investment), it is unlikely that

they directly influence the extent to which managers can disentangle nominal inflation shocks from real firm-level shocks, other than through their impact on managers' investment in internal information quality. Therefore, we believe that the instruments provide variation in internal information quality that is plausibly exogenous to firms' investment responses to inflation shocks.

6.2 The 8th EU Company Law Directive

In our second identification strategy, we use the 8th EU Company Law Directive of March 17th, 2006 as a plausibly exogenous shock to internal information quality. Similar to the Sarbanes-Oxley Act in the US, the directive introduced requirements for external quality assurance, clarified the duties of statutory auditors, and harmonized principles of audit independence and ethics across countries. While the directive was adopted to reinforce and to harmonize the statutory audit function throughout the Europe, some of its requirements indirectly pushed firms to improve their internal information systems. Specifically, the Directive requires firms to provide assurance to the board of directors and the audit committee that adequate and effective controls to monitor and manage critical risks exist, and that a process to adequately report on this monitoring is in place. Therefore, similar to corporate responses following adverse audit opinions (Cheng, Dhaliwal, and Zhang 2013) or following the adoption of new accounting standards (Shroff 2017), the Directive likely induced firms to improve their internal information systems to provide sufficient assurance to the board and the audit committee.

In addition to directly affecting firms' internal information system quality, another feature of the Directive make it well suited to address endogeneity concerns: the Directive applies only to public firms located in countries that adopt it. Our data includes both public and private firms from different European countries that adopted the Directive at different points in time. We therefore observe both within-country and across-country variation in the potential effects of the Directive,

helping us to mitigate concerns that variables other than internal information system quality drive the statistical associations we document in this test. Specifically, we use the directive in a staggered difference-in-differences design that focuses on firms from countries that adopted the directive and that are included in our sample: Germany, Ireland, Italy, Poland, Portugal, Spain, Sweden, United Kingdom.[14] Within these countries, we define public firms as the treatment group and private firms as the control group, respectively. Further, we define the post-adoption period as the years after the adoption of the Directive in the firms' home country.[15]

Table 8 presents the results. First, we show that the directive lead to higher internal information quality for public firms relative to private firms in the post-adoption period. The difference-in-differences coefficient in columns (1) and (2) is significantly positive, consistent with public firms improving their internal information quality following the adoption of the Directive by their home country. Furthermore, Figure 4 shows that treated and control firms follow parallel trends in the outcome variable during the years leading to the adoption of the Directive. This evidence is consistent with our identifying assumption that treatment and control firms would have continued to have similar levels of internal information quality had the directive not been adopted by their home country. In the years following the adoption, internal information system quality increases for treatment firms relative to control firms.

Second, columns (3) and (4) show that the investment of treated firms becomes less responsive to monetary shocks following the adoption of the Directive by their home country: using Investment as the dependent variable, the coefficient of interest, i.e., the interaction between the difference-in-differences estimator and *Inflation Shock*, is significantly negative. Together,

[14] For the 8th EU Company Law Directive tests, we exclude France and Greece from our sample because they implemented the Directive only partially during the sample period.
[15] Details on the adoption status by country can be found at the EU Audit Legislation page.

these findings are consistent with the notion that treated firms improved their internal information quality following the adoption of Directive and, as a result, are also became better at separating nominal from real productivity shocks.

Overall, the evidence from our instrumental variable and difference-in-differences analyses suggest that internal information has a causal effect on the relation between corporate investment and inflation, as posited by imperfect information models.

7. Conclusion

Distinct macroeconomic models formulate different predictions about the relation between inflation and corporate investment. RBC models predict that nominal variables, such as inflation, do not affect real variables, such as investment, a prediction known as the classical dichotomy. By contrast, imperfect information models predict that managers will adjust their investment decisions to inflation shocks since they cannot perfectly distinguish between nominal inflation and real technology shocks. This information-based prediction, distinct from the sticky price channel posited by standard NK models, highlights the role of information quality: the higher the quality is of the information managers use to make their investment decisions, the less they will react to nominal inflation shocks. Building on this prediction, we examine in this paper whether the quality of a firm's internal information system acts as a channel through which inflation affects corporate investment.

Our empirical analyses provide evidence consistent with the prediction of imperfect information models in two ways. First, we document a positive association between inflation shocks and firm investment. Second, we show that this association weakens as a function of the WMS monitoring score, our proxy for the quality of the firm's internal information systems. Our base line results are robust to using individual internal information quality components instead of

the aggregate internal information quality score; using import competition, inheritance tax levels, and education levels as instruments for internal information quality within as 2SLS design; and using the 8th EU Company Law Directive as an instrument for internal information quality within a staggered difference-in-differences design. We therefore contribute to the literature by presenting evidence that internal information systems function as a mechanism through which aggregate nominal shocks drive real firm-level decisions.

Our results are subject to several limitations. First, while the WMS monitoring score more directly measures internal information system quality than alternative estimates employed in prior literature, it is impossible to capture all dimensions of the quality of the firm's internal information system in a single score. We leave it to future research to examine how aspects other than the dimensions of the internal information system that we study affect the transmission of nominal aggregate shocks into real firm-level decisions. Second, although we measure inflation shocks as deviations from expectations, in line with previous academic research, we likely capture unpredictable fluctuations in inflation with measurement error in this proxy. Future research can examine other settings to estimate inflation shocks such as the Volker disinflation shocks to verify the robustness of our results to alternative measurement approaches (Nakamura and Steinsson 2018). Third, while our 2SLS and staggered differences-in-differences tests provide some assurance that internal information system quality deriving from country-level import competition, country-level inheritance tax levels, country-level education levels, and the 8th EU Company Law Directive helps firms to disentangle nominal aggregate from real firm-level shocks, our inferences based on these measures are potentially not generalizable. Future research can examine different instruments for internal information system quality to validate whether our inferences carry over to alternative settings.

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Appendix. Variable Definitions

Variable	Source	Definition
Macro Variables		
Inflation Shock	OECD	Country-level realized inflation minus consensus inflation forecast made in the previous year.
Growth Expectations	OECD	Country-level GDP forecast made in the previous year.
Macroeconomic Uncertainty	Baker et al. (2016)	Global Economic Policy Uncertainty score averaged over the year.
Firm-level Variables		
Documentation	WMS*	Score from 1 to 5 based on the question: Are process improvements made only when problems arise, or are they actively sought out for continuous improvement as part of normal business processes?
Tracking	WMS*	Score from 1 to 5 based on the question: Is tracking ad hoc and incomplete, or is performance continually tracked and communicated to all staff?
Review	WMS*	Score from 1 to 5 based on the question: Is performance reviewed infrequently and only on a success/failure scale, or is performance reviewed continually with an expectation of continuous improvement?
Dialogue	WMS*	Score from 1 to 5 based on the question: In review/performance conversations, to what extent are the purpose, data, agenda, and follow-up steps (like coaching) clear to all parties?
Consequences	WMS*	Score from 1 to 5 based on the question: To what extent does failure to achieve agreed objectives carry consequences, which can include retraining or reassignment to other jobs?
Internal Information	WMS*	Average of *Documentation*, *Tracking*, *Review*, *Dialogue, and Consequences*.
Operating Quality	WMS*	Average of WMS questions pertaining operating quality (questions 1 and 2).
Target Focus	WMS*	Average of WMS questions pertaining target focus (questions 8 to 12).
People Management	WMS*	Average of WMS questions pertaining people management (questions 13 to 18).
Investment	Amadeus	Change in fixed assets scaled by average total assets.
Future Profitability	Amadeus	Year-ahead return on operating assets.
Cash Flow	Amadeus	Earnings before interest and taxes (EBIT) scaled by average total assets.
Δ*Cash Flow*	Amadeus	Change in earnings before interest and taxes (EBIT) scaled by average total assets.
Size	Amadeus	Natural logarithm of total assets.
Leverage	Amadeus	Long-term debt scaled by total assets.
Δ*Sales*	Amadeus	Change in operating revenue scaled by average total assets.
Public	Amadeus	Indicator that the firm is traded on a public exchange.

*World Management Survey, †Bureau van Dijk

Figure 1. Hypotheses Development

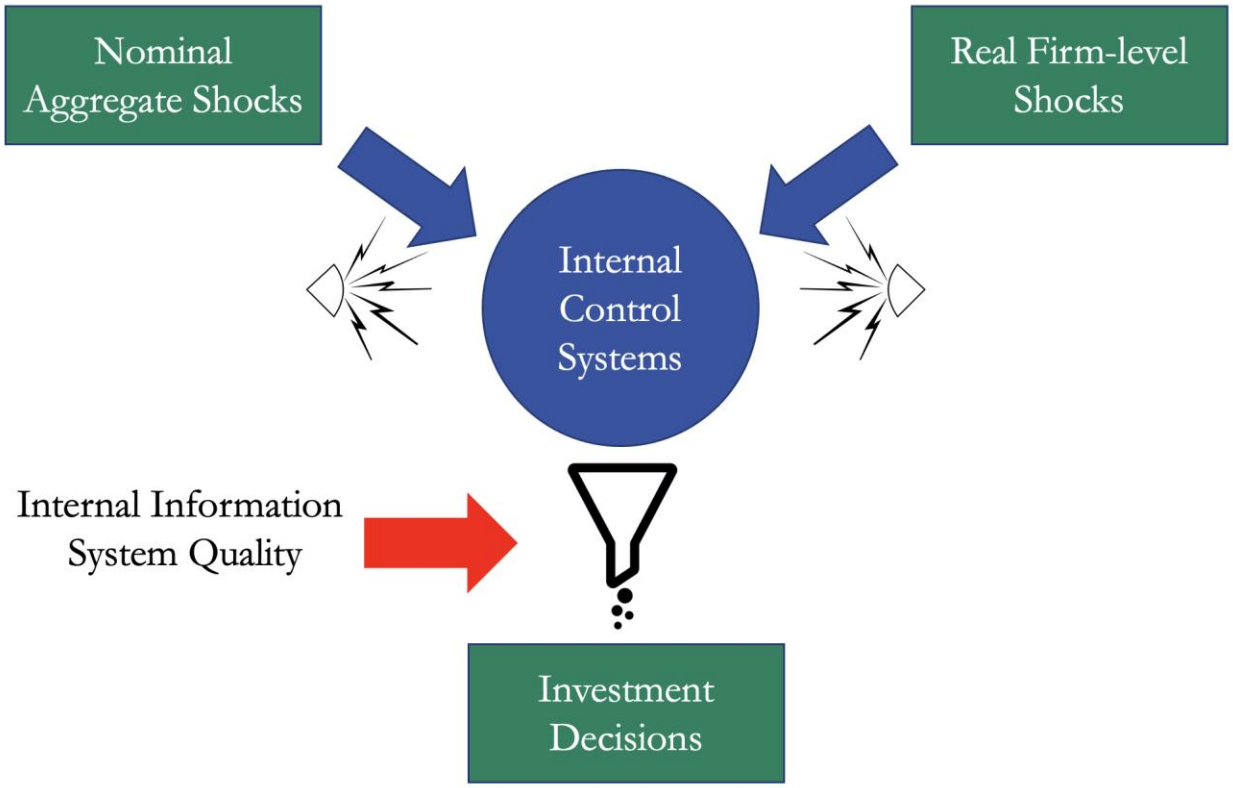


Figure 1 illustrates our hypotheses development.

Figure 2. Inflation Shock Regimes

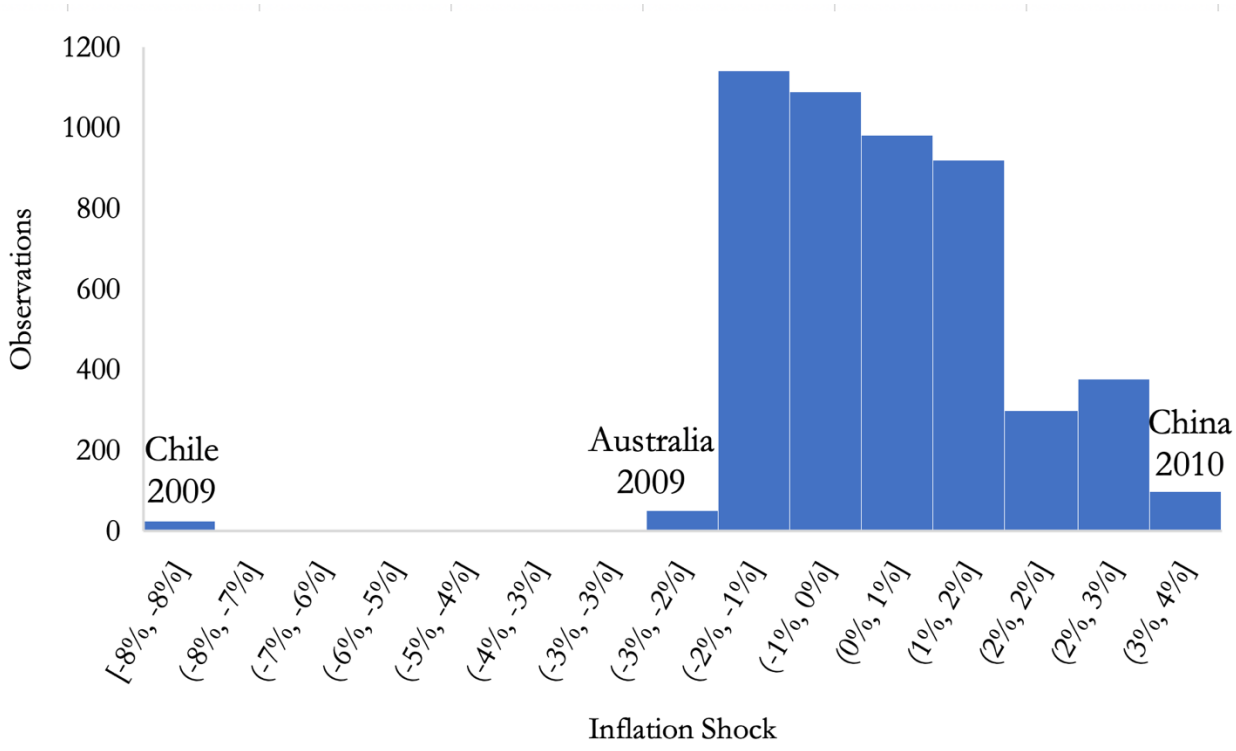
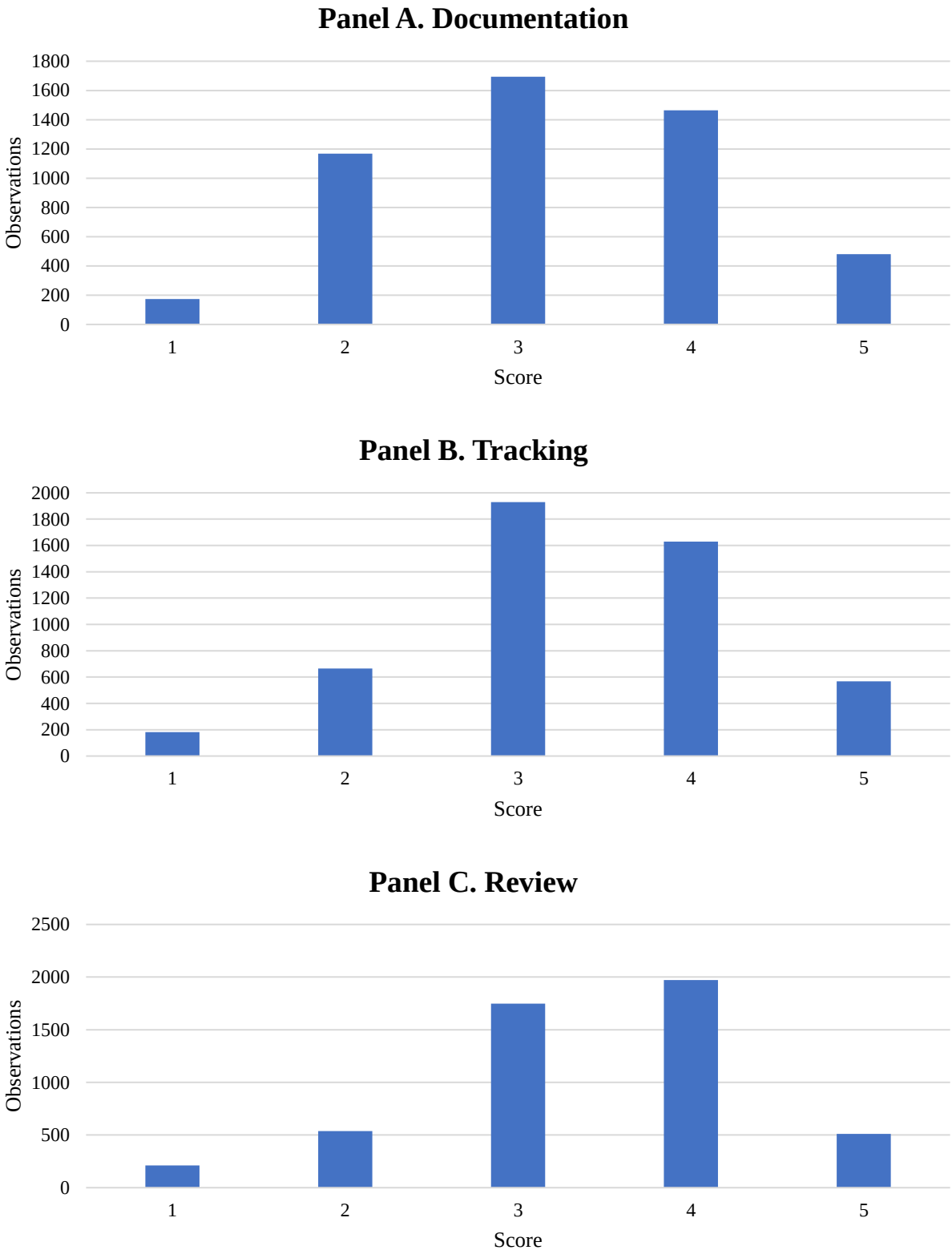


Figure 2 presents a histogram of our inflation shock measure.

Figure 3. World Management Survey Internal Information System Quality Scores



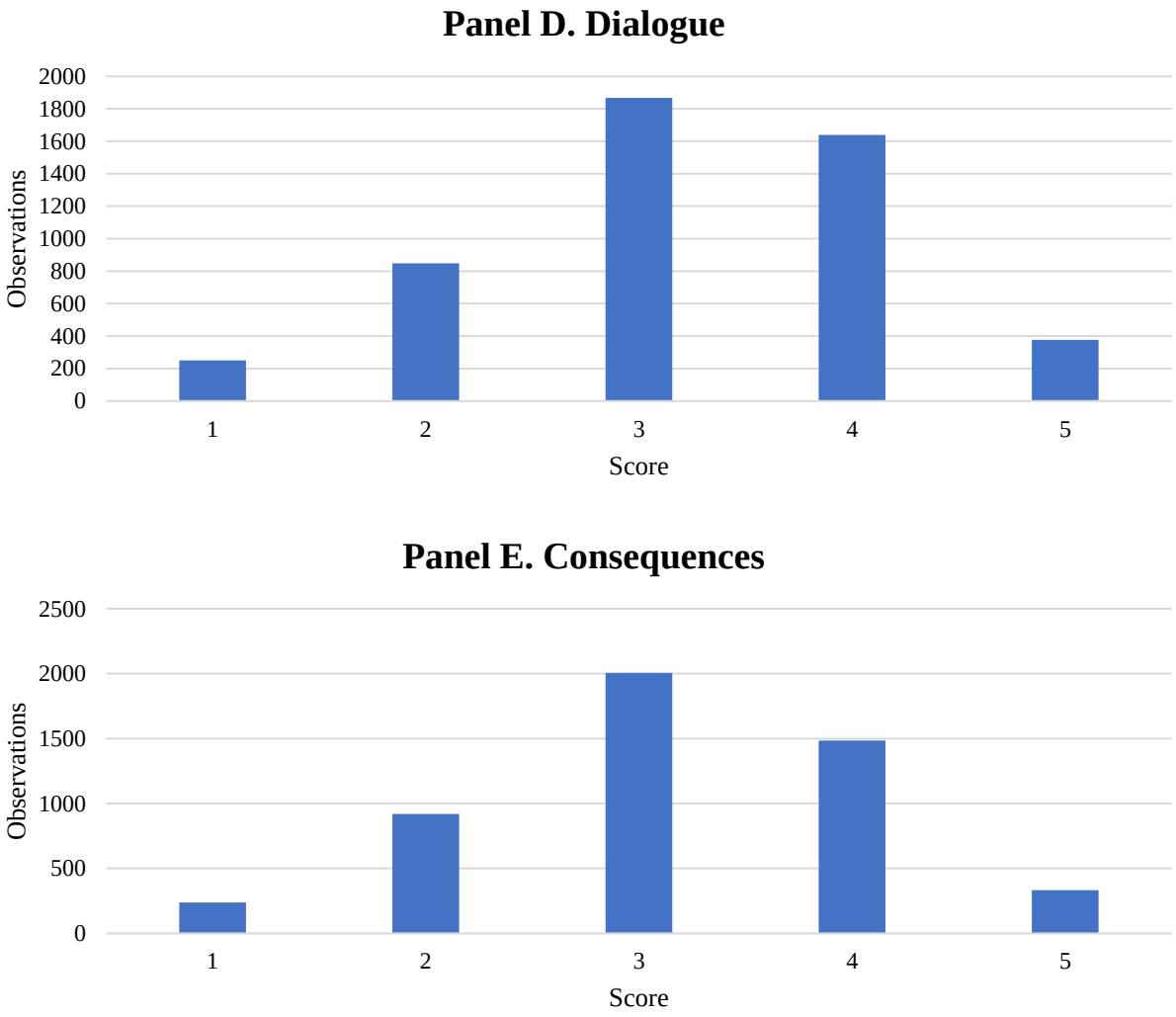


Figure 3 Panels A to E present internal information system quality scores for five aspects of monitoring examined by the World Management Survey: Information documentation, tracking, review, dialogue, and consequences. All variables are defined in the Appendix.

Figure 4. 8th EU Company Law Directive as an Instrument for Internal Information System Quality: Parallel Trends Test

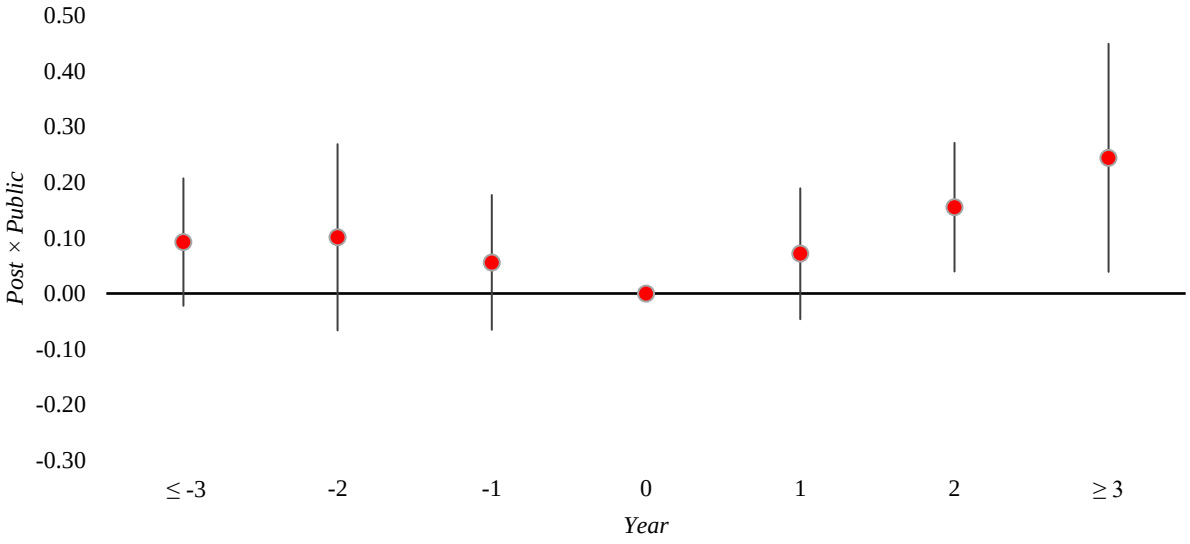


Figure 4 tests the parallel trends assumption of our 8th EU Company Law Directive staggered difference-in-differences design by regressing *Internal Information* on an indicator that the firm is publicly traded (*Public*) interacted with indicators for the difference between the year in which the firm's home country adopted the Directive minus the year of the observation, controls, and industry and country-year fixed effects. The year in which the firm's home country adopted the Directive constitutes the base year. The figure displays the slope coefficients and 90% confidence intervals for the interaction term between *Public* and each of the fiscal year indicators. Standard errors are clustered by industry. All continuous firm-level variables are winsorized at the 1st and 99th percentiles. All variables are defined in the Appendix.

Table 1. Country Composition

Country	Observations	Percent of Total (%)
Australia	60	1.23
Brazil	60	1.23
Canada	4	0.08
Chile	34	0.70
China	434	8.87
France	108	2.21
Germany	356	7.28
Greece	481	9.83
India	111	2.27
Ireland	55	1.12
Italy	569	11.63
Japan	109	2.23
Mexico	10	0.20
New Zealand	2	0.04
Poland	266	5.44
Portugal	341	6.97
Spain	192	3.93
Sweden	302	6.17
Turkey	153	3.13
United Kingdom	1123	22.96
United States of America	121	2.47
Total	4891	100.00

Table 1 presents our sample's country composition.

Table 2. Descriptive Statistics

Variable	N	Mean	Std	P1	P25	Median	P75	P99
Investment	4891	0.01	0.11	-0.36	-0.04	0.00	0.05	0.42
Inflation Shock	4891	0.00	0.01	-0.03	-0.01	0.00	0.01	0.03
Internal Information	4891	3.26	0.78	1.40	2.80	3.20	3.80	4.80
Documentation	4891	3.19	1.01	1.00	2.00	3.00	4.00	5.00
Tracking	4891	3.35	0.97	1.00	3.00	3.00	4.00	5.00
Review	4891	3.41	0.96	1.00	3.00	3.50	4.00	5.00
Dialogue	4891	3.21	0.98	1.00	3.00	3.00	4.00	5.00
Consequences	4891	3.16	0.96	1.00	3.00	3.00	4.00	5.00
Growth Expectations	4891	0.04	0.06	-0.05	-0.01	0.04	0.06	0.17
Macroeconomic Uncertainty	4891	0.94	0.26	0.64	0.64	1.09	1.21	1.27
Operating Quality	4891	2.93	0.98	1.00	2.50	3.00	3.50	5.00
Target Focus	4891	2.91	0.74	1.20	2.40	3.00	3.40	4.60
People Management	4891	2.77	0.63	1.33	2.33	2.83	3.17	4.33
Cash Flow	4891	0.06	0.11	-0.28	0.01	0.05	0.11	0.42
Δ*Cash Flow*	4891	0.01	0.08	-0.28	-0.02	0.01	0.04	0.34
Size	4891	17.77	1.41	14.60	16.79	17.64	18.66	21.56
Leverage	4891	0.10	0.15	0.00	0.00	0.03	0.16	0.73
Δ*Sales*	4891	0.08	0.33	-1.01	-0.08	0.06	0.23	1.37

Table 2 presents our descriptive statistics. All continuous firm-level variables are winsorized at the 1st and 99th percentiles. All variables are defined in the Appendix.

Table 3. Correlation Matrix

Variable		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Investment	1	1.00	0.06*	0.02	0.00	0.02	0.01	0.03	0.01	0.13*	-0.23*	-0.01	0.04*	0.04	0.19*	0.08*	0.11*	0.01	0.29*
Inflation Shock	2	0.10*	1.00	-0.05*	-0.09*	0.00	-0.02	-0.05*	-0.05*	0.32*	-0.20*	-0.06*	-0.03	0.01	0.05*	0.04*	-0.05*	-0.03	0.14*
Internal Info	3	0.02	-0.01	1.00	0.79*	0.79*	0.83*	0.83*	0.76*	-0.14*	0.01	0.62*	0.71*	0.58*	0.03	0.00	0.32*	-0.05*	0.01
Documentation	4	0.00	-0.05*	0.79*	1.00	0.55*	0.54*	0.54*	0.49*	-0.15*	0.05*	0.55*	0.57*	0.48*	0.04*	0.01	0.27*	-0.06*	-0.01
Tracking	5	0.03	0.04*	0.78*	0.54*	1.00	0.61*	0.55*	0.46*	-0.08*	-0.03	0.51*	0.57*	0.43*	0.03	0.00	0.26*	-0.04	0.04*
Review	6	0.00	0.00	0.82*	0.54*	0.59*	1.00	0.66*	0.53*	-0.10*	0.01	0.48*	0.57*	0.45*	0.03	0.00	0.25*	-0.04*	0.01
Dialogue	7	0.03	-0.02	0.82*	0.54*	0.54*	0.63*	1.00	0.56*	-0.08*	0.03	0.49*	0.57*	0.46*	0.03	0.00	0.27*	-0.03	0.00
Consequences	8	0.01	0.00	0.75*	0.48*	0.45*	0.52*	0.55*	1.00	-0.14*	-0.03	0.45*	0.55*	0.49*	0.00	0.01	0.25*	-0.04*	-0.01
Growth Expectations	9	0.18*	0.15*	-0.12*	-0.12*	-0.06*	-0.11*	-0.07*	-0.10*	1.00	-0.36*	-0.17*	-0.10*	-0.01	0.11*	0.01	-0.16*	-0.03	0.17*
Macro Uncertainty	10	-0.29*	-0.15*	-0.02	0.02	-0.04*	-0.02	0.01	-0.07*	-0.26*	1.00	0.06*	-0.01	-0.01	-0.08*	-0.04*	0.01	0.07*	-0.31*
Operating Quality	11	-0.01	0.00	0.63*	0.55*	0.52*	0.49*	0.50*	0.46*	-0.14*	0.02	1.00	0.54*	0.45*	0.06*	0.02	0.29*	-0.06*	-0.02
Target Focus	12	0.04*	0.01	0.69*	0.56*	0.55*	0.56*	0.55*	0.54*	-0.08*	-0.03	0.54*	1.00	0.62*	0.07*	0.00	0.31*	-0.08*	0.02
People Mgmt.	13	0.03	0.04	0.56*	0.47*	0.42*	0.45*	0.45*	0.48*	0.01	0.01	0.45*	0.60*	1.00	0.08*	0.00	0.25*	-0.08*	0.03
Cash Flow	14	0.20*	0.03	0.06*	0.06*	0.06*	0.04*	0.05*	0.02	0.11*	-0.07*	0.08*	0.09*	0.09*	1.00	0.44*	0.06*	-0.14*	0.31*
Δ*Cash Flow*	15	0.09*	0.03	0.02	0.02	0.02	0.01	0.01	0.01	-0.01	-0.06*	0.04*	0.02	0.01	0.42*	1.00	-0.01	-0.01	0.38*
Size	16	0.09*	0.05*	0.33*	0.28*	0.27*	0.26*	0.27*	0.25*	-0.14*	0.00	0.29*	0.32*	0.26*	0.07*	0.01	1.00	0.07*	0.02
Leverage	17	0.01	-0.04*	-0.08*	-0.08*	-0.07*	-0.06*	-0.06*	-0.06*	-0.10*	0.08*	-0.08*	-0.10*	-0.11*	-0.11*	-0.01	0.06*	1.00	-0.05*
Δ*Sales*	18	0.41*	0.16*	0.02	0.00	0.07*	0.01	0.01	0.00	0.19*	-0.34*	0.01	0.05*	0.05*	0.33*	0.41*	0.04*	-0.06*	1.00

Table 3 presents our correlation matrix. * indicates significance at the 1% level. Pearson (Spearman) correlations are above (below) the diagonal. All continuous firm-level variables are winsorized at the 1st and 99th percentiles. All variables are defined in the Appendix.

Table 4. Inflation, Investment, and Internal Information Systems as a Transmission Channel

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
					Investment			
Inflation Shock	**2.041*** **	**2.039*** **			**0.748*** **	**0.743*** **		
	(10.52)	**(10.96)**			**(3.96)**	**(4.04)**		
Internal Information	0.004***	0.004***	0.004***	0.003***	-0.002	-0.002	-0.002	-0.002
	(5.50)	(5.41)	(5.88)	(5.85)	(-0.38)	(-0.39)	(-0.43)	(-0.48)
Inflation Shock × Internal Information	**-0.501*** **	**-0.501*** **	**-0.179** **	**-0.180** **	**-0.266*** **	**-0.265*** **	**-0.195*** **	**-0.196*** **
	(-6.06)	**(-6.20)**	**(-3.17)**	**(-3.23)**	**(-4.73)**	**(-4.92)**	**(-4.00)**	**(-4.07)**
Growth Expectations					0.063***	0.063***		
					(4.43)	(4.52)		
Macroeconomic Uncertainty					-0.059***	-0.060***		
					(-5.84)	(-5.82)		
Operating Quality					-0.004*	-0.004*	-0.003**	-0.003**
					(-2.01)	(-1.99)	(-2.32)	(-2.30)
Target Focus					0.004	0.004	0.005	0.005
					(1.52)	(1.52)	(1.56)	(1.58)
People Management					0.001	0.001	-0.001	-0.001
					(0.71)	(0.89)	(-0.50)	(-0.48)
Cash Flow					0.132***	0.132***	0.140***	0.139***
					(8.94)	(8.94)	(12.91)	(12.51)
Δ*Cash Flow*					-0.087**	-0.085**	-0.083**	-0.082**
					(-2.89)	(-2.73)	(-3.25)	(-3.08)
Size					0.008***	0.008***	0.010***	0.010***
					(8.39)	(8.20)	(9.45)	(9.01)
Leverage					0.032***	0.032***	0.026***	0.026***
					(3.94)	(3.70)	(4.05)	(3.87)
Δ*Sales*					0.073***	0.073***	0.056***	0.056***
					(13.54)	(13.51)	(8.75)	(8.63)
Constant	-0.003	-0.002	0.000	0.001	-0.089***	-0.091***	-0.177***	-0.178***
	(-1.15)	(-1.03)	(0.12)	(0.63)	(-3.36)	(-3.57)	(-8.10)	(-7.94)
Observations	4,891	4,891	4,891	4,891	4,891	4,891	4,891	4,891
Adjusted R-squared	0.006	0.005	0.119	0.120	0.136	0.135	0.181	0.181
Industry FE	NO	YES	NO	YES	NO	YES	NO	YES
Country-Year FE	NO	NO	YES	YES	NO	NO	YES	YES

Table 4 regresses investment on the interaction between inflation shocks and the composite internal information score, controls, and industry and country-year fixed effects. Robust t-statistics are reported in parentheses. Standard errors are clustered by industry. All continuous firm-level variables are winsorized at the 1st and 99th percentiles. All variables are defined in the Appendix.

Table 5. Internal Information System Quality Components

Panel A. Documentation

Variables	(1)	(2)	(3)	(4)
	Investment			
Inflation Shock	1.739***	1.736***	0.519**	0.501**
	(8.22)	(8.31)	(2.69)	(2.76)
Documentation	0.002*	0.002*	-0.001	-0.001
	(1.93)	(1.89)	(-0.65)	(-0.67)
Inflation Shock × Documentation	-0.419***	-0.419***	-0.200**	-0.195**
	(-4.30)	(-4.30)	(-2.76)	(-2.83)
Observations	4,891	4,891	4,891	4,891
Adjusted R-squared	0.006	0.006	0.136	0.135
Industry FE	NO	YES	NO	YES
Controls	NO	NO	YES	YES

Panel B. Tracking

Variables	(1)	(2)	(3)	(4)
	Investment			
Inflation Shock	1.389***	1.371***	0.378	0.365
	(8.99)	(8.85)	(1.50)	(1.46)
Tracking	0.003***	0.003**	-0.001	-0.001
	(3.49)	(3.24)	(-0.62)	(-0.64)
Inflation Shock × Tracking	-0.288***	-0.283***	-0.145**	-0.141**
	(-7.79)	(-7.74)	(-2.40)	(-2.33)
Observations	4,891	4,891	4,891	4,891
Adjusted R-squared	0.005	0.004	0.136	0.135
Industry FE	NO	YES	NO	YES
Controls	NO	NO	YES	YES

Panel C. Review

Variables	(1)	(2)	(3)	(4)
	Investment			
Inflation Shock	0.611***	0.616***	-0.055	-0.041
	(3.38)	(3.58)	(-0.13)	(-0.10)
Review	0.001	0.001	-0.002	-0.002
	(0.67)	(0.57)	(-1.17)	(-1.18)
Inflation Shock × Review	-0.049	-0.050	-0.014	-0.018
	(-1.05)	(-1.17)	(-0.14)	(-0.18)
Observations	4,891	4,891	4,891	4,891
Adjusted R-squared	0.003	0.003	0.135	0.135
Industry FE	NO	YES	NO	YES
Controls	NO	NO	YES	YES

Panel D. Dialogue

Variables	(1)	(2)	(3)	(4)
	Investment			
Inflation Shock	1.660***	1.666***	0.605**	0.605**
	(5.26)	(5.33)	(2.58)	(2.54)
Dialogue	0.005***	0.004***	0.003	0.003
	(11.08)	(10.02)	(0.98)	(1.00)
Inflation Shock × Dialogue	-0.386**	-0.388**	-0.224**	-0.223**
	(-3.01)	(-3.04)	(-2.30)	(-2.30)
Observations	4,891	4,891	4,891	4,891
Adjusted R-squared	0.007	0.006	0.136	0.136
Industry FE	NO	YES	NO	YES
Controls	NO	NO	YES	YES

Panel E. Consequences

Variables	(1)	(2)	(3)	(4)
	Investment			
Inflation Shock	1.496***	1.500***	0.451	0.463
	(7.65)	(7.74)	(1.48)	(1.52)
Consequences	0.002*	0.002*	-0.001	-0.001
	(2.14)	(1.91)	(-0.54)	(-0.55)
Inflation Shock × Consequences	-0.344***	-0.345***	-0.181**	-0.185**
	(-7.45)	(-7.76)	(-2.42)	(-2.50)
Observations	4,891	4,891	4,891	4,891
Adjusted R-squared	0.005	0.005	0.136	0.135
Industry FE	NO	YES	NO	YES
Controls	NO	NO	YES	YES

Table 5 regresses investment on the interaction between inflation shocks and the individual components of the composite internal information score (documentation, tracking, review, dialogue, and consequences), controls, and fixed effects. Robust t-statistics are reported in parentheses. Standard errors are clustered by firm. All continuous firm-level variables are winsorized at the 1st and 99th percentiles. All variables are defined in the Appendix.

Table 6. Implications for Investment Efficiency

Variables	(1)	(2)	(3)	(4)
	Future Profitability			
Inflation Shock	**-0.920*** **	**-0.929*** **		
	(-3.51)	**(-3.63)**		
Internal Information	0.002	0.001	-0.001	-0.001
	(1.12)	(0.73)	(-0.35)	(-0.46)
Inflation Shock × Internal Information	**0.224*** **	**0.224*** **	**0.176** **	**0.183** **
	(4.10)	**(4.13)**	**(2.53)**	**(2.43)**
Observations	4,577	4,577	4,577	4,577
Adjusted R-squared	0.313	0.318	0.32	0.324
Controls	YES	YES	YES	YES
Industry FE	NO	YES	NO	YES
Country-Year FE	NO	NO	YES	YES

Table 4 regresses year-ahead profitability on the interaction between inflation shocks and the composite internal information score, controls, and industry and country-year fixed effects. Robust t-statistics are reported in parentheses. Standard errors are clustered by industry. All continuous firm-level variables are winsorized at the 1st and 99th percentiles. All variables are defined in the Appendix.

Table 7. Import Competition, Inheritance Taxes, and Education Levels as Instruments for Internal Information System Quality: 2SLS Estimates

Variables	(1)	(2)	(3)	(4)
	Investment			
Inflation Shock	12.578*	12.570*	14.285**	14.166**
	(2.08)	(2.08)	(2.45)	(2.45)
Internal Information	0.028	0.034	0.061	0.068
	(0.98)	(1.13)	(1.01)	(1.16)
Inflation Shock × Internal Information	-4.029**	-4.025**	-4.584**	-4.549**
	(-2.30)	(-2.30)	(-2.67)	(-2.65)
Observations	4,257	4,257	4,257	4,257
Industry FE	NO	YES	NO	YES
Year FE	YES	YES	YES	YES
Controls	NO	NO	YES	YES
Kleibergen-Paap (2006) F-Statistic	4.15	4.77	17.55	17.38

Table 7 regresses investment on the interaction between inflation shocks and the composite internal information score (*Internal Information*) instrumented by import competition, inheritance tax levels, and education levels; controls; and industry and country-year fixed effects. Robust t-statistics are reported in parentheses. The last row reports the F-statistic obtained via a Kleibergen and Paap (2006), which examines whether import competition, inheritance tax levels, and education levels are valid instruments for *Internal Information.* Standard errors are clustered by industry. All continuous firm-level variables are winsorized at the 1st and 99th percentiles. All variables are defined in the Appendix.

Table 8. 8th EU Company Law Directive as an Instrument for Internal Information System Quality: Staggered Difference-in-Differences Estimates

Variables	(1)	(2)	(3)	(4)
	Internal Information		*Investment*	
Post × *Public*	0.097*	0.101**	-0.007	-0.008
	(2.10)	(2.40)	(-0.47)	(-0.58)
Inflation Shock × *Post* × *Public*			-3.613*	-3.479*
			(-2.13)	(-2.04)
Observations	3,201	3,201	3,201	3,201
Adjusted R-squared	0.313	0.318	0.319	0.323
Industry FE	NO	YES	NO	YES
Country-Year FE	YES	YES	YES	YES
Controls	YES	YES	YES	YES

Table 8 columns estimates the effect of the 8th EU Company Law Directive on internal information system quality and the resulting effects on firms' ability to disentangle nominal aggregate from real firm-level shocks by regressing *Internal Information* on an indicator that the firm is publicly traded (*Public*) interacted with an indicator that the firm's home country adopted the Directive (*Post*) in columns (1) and (2); and by regressing *Investment* on *Public* interacted with *Post* and *Inflation Shock* in columns (3) and (4). All columns include controls and industry and country-year fixed effects. Standard errors are clustered by industry. All continuous firm-level variables are winsorized at the 1st and 99th percentiles. All variables are defined in the Appendix.