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Blockchain Adoption Gains. Consumers' Willingness to Pay for Transparency in the Coffee Sector

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ABSTRACT

Modern day consumers increasingly value and demand transparency and traceability in their purchased products. However, the verifications of (global) value chains' responsible processes have traditionally been left to trust. Blockchain holds the potential to disrupt entire industries by offering a range of tools to increase and ensure transparency. However, introduced in 2008, it has struggled to gain widespread adoption. Recurrent barriers have been related to fears with its ability to finance itself, once implemented. Aiming to provide empirical evidence on the increased earnings that this technology could provide to companies, this study analyses the willingness to pay of consumers for the verifiable transparency that blockchain technologies could provide. Using Logit and ordinary least squares (OLS) approaches, we find consumers to be concerned with fair production and transparency issues, but still lack full knowledge or trust of blockchain's advantages and/or its adequate use by coffee industry practitioners.

Keywords: Blockchain; traceability; transparency; willingness-to-pay; coffee industry.

PLAGIARISM STATEMENT

The content of this document is the sole responsibility of the author, who declares that he has not committed plagiarism and that all references to the work of other authors have been correctly cited in the text.

– Robert Crowley

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LIST OF ABBREVIATIONS USED:

WTP: Willingness to Pay
DLT: Distributed Ledger Technology
BaaS: Blockchain as a Service
SDGs: Sustainable Development Goals

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1. INTRODUCTION

In this new era of increased digitisation there are constant emergences of new technologies that offer significant promise to businesses in the way of efficiencies and advantages. None more so in recent years than blockchain technology. It is fair to say no other recent technology has garnered as much attention and hype around it as blockchain. PwC, (2020) states in its "Time for trust" report that blockchain technology has the potential to add around 1.7tn USD to the global economy by 2030, enhancing 40m jobs globally by the same date and estimates 10-15% of worldwide infrastructure to be utilising blockchain within the decade. There is an increasing number of studies analysing the drivers and barriers, especially the latter, of blockchain adoption among different industries. Also, there have been efforts on assessing the market impact of such a technology, such as consumer attitudes towards companies implementing it. However, blockchain being so idiosyncratic and its outcomes so ill-defined, both approaches must be combined to gain a truly holistic picture of the potential impact of this technology. This study addresses this need by analysing the advantages of blockchain adoption for firms in the coffee sector, measured as the willingness to pay (WTP) of consumers for increased transparency and reliable traceability information.

Blockchain holds unique characteristics of enhancing transparency, traceability and security whilst also improving transactional efficiency and speed for firms (Hofmann & Strewe, 2018). Given these characteristics companies are starting to consider blockchain as a solution for the increased calls from both governments and consumers to increase firms' transparency and traceability. Traceability and provenance represented the most popular real-world use cases of blockchain in 2020 amongst the world's largest brands (Fenton, 2020). These use cases are of particular importance in developing nations where there are threatening environmental, social and governance issues at play (Kshetri, 2021). Furthermore, given the array of food safety scandals and unethical productions in recent years it seems it is now blockchain's perfect moment to flourish and help regain consumer confidence (Dionysis *et al*., 2022). The biggest debate and barrier to the technologies adoption amongst firms is if it can become a self-financing venture. This thesis explores this point and, furthermore, fulfils the gap of analysing consumers purchasing attitudes towards blockchain confirmed products, something that has received an extremely small amount of attention given how much notoriety blockchain has received throughout recent years (Dionysis *et al*., 2022).

Current day (global) value chains are designed for cost and time efficiencies. Large issues such as traceability and transparency have lagged behind for years (Lund *et al*., 2020). This is particularly true for the coffee sector where these issues have been in the spotlight for some years. Constant news of unfair wages to farmers and volatile prices all leave an increased level of scepticism with the end consumer over whether it is indeed a fairly processed cup of coffee they are consuming. It seems as though blockchain has come along at the perfect time to aid in alleviating many of these concerns that have hampered the coffee sector in this new age of the conscious consumer. So, why has blockchain not been more widely adopted then, if this is the case?

Since its emergence onto the global scene in 2008, as the underlying technology for bitcoin, one would have suspected over a decade later for it to be at the very heart of many different industries giving its advantageous characteristics. This is particularly true for coffee related firms, where provenance information is so pivotal and topical to today's consumers. So much so that the ecologically conscious consumer has received sizeable marketing and academic attention in recent years (Taufique *et al*., 2016), particularly as it pertains to product provenance and eco-labels displaying these facts to aid the conscious consumer's choice (Testa *et al*., 2013). This underutilisation of a seemingly perfectly suited technology leads to the main motivation of this study. After analysing drivers and barriers explored in the literature, evidence is provided on the consumer-based advantages that these technologies offer for coffee practitioners.

1.1 Research Questions and Contribution

The main research objective of this master's thesis is to analyse and contribute to the understanding of the benefits that blockchain adoption can bring to companies in the coffee industry. That is, improved transparency as perceived by the consumers, can generate increased earnings in the form of extracting a higher WTP from those consumers. To begin, the literature surrounding the drivers and barriers of blockchain implementation for firms is analysed. Then the chosen individual variables, some of them being related to blockchain perceptions, that affect the WTP of coffee consumers are measured. While not being able to offer an emphatic answer on the viability of the venture itself, this study provides practitioners with reasons to seriously consider the adoption of blockchain for their businesses, either fully or in same parts of the (global) value chain. Given this route of thinking the research questions are as follows:

> *What are the primary sources of managerial resistance to implementing blockchain technology (in the coffee sector)?*
>
> *What are the effects of increased transparency and traceability on coffee consumer's purchasing attitudes, upon blockchain technologies' adoption?*

To set out and answer these research questions primary data was collected through a survey. Individuals were surveyed, i.e., potential coffee consumers, to analyse purchasing attitudes and blockchain knowledge whilst aiming to measure how increased transparency affects their purchasing attitudes. We also collected price estimates from blockchain service providers and conducted a survey with coffee industry managers to analyse their perceived resistance or lack off to implementing blockchain for their firm.

In sum, blockchain-based technologies have arrived to stay, but their costs and benefits are not entirely understood yet. Originating from a digital currency design, blockchain has transitioned to a completely disruptive technology not only offering advantages to current business activities but also enabling the creation of new ventures. However, its implementation in companies, especially those in traditional sectors (e.g., commodities) continues to be met with reservations. This work aims to provide empirical evidence of the improved performance that blockchain could allow firms to obtain. That is, after describing some of the implementation barriers and

costs generally exerted, this study empirically analyses the potential earnings that could be achieved, based on consumers' increased willingness to pay for improved traceability and transparency. The contribution of this study is twofold. Research-wise, it evaluates whether some of the managerial constraints for implementation exerted still exist or not. Additionally, it analyses consumer perceptions of blockchain technology, as a driver for business opportunities. As far as practitioners are concerned, simply put, this work assesses whether blockchain adoption pays off or not.

1.2 Sustainable Development Goals addressed

As it pertains to the United Nation's Sustainable Development Goals (SDGs), the virtues of blockchain are so broad that it could likely benefit many of the SDGs. Hughes *et al*., (2019) provide a list of reasons why blockchain technology would drive to (positive) changes in all the SDGs. This master's thesis mainly contributes to tackle two of them, those being:

#9: Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

Blockchain as an underlying instrument for global trade is a distinct possibility with various benefits of its implementation to all players involved. This infrastructure would ensure inclusive and transparent business transactions on all fronts, levelling the playing field and eradicating any inequalities making it a fairer process for all. Furthermore, blockchain being one of the greatest innovations in recent years, there's no doubt fostering and aiding in blockchain adoption in industries is the true definition of fostering innovation that will benefit the world globally. This thesis can contribute to promote the advantages of blockchain and make a case for its widespread adoption benefits.

#12: Ensure sustainable consumption and production patterns.

Blockchain at its core ensures traceability and transparency, through its own functioning. These characteristics, in turn, will ensure that whatever product or commodity that is to be traded and exchanged on blockchain's ledger technology will be produced and consumed in a sustainable manner as not to hinder the future production of said product for future generations to be able to do the same. This master's thesis makes the case how blockchain will aid in a more sustainable coffee production, a commodity that has constantly been produced in an improper manner.

Furthermore, stating modestly, this study can help in several other dimensions. Being able to trace products would help to guarantee fair prices to farmers and producers (*no poverty, #1*). In general, blockchain all over the (global) value chain, would help maintaining decent standards among the participants (*decent work and economic growth, #8,* and *reduced inequalities, #10*).

2. LITERATURE REVIEW

2.1 Blockchain Technology Basics

Blockchain is a decentralised, immutable ledger that facilitates the task of tracking transactions and assets in a peer-to-peer network setting (Beck *et al*., 2018). It operates using distributed ledger technology (DLT) which, in essence, is a large database that is revised individually by each network participant (Presthus & O'Malley, 2017). Blockchain's decentralised structure permits the bypassing of third-party intermediaries, enabling utilisers to interact more efficiently and quickly (Sciarelli *et al*., 2021). Any assets, either tangible or intangible, have the capacity to be traded on the blockchain network.

In practice, information about each transaction is stored in digital data packages, the blocks (see *Figure* 1). Each block contains its own data, its own hash (i.e., a type of identification algorithm) and the hash of the previous block. This chronological addition of blocks develops the chain network. The hash linkage is an effective measure against fraud, as any data edit would compromise the validity of the whole chain. In other words, each subsequent block strengthens the verification of the preceding block and the blockchain as a whole entity (Kaur *et al*., 2021). Under DLT, there must be full consensus among network participants for a given block to be added to the chain. Errors can only be rectified by adding a completely new block with the correct information, and both the initial error block, and the corrected one remain on the blockchain visible to all participants. Utilising blockchain increases trust and confidence in the network due to its decentralised nature (Wang *et al*., 2019). Blockchain's network data immutability and distribution among participants has unlocked a new level of transparency and traceability that was not present before its emergence (Treiockblmaier & Garaus, 2022). Blockchain's core characteristics hold distinct benefits for all industries (Ali *et al*., 2020).

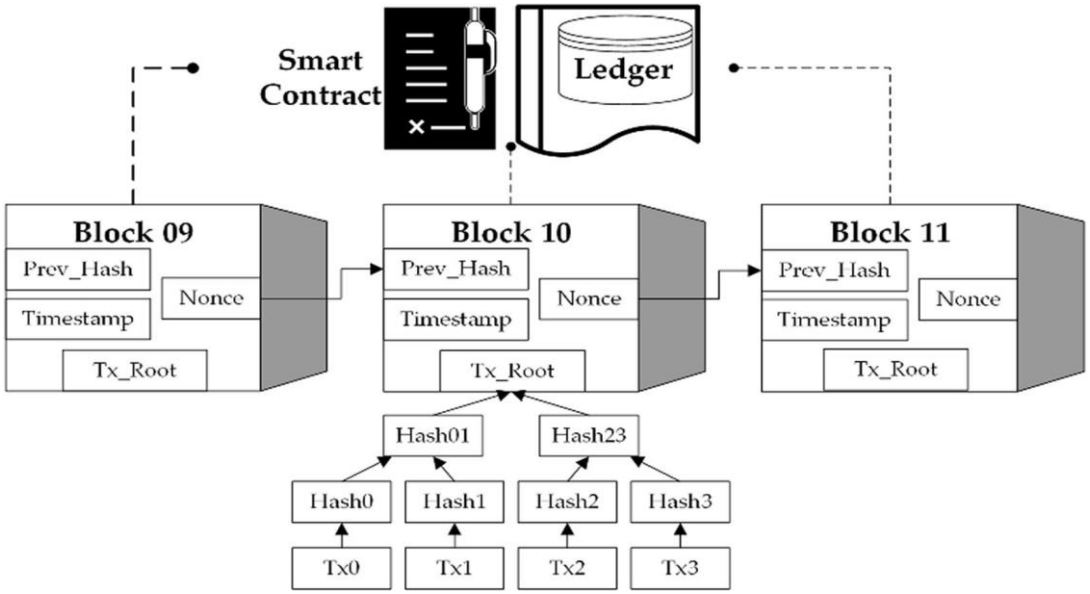

Figure 1. A typical blockchain representation
(source: Agrawal *et al*., 2021)

2.2 The Evolution of Blockchain

Blockchain was first introduced to the world in 2008 by founder Satoshi Nakamoto as the underlying technology for the cryptocurrency Bitcoin. Bitcoin was created using blockchain to tackle shortcomings in the current financial system. Bitcoin is not tied to a currency, nor does it rely on a central monetary authority to oversee its proceedings. Since its inception, blockchain has garnered mainstream attention through the dizzying highs of many cryptocurrencies that operate on its technology. This surge in notoriety has aided blockchain's transition from a digital cash system to a disruptive technology that will have lasting impacts on the further digital transformation of our world (Rosenoer, 2019). The value creating potential of blockchain has gained particular attention, highlighted by the ever-increasing number of practitioners researching use cases that may be of benefit to them in their respective fields. As stated by (Dabbagh *et al*., 2019): "Blockchain as emerging technology is revolutionising several industries, and its abundant privileges have opened up numerous research directions in various industries; thereby, it has acquired many interests from the research community".

Blockchain's biggest value drivers lie in its core traits of security, transparency, and traceability. Industry players can take advantage of these traits to extract value when they identify an opportunity. However, blockchain's advantages are not solely intangible, as it also helps cut multiple business costs, both transactional and administrative (Casino *et al*., 2019), and improve cost efficiencies (Andoni *et al*., 2019). Indeed, Blockchain has evolved into a truly revolutionary technology and different sectors and firms are beginning to realise its potential and value it offers them.

2.3 Costs of Blockchain

The cost of blockchain is a multi-faceted aspect of the technology. There is the initial cost of implementation for a firm and perhaps payments to their blockchain provider. On the other hand, there are large environmental costs to be considered when deciding to implement this technology. For as long as blockchain has been around, there have been frequent claims that its energy consumption is extremely problematic (Truby, 2018). In today's world especially, with the ever-worsening issues surrounding sustainability and climate change, these claims could seriously impede the widespread implementation of blockchain (Beck *et al*., 2018). The environmental costs of blockchain come through its large energy consumption and computational costs, which can be described as the sum of the costs required to finalise a transaction on the blockchain (Wood, 2017). However, an enterprise blockchain, as is the focus of this study, falls far short of the energy consumption of cryptocurrency based public blockchains for both proof of work and proof of stake models for items such as Ethereum and Bitcoin. These blockchains consume the vast amount of their energy through the mining process (see *Figure 2*). Unfortunately, blockchain's energy consumption is here to stay, as its own decentralised nature acts as the main driving force behind these absorbent energy costs (Jabbar & Dani, 2020). Computational costs are seen as pivotal by experts and have a significant

positive effect on the consensus algorithms, ensuring a transparent and efficient system (Mondal *et al*., 2019).

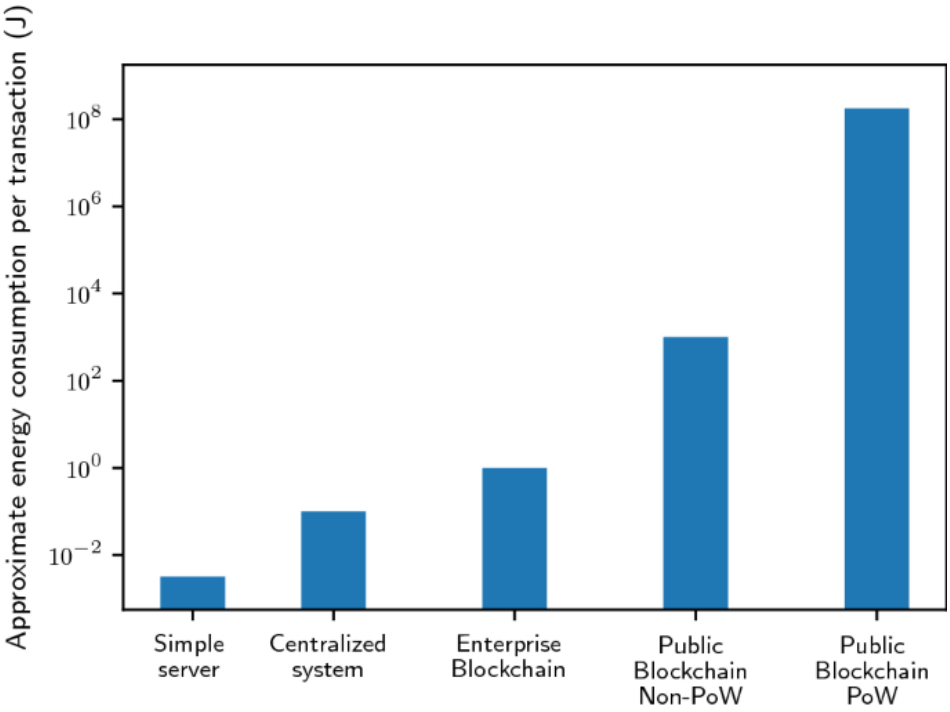

Figure 2. Various Blockchain's energy consumption
(source: Sedlmeir *et al*., 2020)

For small coffee firms, perhaps the more pressing issue would be the sheer cost of adoption of blockchain. Different businesses require different blockchains, for example, a coffee firm attempting to ensure traceability for their product does not need a high complexity blockchain and therefore does not need to create a platform from scratch. Blockchain being in its infancy and each case being so idiosyncratic, it is almost impossible to say with certainty the cost of a project without knowing the exact features necessary. However, an accurate range for most commercial blockchain app developments start from $5,000 and can even reach $200,000 in some cases (Azati, 2019). It is costly and extremely difficult for common developers and firm's teams to create, sustain and observe a blockchain network (Zheng *et al*., 2019). The most cost-efficient way for small businesses to implement blockchain technology is through hiring an agency or utilising blockchain as a service (BaaS) (Takyar, 2019). BaaS successfully embeds blockchain framework onto a cloud computing network, which allows for the fast and effective start-up and monitoring of a blockchain network (Zheng *et al*., 2019). BaaS runs on Hyperledger Fabric, which is a permissioned blockchain network launched to target commercial use cases (Cachin, 2016). There are many large technology companies actively participating and researching Hyperledger technology such as IBM, Intel and SAP. Below in *Figure 3.* shows the pricing for one of IBM's BaaS products (Food Trust) available to enterprises. Food Trust is specifically for companies in the food sector that want to increase and improve their food provenance. It is the perfect product for coffee firms who want to implement blockchain, to provide their consumers with traceability information.

Figure 3. IBM Food Trust pricing.
(source: IBM, 2019)

2.4 Managerial Concerns and Adoption Barriers

The advantages described above have not, as of yet, been strong drivers for blockchain adoption. Academics and practitioners continue to debate whether it is indeed more financially viable than pre-existing solutions (Rimba *et al*., 2018). Major mainstream adoption hurdles can be clustered into regulation uncertainties, internal governance, and related costs. In this same vein, there exists a knowledge gap with respect to blockchain and there is a need for more specific research and education (Holotiuk *et al*., 2017). Ultimately, strong managerial support is pivotal for the successful adoption of blockchain by a firm and the failure to address managerial resistance is likely to impede the technologies widespread integration (Betzwieser *et al*., 2019). The objective of this study is to provide evidence of the benefits and costs that would be incurred from implementing blockchain.

The foremost managerial concern is the perceived high cost of embedding blockchain into a firm's operations. Blockchain has developed far more rapidly in industries with lower adoption costs, namely digitally based firms where managers often create their own blockchain solutions (Walsh *et al*., 2021). Conversely, high adoption cost industries, such as tech and banking are more likely to opt for BaaS platforms (Zhang, 2018). BaaS can prove to be a viable alternative for firms, as it mitigates the need to create their own blockchain from scratch, reducing costs and with it, managerial resistance to adoption. Walsh *et al*. (2021) find that switching costs do not appear to make a significant difference to managerial resistance to blockchain-based systems. These authors attribute this to managers either being confident in the technology and the certainty that its benefits can outweigh the costs of implementation or to a lack of awareness of the actual cost involved in blockchain and unknowingly omitting them from their evaluations. Simply educating managers about blockchain and the advantages it provides them with, will naturally alleviate many of the concerns they have, thus making them more willing to utilise the technology.

Lacking the skills to extract maximum utility and benefits from blockchain is another common source of managerial resistance within firms. The greatest scepticism for blockchain adoption was found among stakeholders with little know-how of blockchain technology (Ge *et al*., 2017). To combat the lack of skills, Ge *et al*. (2017) proposed two straightforward learning objectives: 1) Learn the general knowledge of blockchain technology and 2) Identify the benefits of blockchain technology.

In Hackius & Petersen (2017) study of small and medium-sized companies which received 152 participants the following figures highlight parts of their findings. *Figure 4.*, highlights the fact that the majority of firms in the study (57%) have either implemented blockchain solutions or are actively investigating possible use cases that will benefit their operations. The remaining 43% of firms either observe blockchain developments from a distance or simply do not investigate blockchain technology at all for their business.

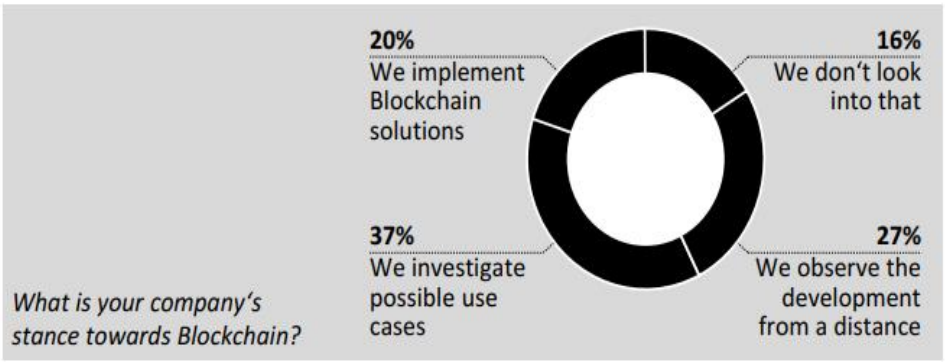

Figure 4. Company's stance towards blockchain.
(source: Hackius & Petersen, 2017)

Figure 5., details from the same aforementioned study, what the most significant barriers to adoption were amongst participants. Regulatory uncertainty was seen to be the largest barrier followed by different parties having to join forces. Uncertainty around regulation as well as cohesion are commonly among the most prolific barriers to blockchain adoption in the literature. Hackius & Peterson (2017) study concluded that middle managers are far less enthusiastic when it comes to blockchain adoption when compared to both operational employees and c-suite executives. Similarly, there is evidence of middle managers stunting innovation by speaking negatively on it and even preventing their staff from participating in innovation application tasks (Birken *et al*., 2012). Further studies such as Floyd & Wooldridge (1992) concluded middle managers impede innovative leaps by 'dragging their feet' or going after other priorities. And Huy (2002) who similarly found that in IT firms, a lack of mid-managerial support constantly led to the ineffective implementation of innovative technologies. It is clear that the adoption barriers for blockchain are multi-faceted, it is not only a monetary or regulatory issue but mid-level managerial resistance also poses a large threat to blockchain.

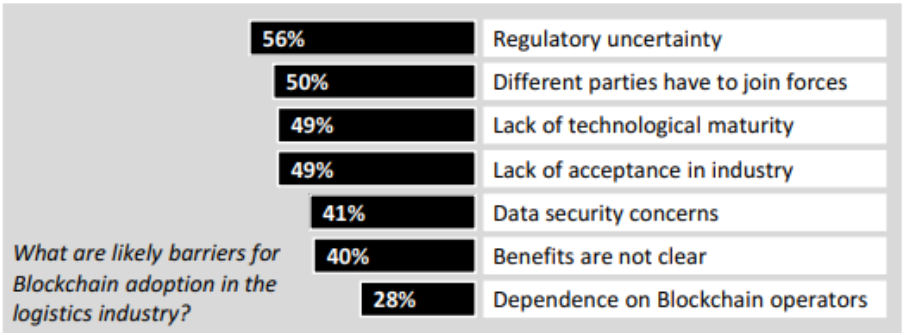

Figure 5. Barriers to blockchain adoption.
(source: Hackius & Petersen, 2017)

2.5 Blockchain in the Food Sector

As aforementioned, blockchain is actively being widely researched for its potential and possible avenues of implementation in many different industries. One of the main sectors where this holds true is within the food industry. Blockchain's core characteristics of immutability, transparency and decentralisation make it particularly suited to the food industry and the challenges the sector is faced with in today's world. Not only is the industry facing large challenges over food safety and quality but consumers are becoming more conscious with regards to their food choices and what they buy (Latino et al., 2022). Given this situation and the calling from current days consumers for increased food provenance, as well as the shortcomings in many traceability networks worldwide; it comes as no surprise that the biggest players in the technology world have rushed to get to the forefront of practical use cases.

IBM was the first company to utilise blockchain to establish a permissioned distributed ledger network for of all the players involved along the food supply chain. IBM's "food trust" network, links every step of the production process and aims to touch on numerous factors such as food safety, increase efficiencies, minimise waste and increase traceability. It ensures all the various actors along the food supply chain maintain a high standard of transparency and accountability for their product by sharing the ledger of the exact and updated details of each food's origin and transportation intricacies (Gupta, 2018). Food Trust is a permissioned blockchain, meaning, in order to view the details on the network proper credentials must be held. This is different from a completely public blockchain e.g. Bitcoin, where anyone can view each transaction. A service like this is invaluable to firms in today's world of the conscious consumer. This study aims to assess whether joining a program such as food trust is financially viable for firms.

Figure 6, illustrates Hackius & Peterson, (2017) study respondents' thoughts on potential use cases across multiple different scenarios. As it pertains to the food industry, identifying counterfeit products and facilitating origin tracking score highly in terms of the advantages blockchain would provide if implemented in these areas. The majority of respondents also believe that the likeliness of adoption in these scenarios is more likely than not.

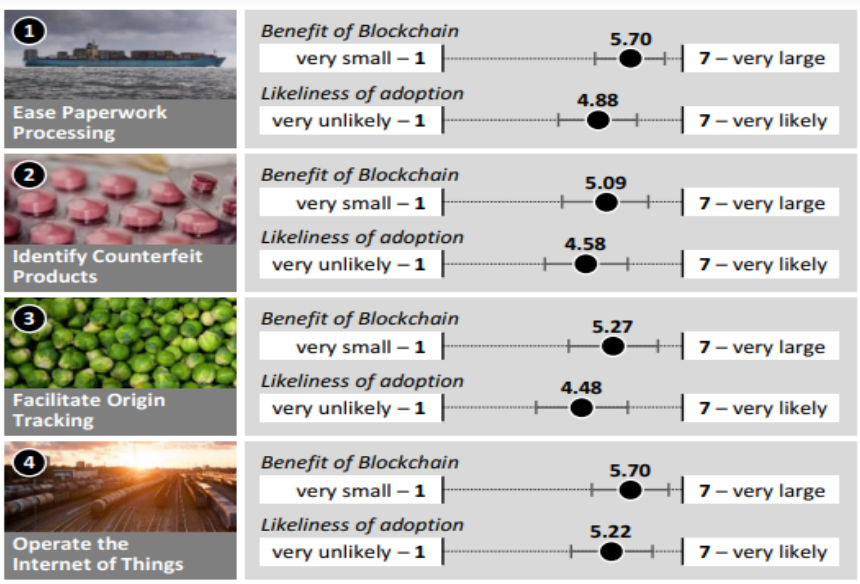

Figure 6. Evaluation of Use Cases.
(source: Hackius & Petersen, 2017)

2.6 Demand for Traceability from Consumers

It is evident that blockchain provides many operational benefits to firms, but its characteristics are also in high demand in recent years due to the ever-increasing amount of socially conscious consumers. Consumers have become increasingly demanding for increased food provenance and safety. Firms in the food industry are willing to oblige due to numerous studies finding consumers are willing to pay a premium to ensure traceability and an even higher premium when quality and safety attributes complete that triad (Zhang *et al*., 2012). Food safety has also become a pressing issue for governmental bodies (Hobbs, 2003). Further pressing the need for increased traceability over the years are high profile food scandals, which every time come with a fresh calling for improved transparency and traceability practices from consumers and governmental bodies alike. One such case was the 1996 E. Coli outbreak in the UK which resulted in 496 cases of E. coli O157 along with 18 subsequent deaths (Nayak & Waterson, 2016. This 1996 outbreak was investigated and labelled as a direct example of a lack of regard for safety and hygiene standards within the food operators involved (Stanwell-Smith, 2013). Scandals such as this push the narrative and demand for increased food provenance further and further with each event. Pouliot & Sumner (2008) state that traceability can be an effective tool to combat the asymmetry of information amongst consumer and producers and improve the safety of the food.

However, despite the increased calls from consumers for increased traceability efforts and processes, there still exists a wide variety of regulatory frameworks amongst countries conducting business which allows these crises to still happen relatively frequently across the globe (Chammem *et al*., 2018). There exists little change in many industries to really combat the issue of traceability. Blockchain will be the technology to truly revolutionise many aspects of industries involving food safety and quality. This study aims to assess the end consumers attitude to products that are 100% traceable from its origin, via blockchain technology.

3. METHODOLOGY

3.1 Data Collection and Sample

This study aimed to analyse whether consumers were willing to pay a premium for a blockchain confirmed coffee, given the increased level of transparency and traceability this would provide. Both the proportion of respondents willing to pay (WTP%) and the willingness to pay in monetary amount (WTP€) were assessed. Furthermore, the study examined how these variables were affected by other individual characteristics, such as: coffee characteristics that consumers find important when purchasing, blockchain knowledge and awareness, ethicalness of production concerns and various demographic features.

An online-based survey was carried out over a two-week period in May 2022, making use of several social networks and digital platforms. This data collection method is acknowledged as an effective way to quickly gather reliable insights from real consumers around the world. The survey was launched in both English and Spanish, to ensure as diverse of a reach as possible. There was no specific sampling method, as any potential coffee customer could contribute. The final sample contains 113 observations from individual consumers, from a variety of backgrounds and origins. This sample size, while being modest, allows for the validity of our results and some basic generalisations.

The survey aimed to gain a multitude of insights into the participants answering it (see *Annex* 1, for the questionnaire). The first section pertained to the respondent's coffee attitude, namely their consumption habits. Clear and concise questioning asked how much coffee one drinks per week and what is important to them when purchasing (e.g., brand, price etc.). The survey then moved onto gauging the participants' knowledge on blockchain technology. A 5-point Likert scale measurement aided the participants in categorising their thoughts from 'strongly disagree' to 'strongly agree'. By utilising a Likert scale, it provided independence to the participant to select their preferred answer in a fair and balanced manner, whatever their preferences (Joshi *et al*., 2015).

The next section aimed to analyse what blockchain's actual impact could be in the coffee sector and, namely, how coffee consumers feel about that. This was done by asking if the participants would be willing to pay a premium for the various advantages a proven blockchain product would offer. This section was prefaced with a brief and non-biasing explanation of how blockchain could be used in the coffee industry, i.e., improving transparency and traceability all over its value chain. Following on from this, the willingness to pay of the participant was assessed. Among respondents not willing to pay any extra premium, a follow-up question examined their reasons, to ensure a holistic approach to the research.

The survey concluded with general demographic questions surrounding age, gender, education, income, origin and employment status. This section was purposely placed at the end, as opposed to the beginning, as not to feel overly intrusive with the off-topic nature of the questioning. It also ensured increased honesty from participants when answering the preceding sections of the

survey; as they would have felt no threat of being identified having not answered a demographic section to begin with (Teclaw *et al*., 2012). In fact, this approach is recommended when willingness to pay is the variable of interest (i.e., asking for income at first, could potentially bias respondent's subsequent answers).

3.2 The Variables

This section explains the variables collected and/or constructed for each individual (i.e., consumers), which is the *unit of analysis* in this study.

The survey questions allow for two different *dependent variables* to be addressed: the proportion of consumers that would pay a premium and the monetary amount that they are willing to pay. The proportion is measured as a binary variable asking interviewees whether they want to pay or not for increased transparency in the coffee sector (yes = 1, zero otherwise), thanks to the implementation of blockchain technologies. This study aimed to assess which characteristics enhance the willingness to pay propensity. Subsequently, among respondents saying 'yes' to the previous question, the amount they would contribute with, in euros was measured and recorded. Through this variable, each characteristic that makes them more willing to pay higher amounts can be assessed.

As for the *independent variables*, several sections were built. These included all the standard demographics asked in the survey (see *Annex* 1 and descriptive statistics in Section 4.1 for further details). The coffee consumption was measured as cups per week (Yang *et al*., 2015). As for the sections on coffee characteristics, production awareness and blockchain awareness, a cluster analysis was conducted to identify similarly behaving groups. Ultimately, for each of the three blocks of questions the *k*-means method was utilised to split the sample into two different clusters. From here it was possible to identify groups diverging on (i) coffee preferences, (ii) production awareness and (iii) blockchain knowledge and acceptance. Three binary independent variables resulting from the cluster analysis were introduced, labelled as 'coffee selective', 'process aware' and 'blockchain acceptant' (see *Annex* 2 for further internal information on each cluster).

It is valid to believe that there would be some positive impact between these clusters and both the propensity to pay an extra and the amount willing to pay. For example, respondents paying attention to coffee characteristics, being aware and/or concerned about the coffee production process and having some knowledge of the blockchain advantages would be willing to pay (more). It was decided to only create two clusters per block, given the small sample size present in the study.

3.3 Econometric Models

This study utilised two different econometric methods: logit and ordinary least squares (OLS). Logit was employed to analyse the propensity to pay of respondents, as recommended when dealing with a dichotomous dependent variable. The model is as follows:

$$
\begin{aligned}
WTP = \ & \beta_0 + \beta_1\, age + \beta_2\, female + \beta_3\, education + \beta_4\, employee(public) \\
& + \beta_5\, employee(private) + \beta_6\, employee(other) \\
& + \beta_7\, salary\ level + \beta_8\, female * age + \beta_9\, female * education \\
& + \beta_{10}\, consumption + \beta_{11}\, coffee.selective \\
& + \beta_{12}\, process.aware + \beta_{13}\, blockchain.acceptant + \varepsilon
\end{aligned}
\qquad \text{[Eq. 1]}
$$

In equation [1], WTP represents the binary dependent variable that indicates whether the respondent is willing to pay or not (1 = "yes"). Terms β_1 to β_{13} are parameters to be estimated by the model. Parameter β_1 corresponds to the continuous variable of age. Parameter β_2 corresponds to gender. Parameter β_3 corresponds to education, transformed into an ordinal variable (1 = "primary", 2 = "secondary", 3 = "bachelor", 4 = "master" and 5 = "doctorate"). Parameters β_4 to β_6 correspond to the employment status, where "student" is the baseline category. Terms β_8 and β_9 measure the interaction of gender with age and education, respectively. Parameter β_{10} measures the weekly consumption effect on the propensity. Estimates β_{11}, β_{12} and β_{13} correspond to the cluster explained above on coffee attitudes, process awareness and blockchain acceptance. Finally, β_0 and ε refer to the constant and the error term of the model, respectively.

No results are predicted for any result relating to the demographic and consumption variables. However, its expected parameters β_{11}, β_{12} and β_{13} will be positive, as more selective consumers, being more aware about the production of the coffee that they purchase and accepting the advantages of blockchain would be willing to contribute with an extra premium.

As for the other dependent variable, OLS regressions were used for the estimation. In this case, a continuous dependent variable is used, and this model can properly measure the impact of independent variables. It is important to mention that all the observations are included in this model. That is, respondents answering "no" to the WTP question are also considered, to which a value of zero is assigned, in the amount that they are willing to pay. Given the majority of positive WTP found in the sample, the lower bound being zero is valid in this model. The independent variables used replicate those exposed in equation [1].

4. RESULTS

This section describes the main results found in this study. It starts by describing the sample and the main variables used. The second part presents the findings for the models described above on the WTP propensity and amount.

4.1 Descriptive Statistics

It is important to preface this section with given that the survey was carried out via social networks, the sample is dominated by the researcher's contact's profile. That is, a large portion of respondents are students, placed in two main European countries. *Table 1* shows the descriptive statistics of the variables used in the models.

The participants in this survey were between 18 and 66 years old, with a mean age of 31.78. The age mode was 23 and the median age was 26. They were 62% male, 36% female, 1% Non-binary/non-conforming and 1% preferred not to say. The participants were distributed throughout the world with origins in five different continents of Europe, North and South America, Asia and Oceania. In total, individuals from 20 countries participated in the survey. However, the data was concentrated in Europe, with 82% of the respondents. The top three answering countries were Ireland with 35% of respondents, followed by Spain (30%) and The United States (9%).

Furthermore, all respondents have finished secondary education with 96% having obtained an undergraduate degree or higher. The data consisted of Bachelor (42%), Master's degree (34%) and Doctorate (20%). In *Table 1*, the constructed ordinal variable for education is shown (levels 1 to 5). Pertaining to the employment status of the participants, students represent 29% of the sample, and together with employed individuals (both public and private) comprised 90% of the data. The remaining 10% is dispersed among residual categories and labelled here as "others". Finally, the income of the participants shows the highest proportion to be within the interval of € 30,001-50,000, 28% of the sample, with 50% earning less than € 30,001. Interestingly 4% of respondents earn more than €120,000. *Table 1* shows the constructed ordinal variable for salary (levels 1 to 6).

When making a purchasing decision, participants listed quality as the most crucial aspect of the coffee, with a mean of 3.94. Relating to the section surrounding production methods, traceability and trade transparency, participants stated to be concerned about the ethical production of the coffee they buy, with a mean answer of 3.04. When looking at the blockchain focused section, almost two thirds of the respondents either strongly agree (46%) or agree (17%) that they have heard about blockchain (average 3.7 in the table). However, only half of them (25% strongly agree and 24% agree) that they know some blockchain advantages. And even less, agree (19%) and strongly agree (11%) that blockchain could allow for coffee traceability. These findings go hand in hand with Risius & Spohrer (2017) statement on there being a true paucity of knowledge in society surrounding where and how blockchain can be utilised effectively to benefit trade and society.

Table 1. Descriptive Statistics (n = 113)

		Type	Mean	Median	SD	Min.	Max.
Demographics	Age	*continuous*	31.78	26	11.47	18	66
	Female	*dummy (1, female)*	0.36	0	0.48	0	1
	Education	*ordinal*	3.70	4	0.84	2	5
	Student	*dummy (1, student)*	0.29	0	0.46	0	1
	Salary	*ordinal*	2.49	2	1.28	1	6
Habits	Cups per week	*continuous*	10.62	10	7.34	0	35
	Drink home *	*Likert*	3.60	4	1.33	1	5
	Drink work *	*Likert*	3.36	4	1.30	1	5
	Drink social *	*Likert*	3.02	3	0.99	1	5
Coffee Choice	Brand	*Likert*	2.48	2	1.26	1	5
	Price	*Likert*	3.08	3	1.17	1	5
	Quality	*Likert*	3.94	4	1.01	1	5
	Origin	*Likert*	2.58	2	1.27	1	5
	Ethical Production	*Likert*	2.89	3	1.22	1	5
Process Aware	Check origin	*Likert*	2.18	2	1.31	1	5
	Aware of production	*Likert*	2.23	2	1.18	1	5
	Selects ethical production	*Likert*	3.04	3	1.34	1	5
	Aware of traceability	*Likert*	1.99	2	1.14	1	5
	Checks traceability	*Likert*	2.93	3	1.37	1	5
	Concern of transparency	*Likert*	2.45	2	1.30	1	5
Blockchain	Heard of BC	*Likert*	3.70	4	1.50	1	5
	Knows BC advantages	*Likert*	3.22	3	1.45	1	5
	BC increases transparency	*Likert*	3.39	3	1.25	1	5
	BC allows traceability	*Likert*	2.97	3	1.18	1	5
	BC certifies origin	*Likert*	3.13	3	1.15	1	5
	Trust BC technologies	*Likert*	3.12	3	1.16	1	5
WTP	Cup average price *	*continuous*	2.72	3	1.05	1	5
	WTP %	*dummy (1, yes)*	0.68	1	0.47	0	1
	WTP, € (only pay =1) *	*continuous*	0.38	0.30	0.25	0.10	1
	WTP, € (including zeros)	*continuous*	0.27	0.20	0.27	0	1

Education: 1 = Primary; 2 = Secondary; 3 = Bachelor; 4 = Master; 5 = Ph.D.
Salary (in thousand €): 1 = < 15; 2 = 15-30; 3 = 30-50; 4 = 50-80; 5 = 80-120; 6 = > 120
* Not included in the models.

The final part of *Table 1* shows that 68% of the respondents in the sample are willing to pay. This propensity level of willingness to pay was expected, in accordance with prior other studies (Yang *et al*., 2015). As for the average amount that participants are willing to pay, an average of 0.38 € is obtained, among those who stated to be willing to pay something. Interestingly, more than half of respondents were willing to pay 0.30 € or more. Including zeros in this calculation (respondents not willing to pay), this average goes down to 0.27 €.

4.2 WTP and Individual Characteristics

Willingness to pay, both propensity and amounts, per groups of respondents are displayed in *Table 2.* Column (1) shows the percentage of respondents willing to pay an extra premium to certify the traceability of their coffee using blockchain technology. The interpretation is straightforward, in percentual terms. Column (2) shows the average amount that sub-sample of respondents are willing to pay (in cents) for the premium mentioned above. The value shows the average only for those who answered "yes" to the previous question, average including zeros are presented in parenthesis. Column (3) shows the WTP amount in relative terms, as compared to the average coffee price that the respondents already pay which was gathered from the survey data. This variable is not used later in the analyses.

In general, as in the previous table, it is seen that more than two thirds of interviewees (68%) are willing to pay a premium. That premium is just shy of 40 cents of euro (0.38 €), on average, and it represents a willingness to pay a 15% premium on their average usual coffee price. Per groups, on average, younger people, male, with tertiary education, high income and being heavy coffee drinkers are willing to pay higher amounts (column 2).

I consider interesting to mention the origin results. It is observed that North American respondents hold both the highest WTP propensity (82%) and WTP amount (0.58 €), both exceedingly above the sample average. This derives significant implications for any businesses considering implementing blockchain protocols to increase their product's traceability. It is clear this area offers some attractiveness and coffee firms which have a base of operations in North America should seriously consider blockchain adding solutions to their operations.

As for the clusters explained above (and described in *Annex* 2), the following profiles are proposed for the respondents included within them, in tandem with the WTP results:

> *Cluster* A1: respondents strongly valuing coffee brand, quality, origin and ethical production, but giving lower importance to price. Demographically, there are slightly older, with higher salary and heavy coffee drinkers. This group is found to have a slightly higher proportion of them being willing to pay (70%) and those who pay are willing to offer higher amounts (0.42 €), as compared to *Cluster* A2.
>
> *Cluster* B1: respondents highly concerned with coffee production methods, traceability and trade transparency, and they want to be informed. Demographically, they are more educated. They are found to have a much higher proportion of them being willing to pay (77%), but they only pay a shy higher amount (0.42 €), as compared to *Cluster* B2.
>
> *Cluster* C2: respondents with higher knowledge and general acceptance of blockchain technologies. Demographically, they are much younger, further educated and drinking less coffee. Although there is a slightly higher proportion of respondents willing to pay within this group (69%), they exert the lowest WTP amount, as compared to *Cluster* C1.

Table 2. WTP per groups of respondents

Groups		n	(1) WTP (%)	(2) WTP * (€)	(3) WTP/price (%)
General		113	0.6814	0.38 (0.27)	0.1539
Age	Under 25	47	0.7447	0.36 (0.27)	0.1219
	25-40 ♠	39	0.6667	0.44 (0.29)	0.1821
	Over 40	27	0.5926	0.36 (0.21)	0.1781
Gender	Male	71	0.6761	0.40 (0.27)	0.1556
	Female	40	0.7000	0.37 (0.27)	0.1548
Origin	EU	93	0.6559	0.36 (0.24)	0.1495
	North America ♠	11	0.8182	0.58 (0.47)	0.1778
	Other	8	0.7500	0.35 (0.26)	0.1722
Education	Secondary	5	0.8000	0.20 (0.16)	0.0938
	Bachelor	47	0.6596	0.40 (0.26)	0.1299
	Master	38	0.7368	0.41 (0.31)	0.1735
	Doctorate	23	0.6087	0.34 (0.21)	0.1851
Salary	< 15,000	32	0.7500	0.39 (0.29)	0.1576
	15,000-30,000	25	0.6800	0.32 (0.22)	0.1598
	30,001-50,000	35	0.6571	0.38 (0.25)	0.1591
	50,001-80,000	15	0.5333	0.48 (0.25)	0.1250
	80,001-120,000	2	0.5000	0.30 (0.15)	0.0750
	> 120,000	4	1.0000	0.50 (0.50)	0.1542
Employment	Student	33	0.8182	0.37 (0.30)	0.1395
	Public Employee	37	0.8108	0.36 (0.29)	0.1483
	Private Employee ♠	32	0.3750	0.51 (0.19)	0.2146
	Oher	11	0.7273	0.34 (0.25)	0.1323
Drinkers	< 10 cups/week	53	0.6415	0.37 (0.24)	0.1593
	≥ 10 cups/week	60	0.7167	0.40 (0.28)	0.1496
Coffee selective	*Cluster* A1	51	0.7059	0.42 (0.29)	0.1574
	Cluster A2	62	0.6613	0.36 (0.24)	0.1508
Process aware	*Cluster* B1 ♠	48	0.7708	0.41 (0.32)	0.1691
	Cluster B2	65	0.6154	0.36 (0.22)	0.1398
BC acceptant	*Cluster* C1	42	0.6667	0.45 (0.30)	0.1575
	Cluster C2	71	0.6901	0.35 (0.24)	0.1519

* WTP for the subset of respondents who pay a premium. In parenthesis, with zeros included.

♠ Consistently show significant differences on mean tests, compared to same group categories.

Throughout the results there exists an interesting pattern, where although the WTP % of a group can be seen as below average, the actual WTP€ of said group is often considerably above the sample's average. For example, one such standout result is that private employees who actually have the lowest WTP% at 38%; go on to have the highest WTP€ at 0.51. In stark contrast to this, in the employment categories both student and public employees have an 81% WTP% but both their WTP€ fall below the average. A particularly lucrative group can be seen as expected with salaries of greater than 120,000 €. This group, albeit only a sample of 4, have a 100%

WTP% with the second highest WTP€ of 0.50. These trends and results have great implications for coffee sector firms that are considering implementing blockchain solutions in their operations. It shows that firms do not necessarily need to target the most agreeable consumers but a niche crowd with higher WTP€ could potentially be more financially viable.

4.3 Primary Results

The main results of the study are shown below in *Table 3*. Columns 1 to 3 show the results for the Logistic regression (Logit) models, explaining the fact of paying or not (0, 1). Initially only the main demographic variables are included, then only the clusters as explanatory variables, to conclude with the full model. Columns 4 to 6 explain the WTP€, making use of the Ordinary least-squares (OLS) estimation, and mimicking both variables and steps.

To begin, we see how age has a negative effect on the WTP% as well as the WTP€. That is, younger individuals seem to be more willing to pay a premium, and they also offer higher amounts for enhance transparency in the coffee value chain. A negative effect is seen once again in terms of level of education, on the WTP%, which is a result that may need future research. Interestingly, being employed in the private sector also has a negative effect (as compared to the reference category of students). Both these points seem almost counterintuitive, as one would expect someone who is further educated to be better informed on blockchain and its advantages. As for private employees, who on average earn a higher level of income, it is reasonable to expect these people to therefore have a higher WTP€. These results strongly counter act that reasoning. However, it is important to remember these findings in the descriptive statistics, where private workers are found to be less propense to contribute but they offer a considerably high WTP%, over the average.

Models (3) and (6) show that older respondents and females, per se, are less willing to pay and offer lower amounts. However, the interaction between female and age consistently shows that older females are willing to pay more for increased transparency in the coffee sector. In fact, the group of older female reaches the highest propensity to pay (84%) and quite a high WTP (0.45 €). For the purpose of information, males between 25 and 40 years old reach the highest WTP average (0.54 €).

Finally, the clusters explained above also show some insights. How people choose their coffee, does not have any impact on the propensity or the WTP amount. However, the more aware respondents are about the process and the transparency, positively affects to their WTP. This research confirms this fact, both in the propensity and the amount that they are willing to pay. Surprisingly, the blockchain knowledge, while not affecting the propensity to pay, negatively impacts the amount that people are willing to offer. That is, the higher the knowledge and the acceptance of this technology, the lower the amount they are willing to pay. This may follow a sensible intuition for this sample: a big portion of well-educated students have a good knowledge on blockchain and its virtues, but they cannot afford to pay any premium.

Table 3. Logit and OLS models for WTP variables

	Logit Models Dep. WTP (pay = 1)			OLS Models Dep. WTP (€)		
	(1)	(2)	(3)	(4)	(5)	(6)
Age	-0.0799**		-0.1075***	-0.0086**		-0.0108***
	(0.034)		(0.039)	(0.002)		(0.002)
Female	-4.3007		-5.2748*	-0.3729		-0.4694*
	(2.722)		(2.974)	(0.272)		(0.251)
Education	-0.7622*		-0.9563**	-0.0261		-0.0153
	(0.391)		(0.446)	(0.041)		(0.038)
Employee - Public	0.1460		-0.2189	-0.0269		-0.0540
	(0.820)		(0.863)	(0.076)		(0.078)
Employee - Private	-2.1849***		-2.6977***	-0.1153*		-0.1240*
	(0.714)		(0.827)	(0.073)		(0.081)
Employee - Other	0.0086		-0.1097	-0.0196		-0.0428
	(1.190)		(1.278)	(0.098)		(0.092)
Salary Level	0.1903		0.2833	0.0266		0.0292
	(0.2311)		(0.253)	(0.030)		(0.029)
Female * Age	0.1416**		0.2068***	0.0156***		0.0183***
	(0.061)		(0.072)	(0.008)		(0.006)
Female * Education	0.0574		-0.2038	-0.0303		-0.0327
	(0.847)		(0.912)	(0.114)		(0.096)
Cups per week		0.0096	0.0585		0.0010	0.0036
		(0.028)	(0.039)		(0.003)	(0.003)
Coffee selective		-0.0581	-0.5646		0.0227	0.0033
		(0.440)	(0.562)		(0.050)	(0.053)
Process aware		0.7963*	1.5209**		0.1132**	0.1336**
		(0.473)	(0.640)		(0.058)	(0.057)
BC acceptant		-0.1080	-0.5202		-0.0901*	-0.1428**
		(0.441)	(0.585)		(0.061)	(0.062)
constant	6.2031***	0.4414	7.2050***	0.6021***	0.2498***	0.6350***
	(1.828)	(0.484)	(2.076)	(0.157)	(0.061)	(0.160)
N	111	113	111	111	113	111
AIC	126.9	148.1	126.3	34.3	33.6	30.0
BIC	154.0	161.7	164.2	64.1	49.9	70.6
Pseudo R2	0.35	0.04	0.43			
R2				0.13	0.06	0.23

Employment reference category: "Student"

Robust standard errors in parenthesis

*, ** and *** denote significance at the 10%, 5% and 1% level, respectively

4.4 Reasons to Not Pay

Now, to briefly present the reasons that respondents who did not want to pay any extra premium listed. As a reminder, they could select more than one option within this question. There were 36 individuals in the sample (roughly one third) not paying anything. *Table 4* shows the main reasons selected.

Table 4. Main reasons to WTP = 0

	Full sample	Do not want to pay more	Distrust blockchain	Distrust coffee agents	Can find information myself	Distrust sellers	Other reasons
n	*113*	24	9	9	5	4	5
Age	*31.8*	31.7	39.9	34.9	34.6	44.8	23.8
Female	*0.36*	0.29	0.33	0.22	0.40	0.00	0.50
Education	*3.70*	3.71	3.78	3.22	3.60	3.00	3.80
Students	*0.29*	0.21	0.11	0.22	0.00	0.25	0.00
Salary	*2.49*	2.54	2.44	2.00	2.40	1.75	2.60
Coffee selective	*0.54*	0.62	0.56	0.44	0.40	0.50	0.40
Process aware	*0.57*	0.75	0.78	0.67	0.40	0.75	0.00
BC acceptant	*0.37*	0.38	0.44	0.44	0.20	0.50	0.00
Cups per week	*10.62*	10.67	6.78	9.11	9.80	9.50	11.40

A vast majority of the respondents who did not pay stated that the "*I do not want to pay more*" for enhance transparency. In fact, a few of them added that could be interpreted as a critique, such as "it should be transparent by default". We find these respondents to be the average interviewee, but more aware of the coffee value chain than the average. This, together with the fact that they have higher average income, reinforces the idea that, while being concerned and able to afford to pay, their answer is a type of protest against coffee traders.

Some also distrust the advantages of blockchain itself. They are older and very concerned with production transparency. Thus, it is understandable that they lack enough knowledge about the technology to give it a change in the sector. Among those distrusting coffee agents and sellers, they are somewhat older and less educated than the average, and also with lower income levels. They are highly aware, as compared to average levels (they even accept blockchain) but it seems they feel that coffee traders will not use the technology properly. Finally, those who think they can find the information themselves, are less coffee selective, less aware on the process and more reluctant to blockchain technologies.

Among the category of others, we found some insightful comments. The main ones were "*it does no need to be verified*", "*traceability does not translate into quality*", "*blockchain is not appropriate for the traceability purpose*" or "*I believe this information [traceability] should be publicly disclosed by brands*". It is visible some answers present an opposite air to them, more than a lack of interest towards the increased transparency.

4.5 General Discussion

Throughout the analysis of the results, many outcomes fell in line with prior expectations. However, there were also some rather surprising results that will be discussed later. To begin with the expected, those being, that quality of the coffee and it being ethically produced are the most important characteristics to consumers when purchasing. As aforementioned in section 2.5: '*Demand for Traceability from consumers',* in recent years consumer have undoubtedly become more conscious and demanding for their products to be of a higher standard for both ethical and safety reasons alike. This is supported further by the significant majority of respondents in the study willing to pay a premium to verify the traceability of their cup of coffee, aligning with Hobbs *et al*., (2005) findings that any excess assurances surrounding traceability increases willingness to pay. This is a finding that was expected in today's world, as it is evident just how important the issue of traceability and transparency has become particularly in the food sector. The food supply chain has faced constant food safety and point of origin issues making traceability the most pivotal characteristic (Patidar *et al*., 2021). And it is fair to say this feature is gaining importance.

The business world has transitioned into utilising corporate social responsibility (CSR) as a key strategic element over the recent years. The findings of this study reiterate the main ideas of Porter & Kramer (2007) who concluded how CSR must be used as a truly strategic instrument for businesses to succeed. This rings true when examining *Cluster* B1, that is those who give added importance to coffee production methods, traceability, and trade transparency. Belonging to this group of conscious consumers has a positive effect on both a person's WTP% and WTP€. This aligns with our prior expectations before conducting this research. That for these conscious consumers, who value ethical production and traceability, etc., would benefit from a blockchain proven coffee, where all this information would be readily available to them, thus, making them content to pay a premium for said product.

Additional findings which aligned with prior expectations is that younger people are more likely to pay a premium than their older counterparts. This is a result which further reiterates the changing state of the world and the rise of the conscious consumer. Nowadays the younger generations are growing up in a world where they know no different than entities such as fair trade and various NGOs, that fight against disparities in the coffee sector. It is said that the millennials can be characterised as socially conscious (Klimkiewicz & Oltra, 2017) as well as more supportive of Sustainable Development Goals (SDGs). Furthermore, findings from Yamane & Kaneko (2021) study show that younger people live more sustainable lifestyles than their older counterparts. Therefore, it makes sense for the results to reflect the negative effect age has on WTP% and WTP€ for this blockchain proven good, which would ensure a sustainably produced coffee product.

Moving on to some thought-provoking findings that were contradictory to expectations. One such example is *Cluster C2*, being, the group of respondents who have a higher knowledge and general acceptance of blockchain technology. Belonging to this group is actually found to impact WTP€ negatively. One would assume this relationship to be positive. A possible

explanation for this is that although these consumers may have heard of blockchain, they may not be truly knowledgeable on all the various intricacies and advantages of the underlying technology and how it can be used in this particular traceability scenario. There is a lack of understanding in relation to the benefits of blockchain technology and how it can be used in various fields (Fu *et al*., 2020). Similarly, it may be true that this group is extremely knowledgeable and know how blockchain can be advantageous in helping the traceability in the coffee sector but may simply not value the outcomes highly enough to pay a premium. As mentioned above, the high presence of (educated but low-income) students may support this finding. It is fair to say blockchain technology, particularly in the most widely utilised application, cryptocurrencies, is not the most environmentally friendly of processes. The issue is summarised well by Truby, (2018):

> *"Mining and* transactions *are an application of Blockchain technology employing an inefficient use of scarce energy resources for a financial activity at a point in human development where world governments are scrambling to reduce energy consumption through their Paris Agreement climate change commitments and beyond to mitigate future climate change implications."*

It is reasonable to assume that a person who is more accepting of an environmentally damaging technology, pays less head to the traceability and ethicalness of their coffee. Thus, for this blockchain accepting cluster, it makes sense for them to give less value to the traceability benefits that can be achieved and therefore explains having a negative relationship with WTP€.

Further surprising results come in the form of education having a negative effect on WTP%. One would expect for a person of higher educational experience to not only be aware of the traceability benefits of blockchain but also be more aware of the societal importance of it. Finally, the private employee category, when compared with the base group of students have a lower WTP% and WTP€. Again, one potential explanation for these outcomes could be those of higher education lead onto higher paying private sector jobs where all things sustainability, many times can fall second priority to capitalism and an emphasis on monetary gains above all else. It is almost unconsciously that people learn that exploitation of resources, labour and countries is acceptable and even good for society as it allows our economy to function (Magdoff & John Bellamy Foster, 2011). For these people, who are driven by monetary gain, the added traceability element may be seen as futile and not worth their money.

5. CONCLUSION

In order to analyse and discuss the research objectives of this study which were again:

> *What are the primary sources of managerial resistance to implementing blockchain technology (in the coffee sector)?*
>
> *What are the effects of increased transparency and traceability on coffee consumer's purchasing attitude, upon blockchain technologies' adoption?*

A literature review, survey and quantitative analysis of the gathered data were conducted to draw conclusions.

Blockchain has not been as widely adapted as one would have expected given its potential when it arrived onto the world stage in 2008. One of the main reasons for this is that it faces strong resistance from firms and managers alike. Elements at the forefront of this resistance are costs, lack of knowledge and internal capabilities, cohesion between industry players and regulatory uncertainty. These are the main barriers but more exist. Each plays a different role in standing in the way of blockchain adoption for different reasons. Some can be labelled and seen as monetary, and others seen as a risk to the efficiency of normal business. Furthermore, it is seen that mid-management's disparity for fostering innovation is in itself a considerable barrier and threat for blockchain moving forward. Money, skills and regulation are constantly at the forefront of business decisions regardless of what the exact decisions is about, and in essence, it is no different for blockchains adoption. However, it is clear that managerial resistance is a severe hurdle for the technology to overcome if it is going to become what many expect it to become in the coming years, a truly revolutionary, disruptive and transformative technology of great potential and power that will transform the very face of any industry that choose to utilise it. Before becoming this omnipotent entity, it needs to win this fight first to gain mainstream adoption.

Blockchain's core characteristics of decentralisation, immutability, security and time stamping, seemingly make it the perfect fit in today's world to fill the void, finally and emphatically, for the demand for coffee traceability. For years issues of unsustainable production due to lacklustre compensation for farmers, unethical sourcing and even in some cases fraud in terms of labelling coffee beans have been issues in the sector. Blockchain as a technology holds the capacity to put an end to all this, by creating a collaborative and trustworthy network for all players in the sector to utilise, lifting the sector from disparity. Widespread implementation must occur for positive outcomes to materialize.

The effects of implementing blockchain technologies overall have a positive impact on consumer purchasing attitudes. Consumers are more thoughtful and conscious about their purchases now more than ever before. A blockchain proven good plays into this new world ethos of sustainability and being a responsible consumer perfectly. This is reflected in the consumer attitudes in this study, as any form of improving traceability, transparency, origin certification, were all received positively with increases in WTP propensity and WTP€,

especially among young consumers. However, that being said, knowledge and acceptance of blockchain was found to impact negatively on consumers WTP€. So, it is clear businesses must improve traceability to extract higher prices from their consumers but perhaps blockchain is not the best nor most efficient way of doing this. Should a business be able to verify the origins and ensure full traceability of their products in a cheaper, less complex way than blockchain; then, that seems like the more viable option for them to take at this stage of blockchain's development. Some hints were found when looking at the protest answers by individuals who would not pay a premium. These consumers are concerned and can afford to pay extra but do not fully trust industry practitioners to correctly use the technology for the addressed purpose of transparency. Businesses should focus on appeasing the socially conscious consumer, providing food provenance information first and foremost. Whether blockchain is the best way for them to do this needs further empirical evidence.

Future research is needed to convincingly conclude whether a blockchain project can indeed self-finance itself or not. It is evident that blockchain has large monetary and environmental impacts to be considered. However, for smaller firms in the coffee sectors there are cost and energy effective alternatives such as BaaS, that provide extremely promising alternatives to creating a blockchain from scratch. That being said, with the conscious consumer in the data responding positively to traceability information, whilst being blockchain aware resulting in a negative impact on WTP€ of respondents, arises the need for debate. It begs the question, why risk utilising a technology, whose name is so tightly bound with adverse environmental impact as blockchain's is and risk losing the business of the evidently lucrative conscious consumer because of this.

5.1 Limitations and Future Research

Although great efforts were made to ensure the highest quality and efficacy of this research there does exists limitations to the study. One such being the sample size and sample make up. It is worth noting that the sample size of 113 is statistically effective for a study of this nature but not for any truly applicable real-world conclusions. Furthermore, the data consisted of a large number of students which in turn can skew the data to a common mindset particularly when considering the financial constraints on students. While being found to be concerned with transparency and traceability, they show a low WTP levels for the previous reasons. Furthermore, respondents are from areas that are mainly coffee-consumers. The production awareness is certainly increasing (recall higher levels among young respondents) but it may not have the same vision as respondents from coffee-producer's regions. Individuals in touch with farmers would be expected to have a more conscious vision on the fact of transparency, fairness, traceability, etc. Whilst WTP-based methods are often said to not be sufficient to validate real purchase behaviours (Breidert *et al.*, 2016). Some authors have argued surveys provoke pleasing answer from respondents, who aim to contribute to foreseeable outcomes of the study but would not actually behave accordingly. In this vein, field experiment would surely complement empirical evidence of studies similar to this one.

Further research areas to sprout form this study should delve deeper to encourage true use cases to appear in various sectors. For example, conducting a large-scale cost/benefit analysis with interviews from actual blockchain providers to obtain accurate quotes on a blockchain system needed to provide the added traceability and compare that with the increase willingness to pay from conscious consumers and make a truly viable business case for blockchain's adoption.

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ANNEXES

Annexe 1. The Survey

BLOCKCHAIN IN THE COFFEE SECTOR

This research aims to assess the viability of implementing blockchain technology in the coffee sector. Specifically, this survey will explore how clients would react to improved transparency in the coffee supply chain. Your answer will aid in providing pivotal data for our analysis of this research question.

Rest assured that the data collected from this survey is totally anonymous, will be kept confidential and used strictly for our research purposes.

Thanks for your participation!

(Estimated completion time: 4-5 minutes)

COFFEE ATTITUDES

This section is to understand your coffee consumption

What is your average coffee consumption per week, in cups?

_____ cups/week

In a normal a week, what are the places you mostly drink coffee?

	Never	Rarely	Sometimes	Often	Always
At home					
At work					
Socially					

Indicate the importance you give to the following items when purchasing coffee (1, no important; 5, very important)**:**

	1	2	3	4	5
Brand					
Price					
Quality					
Origin					
Ethically produced					

Choose whether you agree or disagree with the following statements (1, strongly disagree; 5, strongly agree)**:**

	1	2	3	4	5
I always check the coffee's source/origin					
I am aware how coffee has been produced					
It is important for me that coffee has been ethically produced					
I am aware about coffee traceability					
I prefer to buy coffee that I can trust its traceability					
Transparency on coffee production is something that worries me					

BLOCKCHAIN PERCEPTIONS

This section is to help us gauge your knowledge of Blockchain

Choose whether you agree or disagree with the following statements (1, strongly disagree; 5, strongly agree)**:**

	1	2	3	4	5
I have heard about blockchain					
I know some blockchain advantages					
I think blockchain will increase transparency in many fields					
I know blockchain could allow for coffee traceability					
I believe blockchain could certify coffee origin and production					
In general, I trust blockchain technologies					

BLOCKCHAIN IN THE COFFEE SECTOR

This section is to assess the impact that blockchain implementation could have in the coffee sector

Blockchain Summary

Blockchain is a digital system to record information. Blocks of information are added chronologically and each block contains partial information from the previous one (the chain). Every block is duplicated across the entire network of participants. For example, in a business network, each single transaction should be approved by all participants for the information to be stored and certified. That information cannot be later altered because (1) it would be detected and (2) it would modify all other blocks in the chain.
Simply put, and referring to the coffee supply chain, it would ensure improved transparency and traceability of consumer goods. Customers could verify origins and production processes at the moment of purchasing coffee (e.g., with a QR code).

What is the price of a regular cup of coffee you would pay in your usual cafe? _____ €

Would you be willing to pay a small premium if you could certify the traceability of the coffee you are purchasing?

Yes	☐	[to section 'About you' section]
No	☐	[to section 'Reasons not to pay']

REASONS NOT TO PAY

Select the reasons why you would not pay a small premium (you can choose more than one and/or add 'others')

I do not trust the blockchain yet	☐
I do not trust intermediaries	☐
I do not trust the coffee sellers	☐
I can find the information myself	☐
I do not want to spend more	☐
Other: _____	☐

ABOUT YOU

This is the last section. Thank you for your collaboration so far.
The aim is to get to know you better and we guarantee it is totally anonymous

Your Age (write down the number)

_____ years old

Your Gender

Male	☐
Female	☐
Non-binary/non-conforming	☐
Transgender	☐
Prefer not to respond	☐

Place of origin?

(Select a country from the list)

Your Education Level

Primary Education	☐
Secondary Education	☐
Bachelor or similar	☐
Master's Degree	☐
Doctorate	☐
Other: _____	☐

Your Employment Status

Student	☐
Employed - Private company	☐
Employed - Public company	☐
Self-employed (freelance)	☐
Unemployed	☐
Retired	☐
Other: _____	☐

Which range better describes your personal income last year?

Less than € 15,000	☐
€ 15,000 - € 30,000	☐
€ 30,001 - € 50,000	☐
€ 50,001 - € 80,000	☐
€ 80,001 - € 120,000	☐
Greater than € 120,000	☐

Annexe 2. Cluster analysis description

The following table depicts the characteristics of the clusters used in our models. All the cluster variables are measured in a 5-points Likert scale.

	Coffee Selective		**Process Aware**		**Blockchain Acceptant**	
	Cluster A1 (v = 1)	*Cluster* A2 (v = 0)	*Cluster* B1 (v = 1)	*Cluster* B2 (v = 0)	*Cluster* C1 (v = 0)	*Cluster* C2 (v = 1)
n	51	62	48	65	42	71
Brand	2.8824	2.1452				
Price	2.9412	3.1935				
Quality	4.3725	3.5806				
Origin	3.7059	1.6452				
Ethical Production	3.7059	2.2258				
Checks origin			3.2500	1.3846		
Aware of production			3.0833	1.6000		
Selects ethical production			4.0625	2.2769		
Aware of traceability			2.7708	1.4154		
Checks traceability			4.1458	2.0308		
Concern of transparency			3.4583	1.7077		
Heard about BC					2.0952	4.6479
Knows BC advantages					1.7381	4.0986
BC increases transparency					2.2381	4.0704
BC allows traceability					2.1190	3.4789
BC certifies origin					2.1429	3.7183
Trust BC technologies					2.2619	3.6338
Age	32.8	31	32.4	31.3	34	30.4
Female = 1	0.35	0.37	0.36	0.36	0.43	0.32
Education (1 to 5)	3.67	3.73	3.79	3.63	3.48	3.83
Student (%)	0.25	0.32	0.29	0.29	0.24	0.32
Salary (1 to 6)	2.67	2.34	2.54	2.45	2.4	2.54
# cups a week	11.3	10.1	10.5	10.7	11.3	10.2