# Channels of risk-sharing at a micro level: savings, investments and the risk aversion heterogeneity

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## Abstract

Applying the variance decomposition developed by Asdrubali et al. (1996), the paper explores for the first time the role and the extent of smoothing channels at a micro level using a sample of UK households. Our empirical analysis of British Household Panel Survey (BHPS) data concludes that the bulk of risk-sharing in the UK is driven by the savings channel. By allowing for risk aversion heterogeneity, we detect an inverted U-shaped relationship between risk aversion and the extent of smoothing achieved through financial markets. We also analyze the issue of risk-sharing by income, education levels and by region. We find that risk-sharing is more effective (higher) for individuals whose savings are more flexible, while it is less effective (lower) for individuals characterized by relatively more stable savings rate (like the Scottish population), regardless of their economic conditions.

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# 1  Introduction

Under the hypothesis of complete markets, agents can completely diversify idiosyncratic risk, thereby breaking the link between individual income and consumption. Therefore, risk-sharing is desirable since it enables agents to distribute consumption evenly across time and states of nature. Following the seminal contributions by Cochrane (1991) and Mace (1991), empirical literature has tested the hypothesis of markets completeness ("full risk-sharing"), through regression-based tests. Even though this empirical approach was developed through microeconomic applications, the micro-founded macroeconomic model of full international risk-sharing has been more extensively investigated as from the contributions by Obstfeld (1986) and Backus and Smith (1993). This can be partly explained with the wider availability of macro data and with the relevance of these analyses in terms of policy implications, especially with regard to international economics, financial integration, and financial market regulation.[1] Asdrubali et al. (1996) introduced the variance decomposition, allowing for testing of the hypothesis of full international risk-sharing, along with the evaluation of the extent of effectiveness of the smoothing channels. Within this strand of literature, the focus of the analysis moved to investigation of the patterns of risk-sharing in different regions of the world, and to the relative importance of each risk-sharing channel.[2] Therefore, empirical literature has investigated the channels (and their determinants) through which income shocks are absorbed at macroeconomic level. However, there are very few analyses exploring the mechanism through which individuals (or households) cope with income shocks, in particular with respect to industrialized countries. To the best of our knowledge, within the body of empirical literature about risk-sharing channels, there is a lack of contributions at a microeconomic level of analysis of the various channels of income and consumption smoothing, with a particular focus on the functioning of the investment-income channel, the fiscal-system channel, and the savings channel. The goal of this work if to fill this gap, by empirically "micro-founding" the variance decomposition developed by Asdrubali et al. (1996), so as to analyze the functioning of the insurance channels at a household level.

One of the main advantages of using a microeconomic panel dataset lies in the availability of a very large sample, which allows for evaluating the role and the relevance of the channels by subgroups of individuals. In fact, each channel might function differently with respect to individuals' characteristics, and the detection of relationships between the characteristics of individuals (households) and the role played by each channel might be useful in deriving group-specific policy implications.

This work contributes to the risk-sharing literature in several ways. First, using the British Household Panel Survey (BHPS) and the "derived current and annual net household income variables, BHPS waves 1–18" (Levy and Jenkins, 2012) we apply, for the first time, the variance decomposition developed by Asdrubali et al. (1996) to a group of UK

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[1]See (Obstfeld and Rogoff, 1996) for a detailed description of the theoretical global model.

[2]See section 3 for a brief survey of the most recent and significant contributions on this topic. Another aspect which has received increasing attention in economic literature is the impact of financial integration on the extent of international risk-sharing among countries.

households over a time horizon of more than 10 years (from 1996 to 2007) exploring how households cope with income shocks through each insurance channel. Second, the large sample size allows us to investigate the role played by individual (household) heterogeneity in risk sharing-channels. In particular, classifying households by quartile of equivalized income, we analyze how the economic conditions of the households affect the extent of income and consumption insurance. Third, using a new question on the propensity of individuals to take risk, introduced in the BHPS questionnaire starting from the last available wave (R), our work analyzes risk-sharing channels for different levels of risk attitude/aversion.[3]

In the basic theoretical risk-sharing model, risk aversion is assumed to be equal for all individuals. This stringent assumption is difficult to relax due to the difficulty of computing risk aversion with macroeconomic data. In some microeconomic datasets, it is possible to compute an individual measure of risk aversion indirectly, however microeconomic survey data often do not include the questions needed for computing risk aversion together with data on consumption and net income. Therefore, the role and the extent of insurance channels at different levels of risk aversion are issues that we aim to investigate. Fortunately, the latest BHPS survey contains, for the first time, a question on the (subjective) attitude toward risk that we could employ in the empirical analysis.

Our main findings show that the bulk of the risk-sharing is achieved through the savings channel (around 70%-80%). Grouping individuals by regions, educational achievement, and risk-attitude, it is possible to observe that inflexible savings behaviors are associated with lower degrees of risk-sharing via the savings channel. Furthermore, an inverted U-shaped curve exists between risk aversion and the extent of income smoothing achieved through financial markets. Therefore, the extent of smoothing achieved by risk-averse households is similar in magnitude to that achieved by risk-lovers households. Last but not least, the financial markets channel results to be wider for lower-income households.

The remainder of the paper is organized as follows. Section 2 outlines the risk-sharing theory and the most relevant literature in the field of risk-sharing channels. Section 3 describes how we adapt the variance decomposition developed by Asdrubali et al. (1996) to the BHPS dataset, while empirical findings are commented in Section 4. Concluding remarks are reported in Section 5.

## 2  Risk-sharing theory and channels: a brief overview

The standard model of complete markets assumes one homogenous good, J infinitely lived agents in a context of choices under risk, represented by a set of mutually exhaustive states of the world. From the maximization problem, it follows that marginal rates of substitution between current consumption and future state-contingent consumption are equalized across individuals.[4] The most relevant prediction of the model is that per capita consumption growth rates must be correlated across individuals. Therefore individual consumption growth should only depend on aggregate consumption growth, and should

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[3]See Appendix A for details about the variable.
[4]See Mace (1991) for a detailed description of the underlying theoretical model.

be completely independent of idiosyncratic income. Following the seminal contributions by Cochrane (1991) and Mace (1991), the hypothesis of complete consumption insurance ("full risk-sharing") has been tested in a wide variety of contributions at a micro and macro level in the form of a simple regression test of the following type:[5]

$$\Delta \log(C_{it}) = \nu_t + \beta_u \Delta \log Y_{it} + u_{it} \tag{1}$$

where $\Delta \log(C_{it})$ is the consumption growth rate; $\Delta \log Y_{it}$ is the income growth rate and $\nu_t$ are time fixed effects included to subtract time averages to the consumption and income growth rates. The testable implication of complete consumption insurance is that the estimated coefficient $\beta_u$ should not be significantly different from zero. On the contrary, if $\beta_u$ is significantly different from zero, it can be interpreted as the uninsured portion of risk and $(1-\beta_u)$ represents the fraction of insured risk. Asdrubali et al. (1996), by exploiting national accounting identities, propose a variance decomposition which allows for identifying the relative weight of the insurance channels through which income is smoothed. The main smoothing channels identified by the macroeconomic literature (see Asdrubali et al., 1996 and Sørensen and Yosha, 1998) are the following: the financial-markets channel; the capital-depreciation channel; the fiscal-transfers channel; and the savings channel. Empirical literature has extensively investigated the role and the extent of these channels within and between countries,[6] highlighting that intranational risk-sharing is higher than international risk-sharing (Sørensen and Yosha, 2000). This is largely attributable to the fact that the fiscal-transfers system is virtually absent at international level. In fact, since the seminal contribution by Asdrubali et al. (1996) and Sørensen and Yosha (1998), it has been recognized that the largest part of smoothing for U.S. federal states is achieved through the financial-markets channel, followed by the credit/savings channel and the fiscal-transfers system. Instead, for EU and OECD countries the bulk of smoothing is attributed to the credit/savings channel, whereas the fiscal-transfers channel is almost irrelevant and the financial-markets channel smoothes a limited fraction of risk; the overall degree of insurance is much lower than that registered for U.S. federal states.[7] As a consequence of the ongoing globalization process, a particular interest has recently been devoted to the measurement of potential benefits associated with risk-sharing in different regions of the world.[8] Many recent contributions focus on the financial-markets channel, which, for OECD countries, is driven by the holdings of net financial assets resulting from the portfolio-diversification choices of investors (see Balli et al. 2011).[9]

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[5]CRRA preferences are assumed and individuals are assumed to share the same risk aversion coefficient.

[6]See, inter alia, Asdrubali et al. (1996) for U.S. federal states and Balli et al. (2012) for Canadian provinces. The first contributions for European and OECD countries are attributable to Sørensen and Yosha (1998) and Balli and Sørensen (2006).

[7]The advent of the European Monetary Union considerably enlarged the financial-markets channel but its extent remains far below to that registered for U.S. federal states.

[8]See inter alia, Kim et al. (2006) for East Asian countries, Yehoue (2011) for African economic and monetary unions, Balli and Balli (2011) for Pacific Island countries, Balli et al. (2013) and Balli et al. (2013) for Middle East and North African countries.

[9]Amongst the most recent contributions about the factor-income channel of smoothing, see Balli and Balli (2013), Yehoue (2011), Volosovych (2013).

# 3 Empirical strategy

Exploiting the "derived current and annual net household income variables, BHPS waves 1–18" (Levy and Jenkins, 2012), we are able to apply the variance decomposition developed by Asdrubali et al. (1996) at micro level for the first time. We use a sample of 529 households over the time horizon 1996-2007.[10] The sample has been restricted to include those households interviewed in all the waves considered, characterized by a stable structure and always reporting (gross) income, food consumption and other expenditures for durables and non-durables.[11] We start from the following identity:

$$YLPB = \frac{YLPB}{YLPBI} \cdot \frac{YLPBI}{TI} \cdot \frac{TI}{DNI} \cdot \frac{DNI}{C} \cdot C \tag{2}$$

where YLPB stands for income from labour, pensions and benefits; YLPBI = YLPB + investment income; total income TI=YLPBI + transfer income; disposable net income (DNI)= TI - taxes and contributions.[12] To obtain the variance decomposition, we take logs and differences, and multiply both sides by the deviation of $\Delta \log YLPB$ from its mean, and take the cross-sectional average, obtaining:

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\begin{aligned}
var\{\Delta \log YLPB^i\} &= cov\{\Delta \log YLPB^i, \Delta \log YLPB^i - \Delta \log YLPBI^i\} \\
&+ cov\{\Delta \log YLPB^i, \Delta \log YLPBI^i - \Delta \log TI^i\} \\
&+ cov\{\Delta \log YLPB^i, \Delta \log TI^i - \Delta \log DNI^i\} \\
&+ cov\{\Delta \log YLPB^i, \Delta \log DNI^i - \Delta \log C^i\} \\
&+ cov\{\Delta \log YLPB^i, \Delta \log C^i\}
\end{aligned}
\tag{3}
$$

Dividing both sides by $var\{\Delta \log YLPB^i\}$ we have:

$$1 = \beta_k + \beta_\tau + \beta_f + \beta_s + \beta_u \tag{4}$$

where for instance:

$$\beta_k = \frac{cov\{\Delta \log YLPB^i, \Delta \log YLPB^i - \Delta \log YLPBI^i\}}{var\{\Delta \log YLPB^i\}} \tag{5}$$

which is the OLS estimate of the slope of the regression of $\Delta \log YLPB^i - \Delta \log YLPBI^i$ on $\Delta \log YLPB^i$. Correspondingly the same is true for all other betas $\beta_\tau$, $\beta_f$, $\beta_s$, while $\beta_u$ is the same as in equation (1) and represents the unsmoothed fraction of risk. If risk-sharing is complete, $cov\{\Delta \log YLPB^i, \Delta \log C^i\}$ should equal zero, and consequently $\beta_u$

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[10]From wave G to R.

[11]See Appendix A for details on data.

[12]See Appendix B for a complete description of the identities that apply for the survey variables.

would also equal zero. Otherwise, if $cov\{\Delta \log YLPB^i, \Delta \log C^i\} > 0$, $\beta_u > 0$ meaning that consumption growth reacts to income changes. This decomposition allows for quantifying not only the amount of risk-sharing, but also the relative importance of each channel. As in the standard macroeconomic decomposition, we identified four smoothing channels: financial markets; transfers from outside the household; the fiscal system; and savings. Therefore $\beta_k$ is the fraction of income smoothing achieved through financial markets and it includes investment income and property rental income,[13] $\beta_\tau$ is the fraction of smoothing "from outside the household" achieved through formal and informal smoothing channels such as education grants and payments from friendly societies,[14] $\beta_f$ and $\beta_s$ respectively represent the fractions of income smoothing achieved through the national fiscal system and savings.

To estimate the parameters we run the following panel regression:

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\begin{aligned}
\Delta \log YLPB_t^i - \Delta \log YLPBI_t^i &= \nu_{k,t} + \beta_k \Delta \log YLPB_t^i + u_{k,t}^i \\
\Delta \log YLPBI_t^i - \Delta \log TI_t^i &= \nu_{\tau,t} + \beta_\tau \Delta \log YLPB_t^i + u_{\tau,t}^i \\
\Delta \log TI_t^i - \Delta \log DNI_t^i &= \nu_{f,t} + \beta_f \Delta \log YLPB_t^i + u_{f,t}^i \\
\Delta \log DNI_t^i - \Delta \log C_t^i &= \nu_{s,t} + \beta_s \Delta \log YLPB_t^i + u_{s,t}^i \\
\Delta \log C_t^i &= \nu_{u,t} + \beta_u \Delta \log YLPB_t^i + u_{u,t}^i
\end{aligned}
$$

$$(6)$$

where $\nu_{\cdot,t}$ are time fixed effects. Following the same estimation procedure as in Asdrubali et al. (1996) and in Sørensen and Yosha (1998), we specified an AR(1) process for the residuals where, given the limited time horizon, the autocorrelation coefficient is identical for each equation and each individual; heteroscedasticity is also taken into account. One of the advantages associated with this variance decomposition is the possibility of accounting for different household characteristics such as for example the level of income or the extent of risk attitude/aversion; our analysis differs from standard analyses where it is assumed that all individuals have an identical risk aversion. The high number of observations available at microeconomic level, makes it possible to evaluate the relevance of the risk-sharing channels for individuals who differ according to some socioeconomic variable. In this regard, we estimate the system (6) by subgroups of households characterized, for example, by different levels of income and/or risk aversion.

The last wave of the BHPS included a question about the propensity of individuals to take risks, which can be taken as a proxy of individuals' risk aversion.[15] Therefore, to explore how risk aversion impacts the soothing channels we estimated equation (6) for distinct groups of households, moving from more risk-averse (low risk attitude) to more risk-lovers (high risk attitude). We decided to run separate regressions for sub-samples of individuals characterized by similar values of risk attitude/aversion, rather than

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[13]For the exact definition of variables see Appendix A.

[14]For details see the description of "Total annual household transfer income" in Appendix A.

[15]The question is the following: "*Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?*" and it takes values from 1 ("won't take risks") to 10 ("ready to take risks").

interacting the variables as in Melitz and Zumer (1999) due to the subjective and ordinal nature of our proxy for risk aversion. It is worth mentioning that risk attitude/aversion is recorded at individual level and that we identified its value with risk attitude/aversion of the household's head, that is considered representative of the entire household.[16] Therefore, we do not consider all household members to be contributors to the household's overall degree of risk attitude/aversion as highlighted by Mazzocco (2004) who finds that "an increase in risk aversion and prudence of an individual member can reduce household risk aversion and prudence". This is an issue that remains open to future research.

# 4  Empirical Findings

The first step of our analysis consisted in identifying and estimating risk-sharing channels among UK households. Table 1 reports the percentage of smoothing achieved through financial markets, transfers from outside the household, the fiscal system and savings. The first notable finding is that UK households are almost completely insured, with the fraction of uninsured risk equal to approximately 7%.[17] In line with macroeconomic empirical evidence about EU countries, presented by Sørensen and Yosha (1998) and Balli et al. (2012), the largest part of insurance occurs via the savings channel and the role played by investment income (financial-markets channel) is rather limited (about 8%). The national fiscal system smoothes around 7% of shocks and 1% results from transfers from outside the household, including education grants, payments from trade unions and friendly societies. The total amount of the risk insured is similar to what Dedola et al. (1999) found for UK on the basis of regional data. The authors, applying the Asdrubali et al. (1996)'s decomposition found a relatively high extent of smoothing via the capital markets (50%) and lower levels of credit-markets smoothing (50%-55%) compared with our findings (77%). The relevance of the capital-markets channel in regional risk-sharing is confirmed by the analysis of U.S. federal states by Demyanyk et al. (2007), where it is shown how interregional financial links are effective in smoothing regional income. The big discrepancy between these results and ours, with respect to the extent of risk-sharing through capital markets, is mainly attributable to the different structure of the datasets employed. Indeed, Demyanyk et al. (2007) employ regional macroeconomic datasets, which include information on interregional links generated by financial flows such as cross-regional investments, whereas such data are missing in our microeconomic dataset, where the statistical units are the UK households.

In Table 2 we explore the role of each channel of smoothing, grouping households by quartile of equivalent income to understand if the width of channels depends on households' income. Unexpectedly, we find that the financial-markets channel exhibits a counterintuitive U-shaped relationship with respect to income. The highest level of risk-sharing via investment income (14%) is achieved by lower income households (first quartile), while

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[16]The head of household in the survey is the principal owner or renter of the property; see Appendix A for details on this issue.

[17]This result is in line with Pericoli et al. (2013).

households in the second and third quartile smooth 3% and 6% respectively, and higher income households smooth about 9%. The share of investment income over total income by quartile explains our findings. Indeed, the investment income shares are 4.2% on average for the first quartile, and 2.9%, 4.5%, and 6.4% for the second, third and fourth quartiles, respectively, showing the same U-shaped pattern observed for risk-sharing via investment income. This finding is consistent with Sørensen et al. (2007) and Balli et al. (2011), who found a positive relationship between the amount of international investments and the extent of risk-sharing via the investment channel. We observe that the extent of risk-sharing via taxes/transfers increases with income, as a consequence of the progressive structure of the tax system. On the other hand, the savings channel remains quite stable across income levels ranging from 76% to 79%. The extent of the smoothing through the savings channel is remarkably higher compared to the other channels, indicating the importance of savings on risk-sharing at every level of income.

The savings channel is responsible for the big bulk of total risk-sharing. In Tables 3-5, we have grouped households by regions, educational achievement and gender of the head of household and we have re-estimated the extent of the risk-sharing via savings. Starting with the regional differences, Table 3 exhibits the extent of risk-sharing via savings in different regions of UK. In general, among the regions, the extent of risk sharing is around 70%-80%. However, this ratio decreases to 55% in Scotland and to 65% in South West (including Wales). This finding is along with the higher savings ratios of Scottish households, if compared to other UK regions.[18] Indeed, savings that are inelastic with respect to the state of the economy, (i.e., higher and stable saving rates) do not contribute effectively to risk sharing. The standard mechanism of the savings channel works as follows: people save more when the economy is growing and save less during an economic downturn, thus following a pro-cyclical pattern. On the contrary, Scottish households seem to have a relatively fixed target in terms of their savings ratio, and this might decrease the buffering role (and the observed extent of risk-sharing) of savings.

Table 4 reports the extent of the savings channel of risk-sharing for different levels of educational achievement. At first glance, we observe that there is a negative relationship between education and the extent of the risk-sharing via savings. This can be explained by the fact that education should lead households to invest in financial assets other than bank deposits in order to smooth income shocks. Another explanation, based on the life-cycle model, is that lower education levels lead to greater insecurity for the household's future economic prospects, while more educated individuals are likely to benefit from greater job security. Accordingly, the more educated would care less about saving for the raining days. Thus our findings are consistent with the life-cycle theory and with Hubbard et al. (1995) who claim that less educated people – in particular those that do not hold wealth – have

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[18]A recent report released by the Scottish government shows that the household savings ratio of Scotland is systematically higher than the savings ratio registered in other UK regions. This report is available at http://www.scotland.gov.uk/Publications/2013/02/3017/7.

a stronger precautionary motive to save, compared to more educated people.[19] [20]

In Table 5, we discuss the effectiveness of the savings channel with regard to head-of-household gender differences. Except for couples without children, we observe that the extent of the risk-sharing via savings is clearly lower among households headed by women. A number of studies have shown that the economic well-being and financial behaviors of men and women differ significantly. Previous studies have generally shown that women hold less wealth and have significantly lower earnings than men. Moreover, women invest their funds in less risky assets, and mostly hold risk-free assets, whereas men generally hold more risky assets (Bajtelsmit and Bernasek, 1996; Faff et al., 2008; Neelakantan, 2010). These might be the main reasons that explain the big differences between the extent of risk-sharing via the savings channels for households headed by women and for households headed by men. Therefore, we can surmise that women with children are more risk-averse and have higher and stable saving rates and this would limit the extent of risk-sharing via savings.

The second key point of our analysis is the investigation of the role of the financial markets and saving channels with respect to heterogeneity in risk attitude/aversion.[21] To investigate the issue, we exploit the new question about risk attitude. The original variable has values from 1 to 10, which we regrouped into three classes: between 1 to 3 (risk-averse households); from 4 to 6 (risk-neutral households) and from 7 to 10 (risk-lover households). In Table 6 we present the results for the smoothing channels for the three groups of households according to their risk attitude/aversion. The innovative aspect of this empirical analysis lies in the possibility of assessing the role of the smoothing channels, relaxing the theoretical assumption of identical risk aversion among individuals (households). With regard to the financial-markets channel, the most interesting result is the inverted U-shaped relationship between the extent of this channel and risk attitude: risk-lover households and risk-averse households smooth the same percentage of risk through investment income (6%), while households with intermediate levels of risk attitude (from 4 to 6) smooth the highest percentages of risk. Therefore, households with a moderate degree of risk aversion benefit more from the financial-markets channel.[22]

The extent of the savings channel is higher for risk-lover households than it is for risk-averse households.[23] This can be explained by the behavior of risk-averse individuals, on

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[19]This is at odds with (Solomon, 2004), who finds that more schooling is associated with higher precautionary savings rates.

[20]Supporting the argument above; the savings channel would be more effective for less educated people because more educated people have a greater propensity to hold risky assets, compared to less educated people (Guiso et al., 1996). Similarly, Haliassos and Bertaut (1995) show (with data from the Survey of Consumer Finances) that education and equity asset holdings are positively correlated. For the first quartile of income (the lowest income group), only 1.7% of high school dropouts holds risky assets, whereas 18% of individuals with a college degree invest their wealth in risky assets. For the fourth quartile of income (the highest income group) the difference is even higher: 42% of the fourth quartile holds risky assets and almost 70% of individuals with college education holds risky assets.

[21]See Appendix A for a detailed description of the variable representing risk attitude/aversion.

[22]This finding is robust with respect to the way the risk-aversion classes are defined.

[23]See column 3 in Table 6.

a basis consistent with Leland (1968), who stressed that risk-averse people save more, regardless of their economic conditions. In so doing, risk-averse individuals would reduce the elasticity of savings to income, thus reducing the effectiveness of the savings channel. Since our results might be affected by household income, we have analyzed the role played by the risk attitude at different levels of equivalent income (results reported in Table 7). We find that the extent of risk-sharing via savings decreases with risk aversion for lower-income households: the extent of risk-sharing via savings goes from 103% for risk-lover households to 68% for risk-averse households. This is consistent with Dynan et al. (2004) and Leland (1968) who showed that poorer people save more against future uncertainties and that this behavior is more significant for risk-averse individuals. Supporting the argument above, the first three columns of the Table 7 (relative to the first quartile of income) clearly show that higher and stable (precautionary) saving rates of risk-averse low-income individuals limit the extent of risk-sharing via the savings channel.

Regarding the financial markets, we find that the inverted U-shaped relationship between the percentage of risk smoothed through financial markets and risk aversion is confirmed within the first three quartiles of equivalent income, while this relationship is positive for wealthier households (fourth quartile). With the exception of the fourth quartile of equivalent income, the highest percentages of risk shared through financial markets are obtained by households with an intermediate level of risk aversion.

# 5    Conclusions

In this paper, we estimate the extent of channels of income and consumption smoothing at a micro level on a sample of UK households, with the objective of shedding light on how households cope with income shocks. We observe that savings account for the bulk of the total risk-sharing, whereas the role played by financial assets holdings is rather limited. We detect an inverted U-shaped relationship between risk aversion and the extent of income smoothing achieved through financial markets. Even though the bulk of the risk-sharing occurs through the savings channel, its extent depends on the region of residence, the level of educational achievement and the degree of risk aversion. For households with higher and more stable saving rates (such as Scottish households), risk-averse and less educated, the savings channel does not work as effectively in risk-sharing, since the elasticity of savings to income is lower for such groups. Among low-income households, we also observe the relatively ineffective role of the savings channel for risk-averse households. Conversely, for households that are more flexible in saving, i.e. save more when income rises and save less in the downturns, the extent of risk-sharing via savings is greater.

# Appendix A - The Dataset

Waves included: from G to R (from year 1996 to year 2007, released respectively in 1997 and 2008).

All "missing or wild" cases (which take value of -9), "don't know" cases (which take value of -1), "proxy respondent" cases (which take value of -7), "refused" cases (which take value of -2) and "inapplicable" cases (which take value of -8) are considered missing values and are thus excluded. [24]

**Consumption**:[25]

**1) food**

Total weekly food and grocery bills (W)XPFOOD.

Food consumption data were converted from weekly classes to numeric values per year, multiplying average weekly consumption of each class by the number of weeks in a year (53);

**2) non durables**

Amount spent on gas (W)XPGASY; Amount spent on electricity (W)XPLECY; Amount spent on oil (W)XPOILY; Amount spent on coal/other (W)XPSFLY;

**3) durables**

Cost of TV (W)CD1CST; Cost of VCR (W)CD2CST; Cost of deep freezer (W)CD3CST; Cost of washer (W)CD4CST; Cost of tumble dryer (W)CD5CST; Cost of dishwasher (W)CD6CST; Cost of microwave (W)CD7CST; Cost of computer (W)CD8CST; Cost of CD player (W)CD9CST; Cost of satellite (W)CD10CST; Cost of cable TV (W)CD11CST; Cost of landline phone (W)CD12CST.

Data on non-durable and durable goods are annual. All "inapplicable" and "missing or wild" responses were considered as zeroes in the case of durables. Our consumption variable in the empirical analysis is $C_{it}$, which includes consumption of food, durables and non-durables.

**Household income**: for the purpose of the decomposition, data on income were taken from the "Derived Current and Annual Net Household Income Variables, BHPS waves 1–18" (Levy and Jenkins, 2012). The data set is an unofficial supplement to the set of derived income variables in the official BHPS release (which focus on gross income).

**Total annual household income** (W)FIHHYR: Sum the values of individual annual total income for individuals in the household = household gross labour income (W)FIHHYL + household non labour income (W)FIYRNL.

**Household non labour income** (W)FIYHHNL = household investment income (W)FIHHYRI + household pension income (W)FIHHYRP + household transfer income (W)FIHHYRT + household benefit income (W)FIHHYRB.

**Total annual household investment income** (W)FIHHYRI: totals the estimated income from savings and investments, and all receipts from rent from property rental or boarders and lodgers, received

**Total annual household pension income** (W)FIHHYRP: total of all receipts from non-state pension sources received.

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[24]Exceptions are reported in the description of variables.

[25]The names of variables as in British Households Panel Survey are reported in capital letters. (W) represents the generic wave W. The processing of the data is quite complex and while this appendix aims to be as much accurate as possible, it can not be completely exhaustive. Stata codes generating the dataset are available upon request.

**Total annual household transfer income** (W)FIHHYRT: total of all receipts from other transfers (including education grants, health insurance, maintenance, foster allowances and payments from TU/friendly societies, from absent family members).

**Total annual household benefit income** (W)FIHHYRB: total of all receipts from state benefits (including National Insurance retirement pensions).

**Total annual household net income** (W)HHYNETI: Total annual household net labour income (W)HHYRLN + Total annual household investment income + Total annual household benefit income + Total annual household pension income + Total annual household transfer income

**Total annual household net labour income** (W)HHYRLN: Total annual household labour income -Total annual household national insurance contributions -Total annual household occupational pension contributions - Total annual household income tax after credits

**Taxes and contributions**: Total annual household national insurance contributions (W)YRNI + Total annual household occupational pension contributions (W)YRCONTR + Total annual household income tax after credits (W)YRTAXNT (which is equal to Total annual household income tax before credits (W)YRTAXGR - Total annual household credits on income tax (W)YRTAXCR).

**Risk attitude (aversion)**: variable (W)RISKA taken only from wave R since the relative question was introduced in the survey with the last available wave. The question is *"Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?"* It takes values from 1 ("won't take risks") to 10 ("ready to take risks"). In our estimation we considered the risk attitude/aversion of the head of household.

**Conventional Head of Household Indicator:** (W)HOH. "Indicator of the head of household as defined, for example by the Globally Harmonized System, i.e. the principal owner or renter of the property; where there is more than one head of households, the male takes precedence, and where there is more than one potential head of household of the same sex, the eldest takes precedence. The BHPS household reference person (HPR) definition is similar except that only the age criterion is used to distinguish multiple potential household reference persons. In the calculation, where any potential information is missing, the HRP definition takes precedence".

# Appendix B

Total annual household income from labour, pensions and benefits **YLPB**
(W)FIHHYL+(W)FIHHYRP+(W)FIHHYRB

+ Total annual investment Income
(W)FIHHYRI

---

= Total annual household income from labour, pensions, benefits and investment income **YLPBI**
(W)FIHHYL+(W)FIHHYRP+(W)FIHHYRB+(W)FIHHYRI

+ Total annual household transfer income
(W)FIHHYRT

---

= Total annual household income **TI**
(W)FIHHYR

– Taxes and contributions
(W)YRNI+(W)YRCONTR+(W)YRTAXNT

---

= Total annual household net income **DNI**
(W)HHYNETI

– Savings
DNI-C

---

= Consumption **C**

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Table 1: Income and consumption smoothing (percent)

| | |
|---|---|
| Investment income ($\beta_k$) | 8*** |
| | (1) |
| Transfers from outside the household ($\beta_\tau$) | 1*** |
| | (0) |
| Fiscal system ($\beta_f$) | 7*** |
| | (0) |
| Saving ($\beta_s$) | 77*** |
| | (4) |
| Not smoothed ($\beta_u$) | 7* |
| | (4) |
| N. Obs | 5,626 |

*** p<0.01, ** p<0.05, * p<0.1. Standard errors reported in brackets.

Table 2: Income and consumption smoothing by quartile of equivalized income (percent)

|  | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Quartile | I | II | III | IV |
| Investment income ($\beta_k$) | 14*** | 3* | 6*** | 9*** |
|  | (3) | (2) | (2) | (2) |
| Transfers from outside the household ($\beta_\tau$) | 0 | 1 | 1* | 0 |
|  | (1) | (1) | (0) | (0) |
| Fiscal system ($\beta_f$) | 3*** | 8*** | 9*** | 10*** |
|  | (0) | (1) | (1) | (1) |
| Saving ($\beta_s$) | 77*** | 77*** | 79*** | 76*** |
|  | (10) | (8) | (6) | (7) |
| Not smoothed ($\beta_u$) | 6 | 10 | 6 | 5 |
|  | (9) | (7) | (6) | (6) |
| N. obs | 1,414 | 1,395 | 1,411 | 1,406 |

*** $p<0.01$, ** $p<0.05$, * $p<0.1$. Standard errors reported in brackets.

Table 3: Saving channel by Region(percent)

| | Inner+Outer London | Rest of South-East | South West | East of England | East Midlands | West Midlands | North West | Yorkshire | Scotland |
|---|---|---|---|---|---|---|---|---|---|
| Saving channel ($\beta_s$) | 72*** | 83*** | 66*** | 73*** | 79*** | 77*** | 87*** | 84*** | 55** |
| | (10) | (8) | (20) | (13) | (10) | (8) | (11) | (7) | (22) |
| N. Obs | 447 | 1269,00 | 413 | 272 | 567 | 585 | 601 | 1010,00 | 462 |
| R-squared | 0.111 | 0.089 | 0.05 | 0.136 | 0.111 | 0.164 | 0.133 | 0.135 | 0.028 |

*** p<0.01, ** p<0.05, * p<0.1. Standard errors reported in brackets.

Table 4: Saving channel by education level of the head of household(percent)

| years of education | less than 11 years | 11 years | 13 years | 16 years | more than 19 years |
|---|---|---|---|---|---|
| Saving channel ($\beta_s$) | 92*** | 75*** | 68*** | 77*** | 71*** |
| | (10) | (10) | (10) | (5) | (20) |
| N. Obs | 1056 | 1275 | 466 | 2601 | 174 |
| R-squared | 0.089 | 0.049 | 0.112 | 0.089 | 0.103 |

*** p<0.01, ** p<0.05, * p<0.1. Standard errors reported in brackets.

Table 5: Saving channel by household type and gender of the head of household(percent)

| household type | Single non-eldery | | Single elderly | | Couple no children | | Couple with children (dependent non dependent) | |
|---|---|---|---|---|---|---|---|---|
| gender | male | female | male | female | male | female | male | female |
| Saving channel ($\beta_s$) | 72*** | 48*** | 78*** | 66*** | 75*** | 99*** | 84*** | 78*** |
| | (16) | (13) | (25) | (16) | (8) | (6) | (7) | (8) |
| N. Obs | 428 | 329 | 207 | 673 | 520 | 1,296 | 1,686 | 515 |
| R-squared | 0.072 | 0.1 | 0.121 | 0.068 | 0.065 | 0.229 | 0.135 | 0.174 |

*** p<0.01, ** p<0.05, * p<0.1. Standard errors reported in brackets. Remaining household type were not considered due to very limited (insufficient) number of cases.

Table 6: Income and consumption smoothing by risk attitude (percent)

|                                                  | (1)     | (2)     | (3)     |
| ------------------------------------------------ | ------- | ------- | ------- |
| Risk attitude                                    | 1-3     | 4-6     | 7-10    |
| Investment income ($\beta_k$)                    | 6***    | 10***   | 6***    |
|                                                  | (2)     | (1)     | (2)     |
| Transfers from outside the household ($\beta_\tau$) | 1*      | 0       | 0       |
|                                                  | (0)     | (0)     | (0)     |
| Fiscal system ($\beta_f$)                        | 6***    | 8***    | 8***    |
|                                                  | (1)     | (1)     | (1)     |
| Saving ($\beta_s$)                               | 74***   | 76***   | 80***   |
|                                                  | (10)    | (5)     | (6)     |
| Not smoothed ($\beta_u$)                         | 13      | 6       | 4       |
|                                                  | (10)    | (4)     | (6)     |
| N. obs                                           | 1,204   | 2,687   | 1,735   |

*** p<0.01, ** p<0.05, * p<0.1. Standard errors reported in brackets. The question is "*Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?*" It takes values from 1 ("won't take risks") to 10 ("ready to take risks"). In our estimation we considered the risk attitude/aversion of the head of household.

Table 7: Income and consumption smoothing by quartile of equivalized income of income and risk attitude (percent)

| Quartile | I | | | II | | | III | | | IV | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Risk aversion | 1-3 | 4-6 | 7-10 | 1-3 | 4-6 | 7-10 | 1-3 | 4-6 | 7-10 | 1-3 | 4-6 | 7-10 |
| Investment income ($\beta_k$) | 14*** | 15*** | 10 | 3 | 4* | 2 | 2 | 10*** | 1 | 1 | 9*** | 10*** |
| | (4) | (4) | (7) | (3) | (2) | (4) | (4) | (2) | (2) | (4) | (2) | (3) |
| Transfers from outside the household ($\beta_\tau$) | 0 | 0 | 0 | 1* | 1 | 2 | 1 | 1** | 0 | 2*** | 0 | 0 |
| | (1) | (1) | (1) | (1) | (1) | (4) | (2) | (0) | (0) | (1) | (1) | (0) |
| Fiscal system ($\beta_f$) | 1*** | 3*** | 3*** | 6*** | 10*** | 8*** | 14*** | 9*** | 8*** | 9*** | 9*** | 11*** |
| | (0) | (0) | (1) | (1) | (1) | (1) | (2) | (1) | (1) | (1) | (1) | (1) |
| Saving ($\beta_s$) | 68*** | 74*** | 103*** | 88*** | 73*** | 66*** | 67*** | 80*** | 88*** | 76*** | 79*** | 73*** |
| | (25) | (12) | (18) | (18) | (8) | (16) | (17) | (9) | (10) | (15) | (10) | (11) |
| Not smoothed ($\beta_u$) | 16 | 9 | -16 | 2 | 12 | 23 | 17 | 0 | 3 | 12 | 4 | 5 |
| | (25) | (10) | (18) | (18) | (8) | (15) | (16) | (9) | (10) | (15) | (9) | (10) |
| N. obs | 387 | 729 | 298 | 394 | 651 | 350 | 222 | 723 | 466 | 201 | 584 | 621 |

*** p<0.01, ** p<0.05, * p<0.1. Standard errors reported in brackets. The question is *"Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks?"* It takes values from 1 ("won't take risks") to 10 ("ready to take risks"). In our estimation we considered the risk attitude/aversion of the head of household.