

Financial Literacy, Environmental Literacy, and Environmental Related Financial Preference

The Case of China

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Abstract

This paper describes a survey of a sample of Chinese individuals regarding their financial literacy, environmental literacy, attitudes toward ESG, and environmentally related financial preference to investigate if pro-investment attitudes are related to financial decision-making. The data revealed that individuals with higher financial knowledge (FL) also have higher environmental knowledge (EL) and the effect is stronger among consumers who incorporate sustainability factors into their investment selection. Moreover, there is a large gender gap in financial and environmental literacy in China. Male respondents have higher FL and are more likely to participate in the stock market, while females have higher EL and stronger environmental beliefs. This results from different levels of financial and environmental engagement and females' lack of confidence. By segmenting respondents into three groups according to their preferred position on the ESG-efficient frontier, it is found that people with stronger environmental beliefs reflect their preference in their financial decision-making, and gender enhances the relationship. Regarding market participation, the opposite effect was found. Female investors have a clear preference for sustainable investing, but they fail to act on it by actively engaging with the market. Furthermore, the results show that financially literate investors are less likely to hold green investments and that some people hold green investments for purely non-peculiar reasons.

Keywords:

Behavioural Finance, Financial Literacy, Environmental Literacy, ESG-Investing

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1. Introduction

With continuing financial liberation, individuals obtain more knowledge about the financial market and more opportunities to participate in it. Consumers also often face situations that require them to have a basic level of financial and economic knowledge on a daily basis. On the other hand, the sophistication of financial products including mortgages, loans, credit cards, etc. has increased dramatically during the past few decades (Lusardi, 2015). To make sound investment decisions, it is essential for retail investors to have substantial financial literacy (Lusardi, 2012). Selim et al. (2014) suggest that many people are financially illiterate, which raises questions about their ability to make financial decisions that can optimize their use of financial resources.

Next to traditional financial products, environmental, social, and governance (ESG) investing, also known as sustainable investing or socially responsible investing is a relatively new financial product, which has garnered a lot of attention in the finance industry. Several international initiatives have used finance to promote the development of green markets by developing a substantial amount of green financial products. As a result, investments based on ESG criteria have expanded significantly in global capital markets during the last few decades. Socially responsible investing is moving away from being a niche and is becoming more popular in global financial markets (Yan et al., 2019).¹ According to Qiu (2021), the global ESG asset scale is about 4 trillion US dollars, and it accounts for 33% of investor portfolios on average. At the same time, it accounts for nearly 50% of the European Union, indicating that half of the European investor portfolios are ESG financial products, including ESG ETFs, ESG public funds, etc.

Although governments support the creation and introduction of green investment products through subsidies and funding, little has been done to encourage the demand side of this market. While the proportion of institutional investors in ESG investment remains high, the proportion of retail investors has increased over the years. According to Eurosif,² in 2005, the proportion of institutions and individuals in Europe was 94% and 6%, respectively, and in

¹ For more information about ESG investments in China please look up Appendix A

² Eurosif report 2021 <https://www.eurosif.org/wp-content/uploads/2021/10/European-SRI-2018-Study.pdf>

2018 it was 69% and 31%. Unlike institutional investors, retail investors also receive less attention from researchers.

For this reason, this paper investigates the environmental and financial literacy of Chinese consumers, as well as their environmentally related financial decision preferences. It identifies specific characteristics, most notably gender, of the people most likely to participate in the market, to use sustainability measures for selecting stocks. The paper also investigates what behavior people with stronger environmental values absorb regarding their financial decision preference.

This paper analyses a survey of 400 respondents from China and provides insights into their characteristics and behavior that can be used to make generalized conclusions about Chinese consumers. The survey found a strong gender gap, with male respondents having higher financial literacy and lower environmental literacy than females. This effect remains persistent when controlling for different factors such as education, age and experience with business-related topics. Moreover, males tend to be more active on the stock market and, thus, have more experience with financial decisions. While Anderson & Robinson (2021) showed that people with higher environmental literacy are less interested in financial matters and in actively managing stocks, this paper found that environmental literacy does not play a significant role in stock market participation and even slightly correlates with it. The survey also found that despite higher environmental literacy, women do not participate actively in investing as much as men do and have lower financial literacy. Female participants hold stronger environmental beliefs but have lower confidence in both their financial and environmental knowledge. This could explain why men are more active on the stock market and more general, why sustainable investing in China is lagging many other countries. From the conducted regressions, one can conclude that like the connection for males between financial literacy and active financial involvement, females have higher environmental literacy, which stems from them holding stronger environmental values.

1.1 The ESG-Efficiency Frontier

Traditional financial theory may not be applicable to ESG investing. Pedersen et al. (2021) have developed the ESG-efficient frontier model that is distinguished from the traditional risk-return model. Investors only need to consider the trade-off between risk and return to

achieve an optimized Sharpe ratio. However, under Pedersen et al. (2021)'s model, investors make trade-offs in a three-dimensional model between risk, return, and ESG performance. Without mutual financial theory as guidance, retail investors face huge challenges and difficulties in making ESG investing decisions.

This paper adopts a variation of the framework, as described in Pedersen et al. (2021). Their paper defines the ESG-efficient frontier, which shows the highest attainable Sharpe ratio in each of the ESG levels. In the framework, investors are identified into three types: Type-U (ESG-unaware) investors who seek to maximize their unconditional mean-variance utility without knowing that ESG factors could affect the risk and expected return of their investments. In contrast to Type-U investors, Type-A (ESG-aware) are aware that ESG factors could affect their risk and expected return and seek to optimize the trade-off between return and sustainability. Type-M (ESG-motivated) investors are not only aware of ESG factors but actively seek to integrate a lower Sharpe ratio at the cost of higher ESG scores in portfolios. They have a target portfolio that is to the right of the tangency portfolio but with higher ESG score. That is, the respondents have to be aware that ESG factors could affect their risk and expected return first, then seek an optimized utility trade-off between the Sharpe ratio and ESG in their portfolio, as described by Pederson et al. (2022).

Based on the results with a very large portion of people who own stocks, the paper reached the conclusion that the survey captures ESG-Aware respondents who are more affluent and skilled individuals and who seek to incorporate sustainability metrics in their investing practices. By conducting two multi-regression models, using scores on the financial literacy and the environmental literacy questions as dependent variables, this paper found that stock ownership consistently correlates with financial literacy regardless of the group type. Moreover, the gender gap in FL narrows when looking at type-A consumers and the EL of the two genders widens. The survey found that ESG-Aware respondents perceive firms that publish their effect on the environment to be better. Respondents from this group are also ready to give up returns. ESG-Aware respondents and particularly female ones rely more on sustainability as a criterion for valuing stocks and pay more for green stocks. A limitation of this study is the small number of ESG-Motivated people which does not allow for a meaningful analysis of this group.

By using empirical approaches this paper answers the question: What is the relationship between Chinese investors' financial and environmental literacy? What factors are affecting the financial and environmental literacy of Chinese investors? And do Chinese investors reflect their environmental beliefs in their financial decision-making?

2. Related Literature

This paper is built on top of two sets of literature: literature on the financial literacy of retail investors and literature on ESG investing. A comprehensive review of this literature will be provided in this section.

Financial literacy has proven to be a very important factor in societal development. Multiple studies have proven that financial literacy affects behavior (Lusardi & Mitchell 2014). One simple example is that financially literate people tend to save money when their income is high and use those when it decreases (e.g., after retirement). Financial literacy allows individuals to assess a situation from a financial perspective and make a decision in their best interest. As a fundamental starting point for the described research, the following definition of financial literacy, as provided by the Organization for Economic Co-operation and Development (OECD) is used. Financial literacy is defined as a combination of awareness, knowledge, skill, attitude, and behavior necessary to make sound financial decisions and ultimately achieve individual financial well-being.

In the last decade, research has started to connect financial literacy with sustainable finance and knowledge of a person about the environment. Décamps et al. (2017) have very well-defined sustainability literacy as the knowledge, skills, and mindsets that help compel an individual to become deeply committed to building a sustainable future and allow him or her to make informed and effective decisions to this end. The paper of Luo & Chang (2022) examined the relationship between financial literacy and environmental sustainability in China's SMEs (small and medium enterprises). It shows that higher financial literacy enables easier money management and access to funding. This boosts innovation and, as a result, environmental sustainability. Moreover, investors today increasingly include ESG information as part of their analysis and depending on their level of preference for sustainability have a tangency portfolio with a higher Sharpe ratio and an efficient frontier to the right of the tangency portfolio (Pederson, et al. 2021). This leads to the conclusion that green financial

products require a good understanding of both financial aspects and environmental ones. To be a financially literate investor today, one must also have a good degree of environmental literacy.

According to Qiu (2021), ESG investment is highly related to the specific ESG issues of the observed company, for example, environmental protection and corporate governance. Such issues prolong the time a company takes to make improvements. At the same time, retail investors tend to hold short-term investments, which implies that ESG investments may not be suited to retail investors, especially in a less mature market. ESG investment decisions also require knowledge about ESG-related concepts such as environmental knowledge, how the ESG system is established and promoted by the company, and how to evaluate the company's ESG performance through ESG indicators. Those are all barriers to retail investors making sound ESG investment decisions.

Another argument behind the reasoning that financial and environmental literacy go hand in hand is the increasing popularity of sustainable investing and its effect on company stock performance. Sustainable investing in China is still in its infancy, in other words, there is an asymmetry of information that implies a potential alpha for investors when those take ESG into account. Saci, Jasimuddin & Hasan (2022) looked into the performance of 64 social responsibility investing funds (SRI funds) and 64 traditional funds in the Chinese stock market. While they found that SRI funds do not outperform traditional ones (nor do they underperform them either), sustainable funds are less risky. Moreover, their study revealed that SRI funds are associated with a positive indicator for performance and are becoming an increasingly more important risk factor when screening investment opportunities. Lastly, social responsibility has a significant positive impact on the total fund's return in China. All this leads to the conclusion that understanding the ESG aspects of a company can create better risk-adjusted returns and is, therefore, important knowledge a financially literate consumer in China should have.

A paper by He & Ahunov (2022) has implemented the Big-3 questions developed by Lusardi and gathered more than 27,000 responses. Their research shows that financial literacy in China, as in most centrally planned economies, is low. At the same time, Chinese participants are aware of their lack of financial literacy, something that can make educational programs in this area more successful. This paper shows that younger people are also more

literate – an inverse relationship when compared with developed Western economies like the US. The paper by Yana & Muzzafarjon finds that, while inflation and interest-related financial literacy in China are lower than in high-income economies, risk-related financial literacy is on the same comparative level.

To the best of our knowledge, little research has been conducted on the behavior of retail investors towards environmental financial products. Retail investors are more easily influenced by market movements. They tend to sell their assets when the market drops and buy when it is expensive (Nofsinger 2022). Retail investors also increase stock volatility, adding additional risk without increasing the stock's fundamental value (Foucault et al. 2011). Investors with higher environmental considerations are shown to be less considerate about their finances and to be on average 10% less likely to hold stock. (Anderson & Robinson 2021). Louche & Hebb (2014) state in their paper that socially responsible investors must perceive a product as both financially profitable and environmentally positive to consider investing. An obstacle to this is the current structure of the market and the lack of a clear definition of what quantifies as a sustainable investment. This prevents many investors from accurately evaluating the sustainability quality of a product (Friede, 2019). To simplify the decision-making process of investors regarding socially responsible investing, various forms of labelling profiling mutual funds have been introduced (Hauff 2022). While this certainly helps, investors must have a certain degree of environmental knowledge to adequately evaluate such labelling and actively seek ESG-positive investments.

Heeb et al. (2022) investigate the relationship between consumers' willingness to pay and the environmental impact of the purchased good. According to their research, consumers would pay higher for environmentally sustainable goods, but the actual impact of the goods on the environment (e.g., it saves 1 ton of CO₂ emissions vs. 10 tons of CO₂) is not considered. Their research further finds that this insensitivity applies also to consumers with a large experience in impact investing. A possible critique towards Heeb et al. (2022) is that they missed controlling the impact of environmental literacy and, therefore, this paper investigates the relationship between literacy and financial preference behaviour further.

A paper by Bethlendi, Nagy & Pora (2022) has developed a framework to analyse the underlying factors that define the demand for green products. According to their paper, there is a clear flow from knowledge to attitude and from behaviour attitude. First, by combining a

person's financial and environmental knowledge and attitude, a person's green demand can be defined. This is further influenced by socio-demographic factors and personal economic preferences and needs. One of the main hypotheses in their paper is that consumers are not homogenous and that groups of consumers can be distinguished based on socio-demographic, financial and environmental knowledge, and financial and environmental attitude factors. According to Peattie (2001), consumers react positively to environmentally sustainable products in their day-to-day life but will not necessarily prefer those because they have different characteristics. Consumers will not choose green products when those are of inferior quality or a higher price. On the other hand, knowledge about sustainable financial products has a highly significant impact on financial decisions (Filippini et al., 2021).

Chen et al. (2020) further connect financial and sustainable financial education with increased life satisfaction. Especially people with good education who actively seek ways to increase their knowledge in sustainable finance and manage to increase the quality of their life. The findings of this and the previously mentioned studies lead to the conclusion that consumers who have good financial and environmental literacy must be prone to make prosocial investments to increase their utility.

Gutsche, Nakai and Arimura (2021) have conducted case research on the determinants of individual sustainable investments in Japan. Their paper suggests that country and cultural differences play a significant role in determining the financial behaviour of investors. Unlike in Western countries, financial literacy is negatively correlated with sustainable investing and non-financial factors such as attitudes, values and beliefs do not have an impact on sustainable financial behaviour in the Japanese market. In the case of China, also one of the most polluting countries worldwide, the country faces significant challenges in solving its environmental problems. One factor that can reduce pollution is environmental literacy, which, like financial literacy, is increasing among younger people. While people of all ages show a high appreciation of nature, people of higher age tend to have more inaccurate knowledge but, at the same time, to be more concerned about the environment (Clayton et al., 2019).

Anderson and Robinson (2021) investigate consumers' behaviour by splitting households into two parts according to their green preferences. Døskeland & Pedersen (2016) have conducted a study to investigate how wealth and moral concerns influence an individual

investor's decision to invest responsibly. They designed a framework where they show investors information about a product from a financial perspective and a moral one. The ones who are shown the financials are more likely to further research and consider the "greenness" of this product than the investors who receive an informational framework with an emphasis on the moral aspect of this product. The writers also make the argument that people view responsible investments as a way to improve their prosocial status and lifestyle.

Pedersen et al. (2021) investigate how the preferences of the three types of investors determine the optimal portfolio for each group using the CAPM. Their paper has proven that investors' risk preference and Sharpe ratio also depend on their view about sustainability. Furthermore, they make the point that if the economy has a lot of investors who prioritize ESG factors when selecting stocks, a good ESG rating will deliver lower returns because investors are willing to accept those. An economy dominated by investors who seek to maximize the trade-off between returns and sustainability will lead to ESG rating being fully priced in. An economy with investors who disregard sustainability factors altogether will enable investors to profit by looking into those and gain access to additional information about a company's performance.

The approach in this study, similar to the frameworks described above, investigates Chinese consumers' traits that influence environmentally-related financial behaviour and then what is their actual environmentally-related financial behaviour. To capture the degree to which an individual's personal values are oriented towards the environment, the research approach in this study follows Anderson and Robinson (2021) and the survey investigates to what degree the participants are willing to accept financial trade-offs for better environmental conditions. Heeb et al. (2022) have similar findings that investors try to optimize the impact of their financial behaviour but, at the same time, prioritise financial performance.

Bethlendi et al. (2022) also state in their paper that financial and environmental knowledge are positively correlated and that financial knowledge is positively linked with financial attitude. The same relationship applies to green knowledge and green attitude. While Anderson & Robinson (2021) found that households with strong environmental attitudes do not have a high interest in financial matters, Bethlendi et al. (2022) discovered

the opposite relationship. To test this in the context of China, this study follows the methodology as described below.

3. Empirical Design

In this section, the control variables used in this paper will be introduced and discussed. The procedure of survey distribution and data collection will also be provided. Lastly, the summary statistics are conducted and discussed in this section.

The analysis is based on a survey with 400 respondents. The full version of the survey is in Appendix B. Initially, a random sample of 900 Chinese individuals were invited to take part in this survey through an online platform. After a testing questionnaire and then the final version of the survey, the survey was closed on January 25, 2023. A total of 400 observation was collected at the end. Appendix C shows the details of the data collection procedure.

3.1 Survey

The survey includes five sections: Section one contains questions about the basic characteristics of the respondents, which entail the control variables of the study. Section two includes five questions that test respondents' financial literacy. Section three includes five questions that test respondents' environmental literacy. Section four includes six questions about respondents' pro-environmental beliefs. Section five includes six questions about respondents' environmentally related financial preferences.

3.1.1 Control Variables

Following Lusardi & Mitchell (2014) and Anderson & Robinson (2021), this paper uses similar control variables.⁶ The control variables for financial and environmental literacy are the same as those used in Lusardi & Mitchell (2014) and Anderson & Robinson (2021), because of rather scarce research on environmental literacy.

According to the papers mentioned above, younger and older people are more financially illiterate compared to middle-aged ones. This result is surprising for older people, since they have made multiple financial decisions in their life and have lived through many different financial and economic conditions. Anderson & Robinson (2021)

~~divide age into five~~—————

⁶ A summary of all the control variables is provided in appendix D.

groups where the first one accounts for people between 18 and 24 and the next ones are 10 apart until 65. This paper divides participants among six age groups which include people younger than 18 and older than 65 as well. The purpose of this is to capture more younger people whose behaviour can be compared with Anderson & Robinson (2021)

Research in many different countries has shown that there are differences regarding sex as well. Regardless of age, men have a higher financial literacy irrespective of the sophistication of the questions asked. Women, on the other hand, tend to have a better evaluation of their knowledge. They would answer more often “Don’t know” than men would. Controlling for gender is done similarly to most other papers on this topic.

Scientific studies have also found differences in financial knowledge by education. Unlike Anderson & Robinson (2021), the conducted survey differentiates people not only by the level of education in terms of High School and University but also by different levels of university education such as Bachelor’s, Master’s and Specialised school. The purpose of this is to get a more detailed overview of the educational level of the participants. It is expected that Master students will have better financial or environmental knowledge than Bachelor students, for example. Moreover, people without any college education are much less likely to deal well with numerical or financial questions.

Lusardi & Mitchell (2014) suggest living in a densely populated area could lead to higher financial literacy owing to a higher chance of interacting with financially literate people. This study also has a question about whether the surveyed live in an urban or rural region

Market participation is also positively correlated with financial literacy. Financially literate people tend to apply their knowledge to day-to-day financial management and investing. Therefore, stock ownership is included as a control variable. The proxy for stock participation is a standard one following Anderson & Robinson (2021) and Lusardi & Mitchell (2014).

Another important control variable to mention is ethnicity. For example, in the US African Americans and Hispanics are associated with the lowest financial literacy. The analysed survey is conducted focusing on the Chinese consumer, therefore there is no control variable for ethnicity.

3.1.2 The “Big Five” Financial Literacy Questions

To test financial literacy, this paper focuses on the Big-5 financial literacy test, first developed by Lusardi and Mitchell (2007). An important advantage of this test is that it includes a global comparison (Lusardi, 2019). The set of questions tests respondents’ financial knowledge in five aspects: Knowledge in compounding, knowledge in inflation, knowledge in diversification, knowledge in long-term saving, and knowledge in bond pricing.

- **Compounding:** Suppose you had \$100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
- **Inflation:** Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?
- **Diversification:** Buying a single company’s stock usually provides a safer return than a stock mutual fund.
- **Long-Term Saving:** If you get a gift of \$10,000 and you want to double the amount by saving the money for ten years without touching it. What interest rate do you need to achieve this goal?
- **Bond Pricing:** If interest rates fall, what should happen to bond prices?

Each question contains several options, where only one of the options is correct. Respondents can also choose “Don’t know” or “Prefer not to say” if they do not know the answer or prefer not to answer the question.

3.1.3 The Environmental Literacy Questions

The literature on measuring environmental literacy is scarce. While the most accurate way to test environmental literacy would be to use the Sustainability Test developed by the UN, for the purpose of practicality and feasibility this survey uses the Big-5 environmental literacy test introduced by Anderson and Robinson (2021). Adjustment to their test is added, following a proposed framework for assessing environmental literacy developed by the North American Association for Environmental Education (NAAEE). The questions in this study test

the competency of the participants regarding identifying and analysing environmental issues as well as justifying actions that address the environmental issue.

- A low-energy (CFL or LED) lightbulb costs more than a regular lightbulb but uses less energy. About how long does one last?
- The ozone layer filters what harmful substances?
- Which of the following statements is correct: Global warming will make some places wetter and others drier; Any recent global warming has been caused by the sun; Earth is actually cooling, not warming; Earth's climate has also warmed in the past, so humans are not the cause of global warming.
- Why don't polar bears eat penguins?
- On average, how long does carbon dioxide stay in the atmosphere once it has been emitted?

Each question contains several options, only one of the options is correct, respondents can also choose "Don't know" or "Prefer not to say" if they do not know the answer or prefer not to answer the question.

3.1.4 Environmental Attitude Questions

To better understand how consumers reflect their environmental attitudes in their financial decision-making, it is essential to empirically identify respondents with pro-environmental beliefs. The conducted survey in this paper uses three environmental value questions to categorize respondents according to their beliefs and attitude towards the environment and environmentally related financial decisions following Anderson and Robinson (2021). A more precise description of the methodology is added in section 4.1 and shown in flow chart I.

The first two questions aim to identify respondents who would include ESG factors in their return-risk consideration for a purely pecuniary reason by asking if they agree that green investments would outperform other types of investments and if they are willing to pay a higher fee for investing in green financial products. By looking at the cost and return aspects of an investment, those two questions best serve to identify whether a consumer would

sacrifice financial gains for sustainability, in other words, to identify ESG-Aware consumers. It was also considered to include a question capturing risk, but distinguishing between general financial risk preference and one tied to sustainability would add too much complexity and fail to deliver a clear result. Therefore, we followed Anderson & Robinson (2021).

- **Higher return:** I believe environmentally sustainable investments generate a higher return in the long term.
- **Higher cost:** I am willing to pay higher fees for mutual funds that only make environmentally sustainable investments.

The third question tests if the respondent is willing to give up their financial welfare for a better environmental condition. This is a proxy to find out whether the pro-ESG investment decision is made because of a non-pecuniary reason. Following Anderson & Robinson (2021), the paper uses the same question to segment ESG-Motivated (or Type-M) consumers. As mentioned earlier, type-M consumers are segmented from type-A based on this question and the “higher return” and “higher cost” ones. To best explain financial decision preference, type-M consumers are defined as people seeking to incorporate sustainability factors in their financial behaviour (“higher cost” and “higher return” questions), but at the same time, actively focusing on the sustainability side of financial decision (“clean planet”).

- **Clean planet:** A clean planet is more important to me than financial welfare.

To capture respondents’ environmental attitudes in a more general sense, three additional questions have been developed:

- **Global warming:** How worried are you about global warming?
- **Human activity:** I believe human activity is the primary factor for global warming today.
- **Recycle more:** I recycle a great deal more than my neighbours.

“Global warming” and “Human activity” capture the general environmental belief of the respondents. The first question tests if the respondent believes that global warming is a situation that needed to be paid attention to. The second question aims to see if the respondent thinks that human behaviour could make positive environmental changes. The last question captures whether the respondents reflect their environmental beliefs in their

behaviour. Participants are asked to select a number from 1 (Strongly disagree) to 5 (Strongly agree).

3.1.4.1 The ESG-Efficiency Frontier

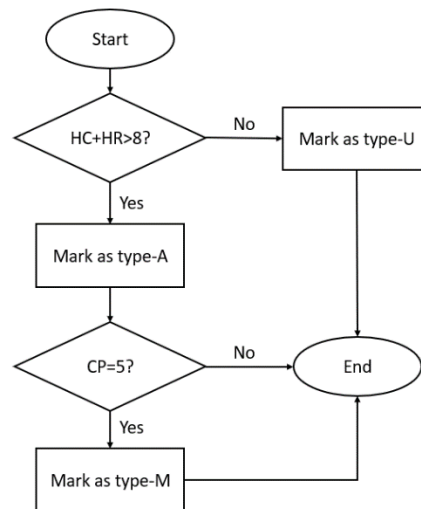
Given the time frame of this paper, it would be infeasible to look at the exact portfolios of respondents, in the same way, Pedersen et al. (2021) and Anderson & Robinson (2021) did. Therefore, a more general segmentation based on beliefs regarding sustainable investments and the relationship between financial welfare and SRI is adopted. As Anderson & Robinson (2021) point out, their values and beliefs are direct guiding principles for specific behaviour. To capture the degree of environmental orientation and its connection with returns, the survey in this paper asked respondents three questions titled as “higher return”, “higher cost” and “clean planet”. This helps to narrow down the problem and categorize the sample into groups to see how each investor type reflects its environmental beliefs in its financial preference. The conducted survey in this paper defines questions about the beliefs of respondents towards sustainable investments as proxies for consumer behaviour.

Flow Chart I. gives an overview of how each respondent is segmented into one of the three groups: ESG-Unaware, ESG-Aware and ESG-Motivated. Each response to the “higher cost”, “higher return” and “clean planet” is given a score from 1 (strongly disagree) to 5 (strongly agree). If the summed-up scores to the “higher cost” and “higher return” questions are above 8 a respondent is flagged as type-A. If he also received 5 on the “clean planet” question as well, the respondent is considered type M. In this way all respondents are segmented into the three main groups.

As in Anderson & Robinson (2021), the “higher cost” and “higher return” questions serve to segment people who show pro-environmental beliefs and whose reasons for investing are still pecuniary and aim to deliver returns. Those questions identify investors (also called ESG-Aware or Type-A respondents) who would incorporate sustainability factors in their investment selection. As in Anderson & Robinson (2021), the results of the “higher cost” and “higher return” questions are summed to allow for a more general ESG preference. It is necessary to take into account “higher cost” and “higher return” questions together in order to assess that respondents do not choose sustainable investments only to get a higher return or only to have green stocks in their portfolio, but rather those are people who still

maximise the performance of their portfolio by leveraging sustainability. After several attempts to filter the data, it was decided to filter any respondent who ticked strongly agree (equals 5) on at least one of the two questions and 4 on the other, otherwise said the sum equals 9 or 10. Segmenting people who strongly agree on both questions (the sum equals 10) results in a very small sample for ESG-Aware and anything below 9 – does not allow for meaningful segmentation based on environmental beliefs. Once, the appropriate sample was divided, ESG-Motivated investors are filtered from that set with the “clean planet” question. This question identifies people who acknowledge ESG information and incorporate sustainability criteria like type-A, but type-M respondents (who strongly agree to “clean planet”) make financial decision also driven by non-pecuniary reasons and prioritise sustainability over returns. Due to a relatively small sample size of 64 respondents for the ESG-motivated group, the focus of this paper is on financial behavioural differences regarding the unaware and aware groups. The motivated group is excluded from the regression analysis.

Flow Chart I. Segmentation process of each response



HC or Higher cost: “I am willing to pay higher fees for mutual funds that only make environmentally sustainable investments.” HR or Higher return: “I believe environmentally sustainable investments generate a higher return in the long term.” CP or Clean planet: “A clean planet is more important to me than financial welfare.” Each answer to those questions is given a number from 1 to 5, where 1 corresponds to “strongly disagree” and 5 to “strongly agree”. Based on those scores the respondents are segmented into three groups. Type-U, type-A and type-M corresponds to the three definitions of ESG-Unaware, ESG-Aware and ESG-Motivated according to the definitions described in the introduction of this paper.

3.1.5 Environmentally Related Financial Preference Questions

The section named “Environmentally Related Financial Preference” in the survey aims to define the investment preferences of the respondents. The section includes six questions, which are used as dependent variables in the regression model described below. The

questions are divided further into three sub-sections. Each section contains two questions and serves different purposes.

Section one:

- **Perceived better:** I perceive a firm to be better if they publish the effect of its operations on the environment.
- **Criteria:** I use environmental sustainability as one of the primary criteria when making investment decisions.

Section two:

- **Lower returns:** I would give up returns from investing if the securities are more environmentally friendly.
- **Pay higher:** I am willing to pay more for environmentally friendly products.

Section three:

- **Record spending:** I always keep track of my expenses.
- **Save:** I try to save as much money as possible.

The first sub-section captures respondents' preferences in selecting an investment. The questions "perceived better" and "criteria" determine a person's preference when selecting an investment. The second sub-section related more directly to respondents' perceived returns and risks. The questions "lower returns" and "pay higher" are proxies for determining a person's trade-off between returns and sustainability. The third sub-section captures the more general financial preference of the respondents. The questions "record spending" and "save" are proxies for establishing a respondent's financial behaviour without considering sustainability factors. Respondents are asked to select a number from 1 (Strongly disagree) to 5 (Strongly agree).

3.2 Data Statistics

Tables I a and b (see below) provide the summary statistics of the average test scores and sample proportions of the key survey questions. It also includes population data of the demographic variables.

The population data is obtained from China's seventh population census generated by the National Bureau of Statistics of China⁷. By comparing the gathered sample data to the overall Chinese population, it becomes apparent that the survey has an overrepresentation of females, in the working-age population (98% of the respondents are from 19-60, where only 62% of the population falls into this group), of people who went to university (15% in the population compared with 80% in the sample data), and of the urban population.

Table Ia shows the proportion of respondents who answered strongly agree (5 out of 5) to the 6 environmental beliefs questions. Moreover, the next rows provide segmented information of those respondents based on their gender, age, educational level, whether their studied subjects relate to business or environment and whether they live in an urban area.

The data shows a small discrepancy between male and female participants who are very worried about global warming and those who believe that it is mainly caused by human activity. It seems that an equal portion of males and females in China is very worried about global warming (score 5), but a higher portion of females agree that human activity is a main factor for it. A comparison between peoples' view on global warming from other countries and our data, suggests that 37%, of Chinese people consider global warming as a top environmental priority to a lesser degree. A report published by Ipsos in 2019 shows that the 3 top countries are Japan, Spain and Germany, each with 52%, 51% and 50% respectively.

Table Ia shows that a higher portion of women than men that strongly agree to the questions "clean planet" and "high cost". At the same time, a higher portion of men than women strongly agree with the recycling question. This comes somewhat in contradiction with scientific literature in the West. For example, McCright & Mayer (2009) have discovered through a study in the USA that women both hold stronger environmental beliefs and engage to a higher degree in pro-environmental behaviour. Zhao et al. (2021) also found similar differences in pro-environmental behaviour in China between genders and suggest that such differences are much more subject to culture and contextual factors. This connection between genders will be investigated later in greater detail.

Generally, a smaller percentage of graduates than undergraduates hold very strong pro-environmental beliefs. This could be explained by the fact that graduates are more career

⁷ http://www.stats.gov.cn/ztjc/zdtjgz/zgrkpc/dqcrkpc/ggl/202105/t20210519_1817693.html

driven. In any case, the data is aligned with scientific literature, which states that people with a university degree have stronger pro-environmental beliefs. Further in this study, multivariate regression models will test if this is true as well.

Table 1b shows the proportion of respondents who strongly agree (choose 5) to the environment-related financial preference and their average score in financial and environmental literacy.

He & Ahunov (2022) have thoroughly investigated financial literacy in China and compared it to other countries. According to a survey conducted in 2015, the Chinese population has increased its financial literacy compared to 2013 but, as previously mentioned, is still significantly lagging behind other countries with only 6% of the respondents in their paper answering all of the Big-3 questions correctly. Even though the survey in this paper uses the extended version of the Big-3 questions by adding 2 more questions according to Lusardi & Mitchell (2007), the result of 10.25% of respondents answering all 5 questions correctly suggests that financial literacy in China is improving steadily but slowly. In comparison, countries in the West like Germany or the US or Sweden score much higher in financial literacy. 53.2%, 30.2% and 21.4% respectively answered all Big-3 questions correctly.

It should be noted that those results are rather old and newer studies have found different scores which are nevertheless much higher than in China. Nicolini & Haupt (2019) have tested different frameworks including the Lusardi-Mitchell Big-5 to better understand financial literacy. According to their findings, the Nordic countries have the highest scores in Europe. By developing different frameworks to measure financial literacy, it turns out that results vary from country to country. For example, Lusardi & Mitchell (2007) showed much higher results in Germany compared to the FL-unbiased framework.

Another study by Pasa et al. (2022) found that financial literacy positively correlates with GDP growth and is significantly lower in poorer countries. Their study stated that Bulgaria, Croatia and Romania have lower FL scores than their Western counterparts, but higher than non-EU countries such as Georgia, Moldova and Montenegro. Given that China is still a developing economy and like the ones investigated in this study, used to be centrally governed, one can easily understand why China scores lower on FL and that there is much to be done regarding financial education in the country.

He & Ahunov (2022) also found a gender gap that significantly increased in 2015 compared to 2013. Looking back at table I.b, one can see consistency with what He & Ahunov discovered. Female respondents score on average lower than male ones in financial literacy (3.11 vs. 3.58).

Table Ib also shows that the highest proportion on average of people who strongly agree to the different environment-related financial preferences are between 36 and 60 years old. This is aligned with reports such as the “2020 US Sustainable Investing Trends” report by the US SIF Foundation and “2020 Schroders Global Investor Study”. Those reports found that people between 30 and 50 are most likely to be interested in sustainable investing.

Table I.a. Sample Characteristics (Environmental Belief)

	Proportions		Environmental Belief					
	Sample	Pop.	Global warming	Human	Recycle	Clean planet	High cost	High return
Overall	1.00	1.00	0.37	0.39	0.28	0.25	0.25	0.41
Gender								
Men	0.47	0.51	0.36	0.33	0.31	0.20	0.19	0.41
Women	0.53	0.49	0.38	0.45	0.25	0.30	0.29	0.41
Age								
0-18	0.02	0.20	0.29	0.00	0.14	0.00	0.29	0.14
19-25	0.28		0.24	0.44	0.14	0.16	0.22	0.30
26-35	0.42	0.62	0.40	0.39	0.34	0.33	0.27	0.43
36-45	0.18		0.43	0.38	0.33	0.23	0.29	0.52
46-60	0.10		0.50	0.40	0.34	0.29	0.11	0.53
60 and above	0.00	0.19	1.00	0.00	0.00	0.00	0.00	0.00
Edu								
Some school	0.02	-	0.38	0.13	0.25	0.25	0.00	0.50
High school	0.07	-	0.37	0.48	0.22	0.22	0.22	0.30
Specialized school	0.11	-	0.49	0.49	0.33	0.37	0.16	0.54
Undergraduate	0.57		0.39	0.38	0.31	0.26	0.30	0.40
Graduate	0.20	0.15	0.25	0.37	0.17	0.20	0.16	0.37
PhD	0.03		0.46	0.39	0.39	0.15	0.23	0.69
Subjects								
Studied Env/Bio	0.44	-	0.43	0.42	0.31	0.33	0.25	0.49
Studied Econ/Bus	0.43	-	0.40	0.47	0.31	0.31	0.25	0.51
City								
Urban	0.90	0.64	0.39	0.39	0.30	0.26	0.26	0.43
Rural	0.10	0.36	0.26	0.41	0.12	0.19	0.12	0.24

Table I.a and Table I.b report summary statistics, average test scores and sample proportions of the key survey questions. The first column shows the proportions of the samples. Columns labelled "Environmental Belief" show the proportions of respondents that strongly agree with, believe in, or strongly show preference in the statements and questions: "How worried are you about global warming? (Global Warming)", "I believe human activity is the primary factor for global warming today (Human)", "I recycle a great deal more than my neighbours (Recycle)", "A clean planet is more important to me than financial welfare (Clean planet)", "I am willing to pay more for environmentally friendly products (High cost)", "I believe environmentally sustainable investments generate a higher return in the long term (High return)", all the questions are scored from 1 to 5. There are in total of 400 respondents in the sample.

Table I.b. Sample Characteristics (Environmental Related Financial Preference & Literacy & Stock)

	Environment Related Financial Preference						Literacy			Own Stock
	Proportions Sample	Perceived better	Criteria	Lower Return	Pay higher	Record spends	Save	FL	EL	
Overall	1.00	0.39	0.34	0.25	0.30	0.26	0.24	3.33	3.38	0.68
Gender										
Men	0.47	0.36	0.28	0.25	0.26	0.31	0.26	3.58	3.23	0.77
Women	0.53	0.41	0.39	0.24	0.32	0.21	0.22	3.11	3.51	0.61
Age										
0-18	0.02	0.29	0.29	0.00	0.14	0.00	0.00	2.00	2.29	0.29
19-25	0.28	0.37	0.25	0.22	0.21	0.23	0.21	3.25	3.23	0.42
26-35	0.42	0.35	0.41	0.25	0.36	0.29	0.25	3.36	3.52	0.85
36-45	0.18	0.44	0.30	0.29	0.29	0.23	0.23	3.36	3.34	0.73
46-60	0.10	0.50	0.34	0.26	0.29	0.24	0.34	3.66	3.42	0.68
60 and above	0.00	1.00	0.00	0.00	1.00	1.00	0.00	3.00	4.00	1.00
Edu										
Some school	0.02	0.25	0.25	0.13	0.13	0.13	0.00	2.13	2.75	0.38
High school	0.07	0.33	0.33	0.19	0.15	0.22	0.19	2.11	2.78	0.30
Specialized school	0.11	0.59	0.35	0.40	0.28	0.28	0.30	3.12	3.14	0.54
Undergraduate	0.57	0.41	0.37	0.29	0.36	0.26	0.22	3.34	3.43	0.74
Graduate	0.20	0.25	0.27	0.12	0.16	0.22	0.27	3.81	3.51	0.75
PhD	0.03	0.39	0.15	0.08	0.46	0.39	0.46	4.15	4.15	0.77
Subjects										
Studied Env/Bio	0.44	0.41	0.40	0.28	0.34	0.22	0.27	3.05	3.51	0.60
Studied Econ/Bus	0.43	0.42	0.39	0.26	0.31	0.28	0.23	3.53	3.31	0.79
City										
Urban	0.90	0.39	0.35	0.25	0.31	0.26	0.25	3.44	2.40	0.72
Rural	0.10	0.36	0.21	0.24	0.14	0.19	0.14	3.43	2.95	0.36

Columns labelled “Environmental related financial preferences” show the proportions of respondents that strongly agree with the statements: “I perceive a firm to be better if they publish the effect of its operations on the environment (perceived better)”, “I use environmental sustainability as one of the primary criteria when making investment decisions (criteria)”, “I would give up returns from investing if the securities are more environmentally friendly (Lower returns)”, “I am willing to pay higher fees for mutual funds that only make environmentally sustainable investments (pay higher)”, “I always keep track of my expenses (Record spends), and “I try to save as much money as possible (save)”. All the questions are scored from 1 to 5. Columns labelled “Literacy” show the average scores of the respondents on the financial and environmental literacy questions. The last column shows the proportion of respondents who own stocks. The samples are compared across gender, age, education, and location. There are in total of 400 respondents in the sample.

4. Methodology and Results

The methodology of the paper is as follows. First, the relationship between financial and environmental literacy and their determinants are investigated. Second, a deep down into the behavioural differences related to gender is investigated. Third, this paper describes a multivariate regression analysis of environmental beliefs based on three main questions – higher cost, higher return and clean planet. Lastly the respondents are segmented into 3 groups following Pedersen et al. (2021) and Anderson & Robinson (2021). A detailed description of the operationalization of their model in this paper is discussed in the next chapter.

4.1 Financial and Environmental Literacy

The following sections describe the analysis and findings of the data from the survey responses. Each financial and environmental literacy questions is represented as a dummy variable. The value of the variables is “1” if the respondents correctly answered the question, and “0” otherwise. Then, the dummies are added to calculate the total score of the respondents’ financial and environmental literacy levels. The sum is represented by two new variables, namely, “FL (financial literacy)” and “EL (environmental literacy)”. The value of the two new variables is integers from “0 (the respondent answers all five questions wrong)” to “5 (the respondent answers all five questions correctly)”.

4.1.1 Determinants of Financial and Environmental Literacy

This section describes multi-regression models to estimate the determinants of financial literacy and environmental literacy (table II). The dependent variables are financial literacy and environmental literacy. Financial literacy is a number from 0 to 5, representing the scores that the respondents get in answering the “big five” financial literacy questions, where 0 indicates that the respondent got wrong in all the questions and 5 indicates that the respondent got correct in all the questions. Environmental literacy is a number from 0 to 5, representing the scores that the respondents get in answering the five environmental literacy questions, where 0 indicates that the respondent got wrong in all the questions and 5 indicates that the respondent got correct in all the questions.

Table II. Determinants of Financial Literacy & Environmental Literacy

Variables	Financial Literacy			Environmental Literacy		
	(1)	(2)	(3)	(4)	(5)	(6)
FL					0.166*** (0.052)	0.080 (0.059)
EL		0.151*** (0.047)	0.059 (0.043)			
Male	0.470*** (0.114)	0.512*** (0.113)	0.354*** (0.103)	-0.277** (0.119)	-0.355*** (0.120)	-0.363*** (0.120)
Age			0.058 (0.054)			0.092 (0.063)
Edu			0.320*** (0.058)			0.216*** (0.069)
Studied_Bio			-0.277*** (0.110)			0.161 (0.129)
Studied_Bus			0.063 (0.112)			-0.141 (0.131)
City			0.598*** (0.173)			0.177 (0.204)
Stock			0.507*** (0.120)			0.050 (0.143)
Observations	400	400	400	400	400	400
R ²	0.041	0.065	0.273	0.013	0.038	0.077

The dependent variable in columns (1), (2), and (3) is the financial literacy scores of the respondents based on their number of correct answers in answering the “big five” financial literacy questions. The dependent variable in columns (4), (5), and (6) is the environmental literacy scores of the respondents based on their number of correct answers in answering the five environmental literacy questions. For a detailed description of the independent variables please read Appendix D. The table is the result of a standard OLS regression, and the standard error is reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

The independent variables include basic characteristics including gender, age, level of education, relative subjects that the respondent has studied through their education and whether the surveyed is living in an urban area. According to Lusardi (2019), respondents who are exposed more to the stock market obtain a higher level of financial literacy, therefore, stock ownership has been included in the model as an independent variable. Financial literacy and environmental literacy level are also included to illustrate the co-relationship between them. Table II reports the results of the regression tests.

Column (1) shows that gender significantly positively correlates to financial literacy. In other words, men significantly outperform women in answering the “big five” financial literacy questions. This result is consistent with He and Ahunov (2022) regarding their findings

about financial literacy in China and with Bucher-Koenen et al. (2017) who concluded that this is a worldwide phenomenon. They have found that Chinese women significantly underperform men in financial literacy, and the gender gap is enlarged over time. The results also provide evidence to the statement “women have more difficulty catching up with economic and financial market developments than men do” that was made by Lusardi and Mitchell (2011, p. 504).

In column (2), environmental literacy is added as an independent variable on top of gender. The results show that there is a significant positive correlation between financial literacy and environmental literacy. The results of column (3) suggest the importance of education to people’s financial literacy. In the regression result, education is significantly positively correlated to financial literacy. The result is also consistent with He and Ahunov (2022)’s finding. He and Ahunov (2022) used the China Household Finance Survey which has over 27,000 responses and is representative to the whole economy. The responses to the survey in this paper have a concentration of people who are active investors (around 68% own stocks). This can further explain the differences in the results. Notably, people who live in an urban area significantly correlate with having higher financial literacy. Although, the survey has a very strong representation of people who live in urban areas (90%), the conclusion is supported by literature and makes sense given the stark difference of development between urban and rural areas in China.

Column (3) also includes respondents’ stock ownership status as one of the independent variables to test if involvement in the financial market will increase the financial literacy level. Stock ownership shows a significant positive relationship with financial literacy, which is consistent with Lusardi (2019)’s finding, suggesting that by participating in the financial market, people will obtain a higher level of financial knowledge. In columns (4) and (5), environmental literacy is the dependent variable of the regression. The results show that men significantly underperform women in environmental literacy.

Columns (3) and (6) show that the positive correlation between financial literacy and environmental literacy becomes insignificant after loading up the control variables. People with higher financial knowledge have higher environmental literacy. The result is consistent with Anderson and Robinson (2021). Higher education level also indicates a higher

environmental literacy level. Finally, the model clearly shows a gender gap. Male consumers have higher financial literacy, while females – higher environmental literacy. On the other hand, one can see later in this paper that females comprise a bigger portion of type-A investors and thus hold in general stronger environmental values that could stem from a focus on sustainability rather than financial welfare. The gender differences are explained in the next section.

4.1.2 Gender Effect on the Chinese Market⁸

The gender differences regarding the relationship between financial literacy and financial involvement provide a possible explanation: Women in general hold stronger environmental beliefs and engage in more environmentally friendly behaviour in their daily life. Therefore, they are more motivated to obtain environmental knowledge than men are. To find out if it is the case, this paper uses environmental literacy and the three general environmental attitude questions as dependent variables to test a multi-regression model. The results of the regression model are presented in table III.

The first column of the table shows that people who hold stronger environmental beliefs would obtain a higher level of environmental literacy. The second column shows that respondents tend to reflect their belief toward the environment in their actions. Columns (3) and (4) show significant positive co-relationship between female participants and strong general belief towards the environment. From the result, one can conclude that, similar to the financial involvement effect on financial literacy, women's outperformance in environmental literacy questions may be due to their stronger environmental beliefs and a higher degree of environmental involvement.

⁸ For more detailed information regarding the differences in survey responses of males and females please see Appendix E.

Table III. Respondents' General Environmental Beliefs and Behaviour

	Environmental Literacy	Recycle more	Human activity	Global warming
	(1)	(2)	(3)	(4)
Recycle more	0.066 (0.066)			
Human activity	0.280*** (0.065)	0.146*** (0.049)		
Global warming	0.161** (0.084)	0.502*** (0.059)	0.520*** (0.055)	
Male	-0.184 (0.115)	-0.059 (0.089)	-0.166* (0.090)	-0.294*** (0.082)
Controls	Yes	Yes	Yes	Yes
Observations	400	400	400	400
R ²	0.177	0.312	0.253	0.112

Control variables include Age, Education, Studied_bio, Studied_bus, Stock, and City. For a detailed description of those please read Appendix D. Environmental Literacy represents the total environmental literacy scores of respondents, which is a number between 1-5. Recycle more is a number between 1-5 for the respondents' agreement toward the question "I recycle a great deal more than my neighbours", Human activity is a number between 1-5 for the respondents' agreement toward the question "I believe human activity is the primary factor for global warming today". Global warming is a number between 1-5 for the respondents' agreement toward the question "How worried are you about global warming?" The table is the result of a standard OLS regression, and the standard error is reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

The conducted survey has shown multiple signs for a strong gender gap among Chinese consumers. To investigate further, a detailed analysis of the relationship between gender and market participation is investigated. The results of this regression are presented in table IV.

Stock ownership, as a proxy for market participation, is included in the model as a dependent variable. Findings from previous sections show the gender gap in environmental literacy: women are more environmentally literate than men. Results from previous sections also found that women are more likely to make environmentally oriented financial decisions. However, from table IV, it seems that women tend to participate in the stock market less than men, meaning that they are less likely to put their preference into action. Therefore, there may exist a mismatch between knowledge and action. This finding is consistent with Anderson and Robinson (2021), who found similar mismatch between pro-environment values and investment choice. They concluded that the mismatch is due to the disengagement of pro-environment investors in the stock market.

Table IV. Determinants of stock market participation

	Stock ownership		
	(1)	(2)	(3)
Male	0.164*** (0.046)	0.111** (0.045)	0.113*** (0.043)
FL		0.127*** (0.020)	0.086*** (0.020)
EL		0.021 (0.019)	0.006 (0.018)
Age			0.087*** (0.022)
Edu			0.079*** (0.024)
Stu_Bio			-0.035 (0.046)
Stu_Bus			0.191*** (0.045)
City			0.149** (0.072)
Obs.	400	400	400
R ²	0.031	0.134	0.242

The dependent variable in columns (1), (2), and (3) is the dummy variable “stock ownership” of the respondents based on whether they own stocks or not. For a detailed description of the independent variables please read Appendix D. The table is the result of a standard OLS regression, and the standard error is reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

Moreover, table IV shows that financial literacy, unlike environmental literacy, significantly correlates with stock ownership and that FL diminishes the significance of gender. Column (3) takes into account all of the described control variables in this paper and shows that gender remains the strongest factor influencing market participation. Education, age and knowledge about business related topics are also significant factors. The findings of this table are aligned with the traditional gender roles in China as found by Cao et al. (2007). Their paper describes a case study of Shenzhen and states that men dominate out-of-home activities (which includes managing household finances) and women spend significantly more time on unpaid work such as household chores. Age and education influence gender-based time allocation as well. Overall, traditional gender roles are still very much persistent in China,

something that helps explain why males participate more in the market and have higher financial literacy.

Thanks to the discovery of a significant gender gap in the data, later sections pay more attention to examining how such a gender effect influences the described models.

4.2 Environmental Attitude

Table V shows the results of a multi-regression model that aims to find the determinant of respondents' environmental beliefs. The "clean planet", "higher cost", and "higher return" questions described above are used as dependent variables in the model. All three variables are dummy variables. The variables are given a value of "1" if the respondents choose "Strongly agree" and value of "0" otherwise. A respondent's basic characteristics, financial and environmental literacy and the higher cost and higher return questions are independent variables in the model.

Columns (1) to (3) of table V show that gender has a significant negative correlation with the clean planet question, meaning females focus more on sustainability and males – on financial welfare. While the correlations weaken when controlling financial literacy this effect remains strong. The correlation remains strong even when adding all control variables. Age also has a significant positive correlation with it, indicating that older female respondents tend to hold stronger environmental views. The results are supported by the already mentioned paper in the literature review (Clayton et al., 2019). Respondents with a higher level of financial literacy (predominantly males) are less likely to sacrifice financial gains for the environment, while those with a higher level of environmental literacy (predominantly females) are more likely to do so. Those findings are well connected by scientific literature. Zhao et al. (2021) have found that women show a more positive green consumption intention, consume less carbon, and purchase green products more frequently. The survey here shows that this could be due to females having stronger green beliefs than men.

Table V also shows that respondents who believe that ESG investment will generate higher returns than other types of investments and respondents who are willing to pay higher fees for green funds also respond positively to the clean planet question. Regarding gender differences, females positively correlate with incorporating sustainability factors in their financial decision making. However, when looking at columns (4) and (7), it is clear that female

respondents agree to pay higher fees for environmentally friendly investments, but do not believe that those investments generate higher returns. By taking into account the results from table II that females are more environmentally than financially literate, one can conclude that females tend to invest because of non-pecuniary reasons. Respondents who are willing to pay higher fees may not think about the return that the green investment would give them because they do not show a significant positive correlation with financial literacy but do so with environmental literacy. Their willingness may come from purely non-pecuniary reasons. The beliefs of females, held towards green investments, are aligned with behavioral difference found by scientific literature. Faradynawati & Söderberg (2022), for example, have found that female clients of robo-advisors are more likely to become sustainable investors, thus females should also be more likely to hold stronger environmental beliefs.

While financial literacy does not correlate with paying higher costs for green investments or investing in fully sustainable funds, there is a significant correlation between the higher return question and people who have studied business-related subjects. After having added all of the control variables, a significant positive correlation between the higher cost question and subjects who participate in the stock market becomes apparent. This implies that people on the stock market are willing to pay more for sustainable investments driven by reasons other than a search for higher returns.

Lastly, the data shows a significant positive relationship between people who believe in sacrificing financial returns for the environment (clean planet question) and those both willing to pay more for sustainable investments and agreeing with sustainable funds having an alpha. While this shows an alignment of those who have strong environmental values and believe in the superior performance of green investments, the significant but rather small correlation between the “higher cost” and “higher return” questions show that there may exist a group that is willing to pay a higher cost for purely non-pecuniary reasons. Some people hold strong environmental beliefs (clean planet) and are willing to accept the higher costs of green products without receiving financial benefits. Those ESG-motivated investors have, as Pederson (2021) predicted in his model, a desired portfolio to the right of the efficient frontier.

Table V. The Correlation in Environmental Beliefs

Variables	Clean planet			Higher cost			Higher return	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Higher cost							0.043*	
							(0.026)	
Clean Planet						0.089***		0.130***
						(0.023)		(0.027)
EL			0.041**		0.030*	0.009	0.057***	0.020
			(0.018)		(0.018)	(0.018)	(0.021)	(0.021)
FL		-0.053***	-0.076***		-0.007	-0.013	-0.008	0.002
		(0.018)	(0.021)		(0.019)	(0.021)	(0.022)	(0.024)
Male	-0.105**	-0.080*	-0.074*	-0.101**	-0.089**	-0.083*	0.017	0.057
	(0.042)	(0.043)	(0.043)	(0.042)	(0.043)	(0.043)	(0.051)	(0.048)
Age			0.045**			-0.040*		0.084***
			(0.022)			(0.022)		(0.025)
Edu			0.008			-0.001		0.021***
			(0.025)			(0.025)		(0.028)
Studied_Bio			0.048			-0.022		0.003
			(0.046)			(0.046)		(0.051)
Studied_Bus			0.042			-0.019		0.106**
			(0.046)			(0.046)		(0.052)
Stock			0.068			0.124**		-0.043
			(0.051)			(0.050)		(0.057)
City			0.043			0.093		0.087
			(0.072)			(0.072)		(0.081)
Observations	400	400	400	400	400	400	400	400
R^2	0.015	0.035	0.083	0.014	0.021	0.085	0.018	0.164

The above table represents the correlation between environmental attitudes. The attitudes are measured by the following questions: "Clean planet: A clean planet is more important to me than financial welfare.", "Higher return: I believe environmentally sustainable investments generate a higher return in the long term.", and "Higher cost: I am willing to pay higher fees for mutual funds that only make environmentally sustainable investments.". The dependent variables are dummy variables. For columns (1) to (8), the dependent variable equals one if the respondent answers "strongly agree" to the statement "A clean planet is more important to me than financial welfare." All zero otherwise. For a detailed description of the independent variables please read Appendix D The table is the result of a standard OLS regression, and the standard error is reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

4.3 The Three Types of Investors

In the sample of the conducted survey, respondents who recognize that green investment would generate a higher return and are willing to pay a higher cost for such investment (in other words, respondents who answer "strongly agree to both questions or answer "agree"

to one of the questions and answer “strongly agree” to the other question) is considered as Type-A (ESG-aware) investors. Otherwise, the respondents are labelled as Type-U (ESG-unaware) investors. Within the ESG-aware group, respondents who strongly agree with the “clean planet” question indicate that they seek out green investments both because of pecuniary and non-pecuniary motivation. Thus, such respondents are recognized as ESG-motivated investors.⁹

Most of the sample is comprised of Type-U investors (58%). This may be due to the current development stage of the Chinese ESG investment market, which is comparatively lower than other developed markets, and because of the obstacles that prevent Chinese retail investors from investing in ESG investment as mentioned in the prior sections. Gender is more balanced in the Type-U group than in the other two groups. Fitting with the previous tables, female participants are more represented in Type-M than in the other two groups. As expected, average environmental literacy is high for Type M and financial literacy is lower. At the same time, the average of both Type-U and Type-A are similar. A larger portion of type-A participate in the market (own stocks) than type-U consumers. It should be noted that most people in the sample have answered positively to the stock ownership question, but the scope of the survey does not cover the depth of investing experience of the respondents.

4.3.1 Determinant of FL and EL for Different Types of the Investors

To examine the financial and environmental literacy levels of the different types of investors, and what role the gender gap plays, two multi-regression models, using scores on the financial literacy and the environmental literacy questions as dependent variables, are analyzed in this section (table VI). The independent variables include basic characteristics such as gender, age, level of education, subjects that the respondents have studied through their education and whether the respondents are living in an urban area. Financial literacy and environmental literacy are also included as independent variables to see if the relationship between financial literacy and environmental literacy changes for different investor types.

Education is an important factor that influence the environmental literacy of type-U investors, but its significance disappears when looking at type-A. This could be because

⁹ For more information regarding the sample characteristics of the three types of investors please see appendix F

financial literacy significantly correlates with environmental literacy among ESG-aware consumers and, at the same time, education for this group positively influences financial literacy. Type-A consumers who have studied business related topics show negative correlation with environmental literacy and who own stock – significant positive correlation with financial literacy. This would imply that some type-A investors are interested in green stocks for financial purposes such as returns or diversification and not because of having strong environmental beliefs.

Financial literacy among type-U correlates only to a small extent with environmental literacy and this effect disappears once the control variables are added, whereas among type-A there is a significant correlation remains. This means that financially literate type-A respondents understand the value of environmental factors and include them in their financial analysis. While scientific literature on this matter often contradicts, Geraldine et al. (2021) found through an analytical study that FL has a significant positive effect on interest in green investing among stock participants. This would explain the correlation between FL and EL for this group.

Market participation or stock ownership proves to be important when looking at the correlation with financial literacy, regardless of the group type. In other words, stock market participation consistently correlates with financial literacy.

Table VI further proves that there is a high gender gap among Chinese consumers. This effect is even stronger when respondents are segmented based on their ESG awareness. Columns (1) and (2) in the table show a significant positive correlation between males and their level of financial literacy. However, the correlation, while still high and significant, substantially decreases after the control variables of education and stock ownership are added. The gender gap among type-A consumers is observed when looking at EL instead. While unaware male participants show a significant correlation with financial literacy, columns (9) and (10) show how the environmental literacy of males is significantly lower than that of female respondents among type-A consumers. One can attribute this to female respondents having in general higher environmental literacy and lower financial literacy than men (Anderson & Robinson 2021 and Franzen et al., 2008). The sample of type-A investors is predominantly represented by females (55%).

Table VI. Determinants of FL and EL

	Type-U investors					Type-A investors				
	Fin. Literacy			Env. Literacy		Fin. Literacy			Env. Literacy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Male	0.676*** (0.149)	0.693*** (0.148)	0.478*** (0.136)	-0.226 (0.161)	-0.214 (0.163)	0.187 (0.174)	0.271 (0.174)	0.220 (0.163)	-0.474*** (0.177)	-0.452** (0.177)
FL				0.127* (0.068)	0.022 (0.079)				0.206*** (0.079)	0.146* (0.086)
EL		0.117* (0.063)	0.016 (0.057)				0.271*** (0.174)	0.120* (0.071)		
Age			0.046 (0.070)		0.130 (0.082)			0.085 (0.088)		-0.004 (0.097)
Edu			0.316*** (0.072)		0.213** (0.088)			0.303*** (0.099)		0.206 (0.111)
Stu_Bio			-0.234 (0.144)		0.148 (0.170)			-0.312* (0.173)		0.196 (0.192)
Stu_Bus			0.214 (0.147)		0.082 (0.173)			-0.033 (0.184)		-0.551*** (0.198)
Stock			0.511*** (0.146)		-0.048 (0.177)			0.562** (0.223)		0.186 (0.251)
City			0.660*** (0.204)		0.299 (0.245)			0.539 (0.345)		-0.325 (0.382)
Obser.	231	231	231	231	231	169	169	169	169	169
R ²	0.083	0.096	0.327	0.018	0.069	0.007	0.046	0.227	0.072	0.143

For the next part of the analysis, respondents are segmented based on their ESG preferences. Higher cost and higher return questions are proxies to distinguish ESG-Unaware from ESG-Aware consumers. Those who have scored 8 or lower when answering the higher cost and higher return questions (231 responses) are considered unaware. From (1) to (3), and from (6) to (8) the dependent variable equals the score that the respondent gets in the “big five” financial literacy questions. From columns (4), (5), (9), (10), the dependent variable equals the score that the respondent gets in the “big five” environmental literacy questions. For a detailed description of the independent variables please read Appendix D. The table is the result of a standard OLS regression, and the standard error is reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

4.5 Environmental Related Financial Preferences

After the division of the sample into different groups the goal of this paper is to further examine if different types of investors reflect their preferred position on the ESG-efficient frontier relative to their preference in making environmentally driven financial decisions. For that purpose, multi-regression models using the six financial preference variables as dependent variables are built to estimate the determinants of environmentally related financial preference.

The independent variables in the regression models in tables VII and VIII include a dummy variable named “Type-A”, in addition to the basic characteristics of the respondents and respondents’ financial and environmental literacy. A dummy variable indicates whether the respondent is a Type-A investor or not. The value of the variable is 1 if the respondent is a Type-A investor and 0 if the respondent is a Type-U investor. The questions “Record spending” and “Save” are also included as independent variables as a means to examine if general financial preference would, to some extent, impact one’s environmental-related investment behaviour.

4.5.1 Do Investors Reflect Their Preference on Investment Selection?

The questions “Perceived better” and “Criteria” are used as dependent variables in the regression model in table VII in order to investigate if respondents who are ESG-aware would reflect their preference in their investment selection process.

From the results, gender has no significant co-relationship with “perceived better”. On the other hand, a strong gender gap persists to exist in the criteria question. Females are more likely to consider environmental factors as primary when making investment decisions, which is not surprising when considering that women in China are less financially and more environmentally literate (Table II & Niu et al. 2020). Moreover, the correlation between type-A and both questions decreases when adding financial literacy to the regression. The results show that type-A respondents significantly positively correlate with both the perceived better and the criteria questions.

Table VII. Types of impacts on Environmental Related Financial Preferences (Perceived Better & Criteria)

	Perceived better				Criteria			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Type-A		0.571*** (0.071)	0.500*** (0.072)	0.485*** (0.072)		0.774*** (0.094)	0.702*** (0.095)	0.702*** (0.096)
Male	-0.109 (0.076)	-0.098 (0.070)	-0.032 (0.071)	-0.035 (0.071)	-0.429*** (0.100)	-0.402*** (0.093)	-0.317*** (0.095)	-0.313*** (0.095)
FL			0.019 (0.035)	0.019 (0.035)			-0.141*** (0.046)	-0.139*** (0.046)
EL			0.122*** (0.030)	0.121*** (0.030)			0.042 (0.040)	0.039 (0.040)
Age			0.037 (0.037)	0.030 (0.037)			0.031 (0.049)	0.028 (0.050)
Edu			-0.066 (0.041)	-0.064 (0.041)			-0.064 (0.054)	-0.061 (0.054)
Stu_Bio			0.145* (0.076)	0.173** (0.077)			0.254** (0.100)	0.269*** (0.102)
Stu_Bus			0.089 (0.077)	0.074 (0.077)			0.122 (0.102)	0.116 (0.103)
Stock			-0.147* (0.084)	-0.166* (0.087)			0.040 (0.112)	0.056 (0.116)
City			0.193 (0.120)	0.185 (0.120)			0.077 (0.159)	0.069 (0.159)
Record spending				0.061* (0.035)				-0.001 (0.046)
Save				-0.053 (0.034)				-0.038 (0.046)
Observations	400	400	400	400	400	400	400	400
R^2	0.005	0.144	0.211	0.219	0.044	0.183	0.246	0.247

For the next part of the analysis, respondents are segmented based on their ESG preferences and included a dummy variable, distinguishing between type-U (equals 0) and type-A (equals 1). From columns (1) to (4), the dependent variable equals the score that the respondent has given to the question: "I perceive a firm to be better if they publish the effect of its operations on the environment." From columns (5) to (8), the dependent variable equals the score that the respondent has given to the question: "I use environmental sustainability as one of the primary criteria when making investment decisions." For a detailed description of the independent variables please read Appendix D. The table is the result of a standard OLS regression, and the standard error is reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

The results show that higher environmental literacy correlates with people's affinity to firms who report their ESG-related operations, but somewhat counterintuitive this effect disappears when looking at people's answers to environmental sustainability as a primary selection criterion for investing. The "criteria" question relates much higher to ESG-Motivated investors, since it implies that sustainability is a primary selection criteria and that a person who scores high on this question is more likely to have an efficient portfolio to the right of the tangency portfolio. In other words, a respondent is willing to sacrifice financial gains for a higher ESG score in her portfolio.

This theory is further strengthened when looking at the correlation of financial literacy with the two questions. Again, no significant result comes from the perceived better question, while there is a significant negative correlation with the criteria question. Despite the argument made earlier in this paper that high ESG companies deliver better risk-adjusted returns and, thus, financially literate Chinese consumers should reflect that in their screening, the data shows that financially literate respondents also understand that ESG scores are important, but they are not the primary factor and thus would not focus primarily on them. Such type of behaviour is foundational when looking at general consumer behaviour. As referenced earlier to Pattie (2001), consumers on average would first look at the quality of a product and only then at its "greenness" status. Same analogy can be translated to investment decisions. The correlation with ESG-aware respondents could be slightly negative for that reason.

The correlation of type-A respondents with the "perceived better" question and slightly with the "criteria" question decreases once additional factors such as environmental literacy, education related to biology, stock ownership and the record spending question are loaded.

4.5.2 Do Investors Reflect Their Preference on Their Investments' Perceived Sharpe Ratio?

The questions "Lower Return" and "Pay Higher" are used as dependent variables in the regression model in table VIII to investigate if respondents who are ESG-aware are willing to give up returns or pay higher prices for environmentally friendly investments.

Table VIII gives further insights into the environmental financial preference of the Chinese population. Gender continues to be a significant factor in the financial decision-making process among the Chinese investors. Females are more likely to accept lower return for sustainable investments; females are also more willing to pay higher price for environmentally friendly investment products. However, the effects weaken after adding more control variables. Column (2) and (6) show that the gender effect is decreased when adding investors' type in the model. Type-A respondents would give up returns for environmentally friendly products and are willing to pay a higher price at the same time. While this is very similar to the definition of type-A as explained earlier, the data shows interesting results about the demographic of the surveyed.

It seems that people who agree to either of the two questions have lower financial literacy, although the correlation is very small. They are inclined to combine sustainability metrics with financial ones instead of focusing on the latter primarily. The effect is stronger for the lower return question. This shows that more financially literate type-A investors would agree to pay higher for sustainable products, but they would not accept lower returns.

The correlations between gender and the two dependent variables are further weakened when adding more control variables. The "pay higher" question shows a significant positive correlation with environmental literacy, connecting previous findings from table V that female participants have higher environmental knowledge. Such results suggest that if financial literacy in China improves overall, female participants could outperform the market because they would account for the additional information provided by sustainability metrics while male investors would not.

Lower education level correlates with the "lower return" but not with the "pay higher" question. This suggests that regardless of education level people would accept paying a premium for better ESG, but only the less educated will accept the lower return on those investments. This argument is further strengthened when taking into account the FL also has significant negative correlation with "lower return". Scientific literature has a general consensus about the impact of education on financial literacy and Zhou et al. (2022) even found a causal one. This help to explain the negative correlations of both variables in table VIII.

Table VIII. Types Impacts on Environmental Related Financial Preferences (Lower return & Pay higher)

	Lower return				Pay higher			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Type-A		0.778*** (0.095)	0.745*** (0.095)	0.732*** (0.096)		0.823*** (0.092)	0.666*** (0.092)	0.647*** (0.091)
Male	-0.231** (0.101)	-0.203** (0.094)	-0.158* (0.094)	-0.156* (0.094)	-0.382*** (0.100)	-0.353*** (0.091)	-0.288*** (0.091)	-0.280*** (0.090)
FL			-0.124*** (0.046)	-0.121*** (0.046)			-0.087** (0.044)	-0.081* (0.043)
EL			-0.009 (0.040)	-0.013 (0.040)			0.188*** (0.038)	0.178*** (0.038)
Age			-0.055 (0.049)	-0.064 (0.049)			0.117** (0.047)	0.102** (0.047)
Edu			-0.135** (0.054)	-0.131** (0.054)			-0.024 (0.052)	-0.016 (0.051)
Stu_Bio			0.275*** (0.100)	0.316*** (0.102)			0.209** (0.096)	0.284*** (0.097)
Stu_Bus			-0.035 (0.102)	-0.055 (0.102)			0.077 (0.098)	0.041 (0.097)
Stock			0.243** (0.112)	0.244** (0.115)			0.106 (0.108)	0.124 (0.109)
City			-0.119 (0.159)	-0.134 (0.158)			0.259* (0.153)	0.229 (0.151)
Record spending				0.051 (0.046)				0.075* (0.043)
Save				-0.088* (0.045)				-0.168*** (0.043)
Observations	400	400	400	400	400	400	400	400
R^2	0.013	0.157	0.233	0.241	0.035	0.196	0.290	0.317

For the next part of the analysis, respondents are segmented based on their ESG preferences and included a dummy variable, distinguishing between type-U (equals 0) and type-A (equals 1). From columns (1) to (4), the dependent variable equals the score that the respondent has given to the question: "I would give up returns from investing if the securities are more environmentally friendly." From columns (5) to (8), the dependent variable equals the score that the respondent has given to the question: "I am willing to pay more for environmentally friendly products." For a detailed description of the independent variables please read Appendix D. The table is the result of a standard OLS regression, and the standard error is reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.

People who have studied biology related topics positively correlate with both questions, but no significant correlation is found among those who have studied business related topics. This could identify respondents who have little knowledge of business and are holding stronger environmental beliefs.

Somewhat counterintuitive, people who own stocks positively correlate with the “lower return” question. This references to the group mentioned earlier in the thesis that invests due to non-pecuniary reasons.

Lastly, there is negative correlation between the people who try to save as much money as possible and those who both pay higher and receive lower gains. While the negative correlation is much lower in comparison to others, it suggests that more cautious behaviour does not align well with sustainable investing. Referencing to Pedersen et al. (2021), ESG-Aware investors typically have a higher Sharpe ratio (as defined by Pedersen et al., 2021) and are willing to accept more risk. On the Chinese market, socially responsible investing is a very new topic and potentially attracts investors willing to accept higher risk.

As a last step, this study looked into investors’ general financial behaviour and whether it would be affected by their environmental preferences.¹⁰

ESG-Aware respondents tend to record their spending more than ESG-Unaware ones and participate more in the stock market. One interpretation could be that they are also accepting to pay higher for sustainable products and thus keep a tighter track of their personal finances. It seems that the correlation is explained by stock ownership, which is a significant factor for both questions: “Does the participant keeps track of her savings?” and “Does the participant tries to save as much as possible?” The results from the survey show that not financial literacy but stock market participation define general financial behavior. It can be reasonably assumed that type-A consumers are more skilled and affluent individuals. However, it should also be noted that the sample of this survey is predominantly consisted of people who have an exposure to the stock market (hold at least one stock) and are, therefore, not representative of the whole Chinese population.

¹⁰ For more details, please look the table in appendix G

When it comes to financial behaviour, the gender effect weakens but still remains. Males tend to record their expenditures more thoroughly; the significance of the correlation becomes stronger once controlling investors' type. The results are consistent with Westaway & McKay (2007), who discovered that women in the UK were as likely to save as men, but they would save less and for the shorter term. As a future extension to this paper, investigating this matter more thoroughly in China and among non-stock owners might give valuable insights.

5. Conclusion

This paper provides answers to three questions: What is the relationship between Chinese investors' financial and environmental literacy? What factors are affecting the financial and environmental literacy of Chinese investors? And does the environmental belief of the Chinese investors reflect their preference in financial decision-making? The findings show that in China, people with higher financial knowledge also have higher environmental knowledge.

Just like what has been observed in other markets around the world, other than education and financial market participation, there are explicit gender effects on the level of financial and environmental literacy. Men tend to have higher financial knowledge than women and women tend to have higher environmental knowledge than men. Multivariate regression analysis has shown that males correlate with market participation, which is significantly influenced by high financial literacy. On the other hand, female participants in the study do not participate in the market as much as male respondents. Due to females having higher environmental preference one sees less interest into sustainable investments than if more women actively engaged with stocks. Moreover, Chinese females show a lack of confidence which is one of the reasons why males deal with finances. Chinese women also lack confidence and persistence when they are facing environmental questions. This implies the confidence effect may not explain the gender gap in environmental literacy. Such a gap may be due to the stronger attitude toward the environment and higher level of environmental involvement among Chinese women. Finally, traditional gender roles in Chinese society are still very much prevalent, something that leads to the finance management sector being dominated by males.

In later sections, the sample was divided into three groups based on their preferred trade-offs between the Sharpe ratio and ESG factors. It appears that other than the three types of investors proposed by Pederson et al (2021), there exists a group of people who are willing to give up their financial welfare for environmental welfare for purely non-pecuniary reasons. Another conclusion from this paper is that people with stronger environmental beliefs reflect their preference in their financial decision-making. Moreover, the gender effect plays a significant role in enhancing this relationship. Lastly, Chinese people with higher financial literacy may refuse to invest in green investments.

The findings of this study have several implications. First, it can be used by policymakers to understand the current financial literacy and environmental literacy situation in China. A better understanding of the gender gap in financial and environmental knowledge could help policymakers put more effort to encourage women in China to express their environmental preference on the financial market and, as a result, reduce the mismatch between pro-environment values and investment choice similarly found by Anderson & Robinson (2021). This paper has found that not EL but FL correlates with stock ownership. This means that if FL among women increases, female consumers in China will participate in the market more and, thanks to the stronger environmental preferences for women, the demand for green investing on the market will increase as a whole. Secondly, the findings help policymakers understand the challenges that green investment products face in the Chinese market. China is going through the implementation of its ambitious plan for green transformation. As Chinese president, Xi Jinping proposed in the UN General Assembly's 76th session, China aims to peak carbon dioxide emissions before 2030 and achieve carbon neutrality before 2060¹¹. Encouraging people to invest in green investment is an essential part of the green transformation of the economy. The results in this paper suggest that the government needs to put more effort into promoting ESG concepts among Chinese investors, building their belief in the financial welfare that green investment could deliver.

This study could also be used to support Chinese regulators in their effort to strengthen the regulations for the Chinese listed companies to increase their quantity and quality of ESG-related information disclosure, thus, helping to build the “green financial

¹¹ UN General Assembly's 76th session, <https://news.un.org/en/story/2021/09/1100642>

system". Financial market participants can also use the paper as a reference in researching how to attract more retail investors into participating in the green investment market.

This paper contributes current ongoing theoretical research on ESG investment behaviour finance. As a relatively new concept, ESG investment receives increasingly more attention from researchers, but fewer theoretical achievements have been made compared to traditional financial theories. The study applies the theory of ESG-efficient frontier in an emerging market and provides a practical implementation of this theory. The data could also be used as a base for further research on Chinese retail investors' behaviour in ESG investment.

There are some limitations of this paper. Firstly, due to a relatively small sample size the ESG-motivated investors' financial preferences and financial behaviour cannot be reasonably investigated. Secondly, some of the social groups are over-represented in the sample, such as the working-age population, people who participate in the financial market, and people with higher levels of education. However, this may also potentially make the results more practical for implication purposes as mentioned above. The overrepresented groups are also people who are more likely to participate in the ESG investment market.

As pointed out by Nicolini & Haupt (2019), the Lusardi-Mitchell questions could potentially fail to connect financial and in the case of this paper environmental literacy with financial behaviour due to being based on very basic financial knowledge and being too broad. Thus, it might be beneficial to use more extensive frameworks that thoroughly test financial literacy and environmental literacy. Nicolini & Haupt (2019) have proven that factors such as savings, retirement planning or use of credit cards may not be easily connected to financial literacy if using only one framework. As a recommendation for future papers on this topic it would also be beneficial to include a larger variety of frameworks.

This paper concentrates on the environmental part of ESG attitude and sustainable literacy. As a proposition for further research, one can investigate the relationship between the social and governmental parts of ESG investing and how they connect with financial literacy, something that will provide a deeper understanding of this topic.

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Appendix

Appendix A. ESG Investment in China

China leverages ESG investment through "double carbon" (government goal of carbon peaking by 2030 and carbon neutrality by 2060), and the sector has progressed from a nascent stage to a fast stage¹². The continuous opening-up of the capital market of China has also attracted more and more international capital with ESG investment ideas in China. As a result, the concept of ESG investment and responsible investment gained further acceptance in the Chinese market. At the same time, the promotion of a “green financial system (in Chinese, 绿色金融体系)” and the strengthening of regulations on information disclosure by the Chinese regulators force the Chinese listed companies to increase their quantity and quality of ESG-related information disclosure making China’s ESG investment market to develop rapidly.

ESG investment is not only getting more attention from institutional investors in China but also receiving increasing popularity among retail investors, who account for the majority of Chinese investors. To further enhance the asset allocation of retail investors, wealth management departments of banks have started introducing ESG investing methods and developing ESG-themed wealth management products. Many wealth management clubs in China regularly host investment forums where they present ESG- related financial products and promote themselves as resources for VIP clients seeking fresh financial information. Although retail investors in China are not the major player in ESG investment, they are expected to become increasingly important in the market. In comparison to Europe, China's ESG market still lacks elements such as clear laws, regulations, and ESG cognitive models that would promote ESG investments among retail investors. The increasing global trend of retail investors' involvement in ESG investing served as a model for the future development of the ESG market in China.

¹² 中国 ESG 投资报告 2.0 https://www.sohu.com/a/595215958_121112996

Appendix B. Survey questionnaire

The original survey was conducted and distributed in Chinese. The following survey questions are translated from Chinese.

Questions on respondents' basic information (see table I for detailed response statistics)

1. What is your gender?
 - a. Male
 - b. Female
2. What is your age?
 - a. 0-18
 - b. 19-25
 - c. 26-35
 - d. 36-45
 - e. 46-60
 - f. 60 and above
3. What is your highest education?
 - a. Some school
 - b. High school
 - c. Specialized school
 - d. Bachelor's degree
 - e. Master's degree
 - f. PhD
4. What subjects have you learned at school?
 - a. Environment/biology-related subjects
 - b. Economics / business-related subjects
5. Are you living in a city or a rural area?
 - a. Urban
 - b. Rural
6. Are you currently holding stocks?
 - a. Yes
 - b. No

The "Big Five" Questions for Financial Literacy:

1. Suppose you had \$100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
 - a. **More than \$102 (355, 88.8%)**
 - b. Exactly \$102 (26, 6.5%)
 - c. Less than \$102 (11, 2.8%)

- d. Don't know (6, 1.5%)
 - e. Prefer not to say (2, 0.5%)
- 2. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?
 - a. More than today (26, 6.5%)
 - b. Exactly the same as today (14, 3.5%)
 - c. Less than today (347, 86.8%)**
 - d. Don't know (12, 3%)
 - e. Prefer not to say (1, 0.3%)
- 3. Buying a single company's stock usually provides a safer return than a stock mutual fund.
 - a. True (56, 14%)
 - b. False (310, 77.5%)**
 - c. Don't know (31, 7.8%)
 - d. Prefer not to say (3, 0.8%)
- 4. If you get a gift of \$10,000 and you want to double the amount by saving the money for ten years without touching it. What interest rate do you need to achieve this goal?
 - a. An annual interest rate of about 15% (99, 24.8%)
 - b. An annual interest rate of about 10% (153, 38.3%)
 - c. An annual interest rate of about 7% (130, 32.5%)**
 - d. Don't know (16, 4%)
 - e. Prefer not to say (2, 0.5%)
- 5. If interest rates fall, what should happen to bond prices?
 - a. They will rise (191, 47.8)**
 - b. They will fall (131, 32.8%)
 - c. Don't know (43, 10.8%)
 - d. Prefer not to say (1, 0.3%)

The Five Questions for Environmental Literacy:

- 1. A low-energy (CFL or LED) lightbulb costs more than a regular lightbulb but uses less energy. About how long does one last?
 - a. About the same as a regular lightbulb (17, 4.3%)
 - b. About 10 times as long as a regular lightbulb (266, 66.5%)**
 - c. About 100 times as long as a regular lightbulb (88, 22%)
 - d. Don't know/Prefer not to say (29, 7.2%)
- 2. The ozone layer filters what harmful substance?
 - a. Acid rain (41, 10.3%)
 - b. UV radiation (329, 82.3%)**
 - c. Sewage (5, 1.3%)
 - d. The Greenhouse Effect (22, 5.5%)

- e. Don't know/Prefer not to say (3, 0.8%)
- 3. Which of the following statements is correct?
 - a. **Global warming will make some places wetter and others drier (314, 78.5%)**
 - b. Any recent global warming has been caused by the sun (18, 4.5%)
 - c. Earth is actually cooling, not warming (22, 5.5%)
 - d. Earth's climate has also warmed in the past, so humans are not the cause of global warming (15, 3.8%)
 - e. Don't know/Prefer not to say (31, 7.8%)
- 4. Why don't polar bears eat penguins?
 - a. They have both been driven out of their natural environment (32, 8%)
 - b. Polar bears do not eat meat (12, 3%)
 - c. Penguins are only active when polar bears hibernate (70, 17.5%)
 - d. **None of the above (266, 66.5%)**
 - e. Don't know/Prefer not to say (20, 5%)
- 5. On average, how long does carbon dioxide stay in the atmosphere once it has been emitted?
 - a. A few days (43, 10.8%)
 - b. A few months (51, 12.8%)
 - c. A few years (79, 19.8%)
 - d. **A few hundred/thousand years (176, 44%)**
 - e. Don't know / Prefer not to say (51, 12.8%)

Environmental Beliefs Questions

- 1. How worried are you about global warming?
 - a. Strongly disagree 1 (0.5%)
 - b. 2 (5.5%)
 - c. 3 (10%)
 - d. 4 (47%)
 - e. Strongly agree 5 (37%)
- 2. I believe human activity is the primary factor for global warming today.
 - a. Strongly disagree 1 (2.5%)
 - b. 2 (6%)
 - c. 3 (13.3%)
 - d. 4 (39%)
 - e. Strongly agree 5 (39.3%)
- 3. A clean planet is more important to me than financial welfare.
 - a. Strongly disagree 1 (25.3%)
 - b. 2 (45.5%)
 - c. 3 (17.3%)
 - d. 4 (9.5%)
 - e. Strongly agree 5 (2.5%)

4. I recycle a great deal more than my neighbours.
 - a. Strongly disagree 1 (1.8%)
 - b. 2 (11%)
 - c. 3 (17.8%)
 - d. 4 (41.8%)
 - e. Strongly agree 5 (27.8%)
5. I am willing to pay higher fees for mutual funds that only make environmentally sustainable investments.
 - a. Strongly disagree 1 (1.3%)
 - b. 2 (12.5%)
 - c. 3 (18.8%)
 - d. 4 (43%)
 - e. Strongly agree 5 (24.5%)
6. I believe environmentally sustainable investments generate higher returns in the long term.
 - a. Strongly disagree 1 (1.5%)
 - b. 2 (5%)
 - c. 3 (6.8%)
 - d. 4 (45.3%)
 - e. Strongly agree 5 (41.3%)

Environmental financial decision preference

1. I perceive a firm to be better if they publish the effect of its operations on the environment.
 - a. Strongly disagree 1 (0.3%)
 - b. 2 (4%)
 - c. 3 (6%)
 - d. 4 (51.3%)
 - e. Strongly agree 5 (38.5%)
2. I use environmental sustainability as one of the primary criteria when making investment decisions.
 - a. Strongly disagree 1 (2%)
 - b. 2 (10.3%)
 - c. 3 (13%)
 - d. 4 (41%)
 - e. 5 (33.8%) Strongly agree
3. I would give up returns from investing if the securities are more environmentally friendly.
 - a. Strongly disagree 1 (2.8%)
 - b. 2 (10.8%)
 - c. 3 (14.5%)

- d. 4 (47.3%)
 - e. Strongly agree 5 (24.8%)
4. I am willing to pay more for environmentally friendly products.
- a. Strongly disagree 1 (2.5%)
 - b. 2 (9%)
 - c. 3 (17.5%)
 - d. 4 (41.5%)
 - e. 5 (29.5%) Strongly agree
5. I always keep track of my expenses.
- a. Strongly disagree 1 (4.8%)
 - b. 2 (16%)
 - c. 3 (19.8%)
 - d. 4 (34%)
 - e. Strongly agree 5 (25.5%) Strongly agree
6. I try to save as much money as possible.
- a. Strongly disagree 1 (4.8%)
 - b. 2 (14.5%)
 - c. 3 (19.8%)
 - d. 4 (37.3%)
 - e. Strongly agree 5 (23.8%)

Appendix C. Survey Distribution Procedure

This section presents the procedure of data collection in detail. In late 2022, a total of 30 testing surveys were distributed through a paid survey distribution platform named “Credamo”, which sends the survey to participants in exchange for compensation. After the testing samples were collected, the sample data has been checked for accuracy. After the sample data has been approved to be accurate, a total of 900 surveys have been distributed through Credamo. On the online platform, the surveys have been sent out through two major channels, in the first channel, respondents complete the survey in exchange for an incentive fee. 75% of the sample comes from the first channel. For the second channel, the survey is designed in the platform and manually distributed to respondents. Afterwards, the responses are inserted into the data set. The following table gives details about the data collection process.

Survey Distribution				
Note	Channel	Responses	% Of Total	Date
Testing survey	1	30	3.3	Jan 18, 2023
Distribution 1	1	30	3.3	Jan 23, 2023
Distribution 2	1	240	26.7	Jan 24, 2023
Distribution 3	2	101	11.2	Jan 25, 2023
Total responses		400	44.4	
No response		499	66.6	
Declined		1	0	
Total invitations		900	100	

Appendix D. Overview of Control Variables

Variables	Description
FL	Financial literacy, indicating the level of financial knowledge of the respondents based on the financial literacy questions. Scored from 0 to 5.
EL	Environmental literacy, indicating the level of environmental knowledge of the respondents based on the environmental literacy questions. Scored from 0 to 5.
Gender	A dummy variable, “1” if the respondent is a male and “0” if the respondent is a female.
Age	Indicates the age of the respondents. The variable is valued “1” if the respondent is aged between 0-18, “2” if the respondent is aged between 19-25, “3” if the respondent is aged between 26-35, “4” if the respondent is aged between 36-45, “5” if the respondent is aged between 46-60, and “6” if the respondent is aged above 60.
Edu	Indicates the education level of the respondents. The variable is valued “1” if the respondent took some school, “2” if the respondent went to high school, “3” if the respondent went to specialized school, “4” if the respondent went to university, “5” if the respondent has a master’s degree, and “6” if the respondent has a PhD degree.
Studied_Bio	A dummy variable, “1” if the respondent studied environment and biology related subjects as the major of their previous studies and “0” if the respondent majored in other subjects.
Studied_Buss	A dummy variable, “1” if the respondent studied business and economics related subjects as the major of their previous studies and “0” if the respondent majored in other subjects.
City	A dummy variable, “1” if the respondent is currently living in the urban area and “0” if the respondent is currently living in the rural area.
Stock	A dummy variable, “1” if the respondent is currently owning stocks and “0” if the respondent is not.

Appendix E. Differences in Survey Responses Based on Gender

There are distinct financial and environmental literacy levels between males and females. Table below provides a deeper understanding of the gender specific scores on financial and environmental literacy.

Statistics of Financial and Environmental Literacy by Gender

	Female_FL	Female_EL	Male_FL	Male_EL
N	213	213	187	187
Mean	3.11	3.51	3.58	3.23
Median	3	4	4	3
Std	1.15	1.20	1.12	1.18

The table presents the basic statistics of financial and environmental literacy scores of males and females.

With similar proportions among the sample (male: 47%, female: 53%), males perform better than females on financial literacy questions in terms of mean and median scores. Male respondents also perform more stable than female ones on financial literacy questions with a lower standard deviation. On the other hand, the effect is inverse when looking into the environmental literacy questions. Females outperform males on environmental questions with higher mean and median scores. Males still show more stability in answering environmental literacy questions with a lower standard deviation.

Moreover, three sets of historiographies show the differences in performance between males and females on financial and environmental literacy questions. Chart I.a shows the distribution of financial and environmental literacy scores among the whole sample. The x-axis represents the total literacy score, the y-axis represents the proportion of each score in the sample. Chart I.b and Chart I.c show the distribution of financial and environmental literacy scores among males and females, respectively. The x-axis represents the total literacy score, the y-axis shows the frequency of each score in the sample

Chart I-a. Financial and Environmental Literacy Scores Distribution

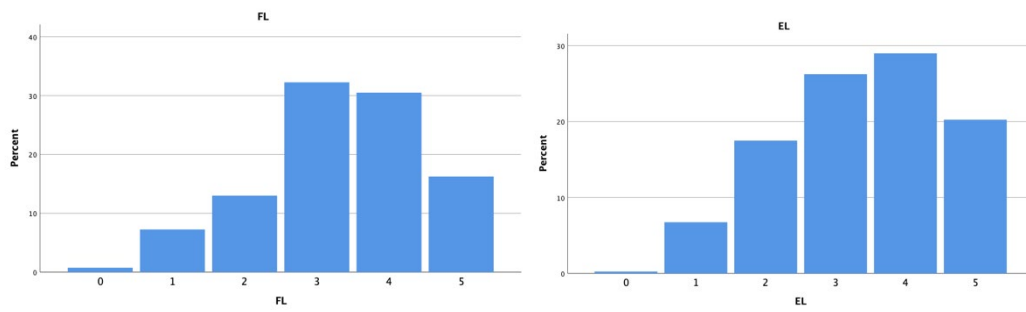


Chart I-a shows the financial and environmental literacy scores distribution. the x-axis indicates the number of questions that the respondent answered correctly, the y-axis indicates the proportion of each group.

Chart I-b. Financial and Environmental Literacy Scores Distribution - Male

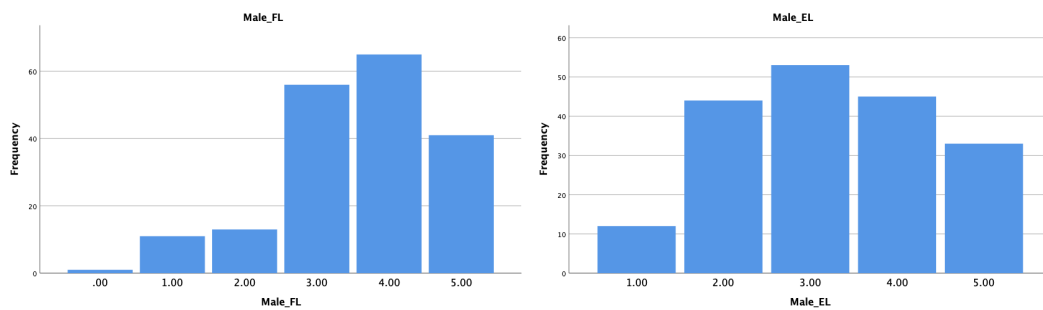


Chart I-b show the financial and environmental literacy scores distribution among male. the x-axis indicates the number of questions that the respondent answered correctly, the y-axis indicates the frequency of each group.

Chart I-b. Financial and Environmental Literacy Scores Distribution - Female

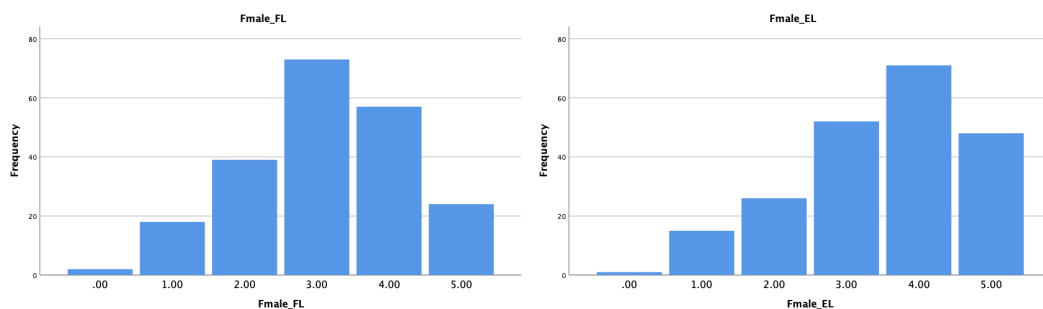


Chart I-c show the financial and environmental literacy scores distribution among female. the x-axis indicates the number of questions that the respondent answered correctly, the y-axis indicates the frequency of each group.

After having analyzed the charts above, it becomes apparent that males tend to get higher scores on financial literacy questions than females, but achieve lower scores than females on environmental literacy questions. More specifically, the statistics of financial and environmental literacy by gender show that females have better performance on environmental literacy both by the mean and median of the score, and males have better performance on financial literacy both by the mean and median of the score. Interestingly, there is a gendered tendency in the literacy questions' results. The result is similar to Li et.al (2020) who use a self-test financial literacy survey and find that in China, males are more financially knowledgeable than females.

The gender gap in financial literacy is not only seen in China. According to Bucher-Koenen et. al (2021) the gender gap in financial literacy is universal. One possible explanation for the wide gender gap in China might be that the male population is usually the main source of income for a family and is more likely to be in control of the family's investments. Thus, males are exposed to situations that require a higher level of financial knowledge. The sample statistics support this argument. 77% of male participants in the sample data own stock, compared to 61% of women.

Furthermore, Bucher-Koenen et. al (2021) suggest that the respondents may answer "don't know" even though they know the correct answer to the question. Something worth taking into consideration when analyzing the true financial literacy level of respondents. The difference in confidence between men and women may also help explain the gap. Tables below provide insights whether females in China are more likely to answer "do not know" than males.

Financial Literacy Questions Answer Frequency and Percentage by Gender

Question	Answer Correct				Answer Don't Know			
	Male		Female		Male		Female	
	Freq.	Pct.	Freq.	Pct.	Freq.	Pct.	Freq.	Pct.
Compounding	170	90.9	185	86.9	3	1.6	3	1.4
Inflation	171	91.4	176	82.6	5	2.7	7	3.3
Diversification	153	81.8	157	73.7	9	4.8	22	10.3
LT Saving	80	42.8	50	23.5	1	0.5	15	7.0
Bond Pricing	86	51.3	68	31.9	14	7.5	29	13.6

The table shows the frequency and percentage of the males and the females who answer correctly and who answer “don’t know” to the “big five” financial literacy questions.

The columns that show the frequency and percentages of respondents who answer the question correctly indicate that females outperform males in the compounding question but underperform males in all the other four questions, further supporting the argument that there is a gender gap in financial literacy in China. The percentage and gender of the respondents who answer “Don’t know” to the questions show that in general, females tend to answer “don’t know” more frequently than males. Therefore, confidence is likely to play a role in the gender gap in financial literacy in China. It appears that there is a lack of confidence in Chinese women regarding their financial literacy compared to Chinese men.

A similar table with data on environmental literacy questions provides information whether women also lack confidence in the area that they perform better.

Environmental Literacy Questions Answer Frequency and Percentage by Gender

Question	Answer Correct				Answer Don't Know			
	Male		Female		Male		Female	
	Freq.	Pct.	Freq.	Pct.	Freq.	Pct.	Freq.	Pct.
Light	112	59.9	154	72.3	13	7.0	16	7.5
Ozone	157	84	172	80.8	1	0.5	2	0.9
Warming	145	77.5	169	79.3	14	7.5	17	8.0
Animal	119	63.6	147	69	7	3.7	13	6.1
CO2	71	38	105	49.3	25	13.4	26	12.2

The table shows the frequency and percentage of the males and the females who answer correctly and who answer “don’t know” to the five environmental literacy questions.

Table above shows that female respondents outperform male ones in terms of correct answers in all of the environmental literacy questions except the Ozone question. This supports the argument that there is a gender gap in environmental literacy as well. Moreover, a larger proportion of females answer “don’t know” in all of the questions except the CO2 question. The results indicate that the lack of confidence of women persists when looking at environmental literacy. This also implies that the lack of confidence in females may not be a reason for the gender gap in environmental literacy.

Appendix F. Sample Characteristics of Three Types of Investors

	Type-U	Type-A	Type-M
N	231	169	64
Proportion (%)	57.8	42.2	16.0
FL	3.33	3.35	3.20
EL	3.20	3.21	3.72
Gender (%)			
Men	52.0	45.0	40.1
Women	48.0	55.0	59.9
Age (%)			
0-18	2.2	1.2	0
19-25	32.9	21.3	10.9
26-35	38.1	47.9	59.4
36-45	16.9	20.1	20.3
46-60	9.9	8.9	9.4
60 and above	0	0.6	0
Edu (%)			
Some school	2.6	1.2	1.6
High school	7.8	5.3	3.1
Specialized school	10.8	10.7	15.6
Undergraduate	51.5	64.5	64.0
Graduate	24.7	14.2	14.1
PhD	2.6	4.1	1.6
Subjects (%)			
Studied Env/Bio	39.8	49.1	53.1
Studied Econ/Bus	35.9	52.7	54.7
Stock (%)	61.5	77.5	81.3

The table shows the basic characteristics of the three types of investors.

Appendix G. Impact of general financial behaviour on environmentally related financial preference

	Record spends			Save			Stock		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Type-A		0.345*** (0.116)	0.247** (0.116)		0.010 (0.114)	-0.005 (0.117)		0.164*** (0.046)	0.107** (0.043)
Male	0.311*** (0.115)	0.324*** (0.114)	0.156 (0.115)	0.235** (0.113)	0.236** (0.113)	0.122 (0.116)	0.164*** (0.046)	0.170*** (0.045)	0.113*** (0.042)
FL			0.052 (0.056)			0.060 (0.056)			0.088*** (0.020)
EL			-0.056 (0.048)			-0.085* (0.049)			-0.001 (0.018)
Age			0.072 (0.060)			-0.059 (0.060)			0.084*** (0.022)
Edu			0.029 (0.066)			0.060 (0.066)			0.080*** (0.024)
Stu_Bio			-0.123 (0.122)			0.396*** (0.122)			0.035 (0.045)
Stu_Bus			0.081 (0.124)			-0.183 (0.125)			0.173** (0.045)
Stock			0.663*** (0.136)			0.404*** (0.137)			
City			-0.039 (0.193)			-0.197 (0.194)			0.135** (0.072)
Obs.	400	400	400	400	400	400	400	400	400
R^2	0.018	0.040	0.134	0.011	0.011	0.074	0.031	0.061	0.254

Table X. Types Impacts on Environmental Related Financial Preferences (Lower return & Pay higher) From columns (1) to (3), the dependent variable equals the score that the respondent has given to the question: “I always keep track of my expenses.” From columns (4) to (6), the dependent variable equals the score that the respondent has given to the question: “I try to save as much money as possible.” For the next part of the analysis, respondents are segmented based on their ESG preferences and included a dummy variable, distinguishing between type-U (equals 0) and type-A (equals 1). The table is the result of a standard OLS regression, and the standard error is reported in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% level, respectively.