Aggregate Information Dynamics*

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Abstract

The amount of information produced in an economy varies over time. To understand financial crises as part of overall macroeconomic movements, we define movements in aggregate economic activity very agnostically and introduce some new ways to characterize aggregate economic activity based on stock prices. We empirically investigate changes in economy-wide measures of economic fragility and of economy-wide information as aggregate economic activity changes based on the level of GDP. We find that our stock price-based measures are significant in predicting recessions with a financial crisis compared to recessions without a financial crisis. We then investigate whether there is a feedback effect to investment from the information produced leading to the reallocation of capital. There is some reallocation in crisis recession, consistent with the banking system being in distress. Finally, we show the presence of a global information factor; information produced in advanced countries can predict financial crises in emerging markets.

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1 Introduction

Financial crises are an important feature of aggregate economic activity. How can we understand how crises are related to movements in aggregate economic activity? We empirically explore this question using simple measures to define aggregate economic activity, which we then characterize with stock price-based measures of the amount of information in the economy and the overall fragility of the economy. We find that recessions with crises are indeed different from recessions without crises: more information is produced prior to a crisis and the economy is more fragile. Higher 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 that there are global information spillovers. The information produced in advanced economies can predict financial crises in emerging markets. Movements in the amount of information produced in an economy are an inherent part of movements in aggregate economic activity.

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. 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). These researchers examined levels 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 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. 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.

In this paper, we start from the beginning by proposing definitions of "recessions" and "growth periods." Our definitions are agnostic, intuitive, and ad hoc. But they are no more ad hoc than making up a smoothing parameter when detrending. There are also financial crises in our data set, a panel of countries. These most often occur at the start of a recession or during a recession. We examine the measures of information in the aggregate economy and the economy's fragility (defined below) prior to and during the different types of aggregate activity. These 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).

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 that 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.

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 collateralized 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 weakly yes. Our stock price-based measures are significant in predicting recessions with a financial crisis compared to recessions without a financial crisis. Recessions with crises are different: more information is produced prior and during a crisis.

We also find a significant global information spillover 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. The answer is yes. These principal components also predict some reallocation.

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 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 episode. Section 4 is about reallocation. The information spillovers from developed economies to emerging market economies is the subject of Section 5. And Section 6 concludes.

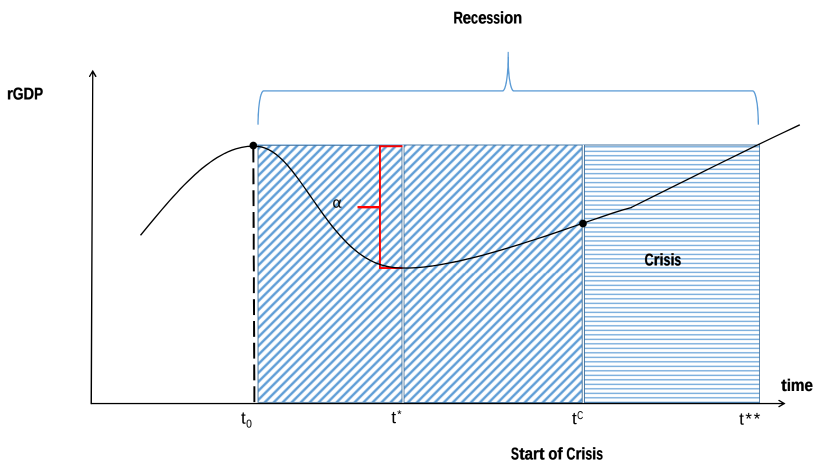
2 Definitions and Data

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 α, and so we say that a recession has started at t_0. The recession continues until the level of real GDP obtains it is 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).

Figure 1: A recession period begins when the minimum quarterly real GDP change over a period of n quarters is less than α. A financial crisis can occur at any point over the course of a recession.



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).[1]

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, nothing, recession, growth, nothing, recession with a crisis, nothing, etc. where "nothing" refers to a period that is neither a recession period nor a growth period. It is a "normal" period.

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.

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 66 growth episodes and

[1] We also look at *growth* periods. A period of *growth* is said to occur when, by the same backward looking procedure we find that rGDP has increased by 0.01.

Table 1: Summary statistics. Duration in years of normal times, growth, recession, recession with crisis, and recession with no crisis episodes. The economic episodes are computed using quarterly real GDP data from the OECD iLibrary over a period of thirty years from 1980 until 2010.

	Count	Mean	StDev	Min	Max
Normal Times	89	2.61	1.92	1.00	9.00
Growth	66	1.55	0.95	1.00	5.00
Recessions	68	2.84	1.39	1.00	7.00
Recessions with Crises	18	3.06	0.94	1.00	5.00
Recessions with No Crises	61	2.26	1.15	1.00	5.00

68 recessions, among which 18 are associated with crises and 61 include instances of no crises.[2]. 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 nonfinancial 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.[3]

[2]There are recession episodes which include both crises and no crises episodes

[3]See the discussion in Gorton (2012), p. 75-77.

We also examine another measure which is the cross section of firms' stock price volatilities, in particular, we look at the standard deviation of firms' volatilities: $CsVol$. In other words, this variable is a cross-section characterization. This variable is related to the cross-section of firms' average returns: $CsAvg$. These two variables are highly correlated, 0.96, so we will restrict attention to $CsVol$. We label this second variable *Information*. "Information" is the name applied because movements in this variable reflect information in stock prices. 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 $1/Vol$ is computed. For each country we find the median $(1/Vol)$ and compute the cross-sectional standard deviation of volatilities. 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 11 and 12 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), patents granted are from the WIPO statistics database, 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, defined below, 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. Later we will use WorldScope data. 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

Table 2: Summary statistics (Annual). The table reports summary statistics for *real GDP in billion* \$, TFP, $Credit/rGDP$, *Labor Productivity in hours*, *Recession Measure*, $\Delta rGDP$, ΔTFP, $\Delta Credit/rGDP$, Δ*Labor Productivity*, $1/Vol$, $CsAvg$, $CsVol$, $\Delta(1/Vol)$, $\Delta CsVol$, and $\Delta CsAvg$. The data are 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 billion \$	618	0.043	0.136	0	0.821
TFP	656	585.407	115.740	187.514	823.585
$Credit/rGDP$	645	85.896	50.568	8.766	232.097
Labor Productivity in hours	645	20.744	7.503	6.520	40.215
Recession Measure	656	-0	0.023	-0.161	0.061
$\Delta rGDP$	607	0.028	0.041	-0.295	0.572
ΔTFP	644	0.003	0.029	-0.179	0.113
$\Delta Credit/rGDP$	633	0.042	0.189	-0.634	2.881
Δ*Labor Productivity*	633	0.019	0.022	-0.110	0.123
$1/Vol$	656	3.406	1.267	0.921	9.367
$CsVol$	656	0.427	0.348	0	3.657
$CsAvg$	656	0.120	0.079	0	0.854
$\Delta(1/Vol)$	639	-0.002	0.949	-4.250	3.403
$\Delta CsVol$	639	0.009	0.298	-1.886	2.181
$\Delta CsAvg$	639	0.002	0.069	-0.403	0.536

with no-crisis episode. Leading to a recession with a crisis, growth in real GDP ($\Delta rGDP$) is lower and α 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 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.[4] In what follows we explore the results

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

Table 3: Summary statistics (all data). The table summarizes mean values for $\Delta rGDP$, α, $1/Vol$, $CsVol$, $\Delta(1/Vol)$, $\Delta CsVol$ 4 quarters prior to the event for (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.

(a) recessions with crises vs. recessions with no-crises

	No-Crisis	Crisis	Mean Diff.
$\Delta rGDP$	0.031	-0.010	0.041***
			(11.62)
α	0.003	-0.030	0.032***
			(22.06)
$1/Vol$	3.522	2.609	0.913***
			(10.38)
$CsVol$	0.396	0.553	-0.157***
			(-6.45)
$CsAvg$	0.113	0.152	-0.039***
			(-7.10)
$\Delta(1/Vol)$	0.005	-0.090	0.095*
			(2.02)
$\Delta CsVol$	0.000	0.025	-0.025
			(-1.28)
$\Delta CsAvg$	-0.000	0.006	-0.006
			(-1.31)
N	102	21	81

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

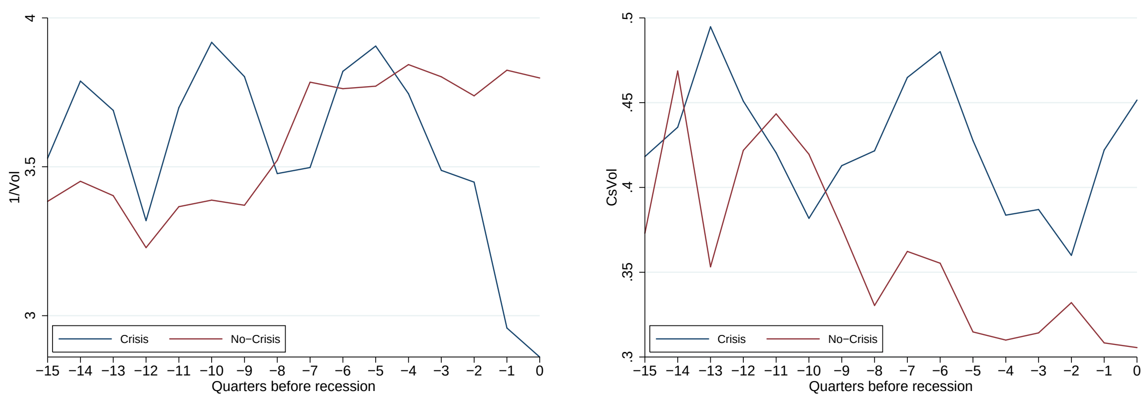
(b) recessions vs. growth

	Recession	Growth	Mean Diff.
$\Delta rGDP$	0.024	0.041	-0.017***
			(-6.89)
α	-0.001	0.006	-0.007***
			(-6.34)
$1/Vol$	3.484	3.296	0.187**
			(3.03)
$CsVol$	0.408	0.414	-0.006
			(-0.34)
$CsAvg$	0.115	0.123	-0.008*
			(-1.99)
$\Delta(1/Vol)$	0.004	-0.028	0.031
			(0.97)
$\Delta CsVol$	0.002	0.002	0.001
			(0.04)
$\Delta CsAvg$	0.001	0.000	0.000
			(0.14)
N	114	166	-52

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

in the figures econometrically.

Figure 2: Average Distance to Insolvency, Cross-Sectional Volatility, and Cross-Sectional Average Returns over 15 quarters before the beginning of: (a) a recession with a crisis, and (b) a recession without a crisis.



(a) 1/Volatility

(b) Cross-sectional Volatility

We also conduct univariate comparisons of variables *during* the course of different types of aggregate events. Table 14a shows a univariate comparison of key variables *during* recessions versus periods of no recession (the complement of recession). By definition of a recession, growth in real GDP ($\Delta rGDP$) is lower and so α 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

Table 4: Summary statistics (all data). The table summarizes mean values for $\Delta rGDP$, α, $1/Vol$, $CsVol$, $\Delta(1/Vol)$, $\Delta CsVol$ for (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.

(a) recessions with crises vs. recessions with no-crises

	No-Crisis	Crisis	Mean Diff.
$\Delta rGDP$	-0.006	-0.011	0.005
			(1.09)
α	-0.020	-0.045	0.024***
			(11.40)
$1/Vol$	3.604	2.499	1.105***
			(10.32)
$CsVol$	0.332	0.630	-0.297***
			(-9.24)
$CsAvg$	0.100	0.170	-0.070***
			(-9.37)
$\Delta(1/Vol)$	0.002	0.027	-0.026
			(-0.45)
$\Delta CsVol$	0.007	0.024	-0.017
			(-0.81)
$\Delta CsAvg$	0.002	0.004	-0.002
			(-0.48)
N	503	210	293

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

(b) recessions vs. growth

	Recession	Growth	Mean Diff.
$\Delta rGDP$	-0.008	0.071	-0.079***
			(-27.25)
α	-0.028	0.017	-0.045***
			(-35.61)
$1/Vol$	3.277	3.395	-0.119
			(-1.56)
$CsVol$	0.420	0.404	0.016
			(0.75)
$CsAvg$	0.121	0.119	0.002
			(0.38)
$\Delta(1/Vol)$	0.009	-0.047	0.056
			(1.48)
$\Delta CsVol$	0.012	0.002	0.010
			(0.65)
$\Delta CsAvg$	0.002	0.002	0.001
			(0.21)
N	713	524	189

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

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

Table 14b compares crises with the complement of crises (no-crises). The levels of all of the information variables are significantly different. Finally, Table 4b shows that in terms of information production recession periods are not different from growth periods.

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 (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 5: Predictive regressions. The table summarizes the predictive power of 1/Vol, cross-sectional volatility, and of the change in cross-sectional volatility on our measure of recession. The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country fixed effects. The specifications are: $y_{n,t} = \alpha_n + \beta' X_{n,t-1} + \epsilon_{n,t}$, and $Pr(y_{n,t}|X_{n,t-1}) = \Phi(\alpha_n + \beta' X_{n,t-1})$, where $X_{n,t-1} = (1/Vol_{n,t-1}, CsVol_{n,t-1}, \Delta Vol_{n,t-1}, \Delta CsVol_{n,t-1})'$.

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

	(1) Linear	(2) Logit
$1/Vol_{t-2}$	-0.065*	-0.362^{+}
	(-2.05)	(-1.87)
$CsVol_{t-2}$	0.041	0.187
	(0.99)	(0.94)
$\Delta(1/Vol)_{t-1}$	-0.029	-0.161
	(-1.03)	(-0.99)
$\Delta CsVol_{t-1}$	0.024	0.108
	(1.07)	(0.98)
Constant	0.079	-0.382
	(0.56)	(-0.63)
N	3150	3077
R^2	0.08	.
F	38.00	.
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) $y_{n,t} = \mathbb{1}_{n,t}(Recession \cap Crisis)$

	(1) Linear	(2) Logit
$1/Vol_{t-2}$	-0.075***	-2.032***
	(-3.85)	(-4.44)
$CsVol_{t-2}$	0.127**	1.137*
	(2.63)	(2.08)
$\Delta(1/Vol)_{t-1}$	-0.036*	-1.033*
	(-2.08)	(-2.23)
$\Delta CsVol_{t-1}$	0.080**	0.703*
	(2.61)	(2.10)
Constant	0.002	2.329^{+}
	(0.04)	(1.90)
N	2693	2167
R^2	0.15	.
F	10.16	.
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 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 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.[5]

On the other hand, a decrease in the information produced in the economy, predicts a recession without a crisis. Appendix Table 17 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.[6] Combining this finding with

[5]The predictive power of information measures is apparent up to two years before the event (Table 16).
[6]This finding holds up to five years before the event, whereas the measure of fragility has no predictive ability for recessions

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 of the recession).

Table 6: Predictive regressions (Logit). The table summarizes the explanatory power of $1/Vol$, cross-sectional volatility, the change in $1/Vol$, cross-sectional volatility, credit, TFP, labor productivity, and patents granted: on the occurrence of a recession (col.1), on the interaction of recession years with financial crisis years (col.2), on the interaction of recession years with non-crisis years (col.3), on the interaction of no-recession years with financial crisis years (col.4), and on growth years (col.5). The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country fixed effects, and standard errors are clustered at the country and year level.

	(1) Recession	(2) Recession×Crisis	(3) Recession×No-Crisis	(4) No-Recession×Crisis	(5) Growth
$1/Vol_{t-2}$	0.025	-0.851	0.213	-0.418	-0.117
	(0.14)	(-1.36)	(1.19)	(-0.91)	(-0.50)
$CsVol_{t-2}$	-0.489	2.545^{+}	-2.561*	-5.966	-0.354
	(-0.75)	(1.93)	(-2.36)	(-1.48)	(-0.77)
$\Delta(1/Vol)_{t-1}$	-0.342	-1.123***	-0.068	-0.051	0.216
	(-1.48)	(-3.33)	(-0.47)	(-0.25)	(0.78)
$\Delta CsVol_{t-1}$	0.155	1.432*	-1.061**	-2.223	0.100
	(0.48)	(2.23)	(-2.73)	(-1.61)	(0.28)
$\Delta Credit_{t-1}$	-0.204	-0.348	-0.202	-4.079*	0.180
	(-0.31)	(-0.55)	(-0.28)	(-2.24)	(0.48)
ΔTFP_{t-1}	-28.411**	-27.689**	-11.701	5.460	19.395***
	(-2.61)	(-2.74)	(-1.40)	(0.43)	(3.40)
ΔLP_{t-1}	3.879	-0.571	1.193	51.254	-5.097
	(0.52)	(-0.04)	(0.13)	(1.00)	(-0.96)
$\Delta Granted_{t-1}$	-0.151	-0.429	0.074	1.036^{+}	-0.150
	(-0.69)	(-1.52)	(0.36)	(1.90)	(-0.40)
Constant	-0.812	-1.776	-0.709	0.539	-1.587^{+}
	(-1.38)	(-0.86)	(-0.81)	(0.26)	(-1.65)
N	588	507	588	161	567
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

without a crisis (Table 18).

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 a reallocation of capital. If these variables are moving around because they are more or less informative, then we conjecture that they are related to reallocation of capital. But, in a financial crisis the banking system, by definition, is not functioning well. So, it may be hard for high productivity firms to get credit meaning that these firms may not benefit from their technological advantage.

We characterize all firms in the sample by their Tobin's q.[7][8] 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.

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 compute firm level investments as the sum of $CAPEX$ and $R\&D$ expenses. We also compute two measures of the cross-sectional dispersion of *q-ratios* at a country level.[9] The first q-dispersion measure is the standard deviation of q-ratios, and the second is the difference between the 75th percentile and the 25th percentile divided by the median of the *q-ratio*. Table 7 summarizes the data.

Table 7: Summary statistics. Data are from WorldScope and span a period of thirty years from 1980 until 2010. All variables are winsorized at the 1% level.

	Count	Mean	StDev	Min	Max
$(CAPEX + R\&D)/Assets$	2663	0.07	0.03	0.00	0.27
$\Delta((CAPEX + R\&D)/Assets)$	2653	0.05	0.43	-0.79	2.94
Q-ratio	2679	1.91	3.11	0.00	27.77
Δ(*Q-ratio*)	2679	-0.02	0.82	-4.54	3.10
σ(*Q*-ratio) $-$ *Aggregate*	2678	2.29	1.76	0.00	8.35
$(Q75\% - Q25\%)/Q50\% - Aggregate$	2679	1.04	0.33	0.00	2.52

Table 8 compares measures of capital expenditures ($CAPEX$) plus R&D, measures of Tobin's q's, and

[7] 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.
[8] We do not have plant level data or firm level employment for firms in all of the countries of our sample.
[9] Since our right-hand side variables are not at the firm level, we sort firms into quintiles based on their Tobin's q's.

measures of reallocation *during* periods of no recession and recession periods, and no-crisis and crisis periods. We see that $CAPEX$ (divided by total assets) is significantly lower during recessions, and the percentage change is as well. 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 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: Comparison of means (recession versus no-recession, crisis versus no-crisis). Data are from WorldScope and span a period of thirty years from 1980 until 2010. All variables are winsorized at the 1% level.

	No-Recession	Recession	Mean Diff.	No-Crisis	Crisis	Mean Diff.
$(CAPEX + R\&D)/Assets$	0.068	0.061	0.007***	0.062	0.059	0.003
			(5.99)			(1.62)
$\Delta((CAPEX + R\&D)/Assets)$	0.069	0.023	0.046**	0.040	-0.020	0.060^{+}
			(2.65)			(1.78)
Q-ratio	2.044	1.665	0.379**	1.685	1.612	0.074
			(3.04)			(0.33)
Δ(*Q-ratio*)	-0.026	-0.008	-0.018	-0.005	-0.017	0.013
			(-0.54)			(0.24)
σ(*Q*-ratio) $-$ *Aggregate*	2.466	1.989	0.477***	1.865	2.304	-0.438***
			(6.82)			(-3.60)
$(Q75\% - Q25\%)/Q50\% - Aggregate$	1.057	1.012	0.045***	0.987	1.075	-0.088***
			(3.42)			(-3.91)
No. of observations	1705	974	731	699	275	424

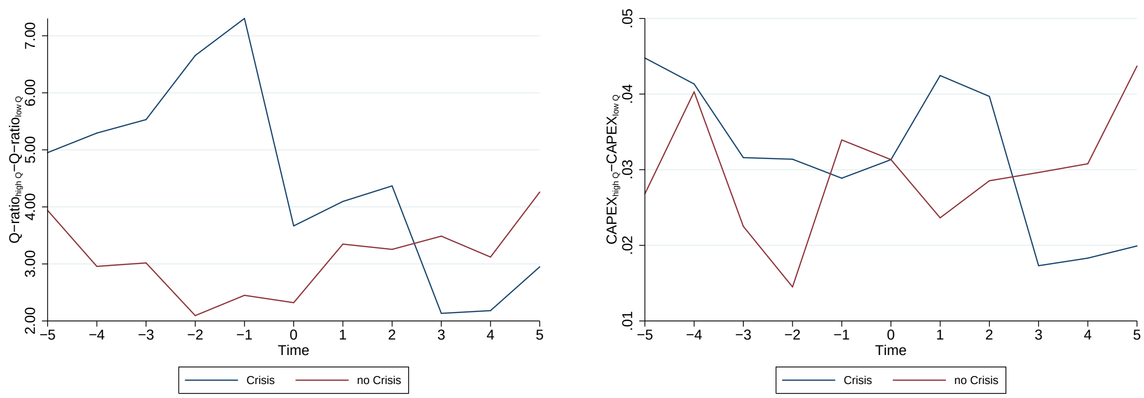
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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 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. *q-ratios* are defined as the ratio of *market capitalization* + *liabilities* divided by the book value of *equity* + *liabilities*. 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 for the fraction of firms that remain in the same quintile or switch quintiles over the course of an economic episode (recession with crisis, recession with no-crisis, normal period, growth period). Table 21 compares these fractions for a recessions with crises and recessions without crises. It immediately becomes clear that the fraction of firms remaining in the first quintile over the course of a crisis recession episode is smaller than that over the course of a non-crisis recession episode. The second and third row of Table 21 suggest that the fraction of firms that does not remain in the first quintile, switches from the first to the second and the third quintile.

Table 9 provides evidence in favor of the proposed link between production of information and reallocation of resources in the economy. The table summarizes the predictive power of $1/Vol$, $\Delta 1/Vol$, cross-sectional volatility ($CsVol$), change in cross-sectional volatility ($\Delta CsVol$), and their interaction with a dummy indicating the occurrence of a crisis 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. In column (1) of Table 9 we observe that an increase in the information measure four years prior to a financial crisis predicts a decrease in the fraction of firms remaining in the lowest quintile of *q-ratios* over the course of the recession with crisis episode. Columns (2) and (3) suggest that firms which do not remain in quintile 1 during crisis episodes, switch to quintiles 2 and 3.[10] In the following section we revisit the issue of reallocation by focusing on the predictive power of global information measures on the occurrence of economic episodes (recession, recession with a crisis, recession without a crisis, normal times, and growth) and reallocation of resources.

Table 9: Predictive regression. The table summarizes the predictive power of $1/Vol$, $\Delta 1/Vol$, cross-sectional volatility ($CsVol$), change in cross-sectional volatility ($\Delta CsVol$), and their interaction with a dummy indicating a crisis 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. All fractions are computed for a single economic episode (recession with crisis, recession with no-crisis, normal periods, growth periods). The regression specification is: $fr(Qx_{start} \to Qy_{end})_{n,t} = \alpha_n + \beta' X_{n,t-4} + \gamma' X_{n,t-4} \mathbb{1}(Crisis)_{n,t} + \epsilon + n, t$, where $X_{n,t-4} = (CsVol_{n,t-5}, \Delta CsVol_{n,t-4}, 1/Vol_{n,t-5}, \Delta(1/Vol)_{t-4})'$ 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) $Q5 \to Q3$
$\Delta CsVol_{t-4}$	0.066	0.012	-0.027*	0.046	-0.027	-0.012
	(0.87)	(0.45)	(-2.44)	(0.94)	(-1.62)	(-0.84)
$\Delta CsVol_{t-4} \times \mathbb{1}_t(Crisis)$	-0.244**	0.085*	0.070	-0.002	-0.035	0.053^{+}
	(-3.49)	(2.46)	(1.63)	(-0.02)	(-0.91)	(1.73)
$\Delta(1/Vol)_{t-4}$	0.050	-0.025	-0.003	-0.005	0.005	-0.001
	(0.99)	(-1.41)	(-0.40)	(-0.11)	(0.40)	(-0.05)
$\Delta(1/Vol)_{t-4} \times \mathbb{1}_t(Crisis)$	-0.011	-0.036	-0.050	-0.027	0.012	0.021
	(-0.12)	(-0.87)	(-1.61)	(-0.29)	(0.36)	(1.03)
$CsVol_{t-5}$	-0.036	-0.008	-0.007	-0.029	-0.001	0.022
	(-0.33)	(-0.27)	(-0.43)	(-0.43)	(-0.04)	(1.07)
$CsVol_{t-5} \times \mathbb{1}_t(Crisis)$	-0.186	0.075	-0.025	-0.029	0.032	0.039
	(-1.15)	(1.05)	(-0.57)	(-0.23)	(0.49)	(1.01)
$1/Vol_{t-5}$	0.001	0.001	-0.002	0.001	-0.001	0.008
	(0.01)	(0.03)	(-0.24)	(0.03)	(-0.08)	(0.98)
$1/Vol_{t-5} \times \mathbb{1}_t(Crisis)$	-0.068*	-0.011	0.009	-0.033	-0.019	-0.002
	(-2.17)	(-0.78)	(0.75)	(-1.04)	(-0.99)	(-0.35)
Constant	0.993*	0.303*	0.156**	0.567**	0.290***	0.051^{+}
	(2.16)	(2.49)	(3.37)	(3.43)	(4.24)	(1.81)
N	170	169	168	180	175	175
R^2	0.43	0.56	0.71	0.51	0.54	0.69
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
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[10]This result is robust for alternative lags of the explanatory variables considered in this specification (Table 22).

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, Austria, Belgium, Denmark, France, the United Kingdom, Ireland, Japan, the Netherlands, and the United States.[11] 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 90% 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.[12] 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.

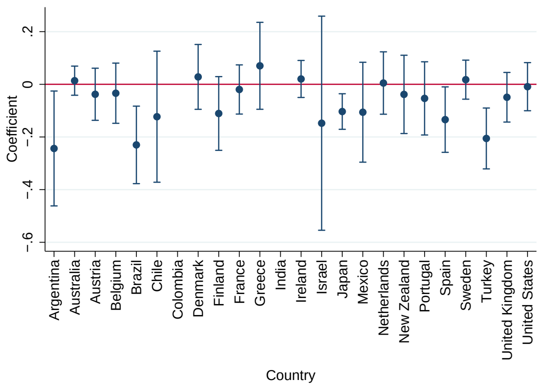
Next we revisit the issue of reallocation, this time using the principal components. The results are shown in Table 10. As before the significance is mostly with the low quintiles. If we focus on the coefficient of the second principal component of the information measure we observe that during a crisis, the fraction of firms in quintile 1 tends decrease, and that of firms in quintiles 2 and 3 to increase.[13] However, the coefficient is statistically significant only for column (1). The coefficients of the information measures are similar to those reported in Table 9, however their predictive power is significantly smaller.

[11] 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.

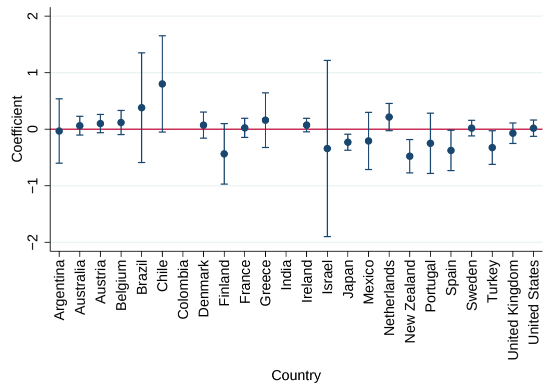
[12] Since we employ principal components as explanatory variables, it is hard to accurately identify their nature and the fundamental information that they summarize.

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

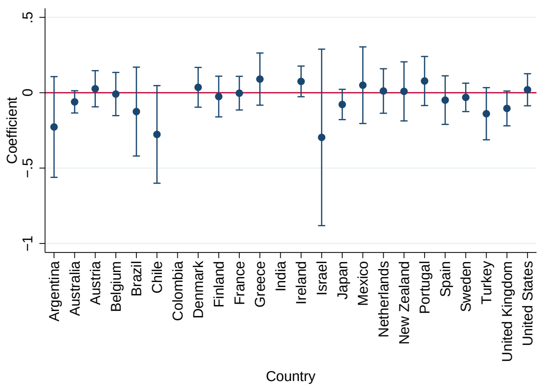
Figure 4: Predictive regressions. Figures (a) through (d) summarize the predictive power of the first two principal components of $1/Vol$ and $CsVol$ on the occurrence of recessions. Figures (e) and (f) report the *F-statistic* its *p-value* respectively. All regressions are performed at the country level and standard errors are corrected using Newey-West (1987) with one lag. The regression specification is: $\mathbb{1}_t(Recession) = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_{t-1} = (PC1(1/Vol_{t-1}), PC2(1/Vol_{t-1}), PC1(CsVol_{t-1}), PC2(CsVol_{t-1}), \Delta Credit_{t-1}, \Delta TFP_{t-1}, \Delta LP_{t-1})'$



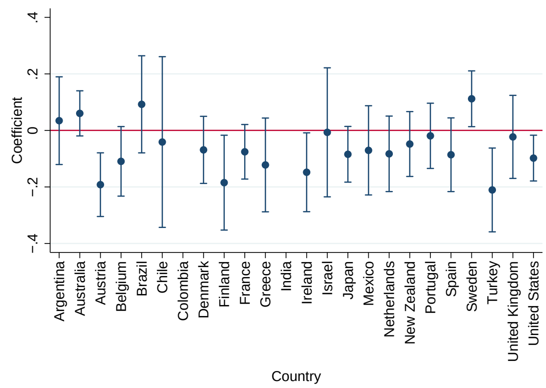
(a) $PC1\ 1/Volatility$



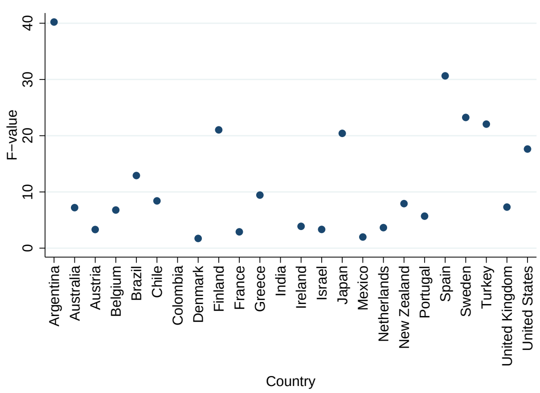
(b) $PC2\ 1/Volatility$



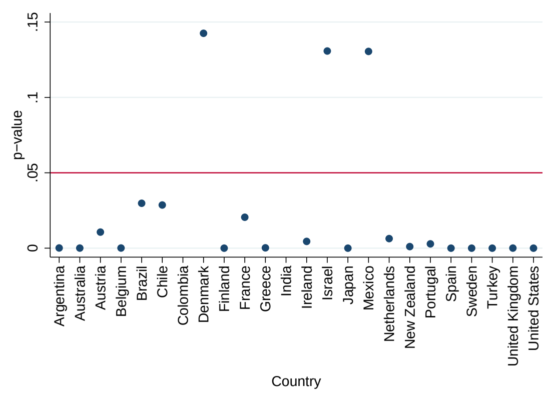
(c) $PC1\ Cross\text{-}Sectional\ Volatility$



(d) $PC2\ Cross\text{-}Sectional\ Volatility$

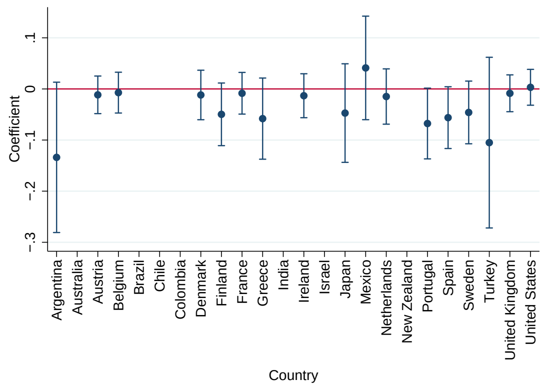


(e) *F-statistic*

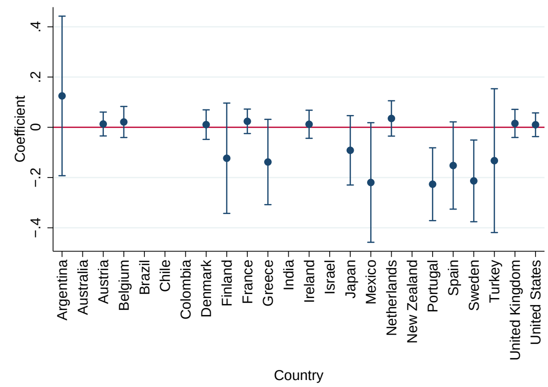


(f) *p-value*

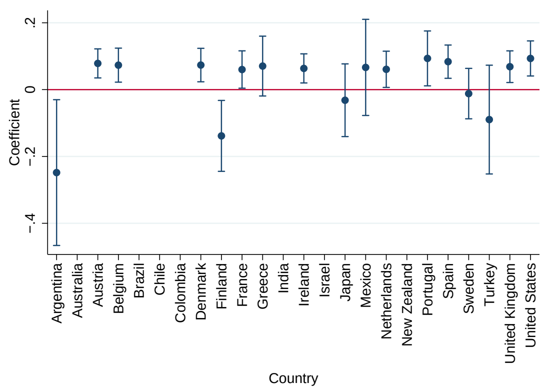
Figure 5: Predictive regressions. Figures (a) through (d) summarize the predictive power of the first two principal components of $1/Vol$ and $CsVol$ on the occurrence of recessions with crises. Figures (e) and (f) report the *F-statistic* its *p-value* respectively. All regressions are performed at the country level and standard errors are corrected using Newey-West (1987) with one lag. The regression specification is: $\mathbb{1}_t(Recession \cap Crisis) = \alpha + \beta' X_{t-1} + \epsilon_t$, where $X_{t-1} = (PC1(1/Vol_{t-1}), PC2(1/Vol_{t-1}), PC1(CsVol_{t-1}), PC2(CsVol_{t-1}), \Delta Credit_{t-1}, \Delta TFP_{t-1}, \Delta LP_{t-1})'$



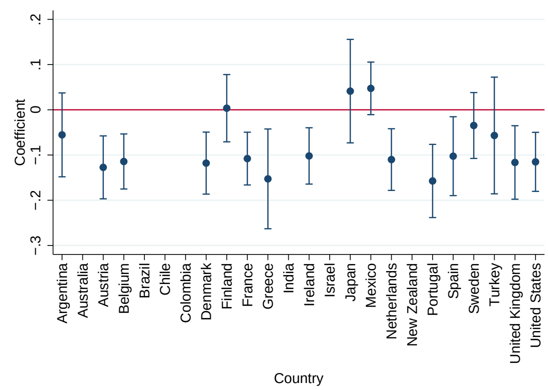
(a) $PC1$ $1/Volatility$



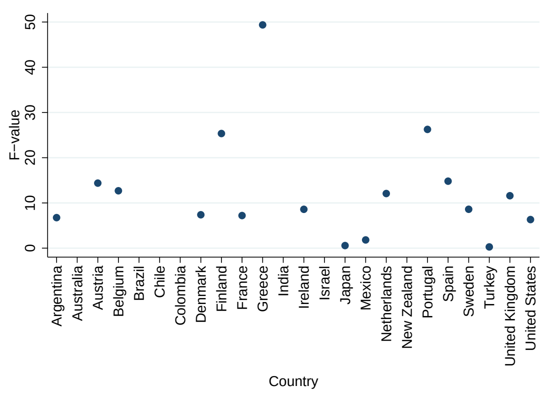
(b) $PC2$ $1/Volatility$



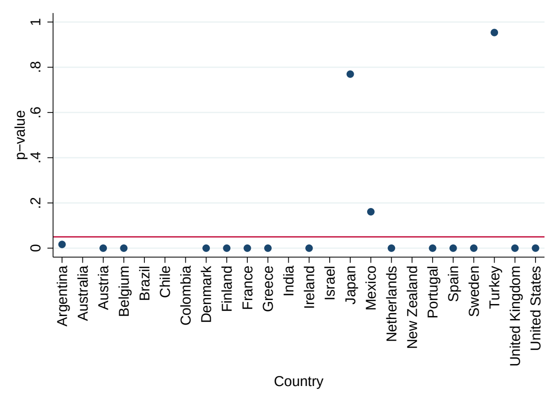
(c) $PC1$ *Cross-Sectional Volatility*



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



(e) *F-statistic*



(f) *p-value*

Table 10: Predictive regression. The table summarizes the predictive power of the first two principal components of $1/Vol$ and $CsVol$ 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. All fractions are computed for a single economic episode (recession with crisis, recession with no-crisis, normal periods, growth periods). The regression specification is: $fr(Qx_{start} \to Qy_{end})_{n,t} = \alpha + \beta' X_{t-1} + \gamma' X_{t-1} \times \mathbb{1}(Recession \times Crisis)_t + \epsilon_t$, where $X_{t-1} = (PC1(1/Vol_{t-1}), PC2(1/Vol_{t-1}), PC1(CsVol_{t-1}), PC2(CsVol_{t-1}))'$ 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) $Q5 \to Q3$
$PC1\ 1/Vol_{t-1}$	-0.086	-0.061	0.024	-0.031	0.034	-0.011
	(-1.01)	(-1.11)	(0.76)	(-0.74)	(1.60)	(-0.82)
$PC1\ 1/Vol_{t-1} \times \mathbb{1}(Recession \times Crisis)_t$	0.140^{+}	-0.063^{**}	-0.013	0.066	-0.021	-0.018
	(1.95)	(-3.65)	(-0.53)	(0.93)	(-0.66)	(-0.85)
$PC2\ 1/Vol_{t-1}$	-0.752	-0.199	0.434	-0.146	0.490^{***}	-0.008
	(-1.53)	(-0.37)	(1.37)	(-0.56)	(3.82)	(-0.10)
$PC2\ 1/Vol_{t-1} \times \mathbb{1}(Recession \times Crisis)_t$	0.467^{**}	-0.105^{***}	-0.032	0.218	-0.007	-0.031
	(3.11)	(-4.64)	(-0.65)	(1.42)	(-0.09)	(-0.61)
$PC1\ CsVol_{t-1}$	-0.058	0.042	-0.039	-0.029	0.031	-0.013
	(-0.51)	(0.35)	(-0.64)	(-0.50)	(1.04)	(-0.79)
$PC1\ CsVol_{t-1} \times \mathbb{1}(Recession \times Crisis)_t$	0.048	-0.019	0.025	-0.010	-0.023	-0.008
	(0.56)	(-0.91)	(0.73)	(-0.10)	(-0.44)	(-0.25)
$PC2\ CsVol_{t-1}$	0.048	-0.047^{*}	-0.003	-0.005	-0.014	-0.020^{*}
	(0.77)	(-2.54)	(-0.27)	(-0.16)	(-0.96)	(-2.11)
$PC2\ CsVol_{t-1} \times \mathbb{1}(Recession \times Crisis)_t$	0.124^{+}	-0.033	-0.028	0.031	-0.002	-0.014
	(1.96)	(-1.32)	(-1.14)	(0.48)	(-0.09)	(-0.63)
Constant	0.599^{***}	0.094	0.228	0.582^{***}	0.291^{***}	0.061^{***}
	(6.90)	(0.36)	(1.62)	(9.87)	(10.98)	(4.13)
N	213	121	121	214	215	216
R^2	0.36	0.57	0.55	0.42	0.30	0.33
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
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6 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 ask whether general economy-wide measures of information move with aggregate economic activity. We further explore the effect of information production on reallocation of resources in the economy. We find that it leads to little reallocation, although firms do move from quintile 1 to quintiles 2 and 3. Finally, we compute the principal components of fragility and information measures respectively and document information spillovers from developed countries to emerging market economies.

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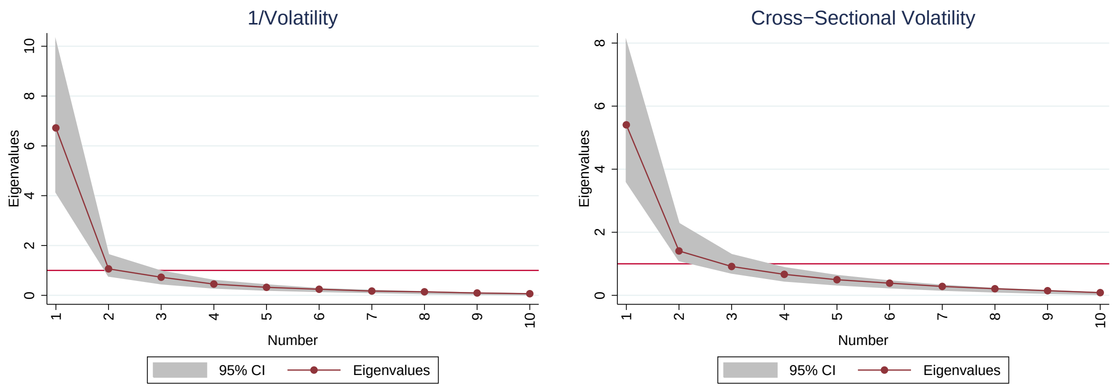
Appendices

A Figures

Figure 6: The figure summarizes the eigenvalues of the first ten principal components along with a 95% confidence interval for $1/Vol$ and $CsVol$. We compute the principal components of $1/Vol$ and $CsVol$ using a panel of countries with available stock market data from 1973 until 2010. The panel of countries includes Australia, Austria, Belgium, Denmark, France, United Kingdom, Ireland, Japan, Netherlands, and United States.



(a) $1/Volatility$ (b) $Cross\text{-}Sectional\ Volatility$

B Tables

Table 11: Correlations (quarterly data). The table summarizes correlations for $1/Vol$, $CsVol$, and $CsAvg$ (Panel A), and $\Delta(1/Vol)$, $\Delta CsVol$, and $\Delta CsAvg$ (Panel B).

A. Levels

	$1/Vol$	$CsVol$	$CsAvg$
$1/Vol$	1.000		
$CsVol$	-0.338***	1.000	
$CsAvg$	-0.422***	0.963***	1.000

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

B. Changes

	$\Delta(1/Vol)$	$\Delta CsVol$	$\Delta CsAvg$
$\Delta(1/Vol)$	1.000		
$\Delta CsVol$	-0.082***	1.000	
$\Delta CsAvg$	-0.116***	0.938***	1.000

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

Table 12: Correlations (annual data). The table summarizes correlations for $1/Vol$, $CsVol$, and $CsAvg$ (Panel A), and $\Delta(1/Vol)$, $\Delta CsVol$, and $\Delta CsAvg$ (Panel B).

A. Levels

	$1/Vol$	$CsVol$	$CsAvg$
$1/Vol$	1.000		
$CsVol$	-0.372***	1.000	
$CsAvg$	-0.455***	0.955***	1.000

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

B. Changes

	$\Delta(1/Vol)$	$\Delta CsVol$	$\Delta CsAvg$
$\Delta(1/Vol)$	1.000		
$\Delta CsVol$	-0.189***	1.000	
$\Delta CsAvg$	-0.211***	0.941***	1.000

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

Table 13: Correlations (Annual data). The table summarizes correlations for $1/Vol$, $CsVol$, $CsAvg$, $\Delta(1/Vol)$, $\Delta CsVol$, $\Delta CsAvg$, $\Delta Credit$, ΔTFP, ΔLP, $\Delta Granted$.

	$1/Vol$	$CsVol$	$CsAvg$	$\Delta(1/Vol)$	$\Delta CsVol$	$\Delta CsAvg$	$\Delta Credit$	ΔTFP	ΔLP	$\Delta Granted$	$CrSpread$
$1/Vol$	1.000										
$CsVol$	-0.464***	1.000									
$CsAvg$	-0.520***	0.958***	1.000								
$\Delta(1/Vol)$	0.380***	-0.096+	-0.116*	1.000							
$\Delta CsVol$	-0.108*	0.459***	0.451***	-0.244***	1.000						
$\Delta CsAvg$	-0.120*	0.429***	0.476***	-0.276***	0.941***	1.000					
$\Delta Credit$	-0.031	0.038	0.046	-0.077	0.013	0.038	1.000				
ΔTFP	0.082+	-0.028	-0.041	-0.085+	-0.052	-0.030	-0.054	1.000			
ΔLP	0.098*	-0.088+	-0.112*	-0.004	-0.066	-0.083+	-0.083+	0.479***	1.000		
$\Delta Granted$	-0.008	0.003	-0.002	0.064	-0.028	-0.040	-0.035	0.024	0.027	1.000	
$CrSpread$	-0.071	0.041	0.069	-0.040	0.018	0.031	0.048	0.033	-0.029	-0.017	1.000

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

Table 14: Summary statistics (all data). The table summarizes mean values for $\Delta rGDP$, α, $1/Vol$, $CsVol$, $\Delta(1/Vol)$, $\Delta CsVol$ for (i) recessions vs. no-recessions, and (ii) recessions with crises vs. no-crises. The third column reports the difference in means and the t-statistic of the difference.

(a) recessions vs. no-recessions

	No-Recession	Recession	Mean Diff.
$\Delta rGDP$	0.041	-0.008	0.048***
			(24.16)
α	0.009	-0.028	0.037***
			(50.85)
$1/Vol$	3.508	3.277	0.231***
			(4.25)
$CsVol$	0.412	0.420	-0.008
			(-0.52)
$CsAvg$	0.117	0.121	-0.005
			(-1.28)
$\Delta(1/Vol)$	-0.002	0.009	-0.011
			(-0.38)
$\Delta CsVol$	-0.001	0.012	-0.013
			(-1.07)
$\Delta CsAvg$	-0	0.002	-0.003
			(-0.99)
N	1910	713	1197

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

(b) recessions with crises vs. no-crises

	No-Crisis	Crisis	Mean Diff.
$\Delta rGDP$	0.031	-0.011	0.042***
			(12.03)
α	0.003	-0.045	0.048***
			(34.48)
$1/Vol$	3.528	2.499	1.029***
			(11.84)
$CsVol$	0.396	0.630	-0.234***
			(-9.30)
$CsAvg$	0.113	0.170	-0.057***
			(-10.07)
$\Delta(1/Vol)$	-0.001	0.027	-0.028
			(-0.61)
$\Delta CsVol$	0.001	0.024	-0.024
			(-1.20)
$\Delta CsAvg$	0	0.004	-0.004
			(-0.91)
N	2413	210	2203

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

Table 15: Predictive regressions (Logit). The table summarizes the predictive power of lagged 1/Vol, cross-sectional volatility, and of the change in cross-sectional volatility on our measure of recession. The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country fixed effects.

	(1) q=0	(2) q=1	(3) q=2	(4) q=3	(5) q=4	(6) q=8
$1/Vol_{t-q-1}$	-0.343^{+}	-0.362^{+}	-0.366^{+}	-0.350^{+}	-0.288^{+}	-0.003
	(-1.75)	(-1.87)	(-1.94)	(-1.93)	(-1.75)	(-0.02)
$CsVol_{t-q-1}$	0.237	0.187	0.136	0.064	0.046	0.071
	(1.28)	(0.94)	(0.65)	(0.30)	(0.21)	(0.31)
$\Delta(1/Vol)_{t-q}$	-0.135	-0.161	-0.206	-0.249	-0.324*	-0.027
	(-0.94)	(-0.99)	(-1.41)	(-1.58)	(-2.23)	(-0.23)
$\Delta CsVol_{t-q}$	0.193^{+}	0.108	0.189	0.134	0.101	0.068
	(1.84)	(0.98)	(1.61)	(1.02)	(0.75)	(0.50)
N	3100	3077	3054	3031	3008	2916
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
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

$$Pr(\mathbb{1}_{n,t}(Recession) = 1|X_{t-q}) = \Phi(\alpha_n + \beta' X_{t-q})$$
$$X_{n,t-q} = (1/Vol_{n,t-q}, CsVol_{n,t-q}, \Delta Vol_{n,t-q}, \Delta CsVol_{n,t-q})'$$

Table 16: Predictive regressions (Logit). The table summarizes the predictive power of lagged 1/Vol, cross-sectional volatility, and of the change in cross-sectional volatility on our measure of recession interacted with the occurrence of a crisis during that period. The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country fixed effects.

	(1) q=0	(2) q=1	(3) q=2	(4) q=3	(5) q=4	(6) q=8
$1/Vol_{t-q-1}$	-1.910***	-2.032***	-1.955***	-1.732***	-1.493***	-0.425
	(-3.84)	(-4.44)	(-4.98)	(-4.89)	(-4.33)	(-1.63)
$CsVol_{t-q-1}$	1.470*	1.137*	0.884^{+}	0.731	0.690	0.990
	(2.45)	(2.08)	(1.75)	(1.53)	(1.41)	(1.61)
$\Delta(1/Vol)_{t-q}$	-0.871*	-1.033*	-1.315***	-1.162**	-1.167***	-0.492
	(-2.16)	(-2.23)	(-3.34)	(-3.21)	(-3.33)	(-1.50)
$\Delta CsVol_{t-q}$	0.895*	0.703*	0.662^{+}	0.439	0.427	0.674*
	(2.42)	(2.10)	(1.89)	(1.31)	(1.41)	(2.11)
N	2182	2167	2152	2137	2122	2062
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
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

$$Pr(\mathbb{1}_{n,t}(Recession \cap Crisis) = 1|X_{t-q}) = \Phi(\alpha_n + \beta' X_{t-q})$$
$$X_{n,t-q} = (1/Vol_{n,t-q}, CsVol_{n,t-q}, \Delta Vol_{n,t-q}, \Delta CsVol_{n,t-q})'$$

Table 17: Predictive regressions. The table summarizes the predictive power of 1/Vol, cross-sectional volatility, and of the change in cross-sectional volatility on our measure of recession interacted with the non-occurrence of a crisis during that period. The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country fixed effects.

	(1) Linear	(2) Logit
$1/Vol_{t-2}$	0.020	0.085
	(0.78)	(0.49)
$CsVol_{t-2}$	-0.141**	-1.704*
	(-3.21)	(-2.29)
$\Delta(1/Vol)_{t-1}$	0.011	0.050
	(0.52)	(0.37)
$\Delta CsVol_{t-1}$	-0.065***	-0.799*
	(-3.52)	(-2.45)
Constant	0.097	-1.260
	(1.40)	(-1.56)
N	2693	2636
R^2	0.05	.
F	13.16	.
Cluster (Time)	YES	YES
Cluster (Country)	YES	YES
FE (Country)	YES	YES

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

$$\mathbb{1}_{n,t}(Recession \cap no-Crisis) = \alpha_n + \beta' X_{n,t-1} + \epsilon_{n,t}$$
$$Pr(\mathbb{1}_{n,t}(Recession \cap no-Crisis) = 1 | X_{n,t-1}) = \Phi(\alpha_n + \beta' X_{n,t-1})$$
$$X_{n,t-1} = (1/Vol_{n,t-1}, CsVol_{n,t-1}, \Delta Vol_{n,t-1}, \Delta CsVol_{n,t-1})'$$

Table 18: Predictive regressions (Logit). The table summarizes the predictive power of lagged 1/Vol, cross-sectional volatility, and of the change in cross-sectional volatility on our measure of recession interacted with the non-occurrence of a crisis during that period. The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country fixed effects.

	(1) q=0	(2) q=1	(3) q=2	(4) q=3	(5) q=4	(6) q=8
$1/Vol_{t-q-1}$	0.089	0.085	0.078	0.081	0.137	0.402**
	(0.50)	(0.49)	(0.47)	(0.53)	(1.00)	(3.18)
$CsVol_{t-q-1}$	-1.568*	-1.704*	-1.917*	-2.173**	-2.288**	-1.869*
	(-2.33)	(-2.29)	(-2.37)	(-2.66)	(-2.79)	(-2.51)
$\Delta(1/Vol)_{t-q}$	0.049	0.050	0.036	-0.009	-0.071	0.240*
	(0.44)	(0.37)	(0.29)	(-0.08)	(-0.63)	(2.45)
$\Delta CsVol_{t-q}$	-0.631^{+}	-0.799*	-0.717^{+}	-0.983*	-1.035**	-0.919*
	(-1.80)	(-2.45)	(-1.86)	(-2.40)	(-2.60)	(-2.09)
N	2656	2636	2616	2596	2576	2496
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
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

$$Pr(\mathbb{1}_{n,t}(Recession \cap no-Crisis) = 1 | X_{t-q}) = \Phi(\alpha_n + \beta' X_{t-q})$$
$$X_{n,t-q} = (1/Vol_{n,t-q}, CsVol_{n,t-q}, \Delta Vol_{n,t-q}, \Delta CsVol_{n,t-q})'$$

Table 19: Predictive regressions. The table summarizes the predictive power of 1/Vol, cross-sectional volatility, and of the change in cross-sectional volatility on our measure of recession interacted with the occurrence of a growth period. The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country fixed effects.

	(1) Linear	(2) Logit
$1/Vol_{t-2}$	0.030*	0.207^{+}
	(2.11)	(1.95)
$CsVol_{t-2}$	-0.064*	-0.867*
	(-1.97)	(-2.35)
$\Delta(1/Vol)_{t-1}$	0.012	0.079
	(0.97)	(0.88)
$\Delta CsVol_{t-1}$	-0.062*	-0.729**
	(-2.53)	(-2.81)
Constant	0.575***	-2.238***
	(7.56)	(-4.96)
N	3150	3150
R^2	0.10	.
F	12.09	.
Cluster (Time)	YES	YES
Cluster (Country)	YES	YES
FE (Country)	YES	YES

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

$$\mathbb{1}_{n,t}(Growth) = \alpha_n + \beta' X_{n,t-1} + \epsilon_{n,t}$$
$$Pr(\mathbb{1}_{n,t}(Growth) = 1 | X_{n,t-1}) = \Phi(\alpha_n + \beta' X_{n,t-1})$$
$$X_{n,t-1} = (1/Vol_{n,t-1}, CsVol_{n,t-1}, \Delta Vol_{n,t-1}, \Delta CsVol_{n,t-1})'$$

Table 20: Predictive regressions (Logit). The table summarizes the predictive power of lagged 1/Vol, cross-sectional volatility, and of the change in cross-sectional volatility on our measure of recession interacted with the occurrence of a growth period. The panel of countries in the regressions includes all countries in the sample. All regression specifications take into account country fixed effects.

	(1) q=0	(2) q=1	(3) q=2	(4) q=3	(5) q=4	(6) q=8
$1/Vol_{t-q-1}$	0.134	0.207^{+}	0.198^{+}	0.150	0.144	0.133
	(1.31)	(1.95)	(1.77)	(1.21)	(1.24)	(1.45)
$CsVol_{t-q-1}$	-1.118**	-0.867*	-0.679^{+}	-0.741^{+}	-0.777*	-0.619*
	(-2.98)	(-2.35)	(-1.70)	(-1.75)	(-1.96)	(-2.22)
$\Delta(1/Vol)_{t-q}$	-0.115	0.079	0.196*	0.140	0.013	0.037
	(-1.35)	(0.88)	(2.20)	(1.63)	(0.10)	(0.53)
$\Delta CsVol_{t-q}$	-0.549*	-0.729**	-0.321	-0.302	-0.333	-0.312^{+}
	(-2.12)	(-2.81)	(-1.35)	(-1.15)	(-1.31)	(-1.84)
N	3174	3150	3126	3102	3078	2982
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
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

$$Pr(\mathbb{1}_{n,t}(Growth) = 1 | X_{t-q}) = \Phi(\alpha_n + \beta' X_{t-q})$$
$$X_{n,t-q} = (1/Vol_{n,t-q}, CsVol_{n,t-q}, \Delta Vol_{n,t-q}, \Delta CsVol_{n,t-q})'$$

Table 21: Summary Statistics. Comparison of average fractions of firms remaining in the same quintile, or switching quintiles over the course of the episode of a recession associated with a crisis, and a recession associated with no-crisis. The data are from WorldScope and span a period from 1980 until 2010.

	No-Crisis	Crisis	Mean Diff.
% of firms remaining in quintile 1	0.607	0.427	0.180*
			(2.36)
% of firms from quintile 1 *to quintile* 2	0.186	0.213	-0.027
			(-1.00)
% of firms from quintile 1 *to quintile* 3	0.056	0.122	-0.066***
			(-4.05)
% of firms from quintile 1 *to quintile* 4	0.033	0.045	-0.011
			(-0.92)
% of firms from quintile 1 *to quintile* 5	0.017	0.020	-0.003
			(-0.36)
% of firms remaining in quintile 5	0.526	0.444	0.082
			(1.59)
% of firms from quintile 5 *to quintile* 1	0.037	0.037	-0
			(-0.00)
% of firms from quintile 5 *to quintile* 2	0.041	0.034	0.007
			(0.29)
% of firms from quintile 5 *to quintile* 3	0.071	0.089	-0.018
			(-0.96)
% of firms from quintile 5 *to quintile* 4	0.178	0.179	-0.001
			(-0.03)
No. of observations	61	18	43

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

Table 22: Predictive regression. The table summarizes the predictive power of $1/Vol$, $\Delta 1/Vol$, cross-sectional volatility ($CsVol$), change in cross-sectional volatility ($\Delta CsVol$), and their interaction with a dummy indicating a crisis 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. All fractions are computed for a single economic episode (recession with crisis, recession with no-crisis, normal periods, growth periods). The regression specification is: $fr(Qx_{start} \to Qy_{end})_{n,t} = \alpha_n + \beta' X_{n,t-1} + \gamma' X_{n,t-1} \mathbb{1}(Crisis)_{n,t} + \epsilon + n, t$, where $X_{n,t} = (CsVol_{n,t-1}, \Delta CsVol_{n,t}, 1/Vol_{n,t-1}, \Delta(1/Vol)_t)'$ 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) $Q5 \to Q3$
$\Delta CsVol_t$	0.071	0.009	-0.007	0.064	0.002	-0.008
	(0.57)	(0.27)	(-0.56)	(0.85)	(0.06)	(-0.37)
$\Delta CsVol_t \times \mathbb{1}_t(Crisis)$	-0.479*	0.093	0.131^{+}	-0.085	-0.095	0.043
	(-2.45)	(1.48)	(1.69)	(-0.44)	(-1.17)	(0.52)
$\Delta(1/Vol)_t$	0.018	-0.017	-0.005	0.003	-0.018	0.001
	(0.27)	(-0.82)	(-0.43)	(0.09)	(-1.03)	(0.10)
$\Delta(1/Vol)_t \times \mathbb{1}_t(Crisis)$	-0.074	0.026	-0.023	-0.024	0.051	0.003
	(-0.51)	(0.41)	(-0.44)	(-0.23)	(1.00)	(0.15)
$CsVol_{t-1}$	0.073	-0.018	0.024	0.098	0.043	-0.003
	(0.41)	(-0.51)	(1.25)	(0.94)	(0.81)	(-0.08)
$CsVol_{t-1} \times \mathbb{1}_t(Crisis)$	-0.533	0.123*	-0.123	-0.260	-0.054	0.090
	(-1.60)	(2.50)	(-1.46)	(-1.28)	(-0.47)	(1.26)
$1/Vol_{t-1}$	-0.043	0.007	-0.007	-0.009	-0.001	-0.001
	(-0.64)	(0.39)	(-0.62)	(-0.18)	(-0.03)	(-0.09)
$1/Vol_{t-1} \times \mathbb{1}_t(Crisis)$	0.010	0.002	0.018^{+}	0.004	0.004	-0.009
	(0.27)	(0.17)	(1.75)	(0.22)	(0.48)	(-1.18)
Constant	1.016**	0.253**	0.175***	0.562*	0.261^{+}	0.075
	(3.43)	(2.80)	(4.62)	(2.13)	(1.94)	(1.01)
N	215	213	213	225	219	220
R^2	0.35	0.52	0.58	0.43	0.42	0.54
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 23: Predictive regression. The table summarizes the predictive power of the first two principal components of $1/Vol$ and $CsVol$ 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. All fractions are computed for a single economic episode (recession with crisis, recession with no-crisis, normal periods, growth periods). The regression specification is: $fr(Qx_{start} \rightarrow Qy_{end})_{n,t} = \alpha + \beta' X_{t-5} + \gamma' X_{t-5} \times \mathbb{1}(Recession \times Crisis)_t + \epsilon_t$, where $X_{t-5} = (PC1(1/Vol_{t-5}), PC2(1/Vol_{t-5}), PC1(CsVol_{t-5}), PC2(CsVol_{t-5}))'$ 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) $Q1 \rightarrow Q1$	(2) $Q1 \rightarrow Q2$	(3) $Q1 \rightarrow Q3$	(4) $Q5 \rightarrow Q5$	(5) $Q5 \rightarrow Q4$	(6) $Q5 \rightarrow Q3$
$PC1\ 1/Vol_{t-1}$	-0.010	0.043^{+}	0.046^{***}	-0.003	0.024	0.008
	(-0.19)	(1.95)	(5.38)	(-0.10)	(1.38)	(1.01)
$PC1\ 1/Vol_{t-1} \times \mathbb{1}(Recession \times Crisis)_t$	0.311^{*}	-0.019	0.006	0.115	0.032	-0.012
	(2.30)	(-0.44)	(0.18)	(1.06)	(0.52)	(-0.30)
$PC2\ 1/Vol_{t-1}$	1.401	-0.125	-0.122	0.363	-0.576^{*}	-0.066
	(1.54)	(-0.33)	(-0.79)	(0.74)	(-2.58)	(-0.56)
$PC2\ 1/Vol_{t-1} \times \mathbb{1}(Recession \times Crisis)_t$	0.425	-0.030	0.187^{**}	0.010	-0.074	0.029
	(1.37)	(-0.29)	(2.86)	(0.05)	(-0.48)	(0.38)
$PC1\ CsVol_{t-1}$	-0.327	0.018	0.063	-0.107	0.118	0.022
	(-1.07)	(0.20)	(1.64)	(-0.64)	(1.58)	(0.59)
$PC1\ CsVol_{t-1} \times \mathbb{1}(Recession \times Crisis)_t$	0.272^{+}	-0.039	-0.116^{*}	0.235^{*}	0.085	-0.039
	(1.80)	(-0.58)	(-2.21)	(2.25)	(1.19)	(-0.82)
$PC2\ CsVol_{t-1}$	-0.481^{***}	0.100	0.007	-0.067	0.219^{***}	0.038
	(-3.82)	(0.94)	(0.16)	(-0.72)	(4.43)	(1.60)
$PC2\ CsVol_{t-1} \times \mathbb{1}(Recession \times Crisis)_t$	-0.149	0.057	0.276^{**}	-0.326^{*}	-0.133	0.062
	(-0.52)	(0.44)	(3.57)	(-2.12)	(-0.98)	(0.81)
Constant	2.007^{*}	0.193	0.062	0.913^{*}	-0.253	-0.009
	(2.78)	(0.51)	(0.42)	(2.30)	(-1.37)	(-0.10)
N	213	121	121	214	215	216
R^2	0.35	0.55	0.57	0.41	0.30	0.33
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
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$