**Competence measurement in the field of financial literacy**

**Results on the handling of online computers from the FILS study**

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**Summary**

Studies on financial literacy are currently carried out in many ways, without the underlying construct being discussed in detail. The article addresses the current lines of discussion and enforces the new FILS study in the research environment. This, too, is based on an independent structure of financial literacy, but unlike all previous studies, it uses simulation calculators, which are often found on the Internet (savings calculators, financing calculators, etc.) and are intended to support consumers in their decision-making. In the course of increased individualization processes, increasing social risks and the growing responsibility to secure oneself financially (Schürz/Weber 2005), these are part of the requirements profile of today's financial literacy. 14- to 17-year-old students in Germany (N=817) were tested. The data is evaluated using methods of classical test theory.

**Abstract**

Studies into financial literacy are currently conducted from a variety of perspectives without the under- lying construct itself being discussed in detail. The paper thematizes the current lines of discussion and classifies the new FILS study in the wider research terrain. This study also assumes its own independent construct of financial literacy; yet unlike all previous studies, it employs simulation calculators which can be found on the internet (savings rate calculator, financial calculator, etc); they support consumers in their decision-making process. Given increased individualisation processes, heightened social risks and greater responsibility to protect individual finances (Schürz/Weber 2005), these calculators form part of the requirement profile of modern-day financial literacy. School pupils in Germany between the ages of 14 and 17 years (N=817) were tested and the data was evaluated by using classical test theory methods.

**1 Basis for discussion**

The terms financial literacy, financial capability and financial education have been found in the daily press, political discussions and scientific contributions for some time. However, they are "cyclically dependent", because they usually occur when consumers have invested in large numbers "wrongly" or have fallen into the debt trap. The image of the "responsible consumer" (FAZ 18 July 2012, 17 with regard to insurance) and its formation are always sought. Otherwise, the German population likes to become "financial illiteracy" (Leinert 2004) or "Financial Illiteracy" (Weltonline 22.07.2004; Handelsblatt 22.07.2004; Häcker 2007). Such press releases are based on various financial literacy studies. However, these are extremely heterogeneous in their concept of content and measurement theory (Gnam et al. 2007).

At the heart of the following article is a perspective of the financial literacy construct, which was first collected in the Financial Literacy Study (FILS): the use of simulation computers. The state of research in Chapter 2 shows the current measurement dimensions in an overview. Chapter 3 is intended to draw attention to measurement problems from the point of view of competance diagnostics, of which the dimensions of task form and simulations were particularly taken into account in FILS (Chapter 4). The results from the handling of the used simulation computers are discussed in Chapter 5.

**2 State of research**

Financial literacy takes up vocabulary from the broad discussion on basic education (locks/shoes 2011). The term basic education is used in it synonymously to the term literacy (Oelkers 2003, 4). For example, "functional illiteracy" or "illiterality" is referred to when, despite attending school, the persons concerned have so few written language skills that they cannot use them functionally in everyday or professional life. In contrast, there is talk of "primary" or "total illiteracy" if a person has never learned to read and write (Grotlüschen/Riekmann 2011). If one follows this very narrow view, a concept such as "financial literacy" would deprive the literary concept of its meaning-bearing core. However, it can be objected to that this risk exists only if it is not possible to specify literacy in terms of the respective context. Used by a wide range of

Concept of literality (UNESCO Institute for Education 2005, 1 and 4), so different literalities in a culture in different areas of life (Bar- ton/Hamilton 2000, 9). Literacy (and also functional illiteracy) are thus subject to a change in time, and the discussion of financial literacy makes sense. Today, it is considered alphabetized who can participate in all the activities of his environment, which require reading, writing and arithmetic, as well as in the further use of these cultural techniques for their own development and that of their community (UNESCO 1962). This includes, for example, the reception of texts of general interest, the handling of user manuals and written work instructions, the filling out of forms, the operation of vending machines and the like. For orientation in a European society, however, a certain degree of media literacy and economic literacy (Remmele et al. 2012) is also required( Remmele et al. 2012), otherwise the target groups cannot participate sufficiently in their different life contexts ("life skills", "basic skills") (Basic Skills Agency 1993; locks/shoes 2011).

In PISA 2012, which also pursues the literacy approach, financial literacy is tested as a permanent construct. This approach, if one considers the empirical studies, seems to be common, because the literature hardly questions the extent to which self-reliance exists at all and to exclude a degree of duplication to perhaps a more comprehensive economic literacy (Macha/Shoes 2012b). In economic education, on the other hand, a broader discussion about the inclusion of financial literacy in economic education has arisen (Schlösser et al. 2011; Kaminski/Friebel 2012), which was not received internationally. Existing studies test elements of perhaps overarching economic literacy, although there has been sufficient evidence for an increase. These include the social consequences and the responsibility of the individual for his actions (Reifner 2006; Joint Initiative 2000; Australian Ministerial Council 2006), economic thinking (FTE 2005; NCEE o.J.) in the sense of calculus and decision-making as well as political judgment (BDA 1998). Rather rarely, the impact of social contexts on the individual situation or knowledge of the financial sector is cited (Gnan et al. 2007, 33f.).

Since a systematic examination of the relationship between the two constructs has so far been omitted, the question remains unanswered whether financial literacy as a construct represents its own dimension of compency, or whether it is perhaps only a matter of knowledge on the subject of fi- nanzen, which, due to the ability to think economically, can think economically.

(concept of scarcity, opportunity costs, handling of risk, etc.), lead to the tested subjects being more competent (Aprea 2012).

To avoid this, financial literacy puts decision-making capacity in financial matters at the heart of PISA. "Financial Literacy is knowledge and understand- ing of financial concepts and risks, and the skills, motivation and confidence to apply such knowledge and understanding in order to make effective decisions across a range of finan- cial contexts, to improve the financial well-being of individuals and society, and to enable participation in economic life" (PISA 2012, 12f.). Approaches to a categorically motivated content-based examination of the construct are recognizable, but remain very openly formulated and unfounded. In the OECD INFE definition, which was defined a year ago, categorical access was misguided, emphasizing awareness and attitudes and behaviour as essential determinants of financial literacy: "A combination of awareness, knowledge, skill, attitude and behaviour necessary to make sound financial decisions and ultimately achieve individual financial wellbeing." (OECD 2011, 3).

**3 Competence measurement or knowledge query?**

If financial literacy is regarded as a competence and not just as a knowledge-based product, certain requirements apply for the measurement of this competence.

Competences, unlike, for example, the construct of intelligence, differ particularly strongly into (domain)-specific constructs. This is already shown by the early work of Chomsky, who is to be classified in the cognitive school and deals with the competence-performance-demarcation in the center (Chomsky 1965). According to Chomsky, (lingu- ist) competence is determined by cognitive structures and rules, without which the ability to generate language would not exist. Linguistic performance would then be the observable ability (language) in practical application. In this sense, the test-theoretical focus on competences is also understood as cognitive performance dispositions, which refer to an overarching meaningful thematic concept of action, the domain. If these cognitive performance dispositions are used for task processing, it is called performance. The dispositions of the students are different when they work on the concrete tasks, i.e. on a performative level. In this way, competence can be traced back from performance to competence (Winther 2010, 9). A competence model thus represents the link between the construct "competence" and the real tasks, which is why the discussion about financial literacy in its

PISA definition (PISA 2012) as an independent competence is relevant and necessary (Ma- cha/Schuhen 2012b).

Competence measurements[[1]](#footnote-1) require problem-based tasks and not pure knowledge (dimension 1 in Figure 1) (Weinert 2001, 27). In addition, competence structure mo- delle form the basis of the test. A competence structure model attempts to understand the internal structure of the competences to be measured, i.e. to investigate the question of which individual sub-competences and which overall competences represent. This dimension of mes- sungen was defined in the following figure under "Aspects of action" (2). Competence level models, on the other hand, measure" which specific requirements a person with a high level of competence can cope with and which requirements a person with low competence is still mastered and which are not" (Hartig/Klieme 2007, 133). Such models, which are also necessary, deal with the precise measurement of requirements levels (3) and their management by the test subjects and relate them to abstractly derived, theoretically based ideas about what a particular group of test subjects should be able to do in a particular content area (4).

Different task formats (5) (Klieme 2005) should help to ensure that, for example, no multiple-choice bias occurs. As further task formats, Klieme suggests open response formats. Other possibilities would be work samples, speech formats, etc. It is decisive that distortions in the results, which are due to the familiarity of the test subjects with certain question formats, are minimized. Weinert (6) also calls for "variable situations" (Weinert 2001, 27) in which problems are to be solved. This not only requires a variable design of the tasks to be solved by the test users, but also requires that these come from different con- texts. Within economic education, the role concept occupies a prominent position here. For example, Jung (2006, 33-60) developed a competence model that was initially six times, then quadruple-graded, based on the assumption that there are life-changing challenges in domain-specific roles (6) (Jung 2009, 204f.). In addition, motivation and volition (8) must be raised (Weinert 2001, 27).

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|  | **Solving problems (1)** | **Hand-lungsas- pekte (2)** | **Requirements- rungsniv eau (3)** | **Content (4)** | **Aufga- benforma te (5)** | **Situation**  **/ Roll (6)** | **Motivati- on / Voli- tion (7)** |
| **Author**  **Study** | 2001 Weinert | Hartig & Klieme 2007 | Hartig & Klieme 2007 | Hartig & Klieme 2007 | 2004 Klieme | 2001 Weinert | 2001 Weinert |
| PISA 2012 Financial  Literacy Framework, 2012 | **Yes** | **Yes** | **Yes** | **Yes** | **Not**  **sighted[[2]](#footnote-2)** | **Yes** | **Yes** |
| Measuring Financial Literacy: Question- naire and Guidance Notes for Conducting an Internationally Comparable Survey  of Financial Literacy, OECD INFE, 2011 | **Restricted[[3]](#footnote-3)** | **Restricted** | **Yes** | **Yes** | **No** | **Restricted** | **Yes** |
| Financial Literacy around the World: An overview ,  Lusardi/Mitchell, 2011 | **Restricted** | **No** | **Yes** | **Yes** | **No** | **No** | **Restricted** |
| Financial Literacy and Subprime Mort- gage Delinquency,  Geradi et al (2010) | **Restricted** | **Restricted** | **Yes** | **Yes** | **No** | **No** | **Restricted** |
| Financial Literacy and Indebtness, Disney/Gathergood,  2011 | **Restricted** | **No** | **Yes** | **Yes** | **No** | **No** | **Restricted** |
| ING International Survey results on financial competence,  Bright/Keller, 2012 | **Restricted** | **No** | **Yes** | **Yes** | **No** | **No** | **No** |
| Evaluation of Finan- cial Fitness for Life Program and Future Outlook in the Mis- sissippi Delta, Smith/  Campbell et al., 2008 | **Restricted** | **Restricted** | **Restricted** | **Yes** | **No** | **Restricted** | **Yes** |
| The Financial Litera- cy of young American adults, Results of the 2008 National Jumptart Coalition Survey of High School Seniors and College Students,  Mandell. | **Yes** | **Restricted** | **Restricted** | **Yes** | **No** | **Yes** | **Yes** |

*Figure 1: Classification scheme: Competence measurement*

At this point, a brief interim conclusion will be drawn with a view to the current studies on financial literacy. For example, the overview in Figure 1 shows studies on financial literacy found on the economics search engine Economics and Finance Research ideas repec[[4]](#footnote-4) for the last 5 years. In the further selection process, only studies (survey) were considered, which explicitly want to examine the terms financial literacy or financial competence or financial capability. Furthermore, studies relating to Lusardi and the Health and Retirement Study 2004[[5]](#footnote-5) or reference to this study[[6]](#footnote-6) have been excluded, as these questions are listed representatively by the study (Lusardi/Mitchell 2011). Furthermore, students who deal with financial competence, but only cover it through questions on the personal handling of funds and products (e.g. Youth and Money 2005, SCHUFA) have been excluded. Two studies from the UK and the US are cited for linking financial literacy with other topics, each of which has examined financial literacy with different priorities. A cross-section of the research landscape around the financial literacy construct of the last 5 years is to be presented. In an overview (see Figure 1), the studies selected in this way are assigned to the different perspectives in a first systematization.

The classification of the selected studies shows that a large proportion cannot meet the requirements of competence measurement. Especially in the area of task formats (5), weaknesses can be identified in individual studies, especially against the background of a gender-specific bias due to the formulation of questions (Macha/Shoes 2013). The roles classified as real in economic education (6) are also not consistently dealt with.

**4 Financial Literacy Study (FILS)**

The Financial Literacy Study (FILS) is part of the project ECOS (Economic Competencies Study) of the ZöBiS. In this project, the authors explore whether there is a specific economic competence and what relationship this competence has to mathematical and verbal skills. In addition to economic knowledge,

computer simulations for the survey of action-based competence are also used in this study (Macha/Shoes 2012a). This concept is also followed in FILS. To obtain a parallel data set, students between the ages of 14 and 17 were interviewed as part of a 45-minute online study. It started in June 2012 and currently comprises 817 students from North Rhine-Westphalia, Rhineland-Palatinate and Baden-Württemberg. In terms of content, five areas are covered, supplemented by the monetary policy dimension, so that the financial policy part of a financial literacy can also be covered and possible interactions between monetary policy interests and knowledge and the individual financial literacy can be established.

*Figure 2: Content Construct*

The measurement model provides for the criteria described in Chapter 3, whereby motivation and volition were collected by means of a recruitment test on money in adolescents and young adults (Barry/Breuer 2012; Yamauchi/Templer 1982; Furnham 1984; Tang.

The main innovation in the previous studies is the online-based simulations in the form of realistic online tools. In FILS, for example, online computers have been imple- mented as help tools and simulation tasks for online banking with different levels of difficulty. The help tools have long been offered to the consumer for decision-making by financial institutions, consumer consumers or financial service providers.

They are intended to help him form opinions and to enable comparisons to be made between various interventions which he may not be able to make without this support. In 2010, for example, about 60% of customers were informed online about prices, products and possibilities for investment, pension or purchase decisions (Krotsch/Locher 2012) before making a decision on how to buy financial products. Therefore, the common definitions of financial literacy within the FILS study are extended by the service of such offers. In the course of increased individualization processes, increasing social risks and the growing responsibility to secure oneself financially (Schürz/Weber 2005), the authors believe that the ability to deal with media action, to use them and to assess the results is part of the requirements profile within today's financial literacy. In particular, the decision-making of decisions with a political impact and the weighing of risks must probably be regarded as a real competence. Confidence in financial service providers and their bids, as well as the individual assessment of rates, savings targets and pension levels, is ensured by the ability to properly use online calculators for their own information and provision. Therefore, this capability represents a new measurement dimension and a new subconstruct in a financial literacy. The online tools can be found in the different content contexts (see Figure 4) and are integrated into different role requirements and situations in the task formats.

**5 Measurement methods and results**

In order to check the measurement dimension, the entered values of the students are fixed and analyzed for possible typing in a first step. Furthermore, the online tools can be sorted according to their degree of difficulty, which ranges from simple savings rate calculators (with or without interest) to complex pension calculators. Specific incorrect entries can be uniquely identified from the values entered in the respective tools, which are listed in Figure 3.

The identification of errors allows conclusions to be drawn about the competence of the students in the handling of the offered tools. The inputs to the tools were encoded with 0 = False, 0.5 = Incorrect and 1 = Correct. Inputs that showed no clear relation to the task, e.g. individual missing inputs or individual false information, were encoded as incorrectly. A distinction is made here between false and invalid. Inputs are displayed as

invalidly identified when it is apparent that the students have entered numerical combinations in each field of the tool that make no sense. Incorrect operation occurs if the student has come to an incorrect result due to incorrect entries (see Figure 3: Typical errors).

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| **Typical errors** | **Cause** | **Example** |
| The wrong values from the text are used | task not understood; the text/offer, the wrong values were  Taken | Minimum price instead of purchase price |
| Incorrect numbers have been transferred to individual fields | Terms of fields (e.g. return) are not known or are associated with other terms. Whether the text probably indicates a return with the corresponding number, a  other value (e.g. salary) entered | Pension calculator maturities, return,  Deposit and withdrawal phase |
| Point and comma setting | Delimiters in the text are directly applied or characters are displayed.  Exchanged | 1,415  1,415 |
| Conversion error (years - months) | The text specifies years, months must be entered in the computer. However, years are exceeded or an incorrect number of monthly counts are calculated; in some ways, this can also be  read back. | 3 years are entered with 3 months and not with 36 months |

*Figure 3: Typical Errors*

The correlation of the individual tools with each other results in a significant correlation between the respective tools, taking into account their difficulty *level p*, the overall context and the task.

The correlations shown are highly significant at a level of 0.01 (two-sided). Exceptions are individual correlations between the online tools debt and insurreinsurance and taxes, as well as between wealth formation and debt.

The significant correlations allow the assumption that the obtained and encoded data of the individual online tools measure the same construct – operation of media action objects – in different content contexts, roles and situations. To confirm this presumption, the values of the power coefficients *rit* are considered in the context of a reliability test.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Content** | | **Debt** | | | **Wealth creation** | | | | **Insurance and taxes** |
| **Content** | Simulation work from the content context | Credit calculator (excluding interest) | Financing calculator | Credit calculator (with interest) | Savings rate calculator (Giro account) | Savings guess calculator (daily money  account) | Savings guess calculator (daily money  account) | Savings guess calculator (savings book) | Pension calculator |
| **Debt** | Credit calculator excluding interest) | 1 | ,296\*\* | ,117\* | ,225\*\* | ,110\* | ,141\*\* | ,091 | ,123\* |
| Financing calculator | ,296\*\* | 1 | ,202\*\* | ,359\*\* | ,244\*\* | ,323\*\* | ,135\*\* | ,232\*\* |
| Credit calculator (with interest) | ,117\* | ,202\*\* | 1 | ,244\*\* | ,160\*\* | ,202\*\* | ,119\* | ,199\*\* |
| **Wealth creation** | Savings rate calculator  (Giro account) | ,225\*\* | ,359\*\* | ,244\*\* | 1 | ,312\*\* | ,317\*\* | ,236\*\* | ,264\*\* |
| Savings rate calculator (daily money account) | ,110\* | ,244\*\* | ,160\*\* | ,312\*\* | 1 | ,483\*\* | ,313\*\* | ,470\*\* |
| Savings rate calculator (daily money account) | ,141\*\* | ,323\*\* | ,202\*\* | ,317\*\* | ,483\*\* | 1 | ,282\*\* | ,480\*\* |
| Savings rate calculator (savings book) | ,091 | ,135\*\* | ,119\* | ,236\*\* | ,313\*\* | ,282\*\* | 1 | ,294\*\* |
| **Insure and taxes** | Pension calculator | ,123\* | ,232\*\* | ,199\*\* | ,264\*\* | ,470\*\* | ,480\*\* | ,294\*\* | 1 |

\*\* The correlation is significant at the level of 0.01 (2-sided).

\* The correlation is significant at the level of 0.05 (2-sided).

*Figure 4: Correlation Matrix*

The reliability test for the online tools results in a Cronbach's alpha of ,726 with a population size of n = 376. The power coefficients *rit*(corrected item-scale correlation) are at an interval of ,252 to .550 and are thus in the middle range. The individual items thus represent the construct "Operation of an online computer" broadly (Bühner 2006, 98f.), which leads, among other things, to a high internal consistency and thus confirms that the items measure the same construct (Cortina 1993, 99f.).

From the results of the reliability analysis and the correlation matrix, the new Va- riable, which henceforth reconstitutes the subconstruct "Operation of online tools" can be calculated. After the incorrect, incorrect and correct input of the students was identified for each individual field of an online calculator, a total result could be drawn for each student and tool. The result is accessible from all inputs into the different fields of an online calculator and is also coded as rich, incorrect or incorrectly. Invalid information has been excluded. In order to give a total statement about all computers and for each student, a function of the final results of the individual online calculators was formed from the values, which moves between 0 and 1 and represents the average of the values as a function. On the basis of these values, the scale for the presentation of results is calculated (Baur/Fromm 2008, 100f.).

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*Figure 5: Expression of*

The calculation rule is:

with (Number of available online tools)

The scale is divided into four intervals, where the levels of the scale are described by four audible values: values between 0 and < 0.25 show a very low , between 0.25 and < 0.5 a small , between 0.5 and < 0.75 a mean - and in the range of 0.75 and 1.00 a very high . This classification enables pupils and specific groups (age, level, school form and gender) to be analysed in terms of the number of pupils.

Overall, about 60% of the students have an action value of 0.75 and are thus in the middle range of the scale. This value is surprising, as it shows that many students have problems using the online computers provided. Within the population, there are significant differences between the groups, which are due, among other things, to age. There is no significant difference in the relationship between gender and .

Between year 9 and 10, there is a significant difference in the ability to use online tools. The difference is 0.1 on the scale, representing an average power drop of 10%. The majority of the students are in the middle level. Only 14-year-olds can speak of a high level of competence (handling of online computers). The proportion of 14-year-old pupils refers to the type of grammar school which introduced G8.

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| --- | --- | --- | --- | --- | --- | --- |
|  | N | Mean  Ψ | Age | | | |
| 14 | 15 | 16 | 17 |
| High school | 215 | ,7256 | ,7917 | ,7465 | ,7034 | ,7094 |
| Secondary school | 104 | ,6743 | ,8125[[7]](#footnote-7) | ,6502 | ,7204 | ,7708[7](https://www.translatoruser.net/bvsandbox.aspx?&from=de&to=en&csId=eb8b8335-7f66-4116-a2e8-0c5c5c0c7d02&usId=05c6066c-f0c3-4a3c-bce6-893bc7d857a4&bvrpx=false&bvrpp=&dt=2020%2F7%2F8%2016%3A34#_bookmark0) |
| Vocational school | 57 | ,4287 | ------ | ,0313[7](https://www.translatoruser.net/bvsandbox.aspx?&from=de&to=en&csId=eb8b8335-7f66-4116-a2e8-0c5c5c0c7d02&usId=05c6066c-f0c3-4a3c-bce6-893bc7d857a4&bvrpx=false&bvrpp=&dt=2020%2F7%2F8%2016%3A34#_bookmark0) | ,4375 | ,4479 |
| Total | 376 | ,6664 | ------ | ------ | ------ | ------ |

*Figure 6: Relationship between school form and age*

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Overall, there is a significant correlation between the forms of schooling. In comparison, 15-year-olds in high school have a 10% higher pupil than their peers in secondary schools. The lowest values are recorded at the gym nasium for 16-year-olds and at the secondary school for 15-year-olds. Overall, there are no significant differences between school types among 16-year-olds.

An explanation for this development could be that in the 10th year of the grammar school many pupils have changed from other forms of school (introduction phase in NRW/G8) and the values are similar between these two types of school. While in grammar schools the values for 14 to 16-year-olds are decreasing and only among 17-year-olds are rising marginally, there is a difference of 0.7 between 15 and 16-year-olds at secondary school.

In the case of vocational schools, the total values remain below 0.5 in all classes of education, thus subjecting the falling values to the age in education 6. The relationship between the values of the values of the school and the motivation and the attitude towards money, in relation to school form and age, should be examined. This could be a possible explanation of these initial results.

**6 Conclusion**

Despite the many studies, the discussion about financial literacy is still in its infancy, as a uniform understanding of a valid survey is not yet foreseeable. Important products, such as the handling of online computers for their own information and risk prevention, have not yet been taken into account and can be used for the first time in FILS. The item analysis and the evaluations of the variable have shown that the collection of action-based data is necessary and further in order to capture financial literacy in all facets.

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1. See the following Macha/Shoes 2011a and 2011b classifications [↑](#footnote-ref-1)
2. The available information on the study does not allow for a clear statement. [↑](#footnote-ref-2)
3. The dimension is recognizable in beginnings. [↑](#footnote-ref-3)
4. <http://ideas.repec.org/>The search query yielded 107 titles for financial literacy survey, 46 titles for fi- nancial capability survey, 12 titles for financial competence survey. [↑](#footnote-ref-4)
5. see <http://hrsonline.isr.umich.edu/> [↑](#footnote-ref-5)
6. <http://ideas.repec.org/>The search search yielded 24 titles for Lusardi, financial, survey (2008-2012) [↑](#footnote-ref-6)
7. Sample size in this age group too small for significant statement () [↑](#footnote-ref-7)