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Risk Aversion and Financial Crisis

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Abstract

It has long been recognized that variations in expected future cash flows are not enough to account for variations in asset prices. Variation in willingness to bear risk is also needed. Asset pricing theories have accordingly focused on models characterized by preferences that allow for time variation in risk aversion. But what drives this variation? How should preferences be characterized? Do risk attitudes of individuals evolve over time? And if so, what are the triggers of these variations? This chapter will discuss these issues, summarizing what we know about individual preferences for risk and motives for them to change over time. It will also provide some evidence on how these preferences changed during the financial crises.

[1] Forthcoming in "Financial Regulation: A Transatlantic Perspective", Michael Haliassos and Pieter Krahnen (Eds.), Cambridge University Press.

On the traditional view, an explanation of economic phenomena that reaches a difference in tastes between people or times is the terminus of the argument: the problem is abandoned at this point to whoever studies and explains tastes (psychologists? anthropologists? phrenologists'? sociobiologists?). On our preferred interpretation, one never reaches this impasse: the economist continues to search for differences in prices or incomes to explain any differences or changes in behavior.'

George Stigler and Gary Becker (1977)

Introduction

Risk preferences are key parameter for financial decisions. They govern portfolio choice and the demand for insurance, they are central for mortgage contract choice. More generally, they enter any decision that has an element of risk in it. Economists' tendency has long been to regard risk preferences as a given attribute, possibly invariant over time and age and possibly independent of circumstances. The typical and most diffuse characterization of preferences for risk – the CRRA utility – conforms to this view. Under CRRA the risk tolerance is a constant parameter, independent of age, independent of wealth and of the state of the world but possibly varying across individuals for reasons that economists have often avoided asking, partly because, in the classical division of labor across disciplines, economists have chosen to leave the explanation of the origin of preferences and technologies to other interested disciplines and focalize on variation in prices and endowments as driving forces of behavior. This traditional view became rooted in Economics after Stigler and Becker (1977) forcefully theorized it by arguing that "The establishment of the proposition that one may usefully treat tastes as stable over time and similar among people is the central task of this essay."

Times have changed and views too. It is now accepted that economists not only rely on tastes to understand behavior, but they even try to understand what drives differences in preferences across individuals and their change over time, possibly linking these changes to economic phenomena: preferences, far from being part of the data for an economist, become part of the factors used to explain economic phenomena. In turn, changes in the economic environment can alter preferences.

This link is most clear in asset pricing where the idea that risk preference are invariant has long been abandoned. Models that assume invariant preferences are in fact unable to account for the observed variation in the prices of risky assets just relying on variation in assets cash flows. Variation in the risk tolerance of individuals is required in order to match the high variability that we observe in assets prices.

But do individuals' risk attitudes actually change over time? If so, what drives variation in individuals' risky preferences? Are they driven by economic factors or by psychological forces? How do preferences for risk evolve dynamically? How enduring are variations over time in risk attitudes? How should time-varying risk preferences be characterized? In this chapter I will tackle these questions. I will summarize what we know about individual preferences for risk and motives for them to change over time. I will also provide some evidence on how much and why these preferences changed during financial crises. This discussion provides some food for thought for a pending but important issue: is there room for policy and regulatory interventions to affect variation in risk preferences and are interventions of this sort desirable? Needless to say, part of the answer will depend on what drives variation in risk preferences and on the effects of these variations on policy relevant outcomes.

The rest of the chapter is organized as follows. In Section 1 I review several factors than can lead to changing risk aversion distinguishing between economic and non-economic drivers. In Section 2 I provide evidence of what actually matters for changing risk aversion and show evidence of risk aversion changing during the last financial crisis. Conclusions follow.

1. Why can willingness to bear risk vary over time?

The risk aversion that matters for assets pricing is the risk aversion of the average investor. This can change over time because the distribution of wealth across individuals with different but constant risk aversion changes or because the risk aversion of the single individuals changes. Here we will focus on changes in the risk aversion of the single investors.

In turn, there are two reasons why the willingness to bear risk of the individual changes over time. Because the risk aversion *parameter* of the period utility function evolves. Or because the individual endowment evolves and risk preferences are sensitive to the movements of the endowment, which could be the mean or its variance or even higher moments.

2.1 Evolving risk aversion parameter

Suppose the utility function is CRRA, so that the period utility is $u(c) = \frac{c^{1-\lambda}}{1-\lambda}$; the individual relative risk aversion is λ . Rather than being a constant, individuals' willingness to bear risk can be made a function of observables z_{it} and $\lambda = \lambda(z_{it})$. The set of observables can vary across individuals and over time. Differences across individuals contribute to creating heterogeneity in risk aversion in a population and potentially in the aggregate risk aversion as the distribution of wealth changes. Some of the time variations in z_{it}can be specific to the individual; some can be common to all and thus shift the risk aversion of a whole population in the same direction. The former will normally have no effect on the aggregate risk aversion except when idiosyncratic variations happen to be correlated with the wealth of the individuals (and thus with the weights used to aggregate the individual risk aversions); the latter can move the overall risk aversion and have important effects on assets prices. As we will see, financial crisis are episodes of the latter type. The literature has identified several factors of both types.

Time invariant characteristics

Before discussing them, it is worth noticing that several time-invariant, demographic characteristics have been found to correlate with individual risk preferences. Thus, variation over time in the composition of the population across groups with different degree of risk aversion can result in variation over time in the average risk aversion of the population. For instance, several papers find that risk aversion is higher for women than for men.[2] Another robust cross-sectional finding is that education has a positive impact on risk taking (e.g. Vissing-Jørgensen, 2002). Recent research has also established strong correlations between measures of risk preferences and individual intelligence. Shane (2006) finds that in a sample of students, laboratory measures of risk aversion are negatively correlated with IQ scores. This result extends outside the lab and in non-student samples (Dohmen et al. (2010); Beauchamp, Cesarini and Johannesson (2011) in a sample of Swedish twins; Grinblatt, Keloharju, and Linnainmaa (2011); Anderson et al., (2011)). Since IQ seems to have a time trend, this can generate a temporal pattern in the average risk tolerance of the population. But because IQ does not evolve over the business cycle, this channel cannot explain changes in risk aversion at the business cycle frequency.

Interestingly, Anderson et al. (2011) also find that specific components of personality measures, in particular neuroticism (individuals' tendency to experience negative emotional states such as anger, guilt and anxiety) are also correlated with risk aversion. This is interesting because emotional states, such as anger and guilt, are bound to change possibly at high frequency. Anger, in particular, is a sentiment that as documented by Guiso, Sapienza and Zingales (2013) is associated with financial crises

[2] In experimental settings, e.g. Holt and Laury (2002) and Powell and Ansic (1997). Using field data and surveys, Hartog, Ferrer-i-Carbonell and Jonker (2002), Dohmen et al. (2011), Guiso and Paiella (2008), Kimball, Sahm and Shapiro (2008) among others. Croson and Gneezy (2009) survey the literature and warn about the bias that only papers finding a gender effect might end up being published.

and can thus be a cause of increased risk aversion following episodes of financial collapses.[3]

A recent and growing literature aims at assessing the genetic component of financial risk taking by using data on the behavior of twins. Cesarini et al. (2009) estimate that about 30% of the individual variation in risk aversion elicited in experiments using hypothetical lotteries is due to genetic variation. They also find that the shared environmental component (due for example to upbringing) is very small and in some specification close to zero.

Even though there is clear consensus on the existence of a genetic component of risk taking, its magnitude is still under debate. A promising approach is taken by Dreber at al. (2009) and Kuhnen and Chiao (2008) who directly look at the effect of actual genes on risk taking behavior. They are able to find a positive and significant correlation between risk taking and the lack or presence of specific alleles.

Finally, an emerging literature studies the role of specific biological factors in shaping investors preferences. Particular attention has been given to the effect of testosterone on risk attitudes. A growing number of contributions study the effect of fetus exposure to testosterone during pregnancy as measured by the 2D:4D ratio finding, so far, weak effects (Garbarino et al. (2011); Sapienza, Zingales and Maestripieri (2009) ; Dreber et al. (2009) and Guiso and Rustichini (2011) find none).

Needless to say, while genetic factors and early experiences reflecting differences in family backgrounds help explain persistent cross-sectional differences in risk attitudes they cannot explain time variation in risk attitudes among adults.

Age

One demographic characteristic that can result in variation over time in risk attitudes is age. Elicited risk aversion parameters tend to be positively correlated with age (e.g. Dohmen et al. 2011; Barsky et al. 1997; Guiso and Paiella, 2008); age may contribute to explain patterns of portfolio choice over the life-cycle, and even trends in risk aversion if

[3] Consistent with these features, Calvet and Sodini (2014) document that twins with depression symptoms tend to have a lower share of financial wealth invested in risky assets.

the age-distribution of the population changes, but per se cannot explain variation in risk aversion over the business cycles and thus the variation in assets prices at the business cycle frequency.

Mood and fear

Emotions can cause changes in people willingness to bear risk. Loewenstein (2000) argues that decisions are not made only on the basis of anticipated results as in a standard expected utility framework. Emotions experienced at the time of decision-making (immediate emotions) can also play a role, sometimes a key one. Emotions – such as mood and fear - originate in the brain's limbic system (amygdala, cingulate gyrus and hippocampus) and they are processed and moderated by the frontal cortex (Pinel, 2009). For instance, mood may be affected by the weather conditions and by exposure to light: people exposed to more light tend to be less risk averse. Because light varies seasonally, this introduces time variation in risk aversion and in people financial decisions (Kamstra et al., 2003 and Kramer and Weber, 2012).

A simple way to embed the role of emotions in the standard utility framework is to assume that emotions can alter some parameter of an individual utility function. That is, fear or some other risk-aversion relevant emotions – can be thought as a state-contingent increase in the curvature of the utility function.

In so far a catastrophic event, either economic or non-economic, triggers an emotional reaction such as fear it can result in an increase in risk aversion. This may explain why during downturns, and particularly during financial crises, also investors who do not lose money directly become more risk averse even with respect to known probabilities gambles, as we will show in Section 2. The terrifying news appearing on television, the interaction with friends who lost money in the market, the pictures of fired people leaving their failed banks might have triggered an emotional response. Of course, because during financial crises also the value of the endowments changes the hypothesis cannot be tested with our data because it is observationally equivalent to a background risk model. Does the picture of Lehman fired employees trigger an

emotional fear response or does it increase the subjective probability of a very bad outcome?

Traumas

A large literature in medicine and psychiatry, such as Holman and Silver (1998), document that exposure to traumas can produce complex and long-lasting consequences on mental and physical health. Shaw (2000) argues that major structural central nervous system changes occur from birth to early adolescence. Traumatic experiences during these critical stages may have a determining effect on brain structural development and sympathetic nervous system responsiveness, and the hypothalamic pituitary adrenal axis[4] (see Lipschitz et al. 1998). Therefore, traumas experienced early in life could reasonably affect adults' risk-taking behavior. Indeed, several papers from psychology and neuroscience, suggest that risk aversion has a specific neural basis and an important emotional component (e.g. Kuhnen and Knutson 2005).

One strand of literature has focused on *non-economic* traumas, in particular the exposure to natural disasters – as causes of change in people risk attitudes. For example, Cameron and Shah (2012), find that individuals, who recently suffered a flood or an earthquake in Indonesia over the lapse of the previous three years, exhibit higher risk aversion than similar individuals living in villages in the same area not touched by the disasters. Others, find that as an immediate reaction to a natural disaster, individuals tend to become *less* risk averse (Eckel et al. (2009); Page et al. (2012)). There are still no studies of the long term consequences of traumatic natural disasters, such as an early-age experience of an earthquake.

[4] The sympathetic nervous system (one of three major parts of the autonomic nervous system) is responsible for mobilizing the body's nervous system fight-or-flight response. The fight-or-flight response is a physiological reaction that occurs in response to a perceived harmful event, attack, or threat to survival.

Traumas can be induced also by large and unusual shocks such as the loss of job or the exposure to a financial crisis. One small but influential body of research on the impact of life experiences on risk attitudes has investigated the impact of macroeconomic events, such as financial busts or the great depression, on risk-taking behavior and people's beliefs. Malmendier and Nagel (2011) find that birth-cohorts of people, who have experienced low stock market returns throughout their life, report greater risk aversion, are less likely to participate in the stock market and, if they participate, invest a lower fraction of liquid wealth in stocks. Their estimates indicate that experiencing macroeconomic events early in life affects risk-taking behaviors but recent realizations have a stronger impact than distant ones. Fagereng, Gottlieb and Guiso (2013) find similar results in a large panel of Norwegian households: investors who were exposed to higher macroeconomic uncertainty in "impressionable years" (age 18-23) invest a lower share in stocks over the life-time.

These effects, though triggered by "bad" economic events, are unlikely to reflect a relation between risk tolerance and wealth. In fact, wealth-induced changes in risk preferences (such as those generated by habit-preferences, as we will discuss below) should revert quickly as wealth recovers over the business cycle. Trauma-induced changes may instead be long lasting. In so far as a financial crisis is a traumatic experience for many, it can induce large changes in risk aversion and, most importantly, this may be long lasting which may help explain why recoveries from recessions induced by financial crises are so slow.

2.2. Evolving endowment and economic environment

Risk preferences can change over time not because the concavity of period utility changes in response to shocks but because the individual endowment and the economic environment change and the structure of preferences is such that people willingness to bear risk is sensitive to variations in the distribution of the endowment or in the structure of the economic environment. Changes of this sort fall in the tradition of

economics: variation in willingness to bear risk is caused by changes in economic endowments, and it can in turn affect equilibrium asset prices.[5]

Financial wealth

One key variable is the level of financial wealth. It is widely accepted and strongly supported by evidence that the absolute risk aversion of an individual is decreasing with the level of the endowment. More controversial is the relation between the endowment and the relative risk aversion of an individual. But it is the latter that matters for asset pricing. In order to generate a link between relative risk aversion and the individual financial wealth one needs to depart from CRRA utility. Let's assume that relative risk aversion depends on financial wealth W_i according to $\lambda = \lambda(\mathbf{z}_{it})$

$$\lambda = \frac{\lambda\gamma_i}{W_{it}^{\eta}}$$

where γ is an individual component that captures unobserved risk preferences and may depend as before on a vector $\mathbf{z}_{it}$ of time varying or time invariant characteristics. A value of $\eta = 0$ corresponds to constant relative risk aversion, and we are back to the previous case in which relative risk aversion can evolve over time because the risk aversion of period utility changes. Positive values of η imply decreasing relative risk aversion. When financial wealth increases people willingness to bear risk increases and vice versa. Hence if $\eta > 0$ movements in individual wealth over the business cycle, for instance caused by a drop or a boom in assets prices, may results in swings in individual willingness to bear risk. Habit persistence models such as those used by Constantinides (1990) and Campbell and Cochrane (1999) have this property and this is the main hypothesis that has been explored by economists. Needless to say, during financial downturns and even more so during financial crises asset values drop and the stock of wealth tends to get closer to the stock of habits, causing risk aversion to increase. Hence, in principle, habit models can explain time variation in risk aversion. One type of

[5] Put it differently the deep preferences for risk do not vary; what changes is the risk aversion of the indirect utility function.

habit that has been recently emphasized in the literature is consumption commitments – expenditures related to durable goods, such as housing and cars, that involve adjustment costs. Commitments can affect investor risk preferences (e.g. Grossman and Laroque, 1990; Chetty and Szeidl, 2007a; Postlewaite, Samuelson and Silverman, 2008). In particular, these papers argue that commitments amplify risk aversion over moderate shocks. Households with housing or expensive cars have an incentive to reduce financial risk exposure to make sure they can continue paying their bills when hit by temporary shocks.

Despite the fact that habit-preferences have been the main explanation economists have put forward for time varying risk aversion, it seems to receive mixed empirical support when tested on micro data. For instance, Brunnermeier and Nagel (2008), find that one key implication of habit models – that the portfolio share invested in risky assets should correlate positively with the level of wealth, does not hold in a sample of US households. Chiappori and Paiella (2011) run a similar test in a panel of Italian households and cannot reject that the risky portfolio share is unaffected by variation in households wealth, leading them to conclude that household preferences are well represented by CRRA utility, and thus to reject the habit model as an explanation for variation over time in preferences for risk.

Lupton (2002) and Calvet and Sodini (2014) find instead evidence that is more consistent with the habit model. They test directly habit formation models on household portfolio allocation decisions by using proxies for habit measured in US and Swedish data. They notice that habit formation models carry four testable predictions. The portfolio risky share should decrease with proxies for habit and increase with financial wealth. Additionally, the elasticity of the risky share to financial wealth should not only be positive but also heterogeneous across investors. It should decrease with financial wealth and increase with the habit. Lupton (2002) tests the effect of internal habit on the risky share in the cross section, finding support for habit formation models. Calvet and Sodini (2014) document the same result on Swedish data, and argue that habit has a causal effect on the risky share by using twin regressions. They also find that

the elasticity of the risky share to financial wealth is decreasing in wealth and increasing in proxies for habit. Finally, Chetty and Szeidl (2007b) provide some empirical evidence that households with more commitments follow more conservative financial portfolio strategies.

One issue with this evidence is that any correlation between the risky share and wealth instead of capturing a relation between habits and risk aversion may reflect some relation between wealth and other determinants of the portfolio risky share, such as information, which may evolve with wealth. To isolate the risk aversion channel, one would require direct measures of risk aversion and of their evolution over time. Guiso, Sapienza and Zingales (2013) use a measure of this sort and find mixed evidence. We will return to their evidence below, in Section 2.

Background risk and access to credit markets

Background risk is probably the most widely cited environmental factor used to explain heterogeneity in risk attitudes. It can be defined as a type of risk that cannot be avoided because it is non-tradable and non-insurable. Under some regularity assumptions on preferences, background risk makes investors less willing to take other forms of risks, such as investment in risky financial assets. Researchers have identified sources of background risk in wealth components that cannot be fully diversified away because of market incompleteness or illiquidity. Human capital (e.g. Bodie, Merton and Samuelson, 1992; Viceira, 2001; Cocco, Gomes and Maenhout, 2005), housing wealth (e.g. Cocco, 2005; Yao and Zhang, 2005) and private business wealth (Heaton and Lucas, 2000a, 2000b) have been used to explain the reluctance of households to invest in risky financial markets. Differently from habits which are concerned with the first moment of the distribution of the endowment, background risk arises in relation to variation in the second moment. The latter in turn may vary over the business cycle, and increase during downturns (Pistaferri and Meghir, 2004).

In addition to background risk, Gollier (2001) argues that risk preferences might also be affected by limited access to credit markets since it restricts the ability of households

to transfer risk in time. Borrowing constraints make investors more risk averse in anticipation of the possibility that the constraint might be binding in the future (Grossman and Vila, 1992; Paxson 1990; Tepla 2000). Finally, background risk might also be affected by household size and composition, as the probability of divorce and the random liquidity needs of a larger family with children might discourage financial risk taking (Love, 2010). Needless to say, credit market accessibility tends to be more severe during downturns and even more so during financial crises, when intermediaries restrict credit granting criteria and credit crunches emerge. Hence, this channel too has a potential for inducing increased risk aversion in downturns and in particular during financial crises.

Empirical evidence on background risk and risk taking behavior relies mostly on cross sectional evidence. Guiso, Jappelli and Terlizzese (1996), Guiso and Jappelli (2002), and Palia, Qi and Wu (2014) find that investors with more uncertain labor income, facing tighter borrowing constraints buy more insurance and tend to participate and invest less in equity markets. Guiso and Paiella (2008) document that households living in areas with more volatile aggregate income growth are more risk averse when offered a hypothetical lottery. Hung et al. (2014) find that in Taiwan, individuals employed at listed companies with greater idiosyncratic return volatilities are less likely to invest in equity in general, and in their employer's stock in particular. Betermier et al. (2012) find that a household moving from an industry with low wage volatility to one with high volatility will, *ceteris paribus*, decrease its portfolio share of risky assets by up to 35%. Heaton and Lucas (2000a) find that entrepreneurial households with more private business wealth hold less in stocks relative to other liquid assets. Similarly, they find that workers with stocks in the firm they work for have a lower portfolio share of common stocks. Cocco (2005) and Yao and Zhang (2005) calibrate life-cycle models of optimal portfolio decisions with data from the PSID and document a background risk component of housing wealth that crowds out equity holdings.

The cross sectional literature cannot distinguish the direct effect of background risk from the extent to which it proxies for latent characteristics. Panel analysis, on the other

hand, might be problematic since some forms of background risk, such as human capital, are highly persistent and others, like housing wealth, might be endogenous to financial decisions. Calvet and Sodini (2014) use twin regressions to shed light into this issue and confirm the importance of background risk on financial risk taking. They verify the cross sectional findings that self-employed and credit constrained twins with more volatile income invest less in equity markets.

2.3. Persistence and contagion

Persistence

How persistent can changes over time in risk aversion be? Answering this question is important. If changes are (possibly small) and short lived, so are their consequences. Furthermore, individuals may be aware that their attitudes are subject to temporary fluctuations and thus act on the expected value of their risk aversion. In this case, the traditional characterization of risk preferences as a stable individual trait may be a reasonable assumption to characterize behavior. If instead departures are (large and) persistent, they may have enduring consequences. And even if individuals may understand these swings in their risk preferences, they may find it difficult to ignore them.

Persistence of variation in risk aversion is likely to differ depending on the underlying cause and the size of the shock. Changes induced by variation in mood, such as those due to light exposure (Kramer and Weber, 2012) or variation in the blood levels of testosterone (Sapienza, Zingales and Maestripieri, 2009) or even fear-inducing not traumatic experiences, are very likely to revert quickly as the cause of this changes reverts too. Variation induced by age is by definition permanent and irreversible. The persistence of scary and traumatic experiences is more problematic to assert. Some early age traumatic experiences are likely to have permanent consequences. The evidence in Malmendier and Nagel (2011) that birth-cohorts of people who have experienced low stock market returns throughout their life report greater risk aversion, is consistent with long-lived effects of traumatic experiences. Some of these effects can

persist even longer than the life time of the individual who has experienced them, if, as shown by Dohmen et al al. (2011), risk aversion transmits across generations.

Finally, variation in risk aversion due to changes in the level of wealth in habit models persists as long as it takes for wealth to revert back to normal. Large drops in wealth may be slow to rebuild, particularly after a financial crisis, implying that increases in risk aversion following a financial depression can last for long periods. Hence, habit models can explain relatively long-lasting changes in risk aversion but cannot explain changes that last beyond the change in wealth. A similar consideration applies to cyclical changes in background risk and households access to the credit market.

Contagion

To explain large fluctuations in assets prices, variation in risk aversion must be common to a substantial portion of investors. This is the case if risk aversion responds to aggregate shocks, such as a drop in wealth due to a financial crisis. Idiosyncratic variations due to for instance changes in mood will tend to wash out. Yet, there is evidence that emotions can be contagious so that an event experienced by a fraction of the population that makes them cautious may spill over to others increasing their cautiousness too. In an experiment on *Facebook*, Kramer et al. (2014) show that emotional states can be transferred to others through emotional contagion which leads people to experience the same emotions even without their awareness. Hence, a traumatic experience – such as fear – that hits a relatively large portion of investors and raises their risk aversion can have similar effects on the remaining portion. Media and social networks can be the vehicle of contagion (Kramer et al. (2014)).

2. Does willingness to bear risk actually vary over time?

The observation that the price of risk varies over time is consistent with fluctuations in investors' risk tolerance; but it is no proof of it. A more direct approach is to rely on direct measures of risk aversion elicited in surveys or even experiments. This is the approach that economists are starting to follow. There are two big advantages in using

direct measures of individuals' risk aversion. The first is that one can directly document whether individuals' attitudes towards risk have a time varying component and thus check directly whether they can lead to a change in aggregate risk aversion or whether the latter is due to changes in the distribution of wealth, with no change in individuals' risk preferences. The second is that one can test different explanations of what produces the changes and possibly distinguish among the various forces discussed in Section 2. The main shortcoming is that data collection on elicited risk aversion has only started recently and there are few panel data.

One useful source with a relatively long time span is the Survey of Consumer Finances (SCF). Since 1989 it includes a question meant to elicit investors risk aversion. In the SCF each participant is asked: "Which of the following statements comes closest to the amount of financial risk that you are willing to take when you make your financial investment: (1) Take substantial financial risks to earn substantial returns; (2) Take above average financial risks expecting to earn above average returns; (3) Take average financial risks expecting to earn average returns; (4) Not willing to take any financial risks." Answers to this question allow classifying investors according to their risk aversion.

In a world where people face the same risk-return tradeoffs and make portfolio decisions according to Merton's formula, their risk/return choice reflects their degree of relative risk aversion. In such a world, the answers to the above question can fully characterize people's relative risk preferences. People opting for low-risk-low return combinations are also individuals with higher risk aversion. Table 1 shows the distribution of the answers to this question in all SCFs where it was asked including the last one (2010). There are a number of intriguing features. First, and most importantly, there is a substantial increase in risk aversion following the last financial crisis. The fraction of risk tolerant individuals – defined as those answering either (1) or (2) - was 26.6% in 2007, before the financial crisis, and drops to 16.9% in 2010 after the crisis (last row); similarly the fraction of individuals who prefer to take no financial risk even if this entails very low returns, jumps from 31.2% in 2007 to 47.4% in 2010 as made clear in

Figure 1. This is consistent with risk aversion changing dramatically during the last financial crisis. The second feature is that risk aversion was higher than average in 1989 and then dropped continuously in the subsequent surveys. The share of people answering "no risk" was around 40% in 1989 and fell to 30% after 11 years. 1989 is the first SCF following the stock market crash of 1987. Based on the patterns observed in 2007/2010 it is tempting to conclude that the high level of risk aversion in 1989 is the reflection of an increase due to the financial collapse of 1987. Unfortunately, we cannot prove it; but if this interpretation were true, it follows that an increase in risk aversion after a scary episode such as a major financial crisis takes considerable time to revert back. Indeed, the fact that investors show a great reluctance to assume financial risk still in 2010 compared to 2007 - that is two years after the collapse of Lehman Brothers and even after the recovery of the stock market - suggests that increases in risk aversion of this sort tend to be long lasting.

The SCF data refer to a sequence of cross sections, not to panel data. They thus are informative of the evolution of the risk aversion of the average investor but not of the one of the single investors. In addition to this there are two more problems with the SFC measure. First, because of the cross sectional nature it cannot easily be used to test which factors can explain the change in risk tolerance. For instance, with this data it is hard to test whether risk aversion has increased more (or mostly) for those who incurred financial losses during the crisis as it would be predicted by habit models. One could bypass this problem by constructing averages of risk aversion and endowments (and other explanatory variables) for different groups in the years covered by the survey and following them over time (and age) – i.e. setting up a pseudo-panel. Clearly results would be conditional on the grouping criteria. Second, if people differ in beliefs about stock market returns and/or volatility these differences will tend to contaminate the answers to the SCF question. This bias would affect not only cross-sectional comparisons, but also inter-temporal ones, possibly revealing a change in risk preferences when none is present.

In a recent paper, Guiso, Sapienza and Zingales (2013) try to overcome these problems. First, they elicit a measure equivalent to the SCF one but in a sample of Italian investors interviewed before the financial crisis (in 2007) and then after the collapse of Lehman, in September 2008. For this panel of investors the authors can rely on several measures of their assets as well as various characteristics and on information on their expectations about stock market returns and volatility, allowing them to assess whether the latter played a role in affecting risk attitudes. Being a panel, they can look at correlations between *changes* in risk aversion and *changes* in potential determinants.

Second, they obtain an additional measure of risk aversion not contaminated by changing beliefs. Each respondent was presented with several choices between a risky prospect, which paid 10,000 euros or zero with equal probability, and a sequence of certain sums of money. These sums were increasing between 100 and 9,000 euros. More risk averse people will give up the risky prospect for lower certain sums. Thus, the first certain sum at which an investor switches from the risky to the certain prospect identifies (an upper bound for) his/her certainty equivalent from which it is possible to obtain the investor risk premium.

Using these measures the authors document a remarkable shift in risk preferences. As in the SCF, the fraction of investors who answer that they normally are not willing to take any financial risk increases from 18% in 2007 to 42% in 2009. Similarly, the risk premium the median investor is willing to pay to avoid the safe lottery prospect increases from 1,000 euros in 2007 to 3,500 in 2009. This corresponds to a doubling or a tripling of the median investor's risk aversion. The paper shows that the change in the distribution of wealth plays essentially no role in explaining the increase in investors' aggregate risk aversion which is totally driven by changes in individual investors' risk preferences.

Guiso, Sapienza and Zingales (2013) then try to test various channels that could potentially explain these patterns. Though changes in these measures of risk aversion predict participation rates in the stock market, they do not correlate with changes in wealth expected for those investors who experienced very large losses during the

financial crisis. But risk aversion increases substantially even among investors who suffered very mild losses and, most importantly, among those who suffered no losses altogether because they held no stocks in the Summer of 2008 when the crisis begun. The latter experienced an increase in risk aversion as large as the former. This evidence is hard to reconcile with pure habit models though it may be consistent with changes in expected future incomes and background risk. However, when the authors check whether risk aversion increased more among investors that are less likely to face background risk (such as public employees or the elderly) they find no evidence in support of this either. What has then driven the change? They put forward a conjecture: fear. People reacted to the crisis by becoming more fearful, and fear automatically triggered more risk aversion[6]. In support of this view, they find that the increase in risk aversion is correlated with measures of knightian uncertainty. In addition, to find some indirect confirming evidence they run an experiment with a sample of students at Northwestern University treating half of the sample with a scary movie and then eliciting risk aversion of all participants using the same questions that they had asked to the sample of investors. They found that people who had watched the movie were systematically more risk averse than those who had not been exposed to the movie. Most importantly, the difference in risk aversion between the two groups was sizeable, as sizeable was the increase in risk aversion during the financial crisis. While the results of this experiment do not represent a direct proof that the increase in risk aversion during the financial crisis was triggered by fear, they show that a mechanism based on fear has the potential to explain large swings in risk aversion as those documented in the SCF and in the panel of Italian investors.

[6]Evidence in neuro-economics and lab experiments shows that risk aversion is increased by panic and fear. Kuhnen and Knutson (2005) find that more activation in the anterior insula (the brain area where anticipatory negative emotions are presumably located) is followed by increased risk aversion. Kuhnen and Knutson (2011) find that subjects exposed to visual cues inducing anxiety were subsequently more risk averse and less willing to invest in risky assets.

3. Conclusions

It is well documented that recoveries from financial crises tend to be slow, much slower than recoveries from standard recessions. Recessions induced by financial crises may also have more persistent effects even on the level of potential output and long - term growth – an issue that is receiving considerable attention in the US (Hall, 2014) and which should be even more relevant in Europe given the extremely slow recovery of the euro area as a whole and particularly of the Southern European economies. The mechanisms underlying the slow recovery and the persistent negative growth effects can be different and they are not well understood yet. In this chapter we have proposed another mechanism: increased investors' risk aversion caused by the crises. Increased risk aversion can affect economic growth directly by diverting entrepreneurs from high-growth but risky investments to safer but lower growth investments, by raising investors' required risk premium and hence the cost of capital thus slowing down capital accumulation. In addition, in so far higher risk aversion increases the relative cost of risky capital it can weaken growth because the relative cost of equity investments increases, thus discouraging investments in innovative firms which rely disproportionately on equity finance.

We have discussed several mechanisms through which people's risk tolerance can change over time. Some are due to variation in economic variables, in particular the distribution of individual endowments or the access to insurance and credit markets; others reflect psychological forces that trigger fear. The evidence on what leads to changing risk aversion is just starting to accumulate. That available up to now suggests that both factors – economic and psychological – seem to matter in explaining why risk aversion increases in response to financial crises.

Is there room for policy and regulatory interventions to stabilize people's risk preferences and of what sort? Can policy makers intervene into the psychological mechanism driving risk aversion during a financial crisis? Can governments, for instance, regulate the dissemination of information or its tone through the high-speed channels

of today's world, in order to pre-empt contagion of fear and the propagation of a crisis? We have no answers to these questions but they are on the table.

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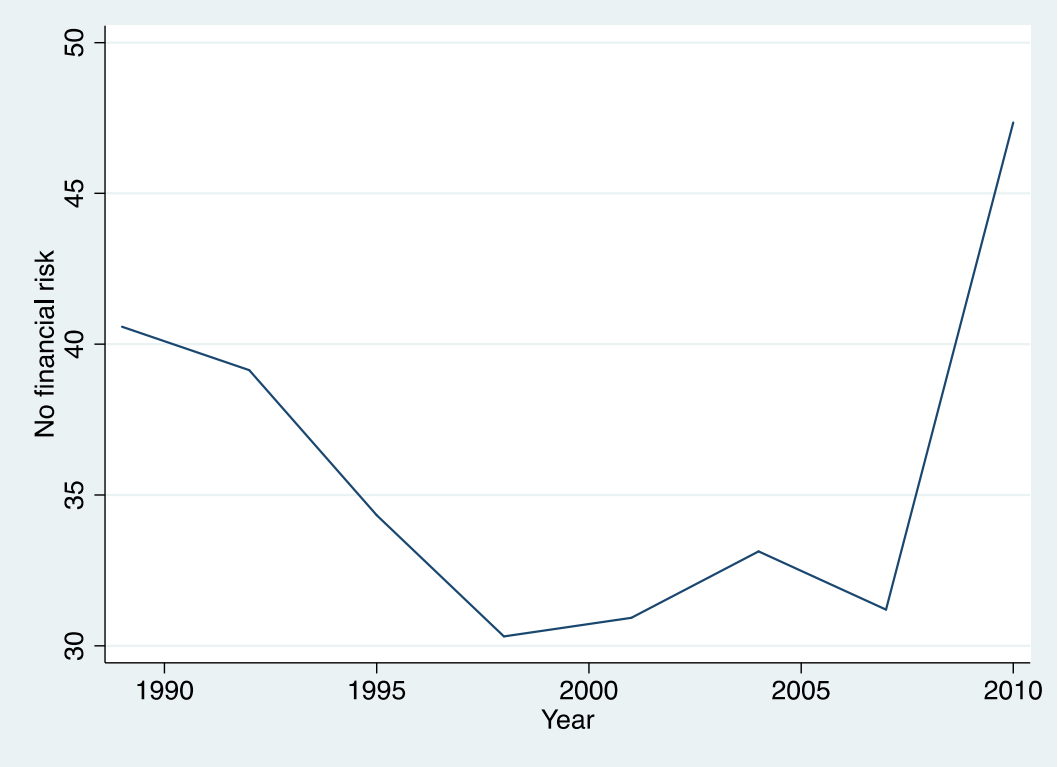
Figure 1. Share of highly risk averse people in the Survey of Consumer Finances



The figure shows the fraction of people answering "Not willing to take any financial risk" to the risk aversion question asked in the Survey of Consumer Finances described in Table 1, year by year.

Table 1: Evolution of the Distribution of Risk Preferences among US Households

	Year							
	1989	1992	1995	1998	2001	2004	2007	2010
1. Substantial risk and return	4.91	5.08	5.15	6.09	5.8	5.12	5.17	3.51
2. Above average risk and return	12.24	16.09	18.64	23.34	23.17	20.25	21.42	13.38
3. Average risk and return	42.27	39.69	41.88	40.26	40.1	41.5	42.2	36.76
4. No financial risk	40.58	39.14	34.33	30.31	30.93	33.13	31.2	47.35
Risk tolerant (1or 2)	17.15	21.17	23.79	29.43	23.75	25.37	26.59	16.89

The table shows the distribution of a qualitative measure of risk aversion in the Survey of Consumer Finances. Investors are asked their preferences about risk and returns when making their portfolio choices. They face four alternatives: 1) Take substantial financial risks expecting to earn substantial returns; 2) Take above average financial risks expecting to earn above average returns; 3) Take average financial risks expecting to earn average returns; 4) Not willing to take any financial risks. The table shows the frequency distribution of the answers to this question. The last row shows the fraction of people answering either 1 or 2.