

Measuring household debt vulnerability in the euro area

Evidence from the Eurosystem Household Finances and Consumption Survey

Katarzyna Bańkowska, Pierre Lamarche, Guillaume Osier and Sébastien Pérez-Duarte¹

Abstract

The financial crisis has emphasised the need for monitoring the indebtedness and vulnerability of households, and in particular identifying the characteristics of the highly indebted or credit constrained households that may pose a threat to financial stability.

Many indicators of financial fragility are possible. To assess the debt vulnerability of households, we analyse the information about household debt as well as income and assets. We take advantage of the information available through the Household Finances and Consumption Survey (HFCS) to assess the debt burden and financial fragility at the household level. We track the situation of households with two twinned indicators: on one hand, the Debt Service Income ratio (DSI) gives an idea of the sustainability of the debt with regards to income. A household with a higher DSI ratio are more likely to face bankruptcy if an adverse shock to income, or to a lesser extent interest payments, occurs. On the other hand, the Debt-to-Asset ratio (DA) links the debt amount with the assets of the household. A high DA ratio highlights the households who would have difficulties paying back their debts, in particular in the case of liquidation. Households who combine both high DSI and DA ratios are thus highly sensitive to many kinds of shocks.

Combining all relevant pieces of information for 15 euro area countries, the HFCS allows us to quantify and characterise the proportion of the population that can be considered as vulnerable, but also evaluate the amounts that could not be repaid if households went bankrupt. The heterogeneity between euro area countries is also assessed and linked with different national institutional features.

Keywords: Indebtedness, Indicator, debt service, debt-to-assets, debt service-to-income

JEL classification: D140, D310

¹ European Central Bank, Statistics Development and Coordination Division; corresponding author e-mail: guillaume.osier@ecb.europa.eu.

Introduction

Assessing debt vulnerability for a given country or for a given geographical area is often a difficult task. Analysing the question of debt vulnerability among indebted households from the point of view of a representative agent hides the heterogeneity in indebtedness. Micro-data constitute a very valuable source of information, whose use may enable an accurate diagnostic of the debt vulnerability of households.

In this article we take advantage of the recent Eurosystem Household Finance and Consumption Survey (HFCS), a harmonized survey in the euro area, which provides information at the household level about wealth, indebtedness and income. As emphasised by many authors, institutions and national specificities have a strong impact on the households' indebtedness and consequently their vulnerability. It is essential to assess debt vulnerability not only for the euro area as a whole but also for at the national level, although it is not the objective of this paper to document institutional differences between countries.

Finally, as always when it comes to assessing a situation with statistical indicators, we need to define what is meant by debt vulnerability: the likelihood for a given household to be unable to finance the service of its debt and respect the reimbursement schedule agreed with the creditor. However, as this likelihood cannot be measured but only estimated, many possible indicators based on observable characteristics have been proposed. Since there is a high heterogeneity between households in terms of income, assets, demographics or even reasons to get credit, the need for taking into account all the various dimensions of indebtedness makes the indicators that are usually used to assess vulnerability incomplete. Each indicator gives only a part of the reality of indebtedness, but a parsimonious combination of indicators might enable drawing an accurate picture of debt vulnerability. HFCS data combining at the same time information on income, debt and assets, are very useful.

The rest of this article is structured as follows; we first give a list of the indicators that have commonly been used to assess debt vulnerability, and refer to some articles focusing on those indicators. We then provide a short description of the two main indicators we will use in this article and the reasons why we have chosen them. We then develop a first approach, consisting of a principal component analysis combining different indicators, to assess how far our main indicators are able to sum up the information about debt vulnerability, before trying to analyse their joint distribution and assessing the proportion of households and debt that can be considered 'at risk'. In a second approach, we offer a graphical representation of the joint distribution of these indicators according to households' characteristics, income, assets and demographics, before concluding.

Brief overview of indicators of household vulnerability

High household debt has attracted a lot of attention in policy debates as it has been regarded as one of the major economic imbalances, playing a role in the origination of the recent financial crisis. Given its importance for financial stability, analysing

differences in debt across-countries and the main determinants of household debt is worthwhile.

Different definitions of overindebtedness are available in the literature e.g. Haas (2006), Oxera (2004), D'Alessio and Iezzi (2012). The European Commission (2008) also reviewed and compared those applied in the EU countries. It is not the objective of this paper to review them, and we will focus in the rest of the paper on the indicators that have been applied in the context of the HFCS.

The HFCS dataset, as described in ECB (2013), points to the significant differences across countries in the prevalence and the value of household debt. The differences were further documented by Bover et al. (2014) and Christelis et al. (2014).² The information collected from the HFCS allows for detecting households that are potentially vulnerable. ECB (2013) presents the most commonly used financial burden indicators with a view to assessing the financial conditions of households. The ones analysed further in this study are the debt to asset ratio (DA) and debt service to income ratio (DSI, see definitions below). Of course, these two indicators are only an imperfect measure of the potential vulnerability of a household. Additional indicators measuring debt burden and financial fragility calculated from the HFCS dataset have been used in the literature (see Table 1).

Having identified the vulnerable households, several papers also estimate the potential losses for the banking sector. The standard measures are exposure at default and loss given default, as described in Albacete and Lindner (2013). Ampudia et al. (2014) and Ziegelmeyer (2014) inspect the measures of risk under alternative scenarios, in the event of negative shocks to interest rates, house prices and income.

² It is not the purpose of this article to detail the impact of regulatory framework and credit conditions, as well as cultural and historical factors, prevailing in each country, which might have an effect on debt and savings. Bover et al. (2014) emphasised the crucial importance of housing finance on household debt behaviour by analysing the influence of factors such as legal procedures for enforcing loan contracts, taxation of mortgage payments, capped loan-to-value ratios, amount of information available to borrowers, amount borrowed and mortgage interest rate paid. The existence of capital redemption schemes in the country, or interest-only payments, as well as the significant increases in housing prices in the years up to the survey can also explain the high debt-to-assets ratios.

Indicators

Used to identify vulnerable household and measure the debt burden

Table 1

	ECB (2013)	Albacete & Lindner (2013)	Ampudia et al. (2013)	Bartiloro et al. (2014)	Costa & Farinha (2012)	Ziegelmeyer (2014)
Debt to assets ratio	✓	✓	✓		✓	✓
Debt to income ratio	✓		✓	✓	✓	
Debt service to income ratio	✓	✓	✓	✓	✓	✓
Mortgage debt service-income ratio	✓					
Loan-value ratio of main residence	✓	✓				
Income – debt payments < food expenses				✓		
Liquid assets < 2 months of income				✓		
Negative net wealth		✓		✓		
Negative financial margin* > liquid assets			✓			
Late or missed debt payments over the past 12 months			✓			
Regular expenses exceeded household's income or were paid with debt		✓	✓			✓

* Negative financial margin is defined as income – taxes – debt payments – basic leaving costs.

Definition of the main indicators used

This paper concentrates on the two most consensual indicators for measuring household vulnerability to indebtedness, namely the Debt-to-assets (DA) and the Debt service-to-income (DSI) ratios.

The DSI ratio links the amount paid annually by an indebted household to repay the loans and the annual income earned at the same time by the household. The household's total payments include interest and repayment but exclude any required payments for taxes, insurance and other fees. They include the payments for mortgages and the payments for other loans, such as car loans, consumer and instalment loans and loans from relatives, friends, employers etc. From the income side, many components of income are included, such as labour income, self-employment income and capital income. Income here is not completely similar to disposable income; for instance, it does not take into account taxes, but it reflects pretty well the ability of the household to pay monthly the debt service. A high DSI ratio indicates a risk of bankruptcy for the household, in particular if its income

would come to decrease substantially. In several countries and studies households with a DSI ratio higher than 30% or 40% are considered as at risk.

The DA ratio compares the total outstanding balance for household's liabilities with the total amount of assets possessed by the household. The household's liabilities include mortgages (household's main residence mortgages as well as other mortgages) and other non-mortgage debts. In particular, this includes all type of unsecured or non-collateralised debts: outstanding balances on credit lines or overdrafts, outstanding balance of credit cards for which the owner of the card is charged interest, and outstanding balances on all other loans (car loans, consumer loans, instalment loans, private loans from relatives, friends, employers). Household's assets include real-estate assets (household main residence as well as other properties), financial assets, business wealth and even valuables. A DA ratio close to 100% indicates that in case of bankruptcy, the household would not be able to reimburse the outstanding amount of debts, even when selling all his assets.

Cluster analysis of indicators of indebtedness by country

In this section, hierarchical cluster analysis is applied to a framework of debt-related indicators with a view to determine 'homogeneous' groups of countries with respect to household debt characteristics. A set of 24 household indicators are calculated in each country. They form a set of coherent indicators on household indebtedness and appear in the existing literature dealing with household debt vulnerability.

Debt participation (%)

- (d1) Total debt
- (d2) Total mortgage debt
- (d3) Mortgage on household main residence
- (d4) Other property mortgage
- (d5) Non-mortgage debt

Debt ratios (median) – (%)

- (r1) Debt to assets ratio of all indebted households
- (r2) Debt to income ratio of all indebted households
- (r3) Debt service to income ratio of all indebted households
- (r4) Debt service to income ratio of households with debt other than credit lines, overdrafts or credit card debt
- (r5) Mortgage debt service to income ratio of households with mortgage debt
- (r6) Loan to value ratio of main residence
- (r7) Net liquid assets as a fraction of annual gross income

Debt ratios (90th percentile) – (%)

- (p1) Debt to assets ratio of all indebted households
- (p2) Debt to income ratio of all indebted households
- (p3) Debt service to income ratio of all indebted households

(p4) Debt service to income ratio, households with debt payments

(p5) Mortgage debt service to income ratio of households with mortgage debt

(p6) Loan to value ratio of main residence

Debt vulnerability indicators – (%)

(v1) Debt to assets ratio of indebted households $\geq 75\%$

(v2) Debt to income ratio $\geq 300\%$

(v3) Debt service to income ratio $\geq 40\%$

(v4) Debt service to income ratio, households with debt other than credit lines, overdrafts or credit card debt $\geq 40\%$

(v5) Mortgage debt service to income ratio $\geq 40\%$

(v6) Loan to value ratio of main residence $\geq 75\%$

Indicators of household debt participation measure the prevalence of household debt in each country, while debt ratios focus on the burden of debt repayment on household finances, both on a short-term perspective (DSI) and a longer perspective (DA).

These indicators were calculated using the data from the first wave of the HFCS,³ and reproduced in Table A in the annex.⁴ Methodological information related to the survey can also be found on the ECB website.

In order to help interpret the clusters to be formed, a principal component analysis (PCA) is performed to identify the main patterns.⁵ PCA is relevant to deal with multivariate settings, where for each country a high number of indicators are recorded. Cross-country analysis of each indicator taken separately does not reflect the correlations between indicators, which are often key determinants.

PCA summarises a set of numerical variables into a reduced set of synthetic variables, known as 'principal components', which are linear combinations of the initial variables and are uncorrelated with each other. The principal components are supposed to reflect as much of the data variability as possible; the first two or three components often capture most of it. Thus, a complex multivariate analysis is reduced to a simpler univariate or bivariate analysis. The factor loadings for the first five components, shown in Table 2, measure the correlation between the principal components and the initial indicators.

³ https://www.ecb.europa.eu/home/html/researcher_hfcn.en.html.

⁴ In the interpretation of results it should be kept in mind that the reference years of the country surveys vary between 2008/2009 and 2010/2011, as indicated in the table of reference periods available on the following pages. The differences in reference years can be particularly relevant for the values of financial and real assets, many of which have declined during the financial and economic crisis.

⁵ Because of some missing indicators, Finland was excluded from the analysis.

Principal component analysis

Factor loadings

Table 2

Variable	Component 1	Component 2	Component 3	Component 4	Component 5
d1	0.23	0.11	0.37	-0.10	0.09
d2	0.24	0.15	0.26	0.09	-0.04
d3	0.23	0.19	0.20	0.04	-0.19
d4	0.18	-0.04	0.32	0.21	0.52
d5	0.19	-0.03	0.42	-0.22	0.29
r1 (DA)	0.13	0.34	-0.04	-0.07	-0.02
r2	0.24	0.15	0.02	0.11	-0.35
r3 (DSI)	0.25	-0.09	0.05	0.25	-0.05
r4	0.26	-0.15	0.02	0.16	0.02
r5	0.20	-0.13	-0.21	0.35	0.27
r6	0.12	0.27	-0.36	0.19	0.13
r7	-0.16	0.06	0.32	0.37	-0.30
p1 (DA 90 th)	-0.03	0.31	0.00	-0.34	0.19
p2	0.27	0.07	-0.05	0.07	-0.22
p3 (DSI 90 th)	0.26	-0.16	-0.06	-0.09	-0.06
p4	0.18	-0.23	0.02	-0.36	-0.14
p5	0.24	-0.15	-0.19	0.00	0.14
p6	0.11	0.33	-0.20	0.12	0.19
v1 (DA >=75%)	0.04	0.36	-0.06	-0.26	0.06
v2	0.26	0.13	-0.03	0.09	-0.28
v3 (DSI >=40%)	0.24	-0.18	-0.06	-0.22	-0.12
v4	0.22	-0.20	-0.09	-0.29	-0.10
v5	0.23	-0.15	-0.28	0.01	0.12
v6	0.13	0.34	-0.13	-0.08	0.00

Source: ECB HFCS – author computations

If we examine these components, graphically displayed in Figure 1 and which account for more than 95% of the total variance of the country-level information, we find that:

- The first component, which accounts for 49% of the total variance, distinguishes Cyprus, the Netherlands, Spain and Portugal from Austria and Malta. This component is positively correlated with nearly all the debt measures. Basically, it measures the overall level of household debt in the country. In Cyprus, the Netherlands, Spain and Portugal, both debt prevalence and debt burden are high. On the other hand, the burden of household debt on Austrian households is relatively lower, particularly with respect to the DSI ratio.
- The second component (27% of the total variance) distinguishes the Netherlands from Cyprus. Although households in both countries are, on average, highly indebted, debt servicing puts much a heavier burden on households in Cyprus than in the Netherlands (the median DSI ratio of all the indebted households is 22.5% in Cyprus against 12.6% in the Netherlands). On

the other hand, the median DA ratio is far higher in the Netherlands than in Cyprus (41.3% vs. 17%).

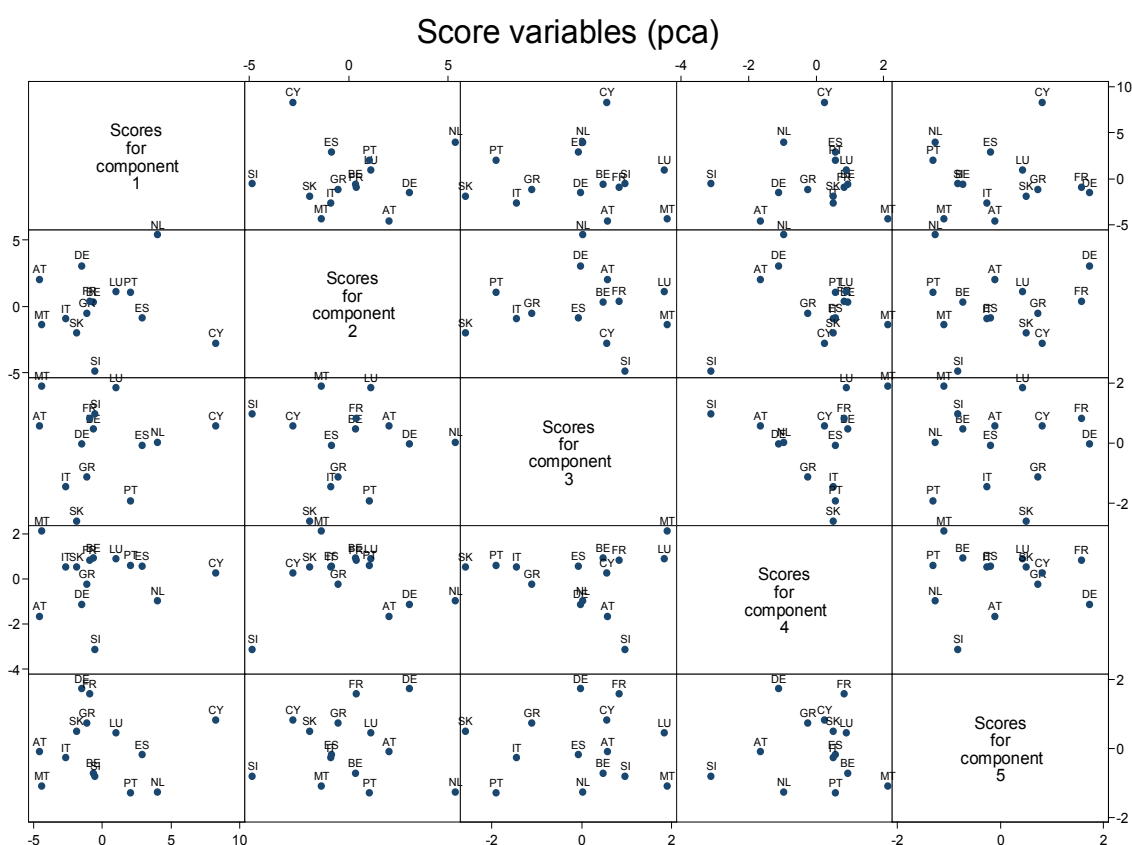
Though they account for a smaller fraction of the variance, the next principal components still bring interesting information:

- The low loan-to-value (LTV) ratio of household main residence for Luxembourg and Malta (27.5% in Luxembourg and, 19.9% in Malta) and, at the opposite, the high values for Portugal and Slovakia, with 41.4% and 37.3%, respectively.
- The comparatively high share (10%) of households with other property mortgages in France.

Principal component analysis

Score plots

Figure 1

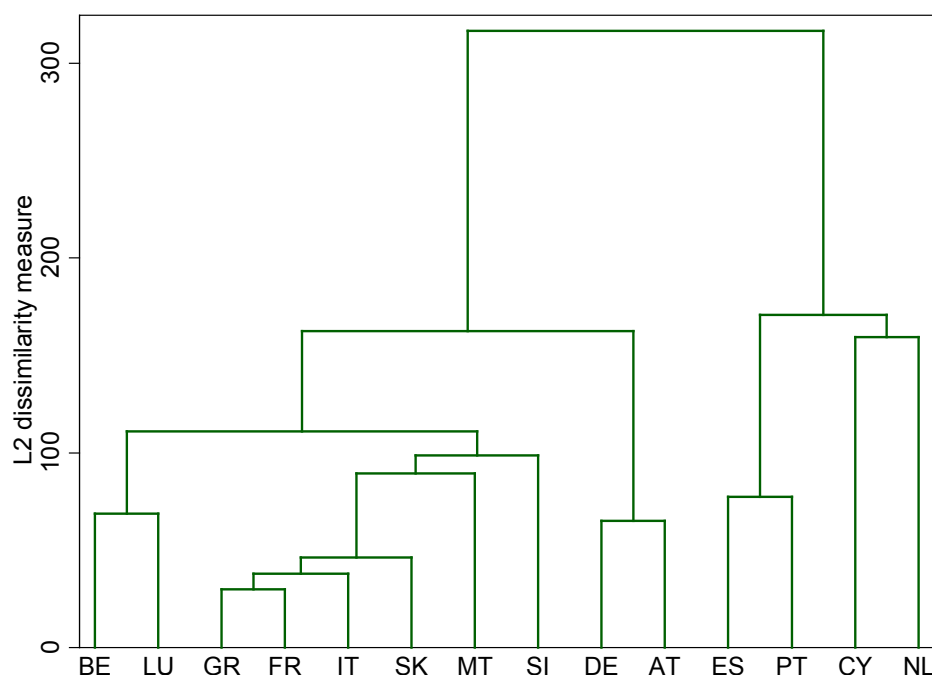


Source: ECB HFCS – author computations.

Cluster analysis of the euro area countries

Dendrogram

Figure 2



Source: ECB HFCS – author computations

The PCA then allows classifying the clusters into groups, based on their similarity (here, the L2 dissimilarity measure). The resulting dendrogram is shown in Figure 2.

A first group of countries (ES, PT, CY and NL) comprises countries where the overall level household indebtedness, as measured by the first component, is important. Among them, the Netherlands has a specific profile as the burden of household debt servicing is there much lower than in the three other countries.

A second group of countries includes Germany and Austria, where the overall importance of household indebtedness is relatively lower than in the previous group and, in particular, where the burden of household debt servicing is low.

Belgium and Luxembourg form a third group of countries, where indebtedness and debt servicing are important. On the other hand, as shown by the third component the loan to value ratio of main residence is low in Luxembourg, probably caused by the increase in housing prices in the country in the last years.

The last group of countries (Greece, France, Italy, Slovakia, Malta and Slovenia) form a 'central' group, which does not mean they may not have distinguishing features (e.g. the importance of non-property mortgages in France or the low loan to value ratio of main residence in Malta).

As a conclusion to the PCA, its first two axes explain 76% of the country variance. The first axis is positively correlated to the DA and DSI ratios, while the second axis highlights the specificity of the DSI ratio. The remaining sections will therefore focus on these two indicators.

Investigating the joint distribution of DA and DSI ratios

Distribution of the DSI ratio in the euro area

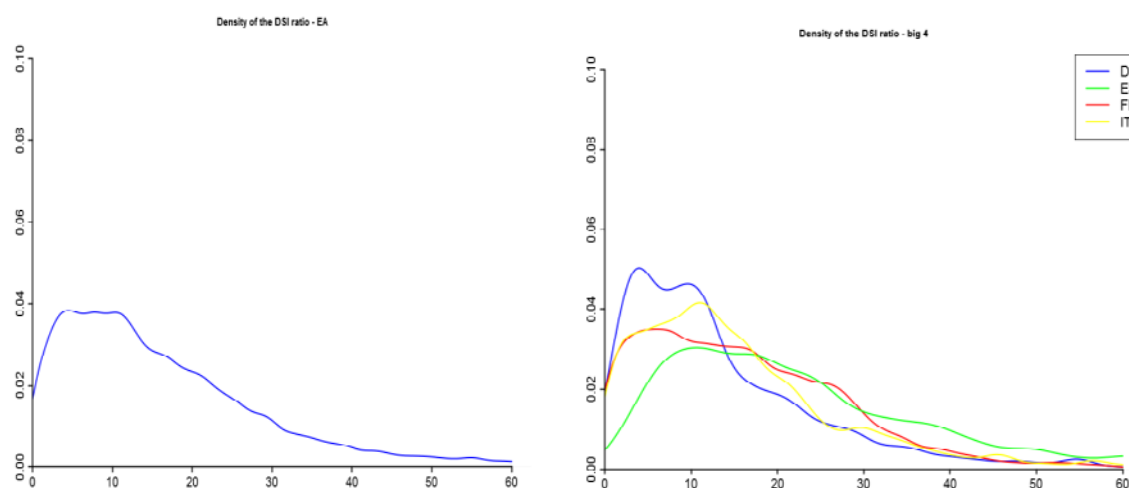
In the euro area, half the indebted households have a DSI ratio over 14%. This means that these households have to use more than 14% of their annual income to pay off their debts. 9% of the households living in the euro area have a DSI ratio over 40%, and even 6% of them have a DSI over 50%.

This result hides large country differences. Cypriot households have very high DSI ratios: half of them pay more than one quarter of their annual income for their debt; 10% of them have a DSI ratio higher than 81%. Spanish indebted households also have high DSI ratios, but lower than the Cypriot ones. The median for the ratio reaches 19% in Spain, and 10% of the households spend more than half of their income for the debt service.

Distribution of the DSI ratio

Left chart: euro area: right chart: Germany, Spain, France and Italy

Figure 3



Source: ECB HFCS – author computations. Kernel density estimates; optimal Gaussian kernel.

On the opposite side, German households that declare having debts dedicate a smaller part of their income for the reimbursement of their debts (see Figure 3): the median ratio for Germany is 11%. Similarly to France and Italy, 90% of the indebted households spend less than a third of their annual income for their debts.

When explaining the distribution of the DSI ratio at the euro area level, two main variables appear to be relevant for the analysis: countries and income, while the age of the reference person and the wealth of the household explain part of the variation observed in the DSI ratios. These variables are particularly significant for the top of the distribution, for which DSI ratio is mechanically the most volatile. When controlling for demographic variables in a conditional quantile regression, differences between countries remain significant: the median DSI ratio for Spain is *ceteris paribus* 8 points above the one for the reference country, Germany. The

difference between the two countries is true for the entire distribution, but is higher on the top of it: the 90th percentile is 18 points higher in Spain than in Germany.

There is almost no significant effect of income on the very bottom of the DSI ratio. However, the effect is increasing along the distribution of the ratio: the higher the income, the lower the ratio and this effect is increasing with the level of the ratio. Households earning more than the 90th percentile of income have median ratio 12 points below those between the 50th and the 60th percentiles; the 90th percentile for the former is 22 points lower than the one for the latter.

The curve for wealth is completely different from the one for income. Households belonging to the bottom of the wealth distribution have lower DSI ratio, and here again, this effect increases along the ratio distribution. The households who possess more than the 90th percentile of gross wealth have a median DSI ratio 6 points higher than the households between the 50th and the 60th percentiles. For the 90th percentile of the ratio, this effect is about 4 times stronger.

Finally, demographics have, as expected, an impact on the distribution of the ratio; in particular, age (of the reference person). The 30–40 year households have slightly higher ratios than the 40–50 (less than 3 points). Labour status of the reference person also has an impact on the ratio, especially on the top of the distribution: the 90th percentile of the ratio is 14 points higher for the self-employed than for the employees. This result could be the consequence of the crisis that has affected heterogeneously the self-employed and especially those who traditionally perceived high income and were able to convince banks to grant them access to credits with higher debt service.

Once households' vulnerability is assessed, it is also essential to have a precise idea of the share of debt at stake. To do so, we weight the households by the outstanding amount of their debt, compare shares in terms of population and debt, and assess the risk of vulnerable households.

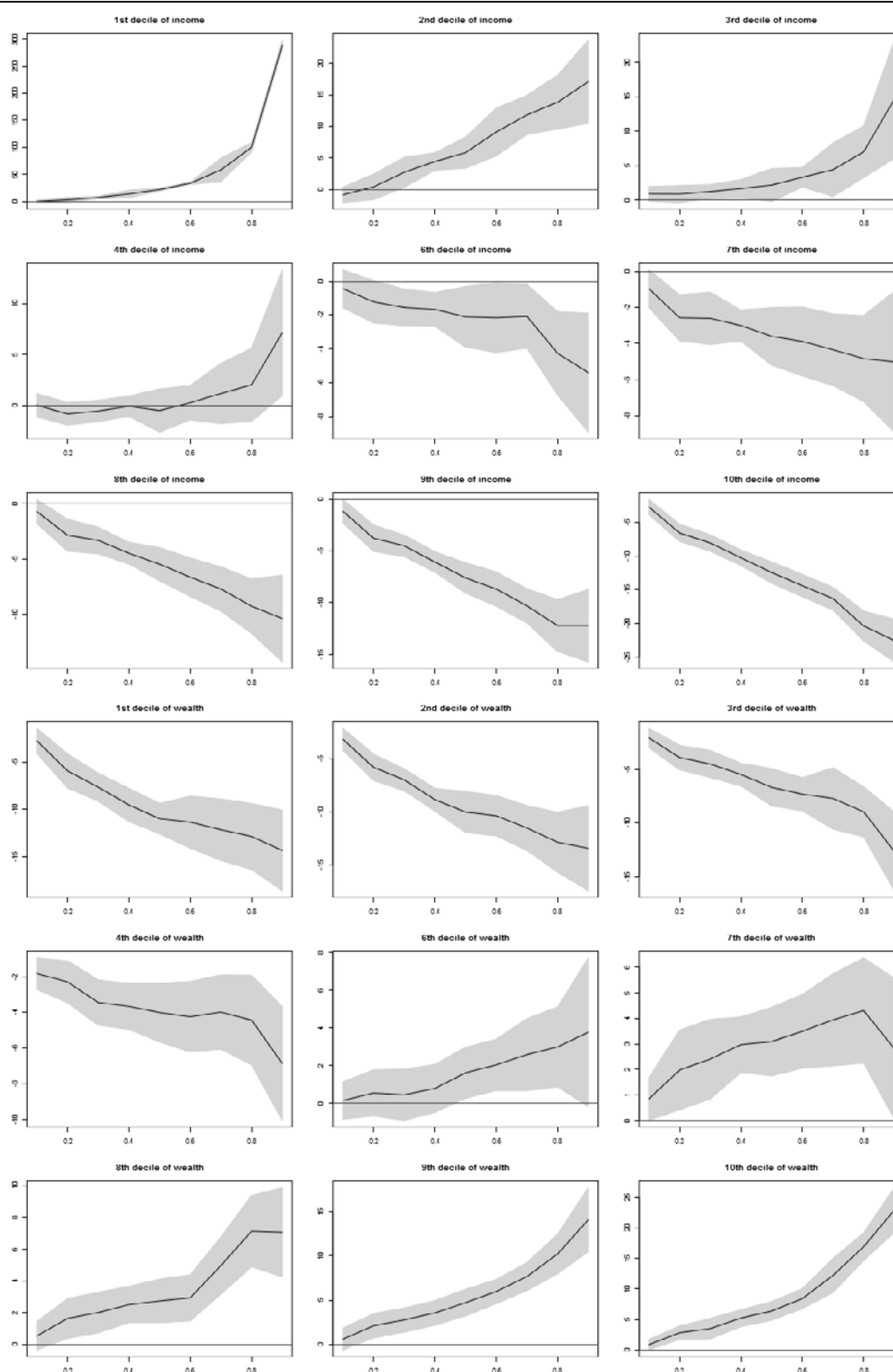
As shown in figure 5, there is a shift along the level of the ratio between the share of households and the share of debt. Whereas 17% of indebted households have a DSI ratio below 5%, their outstanding amount of debt is only 5% of the total amount of debt in the euro area. Conversely, 6% of households have a DSI ratio below 50%, but their total debt is almost 15% of the total household debt in the euro area. When applying the usual DSI threshold of 40%, this figure reaches 21%.

Here again, we find strong difference between countries: Cyprus appears as more vulnerable than the other countries, since about a third of the total debt is held by households with a DSI above 50%. Respectively 25% and 20% of the Spanish and Dutch total debt has been contracted by households that pay more than half of their income to reimburse their debts.

Effect of income and gross wealth

on the distribution of the DSI ratio

Figure 4

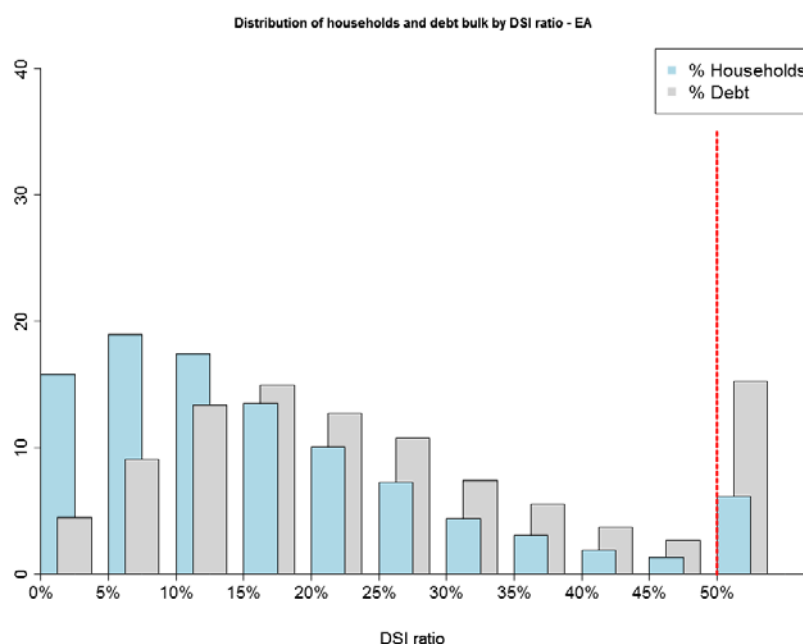


Source: ECB HFCS – author computations. Coefficients of quantile regression of income and wealth deciles.

Shares in terms of population and debt in the euro area

(with respect to the DSI ratio)

Figure 5



Distribution of the DA ratio in the euro area

Focusing on the DSI ratio is not sufficient to properly assess the vulnerability of households. Indeed, households possess often assets they can sell, or savings they can spend out to keep on reimbursing their debt without any interruption. This is the reason why we are also interested in the DA ratio.

In the euro area, the outstanding amount of debt for half of the households stands for more than 22% of the total amount of assets they possess. For 10% of the households, the DA ratio is higher than 99%.

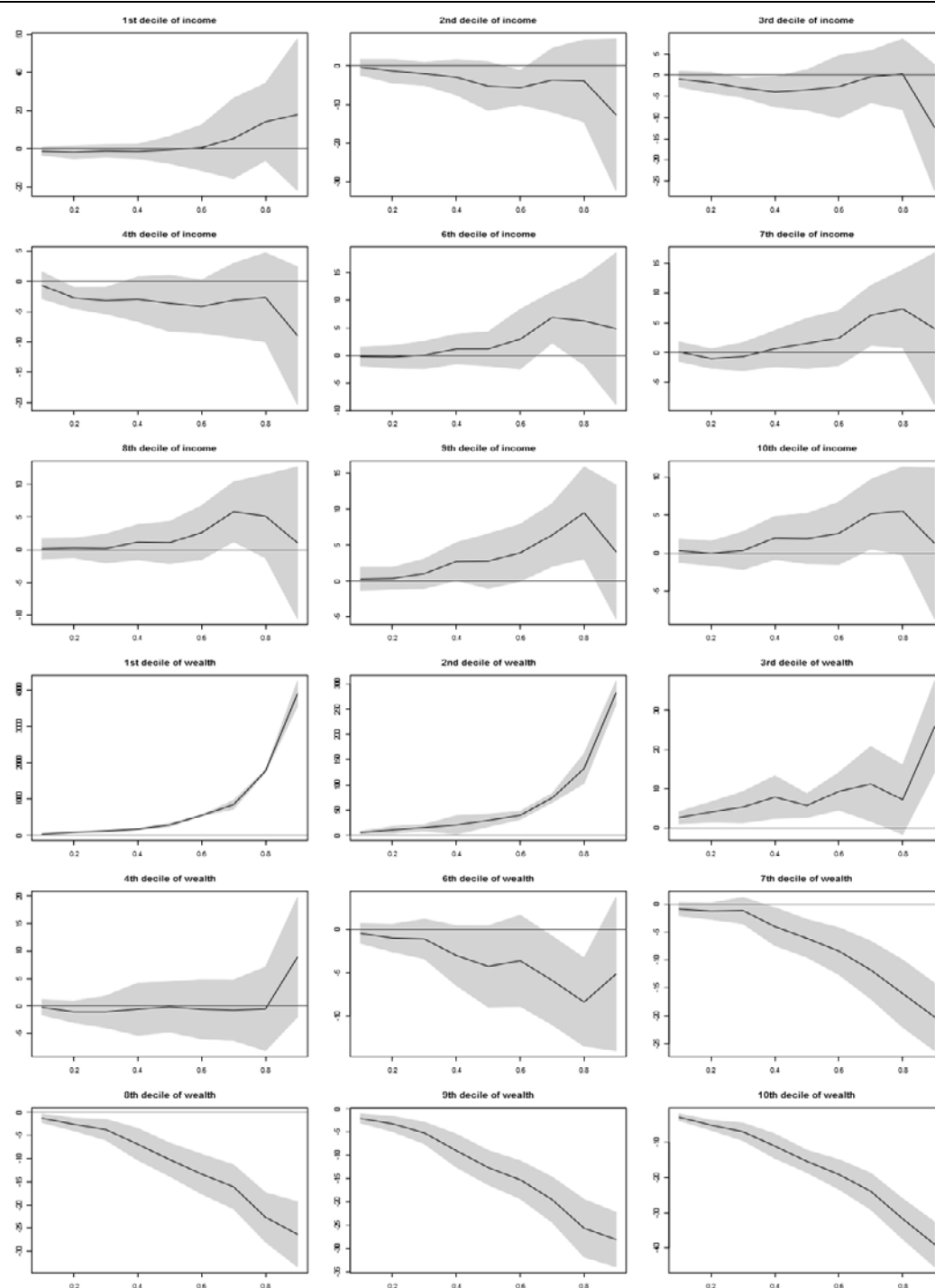
As for the DSI ratio, there are strong differences between countries. Half of the Dutch households have a DA ratio over 41%, and for 16% it is over 100%. In Portugal, the median for the DA ratio is 26%, but only 6% of households have loans that exceed the total value of their assets. Half of the indebted German households have a DA ratio higher than 28%, and 14% of them have a DA ratio higher than 100%. On the contrary, the countries for which high DSI ratios were observed have lower DA ratios: the median for the DA ratio in Cyprus is 17%, and 18% for Spain. About respectively 4% and 6% of Cypriot and Spanish indebted households have a DA ratio higher than 100%.

When explaining the distribution of the DA ratio, quantile regressions show that here again, country fixed effects remain highly significant. Germany and Netherlands have for a given income, wealth and other demographics, higher DA ratios, especially on the top of the distribution. One key finding is that income plays almost no role at all in explaining the distribution of the DA ratio. Whereas Bover et al. (2013) find that income had an impact *ceteris paribus* on the outstanding levels of debt, our regressions fail at proving a significant effect of income on the ratio. Thus debt is often used to finance acquisition of assets, and from that point of view,

higher amounts of debt could be invested to buy more assets. If income affects obviously wealth and debt levels, it has no impact on the ratio between them. This phenomenon is often interpreted in the literature as an absence of credit constraints (at least from the point of view of income).

Effect of income and gross wealth on the distribution of the DA ratio

Figure 6



Source: ECB HFCS – author computations. Coefficients of quantile regression of income and wealth deciles.

Wealth has a huge impact on the distribution of the DA ratio (figure 6): households with gross wealth above the 90th percentile have a median DA ratio 15 points below those with a total amount of assets between the 50th and the 60th percentiles. This effect is increasing along the distribution: it reaches 39 points for the 90th percentile.

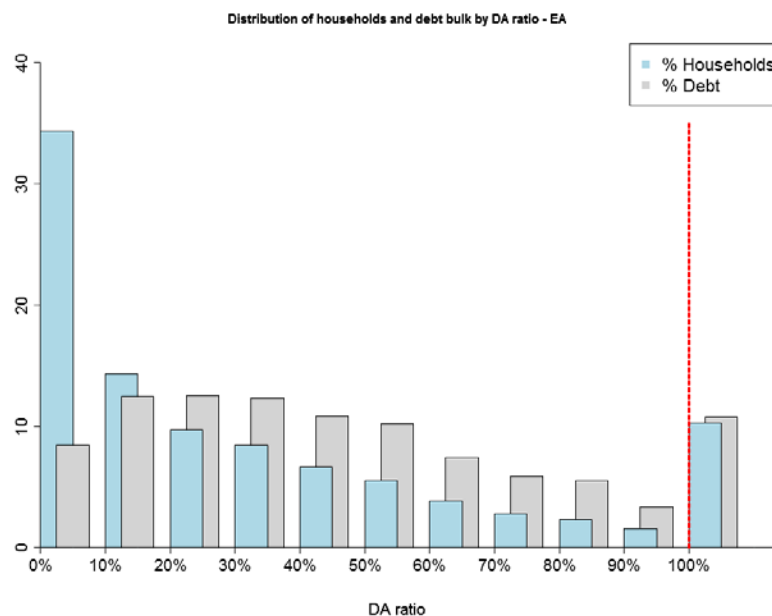
Finally, age of the reference person has an effect on the distribution of the DA ratio. Households with a reference person below 40 have higher DA ratios because they are at the beginning of the wealth accumulation process, whereas older households are less indebted and have had time to save a part of their income.

Here again, we want to assess the proportion of the total outstanding amount of debt that has to be reimbursed by households that have high DA ratios (figure 7). A high proportion of households have low DA ratios: more than one third of indebted households have a DA ratio less than 10%. However, these households also have low outstanding amounts of debt, and the share of the outstanding amounts for these households is about 9%. There is a shift along the distribution of the DA ratio, affecting mainly the middle of the distribution. At the top of the distribution, the proportion of households with DA ratios higher than 100% is less than 10%, which is also the share of their debt over the total.

Shares in terms of population and debt in the euro area

with respect to the DA ratio

Figure 7



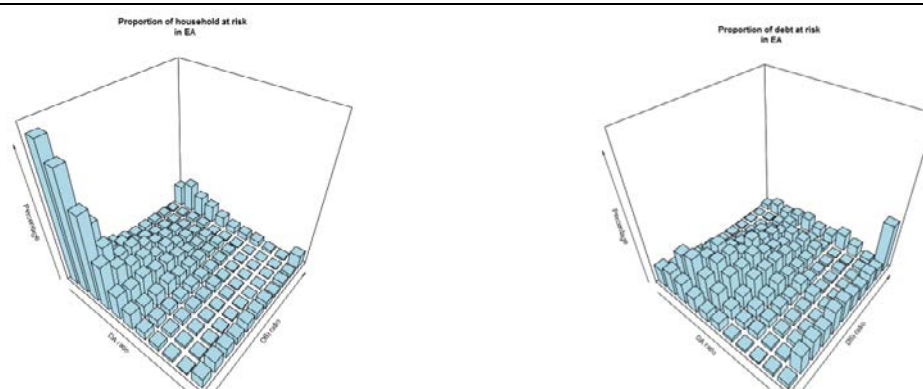
Interplay of the two ratios

It is important to study the joint distribution of the two ratios, to understand how many households have both high DA and DSI ratios and which part of the total outstanding amount of debts this represents. Households that have high DA and DSI ratios are more likely to have troubles reimbursing their loans, and can be considered as 'at risk'. A negative shock on their income could affect their ability in paying their debt service, and they will not be able to reimburse the outstanding amount in case of bankruptcy.

Joint distribution of the DA and the DSI ratios

in the euro area

Figure 8



Notes: The figures above show the repartition of respectively the indebted households on the left and their debt on the right according to both DSI and DA ratios. Each ratio have divided in 11 classes. The first class stands for a DA ratio between 0 and 10%, or a DSI ratio between 0 and 5%. The last class corresponds to a DA ratio above 100% or a DSI ratio above 50%. For the graphic on the right, the height of the bar represents the share of households with corresponding DA and DSI ratios; on the left, it corresponds to the share of these households on the total debt.

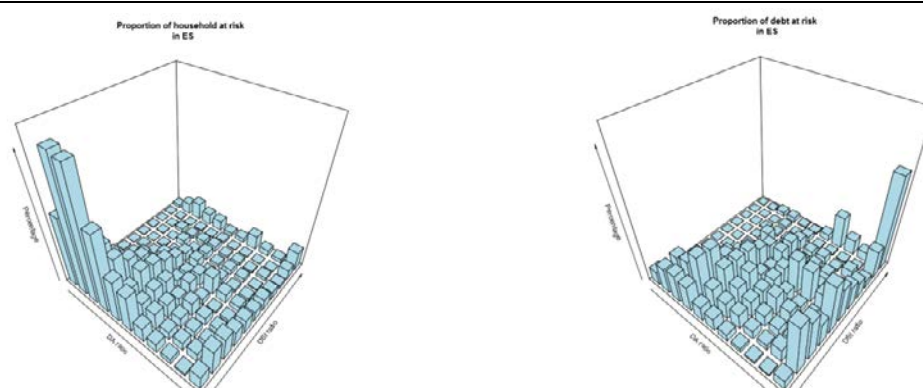
An important proportion of households living in euro area have both low DSI and DA ratios (figure 8). About 10% of households have a DA ratio below 10% and a DSI ratio below 5%. At the same time, a significant part of the households have high DSI ratios (over 50%) but often have lower DA ratios. Finally, those households who are twice at risk with DA ratios above 100% and DSI ratios above 50% (the bar on the right corner) represent less than 1% of the population.

However, once weighted with the outstanding amount of debts, the proportions tend to level because of the low amount of debt for the households in the bottom of the distribution. Conversely, households with high DSI and DA ratios appear to detain about 3% of the total amount of debt in the euro area. This strong shift is particularly obvious for a country like Spain (figure 9).

Joint distribution of the DA and the DSI ratios

in Spain

Figure 9



See the Notes for Figure 8.

Visualising the composition of the joint distribution of DA and DSI ratios

Concentrating still only on the joint distribution of the two indicators of indebtedness used in the previous section, we investigate an alternative to the previous histogram representation.

An added difficulty in the analysis of the ratios is their range and skewness. When including the non-indebted households, the two distributions have a probability mass at 0. Since assets or income can be close to zero (or even negative for the latter), the ratios are theoretically unbounded. One possibility is to transform the indicators. Three transformations that are useful in general to display skewed data were tested: logarithm, inverse hyperbolic sine, and logistic transformation. Of these, only the logarithm produced approximately normal data, and even then, the resulting transformed variables' distributions have fatter tails and are slightly asymmetric, in particular the DSI ratio. Therefore these transformations were not further considered, and an alternative was sought.

Even with the proper transformation, graphical representation of joint distributions is not straightforward. The kernel density in the univariate case loses a lot of its apparent simplicity and usefulness in the bivariate case, and the representation of a surface in a graph is less revealing.

Moreover, it is sometimes more useful to have the deviations from a reference value, or population average, rather than the absolute value. We therefore propose a representation based on the quintiles of the DA and DSI ratios, and for several categories of interest, a measure of under- or over-representation.

Construction of joint quintiles

The values of the DA and the DSI ratios are assigned to the euro area quintiles 1 to 5, computed only for the indebted households but across all countries in the sample (excluding Finland due to missing information on debt service). Households with either no debt or no debt service are assigned to the extra category "0". It is possible for a household to be indebted but have no debt service. Indebted households where income is negative or assets are zero are dropped from the data; this only concerns about 134 households out of 20,892 in the sample of indebted households. By interacting the two variables in quintiles, each with 6 modalities, 32 classes are possible; households with no debt but with positive debt service are excluded (8 households are dropped in this manner). The proportion of households in each class is given in Table 3 below.

Population frequencies (%)

Joint distribution of debt to assets and debt service to income ratios

Table 3

		Debt service to income ratio quintiles						Total
		0	1	2	3	4	5	
Debt to assets ratio quintiles	0	56.6						56.6
	1	3.1	2.2	1.5	0.9	0.5	0.3	8.6
	2	1.4	1.9	1.8	1.5	1.2	0.8	8.6
	3	0.8	1.1	1.7	1.8	1.8	1.6	8.6
	4	0.6	0.9	1.1	1.7	2.2	2.2	8.6
	5	1.5	1.1	1.0	1.3	1.5	2.2	8.6
Total		64.2	7.2	7.2	7.2	7.2	7.2	100

Source: HFCS, author calculations.

More than half of the households have no debt, and 2.2% of the households are both in the highest quintiles of both the DA and the DSI ratio.

Construction of Heat maps

For each category in the variables of interest (e.g. reference person aged between 40 and 49, or households in a particular country), the proportion of this category in each of the 32 classes of DA&DSI quintiles is compared to the average proportion in the population as a whole, and the under- and over-representation is deducted from this comparison, and calculated as the ratio of the share of the category in the class divided by the overall share of this category. This is graphically represented in a heat map, as in Figure 10, with blue parts showing the over-representation of this category and green the under-representation.

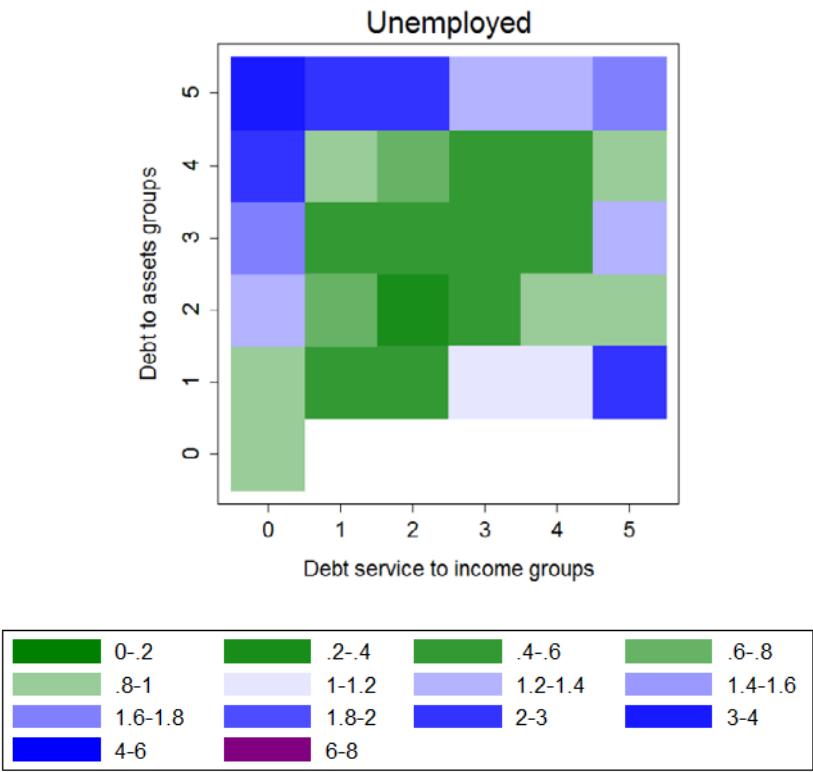
From this particular figure, it appears that the unemployed are overrepresented in either the high DA or in the low DA but high DSI – this last one may coincide with the temporary loss of a job and lower income, leading to higher DSI.

Figure 11 shows the country heat maps. The heat maps of Cyprus, Spain, Luxembourg, and to a lesser extent Belgium and France, show an over-representation of the lower right-hand corner, namely of the high DSI but low DA ratios. Austria and Germany have the opposite. The Netherlands, and to a lesser extent Portugal, have an over-representation of the high DA and high DSI corner. These results match the conclusions of the previous sections, and provide a simple graphical representation of the potential imbalances and risk areas.

Heat map of the unemployed

Out of the total population

Figure 10

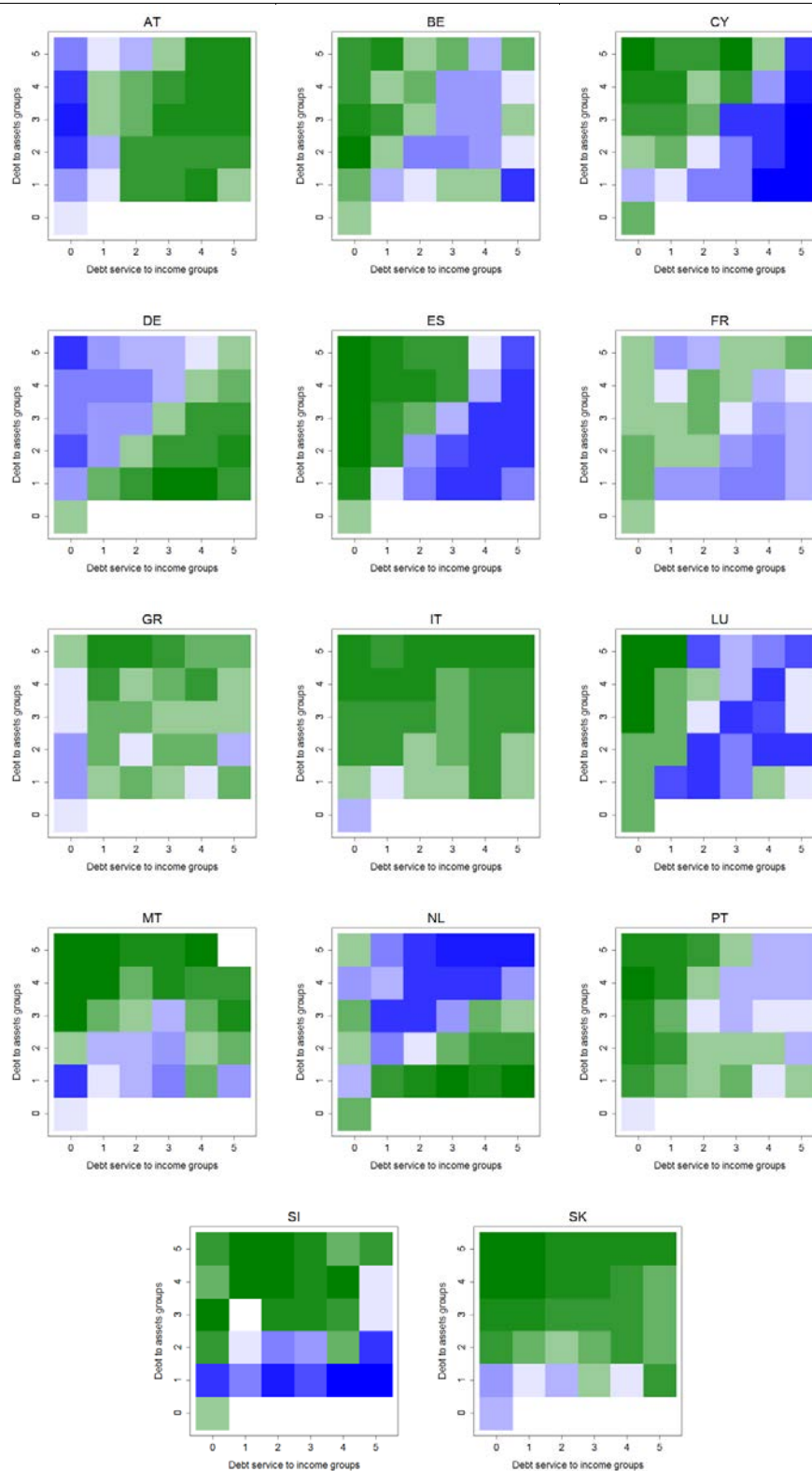


Source: HFCS, author calculations. Blue means that the “unemployed” category is over-represented in the corresponding DA and DSI cells.

Country heat maps

Out of the total population

Figure 11



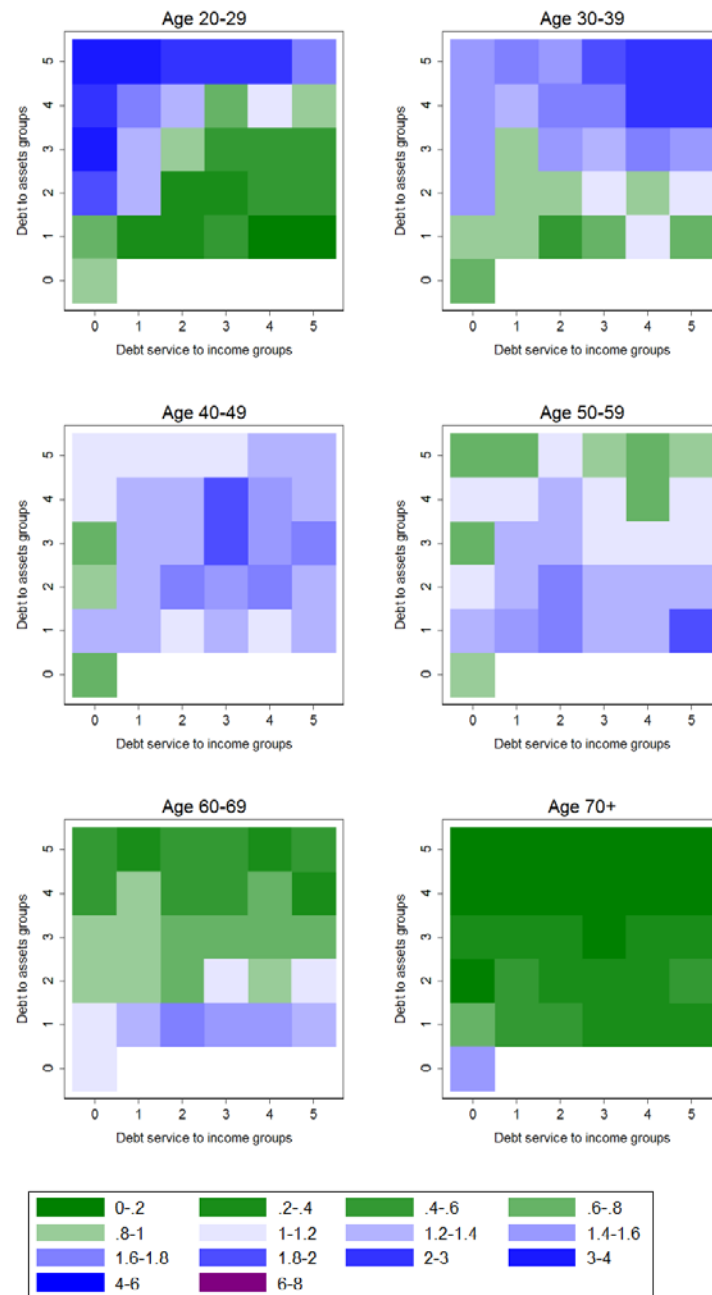
Source: HFCS, author calculations.

In Figure 12 the heat maps by the age of the reference person are computed. As the reference person ages, the over-represented parts travel from the top left corner, to the top right one, then down the right side to the bottom left corner, and finally to the debt-free corner in the bottom left. Debt to assets is high when households are young, and decreases with age, but debt service to income is low when the household is young, reaches a peak in middle age and stays high until retirement age.

Heat maps by age of the reference person

Out of the total population

Figure 12



Conclusion

Different types of analysis give consistent results about indebtedness in the euro area. Thus households in countries like Cyprus, Netherlands, Spain and Portugal are characterised by a heavy debt burden, in particular with respect to the Debt Service-to-Income ratio. Individual characteristics help in explaining the likelihood of being considered as vulnerable from the point of view of the different indicators that have been used in this article. Age of the reference person, income and wealth play an important role of course. Young indebted households with low income and no assets have higher DSI ratios; such situations happen often, conditionally to the fact that such households have been granted access to credit. Life cycle theory offers thus an explanation for such situations. Mid-life households, in the beginning of wealth accumulation and often indebted to acquire for instance their main residence are also more likely to have higher DA ratios. On top of that, the impact of macro-level factors such as the regulatory framework, credit conditions, cultural and history factors must also be considered.

When looking at the data, vulnerable households do not stand for a significant part of the population; only 3% of the indebted households combine both very high DSI and DA ratios. The outstanding amount of debt these households does not represent an important share of the total amount of debt in the euro area. Furthermore, when simulating a negative shock on asset prices and income (not reported in this article), no significant increase appears in the proportion of vulnerable households. However, these results are valid only from a descriptive point of view; indeed such negative shocks should have effect on other components of the economy and could affect more deeply indebted households. To assess such effects, a micro-simulation model is necessary – but is left for future research.

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Table A: Household debt participation and burden indicators (%) in the euro area countries, 2008–2011

		Belgium	Germany	Greece	Spain	France	Italy	Cyprus	Luxembourg	Malta	Netherlands	Austria	Portugal	Slovenia	Slovakia	Finland
Debt participation (%)	(d1) Households with debt	44.8	47.4	36.6	50.0	46.9	25.2	65.4	58.3	34.1	65.7	35.6	37.7	44.5	26.8	59.8
	(d2) Has mortgage debt	30.5	21.5	17.5	32.5	24.4	10.8	44.8	38.8	15.6	44.7	18.4	26.7	14.1	9.6	M
	(d3) Has HMR mortgage	28.5	18.0	13.9	26.8	16.9	9.6	35.0	32.8	12.1	43.9	16.6	24.5	12.5	9.3	32.8
	(d4) Has other property mortgage	3.2	6.0	3.9	7.3	10.1	1.6	15.4	8.4	4.5	2.5	2.4	3.3	1.6	0.6	M
	(d5) Has non-mortgage debt	24.2	34.6	26.1	30.7	32.8	17.8	47.9	36.9	25.2	37.3	21.4	18.3	38.9	19.9	M
Debt ratios (median) – (%)	(r1) Debt to assets ratio of indebted households	18.2	28.4	14.8	17.9	18.9	11.7	17.0	18.2	6.2	41.3	16.7	25.7	3.9	6.6	34.6
	(r2) Debt to income ratio of indebted households	79.8	37.3	47.2	113.5	50.4	50.3	157.0	86.9	52.0	194.1	35.6	134.0	26.6	22.7	64.3
	(r3) Debt service to income ratio, all indebted households	13.8	6.7	9.4	19.2	13.1	10.6	22.5	15.7	8.4	12.6	2.9	16.0	11.0	9.0	M
	(r4) Debt service to income ratio, households with debt other than credit lines, overdrafts or credit card debt	15.1	10.9	14.7	19.9	14.7	13.2	25.0	16.6	11.5	14.5	5.6	17.3	15.8	12.5	M
	(r5) Mortgage debt service to income ratio of households with mortgage debt	14.8	12.8	16.4	20.5	17.4	15.5	25.3	16.3	12.8	14.2	4.6	16.7	11.7	20.4	M
	(r6) Loan to value ratio of main residence	28.8	41.9	31.6	31.0	32.4	30.0	31.9	27.5	19.9	52.5	18.7	41.4	5.4	37.3	48.6
	(r7) Net liquid assets as a fraction of annual gross income	33.5	22.3	4.9	12.3	18.5	21.9	5.1	20.5	75.7	16.4	32.9	15.9	2.2	12.1	9.4

		Belgium	Germany	Greece	Spain	France	Italy	Cyprus	Luxembourg	Malta	Netherlands	Austria	Portugal	Slovenia	Slovakia	Finland
Debt ratios (90th percentile) – (%)	(p1) Debt to assets ratio of indebted households	74.9	200.2	83.3	80.4	88.3	72.2	65.6	84.2	39.0	174.4	211.6	89.7	N	61.3	170.5
	(p2) Debt to income ratio of indebted households	376.0	330.0	345.5	522.5	332.4	323.0	716.9	438.0	306.7	650.9	281.3	590.3	N	332.4	290.2
	(p3) Debt service to income ratio, all indebted households	35.0	28.2	35.4	50.5	32.3	33.5	77.0	34.6	24.5	43.8	22.2	47.4	N	37.4	M
	(p4) Debt service to income ratio, households with debt payments	37.2	33.1	42.5	51.1	33.8	37.4	84.4	35.2	N	49.3	25.3	48.6	N	41.4	M
	(p5) Mortgage debt service to income ratio of households with mortgage debt	35.6	35.3	41.5	45.9	33.8	35.6	79.0	34.3	N	40.3	24.9	47.6	N	47.5	M
	(p6) Loan to value ratio of main residence	79.9	92.8	80.3	79.9	79.7	74.7	80.1	87.5	N	104.6	80.8	93.2	N	72.2	112.5
Household debt vulnerability (%)	(v1) Debt to assets ratio of indebted households >= 75%	9.9	22.0	11.6	11.3	13.2	9.7	6.5	12.8	2.6	27.3	18.8	15.3	5.3	6.3	26.8
	(v2) Debt to income ratio >= 300%	15.0	11.3	12.2	24.2	12.4	11.0	31.5	20.6	10.5	35.2	9.2	28.2	9.6	11.4	9.0
	(v3) Debt service to income ratio >= 40%	7.8	4.9	8.4	16.7	5.4	7.2	24.3	7.0	1.9	11.0	4.0	13.2	19.0	8.6	M
	(v4) Debt service to income ratio, households with debt other than credit lines, overdrafts or credit card debt >= 40%	8.5	6.7	11.4	17.2	6.0	8.8	26.8	7.5	2.4	12.3	5.0	14.2	23.6	11.1	M
	(v5) Mortgage debt service to income ratio >= 40%	8.8	7.0	10.8	14.9	5.8	8.3	28.2	6.8	2.5	9.9	4.3	13.6	10.0	17.3	M
	(v6) Loan to value ratio of main residence >= 75%	12.5	21.6	13.2	11.8	12.4	10.0	12.4	15.9	3.5	32.1	10.9	19.5	3.4	8.9	31.9

Source: Eurosystem Household Finance and Consumption Survey; Note: "M" = information not collected; "N" = information not released for based on less than 25 observations.