# Aggregate Information Dynamics

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*[PRELIMINARY, PLEASE DO NOT DISTRIBUTE]*

**Abstract**

The amount of information produced in an economy varies over time depending on the state of the macro economy. We define movements in aggregate economic activity very agnostically and introduce new ways to characterize aggregate economic activity based on information in stock prices. We empirically investigate changes in economy-wide measures of information and changes in aggregate economic fragility as aggregate economic activity changes based on the level of real GDP. We find that our stock price-based measures of information are significant in predicting recessions with and without a financial crisis. We then show evidence of a feedback effect to investment from the information produced especially during recessions associated with crises. Finally, we document the presence of a global information factor; information produced in advanced countries can predict financial crises in emerging markets and results in reallocation at a global level via capital flows among countries.

**Keywords:** Business Cycles, Financial Markets and the Macroeconomy, Financial Crises
**JEL Classification:** E3, E32, E44, G01

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# 1 Introduction

Financial crises are an important feature of aggregate economic activity. How are crises related to movements in aggregate economic activity? We empirically explore this question using simple measures to define states of aggregate economic activity. Then we characterize these states with stock price-based measures of the amount of information in the economy and the overall level of fragility of the economy. We find that recessions with crises are indeed different from recessions without crises: prior to a crisis more information is produced and the economy is more fragile. More information production results in subsequent reallocation of capital. There is reallocation of capital in both types of recession (with and without a crisis), but less so when there is a crisis, consistent with the banking system being in distress. We also find evidence suggesting global information spillovers. The information produced in advanced economies can predict financial crises in emerging markets. This results in reallocation via capital movements across borders. Movements in the amount of information produced in an economy are an inherent part of movements in aggregate economic activity.

Our finding that more information is produced and that the economy is more fragile prior to a crisis is consistent with the view that crises are information events. Dang et al. (2012) argues that a financial crisis is an information event in which information-insensitive debt becomes information-sensitive when agents produce information about the collateral backing the debt. In Gorton and Ordoñez (2016) and Gorton and Ordoñez (2011) the macroeconomic dynamics are caused by agents producing more information about firms at certain times, but not at other times. Capital is reallocated based on the information produced. They focused on debt. Here we focus on stock prices and ask the same question: Do agents produce more information at certain times rather than other times, and if so is capital reallocated in response? We find that the answer to both questions is yes. Our stock price-based measures are significant in predicting economic events, especially recessions with and without a financial crisis. However recessions with crises are different compared to recessions without crises as information is produced prior and during the event.

The rise and fall of aggregate economic activity is called the "business cycle." But that statement can only be made precise by specifying how aggregate economic activity is measured and categorized into different states. There are two conceptualizations of business cycles. One comes from a long line of investigators, including importantly Mitchell (1913), Mitchell (1927), and Burns and Mitchell (1946).[1] Burns and Mitchell examined levels of a large number of series and viewed cycles in terms of four phases (prosperity, crisis, depression, revival), identifying peaks and troughs by examining the coherence and "turning points" of many

[1]There is a long history prior to Burns and Mitchell which characterizes business cycles. Juglar is the most important. See Niehans (1992) and Besomi (2009).

series. This is essentially the procedure the U.S. National Bureau of Economic Research follows and has been formalized by Harding and Pagan (2002) and Bry and Boschan (1971). This conceptualization imposes structure on the data in that it requires that peaks follow troughs and troughs follow peaks. There is no theoretical basis for this structure, a criticism made by Koopmans (1947) and Kydland and Prescott (1990).

The other approach was proposed by Lucas (1977) who defined business cycles as the deviations from a trend. Hodrick and Prescott (1997) specified an econometric procedure for determining the trend and hence the deviations. The idea that there is a phenomenon called a "deviation" which is conceptually distinct from the "trend" is based on the Solow (1970) growth model. Conceptually, the Solow model determines the "trend" and the residual is the "business cycle." And Hodrick and Prescott's H-P filter shows how to empirically determine the trend. To find the smoothing parameter in the detrending procedure, Hodrick and Prescott analyzed U.S. quarterly data over the period 1950.1-1979.2, a period during which there was no financial crisis. A fundamental problem with the deviations from trend view of business cycles is that there currently exists no basis for determining how much of a time series is "trend" and how much is "deviation." This is not a new point. Eighty years ago Frickey (1934) noted: "What part of the fluctuation of the series is secular and what portion is cyclical? This question cannot be evaded, for our computed representations of secular and cyclical movements are palpably interdependent" (p. 201). Indeed, Gorton and Ordoñez (2016) show how technological change is related to credit booms and financial crises. The H-P filter has been widely criticized for a variety of other reasons as well, e.g., Harvey and Jaeger (1993) and Cogley and Nason (1995) and most recently by Hamilton (2016).

The issue of defining a "business cycle" is further complicated by the fact that the current macroeconomic paradigm says nothing about financial crises. The reason is that the paradigm was built under the assumption that financial crises were a thing of the past, at least in the U.S. The assumption that financial crises could be ignored obviously has turned out to be wrong. In fact, financial crises occur in all market economies, though some economies go for long periods without a crisis. But, the fact of the occurrence of the Financial Crisis of 2007-2008 means that we have to reassess what we mean by "business cycle." Further, the characterizations of aggregate economic activity to date have ignored financial markets, which offer a rich laboratory of data for study. More specifically, equity prices contain information that may be valuable in understanding movements in aggregate economic activity.

Our analysis is in three steps. We first start by proposing definitions of "recessions" and "growth periods." Our definitions are agnostic, intuitive, and ad- hoc. But they are no more ad hoc than choosing a smoothing parameter when detrending or imposing a peak-trough structure. Importantly, our recession periods coincide with instances of financial crises in our dataset which includes country level information on economic events

and macroeconomic activity forming an international panel. Financial crises most often occur at the start of a recession or during a recession. Secondly, we rationalize our categorization of aggregate states by examining the behavior of information measures and measures of the economy's fragility (defined below) at an aggregate level prior to and during the different kinds of aggregate activity (economic events). Both measures are based on stock prices, and the foundation for this is that stock markets are at least weakly (market) efficient; see Fama (2014) and Grossman (1981). We show that our categorization of aggregate states does indeed correspond, in a predictive and contemporaneous sense, to the information measures both at a country and a global level. Finally, we show that our proposed measures of information are indeed informative as they are subsequently associated with reallocation of capital within a country and across countries in a global setting.

More specifically, we show that our information measure of cross-sectional averages increases prior to recessions associated with financial crises while it decreases prior to recessions without financial crises. We interpret this finding as an indication that more information is being produced by agents in the economy in anticipation of a recession with a financial crisis while the opposite is true for recessions without a financial crisis. We also show that this information production is associated with reallocation of resources in the economy. Information measures predict future values of dispersion in $Q$-ratios and the relationship between the two depends on the type of the economic event.

Focusing on the global economy we find a significant information spillovers from advanced countries to emerging market countries. We examine the first two principal components of our information measures from advanced countries and ask whether this information predicts financial crises in advanced and emerging market countries. We indeed find a strong predictive power of the principal components of our information measures on recessions and especially on recessions with crises. We also find that these measures can explain reallocation of resources both at a country and at a global level. We measure reallocation of resources at a country level using the dispersion of $Q$-ratios and at a global level using measures of global imbalances denominated at domestic and international currencies. The finding of country level and global reallocation following the production of information at a global level implies interconnected economies among countries and global investors.

Our approach is motivated by financial crises, which we want to study in the overall context of movements in aggregate economic activity. Gorton and Ordoñez (2016) show that while credit booms typically precede financial crises there are some booms that end in crisis (bad booms) and some that do not (good booms). Both types of boom start with positive technology shocks (as measured by changes in total factor productivity and labor productivity), but growth in technology dies off for bad booms compared to good booms. The average length of a boom is eleven years. This suggests that detrending is motivated by conceptually thinking

of technological change as being unrelated to the "deviations from trend" is not correct, especially when studying financial crises. One prediction of the model in Gorton and Ordoñez (2016) is that firms should be more likely to default during bad booms. They test this using the measure of fragility introduced below, based on stock prices. Stock prices change because they reflect new information, which motivates our interest in stock price-based measures of the aggregate state of the economy.[2]

Our findings are related to those of Muir (2015) who studies risk premia during financial crises, wars, and recessions in an international panel of 14 countries over 140 years. He finds that risk premia increase very significantly in financial crises but not in the other types of events. Atkeson et al. (2013) derive a stock price-based measure of fragility in the economy (which we explain and use below) and study the period 1926-2012. They find that the three worst recessions stand out: the Great Depression, 1937, and the Crisis of 2007-2008. Again, crises appear to be special relative to other periods. Saxena and Cerra (2005) and Krishnamurthy and Muir (2015) also find evidence that financial crises are especially different events, not on a smooth continuum from mild recessions to crises. While we too find that financial crises are special, our main focus is on measuring the aggregate amount of information in the economy relative to aggregate economic activity, and showing how these measures are predictive of certain types of aggregate economic activity and of the reallocation of capital.

With regard to the reallocation of capital, there is a large literature on whether there are "cleansing effects" of recessions, which means that capital and labor are moved - reallocated - from low productivity to high productivity firms, so on net recessions are times of accelerated productivity gains. Such reallocation is relatively less costly to due during recessions. There is a large literature on this subject starting with Schumpeter (1939) and including, for example, Caballero and Hammour (1994), and Caballero and Hammour (1996). Reallocation involves some firms exiting, but also capital (and labor) moving between firms or sectors as well. Except for exit, reallocation may be difficult because in a financial crisis the banking system is damaged. The extant empirical work suggests that this is a problem. E.g., see Ivashina and Scharfstein (2010), Chodorow-Reich (2013), Greenstone et al. (2014) and Lee and Mezzanotti (2015). In this paper, we study the reallocation of resources through the prism of information production in the economy, and find that more information production is associated with reallocation of resources among companies with low $Q$-ratios.

With regard to information spillovers, there are a number of papers that focus on stock market contagion in which a stock market crash in one country causes declines in the stocks of other countries, e.g. King and Wadhwani (1990). Gande and Parsley (2003) find information spillovers when one country's sovereign

[2]Brunnermeier et al. (2012) proposed measures of bank risk that would also be useful in characterizing macroeconomic states. But the proposed measures have not been implemented.

debt is downgraded; it results in the spreads on other countries' sovereign debt increasing. Our question is different. We ask whether the information produced in advanced economies forecasts financial crises in emerging markets.

The paper proceeds as follows. Section 2 is devoted to the definitions of the aggregate economic episodes and the data is explained and summarized. Section 3 examines how our measures of information and fragility are related to the different types of aggregate economic episodes. Section 4 is about reallocation at a country level. The information spillovers from developed economies to emerging market economies is the subject of Section 5. In Section 6 we focus on the reallocation of capital flows at a global level due to the information spillovers. Section 7 concludes our paper.

# 2 Definitions and Data

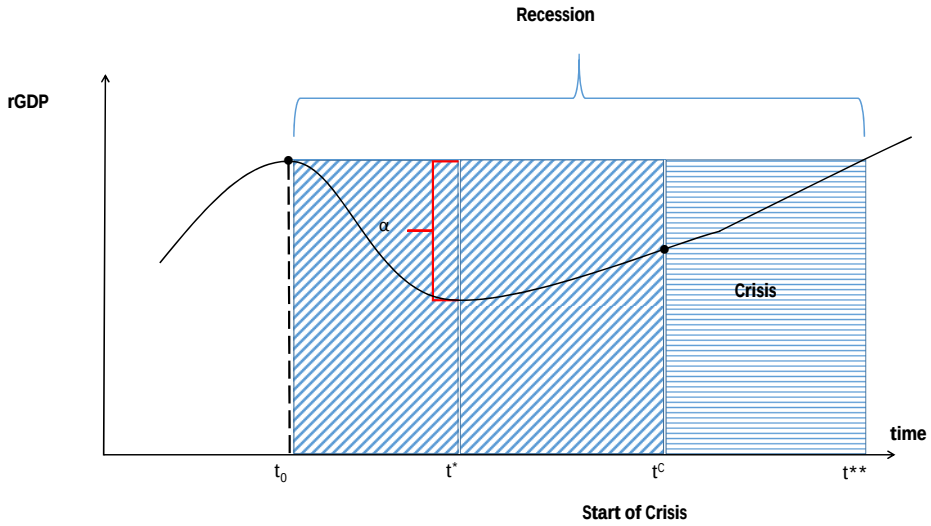
In this section we define different movements in aggregate economic activity, explain the various information measures, and discuss the data.

## 2.1 Definitions

We do not want to impose a great deal of preconceived structure on the data such as detrending or defining peaks and troughs because there is no theoretical justification for this. Instead, we will define recessions and growth periods differently, as follows. At date $t^*$ we look backwards four years and determine if the level of real GDP (rGDP) today is below that level by a threshold of $\alpha \leq -0.005$. If it is, then we say that a *recession* has started from the previous peak and it continues until this previous peak is again attained. In Figure 1, looking back from today, date $t^*$, to date $t_0$ real GDP at date $t^*$ is below the peak at $t_0$ by $\alpha$, and so we say that a recession has started at $t_0$. The recession continues until the level of real GDP is at least the level it was at at date $t_0$. This definition is based on the level of GDP. As Burns and Mitchell (1946) put it: "Aggregate [economic] activity can be given a definite meaning and made conceptually measurable by identifying it with gross national product" (p. 72).

In the figure, a financial crisis starts at date $t^C$ during the recession and continues until date $t^{**}$ which is the end of both the crisis and the recession. A crisis may come anywhere during a recession and in a few cases the crisis is not associated with a recession. In what follows we will look at predictive regressions to try to explain the starting date of recessions (date $t^*$) and the starting dates of crises (date $t^C$). We also look at *growth* periods. A period of *growth* is said to occur when, by the same backward looking procedure we find

Figure 1: **Definition of recessions**. A recession period is identified when the minimum quarterly real GDP change over a period of n quarters ($t^*$-$t_0$) is less than a specified threshold ($\alpha$). The recession begins at the highest GDP level ($t^0$) prior to the drop and continues until the previous peak is again attained ($t^{**}$). A financial crisis can occur at any point over the course of a recession ($t^C$).




that rGDP has increased by 0.01. So, there are four states that macroeconomy may be in: growth, recession, recession with crisis, or normal, where "normal" is the complement of the first three states.

Note that the structure imposed on real GDP is only the choice of the thresholds. We do not detrend, which imposes much more structure. And we do not require that a peak follow a trough and a trough follow a peak. Lastly, we impose the same threshold on all countries. Under our definitions, there can be a pattern of aggregate activity such as the following: recession, normal, recession, growth, normal, recession with a crisis, normal. This pattern would not be possible using a peaks and troughs structure.

Recessions fall into two types: recessions with a crisis and recessions with no crisis. We make this classification by first defining recessions and then checking Valencia and Laeven (2012) who provide crisis dates worldwide since 1970. Based on the data discussed below we identify these different types of aggregate economic activity shown in Table 1.

Table 1: **Duration of economic events**. The table summarizes the total number and duration of the following economic events: recession, recession with a crisis, recession without a crisis, growth, and normal times. The economic episodes are computed using quarterly real GDP data from the OECD iLibrary over a period of thirty years from 1973 until 2010.

| | Count | Mean | StDev | Min | Max |
|---|---|---|---|---|---|
| *Normal Times* | 133 | 2.49 | 1.83 | 1.00 | 9.00 |
| *Growth* | 106 | 1.61 | 1.17 | 1.00 | 8.00 |
| *Recessions* | 109 | 2.78 | 1.26 | 1.00 | 7.00 |
| *Recessions with Crises* | 25 | 2.96 | 0.84 | 1.00 | 5.00 |
| *Recessions with No Crises* | 96 | 2.39 | 1.15 | 1.00 | 5.00 |

The column labeled "count" in Table 1 shows the number of each type of episode across the countries of our sample. As expected, episodes of "normal times" predominate. There are 106 growth episodes and 109 recessions, among which 25 are associated with crises and 96 include instances of no crises.[3]. After the column labeled Count are statistics on the average duration in years of each event type. The average duration of a recession with a crisis episode is longer than that of a recession with no crisis. Growth episodes are the briefest.

## 2.2 Definitions of Measures of Information and Fragility

In what follows we examine two measures of information, the first is a stock price-based measure of economy-wide fragility and the second is a stock price-based measure of information in the economy.

The definition of fragility is from Atkeson et al. (2013). Based on Leland's (Leland (1994)) and Merton's (Merton (1974)) structural models these authors develop two concepts of default: Distance to Insolvency and Distance to Default. They then show that the variable one over the firm's equity volatility ($1/Vol$) is bounded between these two measures. Intuitively, when a firm's equity volatility is high, the firm is more likely to default. The fragility of an economy moves over time and spikes significantly during a crisis. As mentioned above, Atkeson et al. (2013) study the U.S. over 1926-2012 and show that 1932-1933, 1937 and 2008 are especially fragile periods. These periods stand out. Vassalou and Xing (2004) use the Merton (1974) model measure of default risk to show that default risk is a systematic risk and that the Fama-French asset pricing factors partially reflect default risk.

We examine the mean $1/Vol$ of each country in each year as a state variable about the *fragility* of the economy. Fragility is essentially a measure of economy-wide bankruptcy risk. There is a history of research that shows that firms are increasingly prone to bankruptcy leading up to a recession. Burns and Mitchell (1946) show that the liabilities of failed non-financial firms is a leading indicator of recession. Also see Zarnowitz and Lerner (1961). Gorton (1988) shows that when the unexpected component of this variable spikes there is a banking panic during the U.S. National Banking Era. There was never a panic without the threshold being exceeded; and the threshold was never exceeded without a panic.[4]

We also examine another measure which is the cross-section of firms' average stock return, in particular, we look at the standard deviation of firms' average returns: $CsAvg$. In other words, this variable is a cross-section characterization. This variable is related to the cross-section of firms' stock return volatility: $CsVol$. These two variables are highly correlated, 0.96, so we will restrict attention to $CsAvg$. We label this

[3]There are recession episodes which include both crises and no crises episodes
[4]See the discussion in Gorton (2012), p. 75-77.

variable *Information*, although $1/Vol$ is also based on stock information. For both $CsAvg$ and $1/Vol$ we have in mind the idea that underlying these variables are agents in the economy who are producing more or less information in reaction to the unobserved (to us) state of the economy. Based on the private information that these agents produce, they trade and stock prices respond. This interpretation is not crucial. It could be public information, or a combination. In a later section, we will show that thinking of all of these measures as informative is correct because some reallocation of capital occurs in response to these variables in recessions.

These variables are calculated as follows. Using daily stock price data, the monthly return and volatility are calculated for each firm in each country of the sample. Both returns and volatilities are annualized and $CsAvg$ and $1/Vol$ are computed. For each country we find the mean $(1/Vol)$ and compute the cross-sectional standard deviation of averages. Then these two monthly series are averaged across firms to create quarterly series. The annual series are formed using the last quarter observation of the quarterly series.

Appendix tables 17 and 18 show the correlations between the information and fragility variables and changes in those variables at the quarterly and annual horizons. As mentioned above, $CsAvg$ and $CsVol$ are highly correlated, as are changes in these two variables. Notably, the other variables are not highly correlated.

## 2.3 Data Sources and Preliminary Univariate Results

Annual Real GDP is from the Penn World Tables (PWT), TFP is from Kose et al. (2008), domestic credit to private sector is from the World Development Indicators, and labor productivity is constructed using the hours-adjusted output-labor ratio from the Total Economy Database (TED). Our measures of economy-wide fragility and the level of information in the economy, are constructed using daily stock price data for the countries in our sample as discussed above. The source of stock price data is Thomson/Reuters DataStream. The countries and dates of coverage are listed in Tables 30 and 31 of the Appendix. Also see Figure 9 in the Appendix.[5] Later we will use WorldScope data to calculate $Q$-ratios. Table 2 shows the summary statistics for these variables.

We now turn to the first set of results which concerns univariate comparisons of variables before the beginning of different types of aggregate events. Table 3a shows a univariate comparison of key variables *four quarters prior* to the beginning of a recession with a crisis episode versus the beginning of a recession with no crisis episode. Leading to a recession with a crisis, growth in real GDP ($\Delta rGDP$) is lower and $\alpha$ is negative. Prior to recessions with crises, we observe a higher level of fragility ($1/Vol$ is smaller). The significant difference in fragility is natural. As an economy heads towards a crisis, the distance to default

[5]We drop stock price data when there are less than 100 listed stocks.

Table 2: **Summary statistics (Annual)**. The table reports summary statistics for *real GDP in bn.* \$, $TFP$, $Credit/rGDP$, *Labor Productivity in hours*, *Recession Measure*, $\Delta rGDP$, $\Delta TFP$, $\Delta Credit/rGDP$, $\Delta$*Labor Productivity*, $1/Vol$, $CsAvg$, $CsVol$, $\Delta(1/Vol)$, $\Delta CsVol$, and $\Delta CsAvg$. The data are from the Penn World Tables (PWT), WIPO statistics database, World Development Indicators, Total Economy Database (TED), and Thomson/Reuters (DataStream), and span a period from 1973 until 2010. "Count" label refers to country-years.

| | Count | Mean | StDev | Min | Max |
|---|---|---|---|---|---|
| *real GDP in bn* \$ | 886 | 734.419 | 1395.693 | 5.704 | 9651.111 |
| $TFP$ | 732 | 594.578 | 114.943 | 187.514 | 823.585 |
| $Credit/rGDP$ | 886 | 81.129 | 46.947 | 8.766 | 232.097 |
| *Labor Productivity in hours* | 874 | 20.744 | 7.574 | 6.520 | 40.215 |
| *Recession Measure* | 886 | -0.001 | 0.028 | -0.218 | 0.061 |
| $\Delta rGDP$ | 886 | 0.028 | 0.031 | -0.177 | 0.113 |
| $\Delta TFP$ | 732 | 0.003 | 0.028 | -0.179 | 0.113 |
| $\Delta Credit/rGDP$ | 886 | 0.044 | 0.168 | -0.634 | 2.881 |
| $\Delta$*Labor Productivity* | 873 | 0.022 | 0.024 | -0.110 | 0.140 |
| $1/Vol$ | 820 | 3.225 | 1.014 | 0.921 | 6.680 |
| $CsVol$ | 820 | 0.462 | 0.393 | 0.078 | 3.657 |
| $CsAvg$ | 820 | 0.127 | 0.084 | 0.023 | 0.854 |
| $\Delta(1/Vol)$ | 793 | 0.017 | 0.877 | -2.867 | 3.403 |
| $\Delta CsVol$ | 793 | 0.009 | 0.360 | -2.141 | 2.181 |
| $\Delta CsAvg$ | 793 | 0.002 | 0.080 | -0.429 | 0.536 |

of the average firm decreases. Leading to a recession with a crisis, $CsAvg$ and $CsVol$, i.e., the standard deviation of average returns and the standard deviation of firm level volatility, are significantly higher. This is an indication of a higher dispersion of volatility and returns among companies, which we interpret as an increase in the information produced by agents in the economy. None of the other measures are significantly different.

Table 3b reports the results of a univariate comparison of the same variables four quarters prior to the beginning of a recession versus the beginning of a growth period. The only variables which are statistically different between the two events are fragility and $CsAvg$ with the first being lower and the second higher prior to a growth episode. This suggests that the short lived (average duration of 1.55 years) growth stage is associated with higher levels of fragility and more production of information.

Table 3 suggests that information measures have predictive content. Figure 2 corroborates that finding. It shows plots of the two information measures averaged over recessions with a crisis and recessions without a crisis, starting 15 quarters *before* the start of the average recession with a crisis and the average recession without a crisis. It is apparent that these measures of information and fragility vary depending on whether the coming recession will involve a financial crisis or not. We observe that fragility is higher and more information is produced prior to the beginning of a recession with crisis episode.[6] In what follows we explore the results in the figures econometrically.

We also conduct univariate comparisons of variables *during* the course of different types of aggregate events. Table 20a shows a univariate comparison of key variables *during* recessions versus periods of no

[6]Recall that the economy is more fragile when $Vol$ increases, and so $1/Vol$ decreases.

Table 3: **Difference in mean values - 4 quarters prior (all countries)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$ 4 quarters prior to instances of: (i) recessions with crises vs. recessions with no crises, and (ii) recessions vs. growth. The third column reports the difference in means and the $t$-statistic of the difference. The data are quarterly and span a period from 1973 until 2010.

(a) Recessions with Crises vs. Recessions with No Crises

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.031 | -0.011 | 0.042*** |
| | | | (12.83) |
| $\alpha$ | 0.003 | -0.030 | 0.033*** |
| | | | (23.04) |
| $1/Vol$ | 3.311 | 2.547 | 0.763*** |
| | | | (12.11) |
| $CsVol$ | 0.423 | 0.606 | -0.183*** |
| | | | (-7.95) |
| $CsAvg$ | 0.120 | 0.163 | -0.043*** |
| | | | (-8.58) |
| $\Delta(1/Vol)$ | 0.007 | -0.077 | 0.084* |
| | | | (2.41) |
| $\Delta CsVol$ | -0.000 | 0.030 | -0.030 |
| | | | (-1.51) |
| $\Delta CsAvg$ | -0.000 | 0.007 | -0.007 |
| | | | (-1.58) |
| N | 124 | 26 | 98 |

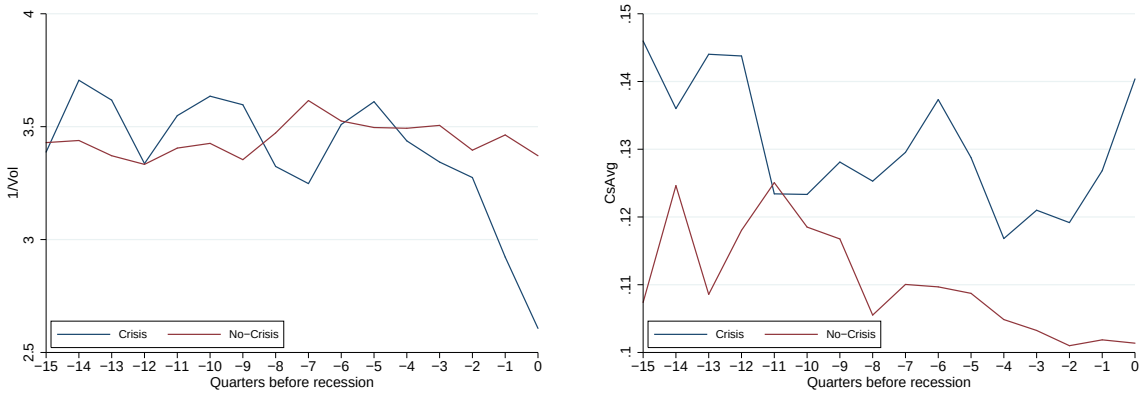
t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

(b) Recessions vs. Growth

| | Recession | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.023 | 0.044 | -0.021*** |
| | | | (-9.60) |
| $\alpha$ | -0.002 | 0.007 | -0.009*** |
| | | | (-8.85) |
| $1/Vol$ | 3.275 | 3.188 | 0.088* |
| | | | (2.02) |
| $CsVol$ | 0.437 | 0.445 | -0.007 |
| | | | (-0.46) |
| $CsAvg$ | 0.122 | 0.129 | -0.006$^{+}$ |
| | | | (-1.82) |
| $\Delta(1/Vol)$ | -0.005 | 0.014 | -0.019 |
| | | | (-0.79) |
| $\Delta CsVol$ | 0.004 | 0.003 | 0.001 |
| | | | (0.06) |
| $\Delta CsAvg$ | 0.001 | 0.001 | 0.000 |
| | | | (0.01) |
| N | 156 | 233 | -77 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Figure 2: **Information variables prior to a recession with and without a crisis**. The figure summarizes the evolution of average distance-to-insolvency ($1/Vol$) and cross-sectional average returns ($CsAvg$) over 15 quarters prior to the beginning of: ($a$) a recession with a crisis, and ($b$) a recession without a crisis. The variables are averaged across all countries in the sample. The data are quarterly from 1973 until 2010.




(a) 1/Volatility

(b) Cross-sectional Average Return

recession (the complement of recession). By definition of a recession, growth in real GDP ($\Delta rGDP$) is lower and so $\alpha$ is negative. Recessions display a higher level of fragility, i.e., $1/Vol$ is smaller in recessions than in non-recession periods. None of the other measures are significantly different.

Table 4a shows the comparison of recessions with a crisis to recessions with no crisis. Recessions with a crisis are significantly deeper in terms of the level of the real GDP decline. Fragility is significantly higher ($1/Vol$ is smaller) as are both $CsAvg$ and $CsVol$, i.e., the standard deviation of returns and the standard deviation of volatility. These two measures are higher, that is there is more dispersion of volatility and returns

Table 4: **Difference in mean values (all countries)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$ for instances of: (i) recessions with crises vs. recessions with no crises, and (ii) recessions vs. growth. The third column reports the difference in means and the $t$-statistic of the difference. The data are quarterly and span a period from 1973 until 2010.

(a) Recessions with Crises vs. Recessions with No Crises

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | -0.007 | -0.012 | 0.005 |
| | | | (0.99) |
| $\alpha$ | -0.023 | -0.046 | 0.023*** |
| | | | (9.72) |
| $1/Vol$ | 3.166 | 2.425 | 0.741*** |
| | | | (11.42) |
| $CsVol$ | 0.383 | 0.675 | -0.292*** |
| | | | (-9.70) |
| $CsAvg$ | 0.113 | 0.179 | -0.066*** |
| | | | (-9.88) |
| $\Delta(1/Vol)$ | 0.014 | 0.028 | -0.014 |
| | | | (-0.34) |
| $\Delta CsVol$ | 0.007 | 0.035 | -0.028 |
| | | | (-1.20) |
| $\Delta CsAvg$ | 0.001 | 0.007 | -0.005 |
| | | | (-1.04) |
| N | 632 | 260 | 372 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

(b) Recessions vs. Growth

| | Recession | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | -0.009 | 0.073 | -0.082*** |
| | | | (-31.59) |
| $\alpha$ | -0.030 | 0.018 | -0.048*** |
| | | | (-36.59) |
| $1/Vol$ | 2.950 | 3.242 | -0.293*** |
| | | | (-6.20) |
| $CsVol$ | 0.468 | 0.426 | 0.042* |
| | | | (2.17) |
| $CsAvg$ | 0.132 | 0.123 | 0.009* |
| | | | (1.98) |
| $\Delta(1/Vol)$ | 0.018 | -0.024 | 0.042 |
| | | | (1.49) |
| $\Delta CsVol$ | 0.015 | 0.009 | 0.006 |
| | | | (0.35) |
| $\Delta CsAvg$ | 0.003 | 0.002 | 0 |
| | | | (0.10) |
| N | 892 | 698 | 194 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

among companies. None of the other measures are significantly different. In Table 4a we get a glimpse of recessions with crises being different.

# 3 Characterizing Aggregate Economic Activity

In this section we further pursue the issue of the predictive power of the information measures for different types of aggregate economic activity. Specifically, we look at predictive regressions of the occurrence of specific economic events (all recessions, recessions with crises, recessions with no crises, growth) on lagged observations of the proposed information measures. Our conjecture is that our measures, being based on stock prices, are forward-looking, have some ability to do this. Figure 2 suggests that this is the case.

We look at each type of aggregate episode using a linear probability model and a Logit model. In all regression specifications, we take into account country fixed effects and perform double clustering over the dimensions of time and country. The dependent variable is an indicator for the years in which the episode takes place; the right-hand side variables are one and two year lags of the fragility and information measures. We start with recessions in Tables 5a and 5b. Table 5a shows that the occurrence of more fragile firms is an indication of a recession. No other variable predicts recessions.

Table 5b looks at predicting instances of recessions with financial crises. The results show a very different picture. Now, *all* the right-hand side variables are significant. Note that the signs on the fragility measure

Table 5: **Information measures and economic events**. The table summarizes the predictive power of information measures ($1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$) on the occurrence of economic events (recession and recession with crisis). The regression specification is: $\mathbb{1}_{n,t}(Economic\ Event) = \alpha_n + \beta' X_{n,t-1} + \epsilon_{n,t}$ for linear probability models, and $Pr(\mathbb{1}_{n,t}(Economic\ Event) = 1|X_{n,t-1}) = \Phi(\alpha_n + \beta' X_{n,t-1})$ for LOGIT models, where $Economic\ Event = (recession, recession\ with\ crisis)$ and $X_{n,t-1} = (1/Vol_{n,t-1}, CsAvg_{n,t-1}, \Delta Vol_{n,t-1}, \Delta CsAvg_{n,t-1})'$. The data are quarterly and span a period from 1973 until 2010. All regression specifications take into account country fixed effects and standard errors are clustered both at a country and time level.

(a) $\mathbb{1}_{n,t}(Recession)$

| | (1) Linear | (2) Logit |
|---|---|---|
| $1/Vol_{t-2}$ | -0.152*** | -0.852*** |
| | (-4.99) | (-4.74) |
| $CsAvg_{t-2}$ | 0.007 | -0.031 |
| | (0.04) | (-0.04) |
| $\Delta(1/Vol)_{t-1}$ | -0.084** | -0.476** |
| | (-2.67) | (-2.68) |
| $\Delta CsAvg_{t-1}$ | 0.068 | 0.377 |
| | (0.72) | (0.76) |
| Constant | 0.684*** | 1.102+ |
| | (7.34) | (1.94) |
| N | 3969 | 3775 |
| $R^2$ | 0.13 | . |
| F | 38.70 | . |
| Cluster (Time) | YES | YES |
| Cluster (Country) | YES | YES |
| FE (Country) | YES | YES |

t-statistics in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(b) $\mathbb{1}_{n,t}(Recession \cap Crisis)$

| | (1) Linear | (2) Logit |
|---|---|---|
| $1/Vol_{t-2}$ | -0.098*** | -2.215*** |
| | (-3.81) | (-7.04) |
| $CsAvg_{t-2}$ | 0.524* | 5.345* |
| | (2.42) | (2.23) |
| $\Delta(1/Vol)_{t-1}$ | -0.052* | -1.254** |
| | (-2.26) | (-2.91) |
| $\Delta CsAvg_{t-1}$ | 0.350** | 3.613** |
| | (2.84) | (2.75) |
| Constant | 0.222** | 2.521** |
| | (2.75) | (2.80) |
| N | 3377 | 2662 |
| $R^2$ | 0.17 | . |
| F | 9.46 | . |
| Cluster (Time) | YES | YES |
| Cluster (Country) | YES | YES |
| FE (Country) | YES | YES |

t-statistics in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

and the change in fragility are negative, meaning that a high level of fragility (low $1/Vol$) and an increase in fragility ($\Delta(1/Vol)$) are associated with the coming recession being one that is more likely to have a crisis. This negative correlation is stronger compared to that of Table 5a for both linear and Logit specifications. The information variables ($CsVol$ and $\Delta CsVol$) both exhibit a positive correlation with the occurrence of a recession with a crisis. An increase in information production points to a higher likelihood of a recession with a crisis.[7]

On the other hand, a decrease in the information produced in the economy, predicts a recession without a crisis. Appendix Table 21a focuses on the predictive power of information measures on recessions without financial crises. The sign of the coefficient of both $CsVol$ and $\Delta CsVol$ is negative indicating that less information produced in the economy predicts a recession without a crisis.[8] Combining this finding with that of Table 5b, we note that an increase in information production is associated with future instances of recessions with crises, while a decrease in information production with recessions without crises, suggesting that agents produce information prior to a recession depending on the aggregate state of the economy (severity

[7]The predictive power of information measures is apparent up to two years before the event (See Table 23 in the Appendix).
[8]This finding holds up to five years before the event, whereas the measure of fragility has no predictive ability for recessions without a crisis (Table 24).

of the recession).

Table 6: **Information measures, macroeconomic variables and economic events (LOGIT model)**. The table summarizes the predictive power of information measures ($1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$) and macroeconomic variables ($\Delta rGDP$, $\Delta Credit$, $\Delta TFP$, $\Delta Labor\ Productivity$) on the occurrence of economic events (recession, recession with crisis, recession without crisis, no recession with crisis, and growth - columns 1 through 5). The regression specification is: $Pr(\mathbb{1}_{n,t}(Economic\ Event) = 1|X_{n,t-1}) = \Phi(\alpha_n + \beta' X_{n,t-1})$, where $Economic\ Event = (recession, recession\ with\ crisis, recession\ without\ crisis, growth)$ and $X_{n,t-1} = (1/Vol_{n,t-1}, CsAvg_{n,t-1}, \Delta Vol_{n,t-1}, \Delta CsAvg_{n,t-1}, \Delta rGDP_{n,t-1}, \Delta Credit_{n,t-1}, \Delta TFP_{n,t-1}, \Delta LP_{n,t-1})'$. The data are annually and span a period from 1973 until 2010. All regression specifications take into account country fixed effects and standard errors are clustered both at a country and time level.

| | (1) Recession | (2) Recession∩Crisis | (3) Recession∩No-Crisis | (4) No-Recession∩Crisis | (5) Growth |
|---|---|---|---|---|---|
| $1/Vol_{t-2}$ | -0.511 | -0.868 | -0.367 | -0.017 | 0.042 |
| | (-1.60) | (-1.25) | (-1.22) | (-0.03) | (0.14) |
| $CsVol_{t-2}$ | -5.602 | 12.335$^{*}$ | -15.876$^{**}$ | -8.615 | -0.344 |
| | (-1.63) | (2.07) | (-3.18) | (-0.46) | (-0.14) |
| $\Delta(1/Vol)_{t-1}$ | -0.851$^{**}$ | -1.484$^{***}$ | -0.492$^{*}$ | -0.251 | 0.364 |
| | (-3.02) | (-4.89) | (-2.36) | (-0.53) | (1.01) |
| $\Delta CsVol_{t-1}$ | -1.231 | 6.334$^{+}$ | -7.799$^{**}$ | -6.650 | 0.850 |
| | (-0.57) | (1.94) | (-3.12) | (-0.62) | (0.42) |
| $\Delta rGDP_{t-1}$ | -47.896$^{***}$ | -60.051$^{***}$ | -19.198$^{+}$ | 9.239 | 17.956$^{**}$ |
| | (-4.87) | (-4.30) | (-1.69) | (0.32) | (2.93) |
| $\Delta Credit_{t-1}$ | 0.030 | 0.178 | -0.044 | -3.174$^{**}$ | 0.059 |
| | (0.07) | (0.66) | (-0.09) | (-3.13) | (0.13) |
| $\Delta TFP_{t-1}$ | 2.161 | 11.066 | 1.314 | 8.859 | 4.673 |
| | (0.35) | (1.37) | (0.23) | (0.41) | (1.01) |
| $\Delta LP_{t-1}$ | 12.593 | 14.538 | 3.358 | -22.590 | -2.955 |
| | (1.30) | (0.93) | (0.28) | (-0.59) | (-0.65) |
| Constant | 2.176$^{+}$ | -1.235 | 2.198$^{+}$ | -1.572 | -2.712$^{*}$ |
| | (1.95) | (-0.57) | (1.73) | (-0.36) | (-2.27) |
| N | 638 | 540 | 638 | 148 | 617 |
| Cluster (Time) | YES | YES | YES | YES | YES |
| Cluster (Country) | YES | YES | YES | YES | YES |
| FE (Country) | YES | YES | YES | YES | YES |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 6 makes clear that recessions with crises are significantly different compared to recessions without crises. Column (2), shows the predictive power of information measures for recessions with a crisis. The information measure $CsVol_{t-2}$ is significantly positive, suggesting that a higher level of information production is associated with a coming recession associated with a crisis. $\Delta(1/Vol)$ is significantly negative, what is fragility is increasing. And $\Delta CsVol$ is significantly positive, suggesting that more information is being produced. Column (3) shows the results for predicting instances of recessions with no crisis. Note that $CsVol_{t-2}$ is significant as is $\Delta CsVol$, but they have the *opposite* signs compared to predicting recessions *with crises*. Going into a recession that is expected to not have a crisis, less information is produced. Finally, the lagged change in TFP is significantly negative leading into recessions and significantly positive going into a growth period.

# 4 Feedback Effects: Reallocation of Capital

In this section we investigate whether our measures of information and fragility are linked to reallocation of capital within the economy. If these variables fluctuate as a result of information produced in the economy, then we conjecture that they are related to reallocation of capital. We characterize the productivity of the firms in our sample by their Tobin's $Q$.[9][10] Reallocation would correspond to disinvestment in low $Q$ firms and investment in high $Q$ firms. If this is occurring, then firms' $Q$-ratios should change; the dispersion of $Q$ should decline. However, in a financial crisis the banking system, by definition, is not functioning well. As a result, it may be hard for high productivity firms to get access to credit, which means that these firms may not benefit from their technological advantage.

## 4.1 Data Sources and Preliminary Univariate Results

Combining the WorldScope data on firms' equity book values with our market values we compute firms' $Q$'s. Tobin's $Q$ is computed as the ratio of $market\ capitalization + liabilities$ divided by the book value of $equity + liabilities$. We also compute two measures of the cross-sectional dispersion of $Q$-ratios at a country level.[11] The first $Q$-dispersion measure is is the difference between the 75th percentile and the 25th percentile divided by the median of the $Q$-ratio, and the second the standard deviation of the change in $Q$-ratios. The first captures cross-sectional dispersion and the second the speed of change in $Q$-ratios in the cross-section. Table 7 summarizes the data.

Table 7: **Summary statistics - country-level dispersion measures**. The table reports summary statistics for the standard deviation of changes in $Q$-ratios ($\sigma(\Delta Q\text{-}ratio)$), the standard deviation of $Q$-ratios ($\sigma(Q\text{-}ratio)$), and a of dispersion in $Q$-ratio in $Q$-ratios ($(Q75\% - Q25\%)/Q50\%$). The data are from Thomson/Reuters (WorldScope), and span a period from 1980 until 2010. "Count" label refers to country-years.

| | Count | Mean | StDev | Min | Max |
|---|---|---|---|---|---|
| $\sigma(\Delta Q\text{-ratio})$ | 710 | 1.05 | 0.74 | 0.02 | 2.99 |
| $\sigma(Q\text{-ratio})$ | 727 | 2.21 | 1.71 | 0.00 | 8.35 |
| $(Q75\% - Q25\%)/Q50\%$ | 727 | 1.02 | 0.32 | 0.00 | 2.52 |
| $Q\text{-}ratio$ | 727 | 0.55 | 1.32 | 0.00 | 22.46 |

Table 8 compares $Q$-ratios, and measures of reallocation *during* periods of no recession and recession periods, and no crisis and crisis periods. The $Q$-ratio is significantly lower during recessions as is the dispersion of $Q$'s, by all the measures. This is consistent with reallocation occurring during recessions compared to non-recession periods (growth and normal periods). In times of no-recession there is no production of

[9] With respect to productivity Dwyer (2001) merges plant-level fundamental data with firm-level financial variables found that firms that are more productive have higher Tobin's $Q$'s.

[10] We do not have plant level data or firm level employment for firms in all of the countries of our sample.

[11] Since our right-hand side variables are not at the firm level, we sort firms into quintiles based on their Tobin's $Q$'s.

information hence agents do not really know which firm is more efficient. Thus they end up allocating resources to all of them and as a result the spread of $Q$-ratios increases. In times of recessions with crises the so called "cleansing effect" leads to a lower dispersion of $Q$'s. Finally, in times of crises, agents do produce information, however the non-functioning financial system makes it hard for them to reallocate resources. Nevertheless, the dispersion of $Q$'s is lower than that of no-recessions indicating some reallocation taking place.

Table 8: **Difference in means values - country-level dispersion measures**. The table reports mean values for the standard deviation of changes in $Q$-ratios ($\sigma(\Delta Q\text{-}ratio)$), the standard deviation of $Q$-ratios ($\sigma(Q\text{-}ratio)$), a measure of dispersion in $Q$-ratios in $Q$-ratios ($(Q75\% - Q25\%)/Q50\%$) for instances of: (i) recessions vs. no-recessions, and (ii) recessions with crises vs. recessions with no crises. The third column reports the difference in means and the $t$-statistic of the difference. The data are from Thomson/Reuters (WorldScope), and span a period from 1980 until 2010.

(a) recessions vs. no recessions

| | No-Recession | Recession | Mean Diff. |
|---|---|---|---|
| $\sigma(\Delta Q\text{-ratio})$ | 1.107 | 0.946 | $0.161^{**}$ |
| | | | (2.82) |
| $\sigma(Q\text{-ratio})$ | 2.353 | 1.918 | $0.435^{***}$ |
| | | | (7.56) |
| $(Q75\% - Q25\%)/Q50\%$ | 1.040 | 1.009 | $0.030^{**}$ |
| | | | (2.80) |
| $Q\text{-}ratio$ | 1.996 | 1.580 | $0.416^{***}$ |
| | | | (4.22) |

$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

(b) recessions with crises vs. recessions with no crises

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\sigma(\Delta Q\text{-ratio})$ | 0.876 | 1.119 | $-0.244^{*}$ |
| | | | (-2.57) |
| $\sigma(Q\text{-ratio})$ | 1.791 | 2.243 | $-0.452^{***}$ |
| | | | (-4.68) |
| $(Q75\% - Q25\%)/Q50\%$ | 0.981 | 1.082 | $-0.100^{***}$ |
| | | | (-5.64) |
| $Q\text{-}ratio$ | 1.591 | 1.551 | 0.040 |
| | | | (0.24) |

$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

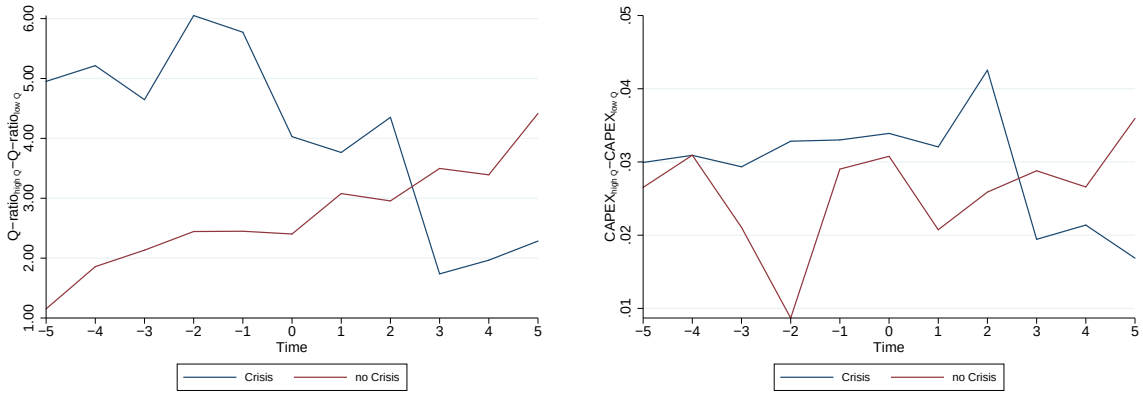
Turning to the no crisis versus crisis comparison, the change in $CAPEX$ and $R\&D$ divided by total assets is significantly negative, suggesting a disinvestment taking place during recessions with a crisis. Both of the aggregate dispersion measures show that dispersion is higher in recessions with crises compared to recessions without crises. This is consistent with the banking system functioning during recessions without crises, but not during crises. This finding also suggests that information production could potentially be correlated with the reallocation of capital among firms during periods of crises.

In Figure 3 we further investigate the relation between the cross-sectional dispersion of $Q$-ratio and $CAPEX$. The figure displays the spread (difference) of average $Q$-ratio and $CAPEX$ among firms in the fifth and first quintile for a period of ten years centered on the start of the crisis and no crisis events. The spread in $Q$-ratio drops significantly prior to the beginning of a financial crisis (Figure 3a), and as predicted by $Q$-theory the spread in $CAPEX$ drops in turn after the beginning of a crisis (Figure 3b). The observed

lag in the reallocation is in line with an improving financial system, which gradually becomes more able to facilitate the reallocation of resources across firms as crises end (note that crises last, on average, for three years), thus leading to a tightening of the spread in $CAPEX$ between the first and fifth quintile.

The observed behavior of the spread of $Q$-ratio and $CAPEX$ in Figure 3 provides a first justification of our proposed mechanism through which the production of information can have a feedback effect to investment. Information production prior to a crisis is reflected in the significant increase and subsequent decrease of the $Q$-ratio spread which is followed by a decrease in the $CAPEX$ spread. Our measure of information production is directly related to the valuation of firms in the stock market and the dispersion of such valuations. Thus, it becomes clear that this measure is directly linked to $Q$-ratio.

Figure 3: Figure (a) summarizes the difference in the level of $Q$-ratios in the first (low $Q$-ratio) and fifth (high $Q$-ratio) quintile for a period of 10 years around the beginning of a recession associated with a crisis and a recession without a crisis. Figure (b) summarizes the difference in the level of the average investment between firms.




(a) $Q\text{-}ratio_{Q5} - Q\text{-}ratio_{Q1}$

(b) $CAPEX_{Q5} - CAPEX_{Q1}$

Motivated by Figure 3, we examine the predictive power of the information measures on reallocation of capital within a country. Table 9 shows the results for two measures of reallocation. The first is measure of dispersion in $Q$-ratios $((Q75\% - Q25\%)/Q50\%)$ and the second is a the standard deviation of changes in $Q$-ratios $(\sigma(\Delta Q\text{-}ratio))$. Looking at the first measure (columns (5) and (6)) we observe a negative correlation between the change in our information measure $(CsAvg)$ and our measure of dispersion of $Q$'s, and a positive correlation between the change in aggregate fragility $(1/Vol)$ and our measure of dispersion of $Q$'s. In words, as the cross-section of average returns rises in the year before the crisis and in the two years before the crisis, the dispersion in $Q$ is expected to fall. That is, capital will be reallocated. The other measure $(\sigma(\Delta Q))$ is a measure of the speed of reallocation. With respect to the speed, during financial crises an increase in our information measure $(CsAvg)$ is associated with a decreasing future speed of reallocation, indicating that reallocation has already taken place and the economy is slowing down.

Table 9: **Information measures and measures of dispersion of $Q$-ratios**. The table summarizes the predictive power of $1/Vol$, $\Delta(1/Vol)$, cross-sectional averages ($CsAvg$), change in cross-sectional averages ($\Delta CsAvg$), their interaction with a dummy indicating a crisis, and macro-variables ($\Delta rGDP$, $\Delta Credit$, $\Delta TFP$, $\Delta LP$) on measures of $Q$-ratio dispersion ($(Q75\% - Q25\%)/Q50\%$ and $\sigma(\Delta Q\text{-}ratio)$). The regression specification is: $Dispersion_{n,t} = \alpha_n + \beta' X_{n,t-1} + \gamma' X_{n,t-1} \mathbb{1}(Crisis)_{n,t} + \delta Macro\ Variables_{n,t-1} + \epsilon_{n,t}$, where $X_{n,t-1} = (CsAvg_{n,t-2}, \Delta CsAvg_{n,t-1}, 1/Vol_{n,t-2}, \Delta(1/Vol)_{t-1})'$. Data are from WorldScope and span a period from 1980 until 2010. All specifications include country fixed effects. Robust *t-statistics* adjusted for country-level clustering are reported in parentheses.

| | (1) $(Q_{75}-Q_{25})/Q_{50}$ | (2) $(Q_{75}-Q_{25})/Q_{50}$ | (3) $\sigma(\Delta Q)$ | (4) $\sigma(\Delta Q)$ | (5) $(Q_{75}-Q_{25})/Q_{50}$ | (6) $(Q_{75}-Q_{25})/Q_{50}$ | (7) $\sigma(\Delta Q)$ | (8) $\sigma(\Delta Q)$ |
|---|---|---|---|---|---|---|---|---|
| $\Delta CsAvg_{t-1}$ | -0.110 | -0.429 | 0.787 | 0.046 | 0.285 | -0.317 | 2.016* | 0.704 |
| | (-0.40) | (-1.65) | (1.27) | (0.14) | (0.96) | (-1.22) | (2.61) | (1.38) |
| $\Delta(1/Vol)_{t-1}$ | -0.080*** | -0.011 | -0.114** | -0.099* | -0.092*** | -0.024 | -0.101* | -0.095* |
| | (-4.55) | (-0.42) | (-3.32) | (-2.20) | (-4.50) | (-0.83) | (-2.67) | (-2.13) |
| $CsAvg_{t-2}$ | -0.052 | -0.845* | 2.510* | 0.795 | 0.463 | -0.596+ | 4.092** | 1.734+ |
| | (-0.10) | (-2.17) | (2.38) | (1.04) | (0.92) | (-2.05) | (3.35) | (1.82) |
| $1/Vol_{t-2}$ | -0.090* | 0.027 | -0.143* | -0.110 | -0.086* | 0.026 | -0.131+ | -0.110 |
| | (-2.80) | (0.64) | (-2.37) | (-1.15) | (-2.67) | (0.62) | (-1.98) | (-1.14) |
| $\Delta rGDP_{t-1}$ | -0.117 | -0.245 | 5.777** | 3.054 | -0.109 | -0.396 | 5.793*** | 3.104+ |
| | (-0.12) | (-0.27) | (3.62) | (1.65) | (-0.12) | (-0.47) | (3.96) | (1.86) |
| $\Delta Credit_{t-1}$ | 0.001 | -0.002* | 0.005 | 0.001 | 0.001 | -0.002+ | 0.005 | 0.001 |
| | (0.52) | (-2.22) | (1.44) | (0.35) | (0.69) | (-1.92) | (1.42) | (0.41) |
| $\Delta TFP_{t-1}$ | 0.003* | 0.002* | -0.003 | -0.005+ | 0.003* | 0.003** | -0.003 | -0.005+ |
| | (2.50) | (2.75) | (-0.79) | (-1.87) | (2.68) | (3.17) | (-0.86) | (-1.87) |
| $\Delta LP_{t-1}$ | 0.003 | 0.039 | -0.076 | -0.025 | -0.025 | 0.032 | -0.150+ | -0.050 |
| | (0.07) | (0.83) | (-0.90) | (-0.33) | (-0.54) | (0.79) | (-1.88) | (-0.75) |
| $\Delta CsAvg_{t-1} \times \mathbb{1}_t(Crisis)$ | | | | | -0.925* | -0.226 | -2.740** | -1.198+ |
| | | | | | (-2.18) | (-0.49) | (-3.58) | (-2.01) |
| $\Delta(1/Vol)_{t-1} \times \mathbb{1}_t(Crisis)$ | | | | | 0.119* | 0.090* | 0.151* | 0.061 |
| | | | | | (2.60) | (2.67) | (2.42) | (0.96) |
| $CsAvg_{t-2} \times \mathbb{1}_t(Crisis)$ | | | | | -1.115+ | -0.558 | -3.829*** | -2.023* |
| | | | | | (-2.01) | (-1.16) | (-4.21) | (-2.75) |
| $1/Vol_{t-2} \times \mathbb{1}_t(Crisis)$ | | | | | 0.058* | 0.018 | 0.206** | 0.068 |
| | | | | | (2.17) | (0.87) | (3.65) | (1.47) |
| Constant | 1.327*** | 1.344*** | 1.142*** | 1.270*** | 1.267*** | 1.312*** | 0.950** | 1.244*** |
| | (10.19) | (7.89) | (4.15) | (4.18) | (9.71) | (7.96) | (2.98) | (3.87) |
| N | 414 | 414 | 414 | 414 | 414 | 414 | 414 | 414 |
| $R^2$ | 0.36 | 0.67 | 0.66 | 0.81 | 0.38 | 0.68 | 0.68 | 0.81 |
| Cluster (Country) | YES | YES | YES | YES | YES | YES | YES | YES |
| FE (Time) | NO | YES | NO | YES | NO | YES | NO | YES |
| FE (Country) | YES | YES | YES | YES | YES | YES | YES | YES |

t-statistics in parentheses
$^+$ $p < 0.10$, $^*$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

# 5 A Global Information Factor

Are there information spillovers across countries? To address this question we extract principal components of the information and fragility measures respectively for a number of advanced countries in our panel: Australia, Belgium, Denmark, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Sweden, the United Kingdom, and the United States.[12] We will examine whether the first and second principal components of the information and fragility measure predict economic episodes and reallocation of resources for the countries of our sample.

We first examine the power of the first two principal components to predict the occurrence of recessions on a country-by-country basis. The results are summarized in Figure 4. The regression coefficients are plotted for each information measure's first two principal components. The coefficients' F-statistics and their p-values are also plotted. The second principal component of $CsVol$ seems to have some predictive power at the 95% level of statistical significance. The results are in line with column (1) of Table 6 and confirm that our information measures do not predict the occurrence of recessions.

Figure 5 shows the results for predicting the occurrence of recessions with crises. Here the results are dramatically different. The principal components of the information measures are generally successful in predicting recessions with crises. The coefficient of the first principal component is positive whereas that of the second is negative.[13] This indicates information spillovers from developed countries to emerging market economies, and reveals a more interconnected global economy. This finding is broadly in line with column (2) of Table 6 suggesting that information measures have predictive power over recessions with crises.

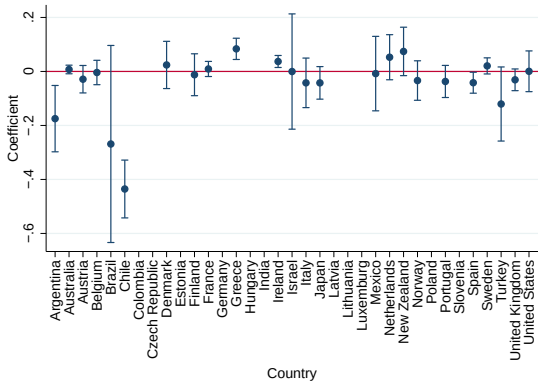
Next we revisit the issue of reallocation, this time using the principal components. The results are shown in Figure 6. As before the significance is mostly with the low quintiles. If we focus on the coefficient of the second principal component of the information measure we observe that during a crisis, the fraction of firms in quintile 1 tends decrease, and that of firms in quintiles 2 and 3 to increase.[14] However, the coefficient is statistically significant only for column (1). The coefficients of the information measures are similar to those reported in Table 26, however their predictive power is significantly smaller.

[12] We extract the principal components using the information and fragility measures for countries for which we have a complete time series from 1980 until 2010.

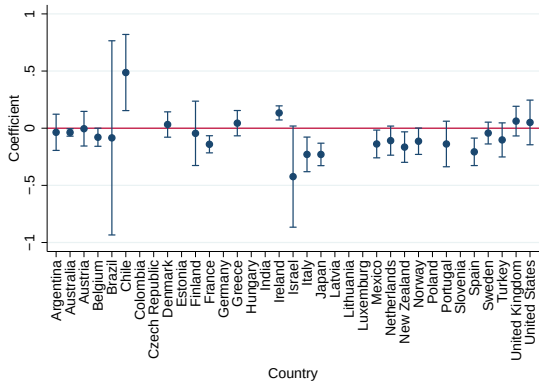
[13] Since we employ principal components as explanatory variables, it is hard to accurately identify their nature and the fundamental information that they summarize.

[14] The effect of the coefficient in column (1) is negative since the values of the second principal component for the information measure are negative.

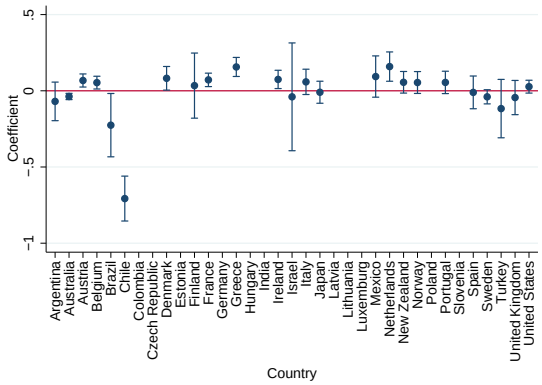
Figure 4: **Global information measures and recessions**. The figure summarizes the predictive power of global information measures ($PC1$ $1/Vol$,$PC2$ $1/Vol$,$PC1$ $CsAvg$,$PC2$ $CsAvg$) on the occurrence of recessions. Figures (a) through (d) summarize the regression coefficients along with a 95% confidence interval for the first two principal components of $1/Vol$ and $CsAvg$. Figures (e) and (f) report the *F-statistic* its *p-value* respectively. The regression specification is: $\mathbb{1}_t(Recession) = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_t = (PC1(1/Vol_t), PC2(1/Vol_t), PC1(CsAvg_t), PC2(CsAvg_t), \Delta rGDP_t, \Delta Credit_t, \Delta TFP_t, \Delta LP_t)'$. Standard errors are heteroskedasticity- (White (1980)) and autocorrelation-robust (Newey and West (1987) and Newey and West (1994)).



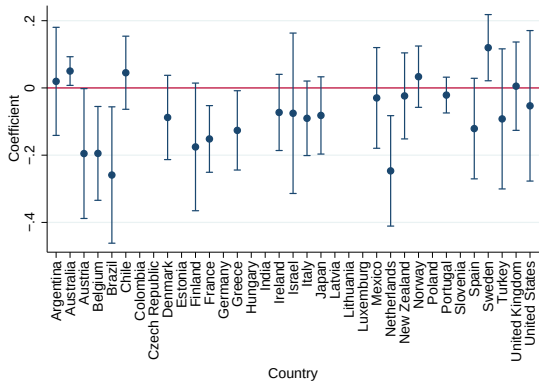

(a) $PC1$ $1/Volatility$



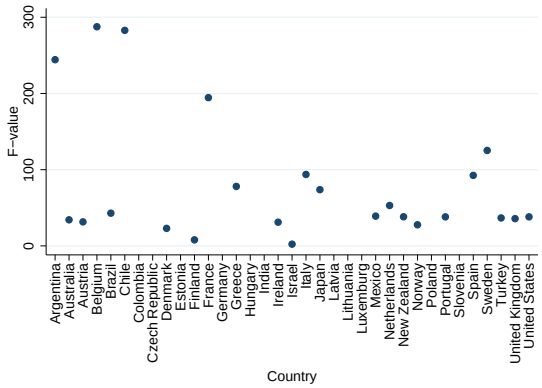

(b) $PC2$ $1/Volatility$



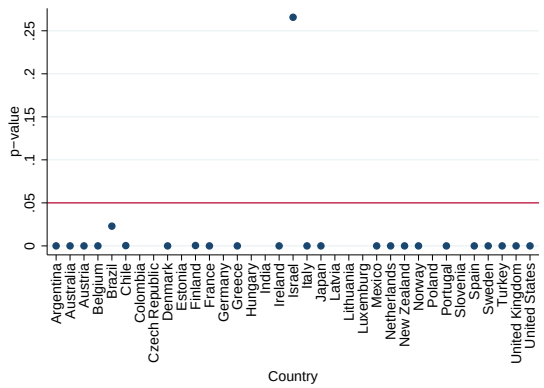

(c) $PC1$ *Cross-Sectional Volatility*




(d) $PC2$ *Cross-Sectional Volatility*

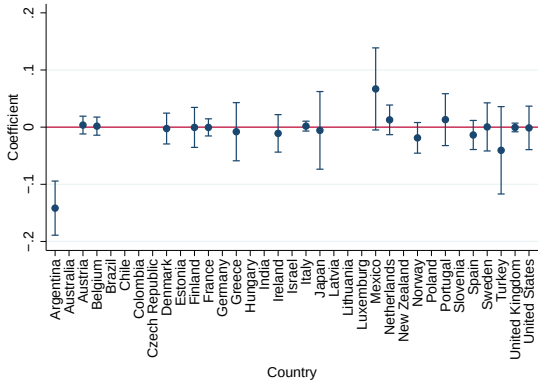



(e) *F-statistic*

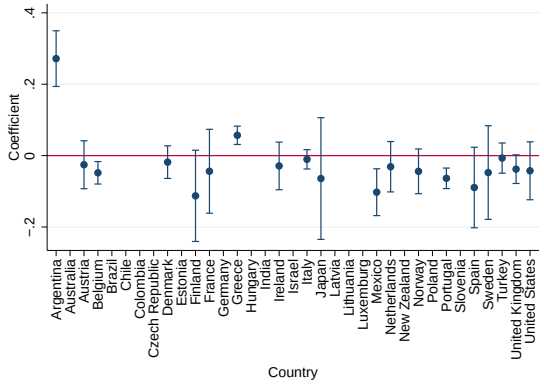



(f) *p-value*

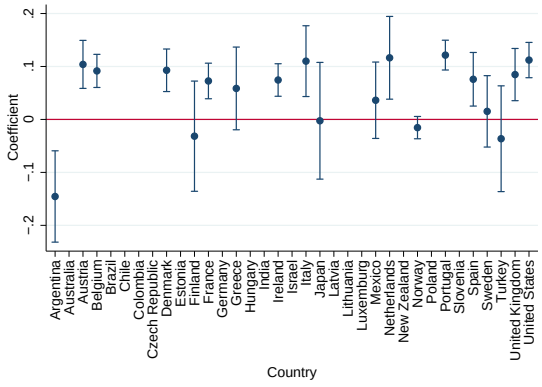
Figure 5: **Global information measures and recessions with crises**. The figure summarizes the predictive power of global information measures ($PC1$ $1/Vol$,$PC2$ $1/Vol$,$PC1$ $CsAvg$,$PC2$ $CsAvg$) on the occurrence of recessions with crises. Figures (a) through (d) summarize the regression coefficients along with a 95% confidence interval for the first two principal components of $1/Vol$ and $CsAvg$. Figures (e) and (f) report the *F-statistic* its *p-value* respectively. The regression specification is: $\mathbb{1}_t(Recession \cap Crisis) = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_t = (PC1(1/Vol_t), PC2(1/Vol_t), PC1(CsAvg_t), PC2(CsAvg_t), \Delta rGDP_t, \Delta Credit_t, \Delta TFP_t, \Delta LP_t)'$. Standard errors are heteroskedasticity- (White (1980)) and autocorrelation-robust (Newey and West (1987) and Newey and West (1994)).



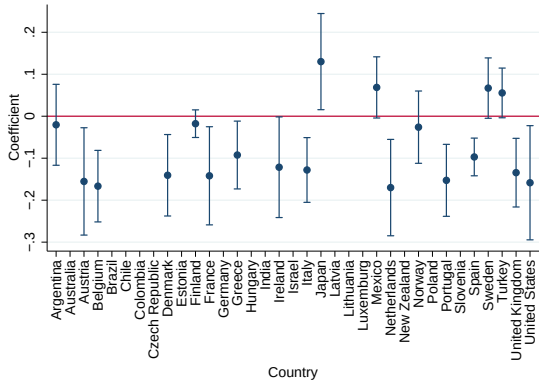

(a) $PC1$ $1/Volatility$



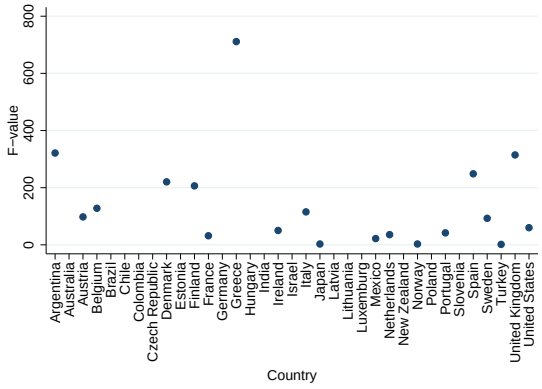

(b) $PC2$ $1/Volatility$



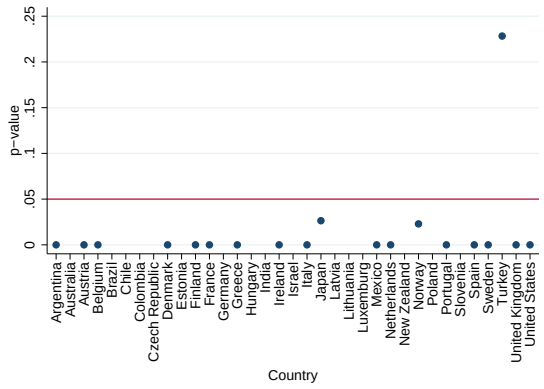

(c) $PC1$ *Cross-Sectional Volatility*




(d) $PC2$ *Cross-Sectional Volatility*

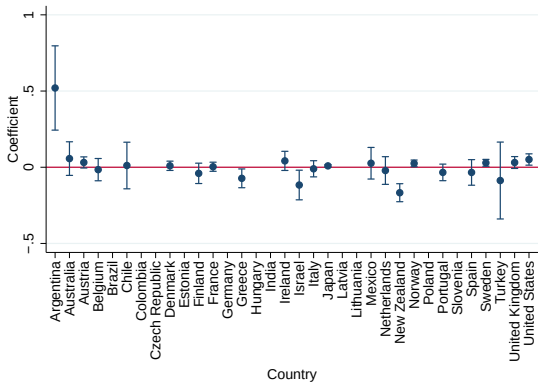



(e) *F-statistic*

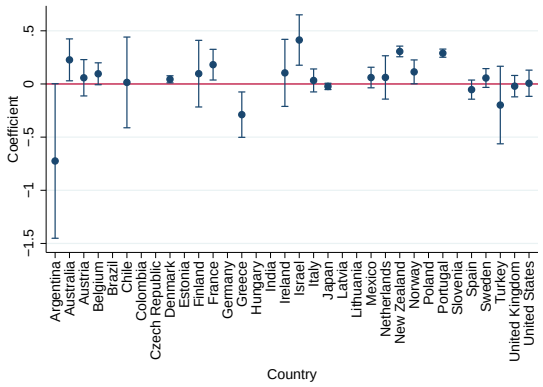



(f) *p-value*

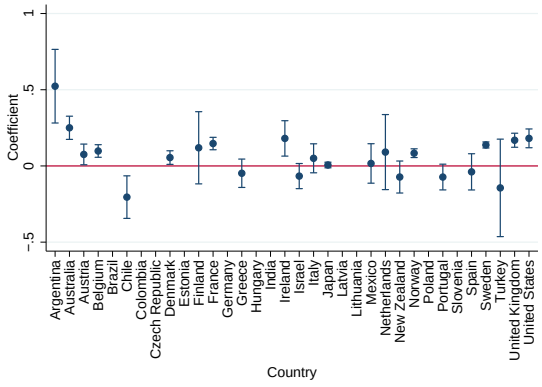
Figure 6: **Global information measures and reallocation within country**. The figure summarizes the predictive power of global information measures ($PC1$ $1/Vol$,$PC2$ $1/Vol$,$PC1$ $CsAvg$,$PC2$ $CsAvg$) on the standard deviation of changes in $Q$-ratios ($\sigma(\Delta Q\text{-}ratio)$) at a country level. Figures (a) through (d) summarize regression coefficients along with a 95% confidence interval for the first two principal components of $1/Vol$ and $CsAvg$. Figures (e) and (f) report the *F-statistic* its *p-value* respectively. The regression specification is: $\sigma(\Delta Q)_t = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_t = (PC1(1/Vol_t), PC2(1/Vol_t), PC1(CsAvg_t), PC2(CsAvg_t), \Delta rGDP_t, \Delta Credit_t, \Delta TFP_t, \Delta LP_t)'$. Standard errors are heteroskedasticity- (White (1980)) and autocorrelation-robust (Newey and West (1987) and Newey and West (1994)).



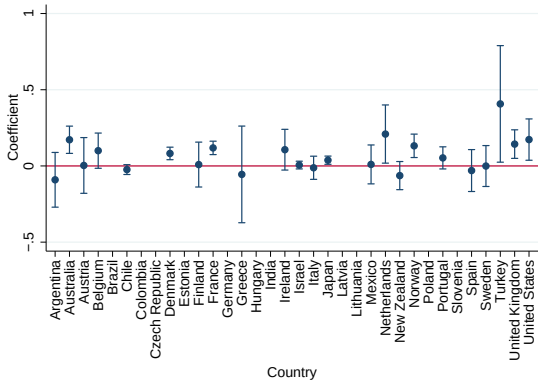

(a) $PC1$ $1/Volatility$



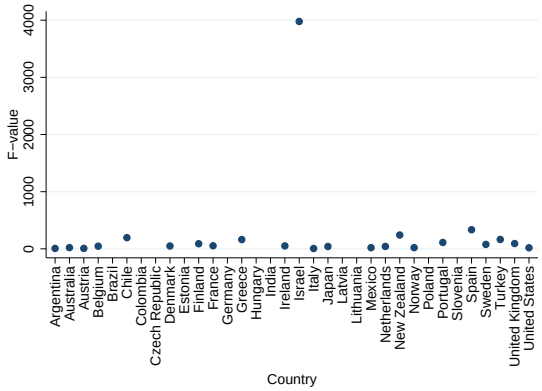

(b) $PC2$ $1/Volatility$



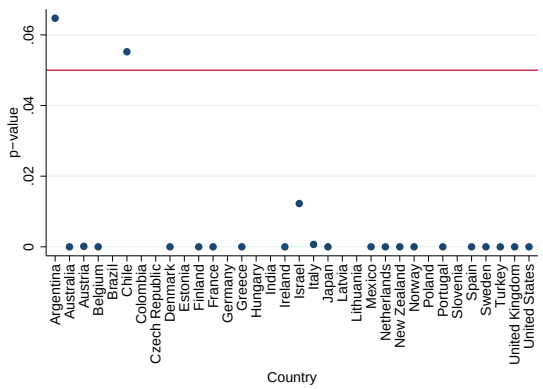

(c) $PC1$ *Cross-Sectional Averages*




(d) $PC2$ *Cross-Sectional Averages*




(e) *F-statistic*




(f) *p-value*

# 6 Feedback Effects: Global Reallocation of Capital

## 6.1 Measures of Global Imbalances

In addition to domestic phases of macroeconomic volatility and domestic measures of information acquisition, in what follows we examine the currency composition (domestic versus foreign) of assets and liabilities and ask whether and how the currency composition changes in response to the changing information produced in advanced countries. The various assets and liabilities in a country are categorized by currency (domestic, or foreign) on the basis of the place of security issuance. For example, an asset in country A owned by nation B is classified as a foreign asset on the national balance sheet of country B; and a liability issued by country A and owned by a nation overseas is classified as a foreign liability. We standardize all measures by GDP levels, where the standardization is based on the GDP denominator in the same currency as the numerator.[15] Global imbalances are defined as the difference between assets and liabilities denominated in the same currency. We use the following measures: $GI(DOM)$ for imbalances in domestic currency; $GI(FOR)$ for global imbalances denominated in foreign currencies; $GI(USD)$ for imbalances in U.S. dollars; $GI(EUR)$ for imbalances in Euros; and $GI(TOT)$ for total which is the sum of global imbalances issued in domestic and foreign currency. For additional details see Bénétrix et al. (2015).[16]

Table 10: **Summary statistics - global imbalances (Annual)**. The table reports summary statistics for domestic ($GI(DOM)$), foreign ($GI(FOR)$), and total ($GI(TOT)$) global imbalances. Global imbalances are defined as the difference between assets and liabilities denominated in the same currency (domestic or foreign). All measures are standardized by GDP levels, where the standardization is based on the GDP denominator in the same currency as the numerator. The data are from Bénétrix et al. (2015) and span a period from 1990 until 2010.

| | Count | Mean | StDev | Min | Max |
|---|---|---|---|---|---|
| $GI(DOM)$ | 592 | -45.502 | 43.823 | -516.487 | 54.671 |
| $GI(FOR)$ | 592 | 21.176 | 43.678 | -43.876 | 415.291 |
| $GI(TOT)$ | 592 | -24.326 | 34.626 | -165.921 | 90.702 |

## 6.2 Information and the Macroeconomy

We now turn to the first set of results which concerns how information fluctuates over time in a country in relation to macroeconomic fluctuations. We do this though an univariate comparisons of variables prior to the different types of aggregate economic events (recession with crisis, recession with no crisis, growth, and normal). Table 11a shows a univariate comparison of key variables *four quarters prior* to the beginning of a recession with crisis episode versus the beginning of a recession with no crisis episode. Leading up to a

[15] This method guarantees that results cannot be due to currency fluctuation effects.

[16] The dataset can be found on Philip Lane's website `http://www.philiplane.org/BLSJIE2015data.htm`.

recession with crisis, growth in real GDP ($\Delta rGDP$) is lower and our recession measure ($\alpha$) of the minimum difference of real GDP levels over a four-year period from the real GDP level at the beginning of the period is negative. Prior to recessions with crises, we observe a higher level of fragility ($1/Vol$ is smaller). The significant difference in fragility is natural. As an economy heads towards a crisis, the distance-to-default of the average firm decreases. Leading up to a recession with a crisis, $CsAvg$ and $CsVol$, i.e., the standard deviation of average returns and the standard deviation of firm level volatility, are both significantly higher. This is an indication of a higher dispersion of volatility and returns among companies, which we interpret as an increase in the information produced by agents in the economy in an attempt to distinguish between possible surviving firms and possible failures. Domestic and foreign global imbalances, which capture the difference between assets and liabilities issued by domestic and foreign investors respectively, exhibit the opposite pattern between instances of recessions with crises versus recessions without crises. Domestic global imbalances are lower and foreign global imbalances are higher prior to recessions with crises episodes.

Table 11: **Difference in mean values (all economies)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$, $GI(DOM)$, $GI(FOR)$, and $GI(TOT)$ 4 quarters prior to the event for (i) recessions vs. no-recessions and (ii) recessions vs. growth. The third column reports the difference in means and the $t$-statistic of the difference. The data are annual and span a period from 1990 until 2010.

(a) crisis vs. no crisis

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.032 | -0.005 | $0.037^{***}$ |
| | | | (6.72) |
| $\alpha$ | 0.004 | -0.035 | $0.039^{***}$ |
| | | | (14.92) |
| $1/Vol$ | 3.294 | 2.424 | $0.870^{***}$ |
| | | | (7.20) |
| $CsVol$ | 0.431 | 0.690 | $-0.258^{***}$ |
| | | | (-5.73) |
| $CsAvg$ | 0.121 | 0.181 | $-0.060^{***}$ |
| | | | (-6.22) |
| $\Delta(1/Vol)$ | 0.033 | -0.298 | $0.331^{**}$ |
| | | | (3.09) |
| $\Delta CsVol$ | 0.001 | 0.117 | $-0.116^{**}$ |
| | | | (-2.69) |
| $\Delta CsAvg$ | -0 | 0.026 | $-0.027^{**}$ |
| | | | (-2.79) |
| $GI(DOM)$ | -40.901 | -60.590 | $19.689^{***}$ |
| | | | (4.15) |
| $GI(FOR)$ | 18.118 | 29.307 | $-11.189^{*}$ |
| | | | (-2.26) |
| $GI(TOT)$ | -22.782 | -31.282 | $8.500^{*}$ |
| | | | (2.05) |
| N | 109 | 27 | 82 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

(b) recessions vs. growth

| | Recession | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.026 | 0.041 | $-0.015^{***}$ |
| | | | (-3.66) |
| $\alpha$ | -0.002 | 0.008 | $-0.011^{***}$ |
| | | | (-5.16) |
| $1/Vol$ | 3.219 | 3.186 | 0.033 |
| | | | (0.38) |
| $CsVol$ | 0.458 | 0.447 | 0.010 |
| | | | (0.32) |
| $CsAvg$ | 0.126 | 0.130 | -0.005 |
| | | | (-0.67) |
| $\Delta(1/Vol)$ | -0.041 | 0.148 | $-0.189^{*}$ |
| | | | (-2.45) |
| $\Delta CsVol$ | 0.016 | -0.003 | 0.020 |
| | | | (0.63) |
| $\Delta CsAvg$ | 0.003 | -0.002 | 0.005 |
| | | | (0.75) |
| $GI(DOM)$ | -43.165 | -44.899 | 1.734 |
| | | | (0.44) |
| $GI(FOR)$ | 20.794 | 15.479 | 5.315 |
| | | | (1.30) |
| $GI(TOT)$ | -22.371 | -29.420 | $7.049^{*}$ |
| | | | (2.07) |
| N | 122 | 129 | -7 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 11b reports the results of a univariate comparison of the same variables four quarters prior to the beginning of a recession versus prior to the beginning of a growth period. The only variable which is statistically different between the two events is $CsAvg$ with a higher value prior to a growth episode. This suggests that the short lived (average duration of 1.55 years) growth stage is associated with more production of information.

Table 11 shows that information measures have predictive content at a domestic level. Figure 2 illustrates that finding. It shows plots of the two information measures averaged over recessions with a crisis and recessions without a crisis, starting *15 quarters before* the start of the average recession with a crisis and the average recession without a crisis. It is apparent that these measures of information and fragility vary depending on whether the coming recession will involve a financial crisis or not. We observe that fragility is higher and more information is produced prior to the beginning of a recession with a crisis episode.[17] We discuss the global imbalances measures below when we separate advanced and developing economies.

Table 12: **Difference in mean values (all economies)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$, $GI(DOM)$, $GI(FOR)$, and $GI(TOT)$ for (i) recessions vs. no-recessions and (ii) recessions vs. growth. The third column reports the difference in means and the $t$-statistic of the difference. The data are annual and span a period from 1990 until 2010.

(a) crisis vs. no crisis

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.013 | -0.005 | $0.018^{***}$ |
| | | | (3.94) |
| $\alpha$ | -0.011 | -0.047 | $0.036^{***}$ |
| | | | (8.43) |
| $1/Vol$ | 3.191 | 2.424 | $0.767^{***}$ |
| | | | (6.35) |
| $CsVol$ | 0.378 | 0.690 | $-0.312^{***}$ |
| | | | (-6.23) |
| $CsAvg$ | 0.110 | 0.181 | $-0.071^{***}$ |
| | | | (-6.71) |
| $\Delta(1/Vol)$ | 0.053 | 0.046 | 0.007 |
| | | | (0.06) |
| $\Delta CsVol$ | 0.013 | 0.053 | -0.040 |
| | | | (-0.80) |
| $\Delta CsAvg$ | 0.002 | 0.012 | -0.009 |
| | | | (-0.83) |
| $GI(DOM)$ | -34.882 | -67.066 | $32.185^{***}$ |
| | | | (4.21) |
| $GI(FOR)$ | 14.191 | 34.120 | $-19.929^{**}$ |
| | | | (-2.77) |
| $GI(TOT)$ | -20.690 | -32.946 | $12.256^{*}$ |
| | | | (2.22) |
| N | 256 | 80 | 176 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

(b) recessions vs. growth

| | Recession | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.007 | 0.049 | $-0.042^{***}$ |
| | | | (-11.03) |
| $\alpha$ | -0.021 | 0.017 | $-0.039^{***}$ |
| | | | (-14.77) |
| $1/Vol$ | 3 | 3.186 | $-0.186^{+}$ |
| | | | (-1.94) |
| $CsVol$ | 0.457 | 0.447 | 0.010 |
| | | | (0.27) |
| $CsAvg$ | 0.128 | 0.130 | -0.003 |
| | | | (-0.33) |
| $\Delta(1/Vol)$ | 0.037 | 0.011 | 0.027 |
| | | | (0.29) |
| $\Delta CsVol$ | 0.034 | -0.027 | 0.061 |
| | | | (1.58) |
| $\Delta CsAvg$ | 0.007 | -0.007 | $0.015^{+}$ |
| | | | (1.72) |
| $GI(DOM)$ | -46.824 | -45.750 | -1.074 |
| | | | (-0.20) |
| $GI(FOR)$ | 21.918 | 14.710 | 7.207 |
| | | | (1.37) |
| $GI(TOT)$ | -24.906 | -31.040 | 6.133 |
| | | | (1.48) |
| N | 320 | 199 | 121 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 12a compares our information measures and global imbalances measures *during* recessions associated with crises with recessions associated with no crises.[18] The levels of all of the information variables are significantly different. Recessions with a crisis are significantly deeper in terms of the level of the real GDP decline. Fragility is significantly higher ($1/Vol$ is smaller) as are both $CsAvg$ and $CsVol$, i.e., the standard deviation of returns and the standard deviation of volatility. These two measures are higher, implying a higher dispersion of volatility and returns among companies. None of the other information related measures are significantly different. Table 12b shows that in terms of information production during the economic event, recession periods are not different from growth periods.

[17] Recall that the economy is more fragile when $Vol$ increases, and so $1/Vol$ decreases.

[18] "Global imbalances" refers to the difference between financial assets and liabilities standardized by the level of GDP of each country.

We also explore any potential differences in global imbalances between recessions with crises and recessions with no crises. Table 12a shows that in recessions with crises, compared to recessions with no crises, there is a significant *decrease* in the domestic currency denominated component of the imbalance and a significant *increase* in the foreign denominated component of the imbalance. This hints at a possible reallocation of resources taking place among economies at a global scale during financial crises. In Section 6.4 we further explore the implications of information production on global imbalances. We now turn to looking at these univariate comparisons separately for developed and emerging economies.

Tables 13 and 14 display univariate results for advanced and developing economies respectively. These tables show that in recessions without crises, global imbalances of foreign issued assets and liabilities ($GI(FOR)$) are positive for both advanced and developing economies suggesting a lower level of foreign issued liabilities compared to that of foreign assets held by domestic investors. The positive foreign global imbalances are counterbalanced by negative imbalances of domestically held assets and issued liabilities ($GI(DOM)$) for both advanced and developing economies. However, in recessions with crises, the behavior of foreign global imbalances differs between advanced and developing economies. $GI(FOR)$ increases for advanced economies and decreases for developing economies reflecting shrinking foreign denominated liabilities. These results suggest a reallocation of investment with the exit of foreign assets. The reallocation takes the form of capital outflows from developing economies, which means capital inflows to advanced economies.

Table 13: **Difference in mean values (advanced economies)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$, $GI(DOM)$, $GI(FOR)$, and $GI(TOT)$ for (i) recessions vs. no-recessions and (ii) recessions vs. growth. The third column reports the difference in means and the $t$-statistic of the difference. The data are annual and span a period from 1990 until 2010.

(a) crisis vs. no crisis

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.013 | -0.007 | $0.020^{***}$ |
| | | | (4.79) |
| $\alpha$ | -0.007 | -0.037 | $0.030^{***}$ |
| | | | (9.61) |
| $1/Vol$ | 3.353 | 2.420 | $0.933^{***}$ |
| | | | (7.29) |
| $CsVol$ | 0.361 | 0.708 | $-0.346^{***}$ |
| | | | (-6.59) |
| $CsAvg$ | 0.103 | 0.181 | $-0.078^{***}$ |
| | | | (-6.93) |
| $\Delta(1/Vol)$ | 0.032 | 0.056 | -0.023 |
| | | | (-0.17) |
| $\Delta CsVol$ | 0.018 | 0.058 | -0.040 |
| | | | (-0.86) |
| $\Delta CsAvg$ | 0.004 | 0.014 | -0.010 |
| | | | (-0.92) |
| $GI(DOM)$ | -34.033 | -70.554 | $36.520^{***}$ |
| | | | (3.66) |
| $GI(FOR)$ | 20.672 | 45.458 | $-24.786^{**}$ |
| | | | (-2.72) |
| $GI(TOT)$ | -13.361 | -25.096 | $11.735^{+}$ |
| | | | (1.76) |
| N | 211 | 62 | 149 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

(b) recessions vs. growth

| | Recession | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.007 | 0.042 | $-0.035^{***}$ |
| | | | (-8.20) |
| $\alpha$ | -0.015 | 0.016 | $-0.031^{***}$ |
| | | | (-14.16) |
| $1/Vol$ | 3.112 | 3.323 | $-0.211^{+}$ |
| | | | (-1.82) |
| $CsVol$ | 0.454 | 0.381 | $0.073^{+}$ |
| | | | (1.77) |
| $CsAvg$ | 0.123 | 0.112 | 0.011 |
| | | | (1.20) |
| $\Delta(1/Vol)$ | 0.032 | -0.033 | 0.065 |
| | | | (0.57) |
| $\Delta CsVol$ | 0.033 | -0.014 | 0.047 |
| | | | (1.35) |
| $\Delta CsAvg$ | 0.008 | -0.005 | 0.012 |
| | | | (1.53) |
| $GI(DOM)$ | -47.995 | -57.938 | 9.943 |
| | | | (1.14) |
| $GI(FOR)$ | 30.085 | 33.899 | -3.814 |
| | | | (-0.47) |
| $GI(TOT)$ | -17.910 | -24.039 | 6.129 |
| | | | (1.00) |
| N | 262 | 130 | 132 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 14: **Difference in mean values (developing economies)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$, $GI(DOM)$, $GI(FOR)$, and $GI(TOT)$ for (i) recessions vs. no-recessions and (ii) recessions vs. growth. The third column reports the difference in means and the $t$-statistic of the difference. The data are annual and span a period from 1990 until 2010.

(a) crisis vs. no crisis

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.013 | 0.007 | 0.006 |
| | | | (0.31) |
| $\alpha$ | -0.028 | -0.079 | 0.051** |
| | | | (3.20) |
| $1/Vol$ | 2.484 | 2.441 | 0.043 |
| | | | (0.17) |
| $CsVol$ | 0.451 | 0.611 | -0.161 |
| | | | (-1.15) |
| $CsAvg$ | 0.142 | 0.184 | -0.042 |
| | | | (-1.51) |
| $\Delta(1/Vol)$ | 0.144 | -0.004 | 0.148 |
| | | | (0.43) |
| $\Delta CsVol$ | -0.009 | 0.029 | -0.038 |
| | | | (-0.20) |
| $\Delta CsAvg$ | -0.003 | 0.002 | -0.005 |
| | | | (-0.13) |
| $GI(DOM)$ | -36.861 | -55.830 | 18.968* |
| | | | (2.20) |
| $GI(FOR)$ | -0.931 | -2.413 | 1.482 |
| | | | (0.21) |
| $GI(TOT)$ | -37.793 | -58.243 | 20.450** |
| | | | (2.83) |
| N | 45 | 18 | 27 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

(b) recessions vs. growth

| | Recession | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.007 | 0.064 | -0.057*** |
| | | | (-6.95) |
| $\alpha$ | -0.048 | 0.020 | -0.068*** |
| | | | (-9.22) |
| $1/Vol$ | 2.485 | 2.950 | -0.466** |
| | | | (-2.76) |
| $CsVol$ | 0.475 | 0.562 | -0.087 |
| | | | (-1.00) |
| $CsAvg$ | 0.149 | 0.162 | -0.013 |
| | | | (-0.71) |
| $\Delta(1/Vol)$ | 0.063 | 0.086 | -0.024 |
| | | | (-0.15) |
| $\Delta CsVol$ | 0.037 | -0.049 | 0.087 |
| | | | (0.75) |
| $\Delta CsAvg$ | 0.006 | -0.012 | 0.018 |
| | | | (0.72) |
| $GI(DOM)$ | -43.568 | -34.799 | -8.769* |
| | | | (-1.99) |
| $GI(FOR)$ | -0.802 | -2.531 | 1.729 |
| | | | (0.44) |
| $GI(TOT)$ | -44.370 | -37.330 | -7.040 |
| | | | (-1.59) |
| N | 58 | 69 | -11 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

## 6.3 Global Information and Global Imbalances

In the previous section we provided evidence in favor of information spillovers. Information produced by a set of advanced countries predicts recessions with crises in other advanced and developing economies. In this section we explore an additional aspect of information spillovers, and its possible source: information produced by a set of countries predict global imbalances (domestic and foreign). Empirically, at a country level we regress series of global imbalances on the first and second principal component of our information measures ($1/Vol$ and $CsVol$).

Figures 7 and 8 summarize the individual country regression coefficients and a 95% confidence interval for the estimated values. Figure 7 looks at global imbalances denominated in foreign currency. The coefficients on both principal components of the distance to insolvency measure, even though statistically significant for a number of countries, are somewhat noisy overall. However, the coefficients on the first principal component of the information measure are consistently negative across the countries of our sample, while the coefficients on the second principal component are positive only for a subset of countries. Figure 8 looks at global imbalances measured in foreign currency. Here the results are reversed. Most coefficients on the first principal component of the information measure are positive, while those on the second principal component are negative. This finding is consistent with the opposite signs we document in Table 15.

The results in Figures 7 and 8 provide additional evidence in favor of information spillovers. Global information measures predict instances of recessions with crises and also are correlated with domestic and foreign imbalances which means that they explain the reallocation of resources among economies. This finding strengthens our interpretation of our information measures as indeed informative.

### 6.4 Reallocation of capital across countries.

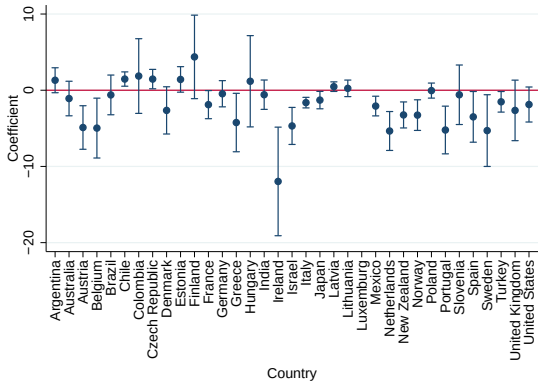
Do measures of information have any predictive power over global imbalances (domestic and foreign)? We primarily focus on three measures of global imbalances: (i) imbalances denominated in home currency, (ii) imbalances denominated in foreign currency, and (iii) total imbalances. Changes in global imbalances reflect a reallocation of capital among countries. There is a large literature on global imbalances, a summary of which would be outside the scope of this paper (see, e.g. Gourinchas and Rey (2013)).

Table 15 shows regression results of the contemporaneous association and the effects of lagged information values ($1/Vol$, $CsVol$), as well as lagged credit-to-private sector as a percentage of GDP ($Credit$), total factor productivity ($TFP$), and labor productivity ($LP$) separately on a number of global imbalance measures, i.e., in domestic currency ($GI(DOM)$), foreign currency ($GI(FOR)$), U.S. dollars ($GI(USD)$), Euros ($GI(EUR)$) and total ($GI(TOT)$). Contemporaneous and lagged $CsVol$ are positively related to the domestic and negatively related to the foreign global imbalance measure. This means that an increase in information production is associated with a larger level of domestic assets compared to domestic liabilities, and with a lower level of foreign assets compared to foreign liabilities.

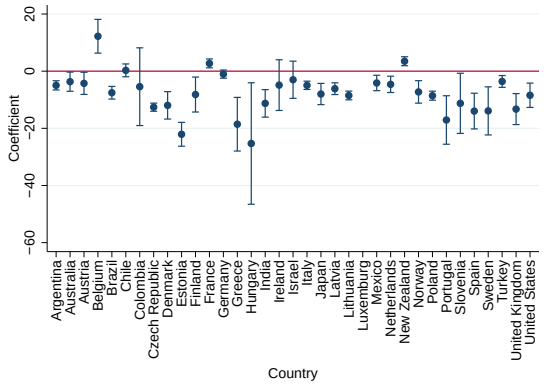
This finding is consistent with our conjecture that a higher level of information produced in the economy leads to a reallocation of resources among countries, and towards countries where information has been produced. More information is associated with a higher level of domestic assets which are funded with foreign liabilities. The sum of the first two columns of Table 15 yields the coefficients for the total global imbalances for each country in the sample. Finally, we observe that the economy-wide solvency measure ($Vol$) as well as a number of macroeconomic variables (Credit, TFP, and LP) do not correlate with global imbalances.

Motivated by this predictive power of the information measures on global imbalances, we address the question of whether lagged measures of global imbalances ($GI(DOM)$ and $GI(FOR)$, respectively) have any predictive power with respect to the occurrence of financial crises. Table 16 summarizes the results of a logit regression of the probability of a recession with a crisis on the global imbalances measures. We observe that a decrease in foreign global imbalances is associated with an increase in the probability of a recession with a crisis. More specifically, when the difference between foreign assets and liabilities decreases, recessions with

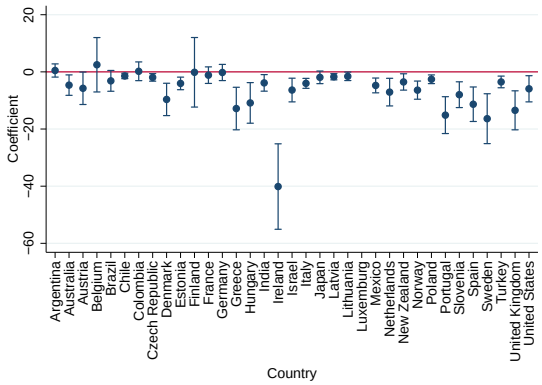
Figure 7: **Global information measures and global imbalances (domestic)**. Figures (a) through (d) summarize the predictive power of the first two principal components of $1/Vol$ and $CsAvg$ on global imbalances denominated in domestic currency. Figures (e) and (f) report the *F-statistic* its *p-value* respectively. All regressions are performed at the country level. Standard errors are heteroskedasticity- (White (1980)) and autocorrelation-robust (Newey and West (1987) and Newey and West (1994)). The regression specification is: $GI(DOM)_t = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_{t-1} = (PC1(1/Vol_{t-1}), PC2(1/Vol_{t-1}), PC1(CsAvg_{t-1}), PC2(CsAvg_{t-1}))'$



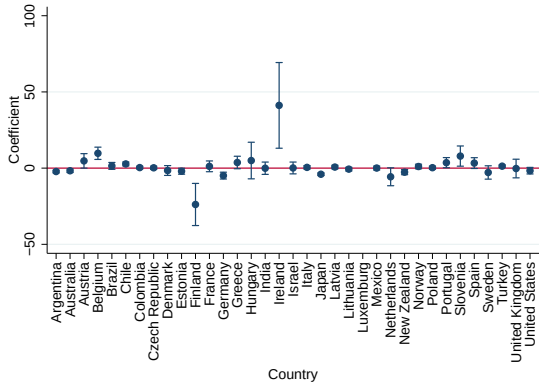

(a) $PC1$ $1/Volatility$



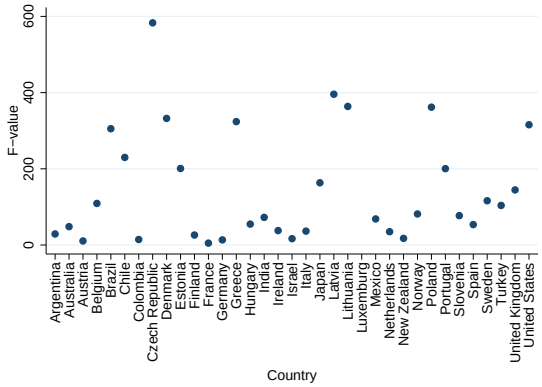

(b) $PC2$ $1/Volatility$



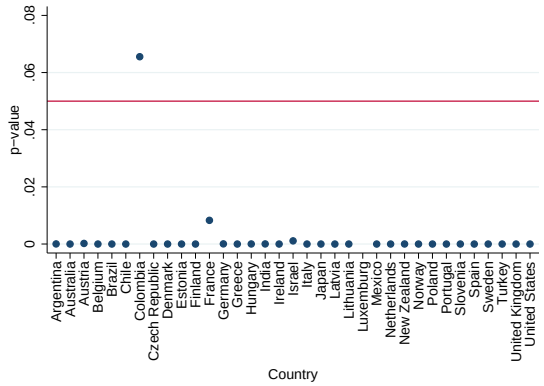

(c) $PC1$ *Cross-Sectional Volatility*




(d) $PC2$ *Cross-Sectional Volatility*

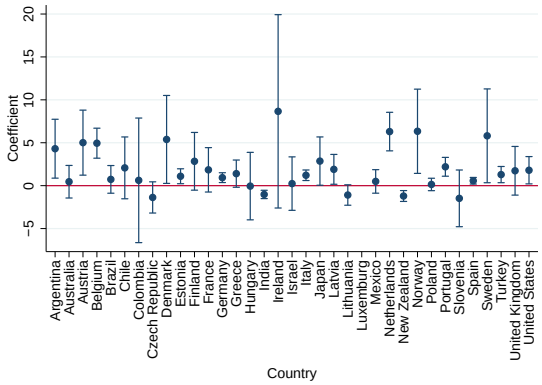



(e) *F-statistic*

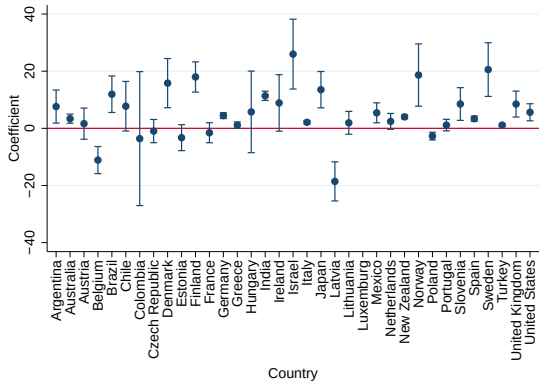



(f) *p-value*

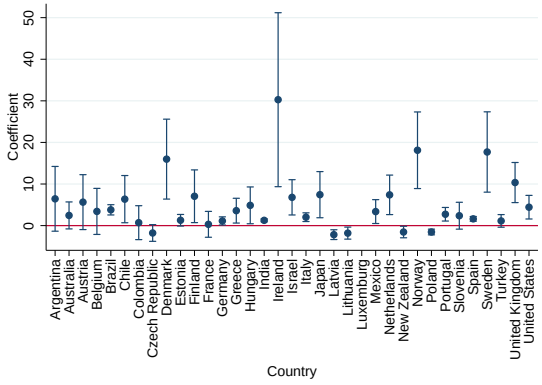
Figure 8: **Global information measures and global imbalances (foreign)**. Figures (a) through (d) summarize the predictive power of the first two principal components of $1/Vol$ and $CsAvg$ on global imbalances denominated in foreign currency. Figures (e) and (f) report the *F-statistic* its *p-value* respectively. All regressions are performed at the country level. Standard errors are heteroskedasticity- (White (1980)) and autocorrelation-robust (Newey and West (1987) and Newey and West (1994)). The regression specification is: $GI(FOR)_t = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_{t-1} = (PC1(1/Vol_{t-1}), PC2(1/Vol_{t-1}), PC1(CsAvg_{t-1}), PC2(CsAvg_{t-1}))'$



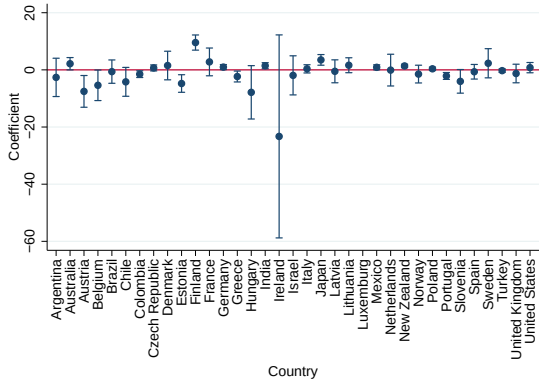

(a) $PC1$ $1/Volatility$



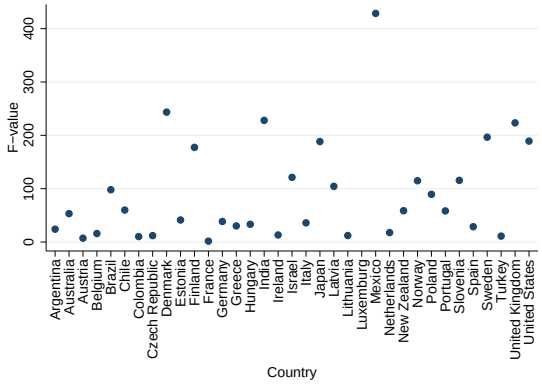

(b) $PC2$ $1/Volatility$



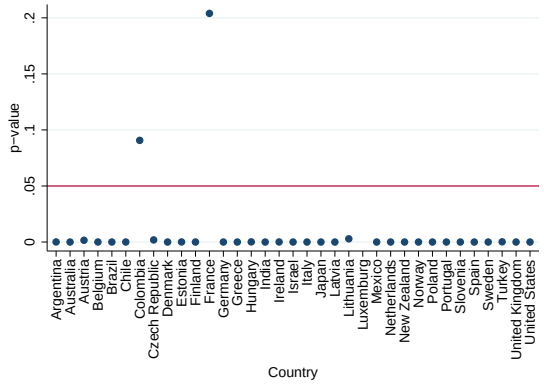

(c) $PC1$ *Cross-Sectional Volatility*




(d) $PC2$ *Cross-Sectional Volatility*




(e) *F-statistic*




(f) *p-value*

Table 15: **Information measures and global imbalances**. The table summarizes the explanatory power of $1/Vol$, $CsAvg$, and their one-year lagged observations on (1) global imbalances denominated in domestic currency, (2) global imbalances denominated in foreign currency, (3) global imbalances denominated in U.S. dollars, (4) global imbalances denominated in euros, (5) total global imbalances (see, e.g. Bénétrix et al. (2015)). The regression specification is: $GI_{n,t} = \alpha + \beta' X_{n,t} + \epsilon_{n,t}$, where $X_{n,t} = (1/Vol_{n,t}, 1/Vol_{n,t-1}, CsAvg_{n,t}, CsAvg_{n,t-1}, Credit_{n,t-1}, TFP_{n,t-1}, LP_{n,t-1})'$. Data are from Bénétrix et al. (2015) and DataStream and span a period from 1990 until 2010. All specifications include year and country fixed effects. Robust *t-statistics* adjusted for country-level clustering are reported in parentheses.

| | (1) $GI(DOM)_t$ | (2) $GI(FOR)_t$ | (3) $GI(USD)_t$ | (4) $GI(EUR)_t$ | (5) $GI(TOT)_t$ |
|---|---|---|---|---|---|
| $CsAvg_t$ | 56.618*** | -23.202$^+$ | -13.340$^+$ | 34.255 | 33.416** |
| | (3.51) | (-1.93) | (-1.67) | (1.13) | (2.79) |
| $CsAvg_{t-1}$ | 19.430$^+$ | -4.731 | -10.842$^+$ | 14.753 | 14.699 |
| | (1.74) | (-0.52) | (-1.74) | (0.79) | (1.23) |
| $Vol_t$ | 3.354 | -1.212 | -1.313 | 2.834 | 2.142 |
| | (0.98) | (-0.53) | (-0.66) | (0.68) | (0.84) |
| $Vol_{t-1}$ | -3.429 | 1.075 | 0.592 | -0.436 | -2.353 |
| | (-1.21) | (0.41) | (0.35) | (-0.13) | (-1.26) |
| $Credit_{t-1}$ | -0.494* | 0.155 | 0.074 | -0.704* | -0.338* |
| | (-2.31) | (0.88) | (0.65) | (-1.97) | (-1.99) |
| $TFP_{t-1}$ | 0.016 | 0.090 | 0.052 | 0.043 | 0.106 |
| | (0.18) | (0.90) | (1.22) | (0.37) | (1.22) |
| $LP_{t-1}$ | -3.644 | 5.101 | -0.711 | -2.323 | 1.457 |
| | (-1.14) | (1.52) | (-0.36) | (-0.42) | (0.59) |
| Constant | 9.302 | -77.598** | -1.485 | -7.814 | -68.297*** |
| | (0.38) | (-3.09) | (-0.08) | (-0.22) | (-3.33) |
| N | 475 | 475 | 475 | 475 | 475 |
| $R^2$ | 0.73 | 0.80 | 0.75 | 0.61 | 0.71 |
| FE (Year) | YES | YES | YES | YES | YES |
| FE (Country) | YES | YES | YES | YES | YES |

t-statistics in parentheses
$^+$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

crises become more likely.

In what follows we further look into the predictive ability of global imbalances with respect to recessions with crises at a country level. Figures 11 and 12 in the Appendix summarize our results. We find that lagged measures of domestic global imbalances do predict instances of recessions associated with crises in about half of the countries of our sample (Austria, Greece, Ireland, the Netherlands, Portugal, Spain, Sweden, and the United States). On the other hand, foreign global imbalances predict crises in more than half of the countries (Denmark and Mexico in addition to the above mentioned countries). The weak results are primarily attributed to the small number of recessions associated with crises in our sample (18 observations). The documented predictive power of global imbalances on the occurrence of crises is consistent with, for example, Bernanke (2005) and Bernanke (2007).

Table 16: **Global imbalances and financial crises**. The table summarizes the predictive power of (1) global imbalances denominated in domestic currency, (2) global imbalances denominated in foreign currency, and (3) total global imbalances (see, e.g. Bénétrix et al. (2015)) on the occurrence of recessions with crises. The regression specification is: $logit\left(\mathbb{E}[Y_{i,t}|X_{i,t-1}]\right) = logit(p_{i,t}) = \alpha + \beta' X_{t-1}$, where $X_{t-1} = (GI(type)_{t-1}, \Delta Credit_{t-1}, \Delta TFP_{t-1}, \Delta LP_{t-1})'$, $type \in \{domestic, foreign, total\}$, and $p_{i,t}$ is the probability of a recession with a crisis occurring for country $i$ at time $t$. Data are from Bénétrix et al. (2015) and DataStream and span a period from 1990 until 2010. All specifications include year and country fixed effects. Robust *t-statistics* adjusted for country-level clustering are reported in parentheses.

| | (1) $Crisis_t$ | (2) $Crisis_t$ | (3) $Crisis_t$ |
|---|---|---|---|
| $GI(DOM)_{t-1}$ | -0.008 | | |
| | (-0.80) | | |
| $\Delta Credit_{t-1}$ | -1.458 | -1.369 | -1.098 |
| | (-0.77) | (-0.67) | (-0.74) |
| $\Delta TFP_{t-1}$ | -33.074* | -39.109* | -33.226* |
| | (-1.98) | (-2.37) | (-2.02) |
| $\Delta LP_{t-1}$ | 16.390 | 18.155 | 8.482 |
| | (0.97) | (1.08) | (0.43) |
| $GI(FOR)_{t-1}$ | | -0.034* | |
| | | (-2.15) | |
| $GI(TOT)_{t-1}$ | | | -0.042+ |
| | | | (-1.70) |
| Constant | -1.087+ | 1.412 | -0.923** |
| | (-1.73) | (1.43) | (-2.77) |
| N | 297 | 297 | 297 |
| $R^2$ | | | |
| FE (Year) | YES | YES | YES |
| FE (Country) | YES | YES | YES |

t-statistics in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

# 7 Conclusion

Financial crises are information events. In this paper, we agnostically define movements in aggregate economic activity - the "business cycle" - and study these movements with respect to measures of information in the economy. More specifically, we ask whether general economy-wide measures of fragility and information move with aggregate economic activity. We find that more information is produced before and during recessions with crises, and that recessions with no crises are associated with production of less information. We further explore the effect of information production on reallocation of resources in the economy. We find that it indeed leads to reallocation of resources since the dispersion of Tobin's $Q$-ratios decreases following an increase in information production. We also document global information spillovers from advanced to emerging economies. Information produced in advanced economies can predict recessions with crises and reallocation of resources at a country level. Finally, global information measures predict global imbalances thus predicting reallocation of resources at a global level.

# References


**Atkeson, Andrew G., Andrea L. Eisfeldt, and Pierre-Olivier Weill**, "Measuring the Financial Soundness of U.S. Firms, 1926-2012," NBER Working Papers 19204, National Bureau of Economic Research, Inc July 2013.

**Bernanke, Ben**, "The Global Saving Glut and the U.S. Current Account Deficit," *Speech*, March 2005. Delivered for the Sandridge Lecture at the Virginia Association of Economists, Richmond.

_ , "Global Imbalances: Recent Developments and Prospects," *Speech*, September 2007. Delivered at the Bundesbank, Berlin, Germany.

**Besomi, Daniele**, "Celement Juglar and His Contempoaries on the Causes of Commercial Crises," *Revue Européenne des Sciences Sociales*, 2009, *47* (143), 17–47.

**Brunnermeier, Markus, Gary Gorton, and Arvind Krishnamurthy**, "Risk Topography," *NBER Macroeconomics Annual*, 2012.

**Bry, Gerhard and Charlotte Boschan**, *Cyclical Analysis of Time Series: Selected Procedures and Computer Programs*, National Bureau of Economic Research, Inc, 1971.

**Burns, Arthur F. and Wesley C. Mitchell**, *Measuring Business Cycles*, National Bureau of Economic Research, Inc, 1946.

**Bénétrix, Agustin S., Philip R. Lane, and Jay C. Shambaugh**, "International Currency Exposures, Valuation Effects and the Global Financial Crisis," *Journal of International Economics*, 2015, *96, Supplement 1*, S98 – S109.

**Caballero, Ricardo J. and Mohamad L. Hammour**, "The Cleansing Effect of Recessions," *American Economic Review*, December 1994, *84* (5), 1350–68.

_ **and** _ , "On the Timing and Efficiency of Creative Destruction," *The Quarterly Journal of Economics*, 1996, *111* (3), 805–852.

**Chodorow-Reich, Gabriel**, "The Employment Effects of Credit Market Disruptions: Firm-level Evidence from the 2008-09 Financial Crisis," *The Quarterly Journal of Economics*, 2013.

**Cogley, Timothy and James M Nason**, "Output Dynamics in Real-Business-Cycle Models," *American Economic Review*, June 1995, *85* (3), 492–511.

**Dang, Tri Vi, Gary Gorton, and Bengt Holmström**, "Ignorance, Debt and Financial Crises," *working paper*, 2012.

**Dwyer, Douglas W**, "Plant-Level Productivity and the Market Value of a Firm," Working Papers 01-03, Center for Economic Studies, U.S. Census Bureau June 2001.

**Fama, Eugene F.**, "Two Pillars of Asset Pricing," *American Economic Review*, June 2014, *104* (6), 1467–85.

**Frickey, Edwin**, "The Problem of Secular Trend," *Review of Economics and Statistics*, 1934, *16*, 199–206.

**Gande, Amar and David Parsley**, "News Spillovers in the Sovereign Debt Market," Working Papers 062003, Hong Kong Institute for Monetary Research March 2003.

**Gorton, Gary**, "Banking Panics and Business Cycles," *Oxford Economic Papers*, December 1988, *40* (4), 751–81.

_ , *Misunderstanding Financial Crises: Why We Don't See Them Coming*, Oxford University Press, 2012.

_ **and Guillermo Ordoñez**, "Good Booms, Bad Booms," Working Paper 22008, National Bureau of Economic Research February 2016.

**Gorton, Gary B. and Guillermo Ordoñez**, "Collateral Crises," IMES Discussion Paper Series 11-E-25, Institute for Monetary and Economic Studies, Bank of Japan September 2011.

**Gourinchas, Pierre-Olivier and Hélène Rey**, "External Adjustment, Global Imbalances and Valuation Effects," Technical Report, Berkeley and London Business School 2013.

**Greenstone, Michael, Alexandre Mas, and Hoai-Luu Nguyen**, "Do Credit Market Shocks Affect the Real Economy? Quasi-Experimental Evidence from the Great Recession and 'Normal' Economic Times," Working Paper 20704, National Bureau of Economic Research November 2014.

**Grossman, Sanford J.**, "An Introduction to the Theory of Rational Expectations Under Asymmetric Information," *Review of Economic Studies*, 1981, *48* (4), 541–559.

**Hamilton, James D.**, "Why You Should Never Use the Hodrick-Prescott Filter," *Working Paper*, 2016.

**Harding, Don and Adrian Pagan**, "Dissecting the Cycle: a Methodological Investigation," *Journal of Monetary Economics*, March 2002, *49* (2), 365–381.

**Harvey, Andrew and A Jaeger**, "Detrending, Stylized Facts and the Business Cycle," *Journal of Applied Econometrics*, 1993, *8* (3), 231–47.

**Hodrick, Robert J and Edward C Prescott**, "Postwar U.S. Business Cycles: An Empirical Investigation," *Journal of Money, Credit and Banking*, February 1997, *29* (1), 1–16.

**Ivashina, Victoria and David Scharfstein**, "Bank Lending During the Financial Crisis of 2008," *Journal of Financial Economics*, September 2010, *97* (3), 319–338.

**King, Mervyn A and Sushil Wadhwani**, "Transmission of Volatility between Stock Markets," *Review of Financial Studies*, 1990, *3* (1), 5–33.

**Koopmans, Tjalling C.**, "Measurement Without Theory," *The Review of Economics and Statistics*, 1947, *29* (3), 161–172.

**Kose, M. Ayhan, Eswar S. Prasad, and Marco E. Terrones**, "Does Openness to International Financial Flows Raise Productivity Growth?," Working Paper 14558, National Bureau of Economic Research December 2008.

**Krishnamurthy, Arvind and Tyler Muir**, "Credit Spreads and the Severity of Financial Crises," *Working Paper*, 2015.

**Kydland, Finn E. and Edward C. Prescott**, "Business Cycles: Real Facts and a Monetary Myth," *Quarterly Review, Federal Reserve Bank of Minneapolis*, 1990, *14* (2), 3–18.

**Lee, James and Filippo Mezzanotti**, "Bank Distress and Manufacturing: Evidence from the Great Depression," *Working Paper*, 2015.

**Leland, Hayne**, " Corporate Debt Value, Bond Covenants, and Optimal Capital Structure," *Journal of Finance*, September 1994, *49* (4), 1213–52.

**Lucas, Robert E.**, "Understanding Business Cycles," *Carnegie-Rochester Conference Series on Public Policy*, January 1977, *5* (1), 7–29.

**Merton, Robert**, "On the Pricing of Corporate Debt: The Risk Structure of Interest Rates," *Journal of Finance*, 1974, *29* (2), 449–70.

**Mitchell, Wesley C.**, *Business Cycles*, Berkeley: University of California Press, 1913.

_ , *Business Cycles: The Problem and Its Setting*, NBER, 1927.

**Muir, Tyler**, "Financial Crises and Risk Premia," *Available at SSRN 2379608*, 2015.

**Newey, Whitney and Kenneth West**, "A Simple, Positive Semi-definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix," *Econometrica*, 1987, *55* (3), 703–08.

**Newey, Whitney K. and Kenneth D. West**, "Automatic Lag Selection in Covariance Matrix Estimation," *The Review of Economic Studies*, 1994, *61* (4), 631.

**Niehans, Jürg**, "Juglar's Credit Cycles," *History of political Economy*, 1992, *24* (3), 545–569.

**Saxena, Sweta Chaman and Valerie Cerra**, "Growth Dynamics; The Myth of Economic Recovery," IMF Working Papers 05/147, International Monetary Fund July 2005.

**Schumpeter, Joseph A.**, *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process*, New York: McGraw-Hill, 1939.

**Solow, Robert M.**, *Growth Theory: An Exposition*, Oxford: Clarendon, 1970.

**Valencia, Fabian and Luc Laeven**, "Systemic Banking Crises Database; An Update," IMF Working Papers 12/163, International Monetary Fund June 2012.

**Vassalou, Maria and Yuhang Xing**, "Default Risk in Equity Returns," *Journal of Finance*, 2004, *59* (2), 831–868.

**White, Halbert**, "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica*, 1980, *48* (4), 817–838.

**Zarnowitz, Victor and Lionel J. Lerner**, "Cyclical Changes in Business Failures and Corporate Profits," in "Business Cycle Indicators, Volume 1," National Bureau of Economic Research, Inc, 1961, pp. 350–385.

# Appendices

## A Figures

Figure 9: **Number of countries**. The figure summarizes the evolution of the number of countries in the equity data sample. The data are quarterly from Thomson/Reuters (DataStream) and span a period from 1973Q1 until 2011Q3.

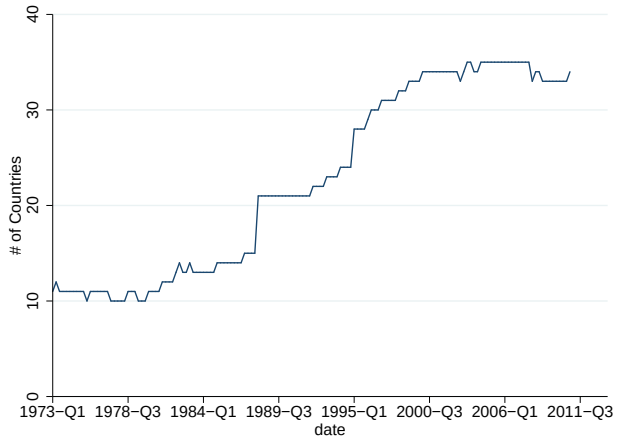
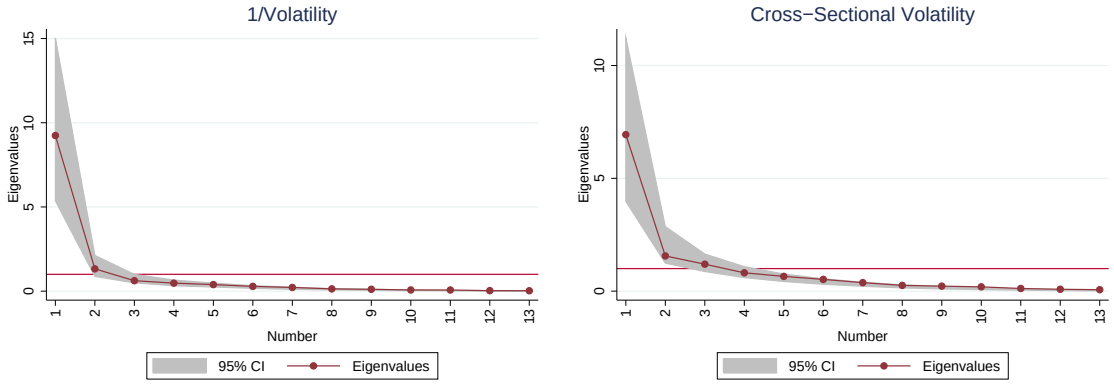



Figure 10: **Eigenvalues of principal components**. The figure summarizes the eigenvalues along with a 95% confidence interval for the first four principal components of $1/Vol$ and $CsAvg$ series. The principal components of $1/Vol$ and $CsAvg$ are computed using a panel of countries with available stock market data from 1973 until 2010. The panel of countries includes Australia, Belgium, Denmark, France, Germany, Ireland, Italy, Japan, Netherlands, Norway, Sweden, United Kingdom, and United States.




(a) $1/Volatility$

(b) $Cross\text{-}Sectional\ Volatility$

# B Tables

Table 17: **Correlations - Information Measures (Quarterly)**. The table summarizes correlations for $1/Vol$, $CsVol$, and $CsAvg$ (Panel A), and $\Delta(1/Vol)$, $\Delta CsVol$, and $\Delta CsAvg$ (Panel B). The variables are computed on a country level using data from Thomson/Reuters (DataStream), and span a period from 1973 until 2010.

| | $1/Vol$ | $CsVol$ | $CsAvg$ |
|---|---|---|---|
| $1/Vol$ | 1.000 | | |
| $CsVol$ | -0.304*** | 1.000 | |
| $CsAvg$ | -0.388*** | 0.965*** | 1.000 |

$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

| | $\Delta(1/Vol)$ | $\Delta CsVol$ | $\Delta CsAvg$ |
|---|---|---|---|
| $\Delta(1/Vol)$ | 1.000 | | |
| $\Delta CsVol$ | -0.094*** | 1.000 | |
| $\Delta CsAvg$ | -0.131*** | 0.952*** | 1.000 |

$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 18: **Correlations - Information Measures (Annual)**. The table summarizes correlations for $1/Vol$, $CsVol$, and $CsAvg$ (Panel A), and $\Delta(1/Vol)$, $\Delta CsVol$, and $\Delta CsAvg$ (Panel B). The variables are computed on a country level using data from Thomson/Reuters (DataStream), and span a period from 1973 until 2010.

| | $1/Vol$ | $CsVol$ | $CsAvg$ |
|---|---|---|---|
| $1/Vol$ | 1.000 | | |
| $CsVol$ | -0.341*** | 1.000 | |
| $CsAvg$ | -0.416*** | 0.961*** | 1.000 |

$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

| | $\Delta(1/Vol)$ | $\Delta CsVol$ | $\Delta CsAvg$ |
|---|---|---|---|
| $\Delta(1/Vol)$ | 1.000 | | |
| $\Delta CsVol$ | -0.217*** | 1.000 | |
| $\Delta CsAvg$ | -0.253*** | 0.953*** | 1.000 |

$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 19: **Correlations - Macroeconomic Variables and Information Measures (Annual data)**. The table summarizes correlations for $1/Vol$, $CsVol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsVol$, $\Delta CsAvg$, $\Delta Credit$, $\Delta TFP$, $\Delta LP$, $\Delta Granted$. The data are from the Penn World Tables (PWT), WIPO statistics database, World Development Indicators, Total Economy Database (TED), and Thomson/Reuters (DataStream), and span a period from 1973 until 2010.

| | $1/Vol$ | $CsVol$ | $CsAvg$ | $\Delta(1/Vol)$ | $\Delta CsVol$ | $\Delta CsAvg$ | $\Delta rGDP$ | $\Delta Credit$ | $\Delta TFP$ | $\Delta LP$ |
|---|---|---|---|---|---|---|---|---|---|---|
| $1/Vol$ | 1.000 | | | | | | | | | |
| $CsVol$ | -0.294*** | 1.000 | | | | | | | | |
| $CsAvg$ | -0.364*** | 0.957*** | 1.000 | | | | | | | |
| $\Delta(1/Vol)$ | 0.444*** | -0.059 | -0.076$^{+}$ | 1.000 | | | | | | |
| $\Delta CsVol$ | -0.120** | 0.498*** | 0.485*** | -0.202*** | 1.000 | | | | | |
| $\Delta CsAvg$ | -0.124** | 0.482*** | 0.523*** | -0.228*** | 0.940*** | 1.000 | | | | |
| $\Delta rGDP$ | 0.095* | -0.104** | -0.104** | -0.118** | -0.065$^{+}$ | -0.057 | 1.000 | | | |
| $\Delta Credit$ | 0.032 | -0.012 | -0.012 | -0.041 | 0.011 | 0.021 | 0.096* | 1.000 | | |
| $\Delta TFP$ | 0.087* | -0.050 | -0.066$^{+}$ | -0.061 | -0.080* | -0.070$^{+}$ | 0.730*** | 0.070$^{+}$ | 1.000 | |
| $\Delta LP$ | 0.140*** | -0.182*** | -0.189*** | -0.000 | -0.112** | -0.106** | 0.508*** | 0.033 | 0.505*** | 1.000 |

$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 20: **Difference in mean values (all countries)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$ for instances of: (i) recessions vs. no-recessions and (ii) growth vs. normal. The third column reports the difference in means and the $t$-statistic of the difference. The data are quarterly and span a period from 1973 until 2010.

(a) recessions vs. no-recessions

| | No-Recession | Recession | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.042 | -0.009 | 0.050*** |
| | | | (27.46) |
| $\alpha$ | 0.010 | -0.030 | 0.039*** |
| | | | (51.97) |
| $1/Vol$ | 3.369 | 2.950 | 0.419*** |
| | | | (10.96) |
| $CsVol$ | 0.434 | 0.468 | -0.034* |
| | | | (-2.33) |
| $CsAvg$ | 0.122 | 0.132 | -0.010** |
| | | | (-3.21) |
| $\Delta(1/Vol)$ | -0.002 | 0.018 | -0.020 |
| | | | (-0.93) |
| $\Delta CsVol$ | -0 | 0.015 | -0.015 |
| | | | (-1.19) |
| $\Delta CsAvg$ | -0 | 0.003 | -0.003 |
| | | | (-1.03) |
| N | 2391 | 892 | 1499 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

(b) growth vs. normal

| | Normal | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.029 | 0.073 | -0.044*** |
| | | | (-29.17) |
| $\alpha$ | 0.006 | 0.018 | -0.012*** |
| | | | (-36.15) |
| $1/Vol$ | 3.420 | 3.242 | 0.178*** |
| | | | (4.02) |
| $CsVol$ | 0.437 | 0.426 | 0.011 |
| | | | (0.70) |
| $CsAvg$ | 0.121 | 0.123 | -0.002 |
| | | | (-0.67) |
| $\Delta(1/Vol)$ | 0.007 | -0.024 | 0.031 |
| | | | (1.28) |
| $\Delta CsVol$ | -0.004 | 0.009 | -0.013 |
| | | | (-0.90) |
| $\Delta CsAvg$ | -0.001 | 0.002 | -0.004 |
| | | | (-1.11) |
| N | 1693 | 698 | 995 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 21: **Information measures and economic events**. The table summarizes the predictive power of information measures ($1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$) on the occurrence of economic events (recession without crisis, and growth). The regression specification is: $\mathbb{1}_{n,t}(Economic\ Event) = \alpha_n + \beta' X_{n,t-1} + \epsilon_{n,t}$ for linear probability models, and $Pr(\mathbb{1}_{n,t}(Economic\ Event) = 1|X_{n,t-1}) = \Phi(\alpha_n + \beta' X_{n,t-1})$ for LOGIT models, where $Economic\ Event = (recession\ without\ crisis, growth)$ and $X_{n,t-1} = (1/Vol_{n,t-1}, CsAvg_{n,t-1}, \Delta Vol_{n,t-1}, \Delta CsAvg_{n,t-1})'$. The data are quarterly and span a period from 1973 until 2010. All regression specifications take into account country fixed effects and standard errors are clustered both at a country and time level.

(a) recessions with no crises

(b) growth instances

| | (1) Linear | (2) Logit |
|---|---|---|
| $1/Vol_{t-2}$ | 0.045** | 0.343** |
| | (2.74) | (2.95) |
| $CsAvg_{t-2}$ | -0.311* | -3.843** |
| | (-2.05) | (-2.83) |
| $\Delta(1/Vol)_{t-1}$ | 0.020 | 0.143 |
| | (1.14) | (1.14) |
| $\Delta CsAvg_{t-1}$ | -0.242* | -2.618** |
| | (-2.49) | (-3.08) |
| Constant | 0.398*** | -2.576*** |
| | (5.62) | (-5.56) |
| N | 3969 | 3969 |
| $R^2$ | 0.11 | . |
| F | 11.63 | . |
| Cluster (Time) | YES | YES |
| Cluster (Country) | YES | YES |
| FE (Country) | YES | YES |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 22: **Information measures and recessions - lagged regressions (LOGIT)**. The table summarizes the predictive power of information measures ($1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$) on the occurrence of recession events. The regression specification is: $Pr(\mathbb{1}_{n,t}(Recession) = 1|X_{t-q}) = \Phi(\alpha_n + \beta' X_{t-q})$, where $X_{n,t-q} = (1/Vol_{n,t-q}, CsAvg_{n,t-q}, \Delta Vol_{n,t-q}, \Delta CsAvg_{n,t-q})'$. The data are quarterly and span a period from 1973 until 2010. All regression specifications take into account country fixed effects and standard errors are clustered both at a country and time level.

| | (1) q=0 | (2) q=1 | (3) q=2 | (4) q=3 | (5) q=4 | (6) q=8 |
|---|---|---|---|---|---|---|
| $1/Vol_{t-q-1}$ | -0.821*** | -0.852*** | -0.843*** | -0.784*** | -0.667*** | -0.234 |
| | (-4.53) | (-4.74) | (-4.89) | (-4.84) | (-4.31) | (-1.57) |
| $CsAvg_{t-q-1}$ | 0.356 | -0.031 | -0.495 | -0.757 | -0.701 | -0.790 |
| | (0.45) | (-0.04) | (-0.53) | (-0.75) | (-0.69) | (-0.74) |
| $\Delta(1/Vol)_{t-q}$ | -0.318+ | -0.476** | -0.465** | -0.573** | -0.597*** | -0.233 |
| | (-1.91) | (-2.68) | (-2.59) | (-3.22) | (-3.55) | (-1.42) |
| $\Delta CsAvg_{t-q}$ | 0.470 | 0.377 | 0.317 | -0.144 | -0.072 | -0.124 |
| | (0.95) | (0.76) | (0.61) | (-0.24) | (-0.13) | (-0.24) |
| N | 3807 | 3775 | 3743 | 3754 | 3722 | 3594 |
| Cluster (Time) | YES | YES | YES | YES | YES | YES |
| Cluster (Country) | YES | YES | YES | YES | YES | YES |
| FE (Country) | YES | YES | YES | YES | YES | YES |

t-statistics in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 23: **Information measures and recessions with crises - lagged regressions (LOGIT)**. The table summarizes the predictive power of information measures ($1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$) on the occurrence of recession with crises events. The regression specification is: $Pr(\mathbb{1}_{n,t}(Recession \cap Crisis) = 1|X_{t-q}) = \Phi(\alpha_n + \beta' X_{t-q})$, where $X_{n,t-q} = (1/Vol_{n,t-q}, CsAvg_{n,t-q}, \Delta Vol_{n,t-q}, \Delta CsAvg_{n,t-q})'$. The data are quarterly and span a period from 1973 until 2010. All regression specifications take into account country fixed effects and standard errors are clustered both at a country and time level.

| | (1) q=0 | (2) q=1 | (3) q=2 | (4) q=3 | (5) q=4 | (6) q=8 |
|---|---|---|---|---|---|---|
| $1/Vol_{t-q-1}$ | -2.123*** | -2.215*** | -2.036*** | -1.721*** | -1.459*** | -0.393 |
| | (-6.25) | (-7.04) | (-6.65) | (-5.40) | (-4.20) | (-1.34) |
| $CsAvg_{t-q-1}$ | 7.053** | 5.345* | 4.319+ | 4.205* | 4.171* | 3.482 |
| | (2.69) | (2.23) | (1.93) | (2.02) | (1.98) | (1.44) |
| $\Delta(1/Vol)_{t-q}$ | -0.973* | -1.254** | -1.454*** | -1.200** | -1.141** | -0.623+ |
| | (-2.33) | (-2.91) | (-3.65) | (-3.17) | (-2.95) | (-1.68) |
| $\Delta CsAvg_{t-q}$ | 4.461** | 3.613** | 2.743* | 1.804 | 2.524* | 2.534* |
| | (2.78) | (2.75) | (1.98) | (1.41) | (2.46) | (2.11) |
| N | 2683 | 2662 | 2641 | 2663 | 2642 | 2558 |
| Cluster (Time) | YES | YES | YES | YES | YES | YES |
| Cluster (Country) | YES | YES | YES | YES | YES | YES |
| FE (Country) | YES | YES | YES | YES | YES | YES |

t-statistics in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 24: **Information measures and recessions with no crises - lagged regressions (LOGIT)**. The table summarizes the predictive power of information measures ($1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$) on the occurrence of recession with no crises events. The regression specification is: $Pr(\mathbb{1}_{n,t}(Recession \cap no\ Crisis) = 1|X_{t-q}) = \Phi(\alpha_n + \beta' X_{t-q})$, where $X_{n,t-q} = (1/Vol_{n,t-q}, CsAvg_{n,t-q}, \Delta Vol_{n,t-q}, \Delta CsAvg_{n,t-q})'$. The data are quarterly and span a period from 1973 until 2010. All regression specifications take into account country fixed effects and standard errors are clustered both at a country and time level.

| | (1) q=0 | (2) q=1 | (3) q=2 | (4) q=3 | (5) q=4 | (6) q=8 |
|---|---|---|---|---|---|---|
| $1/Vol_{t-q-1}$ | -0.508** | -0.470** | -0.535** | -0.516*** | -0.390** | 0.099 |
| | (-3.13) | (-2.91) | (-3.09) | (-3.34) | (-2.95) | (0.61) |
| $CsAvg_{t-q-1}$ | -6.967** | -6.509** | -8.976** | -9.950** | -9.414** | -6.733* |
| | (-2.76) | (-2.61) | (-2.90) | (-3.18) | (-3.09) | (-2.21) |
| $\Delta(1/Vol)_{t-q}$ | -0.205+ | -0.352** | -0.272+ | -0.424** | -0.444** | 0.004 |
| | (-1.76) | (-2.72) | (-1.76) | (-2.98) | (-3.27) | (0.03) |
| $\Delta CsAvg_{t-q}$ | -2.951* | -2.498+ | -3.419* | -4.728** | -4.915** | -2.475 |
| | (-2.13) | (-1.82) | (-2.20) | (-2.91) | (-2.88) | (-1.56) |
| N | 3244 | 3208 | 3186 | 3157 | 3128 | 3012 |
| Cluster (Time) | YES | YES | YES | YES | YES | YES |
| Cluster (Country) | YES | YES | YES | YES | YES | YES |
| FE (Country) | YES | YES | YES | YES | YES | YES |

t-statistics in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 25: **Information measures and growth events - lagged regressions (LOGIT)**. The table summarizes the predictive power of information measures ($1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$) on the occurrence of recession with no crises events. The regression specification is: $Pr(\mathbb{1}_{n,t}(Growth) = 1|X_{t-q}) = \Phi(\alpha_n + \beta' X_{t-q})$, where $X_{n,t-q} = (1/Vol_{n,t-q}, CsAvg_{n,t-q}, \Delta Vol_{n,t-q}, \Delta CsAvg_{n,t-q})'$. The data are quarterly and span a period from 1973 until 2010. All regression specifications take into account country fixed effects and standard errors are clustered both at a country and time level.

| | (1) q=0 | (2) q=1 | (3) q=2 | (4) q=3 | (5) q=4 | (6) q=8 |
|---|---|---|---|---|---|---|
| $1/Vol_{t-q-1}$ | 0.274* | 0.343** | 0.357** | 0.323* | 0.280* | 0.146 |
| | (2.19) | (2.95) | (2.78) | (2.32) | (2.07) | (1.18) |
| $CsAvg_{t-q-1}$ | -4.454*** | -3.843** | -2.474+ | -2.071 | -2.542* | -2.171+ |
| | (-3.36) | (-2.83) | (-1.83) | (-1.62) | (-1.97) | (-1.92) |
| $\Delta(1/Vol)_{t-q}$ | -0.045 | 0.143 | 0.251* | 0.190 | 0.189 | 0.026 |
| | (-0.34) | (1.14) | (2.01) | (1.45) | (1.33) | (0.21) |
| $\Delta CsAvg_{t-q}$ | -1.906* | -2.618** | -1.907* | -0.708 | -1.078 | -1.361* |
| | (-2.27) | (-3.08) | (-2.15) | (-0.95) | (-1.34) | (-2.19) |
| N | 4003 | 3969 | 3935 | 3901 | 3867 | 3731 |
| Cluster (Time) | YES | YES | YES | YES | YES | YES |
| Cluster (Country) | YES | YES | YES | YES | YES | YES |
| FE (Country) | YES | YES | YES | YES | YES | YES |

t-statistics in parentheses
+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 26: **Information measures and reallocation within country**. The table summarizes the predictive power of $1/Vol$, $\Delta(1/Vol)$, cross-sectional averages ($CsAvg$), change in cross-sectional averages ($\Delta CsAvg$), their interaction with a dummy indicating a crisis, and macro-variables ($\Delta rGDP$, $\Delta Credit$, $\Delta TFP$, $\Delta LP$) on the fraction of firms: (1) remaining in quintile 1, (2) switching from quintile 1 to quintile 2, (3) switching from quintile 1 to quintile 3, (4) remaining in quintile 5, (5) switching from quintile 5 to quintile 4, and (5) switching from quintile 5 to quintile 3. The regression specification is: $fr(Qx_{start} \to Qy_{end})_{n,t} = \alpha_n + \beta' X_{n,t-2} + \gamma' X_{n,t-2} + \delta' Macro_{n,t-2} + \epsilon_{n,t}$, where $X_{n,t-2} = (CsAvg_{n,t-3}, \Delta CsAvg_{n,t-2}, 1/Vol_{n,t-3}, \Delta(1/Vol)_{n,t-2})'$, and $Macro_{n,t} = (\Delta rGDP_{n,t-2}, \Delta Credit_{n,t-2}, \Delta TFP_{n,t-2}, \Delta LP_{n,t-2})$ and $x, y \in \{1, ..., 5\}$. Data are from WorldScope and span a period from 1980 until 2010. All specifications include year and country fixed effects. Robust *t-statistics* adjusted for country-level clustering are reported in parentheses.

| | (1) $Q1 \to Q1$ | (2) $Q1 \to Q2$ | (3) $Q1 \to Q3$ | (4) $Q5 \to Q5$ | (5) $Q5 \to Q4$ | (6) $Q5 \to Q3$ |
|---|---|---|---|---|---|---|
| $\Delta CsAvg_{t-2}$ | -0.254$^{+}$ | 0.033 | -0.026 | -0.013 | 0.022 | 0.112$^{*}$ |
| | (-1.73) | (0.31) | (-0.54) | (-0.08) | (0.55) | (2.14) |
| $\Delta CsAvg_{t-2} \times \mathbb{1}_t(Crisis)$ | 0.396$^{*}$ | -0.446$^{+}$ | 0.229$^{*}$ | -0.064 | 0.085 | -0.270$^{*}$ |
| | (2.09) | (-2.07) | (2.65) | (-0.23) | (1.17) | (-2.71) |
| $\Delta(1/Vol)_{t-2}$ | 0.017 | 0.001 | -0.014$^{*}$ | 0.020 | 0.001 | -0.013$^{*}$ |
| | (1.33) | (0.14) | (-2.54) | (1.37) | (0.51) | (-2.44) |
| $\Delta(1/Vol)_{t-2} \times \mathbb{1}_t(Crisis)$ | -0.017 | -0.025 | 0.050$^{***}$ | -0.034 | 0.004 | -0.000 |
| | (-0.94) | (-1.47) | (4.97) | (-1.57) | (0.72) | (-0.00) |
| $CsAvg_{t-3}$ | -0.440$^{*}$ | 0.062 | -0.118$^{+}$ | -0.135 | 0.092 | 0.117$^{+}$ |
| | (-2.10) | (0.42) | (-1.80) | (-0.79) | (1.00) | (1.73) |
| $CsAvg_{t-3} \times \mathbb{1}_t(Crisis)$ | 0.420 | -0.233 | -0.038 | 0.019 | -0.030 | -0.077 |
| | (1.42) | (-0.96) | (-0.19) | (0.09) | (-0.34) | (-0.85) |
| $1/Vol_{t-3}$ | 0.030$^{+}$ | 0.010 | -0.024$^{**}$ | 0.013 | 0.001 | -0.013$^{*}$ |
| | (1.91) | (1.36) | (-3.35) | (0.77) | (0.24) | (-2.18) |
| $1/Vol_{t-3} \times \mathbb{1}_t(Crisis)$ | -0.039$^{*}$ | 0.008 | 0.017$^{+}$ | -0.013 | 0.000 | 0.000 |
| | (-2.30) | (0.94) | (1.73) | (-1.22) | (0.09) | (0.06) |
| $\Delta rGDP_{t-2}$ | -0.894 | -0.073 | 0.300$^{*}$ | -0.202 | 0.168 | 0.290$^{+}$ |
| | (-1.47) | (-0.26) | (2.15) | (-0.31) | (1.28) | (1.93) |
| $\Delta Credit_{t-2}$ | -0.000 | 0.000 | 0.000$^{+}$ | -0.000 | -0.000 | 0.000 |
| | (-0.11) | (0.14) | (1.91) | (-0.11) | (-0.14) | (0.40) |
| $\Delta TFP_{t-2}$ | 0.000 | 0.000 | 0.000 | 0.000 | -0.000$^{*}$ | -0.000 |
| | (0.40) | (0.10) | (0.13) | (0.25) | (-2.58) | (-1.51) |
| $\Delta LP_{t-2}$ | 0.005 | 0.005 | -0.002 | -0.008 | -0.005 | -0.004 |
| | (0.29) | (0.65) | (-0.41) | (-0.66) | (-0.98) | (-0.97) |
| Constant | 0.528$^{***}$ | 0.179$^{***}$ | 0.176$^{***}$ | 0.528$^{***}$ | 0.012 | 0.083$^{***}$ |
| | (6.45) | (6.11) | (6.54) | (9.56) | (0.62) | (4.71) |
| N | 405 | 408 | 407 | 414 | 408 | 407 |
| $R^2$ | 0.46 | 0.32 | 0.31 | 0.41 | 0.27 | 0.30 |
| Cluster (Country) | YES | YES | YES | YES | YES | YES |
| FE (Time) | YES | YES | YES | YES | YES | YES |
| FE (Country) | YES | YES | YES | YES | YES | YES |

t-statistics in parentheses
$^{+}$ $p < 0.10$, $^{*}$ $p < 0.05$, $^{**}$ $p < 0.01$, $^{***}$ $p < 0.001$

Table 27: **Difference in mean values (advanced economies)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$, $GI(DOM)$, $GI(FOR)$, and $GI(TOT)$ 4 quarters prior to the event for (i) recessions vs. no-recessions and (ii) recessions vs. growth. The third column reports the difference in means and the $t$-statistic of the difference. The data are annual and span a period from 1990 until 2010.

(a) crisis vs. no crisis

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.030 | -0.003 | 0.034*** |
| | | | (5.63) |
| $\alpha$ | 0.004 | -0.029 | 0.033*** |
| | | | (14.97) |
| $1/Vol$ | 3.427 | 2.420 | 1.007*** |
| | | | (7.62) |
| $CsVol$ | 0.387 | 0.708 | -0.321*** |
| | | | (-7.77) |
| $CsAvg$ | 0.108 | 0.181 | -0.072*** |
| | | | (-8.24) |
| $\Delta(1/Vol)$ | 0.019 | -0.308 | 0.328** |
| | | | (2.65) |
| $\Delta CsVol$ | 0.008 | 0.108 | -0.100** |
| | | | (-2.94) |
| $\Delta CsAvg$ | 0.002 | 0.023 | -0.022** |
| | | | (-2.77) |
| $GI(DOM)$ | -44.154 | -62.687 | 18.533** |
| | | | (3.04) |
| $GI(FOR)$ | 27.111 | 38.860 | -11.749$^{+}$ |
| | | | (-1.96) |
| $GI(TOT)$ | -17.043 | -23.827 | 6.784 |
| | | | (1.36) |
| N | 84 | 20 | 64 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(b) recessions vs. growth

| | Recession | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.025 | 0.036 | -0.011* |
| | | | (-2.24) |
| $\alpha$ | -0 | 0.008 | -0.008*** |
| | | | (-4.25) |
| $1/Vol$ | 3.331 | 3.323 | 0.008 |
| | | | (0.07) |
| $CsVol$ | 0.426 | 0.381 | 0.045 |
| | | | (1.34) |
| $CsAvg$ | 0.116 | 0.112 | 0.004 |
| | | | (0.53) |
| $\Delta(1/Vol)$ | -0.032 | 0.074 | -0.106 |
| | | | (-1.08) |
| $\Delta CsVol$ | 0.015 | 0.028 | -0.013 |
| | | | (-0.48) |
| $\Delta CsAvg$ | 0.003 | 0.008 | -0.006 |
| | | | (-0.92) |
| $GI(DOM)$ | -45.004 | -57.320 | 12.316* |
| | | | (2.04) |
| $GI(FOR)$ | 27.763 | 34.827 | -7.065 |
| | | | (-1.19) |
| $GI(TOT)$ | -17.242 | -22.493 | 5.251 |
| | | | (1.07) |
| N | 96 | 94 | 2 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 28: **Difference in mean values (developing economies)**. The table summarizes mean values for $\Delta rGDP$, $\alpha$, $1/Vol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsAvg$, $GI(DOM)$, $GI(FOR)$, and $GI(TOT)$ 4 quarters prior to the event for (i) recessions vs. no-recessions and (ii) recessions vs. growth. The third column reports the difference in means and the $t$-statistic of the difference. The data are annual and span a period from 1990 until 2010.

(a) crisis vs. no crisis

| | No-Crisis | Crisis | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.042 | -0.017 | 0.059*** |
| | | | (3.97) |
| $\alpha$ | 0.004 | -0.060 | 0.063*** |
| | | | (6.70) |
| $1/Vol$ | 2.798 | 2.441 | 0.357 |
| | | | (1.40) |
| $CsVol$ | 0.597 | 0.611 | -0.015 |
| | | | (-0.10) |
| $CsAvg$ | 0.168 | 0.184 | -0.015 |
| | | | (-0.51) |
| $\Delta(1/Vol)$ | 0.081 | -0.254 | 0.335 |
| | | | (1.63) |
| $\Delta CsVol$ | -0.025 | 0.158 | -0.184 |
| | | | (-1.08) |
| $\Delta CsAvg$ | -0.007 | 0.040 | -0.048 |
| | | | (-1.30) |
| $GI(DOM)$ | -33.393 | -53.435 | 20.042*** |
| | | | (3.56) |
| $GI(FOR)$ | -2.638 | -3.283 | 0.646 |
| | | | (0.12) |
| $GI(TOT)$ | -36.030 | -56.718 | 20.688*** |
| | | | (3.51) |
| N | 25 | 7 | 18 |

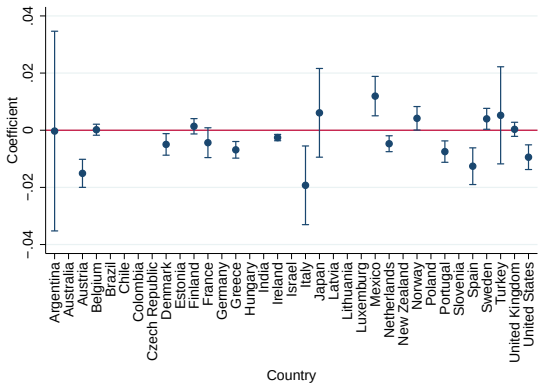
t-statistics in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

(b) recessions vs. growth

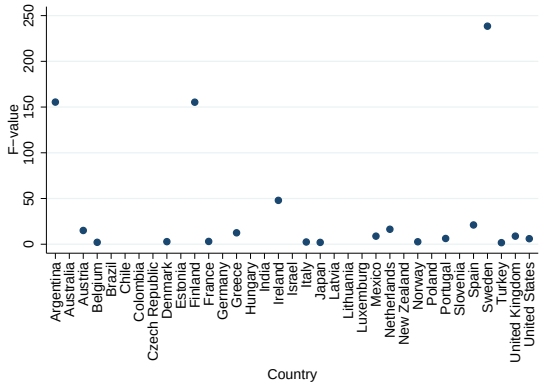
| | Recession | Growth | Mean Diff. |
|---|---|---|---|
| $\Delta rGDP$ | 0.029 | 0.051 | -0.021* |
| | | | (-2.60) |
| $\alpha$ | -0.011 | 0.010 | -0.022** |
| | | | (-3.34) |
| $1/Vol$ | 2.654 | 2.950 | -0.296* |
| | | | (-2.06) |
| $CsVol$ | 0.620 | 0.562 | 0.058 |
| | | | (0.69) |
| $CsAvg$ | 0.174 | 0.162 | 0.013 |
| | | | (0.74) |
| $\Delta(1/Vol)$ | -0.085 | 0.278 | -0.363** |
| | | | (-3.10) |
| $\Delta CsVol$ | 0.021 | -0.059 | 0.080 |
| | | | (0.81) |
| $\Delta CsAvg$ | 0.007 | -0.020 | 0.026 |
| | | | (1.24) |
| $GI(DOM)$ | -37.003 | -33.070 | -3.933 |
| | | | (-1.07) |
| $GI(FOR)$ | -2.552 | -2.948 | 0.396 |
| | | | (0.12) |
| $GI(TOT)$ | -39.555 | -36.017 | -3.538 |
| | | | (-0.92) |
| N | 26 | 36 | -10 |

t-statistics in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

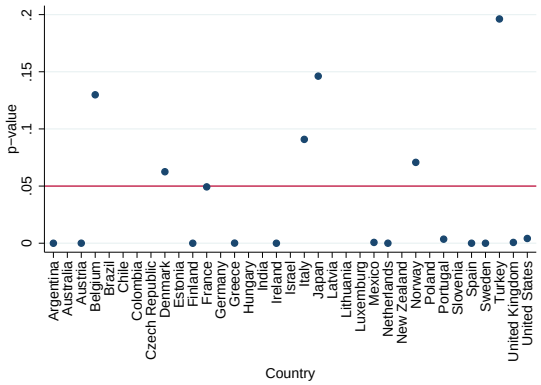
Figure 11: **Predictive regressions**. Figure (a) summarizes the predictive power of global imbalances denominated in domestic currency on the occurrence of recessions with crises. Figures (b) and (c) report the *F-statistic* its *p-value* respectively. All regressions are performed at the country level. Standard errors are heteroskedasticity- (White (1980)) and autocorrelation-robust (Newey and West (1987) and Newey and West (1994)). The regression specification is: $\mathbb{1}_t(Crisis) = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_{t-1} = (GI(DOM)_{t-1})'$




(a) *Global Imbalances* (*Domestic*)

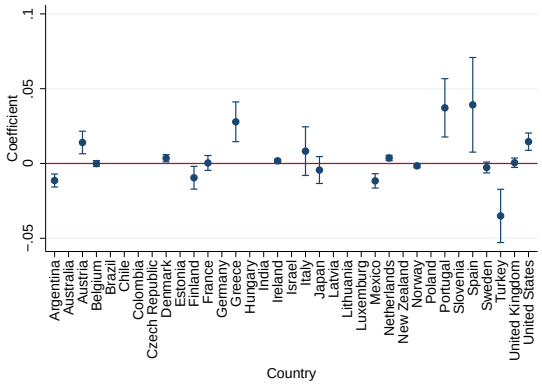



(b) *F-statistic*

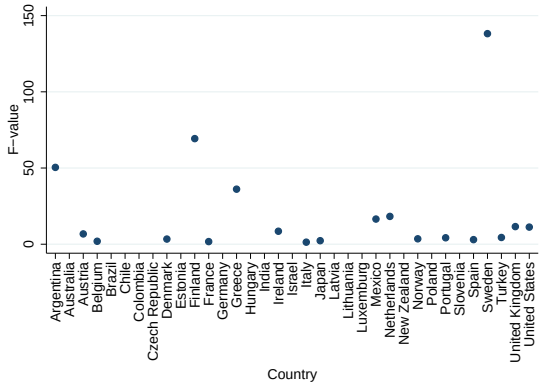



(c) *p-value*

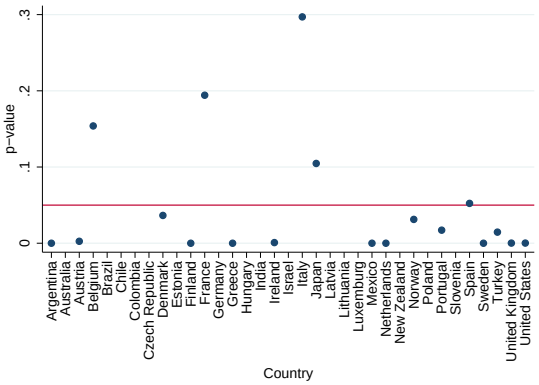
Figure 12: **Predictive regressions**. Figure (a) summarizes the predictive power of global imbalances denominated in foreign currency on the occurrence of recessions with crises. Figures (b) and (c) report the *F-statistic* its *p-value* respectively. All regressions are performed at the country level. Standard errors are heteroskedasticity- (White (1980)) and autocorrelation-robust (Newey and West (1987) and Newey and West (1994)). The regression specification is: $\mathbb{1}_t(Crisis) = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_{t-1} = (GI(FOR)_{t-1})'$




(a) *Global Imbalances* (*Foreign*)




(b) *F-statistic*




(c) *p-value*

Table 29: **Equity data - part 1**. The table summarizes the number of firms for a given country and year for which return data is available. The frequency of the data is daily. Data is from Thomson/Reuters DataStream.

| Country | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | 1991 | 1992 | 1993 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | | | | | | | | | | | | | | | | 13 | 14 | 16 | 18 | 28 | 78 |
| Australia | 73 | 74 | 77 | 79 | 82 | 82 | 82 | 84 | 86 | 80 | 90 | 99 | 100 | 112 | 127 | 250 | 336 | 330 | 370 | 407 | 484 |
| Austria | 15 | 13 | 10 | 9 | 12 | 9 | 15 | 11 | 12 | 16 | 15 | 14 | 27 | 24 | 30 | 27 | 49 | 67 | 69 | 78 | 85 |
| Belgium | 34 | 40 | 39 | 40 | 36 | 37 | 39 | 39 | 40 | 41 | 41 | 44 | 48 | 80 | 92 | 86 | 88 | 89 | 85 | 88 | 93 |
| Brazil | | | | | | | | | | | | | | | | | | 10 | 16 | 24 | 40 |
| Bulgaria | | | | | | | | | | | | | | | | | | | | | |
| Chile | | | | | | | | | | | | | | | | | 83 | 101 | 109 | 120 | 138 |
| Colombia | | | | | | | | | | | | | | | | | | | | 34 | 32 |
| Croatia | | | | | | | | | | | | | | | | | | | | | |
| Czech Republic | | | | | | | | | | | | | | | | | | | | | 94 |
| Denmark | 22 | 29 | 14 | 9 | 16 | 15 | 16 | 19 | 18 | 35 | 39 | 39 | 44 | 45 | 43 | 137 | 151 | 156 | 181 | 191 | 209 |
| Ecuador | | | | | | | | | | | | | | | | | | | | | |
| Egypt | | | | | | | | | | | | | | | | | | | | | |
| Estonia | | | | | | | | | | | | | | | | | | | | | |
| Finland | | | | | | | | | | | | | | | | 32 | 46 | 56 | 54 | 63 | 68 |
| France | 65 | 70 | 83 | 85 | 87 | 86 | 90 | 94 | 98 | 99 | 98 | 104 | 106 | 113 | 130 | 191 | 466 | 559 | 558 | 550 | 590 |
| Germany | 109 | 111 | 107 | 99 | 112 | 111 | 100 | 110 | 118 | 121 | 123 | 120 | 135 | 148 | 157 | 325 | 375 | 414 | 440 | 416 | 470 |
| Greece | | | | | | | | | | | | | | | | 77 | 78 | 110 | 132 | 147 | 160 |
| Hungary | | | | | | | | | | | | | | | | | | | 13 | 10 | 26 |
| India | | | | | | | | | | | | | | | | 10 | 10 | 867 | 985 | 1110 | 1341 |
| Ireland | 30 | 26 | 31 | 32 | 34 | 37 | 30 | 31 | 35 | 28 | 33 | 24 | 31 | 38 | 48 | 50 | 59 | 49 | 49 | 44 | 53 |
| Israel | | | | | | | | | | | | | | 163 | 181 | 180 | 189 | 196 | 181 | 244 | 450 |
| Italy | 62 | 63 | 64 | 61 | 60 | 60 | 62 | 62 | 66 | 64 | 65 | 61 | 67 | 192 | 222 | 242 | 273 | 297 | 305 | 308 | 320 |
| Japan | 738 | 732 | 751 | 767 | 772 | 781 | 789 | 792 | 804 | 831 | 859 | 890 | 890 | 902 | 1031 | 1603 | 1935 | 2172 | 2371 | 2409 | 2545 |
| Kenya | | | | | | | | | | | | | | | | | | | 22 | 27 | 32 |
| Latvia | | | | | | | | | | | | | | | | | | | | | |
| Lithuania | | | | | | | | | | | | | | | | | | | | | |
| Luxembourg | | | | | | | | | | | | | | | | | | | | 26 | 31 |
| Malaysia | | | | | | | | | | | 15 | 26 | 22 | 182 | 203 | 197 | 229 | 260 | 296 | 350 | 403 |
| Mexico | | | | | | | | | | | | | | | | 55 | 39 | 52 | 85 | 118 | 172 |
| Morocco | | | | | | | | | | | | | | | | | | | | | 14 |
| Netherlands | 97 | 103 | 102 | 100 | 98 | 98 | 103 | 102 | 103 | 110 | 106 | 103 | 119 | 132 | 151 | 145 | 156 | 154 | 151 | 159 | 162 |
| New Zealand | | | | | | | | | | | | | | 6 | 15 | 43 | 49 | 50 | 61 | 75 | 91 |
| Nigeria | | | | | | | | | | | | | | | | | | | | | |
| Norway | | | | | | | | 15 | 25 | 26 | 37 | 40 | 50 | 53 | 54 | 61 | 76 | 87 | 91 | 100 | 122 |
| Pakistan | | | | | | | | | | | | | | | | | | | | 119 | 145 |
| Peru | | | | | | | | | | | | | | | | | | | 15 | 40 | 64 |
| Philippines | | | | | | | | | | | | | | | | | 65 | 77 | 78 | 83 | 126 |
| Poland | | | | | | | | | | | | | | | | | | | | 13 | 16 |
| Portugal | | | | | | | | | | | | | | | | 80 | 90 | 103 | 107 | 99 | 103 |
| Romania | | | | | | | | | | | | | | | | | | | | | |
| Russia | | | | | | | | | | | | | | | | | | | | | |
| Slovakia | | | | | | | | | | | | | | | | | | | | | |
| Slovenia | | | | | | | | | | | | | | | | | | | | | |
| South Korea | | | | | | | | | | | | 269 | 259 | 320 | 362 | 477 | 579 | 619 | 642 | 656 | 667 |
| Spain | | | | | | | | | | | | | | | 45 | 50 | 81 | 94 | 103 | 106 | 113 |
| Sweden | | | | | | | | | | 32 | 40 | 45 | 51 | 59 | 66 | 105 | 147 | 157 | 165 | 188 | 215 |
| Thailand | | | | | | | | | | | | | | | 84 | 120 | 163 | 197 | 263 | 297 | 345 |
| Turkey | | | | | | | | | | | | | | | | 48 | 64 | 93 | 120 | 128 | 149 |
| Ukraine | | | | | | | | | | | | | | | | | | | | | |
| United Kingdom | 1372 | 1238 | 1210 | 1215 | 1249 | 1195 | 1226 | 1365 | 1279 | 1309 | 1330 | 1300 | 1379 | 1342 | 1441 | 1348 | 1277 | 1135 | 1006 | 1104 | 1110 |
| United States | 706 | 712 | 759 | 761 | 743 | 756 | 767 | 843 | 863 | 900 | 983 | 1028 | 1146 | 1314 | 1451 | 1474 | 1514 | 1565 | 1697 | 1863 | 2121 |

Table 30: **Equity data - part 2**. The table summarizes the number of firms for a given country and year for which return data is available. The frequency of the data is daily. Data is from Thomson/Reuters DataStream.

| Country | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | 74 | 75 | 79 | 70 | 61 | 66 | 57 | 49 | 69 | 74 | 67 | 66 | 72 | 72 | 68 | 67 | 74 | 66 | 67 | 63 | 64 |
| Australia | 556 | 598 | 869 | 905 | 910 | 979 | 1084 | 1101 | 1113 | 1173 | 1303 | 1411 | 1536 | 1718 | 1610 | 1635 | 1680 | 1655 | 1616 | 1588 | 1597 |
| Austria | 77 | 86 | 77 | 79 | 87 | 94 | 99 | 99 | 79 | 83 | 74 | 81 | 89 | 98 | 99 | 93 | 94 | 79 | 78 | 73 | 80 |
| Belgium | 109 | 107 | 141 | 167 | 187 | 193 | 180 | 183 | 177 | 168 | 173 | 186 | 189 | 199 | 195 | 212 | 187 | 182 | 157 | 143 | 143 |
| Brazil | 47 | 40 | 56 | 59 | 72 | 107 | 93 | 91 | 91 | 121 | 126 | 114 | 147 | 216 | 213 | 213 | 215 | 231 | 215 | 217 | 213 |
| Bulgaria | | | | | 29 | 27 | 31 | 33 | 41 | 38 | 31 | 30 | 38 | 44 | 48 | 51 | 49 | 55 | 53 | 54 | 55 |
| Chile | 139 | 143 | 129 | 145 | 140 | 132 | 122 | 119 | 110 | 114 | 118 | 119 | 122 | 113 | 116 | 123 | 120 | 123 | 116 | 109 | 108 |
| Colombia | 52 | 43 | 48 | 49 | 36 | 25 | 30 | 36 | 32 | 33 | 40 | 49 | 37 | 43 | 30 | 41 | 42 | 34 | 31 | 33 | 29 |
| Croatia | | | 27 | 42 | 32 | 48 | 43 | 49 | 53 | 67 | 97 | 138 | 151 | 175 | 143 | 138 | 119 | 111 | 105 | 95 | 97 |
| Czech Republic | 135 | 224 | 234 | 157 | 148 | 123 | 93 | 87 | 41 | 44 | 65 | 44 | 28 | 30 | 30 | 22 | 26 | 27 | 26 | 21 | 27 |
| Denmark | 198 | 208 | 214 | 218 | 210 | 216 | 209 | 172 | 153 | 162 | 168 | 166 | 184 | 204 | 207 | 199 | 190 | 180 | 164 | 161 | 151 |
| Ecuador | 8 | 6 | 11 | 7 | 9 | 8 | 2 | 2 | 6 | 5 | 7 | 8 | 4 | 4 | 10 | 11 | 6 | 10 | 8 | 7 | 8 |
| Egypt | | | 58 | 60 | 67 | 101 | 93 | 92 | 108 | 125 | 116 | 110 | 117 | 123 | 130 | 135 | 129 | 128 | 134 | 140 | 150 |
| Estonia | | | 10 | 16 | 19 | 21 | 20 | 19 | 17 | 18 | 24 | 25 | 32 | 36 | 39 | 33 | 30 | 29 | 29 | 28 | 28 |
| Finland | 105 | 110 | 128 | 138 | 150 | 166 | 169 | 164 | 158 | 153 | 148 | 141 | 149 | 146 | 142 | 134 | 136 | 131 | 130 | 129 | 137 |
| France | 638 | 655 | 793 | 880 | 892 | 891 | 937 | 924 | 870 | 828 | 799 | 805 | 853 | 871 | 820 | 811 | 756 | 707 | 666 | 669 | 695 |
| Germany | 466 | 474 | 538 | 596 | 786 | 1127 | 1383 | 1462 | 1418 | 1407 | 1457 | 1566 | 1798 | 1944 | 1958 | 1814 | 1828 | 1600 | 1538 | 1372 | 1384 |
| Greece | 206 | 222 | 230 | 242 | 263 | 292 | 336 | 336 | 338 | 335 | 340 | 320 | 300 | 290 | 280 | 269 | 245 | 231 | 206 | 191 | 178 |
| Hungary | 38 | 43 | 51 | 58 | 69 | 77 | 85 | 76 | 71 | 74 | 76 | 70 | 74 | 67 | 66 | 71 | 74 | 79 | 79 | 74 | 76 |
| India | 1911 | 2763 | 2568 | 2213 | 1943 | 2418 | 1938 | 1744 | 1810 | 1978 | 2059 | 2469 | 2567 | 2877 | 2885 | 3031 | 3209 | 3288 | 3408 | 3250 | 3534 |
| Ireland | 43 | 39 | 42 | 49 | 50 | 51 | 58 | 56 | 51 | 51 | 51 | 53 | 59 | 62 | 62 | 52 | 48 | 47 | 44 | 42 | 43 |
| Israel | 538 | 545 | 560 | 544 | 519 | 620 | 549 | 542 | 476 | 465 | 486 | 529 | 559 | 609 | 556 | 565 | 551 | 523 | 487 | 463 | 436 |
| Italy | 325 | 312 | 331 | 351 | 356 | 406 | 452 | 464 | 551 | 489 | 521 | 552 | 565 | 577 | 569 | 554 | 555 | 534 | 507 | 530 | 545 |
| Japan | 2731 | 2948 | 3041 | 3179 | 3205 | 3326 | 3446 | 3577 | 3634 | 3617 | 3703 | 3802 | 3896 | 3928 | 3872 | 3716 | 3610 | 3546 | 3467 | 3507 | 3539 |
| Kenya | 40 | 30 | 31 | 34 | 35 | 33 | 26 | 34 | 30 | 39 | 36 | 35 | 43 | 46 | 46 | 45 | 45 | 47 | 52 | 50 | 54 |
| Latvia | | | | | 16 | 16 | 15 | 13 | 17 | 24 | 19 | 23 | 19 | 20 | 17 | 17 | 39 | 41 | 44 | 32 | 37 |
| Lithuania | | | | | 41 | 35 | 38 | 31 | 35 | 39 | 40 | 42 | 40 | 39 | 38 | 38 | 37 | 61 | 54 | 53 | 55 |
| Luxembourg | 38 | 38 | 47 | 48 | 50 | 45 | 40 | 48 | 48 | 47 | 53 | 50 | 54 | 62 | 70 | 67 | 70 | 63 | 64 | 79 | 58 |
| Malaysia | 462 | 519 | 613 | 698 | 707 | 717 | 738 | 744 | 752 | 855 | 913 | 956 | 1006 | 961 | 890 | 910 | 917 | 905 | 870 | 880 | 896 |
| Mexico | 145 | 137 | 144 | 141 | 140 | 141 | 113 | 120 | 91 | 93 | 100 | 99 | 107 | 92 | 91 | 106 | 107 | 97 | 114 | 121 | 117 |
| Morocco | 19 | 26 | 21 | 31 | 45 | 44 | 42 | 48 | 46 | 47 | 48 | 56 | 64 | 72 | 79 | 71 | 75 | 76 | 75 | 69 | 70 |
| Netherlands | 156 | 173 | 192 | 197 | 221 | 227 | 211 | 188 | 173 | 165 | 151 | 147 | 154 | 153 | 146 | 137 | 125 | 126 | 115 | 108 | 108 |
| New Zealand | 103 | 101 | 107 | 111 | 110 | 103 | 115 | 110 | 103 | 122 | 146 | 139 | 138 | 132 | 116 | 115 | 112 | 107 | 115 | 128 | 132 |
| Nigeria | | | | | | | 18 | 44 | 39 | 39 | 46 | 31 | 32 | 39 | 27 | 25 | 29 | 24 | 23 | 25 | 31 |
| Norway | 155 | 170 | 197 | 230 | 239 | 223 | 218 | 224 | 230 | 219 | 240 | 296 | 334 | 409 | 415 | 412 | 416 | 407 | 401 | 422 | 440 |
| Pakistan | 164 | 158 | 169 | 194 | 196 | 285 | 245 | 222 | 292 | 289 | 301 | 279 | 253 | 255 | 152 | 235 | 231 | 207 | 222 | 225 | 225 |
| Peru | 85 | 86 | 81 | 82 | 64 | 65 | 61 | 56 | 67 | 70 | 83 | 89 | 91 | 96 | 85 | 107 | 92 | 74 | 64 | 63 | 65 |
| Philippines | 152 | 183 | 202 | 203 | 194 | 200 | 170 | 165 | 135 | 170 | 178 | 184 | 197 | 203 | 180 | 212 | 210 | 229 | 234 | 230 | 235 |
| Poland | 35 | 47 | 66 | 121 | 176 | 193 | 196 | 216 | 200 | 190 | 214 | 244 | 274 | 338 | 361 | 412 | 534 | 709 | 797 | 850 | 855 |
| Portugal | 110 | 102 | 105 | 100 | 96 | 95 | 78 | 67 | 64 | 59 | 60 | 57 | 55 | 55 | 54 | 51 | 54 | 51 | 50 | 51 | 52 |
| Romania | | | 37 | 133 | 179 | 174 | 152 | 116 | 217 | 222 | 266 | 253 | 254 | 426 | 312 | 261 | 256 | 236 | 209 | 207 | 208 |
| Russia | | 14 | 15 | 52 | 28 | 33 | 47 | 73 | 32 | 43 | 52 | 91 | 140 | 197 | 221 | 250 | 277 | 277 | 270 | 235 | 215 |
| Slovakia | | | | | | 23 | 16 | 17 | 15 | 19 | 19 | 10 | 11 | 3 | 5 | 4 | 6 | 6 | 8 | 8 | 9 |
| Slovenia | | | 18 | 38 | 51 | 78 | 86 | 107 | 72 | 60 | 51 | 36 | 25 | 18 | 17 | 12 | 10 | 12 | 13 | 12 | 11 |
| South Korea | 694 | 711 | 903 | 1009 | 956 | 1142 | 1300 | 1411 | 1534 | 1569 | 1574 | 1624 | 1684 | 1766 | 1808 | 1784 | 1792 | 1793 | 1753 | 1798 | 1847 |
| Spain | 111 | 107 | 122 | 135 | 164 | 162 | 164 | 157 | 150 | 139 | 124 | 132 | 139 | 146 | 145 | 136 | 144 | 140 | 134 | 133 | 142 |
| Sweden | 247 | 266 | 290 | 339 | 381 | 417 | 433 | 409 | 390 | 367 | 381 | 405 | 446 | 502 | 507 | 499 | 504 | 501 | 477 | 494 | 533 |
| Thailand | 387 | 407 | 422 | 381 | 342 | 315 | 292 | 316 | 326 | 382 | 402 | 435 | 483 | 467 | 491 | 488 | 508 | 521 | 539 | 562 | 633 |
| Turkey | 171 | 197 | 221 | 250 | 268 | 262 | 288 | 279 | 284 | 282 | 293 | 296 | 309 | 311 | 307 | 307 | 329 | 352 | 381 | 400 | 394 |
| Ukraine | | | | | | | | | | | | | 68 | 89 | 82 | 61 | 53 | 46 | 39 | 36 | 37 |
| United Kingdom | 939 | 1016 | 1170 | 1165 | 1180 | 1209 | 1274 | 1295 | 1313 | 1322 | 1478 | 1684 | 1758 | 1754 | 1615 | 1502 | 1480 | 1386 | 1297 | 1328 | 1366 |
| United States | 2359 | 2615 | 2871 | 2924 | 2787 | 2675 | 2525 | 2472 | 2531 | 2593 | 2721 | 2854 | 2976 | 3202 | 3263 | 3330 | 3466 | 3598 | 3738 | 4005 | 4352 |