Consumption risk, inequality, and the real exchange rate

Giancarlo Corsetti [*] Luca Dedola [†] Mar Domenech Palacios [‡]

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Abstract

We investigate whether and how heterogeneity in consumption risk and inflation across households affect consumption demand and growth under the lens of an incomplete markets framework. Our model of household-level risk sharing imposes minimal restrictions on the financial market structure, allowing for both aggregate and idiosyncratic tradeable risks to be at least partially diversified and for precautionary saving motives. We bring the model to bear on empirical evidence, using household-level scanner data from Euro area regions and United Kingdom, together with a matching model for financial market participation. Our contribution is twofold: first, we develop a theoretical framework mapping consumption (rather than income) risk and inflation differentials onto consumption growth at regional level; second, we assess theoretical conditions empirically, exploiting heterogeneity in risk and risk sharing, by preference, income, residence and participation in financial markets. Our empirical analysis provides evidence that tradeable risk is insured primarily among financial market participants, and across regions of the euro area than regions across the border (provided that differences in inflation are accounted for). Consumption risk, proxied using variability of consumption growth within regions and income groups, weigh on consumption demand.

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[*]European University Institute and CEPR
[†]European Central Bank and CEPR
[‡]European Central Bank and University of Cambridge

1 Introduction

What is the relationship between consumption growth and consumption risk? From a risk sharing perspective, perfect risk sharing predicts an absent relationship between the two. From a precautionary savings perspective under exogenously incomplete markets, a higher level of risk should be associated with lower consumption growth. On the other hand, from an endogenous incomplete markets perspective, one would expect that countries with higher risk could develop deeper financial markets and, therefore, lower savings would be required (De Ferra et al. (2021)).

In these analyses, usually the role of inflation and preferences are not accounted for. We develop a theoretical framework to examine the role of consumption heterogeneity in driving aggregate fluctuations in consumption growth. In particular, we allow for preferences to differ across the relevant groups of households. With this, we are able to enrich and test traditional tests of conditional risk sharing. To address this, our study employs a novel dataset and a nuanced empirical approach to assess the relationship between consumption heterogeneity and aggregate fluctuations at the regional level.

In a classic paper, Backus & Smith (1993) posited that, in a complete markets environment, the growth rate of the real exchange rate should exhibit a perfect correlation with variations in *per capita* consumption growth across countries. In essence, this implies that an increase in consumption growth should always be associated with a real depreciation.[1] However, Backus & Smith (1993) also document that this conclusion is drastically contradicted by the evidence available and that, in many cases, the opposite relationship is observed. Overwhelming evidence against perfect cross-country risk sharing suggests that, if anything, the correlations are the opposite sign, where a real appreciation goes hand in hand with positive consumption growth (see the surveys by Lewis (2000), Obstfeld & Rogoff (2000) or Rangvid et al. (2016)).[2] Other studies have centered around understanding what is the source of the friction and what is the resulting relationship between the two variables (see Kocherlakota & Pistaferri (2007) and Kocherlakota & Pistaferri (2009)).

In this paper, we aim at understanding the role of consumption heterogeneity within

[1]One can think of the case where, for example, agents take advantage of cheaper prices by increasing their consumption levels. Consider a country experiencing an exogenous positive shock in productivity, which would tend to bring down the relative prices of the products and services it produces. Accounting for some home bias in consumption, this would, at the same time, increase consumption growth, as residents in that country take advantage of lower prices. Complete markets guarantee that this efficient outcome always materializes in equilibrium, independently of all other non-finance related distortions in the economy, such as nominal rigidities or labour wedges.

[2]A large body of research has focused on understanding what drives the positive correlation between consumption and the real exchange rate (see, e.g. Corsetti et al. (2008), Benigno & Thoenissen (2008), Corsetti et al. (2012), Colacito & Croce (2011), Epstein & Zin (1991) and Itskhoki & Mukhin (2021)).

a region in explaining the discrepancy between theory and the data. To the best of our knowledge, no paper in the literature has focused on deriving a test that accounts for both aggregate and idiosyncratic risks without making assumptions on the structure of the financial markets. More generally, we aim at contributing towards bridging the gap between the household risk sharing literature and the growing literature that studies the role of heterogeneity in aggregate economic fluctuations.

In particular, we focus on the following research questions: Given the incompleteness of financial markets and the non-tradeability of certain risks, what is the role of consumption heterogeneity and risk in determining risk sharing conditions? Are aggregate and idiosyncratic tradable risks diversified? Finally, how do the dynamics change for households when they participate in financial markets?

We proceed in three main steps. First, we augment the risk sharing condition to account for consumption heterogeneity and risk and find a theoretical relationship between regional-level real exchange rate movements, consumption growth and consumption risk. Second, using household-level scanner data on supermarket consumption and prices, we test these predictions in the data for a number of regions in European countries. Finally, we build a matching model to assess the probability that a given household participates in financial markets and test the model predictions for the subset of households that are more likely to participate.

On the theoretical front, our approach aligns with that of Debortoli & Galí (2022) wherein we perform a second-order approximation of the Euler equation, with the difference that we relax purchasing power parity assumptions. While Debortoli & Galí (2022) primarily focus on the role of idiosyncratic risk in causing aggregate fluctuations, we aim at testing household consumption risk sharing in the context of incomplete markets. Notably, our analysis reveals that the presence of non-fully diversified idiosyncratic risk requires additional terms in the Euler equation. We aggregate the equation at the regional level and develop a testable framework that allows us to study whether both tradeable aggregate and idiosyncratic risks are diversified.

In contrast to the approach taken in Kocherlakota & Pistaferri (2007), our objective is not to narrow down the specific source of the friction that explains limited risk sharing. In turn, we propose a highly flexible framework while imposing minimal assumptions on the financial market structure. Within this framework, we develop a testable prediction that allows for consumption heterogeneity, incomplete markets, and both idiosyncratic and aggregate shocks. This allows us to empirically test model-based relationships in the data and further explore the determinants of real exchange rate fluctuations.

Using household supermarket scanner data sourced from GfK, we test the theoretical predictions for regions in France, Germany, Spain and the United Kingdom. Our dataset spans from 2008 to 2018, and we aggregate it at the quarterly level. First, we construct household-level Laspeyres inflation index and household-level consumption and consumption growth. From household level inflation and consumption, we construct region level weighted averages. Each household's level of consumption risk is then imputed based on consumption risk within their income group. Subsequently, we compute region-level aggregates as a weighted average of household-level uncertainty, where weights are assigned proportionally to the household level of consumption. With the aim of differentiating the dynamics of the overall population to the subset of households who participate in financial markets, we build a matching model using the Household Finance and Consumption Survey (HFCS) data to assess how likely it is that a given household does participate. With a Lasso model, we select the most important drivers of participation and estimate a model to establish the relative importance of each driver. We use it to calibrate a propensity to participate in financial markets for each household in the GfK dataset. This allows us to test the theoretical prediction restricting it to households that are more likely participating in financial markets.

While do not find evidence in favour of effective sharing of tradeable risk when we focus on the overall population, when we narrow our focus to financial market participants, we observe a convergence with the theoretical predictions. This, however, requires additionally that we focus on the specific inflation dynamics experienced by this population subgroup, suggesting a large role for differentiated preferences. This suggests that financial markets participants are better insured against tradeable risk. However, our results point towards incomplete financial markets, meaning that not all risk is tradeable. Our study also delves into the impact of the institutional framework by comparing dynamics in scenarios where both regions are part of a monetary union versus one region not being part of it (specifically, the United Kingdom). Notably, even when focusing only on potential asset holders, the theoretical predictions are only validated in the former case.

The remaining of the paper is organised as follows. Section 2 reviews the literature; Section 3 presents the theoretical framework; Section 4 presents the data; Section 5 explains the imputation of assetholding probabilities; Section 6 presents the empirical analysis; and Section 7 concludes.

2 Related Literature

Backus and Smith puzzle

The seminal paper of Backus & Smith (1993) derived, first, the condition that, under perfect risk sharing, domestic households should consume more when their consumption basket is relatively cheap, and showed, second, that this condition contrasts with the empirical evidence, where a low or even negative correlation between relative consumption and real exchange rate is observed, giving rise to one of the main puzzles in new open macroeconomics literature.

There have been a few attempts in the literature to find explanations to the puzzle, both at the theoretical and at the empirical level.

A first line of research aiming at explaining the Backus and Smith puzzle focuses on wealth effects derived from productivity shocks (see Corsetti et al. (2008)). On the other hand, Benigno & Thoenissen (2008) assume limited international trade in assets and investigate the role for the nontradable sector in breaking the link between the real exchange rate and relative consumption.[3] Corsetti et al. (2012) test the mechanism empirically and find that in most countries, a rise in relative domestic consumption is systematically associated with a rise in the domestic relative price of nontradables but also of tradable goods. Colacito & Croce (2011) use a model based on Epstein & Zin (1991) preferences to understand the properties of equity returns, real exchange rates and consumption focusing on preference shocks. More recently, Itskhoki & Mukhin (2021) offer a unifying theory of exchange rates that account for the Meese & Rogoff (1983), purchasing power parity, terms of trade and Backus and Smith puzzles studying the role of shocks in the financial market, besides the common productivity and monetary shocks.[4]

In testing for sharing of risk, Obstfeld (1993) proposed a methodology for empirically testing risk sharing based on the fact that under perfect risk sharing, differentials in intertemporal marginal rates of substitution across national representative agents should be equal to zero. If one additionally assumes purchasing power parity, consumption growth should be perfectly correlated across countries. Similarly, Sørensen et al. (2007) predict that under perfect risk sharing, consumption growth fluctuations should not respond to output fluctuations in a given country. Another line of the literature has focused on proposing different measures of risk sharing (see Brandt et al. (2006), Lustig & Verdelhan (2019)).

On the understanding the source of frictions in explaining the role of idiosyncratic risk leading to limited risk sharing, Kocherlakota & Pistaferri (2007) and, subsequently,

[3] The real exchange rate overall would then appreciate if the effect coming from the relative price of non-traded to traded goods outweights the terms of trade effect caused by a real depreciation of the real exchange rate.

[4] The authors show that the former types of shocks can simultaneously resolve all exchange rate puzzles and deliver the empirically relevant co-movement properties between the nominal exchange rate and macro variables. They add two essential ingredients: home bias in the product market and an imperfect financial market which results in UIP deviations.

Kocherlakota & Pistaferri (2009) incorporate the idea that heterogeneity in consumption and risk within countries might play a role in explaining the relevant friction that explains the puzzle, propose two theoretical frameworks, and test them empirically.[5]

In this paper we propose a theoretical framework that allows to deviate from the representative agent environment and test for diversification of both aggregate and idiosyncratic risks. For it, we allow for market incompleteness and we make minimal assumptions on the asset market structure.

Idiosyncratic risk and aggregate fluctuations

A different strand of the literature focuses on understanding the interplay between consumption heterogeneity and aggregate fluctuations. However the gap between theoretical frameworks and empirical observations remains vast. Some theoretical works have suggested a limited role for consumption heterogeneity in driving aggregate consumption fluctuations, while on the other hand, empirical evidence paints a contrasting picture. For example, Debortoli & Galí (2022) investigate the role of the fact that, in general, the dynamic response of uncertainty is larger for low consumption households, in partially muting the impact of a shock in average uncertainty.

To analyse the role of household heterogeneity in the transmission of foreign shocks, De Ferra et al. (2020) build a quantitative model embedding domestically incomplete markets into the open economy framework. De Ferra et al. (2021) investigate the role of endogenous incomplete markets in explaining the interplay between income inequality and capital flows.

We follow the methodology in Debortoli & Galí (2022) to decompose the aggregate Euler equation into an additional term that captures variations in individual consumption uncertainty, averaged across households. This gives rise to a precautionary savings motive that has potentially large aggregate implications.[6] We provide a framework that allows for limited insurance against both aggregate and idiosyncratic risks and we test

[5]The first one builds on the idea that agents are faced with skill shocks that affect their ability to transform effort into output (incomplete markets model); In the second environment (private information Pareto optimal), agents sign insurance contracts that completely insure themselves against their skill shocks, subject to the incentive compatibility constraint generated by the restriction that the realisations of the shocks are private information - the insurance companies are then allowed to trade on the agents' behalf. In both, households can fully insure themselves against aggregate shocks but not against idiosyncratic shocks. The authors show that under each of the models a different relationship between consumption inequality and the real exchange rate emerges. Kollmann et al. (2021) tests the empirical relationships established in Kocherlakota & Pistaferri (2007) and shows that the real exchange rate does not perfectly track moments of the consumption distribution and argues that the link between consumption and the real exchange rate remains a puzzle.

[6]Relatedly, Coibion et al. (2021) use randomized information treatments to generate exogenous changes in perceived macroeconomics uncertainty to households and find that higher macroeconomic uncertainty induces households to reduce their spending on non-durable goods and services in subsequent months.

the relationships in the data.

Limited participation in financial markets

Limited participation in the financial markets has been investigated largely as a potential reason for low risk sharing (see *e.g.* Mankiw & Zeldes (1991), Kollmann (2012), Cociuba & Ramanarayanan (2019), Zhou (2020), or Zhang (2021)).

Gomes & Smirnova (2021) find that stock market participation is a hump-shaped function of age, Catherine et al. (2016) finds that cyclical skewness of labor income shocks explains the limited stock market participation of households with modest financial wealth and the positive age trend. Attanasio et al. (2002) investigate whether limited participation of households in the stock market might explain the lack of correspondence between the intertemporal marginal rate of substitution and asset returns in the UK. For it, they estimate ownership probabilities and find that the consumption share of shareholders is more volatile than that of nonshareholders. Gârleanu & Panageas (2023) present a model of incomplete markets where the focus is on a lack of intercohort risk sharing creating a wedge between aggregate *per capita* consumption growth and the consumption growth of the representative member of a cohort.

How participation in the financial markets is heterogeneously endogenous to the cycle has been investigated in the literature: De Giorgi & Gambetti (2017) analyse interactions between business cycles and the consumption distributions and find that the right tail of the consumption distribution generally has a larger and a quicker response to shocks, and that financial market participation steeply increases along the distribution of consumption.

Some studies in the literature (see e.g. Campbell & Mankiw (1989), Galí et al. (2007), Bilbiie (2008), Debortoli & Galí (2017) Broer et al. (2020)) analyse models with two types of households, unconstrained and hand-to-mouth, and focus on the role of binding constraints.

We account for a potential large proportion of households that might not participate in financial markets and, therefore, their dynamics might differ from the rest of households. We propose a methodology to restrict the sample to the households that are more likely to hold financial assets and perform the test for this subset.

3 Theoretical framework

We start by considering a simple small open economy with a continuum of households, indexed by $h \in [0, 1]$, who can borrow and lend at a gross world riskless rate I_t, denominated in the world numeraire, subject to a natural debt limit. Individuals maximise lifetime utility:

$$\mathbb{E}_0\left[\sum_{t=0}^{\infty}\beta^t U\left(C_{h,t}\right)\right]$$

– where $C_{h,t}$ denotes household h consumption in period t, $U\left(C\right)=\frac{C^{1-\sigma}-1}{1-\sigma}$, with $\sigma\geq 0$, and β is the discount factor – subject to the following budget constraint for for $t=0,1,2...$:

$$P_tC_{h,t}+B_{h,t}\leq B_{h,t-1}I_{t-1}+[Y_{h,t}+P_t^NY_{h,t}^N].$$

Since the constraint is expressed in the world numeraire, P_t represents the relative price of consumption of the small open economy, $B_{h,t}$ represents household h holding of period t one-period bonds, which yield a gross riskless return I_t. The household-specific income is a composite of the world good $Y_{h,t}$ and a domestic good $Y_{h,t}^N$ with relative price P_t^N; both income components could be subject to idiosyncratic shocks. Finally, observe that P_t is a function of P_t^N, depending on the specification of preferences over the world and domestic goods. In what follows we will assume that preferences are homothethic.[7]

3.1 Individual Euler equation

Consider the standard individual Euler equation describing the optimal intertemporal consumption choice for an individual household:[8]

$$\frac{C_{h,t}^{-\sigma}}{P_t}=\beta I_t\mathbb{E}_t\left[C_{h,t+1}^{-\sigma}\frac{1}{P_{t+1}}\right] \tag{1}$$

Following Debortoli & Galí (2022) we derive a second order approximation of the expression. The key difference is that we have expressed the budget constraint in terms of relative prices, thus we need to approximate around these prices as well.

A second-order approximation of $C_{h,t+1}$ around $C_{h,t}$ and P_{t+1} around P_t yields:

$$\frac{C_{h,t}^{-\sigma}}{P_t}\simeq\beta I_t\mathbb{E}_t\left[\frac{C_{h,t}^{-\sigma}}{P_t}\left(1-\sigma\frac{\Delta C_{h,t+1}}{C_{h,t}}-\frac{\Delta P_{t+1}}{P_t}+\frac{\sigma(\sigma+1)}{2}\left(\frac{\Delta C_{h,t+1}}{C_{h,t}}\right)^2+\left(\frac{\Delta P_{t+1}}{P_t}\right)^2+\sigma\frac{\Delta C_{h,t+1}}{C_{h,t}}\frac{\Delta P_{t+1}}{P_t}\right)\right]$$

Rearranging the above expression yields the standard savings relation between expected household consumption growth and the relevant expected real interest rate, plus

[7] Specifically assuming a CES aggregator over the domestic and the world goods would result in the same specification with traded and non-traded goods as in Backus & Smith (1993).

[8] Under the maintaned assumption of homothetic preferences we do not need to consider the intratemporal consumption problem which determines how total consumption is split between the world and domestic goods.

a second-order term, $v_{h,t+1}$:

$$\sigma \mathbb{E}_t \left[\frac{\Delta C_{h,t+1}}{C_{h,t}} \right] \simeq - \left[\frac{1}{\beta I_t} + \mathbb{E}_t \left(\frac{\Delta P_{t+1}}{P_t} \right) - 1 \right] + \mathbb{E}_t(v_{h,t+1}) \tag{2}$$

where we have defined $v_{h,t+1}$ as follows:

$$\mathbb{E}_t(v_{h,t+1}) = \mathbb{E}_t \left(\frac{\sigma(\sigma+1)}{2} \left(\frac{\Delta C_{h,t+1}}{C_{h,t}} \right)^2 + \left(\frac{\Delta P_{t+1}}{P_t} \right)^2 + \sigma \frac{\Delta C_{h,t+1}}{C_{h,t}} \frac{\Delta P_{t+1}}{P_t} \right)$$

The term $v_{h,t+1}$ therefore captures the effect on the saving decisions of individual households due to consumption risk and, relative to the case of a closed economy, also real exchange rate risk. The effect of this term on expected consumption growth will reflect a precautionary savings motive and results from the convexity of marginal utility. Namely, for a given expected real interest rate (the first term in square brackets on the right hand side of Equation (2)), the larger $v_{h,t+1}$, the larger expected consumption growth and the lower current consumption.

If there were no idiosyncratic shocks, $v_{h,t+1}$ would not depend on cross-sectional consumption volatility but only on aggregate consumption fluctuations and real exchange rate fluctuations, as in standard representative agent models. Conversely, in models with heterogeneous agents $v_{h,t+1}$ is also a function of idiosyncratic shocks. Therefore, its component due to individual consumption uncertainty is likely to be generally larger and more volatile than its aggregate counterparts.[9]

3.2 Aggregate (regional) Euler equation

Next, we derive the aggregate Euler equation. $C_t \equiv \int C_{h,t} dh$ denotes aggregate consumption. Aggregate consumption growth is given by the consumption-weighted average of individual consumption growths:

$$\mathbb{E}_t \left[\frac{\Delta C_{t+1}}{C_t} \right] = \int \frac{C_{h,t}}{C_t} \mathbb{E}_t \left[\frac{\Delta C_{h,t+1}}{C_{h,t}} \right] dh$$

Therefore, aggregating Equation (2) across households, we can write:

$$\sigma \mathbb{E}_t \left[\frac{\Delta C_{t+1}}{C_t} \right] \simeq - \left[\frac{1}{\beta I_t} + \mathbb{E}_t \left(\frac{\Delta P_{t+1}}{P_t} \right) - 1 \right] + \mathbb{E}_t(v_{t+1}) \tag{3}$$

[9] As we describe later, we measure it with the cross-sectional dispersion in consumption within the income group of a given household.

where $\mathbb{E}_t(v_{t+1}) \equiv \int \frac{C_{h,t}}{C_t}\mathbb{E}_t(v_{h,t+1})dh$.

Evaluating the expression at a stochastic steady state with no aggregate risk (namely constant aggregate consumption and inflation) we have the relation

$$0 \simeq \frac{1}{\sigma}(1-\pi) - \frac{1}{\sigma\beta I} + \frac{1}{\sigma}v \tag{4}$$

where π, I and v denote the values of the change in relative prices, interest rate, and average individual consumption risk (since the second and third terms in $v_{h,t+1}$ are zero in this case). Thus a first-order Taylor expansion of equation (3) around this stochastic steady state for log aggregate consumption $c_t \equiv log(C_t)$ gives us:

$$\sigma\mathbb{E}_t(\Delta c_{t+1}) = \left[\frac{1}{\beta}\hat{i}_t - (\mathbb{E}_t(\hat{\pi}_{t+1}) - 1)\right] + \mathbb{E}_t(\hat{v}_{t+1}) \tag{5}$$

where $\mathbb{E}_t(\hat{\pi}_t) \equiv \mathbb{E}_t\left(\frac{P_{t+1}-P_t}{P_t}\right) - \pi$, $\hat{i}_t \equiv \frac{1}{I}\left(\frac{I_t - I}{I}\right)$ and $\mathbb{E}_t(\hat{v}_{t+1}) \equiv \mathbb{E}_t(v_{t+1}) - v$.

This equation shows that aggregate volatility $\hat{v}_{t+1}$ has the the same effect on aggregate consumption as individual volatility in Equation (2). For a given expected real interest rate, the larger $\hat{v}_{t+1}$ the larger expected consumption growth and the lower current consumption. As shown by Galí and Debortoli (2023), the response of $\hat{v}_{t+1}$ to aggregate shocks plays a key role in shaping the effects of idiosyncratic risk on aggregate fluctuations. Here, we are interested in how idiosyncratic risk affects insurance against aggregate shocks, as we discuss in the next subsection.

3.3 Dynamic implications for relative prices and consumption between economies and regions

Now consider two different small economies (or regions), denoted by superscripts i, j, whose households have access to the bond market with common interest rate I_t. Assuming an identical discount factor and risk aversion across the two regions, we obtain the following relationship between the respective aggregate Euler Equations in (5):

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$$\mathbb{E}_t(\Delta c^i_{t+1}) - \mathbb{E}_t(\Delta c^j_{t+1}) = \frac{1}{\sigma}\left(\mathbb{E}_t(\hat{\pi}^j_{t+1}) - \mathbb{E}_t(\hat{\pi}^i_{t+1}) + \mathbb{E}_t(\hat{v}^i_{t+1}) - \mathbb{E}_t(\hat{v}^j_{t+1})\right), \tag{6}$$

where the term $\mathbb{E}_t(\hat{\pi}^j_{t+1}) - \mathbb{E}_t(\hat{\pi}^i_{t+1})$ amounts to the expected rate of real exchange rate depreciation of i relative to j. Given the access to the same nominal bond, this difference can also be interpreted as the real interest rate differential between the two regions.

This equation reflects the relative price implications of differences in *ex-ante* consumption risk at the aggregate and individual level between two regions. Specifically, it is akin to a consumption-based real uncovered interest parity relationship, also embedding the term $(\mathbb{E}_t(\hat{v}^i_{t+1}) - \mathbb{E}_t(\hat{v}^j_{t+1}))$ driven by the interaction between household-level and aggregate risk. According to real uncovered interest parity, the real exchange rate of a country is expected to depreciate if its real interest rate is higher. By the same token, according to Equation (6), average consumption growth is expected to be higher in i if inflation in i is expected to be lower than in j (the bilateral real exchange rate of between i and j is expected to depreciate) or if consumption risk is higher, since in both instances the real interest rate expressed in the consumption basket in i is higher than the real interest rate expressed in the consumption basket in j, adjusted for the risk differential $(\mathbb{E}_t(\hat{v}^i_{t+1}) - \mathbb{E}_t(\hat{v}^j_{t+1}))$.

It is important to note that this outcome arises in the context of an incomplete markets scenario, in which however *ex-ante* risk at the aggregate and household level is fully diversified. Under rational expectations, if agents fully utilize all available information in period t, the discrepancy between realized values *ex-post* and expected values should be uncorrelated with any variable known at time t and thus unforecastable. Therefore, we can write the *ex-post* version of (6) as follows:

$$\Delta c^i_{t+1} - \Delta c^j_{t+1} = \frac{1}{\sigma}\left(\hat{\pi}^j_{t+1} - \hat{\pi}^i_{t+1} + \hat{v}^i_{t+1} - \hat{v}^j_{t+1}\right) + z^{i,j}_{t+1}, \tag{7}$$

where $\mathbb{E}_t(z^{i,j}_{t+1}) = 0$.

This equation entails several implications we will rely upon in our empirical analysis. First, in a complete market setting with full insurance, $z^{i,j}_{t+1} = 0$ and there would be no consumption dispersion term ($\hat{v}^i_{t+1} = \hat{v}^j_{t+1} = 0$). Thus a regression of the the consumption differential on the left hand side on the depreciation rate would yield a positive coefficient, while any other variable should be insignificant, providing a (well-known) test of full insurance. Second, in our benchmark incomplete market setting, $z^{i,j}_{t+1}$ captures all aggregate risk sources which cannot be diversified *ex-ante* and is thus in principle correlated with all the other terms on the right hand side of Equation (7). As a result, the same regression of the consumption growth differential on the real exchange rate depreciation will not in general yield a positive coefficient. Nevertheless, other variables dated as of t included in such a regression should still yield insignificant coefficients under full *ex-ante* diversification, since $\mathbb{E}_t(z^{i,j}_{t+1}) = 0$. Third, including regressors proxying for the undiversified sources of risk $z^{i,j}_{t+1}$ should result in all the other coefficients in Equation (7) being correct (or at least having the correct sign as bias is reduced). This would imply that a rejection of the correct sign of these coefficients will be evidence that there remain significant sources of undiversified risk beyond those we are able to control for. Specifically, rejecting the right sign of the coefficient on relative exchange rate depreciation, and or that the coefficient on the consumption risk term $(\hat{v}^i_{t+1} - \hat{v}^j_{t+1})$ is not zero, would imply that there are aggregate shocks affecting either variable which are not insured.

We test empirically the implications of Equation (7) using household level consumption data from regions in the euro area and the UK which we describe in the next section. While our theoretical framework is based on the assumption that households are able to borrow and lend at a riskless nominal rate, it is well known that many households do not directly hold financial assets. For such households, not only is the condition $\mathbb{E}_t(z^{i,j}_{t+1}) = 0$ violated so that z_{t+1} can be forecast, but additionally, z_{t+1} is likely to be correlated with sources of risks that could be otherwise insurable via financial markets. This can make it more likely that we reject even conditional risk sharing. Therefore, we will also aim at testing the equation for the subset of households that are likely to participate in financial markets and to be at least partially insured.

4 Data

4.1 Data sources

To implement our analysis, we use data from a number of sources. First, we use household scanner data on their purchases in supermarkets, provided by the private firm GfK-Kantar, to compute household level variables needed to test the theoretical predictions. In particular, we use this database to construct consumption and inflation indices at the household level, as well as a measure of consumption risk or uncertainty at the household level. We then aggregate it to have a measure of these variables at the region level.

We include data for France, Germany, Spain and United Kingdom. The data largely constitutes a representative sample of households at the country level. We have a total of 274,546 different households in the entire dataset (46,015 in France, 129,584 in Germany, 31,071 in Spain, and 67,876 in the United Kingdom). We observe the date of purchase, the barcode, value of sales, quantities, the unit in which quantitites are measured, the brand and supermarket of each transaction made by each household. The barcodes are classified into different COICOP products. We observe a number of household characteristics: age, income and social class of the head of the household, zipcode, region and province. We construct the dataset at quarterly frequency, from 2008Q1 to 2018Q4.[10]

[10]While data for Germany and United Kingdom starts in 2005, we choose these dates because data for

To study the determinants of household participation in financial markets, we use the Household Finance and Consumption Survey (HSCF), which collects household-level data on household's finances and consumption in the European Union. The survey consists on three waves: the first wave was collected between 2010 and 2011; the second between 2013 and the first half of 2015 and 2017 for the third wave. The dataset provides detailed household-level data on various aspects of household balance sheets and related economic and demographic variables, including income, pensions, employment, gifts, and measures of consumption, and it provides country-representative data.

We obtain country level GDP at the quarterly frequency and regional-level (NUTS1) at yearly frequency from OECD statistics regional database. We find data on average income at the census section level for Spain at the *Instituto Nacional de estadística*. Finally, nominal exchange rate data between UK pound sterling/Euro is retrieved from the ECB data portal SDW.

4.2 Construction of variables

Using GfK data, we build household-level data on inflation and consumption. We first build a Laspeyres index of inflation at the year on year level and quarterly frequency at the household level and in the spirit of Kaplan & Schulhofer-Wohl (2017). The Laspeyres inflation rate for household i between t and $t+4$ is:

$$\pi_{i,t+4} = \frac{\sum_{j:q_t,q_{ij,t+4}>0} p_{ij,t+4} q_{ijt}}{\sum_{j:q_t,q_{ij,t+4}>0} p_{ij} q_{ijt}} \tag{8}$$

We construct consumption per household in real terms dividing overall quarterly household level expenditure by household-level price index constructed with Laspeyres year-on-year inflation. To adjust for within-household economies of scale, we follow the modified OECD scale, according to which 1 point is given to the first member, 0.5 points to the rest of adults and 0.3 points for each kid below 14 years old. However, because we do not observe the age of the rest of the members, we assign 1 point to the first one and 0.5 to the rest of members. We then measure consumption growth at the household level as log differences.

Income class data is available for France, Germany and the United Kingdom. There are 17 classes for Germany, 18 for France and 8 for United Kingdom. For each household we assume that their income is the centre of the interval provided; for the lowest we assume an income equal to its upper bound and for the highest we assume an income

France and Spain is only available from 2008.

equal to its lower bound. For France, income class data is unavailable for years before 2014. To assign income classes to panelists for earlier years, we use the closest observed income class in the available data, which leaves out panelists that attrite. For Spain, income data is not available. To tackle this problem we impute the income data based on the household zipcode. For this, we use INE censal section data on average income and match the census sections to zipcode. Census section income data is available yearly from 2015 until 2019. Income data from 2015 is imputed to households prior to this date based on the zipcode of households.

We measure household-level and region-level consumption uncertainty, or risk, through the following steps. First, for each region and quarter, we divide households in 5 groups depending on their level of consumption. The idea is that a household in a given group might have systematically different dynamics of consumption uncertainty compared to households with different levels of consumption. For each group, we measure consumption uncertainty following Debortoli & Galí (2022) as:

$$ConsRisk_q = 1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2} \tag{9}$$

We assume that each household faces an uncertainty equal to the cross-sectional measured uncertainty of the group to which they belong. With the computed level of household consumption uncertainty, we compute a weighted average of uncertainty using household level of consumption as the weights.

We build regional data following the NUTS1 classification. For each region and quarter, we construct weighted averages of inflation and consumption growth, where weights are proportional to relative consumption levels by household. We drop a given region and quarter when the number of consumption observations is under 100. To compare the same subset of regions in the analysis, we keep only those for which there are enough households with a high probability of holding assets. Those are defined as households whose probability is above a given percentile, defining the threshold in each country as the proportion of the households in the country that do participate in the financial markets.

To compute inflation uncertainty at the regional level, we aggregate household-level inflation at the region and quarter level by computing a weighted average where weights are determined by the level of household consumption. We then assume that the uncertainty around inflation that a given household faces is the standard deviation of the regional level inflation of past two years (current and 7 previous quarters). Finally, the covariance between consumption and prices is assumed to be zero given the underlying assumption that households face the same price level.

5 Imputing asset holdings

An advantage of our theoretical framework is that it operates on a basic level of assets that are accessible to households, *i.e.* bonds. However, one concern is that not all households necessarily participate in the financial markets. In consequence, their Euler equation might not hold with equality as in Equation 1, which might in turn lead to a deviation from the aggregate Euler equation.

One route to address this issue is to limit the analysis to households that are known to participate in financial markets, and then test the theoretical predictions based on those households. However, in our dataset, it is not possible to observe whether a household participates in financial markets or not. To address this limitation, an alternative approach is to identify the factors that are associated with a higher likelihood of households holding financial assets, and then estimate the probability of holding assets for each household in the dataset based on these factors. This enables us to restrict the analysis to the subset of households that are more likely to participate in financial markets. Once we have estimated the probabilities of holding financial assets for each household, we can select the subset of households with the highest probabilities and perform the analysis on this subset. This approach would enable us to mitigate the impact of the non-participation of some households in the financial markets and provide a more accurate representation of the behaviour of households in these markets.

To implement this, we proceed in three steps. First, we use the HFCS data to identify the primary factors that influence households decisions to hold assets. With the help of a Lasso regression, we select a model that predicts a probability for each household to participate in the financial markets, and we estimate it. Second, we use the model in the GfK data to estimate a probability of participating in financial markets for each household in this dataset. Third, we classify as participants in asset markets the households with probabilities higher than a given threshold.

5.1 Financial market participation

We start by merging the three available waves in the HFCS dataset (2010, 2014 and 2017) and we restrict the sample to households in France, Germany or Spain.[11]

We define a household as holding financial assets if it reports holding publicly traded shares, mutual funds, or bonds. Table 1 presents the percentage of households participating in financial markets by country and survey wave. Table 2 describes some statistical

[11] Because the United Kingdom is not part of the survey sample, we estimate the model without it and extrapolate the results.

differences between participants and non-participants. Households in the first group tend to have substantially larger income and consumption, to be slightly older and to live in households with more members.

Table 1: Percentage of households participating in financial markets

	Wave 1 (2010)	**Wave 2 (2014)**	**Wave 3 (2017)**
France	21.69	17.97	17.61
Germany	22.65	19.26	20.78
Spain	15.15	14.73	15.83

Table 2: Descriptive statistics

	Participating	**Non-participating**
Age	53.88	52.73
Income	41,882.27	22,288.65
Consumption	921.68	762.39
HH size	1.63	1.59

Note: Income and consumption are divided by consumption units within a households, which account for economies of scale within the household, and are such that the first household member has a weight of 1 and the rest have a weight of 0.5. Consumption refers to food expenditure at home and is expressed in Euros and per quarter. Income is the total household gross income per year.

5.2 Building a statistical matching model

In our next steps we proceed with a matching model. The aim is to detect households *likely* to hold assets, and we do so in the spirit of Attanasio et al. (2002).

We build a simple statistical matching model or synthetic matching aiming at using the information contained in the HFCS database (often called the *donor* dataset) to explore and impute to the households of the GfK dataset (referred to as the *recipient* dataset). For it, we first explore the factors that are correlated with individuals to possess financial assets and then create a corresponding model that predicts the likelihood of households possessing assets that leverages all information accessible in both the HFCS dataset and the GfK data. Finally, we use it to estimate a probability for each household to participate in financial markets in the GfK dataset.

The first step entails building a statistical model that predicts asset holdings. In it, we would ideally include all possible information that can be exploited in both datasets. This include age, income, consumption, household size, country (to allow for the drivers to be different across countries), survey wave (to allow for different time trends), the quadratic terms of all these variables, and all possible interactions between them. To avoid overfitting, we select the variables that best predict our outcome variable using a Lasso model for model selection.

We begin by splitting the data into two groups: a training dataset, which we use to select the model; and a testing dataset, used to test the prediction. We fit a linear Lasso model to the training dataset under two different cases: first, we add all variables and let the model decide which ones to include (unrestricted model) and separately we restrict the model to include a dummy variable for each country and an interaction term between country and income for each variable. Tables 13 and 14 in the Appendix reflect the variables included in each model for the unrestricted types. Tables 15 and 16 compare the performance of the different models. We choose Models 16-19 because these are relatively parsimonious and have the highest out-of-sample R-squared. The variables included in the model are: Income, Household size × consumption, age × income squared, Country 3 × Income, Age squared × Household size, Country 2 × Consumption, and Age × Household size.[12]

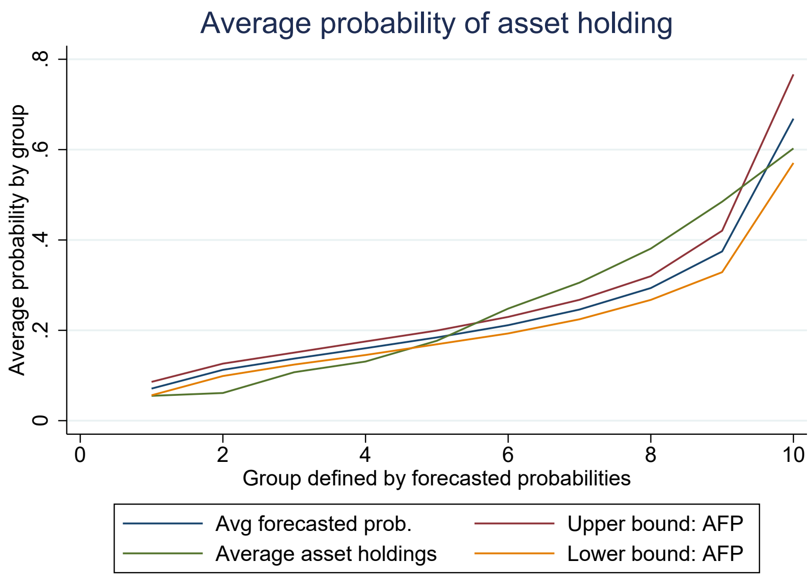
5.3 Results and internal validity

The results from the selected model, and estimated taking account of multiple imputations and survey weights, are presented in Table 17. To test the accuracy of the results obtained , we proceed with the following steps. First, we predict an expected probability of asset holdings for each household, depending on their characteristics. We also predict the uncertainty regarding these probabilities, *i.e.* the standard deviation of these, and construct a 95% confidence interval for these probabilities. We divide households in ten groups, depending on their forecasted predicted probabilities of holding assets. For each group, we compute an average probability of holding assets, the average lower and upper bounds, and compare it to the actual average asset holdings for each of the group. Figure 5 displays the average asset holdings by probability group. The curve is monotonically increasing, with only around 10% of households holding assets in the lowest probability group, compared to around 60% of households doing so in the largest group, suggesting that the model accurately depicts the households probability based on their observable characteristics. In Figure 1 we plot the average forecasted probability for each group together with the average upper and lower bounds, and the actual average number of households that appear to participate in financial markets for each group. We can see

[12] We do not use a Probit or Logit model but instead we use a linear probability model because in this case the concern is the relative resulting propensity between households, rather than the probability itself.

that the prediction generally follows the underlying trend, with the actual probability being close to predicted region along all groups. There appears to be some upward bias for the lower groups and some downward bias for the upper groups, although the extremes match the observed averages.

Figure 1: Average and predicted probabilities of asset holdings



5.4 Results in GfK data

The last step entails using the regression coefficients in Table 17 to impute a probability to participate in financial markets for each household contained in the GfK dataset.[13] To stabilise the subset of households in each group over periods of time, we define a household as an assetholder in subsequent periods following their initial classification as an assetholder. Table 3 summarises the predicted averages by country and equivalent years, which depicts relatively similar dynamics and cross-country differences than in the original data. While the obtained country-level averages with the GfK data are slightly

[13]There are a few important details to note. Firstly, the income data provided by GfK for Germany refers to the income of the household head only, as opposed to the household income provided by the HFCS data. Since income is a crucial variable in our matching model, we have scaled it up if the GfK dataset to match the HFCS average in order to ensure realistic values of the resulting probabilities. We encountered a similar issue with consumption data. In the GfK data, consumption is limited to food purchased in supermarkets, whereas the HFCS includes all food consumed at home, resulting in larger quantities. To address this, we scaled the data by country to match the averages. It is worth noting that these adjustments do not affect the dynamics of these variables or the heterogeneity between households and are only made for the purposes of computing household-level probabilities of holding assets. Therefore, we consider them to be inconsequential.

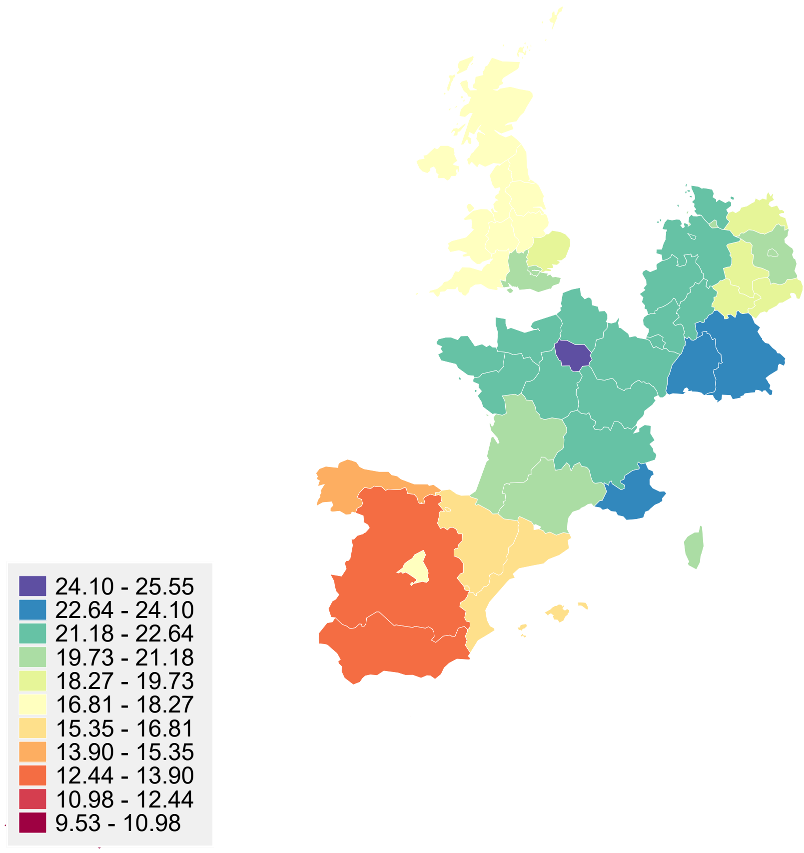
below the actual numbers obtained in the HFCS dataset, this might be due to the fact that households in the GfK dataset tend to be younger on average.

This household-level granularity allows us to construct regional averages, as opposed to the country-averages available in the donor dataset. We present this heterogeneity in Figure 2.

Table 3: Average probabilities of households participating in financial markets

	2010	**2014**	**2017**
France	17.51	17.23	17.27
Germany	18.41	18.97	20.01
Spain	15.29	15.47	16.07
United Kingdom	14.65	16.50	15.99

Figure 2: Average asset holding



Source: Own computations based on GfK data.

After imputing probabilities, we assume that a household holds assets if its probability is greater than the country-wave average presented in Table 1.[14] Table 4 summarises some

[14]We include years 2008 to 2011 to averages for Wave 1, years 2012 to 2015 to Wave 2 and 2016 to

statistics for participants and non-participants separately. It shows that asset-holders tend to be slightly older, substantially perceive higher incomes, have higher consumption levels and slightly less populated households.

Table 4: Descriptive statistics

	Non-participants	Participants	Total
Age	32.47	31.36	32.27
	(22.98)	(23.29)	(23.04)
Income	19517.1	41785.0	23567.2
	(8869.0)	(13917.4)	(13166.8)
HH Consumption	697.8	1066.4	764.9
	(421.0)	(542.3)	(467.7)
Household size	2.638	2.334	2.582
	(1.305)	(1.063)	(1.270)
Observations	3121754		

Notes: Standard errors in parentheses. Age is of the household head. Income refers to household annual income, household consumption is the overall household expenditure in a quarter, in Euros, divided by the consumption units within a household to account for economies of scale within the household, and such that the first household member has a weight of 1 and the rest have a weight of 0.5. The table includes households from Germany, France, Spain and United Kingdom.

6 Empirical analysis

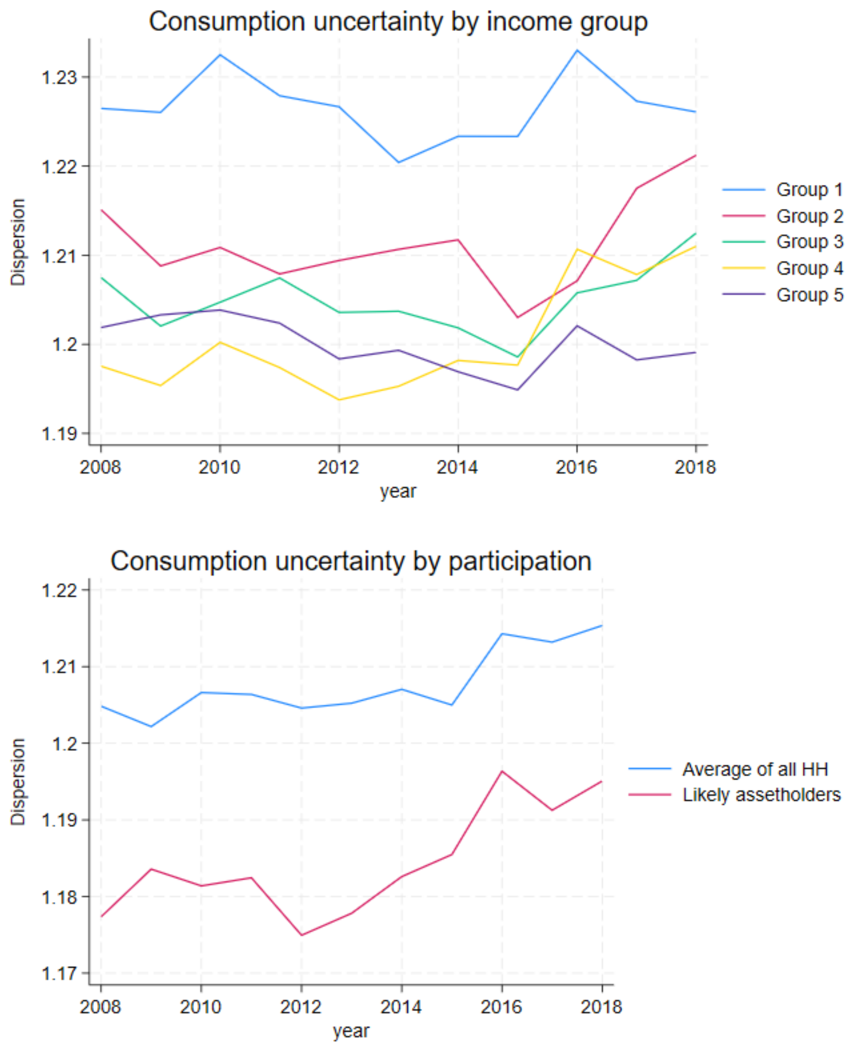
6.1 Descriptive statistics

In this section we present descriptive statistics on the consumption uncertainty shifter and how it is related to the other variables in the model. We construct consumption uncertainty variables according to Section 4.2. Figure 3 reports the resulting average uncertainty shifter for each group of income in the top panel and for all households and likely assetholders, in the bottom panel. The top panel of the figure shows that consumption uncertainty is higher and more volatile over time for the bottom income groups. In the bottom panel, two features stand out: first, likely asset holders experience substantially lower levels of consumption uncertainty compared with the average household. This is probably due to the fact that, on average, asset holders have higher levels of income. Second, consumption uncertainty for the two groups seems to be increasing over time,

2018 to wave 3.

but it is more volatile for asset holders.[15]

Figure 3: Uncertainty shifter across household groups



The remaining tables provide descriptive statistics regarding key properties of the variables incorporated in our regressions, once regional differences are accounted for. First, Table 5 presents summary statistics of the different bilateral variables for regions in the euro area and Table 6 focuses on region pairs within the same country.[16] While the relative risk shifter is as volatile as differentials in consumption and GDP growth, it is much less so than the real exchange rate. Its volatility is slightly higher when based only on households most likely to participate in financial markets. The consumption risk and consumption

[15]This increase seems to be driven mostly by high income earners, especially those in groups 2, 3, 4 and, to a lesser extent, 5.

[16]Tables 18 to 22 present the results for different subsets of regions or country pairs.

growth differentials are also larger when the two regions are in different countries. The standard deviation of changes in real exchange rates varies substantially across regions within a country, regions across countries in the euro area, and UK regions and the euro area regions.[17] This standard deviation across regions within a country (first row in Table 6) is less than half of that of regions across countries sharing the euro (first row in Tables 19 to 21). In contrast, the standard deviation of the relative risk shifter is quite stable across all regional pairs, similarly to that of GDP and consumption growth differentials. This evidence is in line with well-known puzzles in international finance, as the volatility of the relative risk shifter is invariant to the exchange rate regime. But remarkably and in contrast with the real exchange rate, its volatility does not fall when comparing regions within a country with regions across countries in the euro area monetary union.

Table 5: Descriptive statistics - EA

	Std dev.	Min	Max
$\pi\_j - \pi\_i$	1.317	-4.764	3.506
$ConsRisk\_i - ConsRisk\_j$	0.039	-0.090	0.145
$ConsRisk\_i - ConsRisk\_j$ | High	0.044	-0.105	0.162
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$	0.031	-0.122	0.125
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$| High	0.060	-0.233	0.242
$\Delta ln(GDP\_i) - \Delta ln(GDP\_j)$	0.024	-0.071	0.111
Observations	8412		

Table 6: Descriptive statistics - within country

	Std dev.	Min	Max
$\pi\_j - \pi\_i$	0.498	-2.207	2.514
$ConsRisk\_i - ConsRisk\_j$	0.019	-0.078	0.085
$ConsRisk\_i - ConsRisk\_j$ | High	0.028	-0.105	0.112
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$	0.016	-0.074	0.063
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$| High	0.034	-0.146	0.136
$\Delta ln(GDP\_i) - \Delta ln(GDP\_j)$	0.016	-0.071	0.085
Observations	5060		

Table 7 describes the correlation of the relative risk shifter with regional GDP growth differentials depending on the subset of regions or countries included. This correlation is small, and in most cases positive, so it is also invariant to the exchange rate regime. The negative relationship when looking at within-country pairs implies that the relative

[17] In this last case it is obviously highest because of the floating nominal exchange rate regime (see first row in Table 22)

shifter tends to be higher in times of lower GDP growth differentials, even though the correlation is weak.

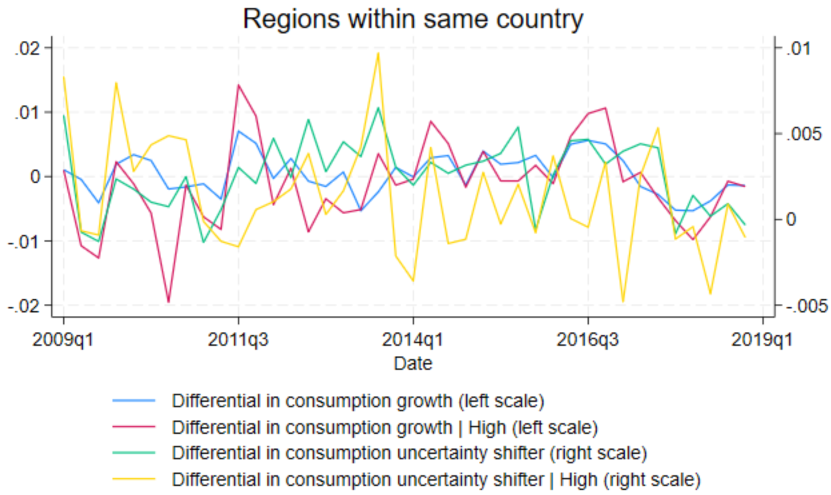
Table 7: Correlation of uncertainty shifter with GDP differentials

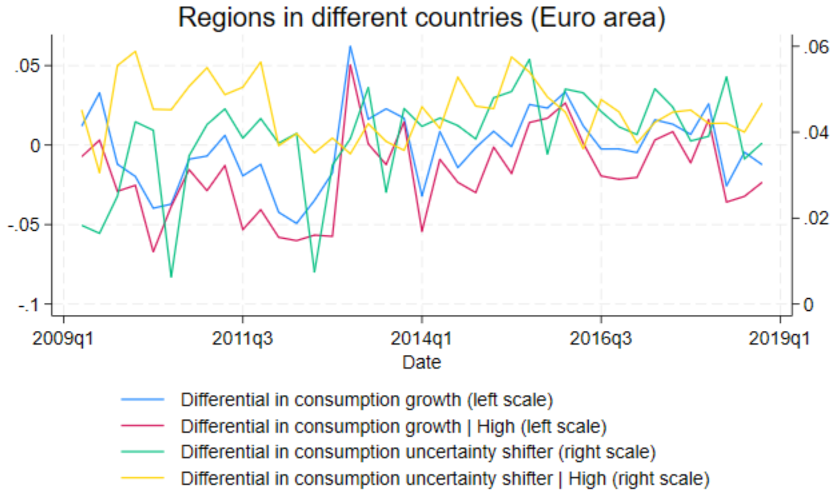
	Mean
Corr. $\Delta GDP\_i, j$ and $\Delta ConsRisk\_i, j$	0.040
Corr. $\Delta GDP\_i, j$ and $\Delta ConsRisk\_i, j$ — Within countries	-0.070
Corr. $\Delta GDP\_i, j$ and $\Delta ConsRisk\_i, j$ — DE and FR regions	0.046
Corr. $\Delta GDP\_i, j$ and $\Delta ConsRisk\_i, j$ — DE and ES regions	0.068
Corr. $\Delta GDP\_i, j$ and $\Delta ConsRisk\_i, j$ — FR and ES regions	0.109
Corr. $\Delta GDP\_i, j$ and $\Delta ConsRisk\_i, j$ — Euro Area and UK regions	0.028
Observations	18274

Figure 4 presents the time evolution of regional pair differences of consumption uncertainty and the dependent variables in our model.[18] While the interpretation of a higher level of these variables depends on the specific regional classification included, and therefore has limited economic interpretation, these visualisations help us get a sense of the correlation between the different variables. Consumption growth for households likely to hold assets appears to be strongly correlated with overall consumption growth, especially when focussing on regions placed in different countries. However, the co-movement between consumption uncertainty between the two groups is less apparent. It appears hard to detect an obvious correlation between consumption growth and consumption uncertainty, but one can see a slightly positive correlation between the differentials in consumption growth and in the consumption uncertainty shifter.

[18]Figure 6 replicates the dynamics for regions in specific country pairs.

Figure 4: Differentials in consumption growth and uncertainty shifter





6.2 Empirical specifications

This section aims at testing the theoretical relationships described in Equations (6) and (7) among European regions. For each region pair, we estimate different versions of (7). First, we aim at testing whether the relationship between regional-level consumption growth, consumption uncertainty, and the real exchange rate point toward the model predictions regarding full risk sharing of aggregate risks. Second, upon rejection of the full risk sharing null, we test whether controlling for different sources of risks results in not rejecting the correct coefficients on consumption differential growth and the additional term capturing consumption dispersion. The model predicts not only a positive relationship between consumption growth and the real exchange rate, but also an insignificant relationship with the regional-level uncertainty shifter, or consumption dispersion. For instance, consider Equation (7) for two regions in the same country, where we control for their GDP growth differential. If we find that we can reject that the coefficients on the consumption growth differential and the uncertainty shifter are positive and zero, respectively, this would imply that there are other sources of risks unrelated to GDP differentials that still are not fully diversified.

Our benchmark empirical counterpart to equations (6) and (7) is the following "ex-post" specification:

$$\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3' X_{ij,t} + \alpha_{i,j} + \epsilon_{ij,t} \tag{10}$$

The dependent variable $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t})$ is the differential in consumption growth between regions i and j.

The first independent variable is the real exchange rate change between regions i and j and is the same as the inflation differential $\pi_{j,t} - \pi_{i,t}$ expressed in the same currency.[19] An increase then amounts to a real depreciation in region i vis-à-vis region j. $v_{i,t}$ now denotes the weighted average of household consumption dispersion we have described above, thus excluding the other terms in the uncertainty shifter in Equation 6. We interpret it as a measure of consumption risk each household is exposed to, depending on their level of income. In the control vector $X_{ij,t}$ we include the other additional Euler equation term due to inflation volatility in Equation (6) and regional-level differences in GDP growth, as a main proxy to control for non-diversified risk correlated with the error term $\epsilon_{ij,t}$. Details about how we construct these variables are described in Section 4.2. We always include region-pair fixed effects $\alpha_{i,j}$ to control for unobserved characteristics that do not vary over time. In all specifications, we cluster standard errors at the region-pair level.

[19]It can also be thought of as the real interest rate differential between the two regions given the access to the same bond.

We also estimate specifications including time-fixed effects at different geographical levels, which allow us to control for common sources of risks, and thus focus on how well the residual risks are diversified across regions. Specifically, we estimate the following equation:

$$\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{ci,cj,t} + \epsilon_{ij,t} \tag{11}$$

where $\gamma_{t,ci,cj}$ controls for country-pair $\times$ time fixed effects, ci is the country where region i belongs to and cj the country where region j belongs to. This variable thus absorbs the bilateral country-level business cycle and other variables common at the country level that vary over time correlated with $\epsilon_{ij,t}$, e.g. fluctuations in the aggregate real exchange rate between the two countries. Therefore, this specification provides a test of sharing of purely region-specific risk uncorrelated with differential regional GDP growth. Finally, we estimate (10) and (11) for all households in our sample and only for those that are likely to hold financial assets according to the analysis in Section 5.

The primary focus of this regression analysis lies on β_1, β_2 and β_3' (especially the coefficient on the regional GDP growth differential). First, $\beta_1 > 0$ with $\beta_2 = 0$ and $\beta_3' = 0$ in (10) would indicate that in line with complete risk sharing, higher bilateral regional-level aggregate consumption is associated with a depreciation of the bilateral real exchange rate, while no other sources of risk matter. If markets were complete and risks were fully diversified at both aggregate and individual level, the presence of any additional control variable, particularly GDP growth or the $v_{i,t+1}$ terms, should not be significantly correlated with the dependent variable. Therefore, statistical significance of β_2 or β_3' would indicate rejection of complete risk sharing at the regional level. Second, even if we reject the null of full risk sharing, we can still test for a conditional version of risk sharing after controlling for the sources of undiversified or non-tradable ex-post risk correlated with the regional GDP differential. In this case, the relevant null will be that $\beta_1 > 0$ and $\beta_2 > 0$. Rejection of this null will entail that other sources of risks not perfectly spanned by regional GDP differentials are also not shared. For instance, a source of such risks could stem from the effects of a financial cycle at the country level. Third, the inclusion of time fixed effects will help us further refine these risk sharing tests. Namely, consider equation (11), where we control for bilateral country-time fixed effects. On the one hand, finding an insignificant coefficient on the GDP growth differential will suggest that the core source of uninsured risks are at the bilateral country level. On the other hand, still rejecting that the coefficient on the inflation differential is positive and that on the uncertainty shifter zero, would imply that bilateral region-specific risks uncorrelated with GDP growth differential are also not diversified. Finally, since we carry out our analysis for all households and only for the subset likely to participate in financial markets, we will provide evidence of the role of financial asset holdings in improving (conditional) risk sharing.

6.3 Results

Table 8 presents the baseline results for euro area regions. Column 1 shows the results when only region-pair fixed effects are included and therefore aims at testing Equation 10. Region-pair fixed effects control for unobserved characteristics of the regions that do not change over time, for example, distance between the two. In Column 2, Country-pair $\times$ time fixed effects are added in addition to region-pair fixed effects. Country-time fixed effects control for country-level aggregate shocks and therefore focuses the analysis on purely regional shocks. In columns 3 and 4, we focus the analysis on likely assetholders.[20]

We reject the null hypothesis of risk sharing of risks not spanned by regional GDP growth. Specifically, the results imply a negative bias for the coefficient on relative inflation differentials.[21]

Table 9 explores the role of specific preferences across groups, adding an additional degree of flexibility. In particular, we allow the inflation differential to be specific to the group studied, that is, we construct a specific inflation level for households with a high probability of participating in financial markets and those that do not. The underlying assumption is that different preferences might imply that the consumption baskets of those two groups are systematically different. This segmentation would make households in a certain group behave according to the price dynamics experienced by them, which might not reflect the aggregate price dynamics. We focus on regions in the euro area as our baseline specification. Columns 1 and 2, which focus on assetholders, present a different relationship between consumption growth and inflation movements compared to the results documented before. In particular, relative higher inflation is associated with lower consumption growth, as predicted by the theoretical relationship. This relationship does not hold when one focuses on the households with a lower probability of holding assets, as documented in Columns 3 and 4, and in line with previous results. Moreover,

[20]Relative consumption growth and consumption uncertainty are restricted to these subset of households, while GDP growth and inflation differentials are still region-wide variables. The assumption is that while the experienced inflation is the same for all households, the theoretical relation in 10 is based on participation in financial markets and thus more likely to hold for households likely to participate in these markets.

[21]See Table 23 for the same specification when the real exchange rate is omitted, which would be the case under the assumption that all households in all regions face same inflation levels, implying an identical basket of consumption. The fact that when the model is enriched with inflation differentials the results differ highlights the importance of including this additional variable.

Table 8: Baseline results: All euro area regions

VARIABLES	(1) $\Delta cons_{ij}$	(2) $\Delta cons_{ij}$	(3) $\Delta cons_{ijh}$	(4) $\Delta cons_{ijh}$
$\pi_j - \pi_i$	-0.000	-0.003***	-0.000	-0.002**
	(0.000)	(0.000)	(0.001)	(0.001)
$ConsRisk_i - ConsRisk_j$	0.230***	0.201***		
	(0.020)	(0.013)		
$ConsRisk_i - ConsRisk_j$ | High			0.103***	0.094***
			(0.024)	(0.018)
$\Delta ln(GDP_i) - \Delta ln(GDP_j)$	-0.212***	0.013	-0.173***	0.139***
	(0.018)	(0.013)	(0.028)	(0.027)
Observations	8,412	8,408	8,412	8,408
R-squared	0.127	0.762	0.493	0.708
Additional Euler eq. terms	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES
Country-pair × Time FE	NO	YES	NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France and Spain. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q, and weights are proportional to household consumption level. "High" denotes that only households with a high probability of holding assets are included in the construction of the variable. More details on how variables are constructed can be found in Section 4.2. Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

an increase in consumption risk is associated with an increase in consumption growth, as expected from the theoretical equation. This positive relationship for assetholders does not imply, however, that risks are fully diversified, as the fact that the coefficient for GDP growth is relevant.

Table 9: Group specific inflation

VARIABLES	(1) $\Delta cons_{ijh}$	(2) $\Delta cons_{ijh}$	(3) $\Delta cons_{ijl}$	(4) $\Delta cons_{ijl}$
$\pi_j - \pi_i\|$ High	0.001***	0.003***		
	(0.000)	(0.001)		
$\pi_j - \pi_i\|$ Low			-0.001***	-0.004***
			(0.000)	(0.000)
$ConsRisk_i - ConsRisk_j$ | High	0.096***	0.082***		
	(0.024)	(0.018)		
$ConsRisk_i - ConsRisk_j$ | Low			0.094***	0.047***
			(0.022)	(0.017)
$\Delta ln(GDP_i) - \Delta ln(GDP_j)$	-0.165***	0.148***	-0.246***	-0.054***
	(0.028)	(0.028)	(0.020)	(0.015)
Observations	8,412	8,408	8,412	8,408
R-squared	0.494	0.709	0.180	0.746
Additional Euler eq. terms	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES
Country-pair × Time FE	NO	YES	NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France and Spain. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q. "High" ("Low") denotes that only households with a high (low) probability of holding assets are included in the construction of the variable. More details on how variables are constructed can be found in Section 4.2.Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Focusing on asset holders, we also explore the role of national borders in the test of conditional risk sharing. Tables 10 and 11 report results for regions within the same country (e.g. Catalonia v. Andalusia) and for regions belonging to different countries (e.g. Catalonia v. Hesse) under, first, the assumption of homogeneous preferences (all households face same inflation rates) and second, heterogeneous preferences (assetholders face their own inflation levels). First, we find that conditional risk sharing is rejected in all specifications when focusing on same levels of inflation, but the theoretical relationship is complied with in qualitative terms when group specific levels of inflation are included.[22] Therefore, the border effect within a monetary union does not appear to make a qualitative

[22] Table 24 replicates the analysis for the overall population.

difference.

To explore the role of nominal exchange rate fluctuations, we now add regions from the United Kingdom in the analysis. In this specification, we include regions pairs where one is part of the euro area and the other is a region in the UK, and so we include only region-pairs that are in different countries. Table 12 presents the results, where the two first columns focus on the overall population. In columns 3 and 4, we restrict the sample to households with a high probability of holding assets. In Columns 5 and 6, we explore the role of segmented markets by including assetholders-specific inflation differentials. As expected given the previous results, we find a negative relationship between inflation differentials and consumption growth when focusing on the overall population and on the restricted population under the common inflation rates assumption. However, the differential effect observed in the previous results under the assumption of different inflation rates is not observable anymore. Therefore, the improved alignement with the theoretical relationship for the likely assetholders is not observable outside the monetary union.

Table 10: Likely asset holders: Border effect

VARIABLES	(1) $\Delta cons_{ijh}$ border	(2) $\Delta cons_{ijh}$ border	(3) $\Delta cons_{ijh}$ no border	(4) $\Delta cons_{ijh}$ no border
$\pi_j - \pi_i$	-0.001	-0.003***	-0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$ConsRisk_i - ConsRisk_j$ | High	0.135***	0.134***	0.076***	0.051**
	(0.038)	(0.025)	(0.023)	(0.023)
$\Delta ln(GDP_i) - \Delta ln(GDP_j)$	-0.279***	0.094**	0.163***	0.172***
	(0.029)	(0.041)	(0.034)	(0.036)
Observations	5,090	5,090	3,322	3,318
R-squared	0.553	0.797	0.091	0.166
Additional Euler eq. terms	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES
Country-pair × Time FE	NO	YES		
Country × Time FE			NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France and Spain. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q. Details on how variables are constructed can be found in Section 4.2. "High" denotes that only households with a high probability of holding assets are included in the construction of the variable. Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 11: Likely asset holders: Border effect, group specific inflation

VARIABLES	(1) $\Delta cons_{ijh}$ border	(2) $\Delta cons_{ijh}$ border	(3) $\Delta cons_{ijh}$ no border	(4) $\Delta cons_{ijh}$ no border
$\pi_j - \pi_i$| High	0.001	0.001**	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)
$ConsRisk_i - ConsRisk_j$ | High	0.131***	0.126***	0.060**	0.034
	(0.039)	(0.026)	(0.023)	(0.023)
$\Delta ln(GDP_i) - \Delta ln(GDP_j)$	-0.274***	0.099**	0.175***	0.185***
	(0.029)	(0.041)	(0.036)	(0.038)
Observations	5,090	5,090	3,322	3,318
R-squared	0.553	0.797	0.102	0.177
Additional Euler eq. terms	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES
Country-pair × Time FE	NO	YES		
Country × Time FE			NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France and Spain. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q. Details on how variables are constructed can be found in Section 4.2. "High" denotes that only households with a high probability of holding assets are included in the construction of the variable. Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 12: Beyond a monetary union

VARIABLES	(1) $\Delta cons_{ij}$	(2) $\Delta cons_{ij}$	(3) $\Delta cons_{ijh}$	(4) $\Delta cons_{ijh}$	(5) $\Delta cons_{ijh}$	(6) $\Delta cons_{ijh}$
$\pi_j - \pi_i$	-0.024***	-0.004***	-0.024***	-0.005***		
	(0.000)	(0.000)	(0.000)	(0.001)		
$\pi_j - \pi_i$| High					-0.023***	0.000
					(0.000)	(0.001)
$(ConsRisk_i - ConsRisk_j)\times$ UK	-0.099***	0.138***				
	(0.036)	(0.016)				
$(ConsRisk_i - ConsRisk_j)\times$ UK | High			0.180***	0.141***	0.211***	0.145***
			(0.030)	(0.017)	(0.032)	(0.018)
$(\Delta ln(GDP_i) - \Delta ln(GDP_j))\times$ UK	-0.042*	0.070***	0.002	0.073**	0.043*	0.086**
	(0.023)	(0.015)	(0.025)	(0.034)	(0.026)	(0.033)
Observations	8,124	8,124	8,124	8,124	8,124	8,124
R-squared	0.917	0.994	0.904	0.973	0.898	0.973
Additional Euler eq. terms	YES	YES	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES	YES	YES
Country-pair $\times$ Time FE	NO	YES	NO	YES	NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France, Spain and United Kingdom. UK indicates that regions i and j are one in the Euro Area and the other in the UK. Only region pairs in different countries are included. Only region pairs in different countries are included. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q. Details on how variables are constructed can be found in Section 4.2. Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

6.4 Robustness

Tables 25 and 26 explore alternative specifications while focusing on euro area regions. In these we explore different percentile based specifications for the construction of consumption uncertainty. In columns 1 and 2, the uncertainty shifter at the household level is constructed as $P90 - P10$ of consumption for each income group, region and quarter, and in Column 3 and 4, it is the growth in consumption equivalent. In both, we see a strong, positive association with consumption growth, suggesting that the specific way in which the uncertainty shifter is constructed does not affect this relationship. The magnitude of the coefficient in Columns 1 and 2 appears smaller probably because of the larger variability due to the way in which the variable is measured. In all, the relationship between consumption growth and the inflation rate differentials remains unchanged, both when using aggregate levels of inflation (where the relationship is negative) and when using group-specific levels of inflation (where the relationship is positive and in line with the theoretical predictions).

6.5 Magnitude of the obtained coefficients

A back of the envelope calculation would allow us to inspect the magnitude of the coefficients in economic terms and in line with the parameters of the model. In particular, if we focus on Column 2 of Table 9, we can infer, from the inflation differential coefficient and Equation 6, that $0.003 = \frac{1}{\sigma}$, meaning $\sigma > 333$. On the other hand, from the coefficient of consumption risk one can infer that $0.082 = \frac{1}{\sigma} \times \frac{\sigma(\sigma+1)}{2}$, implying $\sigma = -0.836$. This contradiction might be due to the fact that our coefficients suffer from an attenuation bias due to nontraded risks being omitted from the specification and being correlated with the dependent variables.

7 Conclusions

In this paper, we investigate the relationship between consumption growth, consumption heterogeneity and inflation heterogeneity under the lens of an incomplete markets framework. We develop a household risk sharing condition that allows for a very flexible setting and for consumption heterogeneity within regions. We test the theoretical predictions in the data using household scanner supermarket data. Moreover, we build a matching model that allows us to impute a probability for households to participate in financial markets. We test the theoretical predictions for the subset of households that are likely holders of financial assets.

The empirical results reveal that effective sharing of tradeable risk is primarily observed among financial market participants and across regions within the monetary union only, and once differences in preferences are accounted for. We read this as suggesting that both capital markets integration and institutional frameworks are necessary to enhance risk sharing between regions. However, even within a monetary union, the magnitude of the coefficients reveals a sizeable attenuation bias.

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A Appendix

A.1 Imputing asset holding

Table 13: Lasso models, 1: unrestricted

	Model 1	**M 2**	**M 3**	**M 4**	**M 5**	**M 6**	**M 7**	**M 8**	**M 9**	**M 10**	**M 11**	**M 12**	**M 13**	**M 14**	**M 15**
$Income$		0.010	0.019	0.027	0.034	0.038	0.042	0.045	0.048	0.050	0.057	0.058	0.060	0.060	0.071
$HHsize \times Consumption$					0.001	0.006	0.011	0.016	0.020	0.024	0.027	0.030	0.032	0.033	0.033
$Age \times Income$						0.001	0.003	0.005	0.005	0.005					
$Country3 \times Income$									0.002	0.005	0.007	0.010	0.012	0.015	0.014
$Age2 \times HHsize$											0.002	0.005	0.008	0.010	0.009
$Constant$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
$Country2 \times Consumption$														0.002	0.004
$Age \times HHsize$														0.001	0.003
$Age \times Income^2$															-0.009

Table 14: Lasso models, 2: unrestricted

	Model 16	**M 17**	**M 18**	**M 19**	**M 20**	**M 21**	**M 22**	**M 23**	**M 24**	**M 25**	**M 26**	**M 27**	**M 28**	**M 29**	**M 30**
$Income$	0.088	0.103	0.117	0.130	0.139	0.150	0.156	0.160	0.165	0.168	0.172	0.174	0.174	0.174	0.174
$HHsize \times Consumption$	0.033	0.033	0.033	0.032	0.034	0.036	0.038	0.037	0.037	0.037	0.038	0.038	0.041	0.044	0.047
$Age \times Income^2$	-0.025	-0.038	-0.051	-0.063	-0.072	-0.080	-0.086	-0.091	-0.095	-0.099	-0.102	-0.104	-0.105	-0.106	-0.106
$Country3 \times Income$	0.010	0.007	0.003	0.001			0.004	0.008	0.011	0.015	0.018	0.022	0.026	0.031	0.036
$Age^2 \times HHsize$	0.009	0.008	0.007	0.007	0.006	0.007	0.006	0.004	0.002						
$Country2 \times Consumption$	0.006	0.008	0.009	0.011	0.012	0.012	0.014	0.014	0.015	0.017	0.019	0.021	0.024	0.027	0.029
$Age \times HHSize$	0.006	0.008	0.011	0.013	0.014	0.014	0.015	0.018	0.020	0.023	0.024	0.025	0.026	0.026	0.027
$Constant$	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-0.021	-0.019	-0.014	-0.010
$Country3 \times Consumption^2$					-0.002	-0.005	-0.008	-0.012	-0.015	-0.018	-0.019				
$Wave \times Country3 \times Income^2$					0.000							0.000	0.000	0.000	0.000
$Country3 \times Income^2$						-0.004	-0.010	-0.015	-0.020	-0.024	-0.028	-0.032	-0.036	-0.041	-0.045
$Country1 \times Income$							0.001	0.002	0.003	0.004	0.005	0.007	0.010	0.013	0.015
$Age \times Consumption$							0.000	0.003	0.006	0.008	0.008	0.008	0.008	0.007	0.007
$Wave \times Consumption$							0.000								
$Country2 \times HHsize$										-0.001	-0.003	-0.004	-0.006	-0.008	-0.010
$Country1 \times Income^2$												-0.002	-0.004	-0.007	-0.009
$HHsize \times Consumption^2$													-0.004	-0.012	-0.020
$Wave \times Country3 \times Age^2$														-0.002	-0.004
$Wave$															0.000

Figure 5: Predicted probabilities and actual asset holdings

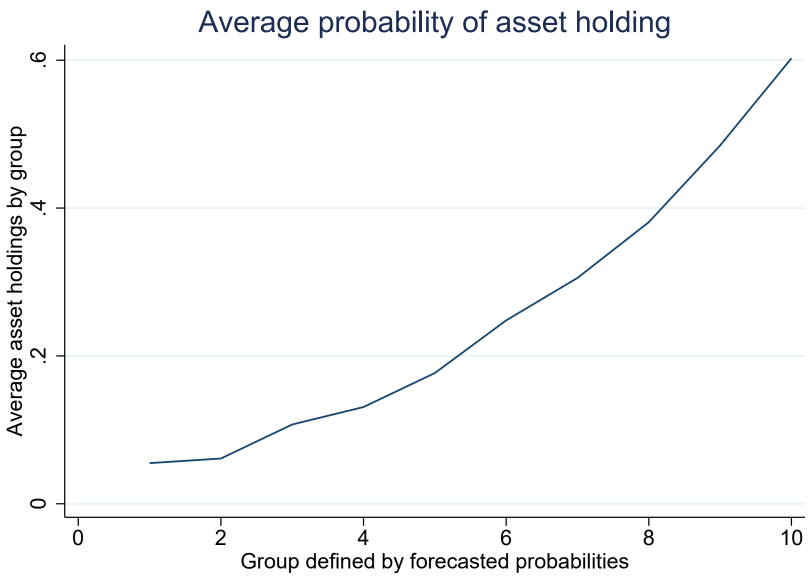

Table 15: Lasso models, 1: Goodness of fit

Model	Sample	MSE	R_Squared	Observations
Model 1	1	0.214	-0.001	36032
	2	0.214	-0.001	36301
Model 2	1	0.198	0.062	32675
	2	0.196	0.069	32904
Model 3	1	0.198	0.062	32675
	2	0.196	0.069	32904
Model 4	1	0.198	0.062	32675
	2	0.196	0.069	32904
Model 5	1	0.193	0.077	26518
	2	0.192	0.093	26719
Model 6	1	0.193	0.077	26432
	2	0.192	0.093	26639
Model 7	1	0.193	0.077	26432
	2	0.192	0.093	26639
Model 8	1	0.193	0.077	26432
	2	0.192	0.093	26639
Model 9	1	0.193	0.080	26432
	2	0.192	0.089	26639
Model 10	1	0.193	0.080	26432
	2	0.192	0.089	26639
Model 11	1	0.192	0.086	26432
	2	0.191	0.095	26639
Model 12	1	0.192	0.086	26432
	2	0.191	0.095	26639
Model 13	1	0.192	0.086	26432
	2	0.191	0.095	26639
Model 14	1	0.191	0.090	26432
	2	0.191	0.095	26639
Model 15	1	0.182	0.132	26432
	2	0.185	0.127	26639

Table 16: Lasso models, 2: Goodness of fit

Model	**Sample**	**MSE**	**R_Squared**	**Observations**
Model 16	1	0.182	0.132	26432
	2	0.185	0.127	26639
Model 17	1	0.182	0.132	26432
	2	0.185	0.127	26639
Model 18	1	0.182	0.132	26432
	2	0.185	0.127	26639
Model 19	1	0.182	0.132	26432
	2	0.185	0.127	26639
Model 20	1	0.180	0.141	26432
	2	0.190	0.100	26639
Model 21	1	0.180	0.142	26432
	2	0.191	0.097	26639
Model 22	1	0.179	0.145	26432
	2	0.192	0.091	26639
Model 23	1	0.179	0.145	26432
	2	0.192	0.092	26639
Model 24	1	0.179	0.145	26432
	2	0.192	0.092	26639
Model 25	1	0.179	0.146	26432
	2	0.191	0.095	26639
Model 26	1	0.179	0.146	26432
	2	0.191	0.095	26639

Table 17: Model results

	(1)	(2)	(3)
VARIABLES	Unr. Lasso	Restr. Lasso	Naive model
Income	4.73e-06***	4.87e-06***	3.68e-06***
	(2.98e-07)	(2.99e-07)	(2.75e-07)
Household size × Consumption	2.09e-05***		
	(3.73e-06)		
Age × Income sq.	-0***	-0***	
	(0)	(0)	
Country 3: France × Income	1.15e-06***		
	(2.28e-07)		
Age sq. × Household size	-3.49e-06		
	(2.15e-06)		
Country 2: Spain × Consumption	2.33e-05***		
	(7.38e-06)		
Age × Size	0.000682***		
	(0.000185)		
HH consumption		3.63e-05***	4.30e-05***
		(5.62e-06)	(6.07e-06)
HH size		0.0360***	0.0359***
		(0.00515)	(0.00523)
Age		0.000456**	0.000406**
		(0.000189)	(0.000190)
Country 2: Spain		-0.0104*	
		(0.00573)	
Country 1: Germany		-0.00975	0.0145*
		(0.00686)	(0.00814)
Country 3: France			0.0178***
			(0.00577)
Constant	-0.0142	-0.0434**	-0.0376**
	(0.0114)	(0.0172)	(0.0177)
Observations	55,060	55,060	55,060
Imputations	5	5	5
Population size	2.130e+08	2.130e+08	2.130e+08
Average RVI	0.00516	0.00480	0.00282
Largest FMI	0.0250	0.0252	0.0135
F test	107	83.62	76.11

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: The dependent variable is a dummy equal to 1 if the household holds assets and 0 otherwise. Standard errors in parentheses. *** denotes 1% significance; ** denotes 5% significance; * denotes 10% significance.

A.2 Additional empirical results

Table 18: Descriptive statistics - all regions

	Std dev.	Min	Max
$\pi\_j - \pi\_i$	1.317	-4.764	3.506
$ConsRisk\_i - ConsRisk\_j$	0.039	-0.090	0.145
$ConsRisk\_i - ConsRisk\_j$ | High	0.044	-0.105	0.162
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$	0.031	-0.122	0.125
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$| High	0.060	-0.233	0.242
$\Delta ln(GDP\_i) - \Delta ln(GDP\_j)$	0.024	-0.071	0.111
Observations	8412		

Table 19: Descriptive statistics - DE-FR

	Std dev.	Min	Max
$\pi\_j - \pi\_i$	1.172	-4.371	3.506
$ConsRisk\_i - ConsRisk\_j$	0.017	0.016	0.145
$ConsRisk\_i - ConsRisk\_j$ | High	0.025	-0.037	0.132
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$	0.032	-0.097	0.097
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$| High	0.046	-0.131	0.147
$\Delta ln(GDP\_i) - \Delta ln(GDP\_j)$	0.020	-0.068	0.103
Observations	1962		

Table 20: Descriptive statistics - ES-FR

	Std dev.	Min	Max
$\pi\_j - \pi\_i$	1.667	-4.168	3.335
$ConsRisk\_i - ConsRisk\_j$	0.021	0.023	0.143
$ConsRisk\_i - ConsRisk\_j$ | High	0.029	-0.105	0.064
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$	0.035	-0.075	0.123
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$| High	0.049	-0.083	0.242
$\Delta ln(GDP\_i) - \Delta ln(GDP\_j)$	0.022	-0.063	0.046
Observations	844		

Table 21: Descriptive statistics - DE-ES

	Std dev.	Min	Max
$\pi\_j - \pi\_i$	1.220	-4.764	1.912
$ConsRisk\_i - ConsRisk\_j$	0.022	-0.090	0.072
$ConsRisk\_i - ConsRisk\_j$ | High	0.030	-0.051	0.162
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$	0.040	-0.122	0.125
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$| High	0.052	-0.233	0.099
$\Delta ln(GDP\_i) - \Delta ln(GDP\_j)$	0.033	-0.069	0.111
Observations	2284		

Table 22: Descriptive statistics - Euro area -UK

	Std dev.	Min	Max
$\pi\_j - \pi\_i$	7.028	-18.904	12.739
$ConsRisk\_i - ConsRisk\_j$	0.040	-0.188	0.059
$ConsRisk\_i - ConsRisk\_j$ | High	0.043	-0.181	0.090
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$	0.169	-0.341	0.444
$\Delta ln(Cons\_i) - \Delta ln(Cons\_j)$| High	0.168	-0.419	0.607
$\Delta ln(GDP\_i) - \Delta ln(GDP\_j)$	0.024	-0.078	0.101
Observations	8124		

Figure 6: Differentials in consumption growth and uncertainty shifter: country pairs

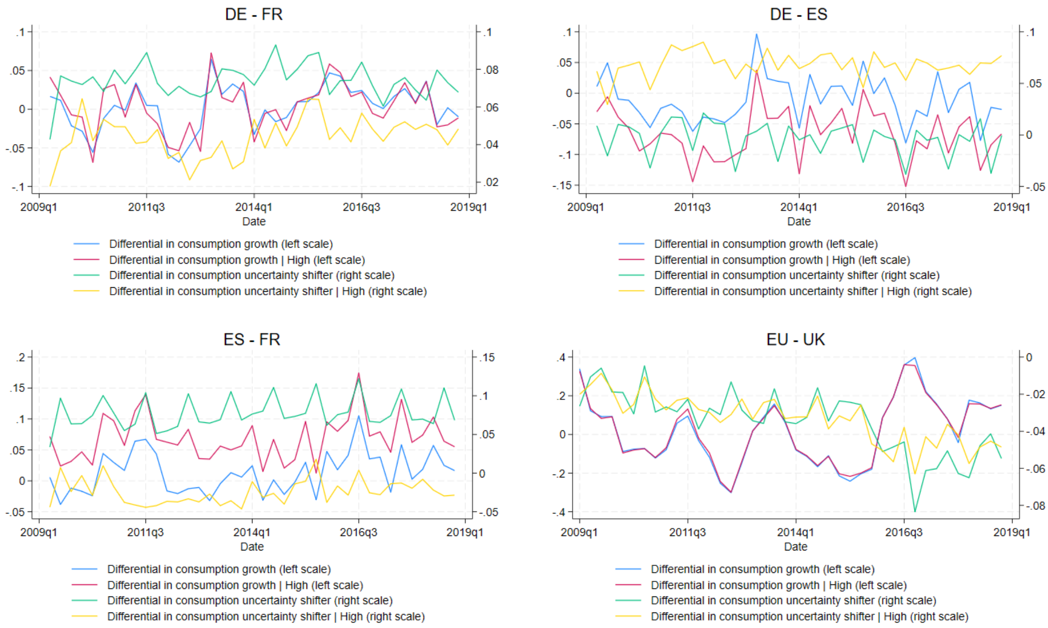

Table 23: Baseline results: All euro area regions, omitting inflation differentials

VARIABLES	(1) $\Delta cons_{ij}$	(2) $\Delta cons_{ij}$	(3) $\Delta cons_{ijh}$	(4) $\Delta cons_{ijh}$
$ConsRisk_i - ConsRisk_j$	0.229***	0.194***		
	(0.020)	(0.013)		
$ConsRisk_i - ConsRisk_j$ | High			0.102***	0.091***
			(0.024)	(0.018)
$\Delta ln(GDP_i) - \Delta ln(GDP_j)$	-0.210***	0.016	-0.172***	0.142***
	(0.018)	(0.013)	(0.028)	(0.027)
Observations	8,412	8,408	8,412	8,408
R-squared	0.127	0.760	0.493	0.708
Additional Euler eq. terms	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES
Country-pair × Time FE	NO	YES	NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France and Spain. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q, and weights are proportional to household consumption level. "High" denotes that only households with a high probability of holding assets are included in the construction of the variable. More details on how variables are constructed can be found in Section 4.2. Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 24: All households: the role of border

VARIABLES	(1) $\Delta cons_{ijh}$ border	(2) $\Delta cons_{ijh}$ border	(3) $\Delta cons_{ijh}$ no border	(4) $\Delta cons_{ijh}$ no border
$\pi_j - \pi_i$	-0.003***	-0.000	0.001	0.001
	(0.000)	(0.000)	(0.001)	(0.001)
$ConsRisk_i - ConsRisk_j$	0.203***	0.152***	0.092***	0.076***
	(0.016)	(0.014)	(0.019)	(0.020)
$\Delta ln(GDP_i) - \Delta ln(GDP_j)$	-0.285***	0.066***	0.052**	0.047**
	(0.013)	(0.017)	(0.020)	(0.022)
Observations	15,132	15,132	8,193	8,193
R-squared	0.099	0.738	0.034	0.093
Additional Euler eq. terms	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES
Country-pair × Time FE	NO	YES		
Country × Time FE			NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France and Spain. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q. Details on how variables are constructed can be found in Section 4.2. "High" denotes that only households with a high probability of holding assets are included in the construction of the variable. Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 25: Likely assetholders: Other controls (euro area regions)

VARIABLES	(1) $\Delta cons_{ijh}$	(2) $\Delta cons_{ijh}$	(3) $\Delta cons_{ijh}$	(4) $\Delta cons_{ijh}$
$\pi_j - \pi_i$	-0.001	-0.002***	-0.001	-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)
$(ConsRisk_i - ConsRisk_j)$—$High(pctile)$	0.000***	0.000***		
	(0.000)	(0.000)		
$(ConsgrRisk_i - ConsgrRisk_j)$—$High(pctile)$			0.085***	0.060***
			(0.010)	(0.009)
$\Delta ln(GDP_i) - \Delta ln(GDP_j)$	-0.176***	0.152***	-0.185***	0.135***
	(0.027)	(0.027)	(0.028)	(0.027)
Observations	8,412	8,408	8,412	8,408
R-squared	0.505	0.713	0.496	0.709
Additional Euler eq. terms	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES
Country-pair × Time FE	NO	YES	NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France and Spain. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q. Details on how variables are constructed can be found in Section 4.2. In Columns 1 and 2, household consumption risk is constructed as $P90 - P10$ consumption for each income group, region and quarter, and in Columns 3 and 4 as $P90 - P10$ consumption growth for each income group, region and quarter. "High" denotes that only households with a high probability of holding assets are included in the construction of the variable. Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table 26: Likely assetholders: group specific inflation, other controls (euro area regions)

VARIABLES	(1) $\Delta cons_{ijh}$	(2) $\Delta cons_{ijh}$	(3) $\Delta cons_{ijh}$	(4) $\Delta cons_{ijh}$
$\pi_j - \pi_i$| High	0.001*	0.002***	0.001**	0.003***
	(0.000)	(0.001)	(0.000)	(0.001)
$(ConsRisk_i - ConsRisk_j)$—$High(pctile)$	0.000***	0.000***		
	(0.000)	(0.000)		
$(ConsgrRisk_i - ConsgrRisk_j)$—$High(pctile)$			0.080***	0.058***
			(0.010)	(0.009)
$\Delta ln(GDP_i) - \Delta ln(GDP_j)$	-0.169***	0.160***	-0.175***	0.144***
	(0.027)	(0.027)	(0.028)	(0.027)
Observations	8,412	8,408	8,412	8,408
R-squared	0.506	0.714	0.497	0.710
Additional Euler eq. terms	YES	YES	YES	YES
Region-pair FE	YES	YES	YES	YES
Country-pair × Time FE	NO	YES	NO	YES

Notes: Results from estimating $\Delta ln(C_{i,t}) - \Delta ln(C_{j,t}) = \beta_1(\pi_{jt} - \pi_{it}) + \beta_2(v_{i,t} - v_{j,t}) + \beta_3 X_{ij,t} + \alpha_{i,j} + \gamma_{t,ci,cj} + \epsilon_{ij,t}$ where i and j are regions of Germany, France and Spain. Consumption risk is constructed as a weighted average of household consumption risk, where household consumption risk is defined as $1 + \frac{Var_q(c_{t+1})}{Mean_q(c_{t+1})^2}$ of the household consumption growth distribution within an income group q. Details on how variables are constructed can be found in Section 4.2. In Columns 1 and 2, household consumption risk is constructed as $P90 - P10$ consumption for each income group, region and quarter, and in Columns 3 and 4 as $P90 - P10$ consumption growth for each income group, region and quarter. "High" denotes that only households with a high probability of holding assets are included in the construction of the variable. Standard errors are clustered at the region-pair level. Significance levels: *** p<0.01, ** p<0.05, * p<0.1