MSc Program
Engineering Management

Accelerated crypto currencies: A systematic analysis of Silvio Gesell's theories and its implementation on local crypto currencies

A Master's Thesis submitted for the degree of
"Master of Science"

supervised by
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Affidavit

I, **FABIAN JANISCH, BSC**, hereby declare

1. that I am the sole author of the present Master's Thesis, "ACCELERATED CRYPTO CURRENCIES: A SYSTEMATIC ANALYSIS OF SILVIO GESELL'S THEORIES AND ITS IMPLEMENTATION ON LOCAL CRYPTO CURRENCIES", 127 pages, bound, and that I have not used any source or tool other than those referenced or any other illicit aid or tool, and
2. that I have not prior to this date submitted the topic of this Master's Thesis or parts of it in any form for assessment as an examination paper, either in Austria or abroad.

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Abstract

This master's thesis evaluated the acceptance of crypto currencies, under the impact an existing local Freigeld crypto currency. The intersections of the underlying technology of crypto currencies with a specific part of Silvio Gesell's Freigeld theory named effective demand, built the basis of a local Freigeld crypto currency scenario. This scenario was then used to evaluate the level of acceptance by comparing the scenario to different crypto currencies. Participants of this study were selected by snowball sampling. The data was gathered by a web browser based self-administered survey.
The results showed that the level of acceptance for the local Freigeld crypto currency exceeds the level of every presented crypto currency. Additionally, this study analyzed factors, to explain the cause of the different level of acceptance of the local Freigeld crypto currency. The evaluation showed that the support of the local economy was the only significant impact which caused the increased acceptance of the local Freigeld crypto currency.

Kurzfassung

Diese Masterarbeit evaluierte die Akzeptanz von Kryptowährungen, unter dem Einfluss der Verfügbarkeit einer lokalen Freigeld-Kryptowährung. Die Überschneidungen, bezüglich der zugrundeliegenden Technologie von Kryptowährungen, und eines Teils der Freigeld-Theorie, genannt effective demand, bildeten dabei die Basis des entwickelten Szenarios einer lokalen Freigeld-Kryptowährung. Dieses wurde im Zug einer Umfrage verwendet, um die Auswirkungen auf die Akzeptanz von Kryptowährungen zu untersuchen. Die Daten wurden mithilfe einer eigenständig auszufüllenden, online Umfrage erhoben. Die Verteilung erfolgt durch das Schneeballsystem.
Das Ergebnis der Studie zeigte, dass die Akzeptanz der lokalen Freigeld-Kryptowährung höher ist als die Akzeptanz aller evaluierten Kryptowährungen. Darüber hinaus untersuchte diese Arbeit Faktoren, die eine Änderung der Akzeptanz erklären könnten. Dabei zeigte lediglich die Unterstützung der lokalen Wirtschaft einen signifikanten Einfluss auf die erhöhte Akzeptanz der lokalen Freigeld-Kryptowährung.

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Abbreviations

SME	small and medium sized enterprises
DLT	distributed ledger technology
POW	proof of work
GDP	gross domestic product
RPI	retail prices index
CPI	consumer price index
QED	quantitative economic development
ZMR	zentrales melderegister
GDPR	general data protection regulation

Symbols

This table contains all symbols used in mathematical expressions.

Symbol	Definition
s	Second
t	Time
M	Money in circulation
V	Velocity of circulation of money
M'	Bank deposits (deposit currency)
V'	Velocity of circulation of deposit currency
$V'' \cdot M''$	Active quantity of money
T	Volume of trade
P	General price level
R	Resilience
E	Efficiency
C	Development capacity
S	Level of sustainability

1 Introduction

1.1 Motivation

Caprio et al. (1996) stated 96 banking crises between 1980 and 1996. [CK96] Margrit Kennedy (2011) referred to the world bank which documented 124 banking crises, 326 currency crises and 64 government debt crises between 1970 and 2007. [Ken11, p. 11] Hence, it can be said that the recent past shows a considerable amount of economic crises. Although boom and bust cycles are widely acknowledged and accepted within the economic scholarly society, the questioning of our capabilities to ease their impact increased considerably over the recent years. After the outbreak of the economic crisis in 2008, *The Economist* wrote: *"With a flawed diagnosis of the causes of the crisis, it is hardly surprising that many policymakers have failed to understand its progression."* [eco, p. 13]

Economic crunches have an impact on a vast majority of market participants, this also includes small and medium sized enterprises (SME). In 2017, 99.6 % of all Austrian enterprises were identified as SME (less than 250 employees), employing 67 % of all employees in Austria and generating 61 % of the Austrian gross value added. [Aus19, p. 16f] This shows the considerable importance of SMEs for the Austrian society. Furthermore, their importance was particularly outlined by the international restrictions during the emerging corona crisis in March 2020. Nonetheless, globalization and competitive international players continue to successfully challenge this backbone of the Austrian society, leaving the question of how this process will effect the society's resilience against the frequent crises and how this will generally impact the society over time. One possible outcome might be that the increasing influence of big international companies will streamline our society towards more efficiency. Thereby, the SME's which might have been an useful balance weight for the seemingly frequent economic crises are diminished. [UGLG09]

Under the premise of this effect, approaches have to be found to tackle the described issue of an efficiency driven global economy, which exhibits frequent boom and bust cycles. Looking back again on the economic history of the past 50 years, it can be said that the economic globalization increased and added pressure on SMEs, but the implemented economic concepts did not change the recurrence of economic crunches.

Therefore the personal conclusion was drawn that concepts aside the conventional position might be useful for the further development of our monetary system. In this regard, theories which are determined as marginal region of economic science should be reevaluated and therefore a theory published around 1900 by the entrepreneur Silvio Gesell was chosen as research topic of this thesis.

1.2 Why Silvio Gesell is applicable today

Silvio Gesell was born in 1862 in St.Vith, Belgium and moved to Argentina in 1887. The ongoing economic and social crisis in Argentina made him question the economic system. This resulted in his first book *"Die Reformation im Münzwesen als Brücke zum sozialen Staat"*. It was published in 1891 and already illustrated one of his key ideas to secure a continuous money circulation by a concept named *"stamped money"*. Between 1891 and 1916 he lived in Switzerland, Bavaria and Argentina. The dominant constant during this period of his life were recurring (financial) crises. [Ilg15] Silvio Gesell broadened and updated his theories over time and published his most famous book *"The natural economic order"* (originally in German *"Die natürliche Wirtschaftsordnung"*) in 1916. [Ges49]

Influenced by the economic situation, Gesell tried to provide a theory to prevent (economic) crises and secure price stability. He argues that stability promotes a feeling of contentment in human beings and a feeling of contentment is the basis for peace between nations, people and the world. Instability will lead to crises, which in turn lead to sorrow and war.

In his monetary theory called *"Freigeld"* he ties (economic) crises and wars back to an unbalance between money and products and thereby outlines that this unbalance is caused by the design of the conventional currency. Therefore he proposes an adaption of the latter and consequently of the monetary system, to ensure (price) stability.

Silvio Gesell's monetary theory was and is successfully applied in local areas. The most famous experiment was executed in an Austrian town and is therefore called *the wonder of 'Wörgl'*. Despite its success it was shut down by the Austrian national bank in 1933. [Sch08, p. 72] Since then Gesell's ideas and alternative monetary concepts in general, did not gain a lot of attention.

Roughly 100 years after the publication of his main book and proposals, the bases of our monetary system, the economic boom and bust cycles including all their collateral social instabilities, haven't changed. The monetary system seemed indisputable.

This changed with the recent economic crises of 2001 and 2008 and the simultaneous disruption of the financial world by the development of the distributed ledger technology (DLT) (blockchain and crypto currencies) in 2009. The situation of an economic crunch combined with the new concept of DLT's created an *environment-of-change*.

Big centralized and/or global corporations (including banks) are challenged by this environment. Financial technology companies (called FinTechs) are emerging with new slim and fast financial solutions. DLTs constantly increase their presence in society. The idea of supporting the local economy seems to experience an upswing within the thoughts of the young European generation. Common buzz words are decentralization, regionality and stability.

By bringing all the above mentioned circumstances together, it is evident why the contemplated discussion of Silvio Gesell's (*Freigeld*) theory matches the current period of time. Furthermore, the new developments enable to study his theories from a new perspective. Complementary local crypto currencies, based on the theories of Silvio Gesell, may have the potential to counter the issues arising from an efficiency driven globalized economy and are therefore elaborated in more detail.

1.3 Problem statement

Silvio Gesell's theories were classified approximately 100 years ago as insufficient and are therefor seen as marginal region of economic science. Only a few well grounded research papers exist and discussion on an academic level is rare.

Since the majority of the academic field doesn't acknowledge Gesell's theories a possible reconsideration aside from the scholarly field of economics is considered to be likely. This refers especially to the domain of crypto currencies and the Freigeld was therefore already picked up by a crypto currency named *Freicoin* [2] In this regard, it is assumed that further development of the economic system without scholarly support, is caused by the failure of the academic society to provide solutions demanded of the prevailing *environment-of-change*.

The altering of the complex economic system, without the support of the scholar society increases the risk of misinterpretations or wrong assumptions. This might hinder a progressive development of our monetary system.

1.4 Aims of the study

The overall objective of this thesis is to support the progressive further development of the monetary system by an accurate and just academic discussion of the formerly rejected Freigeld theory of Silvio Gesell. In detail, the applicability of *effective demand* (a specific part of the Freigeld theory) on crypto currencies is evaluated. Based on these findings, a basic scenario of a local Freigeld crypto currency is developed. The scenario is then used in a social survey to assess the acceptance of the local Freigeld crypto currency by comparing it to the acceptance of other crypto currencies.

Hence, this thesis discusses two main parts:

1. The applicability of the concept of *effective demand* on crypto currencies.
2. A preliminary investigation on how the level of acceptance of crypto currencies is influenced by the availability of a local Freigeld crypto currency.

A more detailed description of the research objectives and tested hypotheses is provided in section 3.2.2 (Survey objective).

1.5 Structure

The 'Background' of this thesis starts by describing the concept of the *effective demand*. Therefore, the line of argument from Silvio Gesell, which ultimately resulted in the development of this concept is outlined in detail. The aim was to allow an accurate assessment of the original work. Next, the theoretical background of *blockchains and crypto currencies* is provided. The third part of the background determines the notation of *sustainability*, which enables an exact demarcation and implementation of a *complementary* currency. The background ends by discussing intersections of the previously outlined concepts and the development of a complementary crypto currency, which includes the concept of effective demand.

The 'Methodology' of the conducted social survey provides definitions, proceedings and theoretical background for *two* sample designs. The reason for the development of two designs was the situation in Austria, caused by the SARS-CoV-2 virus, which lead to a necessary adaption of the originally developed approach. Nonetheless, due to the novelty of the original design it was decided to present both to the full extent.

A detailed description of both sample setups (named original sample and executed sample) and a statement concerning the design change is provided in chapter 4, named 'Implementation'.

The 'Results' of the obtained survey data are presented in chapter 5, followed by the 'Discussion' in chapter 6. The thesis ends with the final 'Conclusion' in chapter 7. The online survey is presented in appendix A.

2 Background

2.1 Freigeld

2.1.1 Structure

"Freigeld" is a monetary theory developed by the entrepreneur Silvio Gesell around 1900 and comprehensively presented in his most famous book "The natural economic order" published in 1916. [Ges16]

The book is separated into two main parts: *"Freigeld"* and *"Freiland"*. The nomenclature has its origin in the German language, and its literal translation means *"Free money"* and *"Free land"*. The theories of *Free money* address the properties of money and the accompanying monetary system and the theories of *Free land* address land ownership and private property. A suitable translation of *Freigeld* is the English term *demurrage money* or *demurrage currency*. Used to a lesser extent are the terms *accelerated money*, *accelerated currency* or *stamped money*. [Bla98] As outlined in the following sections, each of the terms stated shows a considerable overlap with the core concept of Freigeld. Nonetheless, due to the common literal translation of the term *Free money*, it is often wrongly equated with the so called *unconditional basic income*. To be clear, neither Freigeld, nor Freiland have anything to do with any forms of unconditional basic income. After studying both theories it can be said that Freigeld and Freiland are the opposite of an unconditional basic income.

The Freigeld theory can be divided into two concepts: *effective demand* and *Freigeld interest theory* or *capital theory*. [Ges16] The latter is the more prominent part of the Freigeld theory and as emphasized by Ilgmann (2011), the concept of effective demand is often overlooked or neglected in scholarly elaborations. [Ilg15, p. 1]

The term effective demand was not directly assigned by Gesell. Nonetheless, it seems to be very accurate and is therefore used for this report. Considering the elaborations in Gesell's book and the aspired impact of the effective demand, it is evident that it builds the basis of the *Freigeld-interest-theory*. Due to its relevance for the stated research question the concept of effective demand is specifically discussed by this study. In this regard, the considerable criticism about the view points or theories of Gesell have to be acknowledged. Therefore, particular emphasis was placed on presenting the effective demand in a methodical and structured way, starting with a substantial description of the view points of Gesell on money. This allows a detailed review of the underlying assumptions. It was also decided to support the elaborations witch a considerable amount of direct citations to accurately illustrate Gesell's line of argument.

It has be mentioned that the outlined effects of Freigeld are not exhaustive. A complete discussion of all consequences would have exceeded the scope of this study. Nonetheless, the impacts presented concerning the effective demand are carefully discussed and enable a profound understanding of the concept of Freigeld. Additionally, it has to be acknowledged that the statements and conclusions of Gesell's have been written more than 100 years ago and should be seen in the context of the respective time.

In general, this thesis does not evaluate any theories of Gesell and no conclusions of its actual applicability are drawn.

2.1.2 Silvio Gesell's problem statement

During the introduction of his Freigeld theory, Gesell argues that money was regularly criticized and condemned throughout human history and still no precise and lasting answer has ever been provided on why money should be the condemnation of humanity. This also includes historically famous people like Pythagoras or Goethe. The failure to provide this answer is, to his belief, caused by external circumstances, which directly influenced the scientific society. He elaborates that e.g. religion or natural sciences feature far more prestige than the science of money. Money was something an aspiring scientific mind shouldn't worry about. He outlined that only a few fact driven scientists could be bothered to investigate the (as he called it) "stepchild of science". He also states that this circumstance was worsened by the widespread belief in the "value doctrine of money". As described by Gesell, the doctrine back then was predominate. It postulates that money needs an "intrinsic physical value" to work. Commonly, this "intrinsic physical value" refers to silver or gold. [Ges49, p. 90] Gesell argues that no supporter of this theory has ever provided a definition which allows an exact determination of this *intrinsic or inner value*. He therefore summed the value doctrine up as follows:

"Gold has an attribute - the so called 'value', which is grown together with the material in the same way as its physical weight. This attribute is bound to gold, similar as its chemical attributes, inseparable from gold ('inner value'), unchangeable and indestructible ('stable value'). The existence of the 'value' is determined by weighting [Assumption: Against other products]. *Currently no other possible way has been developed. It is not effected by the magnetic needle or the highest known degree of heat, but is there and of fundamental importance for science and life."* [Ges49, p. 96]

Gesell's falsification of this doctrine strongly emphasizes that there is nothing more real than economic validation of a monetary theory by the individual and by the nation state. Everything that defers from this true validation can only be a product of imagination and since the *inner value* can't be defined exactly through economic validation, the stated value doctrine should be seen as imagination. [Ges49, p. 96]

The current fiat money seems to prove him right, although the discussion about the "value doctrine of money" is still not completely settled.

According to Gesell, the described situation shifted the research about currencies away from a profound academic discussion (referring especially to the "inner value doctrine") to the imprecise handling of the currency question and monetary affairs. He also argues that delicate topics are seldom touched at university level, which aggravated the situation even more. At last, he outlined the fact that, to his belief, a certain part of knowledge has to be acquired by practice in commerce, to get a comprehensive understanding of the monetary system. He concludes that for this reason,

over 4000 years and 100 human generations, no substantive definition of money has ever been provided and therefore it is still handled by old habits and without scientific reasoning. [Ges49, p. 88]

Gesell ended his introduction with a short comment on the works of *Karl Marx* and *Proudhon*. He criticizes Marx for writing "three thick books about interest (capital) and dedicating in total only 5 minutes of it on the fundamental theory of money". He also states that most nameable economists, especially those with socialist origins, have dedicated there work against interest, failing to see that interest is a mere symptom while the origin of injustice lies in the design of the currency itself. He positively acknowledges the work of Proudhon for not ignoring this fact and providing an idea after which Gesell was able develop his Freigeld theory. [Ges49, p. 89]

2.1.3 The origin of money

Gesell outlined that without the division of labor, the predominant wealth wouldn't be possible and money was developed to overcome the bottleneck of the ineffective barter trade. He argues that except for the products of farmers, almost all manufactured items are basic commodities, only usable for the means of trade and exchange. [Ges49, p. 92]

Definition 2.1.1 (commodity)**.** An item can be seen as commodity if it features the following two attributes: 1. A demand exists for the item. 2. The offered item has to be useful for the buyer (not the seller). [Ges49, p. 107]

Definition 2.1.2 (money)**.** Money is a medium of exchange for basic commodities and it "is a precondition of the division of labor, as soon its extent disqualifies the barter trade." [Ges49, p. 91]

Gesell emphasized that there is a clear demarcation between basic commodities (objects of utility) and the monetary commodity called money. He explains this statement by saying that money (e.g. coins) can't be consumed and doesn't disappear in terms of a decay - it can only be transferred from one individual to another. [Ges49, p. 103] In this regard regard, the author of this study acknowledges the similarities to the law of conservation of energy, which states: Energy can neither be created nor destroyed; energy can only be transferred or changed from one form to another.

Gesell states: The division of labor (and the thereby induced growing specialization of society) creates a compulsive demand for money. [Ges49, p. 92]

2.1.4 The trade with money (and other commodities)

Hence, according to Gesell, the only duty of money is to be a medium of exchange. The resulting trade of money or trade market is described as follows:

"Everyone who brings something to the trade market bears the same spirit to demand the highest possible price, which is permitted by the market conditions". [Ges49, p. 102] *"He has the right to make demands with his slip of paper as far as the trade allows it."* [Ges49, p. 100] *"The ambition to get for a minimum of service a maximum of service in return is the force which guides and restrains the trade of goods."* [Ges49, p. 102]

Nonetheless, Gesell argues that there is no market without the people who trade. He criticizes trading people who use the market conditions and respectively escalated and depressed prices as an excuse. He states "*What are the market conditions, including the economic cycles, without the demand and supply of the trading people?*" [Ges49, p. 102] By this statement, he emphasises that the issues of the market are influenced by the participating individuals. The individuals should therefore be included in the assessment of the issue and if an actual issue is present, it has to be solved.

2.1.5 The three premises of money

The first premise of money:
Money has to be indifferent for the user, with a minimum amount of physical attributes.

"Money doesn't rust, doesn't rot, doesn't grow, doesn't dissolve, doesn't scrape, burn, or cut. (...). We search for no active, but only to all directions inactive attributes. The society demands the minimum of all embodied characteristics for the substantial part of money." [Ges49, p. 111] *"Money has of all the useful objects the fewest attributes and the lowest applicability in industry and agriculture. We show no higher indifference to any other object. Therefore it was so easy to declare gold as money."* [Ges49, p. 112] *"For money it is sufficient that it is countable, the rest is dead weight."* [Ges49, p. 110] Nonetheless, *"the mediation of trade between basic commodities is a sufficient power"* [Ges49, p. 110]

Given the first premise, Gesell acknowledges that the visible properties of money are only tangible due to the necessary material of transportation. He argues that a utility independent of the material might be the reason why it is so difficult to grasp its concept. *"If someone would remove the physical attributes, no one would miss them"*. [Ges49, p. 110]

The second premise of money:
The economic freedom to create money has to be prohibited and the quantity of available money has to be regulated.

"It should never be free of charge. Money fulfills its purpose due to its nature, which is a constant search for it and the law that it can only be obtained by trade" [Ges49, p. 103]

Gesell outlines by various examples that the free creation of money will lead to a collapse of the currency and therefore concludes, *"the economic freedom to create money has to be prohibited"*. [Ges49, p. 103]

He acknowledges that money is part of society and society is a set of rules on which people have agreed to live. Given the power of the nation states at the beginning of the 20th century, he proposes that only nation states are able to prohibit the free creation of money and also regulate its emission. [Ges49, p. 104]

The third premise of money:
Money depicts a circle which it transverses forever; it returns to its origin. [Ges49, p. 104]

Referring to the definition of money (definition 2.1.2), Gesell argues that due to the division of labor, the produced basic commodities are bound to be traded. The same goes for money, both *"are only useful as bartering object."* [Ges49, p. 103] The difference is that money can't be consumed and will therefore circulate within society.

To explain this claim, Gesell provided the example of tea and salt during colonial time. At that time, both where used as means of exchange, but due to their attributes, both were consumed over time. According to Gesell's definition of money, both examples can't be seen as such. [Ges49, p. 104]

2.1.6 The backing of money

"A commodity is backed as long as there is someone who is willing to trade for it, with another basic commodity or money. In other words, a commodity is backed as long as the demand doesn't fade. A commodity can't back itself." [Ges49, p. 117] *"Besides the division of labor there is no other backing for money. The division of labor creates an uninterrupted flow of basic commodities, which generate an uninterrupted demand for means of exchange, for money".* [Ges49, p. 118] *"The money is not backed by its material, it is backed by the need for it (...) and its function as means of exchange."* [Ges49, p. 118]

"The mandatory need of money, by a simultaneous mandatory need of its control by the nation state, gives the state unrestricted power over money and compared to this absolute power the metallic security of the coin is a chaff in the wind. Hence, the money can't be saved against the misuse of power by the fabric, just as little as the constitution of a nation state written on parchment can safe it from an arbitrary rule (Note: the power lies in the people). *Only the will of those in power (absolute ruler or the parliament as representation of the people) can protect the money from carelessness, imposters and thieves - preconditioned that those in power purposeful know how to use it, which has unfortunately never and nowhere been the case."* [Ges49, p. 116]

Despite his criticism of the nation state, Gesell sees no other possibility for money than the administration by law, which is controlled by the state. He declares, *"the money collapses with the collapse of the state and the state collapses with the collapse of the society".* [Ges49, p. 112]

The provided insight of Gesell's thoughts on the backing of money, can be summarized by the following three conditions:

- *"The material of the money can't influence the demand for it; it can therefore never serve as a backing for money."* [Ges49, p. 118]
- *"The backing of money (...) is exclusively guaranteed by the division of labor."* [Ges49, p. 118]
- *"The protection of money can only be accomplished, if a sound opinion about monetary policies becomes common property of the people and of the those in power."* [Ges49, p. 118]

2.1.7 The value of money

The value of money is determined by the exchange relationship between commodities. A shift of the relation results in a higher (or lower) quantity of basic commodities obtained by the same quantity of money or a higher (or lower) quantity of money obtained by the same quantity of basic commodities. *"From this point of view this would be an indifferent matter, if the obtained money would again be spent instantly, but this is not the case."* [Ges49, p. 119] Gesell elaborates this issue by an example of creditors and debtors. He outlines that by withholding money over time

and presence of an altering exchange rate, either the creditor or the debtor will have a negative return. [Ges49, p. 119]

Hence, **in a society with an overall altering exchange relationship, the question who to support by the determined money regulation needs to be answered.** [Ges49, p. 119]

Gesell states: *"We don't want to betray anyone and the single case which is only benefiting for one individual must not be incorporated in the administration of money. Money must be administered by national, not private accounts. Money should bare the same value over time and space. The price which was paid today (...) should also be claimable the next day, or in one or in ten years. Thereby the debtor pays back what he received and the creditor gets back what he borrowed: No penny more or less."* [Ges49, p. 120]

In this regard, Gesell argues that such a system can only work if a proof for a constant value of money is provided, and states: *"The price of money can only be expressed by the commodities."* He explains that to calculate the current value of money (the price of goods), *"all bills and price lists have to be read backwards."* [Ges49, p. 120] Nonetheless, the aspired state is a constant price *over time* and therefore, the current price is not crucial. [Ges49, p. 121] Thus, Gesell proposes a method which is known today as retail prices index (RPI), consumer price index (CPI) or "basket of commodities". [Atk98, p. 368]

With this method, a set of basic commodities is monitored over time. To be precise, the price for which the basic commodities are sold and quantity is recorded. This is done for specific periods, with the aim to compare the total average price for all goods sold. An example of the described method is presented in table 2.1. To facilitate a comparison of these recordings, a standardization of the quantities sold is necessary. Therefore, the *total quantity of goods sold* in each period is adjusted to be *equal for all periods*. In this regard, a reference period has to be determined beforehand and commonly, the first (earliest) period is chosen. After this standardization, it is possible to compare the resulting average prices and to evaluate if the value of money has increased (deflation) or decreased (inflation) over time. It has to be acknowledged that due to the law of supply and demand, the prices and quantities are likely to change for individual commodities, but the average price of all goods sold may still be constant. [Ges49, p. 121]

Definition 2.1.3 (inflation)**.** "(...) a general and continuing increase in prices." [Atk98, p. 368]

"There are a number of points to note about this definition. First, inflation is about a general increase in prices. An increase in the price of one or two goods is not considered inflation, because most goods make up only a tiny part of total spending. An increase in the price of a few goods does affect relative prices and have implications for the allocation of resources, but it does not affect the price level as a whole, unless the commodities are extremely important. In the more distant past, an increase in the price of a few basic foods could have affected prices generally; more recently, the huge increases in the price of oil in 1973 had knock-on effects that put up prices as a whole. In general, however, price rises for a few goods do not constitute inflation. The second point to note is that inflation is a process that continues over a period of time; a one-off rise in prices is not usually called inflation." [Atk98, p. 368]

Definition 2.1.4 (deflation)**.** A general and continuing decrease in prices. This equals a negative inflation.

Regarding the definitions of inflation and deflation, the following equivalences have to be acknowledged:

- (Inflation) A price increase of basic commodities equals a decrease of the value of money.
- (Deflation) A price decrease of the basic commodities equals an increase of the value of money.

Table to determine the average price of indexed goods									
	1860			1880			1900		
	a.	b.	c.	a.	b.	c.	a.	b.	c.
	Price	Quantity	Total	Price	Quantity	Total	Price	Quantity	Total
Wool	1.00	100	100.00	0.80	90	72.00	0.70	40	28.00
Sugar	1.00	20	20.00	0.90	90	81.00	0.80	110	88.00
Linen	1.00	70	70.00	1.10	40	44.00	1.20	10	12.00
Cotton	1.00	20	20.00	0.90	40	36.00	0.80	60	48.00
Wood	1.00	150	150.00	1.20	100	120.00	1.30	80	104.00
Iron	1.00	50	50.00	0.80	100	80.00	0.70	130	91.00
Grain	1.00	400	400.00	0.80	300	240.00	0.75	260	195.00
Meant	1.00	150	150.00	1.20	200	240.00	1.40	260	364.00
Indigo	1.00	30	30.00	0.80	5	4.00	0.75	1	0.75
Oil	1.00	10	10.00	1.10	35	38.50	1.20	49	58.80
Total		1000	1000.00		1000	955.50		1000	989.55

Table 2.1: This table shows an example of the calculation of the average price of goods. A comparison between different years is enabled by standardizing the quantity. This allows to assess if the value of money (the price of goods) has altered. The method is nowadays called RPI, CPI or basket of commodities and is used to assess the degree of inflation or deflation. The table was derived from [Ges49, p. 122]

Getting back to the example of table 2.1, the total price has to be raised (deflation) for the year 1880 and 1900 to ensure a constant money value. To be precise, a raise by 4.66 % for 1880 and of 1.06 % for 1900. *"This consistent price raise for all goods can only be done by a common origin (...) and an equal affect on all prices can solely have money. We only need to put as much money into circulation until the prices rise (...)"* [Ges49, p. 121]

Regarding the collection of data, Gesell acknowledges the considerable effort, especially in respect to the former time. Nonetheless, he emphasizes on the importance of this measure and proposes a system of data collection with a very high independence of the predominant political system, combined with the development of index prices. [Ges49, p. 123-126]

He concludes that the integrity of the assembly, the correctness of the price evaluation and the proportionally correct weighting of the individual commodities will ultimately provide an accurate result.[1] [Ges49, p. 123]

2.1.8 Supply, demand and needs

To ensure a clear notation, it is necessary to define the terms "supply" and "demand" in more detail. The reason is the ambiguity of the term "supply", which can either be seen as "stock" or "offer" and the ambiguity of the term "demand", which can either be seen as "need" or "request".

[1] As outlined in the following sections, this statement is only valid if the concept of effective demand is present.

For the translation of the subsequent quotes, the implied meaning of the terms *supply* and *demand* had to be interpreted and translated correctly. To outline this personal impact the terms were marked by an '*' (asterisk).

As shown by the example in table 2.1 and elaborated in more detail in section 2.1.9 (The quantity equation), the price depends on the offer and request of both - basic commodities and money. In this regard, Gesell emphasizes that both should not be equated with the needs of people. To clarify this circumstance, he presents the following classification: request for money, need of money, request for goods, need of goods.

"The request for money has its origin within the basic commodities and is induced by the division of labor. The division of labor is the mother of commodities, the inexhaustible source of the request* for money, (...)"* [Ges49, p. 108]

He argues that natural decay prevents long-term stocking of basic commodities. Therefore, stock and offer of basic commodities can be seen as equal. This equalization allows a precise and unambiguous use of the terminology "supply of basic commodities". Given that the production of basic commodities requires the trade for money, it can be said that **the supply of basic commodities naturally embodies the request for money**. [Ges49, p. 108] (see fig. 2.1)

Gesell argues, that *"the entrepreneur, who needs* money from the bank doesn't exchange anything, he gives nothing but the promise to return the money. He borrows, but he doesn't exchange. He gives money for money." "This is no request*, which agrees with the determination of a medium of exchange and the money should be particularly a medium of exchange."* [Ges49, p. 126] *"No trade, no exchange; there is no mention of prices. It is called interest. Also the nation state doesn't request* a medium of exchange with its government loans. It exchanges current for future money. There is no request* for a medium of exchange."* [Ges49, p. 126] *"The need* of money originates from a person, the request* for money from a thing, from a basic commodity".* [Ges49, p. 127]

As outlined, Gesell therefore strictly distinguishes between the request for credit (baring interest), which was named "need for money", and the trade of commodities, which was named "request for money".

This argumentation facilitates the **separation of the request for money from the need of money** and ultimately **from the needs of people.**

A similar argumentation is provided for the separation between the request for basic commodities and the need of basic commodities. Gesell gives the following example: A newly discovered gold mine would generate a higher availability of money, which would results instantly in a higher request for basic commodities. Without the discovery of the gold mine, the availability of money would be lower, which would result in a lower request for basic commodities.[2] [Ges49, p. 128]

"Request for basic commodities exists due to the supply of money; those who have no money, offer no request* for commodities and those who have money, request* the basic commodities. Need for basic commodities is expressed of those in need (beggars, poor people or people in trouble without money)". "The request* for basic commodities, commonly referred to as 'demand', is represented exclusively by the offer for money".* [Ges49, p. 128]

The demarcation stated is illustrated in fig. 2.1 and can be summarized as follows:

[2] The limitations to this statement are discussed in section 2.1.9 (The quantity equation).

1. Request for money = Supply of basic commodities
2. Request for commodities = **Offer** of money

This outlined demarcation emphasizes on the circumstance that the supply of basic commodities equals the request for money, but the supply of money doesn't equal the request for commodities. Only the offer of money represents the request for commodities and the origin of this difference lies within the needs of people.

Therefore, Gesell argues: *"If the offer* of money would be uninterrupted and equal to the fixed quantity* of money, the price (the exchange relation between commodities and money) would be independent of the human factor"* (Note: Independent of peoples needs). *"Money would then be the embodied, precise shape of the demand, similar to the embodied, weighable and calculable supply of the basic commodities."* [Ges49, p. 129]

This led Gesell to the key question: Is it possible and correct to declare the offer of money equal to the quantity of money? It was decided to answer this question by The quantity equation, which is discussed in the following section and it may already be noted that the solution builds the basis of the Freigeld currency.

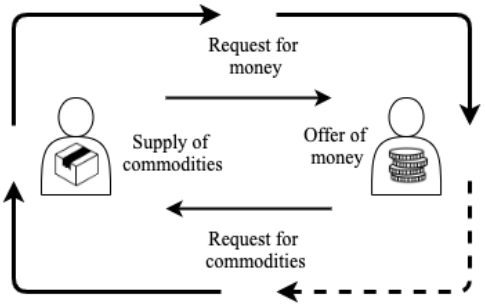


Figure 2.1: This figure illustrates the process of supply and demand (offer and request). As briefly introduced in section 2.1.8 and outlined in more detail in section 2.1.9, the supply of commodities equals the demand for money, the offer of money equals the demand for commodities, but the total quantity of the money available doesn't ultimately equal the money offered. Hence, to correctly depict the market conditions the term 'supply of money' was changed to 'offer of money'. This circumstance is indicated by the dashed arrow.

2.1.9 The quantity equation

Definition 2.1.5 (quantity equation)**.** $P \cdot T = M \cdot V + M' \cdot V'$ [Fis20]

The quantity equation, defined in definition 2.1.5 and illustrated in fig. 2.2, was published in 1911 by Irvin Fisher in his book "The Purchasing Power of Money". [Fis20] It determines that the average price level (P) depends on five other variables [P.11, p. 1]:

- M = money in circulation. [M] = 1 €;
- V = velocity of circulation of money. [V] = 1 $\frac{trades}{s} = \frac{1}{s}$;
- M′ = bank deposits subject to check (deposit currency). [M′] = 1 €;

- V′ = velocity of circulation of deposit currency. $[V'] = 1\ \frac{trades}{s} = \frac{1}{s}$;
- T = volume of trade. $[T] = 1\ \frac{piece}{s} = \frac{1}{s}$;
- (P = general price level. $[P] = 1\ \frac{€}{piece} = 1\ €$;)

In reference to the "basket of commodities" (section 2.1.7), every variable except the *velocity of circulation of money* has already been introduced. It describes the *"number of times that a money in circulation is 'turned over' in a year"*. [P.11, p. 1] In other words, this means how often the money is exchanged for basic commodities in a given period of time and thus changing its owner.

In definition 2.1.5, the *active quantity of money* ($M'' \cdot V''$) is described as the multiplication of the quantity of money (M) times its circulation velocity (V) plus the quantity of deposit currency (M') times its velocity of circulation (V'). Hence, the *active quantity of money* equals the average level of price (P) times the volume of trade (T). To specify, T refers to the number of products (pieces) sold during the chosen time period. This is illustrated in fig. 2.2.

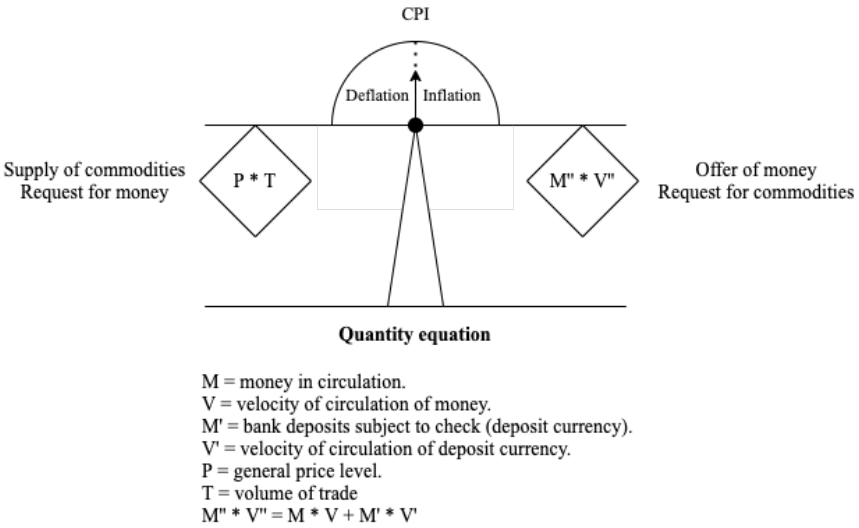


Figure 2.2: This figure illustrates the dependency of the general price level (P) on five (to some extent) independent variables as defined in the quantity equation by Irvin Fisher. [P.11]. The idea for this illustration was taken from [Ben96].

As already indicated, Gesell describes the basic commodities as a continuous stream, originating from the division of labor and running dry in the homes of the consumers. The money however transverses the market without wearing off. He concludes that "*money is no stream, it is a circulating object*" [Ges49, p. 135], and by this comparison, it can be said that the "*offer of money obeys to other laws then the offer of commodities*". [Ges49, p. 135]

"Due to the constitution of the common money it is possible that the demand (the offer of money) is delayed for one day, one week or even a year, without any immediate losses – whereat the supply (the supply of basic commodities) can't be withhold without considerable expanses of all sorts." [Ges49, p. 138] *"The basic commodities command without the allowance of any contradiction. The will of the owner is so powerless that we can leave it unconsidered. In contrast, the offer of money follows the will of the owner, it is a compliant servant of his master."* [Ges49, p. 141]

Gesell outlines that the common requirement for trade is a profit, a tribute or an interest.[3] Without those, there is no trade. Money however allows the owner to postpone the trade as long as he wants without considerable losses. [Ges49, p. 142] Hence, it is evident that the velocity of circulation depends on the free will of all individuals who participate on the trading market. This circumstance was comprehensively discussed by Gesell and his argumentation can be summarized as follows [Ges49, p. 129-160]:

It can be said that money will only be offered if the market provides enough security against losses and offers a certain amount of profit for the money offered. [Ges49, p. 142] If the market features these good conditions, more money is spent and more products are bought. This in turn stimulates production and due to the increased spending, the velocity of circulation of money increases, too. This again stimulates the production of goods, but due to the faster response of the velocity of circulation, the active quantity of money ($M'' \cdot V''$) exceeds the increase of production. This shifts the weight to the active quantity of money (see fig. 2.3 - bottom). The delayed production and the reactive active quantity of money leads to a price raise for the basic commodities (more money then products). In this regard, Gesell argues that the increased velocity of circulation of money induces a higher availability of money, which theoretically leads to lower interest rates for credits (lower request for money). However, the demand for money, pushed by the production, actually increases the interest rates, generating more revenue for creditors. The debtors approve the higher interest rates on the basis of the prospering outlook of the economy. This increases deposit currency and its velocity of circulation, which additionally amplifies the situation. Production starts to increase, but due to the higher *active quantity of money*, prices increase or at best do not fall. If the described situation of increasing prices lasts for a longer period of time, it is called an inflation. This is illustrated by the quantity equation in fig. 2.3 (bottom). Nevertheless, there will be a point in time when the production catches up, or for some reason (e.g. controversial political decisions), the velocity of circulation remains constant or decreases. Thus, the revenues (of the products) shrink, which causes the market participants to lessen their investments and therefore, money will not be spent to the same extent as before. The owners of money will use their right to observe and wait and thereby postpone some of their investments. This process will most probably lead to a decrease of the velocity of circulation of money. If this circumstance extends a certain point, the weight will be shifted to the supply of commodities, which leads to a price decrease. (see fig. 2.3 - top) This shift causes the value of money to increase by itself, challenging the necessity of investments and ultimately leading to an additional decrease of the active quantity of money. This lowers interest rates for credits. It has to be acknowledged that there is a theoretical chance that the lower interests, will lead to an increase of deposit currency (and its velocity of circulation) and thereby counter the possibility of a starting recession. Nonetheless, Gesell argues that with the economic outlook present in this situation, the majority of investors will not take this chance and thereby the total quantity of deposit currency and its velocity of circulation will also decrease. This continuous cycle aggravates over time. Additionally, the fall of the prices puts pressure on the job market. The induced stagnation of production restrains the creation of new jobs and the decrease of prices challenges the payment of employees and the sustainability of companies. Over time, these circumstances increases the unemployment and lead to bankrupted companies, which decreases the velocity of circulation of money even more. As outlined in definition 2.1.4, the situation of decreasing prices over a longer period of time is called deflation.

[3] In this regard, Gesell specifies that this doesn't include the general trading profit and describes it as additional revenue. It should be acknowledged that this also the starting point of his second monetary theory, the *capital theory*. In reference to the research objective stated, this theory, which includes the topic of credit and interest, will not be covered in this elaboration.

In reference to the evaluation outlined it is reasonable that Gesell came to the following conclusion:

"Economic crises, thus stagnation of trade and unemployment, with all their accessory phenomenons, is only thinkable with retreating prices". [Ges49, p. 149] *"How do we prevent these stagnations of trade? (...) The explanation of its origin already gives the condition to prevent the stagnations of trade: The prices must not fall under any conditions".* [Ges49, p. 150]

By examining definition 2.1.5, it can be said that if the price (P) (the value of money) is aspired to be kept constant, the other variables must also be kept in a constant relationship. To ensure this, the exact value has to be known for the quantity of money (M) and deposit currency (M') in circulation, the volume of trade (T) (the supply of basic commodities), the velocity of circulation of money (V) and the velocity of circulation of deposit currency (V'). As outlined in section 2.1.7 (the basket of commodities), compiling the total volume of trade (T) is extensive, but feasible. Since one of the main attributes of money is to be countable, M and M' are comparatively easy to assess. Nonetheless, and as outlined by Gesell, the velocity of money is not determinable to a degree which allows a monetary policy of stable long-term prices. Hence, coming back to the example of the basket of commodities (table 2.1), the mere change of the quantity of money to ensure a constant money value has no mathematical basis to be successful.

Therefore, to ensure price stability and a constant value of money, Gesell provided a solution by proposing a demurrage currency named Freigeld.

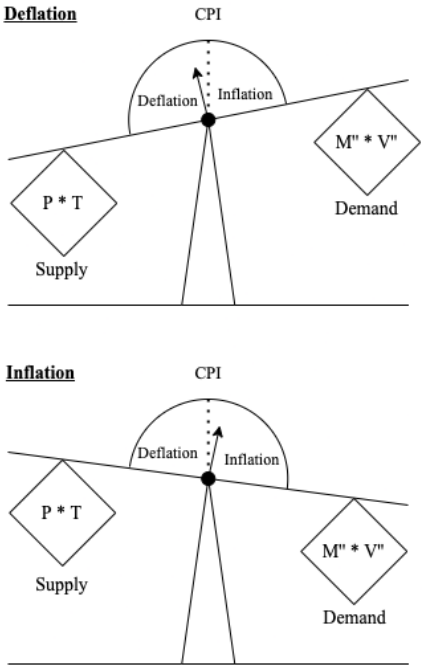


Figure 2.3: This figure interprets inflation and deflation on the basis of the quantity equation. [P.11] A description of the variables indicated is given in fig. 2.2. The idea for this illustration was taken from [Ben96].

2.1.10 The idea of Freigeld

Gesell defined the unbound circulation velocity as the origin for varying average prices. Hence, to ensure a constant average price for commodities (and a constant money value), the incapability of

measuring or controlling the circulation velocity of money (and deposit currency) had to be solved. He traced this issue back to the difference between basic commodities and money by arguing that basic commodities decay and thereby show an absolute demand to be traded. Money however doesn't decay and thus features only an unbound demand for trade. This leads to an unbound velocity of circulation, which creates the stated instability on the trade market.

"Thus, get rid of the privileges of money! The money as commodity shouldn't be better for anyone as the stock of the markets, shops and railroad warehouses, also for savers, speculators and capitalists[4]*. Hence, if it isn't allowed to possess any privileges compared to its counterpart the basic commodities, the money should also rust, get moldy and decay, it should erode, sicken, run away and if it dies the owner should pay the wage of the knacker. Only then we will be able to say, money and basic commodities have the same rank and are equivalent things - as Proudhon would have liked it to be."* [Ges49, p. 13]

Thus, Freigeld was developed as a currency which demands fees for inactivity. The economic term for this tribute for extra lay days is *demurrage* and the corresponding currency is named *demurrage currency* (see definition 2.1.6).

Definition 2.1.6 (demurrage currency)**.** "A currency in which the value of units of currency is designed to fall over time at a fixed rate." [Lie19, p. 9]

To be more precise, Gesell proposed a weekly demurrage of 0.1 % at the expense of the owner. [Ges49, p. 184] According to the records of one of the most famous Freigeld experiments known as "the wonder of Wörgl", a slightly different demurrage of 1 % (due for payment on the first day of each month) was established. [Sch08, p. 45] Given the elaborations of Gesell, the regulator of the monetary system (presumably the state) will receive the demurrage paid by the owners. To prevent misinterpretations, it has to be acknowledged that this is no inflation. As stated in definition 2.1.3, inflation is "a general and continuing increase in prices". [Atk98, p.368] The money paid as demurrage is just somewhere else, but its value stays the same. Unfortunately, this fact is often overlooked. It also has to be acknowledged that the demurrage induces the balance between basic commodities and money. Hence, an exaggeration of the demurrage will shift the balance towards the basic commodities, which might lead to new issues and therefore, Freigeld should not be used as means of taxation (or similar). [Sch08, p. 45] Gesell acknowledges that the demurrage will probably be defined more accurately over time, similar as for the compilation of data for the basket of commodities. Nonetheless, he emphasizes that this should not hinder the general start. [Ges49, p. 188] For details about the distribution or implementation of Freigeld, it is referred to the writings of Gesell [Ges49] or Fritz Schwarz, who documented the Freigeld experiment of "Wörgl" in his book "Das Experiment von Wörgl" [Sch08].

2.1.11 The effective demand

The effective demand describes the exact adjustment of the supply of money to the demand for money (or respectively, to the supply of commodities) (see fig. 2.4).

Hence, Gesell claims that a demurrage currency is a precondition for the effective demand, since otherwise, the unbound circulation velocity of money distorts the adjustment stated and contradicts a long-term constant value of money. As emphasized by Gesell, the demurrage allows

[4]Gesell defined capitalism as follows: *"Capitalism = an economic state, where the demand for credit and real capital exceeds the supply, and therefore causes interest."* [Ges49, p. 150]

to separate the needs of the people from the request for money. Money will then be traded on the market equally to its counterpart - the basic commodities. Hence, the supply of money will generate a demand for basic commodities in the same way as the supply of basic commodities generates a demand for money. This allows to effectively regulate the supply of money according to its demand. This attribute of Freigeld is presumably the reason why Ilgmann (2011) referred to this part of Gesell's theory as the theory of effective demand. [Ilg15] In reference to section 2.1.8, it can be said that the demand for money will then be equal the supply of money. In circumstances where the economy resembles the outlined situation, the continuous production (division of labor) and the continuous offer of money induces a continuous economic cycle. This is illustrated in fig. 2.4.

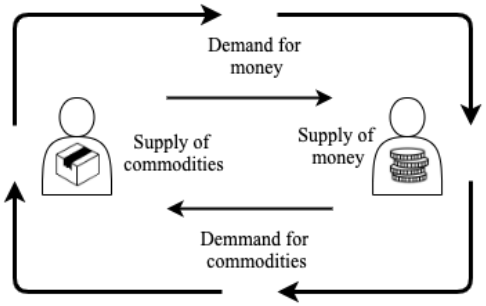


Figure 2.4: This figure depicts the continuous circulation of money and uninterrupted trade, which is the desired goal of Freigeld. Compared to fig. 2.1, Freigeld allows to reject the stated double meaning of supply and demand (see section 2.1.8), yielding an unambiguous use of the common terminology.

To summarize, the effective demand features two preconditions or results:

- Money is excluded as a mean for saving and its supply is adapted to the requirements of the market. [Ges49, p. 150]
- The design of money ensures that it will be offered for commodities under every circumstance, even if *"the interest on capital (...) and the interest on real capital decreases and disappears"*. [Ges49, p. 150]

2.1.12 Postulated impacts of Freigeld

In his book, Gesell discussed a broad variety of the effects of Freigeld. In reference to the discussed topic of effective demand, it was decided to provide a listing of all impacts, while only impacts closely related to the effective demand are described by a concise statement. For a comprehensive description of all factors, it is referred to the original book of Gesell.

1. **Money circulation**

   Impact:

   - A continuous money circulation and trade of commodities.
   - A constant money value.
   - The economic crises which are caused by the unbalance between money and commodities are eliminated.

Statement:
The aim of the demurrage is to induce a constant high circulation velocity of money, ideally the maximum. The thereby postulated nearly unstoppable circulation of money facilitates the regulation of the value of money. The value is then kept constant by changing the quantity of money as contemplated by the example in section 2.1.7 (basket of commodities). Thereby, the weighting between average price (P) times the volume of trade (T) and the *actively circulating money* shows a clear balance as illustrated in fig. 2.2.

2. **Interest and speculations** (Capital theory) [Ges49, p. 179 ff.]

   Impact:

   - The elimination of interest.
   - The elimination of stock exchange speculations.

   Statement:
   As outlined in section 2.1.1, the theory named *Freigeld-interest-theory or capital theory* is not elaborated in this report. Nonetheless, due to the connection of both theories and the contrast to our present monetary system, it was decided to give a short statement about the claimed elimination of interest.

   Gesell postulates that due to the effective regulation of the money supply and the thereby resulting fulfillment of the demand, the interest rates will diminish until they are completely eliminated. In this regard, the change for the banking sector can be considered tremendous. Gesell outlines that the availability of money will eliminate the necessity of debit money and thereby also diminish and eliminate speculations at the stock exchange.

   "He who has money, has no more right as to buy commodities instantaneously. A right for interest contradicts the idea of money, since this right would be similar to a private taxation of the exchange of goods with the support of government facilities." [Ges49, p. 153]

3. **Trade facilities**

   Impact:

   - A reduction of trading facilities in terms of quantity and their share at the gross domestic product (GDP).

   Statement:
   Although Gesell extensively outlines the necessity of trade, he argues that the quantity of trading facilities and their share in the gross domestic product can be used as an indicator for the quality of the trade market.

   He acknowledges that the progress of specializations also increases the need for trading facilities. Nonetheless, he argues that the trading efficiency of facilities also increases with the further development of society. Hence, the share of trade market facilities, can be used as a measurement for the quality of money. Thereby, Gesell argues that a high share of trading facilities in the GDP is an indicator for a low quality of the money. In reference to the issues of conventional money outlined previously, Gesell states that the use of Freigeld would reduce share and quantity of trading facilities. In total, a simplification and reduction for the cost of trade is predicted. [Ges49, p. 157 ff.]

4. **Savings**

   Impact:

- The separation of money as a means of trade and as a means of saving.
- The facilitation of saving.

Statement:
Albeit the stated separation, Gesell argues that Freigeld will facilitate saving by outlining the following new circumstances:

- The capital bears no burdens of interest.
- Price reduction of manufactured items due to reduced trading costs.
- No economic stagnations.

To facilitate a means of saving the approach suggested by Margrit Kennedy in her book "Occupy money" (2012) is noteworthy. Long-term saving can be achieved by lending money to someone with a determining date of repayment. This allows individuals who own money without an urgent need to and enables long-term saving plans. Thereby the intermediate owner bears the liability to pay the demurrage (e.g. on the first day of the week or month). The process can either be facilitated by banks or privately. Either way, the demurrage has to be paid by the current (intermediate) owner of the money. [Ken11, p. 47]

Nonetheless, the elimination of money as a means of saving will shift the focus to products and especially to real estates. According to Gesell, this leads to various issues, which presumably led him to his second main theory named *Free land*.

"Money should be a commodity and a material for personal needs. They want a hybrid, something impossible." [Ges49, p. 117] *"Therefor I demand (...) a complete and factual separation of the means of exchange from the means of saving."* [Ges49, p. 151] *"According to the presented evaluations, Freigeld roughly and recklessly cuts the common union of money as means of exchange and saving. The money becomes the pure means of exchange, freed from the will of its owner, independent of the material and chemically pure demand."* [Ges49, p. 157]

5. **Impacts beyond the area of the effective demand** [Ges49, p. 184 f.]

   - *"The suspension of 'useless' protective tariffs and the transition to free trade"*
   - *"The suspension of economic origins for war"*
   - *"The mediation of a global monetary agreement for trade, given that this is beneficial for all nations"*
   - *"The gradual increase of salaries"*
   - *"The lasting elimination of unemployment"*

2.2 Blockchain and crypto currencies

2.2.1 Structure

In general, crypto currencies have been developed as an incentive to secure the underlying blockchain. In this regard, it can be said that crypto currencies build the top layer (1 = top), followed by a client protocol as a middle layer (2 = middle) and the blockchain as the base layer (3 = bottom). Hence, the following chapter will describe the given parts from bottom to top ([Swa15, p. 6]):

1. Crypto currency: e.g. Bitcoin (BTC)
2. Protocol and client: Software programs conducting transactions
3. Blockchain: Underlying decentralized ledger

2.2.2 Blockchain

A blockchain stores data by connecting blocks of information. Thereby, each block is linked to the previous block and new information is stored by connecting a new block to the last block of the chain.

The original idea of blockchain was developed in 1991 to create digital timestamps for documents. Nonetheless, the concept was not particularly useful until the adaptation of an "unknown person or entity" named Satoshi Nakamoto. The published new framework allowed the creation of a different blockchain, which included a crypto currency named *Bitcoin* (released on January 9, 2009). [Swa15, p. 2]

Over the last years, new developments in the field of crypto currencies and blockchains appeared. However, due to the sustained importance of the original blockchain also known as *Bitcoin blockchain*, this chapter will introduce the topic by elaborating the attributes of the latter. [Swa15, p. 6] Many of these attributes are valid for other blockchains, yet inferences have to be done carefully.

The Bitcoin blockchain is known as *open synchronized distributed ledger technology (DLT)*. Each of these adjectives describes a crucial attribute of the Bitcoin blockchain. Hence, the following elaboration will use this fact to describe its functionality.

2.2.3 Ledger

As indicated above, the blockchain connects blocks of data to store information. The original idea of the Bitcoin blockchain was to store transactions of the crypto currency named Bitcoin. Hence, the description of the blockchain features the term **ledger**, presumably in reference to an account or ledger at a usual bank which also depicts transactions. The data is collected in blocks and each block features (among other attributes - see fig. 2.5) a reference to the previous block and a set of transactions. A successfully added block is immutably stored in the Bitcoin blockchain and the included data can't be manipulated or erased. This outstanding feature is secured by a mathematical function named *Hash-function*, followed by a validation of the newly added block through a consensus mechanism.

2.2.4 Hash code

The hash function is part of the scientific field named cryptography. A commonly used algorithm is the *SHA-256-Hash-Algorithm*. In general, independently of the size of the data file, the function transfers the data into a 64-character-code. [Swa15, p. 1] Under the terms of a correct implementation, the Hash-function has the following features [FM20, p. 5 f.]:

- An explicit representation of the input information. This also includes a high *collision resistance* (a low possibility to create equal results for different inputs) and a sufficient *variance* (a small change of the input results in considerable variation of the output).
- The infeasibility to derive the input data set from the present hash code.
- Without additional constraints, the function should be quick to compute.

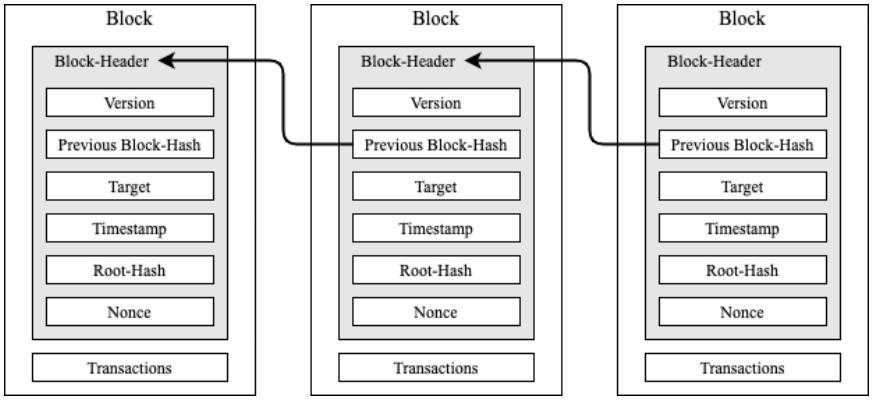


Figure 2.5: This figure depicts the attributes of data blocks and the connection between them, resulting in a chain known as *blockchain*. The figure was retrieved from [FM20, p. 12].

Each block includes a hash code known as root hash (see fig. 2.5). The generation of this root hash includes the complete data set of the present block. Hence, a modification (e.g. any altering of transactions) would result in a different root hash, which allows an easy verification of the integrity of the whole block. Additionally, the data set of the present block also includes the hash code of the previous block, which introduces a connection (chain) between both blocks. Hence, the change of any data in a block will result in a different hash code and the reference from the subsequent block will show a conflict. This is illustrated in fig. 2.5. [FM20, p. 5 f.]

2.2.5 Distributed ledger

The Bitcoin blockchain itself is stored in a peer-to-peer network. This means that every participant of the network stores a complete copy of the Bitcoin blockchain. Thereby, no central organization is needed to organize the storage, which allows a complete decentralized implementation. This approach is therefore referred to as **distributed** ledger. [KD20, p. 5 f.]

Combining the aspects of a blockchain stated before, a successful attack on a block (e.g. the change of one bit or even a transaction) would lead to a necessary adaptation of all hash values in all subsequent blocks of the Bitcoin blockchain. Additionally, this has to be validated by the distributed network of participants. To be precise, each newly added block (or in regard of an attack: changed block) has to be approved by a distributed consensus mechanism. [KD20, p. 3 f.]

2.2.6 Consensus mechanism

The origin of the consensus mechanism lies in a cryptographic puzzle based on the hash-function (a hash puzzle). For the process of validation, every participant of the distributed network tries to

solve the puzzle by an automated computation. The block is added to the blockchain if the proof is successful. This means that the transactions are evaluated as correct, the puzzle is solved and the majority of the network agrees on the solution. The compulsive validation by the network is known as consensus mechanism.

The design of the puzzle only allows to find the solution by trial and error. The underlying algorithm ensures a continuous level of computation effort by automatically adapting the complexity of the puzzle. Thereby, the creation time of one block is set to "nearly" 10 minutes. The total computation effort for the participants who chose to work on the solution of the puzzle is considerable, which is why the consensus mechanism for the Bitcoin blockchain is named proof of work (POW). It can therefore be concluded that cryptography induces a level of computation time and effort to secure that data stored in the blockchain. [KD20, p. 4] [FM20, p. 6 f.]

2.2.7 Synchronized distributed ledger

To enable a just and simultaneous competition for the solution of a puzzle, the timings within the network have to be synchronized, which is why the Bitcoin blockchain is also called a **synchronised** ledger. As soon as a set of transactions is determined to be validated, the data set is distributed to the whole network as a potential new block. The participants who choose to work on the validation of the puzzle are called *miners*. Hence, the miners validate the correctness of the transactions and try to solve the puzzle. The first miner who successfully solves the puzzle broadcasts the solution to the whole network. As stated, the hash puzzle requires considerable effort to be solved, but due to its design, the validation of a correct solution is effortless. Thus, it is fast and not limited by a minimum time for calculation. After a successful validation by the consensus mechanism, the block is added to the blockchain and the first successful miner who solved the puzzle gets rewarded with Crypto currencies (see section 2.2.9) [KD20, p. 6]

2.2.8 Open synchronized distributed ledger

The Bitcoin blockchain *"is open and public to everyone present in the network"*. [KD20, p. 5] Its data is immutable, but not encrypted. This means that everyone in the network of the Bitcoin blockchain can track every transaction and the amount of Bitcoins stored in different *wallets*. The Bitcoin blockchain is therefore called an **open** ledger.

2.2.9 Crypto currencies

As stated in section 2.2.7, crypto currencies have been developed as an incentive for the validation of blocks from the Bitcoin blockchain. For every successfully solved puzzle and validation process, a certain amount of crypto currencies is transferred to the account of the successful miner. This can either be an individual, a company or a consortium. The crypto currency for the Bitcoin blockchain is named *Bitcoin*, which is displayed and stored in an electronic *wallet*. For a small transaction fee, Bitcoins can be used as a means of exchange for goods and services. These transactions are conducted by a client protocol (the middle layer). [Swa15, p. 2]

2.2.10 A "trustless" system

Good cooperation of individuals or organizations has always been one of the principles of progress. But human interaction has always been accompanied by the issue of trust. Is the opponent trustworthy? What happens in case of a deception, an error or some other kind of problem? As a solution to this issue and driven by the growing interconnection of the human world, society developed frameworks such as laws, regulations and governance processes. Along with these developments, institutions emerged which narrowed down frameworks, streamlined processes, solved disputes and, above all, served as liable authority. Especially institutions who are used as liable authorities are known today as *trusted third parties*. In the case of currencies, this has long been to an extensive degree the field of private and national banks. In this regard, it can be said that our society demanded trustworthy interactions and the banks utilized this demand by establishing a trustworthy middleman. Nonetheless, in reference to the recent economic crises, their acting as an intermediary has been considerably questioned. This particular circumstance is intensified by the development of crypto currencies and their incorporated mechanisms. [BAI+18, p. 69 f.]

Crypto currencies (Bitcoins) are regulated by open, distributed proof mechanisms and the data is stored completely transparent. Hence, the Bitcoin Blockchain claims to be free of human influence and equal for every participant. The decentralized approach distributes decision making to the participants of the network, and thereby lowering the threat of the influence of a centralized power. The trustworthy middleman (e.g. the bank) formerly deemed necessary is replaced by a transparent mechanism. Hence, trust is granted by transparent code and not by intermediaries. [BAI+18, p. 69 f.] The blockchain and crypto currency technology is therefore often called a *trustless* system, which means *"at its most basic level, intermediary-free transactions."* [Swa15, p. 3]

2.3 Sustainability and complementary currencies

2.3.1 Quantitative Economic Development

Quantitative economic development (QED) is a concept developed by Goerner S., Lietaer B. and Ulanowicz R. (2009) and allows a "quantitative measure of sustainability for any complex, matter/energy flow system". [UGLG09, p.76] The concept is illustrated in fig. 2.6.

During their research on ecological systems Ulanowicz et al. found a relation between what was named *resilience* (R) and *efficiency* (E). [UGLG09, p.77] Systems who featured a long-term vitality were placed in a region, which showed a certain balance between R and E. This region was named "*The Window of Vitiality/Viability*". [UGLG09, p.77]

Definition 2.3.1 (efficiency)**.** "The network's capacity to perform in a sufficiently organized and efficient manner as to maintain its integrity over time (May, 1972)." [UGLG09, p.77]

Definition 2.3.2 (resilience)**.** "Its reserve of flexible fall-back positions and diversity of actions that can be used to meet the exigencies of novel disturbances and the novelty needed for on-going development and evolution (Holling, 1973, 1986; Walker et al., 2006)." [UGLG09, p.77]

Furthermore, Ulanowicz et al. (2009) defined sustainability as "*an ecosystem's ability to maintain its own vitality over long periods*". A factor named *Development Capacity* (C) was determined to assess the *level of sustainability* (S). The relation of all mentioned factors is shown in eq. (2.1). [UGLG09, p.78]

$$C = S = E + R \tag{2.1}$$

The research by Ulanowicz et al. (2009) can be portrayed as follows: A system is sustainable over a long period of time if the relation of E and R is situated within the *the Window of Vitality/Viability* (see fig. 2.6). A tilt towards too much efficiency will result in heightened fragility, a tilt towards too much resilience (or diversity) will move the system towards stagnation. Once a system is tilted towards too much efficiency an increased "*ability to pull more and more energy into its sway, while reducing extraneous diversity*" can be observed. This introduces a self-amplifying loop, which will result in a collapse of the system. In general it should be acknowledged that the function of the Development Capacity (C) is not symmetric and shows a slight tendency towards the factor of resilience. (see fig. 2.6) [UGLG09, p. 77]

Ulanowicz et al. (2009) transferred the findings derived from ecosystems to our present economic/monetary system, which enabled a new interpretation of the latter as flow system. The conclusion ultimately drawn states that the notable frequency of economic crashes is caused by our present monetary system which seems to exhibit a considerable dislocation towards efficiency.

Figure 2.6: This figure depicts sustainability as a function of efficiency and resilience and was retrieved from [UGLG09, p. 77].

2.3.2 Complementary currencies

As co-founder of the theory named QED the economist Bernard Lietaer strengthened his point of view about the necessity of complementary currencies for our economic system. In his book "Towards a sustainable world", he emphasizes on the necessity of a clear demarcation of complementary currencies and argues that complementary currencies should be designed to support *"the conventional monetary system where it fails to assign money to meet the need"*. Thereby, he especially refers to the social needs of the society. [Lie19, p. 30]

Additionally, in regard to our efficiency driven monetary system, Bernard Lietaer outlines that a complementary currency can only be identified as such if it features at least one of the following attributes [Lie19, p. 30]:

- *"Dampen business cycles of boom and bust, supporting sustainability of businesses, countries and even banks."*
- *"Support longer term thinking rather than short-term thinking."*
- *"Are interest free, thus do not drive exponential growth."*
- *"Bear no interest, or even better, charge fees for storing money, thus discouraging accumulation of money for creating wealth."*
- *"Discourage accumulation of a currency, for instance with a 'demurrage fee' (...)"*
- *"Avoid the ego-centric effects of 'money priming'."*

In reference to the discussed crypto currencies, Bernard Lietaer stresses the point that albeit their distributed decentralized nature, crypto currencies are usually designed to increase efficiency. Their mere usage as a second currency would therefore not change any of the issues outlined by the theory of QED.

2.4 Accelerated crypto currencies

2.4.1 Structure

This section discusses possible intersections of the effective demand and crypto currencies. Based on this evaluation a hypothetical Freigeld crypto currency scenario is developed. The developed currency is then used for the subsequent social survey.

2.4.2 Evaluation of the three premises of money

As outlined in section 2.1.5, Gesell stated three premises of money:

1. Money has to be indifferent for the user, with a minimum amount of physical attributes.
2. The economic freedom to create money has to be prohibited and the quantity of available money has to be regulated.
3. Money depicts a circle which it transverses forever; it returns to its origin.

Comparing the stated premises to the attributes of crypto currencies, it was concluded that the abstract nature of a digital currency fulfills the first premise (minimal physical attributes) to an exceptional high degree. The underlying mechanisms of crypto currencies allow a transparent and clear regulation of the supply of money, implemented by a decentralized system ensuring little to no influence of the respective holders of power. Therefore, the second premise (quantity regulation) was evaluated as fulfilled. The third premise (circulation) is already partly fulfilled by the abstract nature of crypto currencies. Nonetheless, in reference to the outlined history of gold as material for money, the low applicability is a necessary, but no sufficient condition for a continuous circulation of money. Hence, similar as outlined in the elaboration of Freigeld, the underlying double nature of crypto currencies as a means of exchange and as a means of saving

might cause the same issues as with the present fiat currency. It was therefore concluded that the compliance for the third premise depends on the underlying design of the crypto currency. The third premise was therefore evaluated as partly fulfilled, while it can be said that the origin of this partial fulfillment lies in the design and not in the nature of crypto currencies.

2.4.3 Applicability of the effective demand

Following up on the stated partial fulfillment of the third premise, the application of the effective demand might solve this issue and is therefore an evident question.

Based on the previous elaborations and similar to the presently deployed fiat currency, crypto currencies require the following two features to implement the effective demand:

1. A demurrage to ensure a high to maximum velocity of circulation of money.
2. A controlled supply of money, which is solely defined by the demand (not the need) for money.

The implementation of the first requirement (maximum velocity of circulation of money) is simply achievable by a demurrage fee. This results in various effects, which have to be handled carefully to ensure the fulfillment of the second requirement (controlled money supply). In general, the digital format of the crypto currency allows a relatively easy assessment of the CPI (basket of commodities). Even if payments by card and not only by smartphone app are made possible for better accessibility, the Freigeld crypto currency stores the data of the exchanged goods directly in one data base, the blockchain. The data is therefore readily available to prove a possible inflation or deflation. Depending on the outcome of the CPI, money has to be brought into or withdrawn from the system. The process of a necessary withdrawal is ensured by the demurrage. According to historically used designs, the demurrage ranges from 0.5 % to 1 % per month, which was assessed as sufficient mechanism to reduce the quantity of circulating money. [Sch08]

This leads to the question of how to increase the quantity of the respective crypto currency in the system. Hence, three pillars were determined as emission possibilities, whereat it is vital to balance the total emission of all three possibilities with the withdrawal by the demurrage and the demand for money.

First, as outlined in section 2.2.9 (Crypto currencies), crypto currencies are used as a reward for miners to secure the (Bitcoin-) blockchain. Hence, to enable a decentralized approach, this concept is crucial and will per design emit crypto currencies into the system. Second, participants who join or participants who leave the network will increase or lower the money supply. To counter this risk of high variability a subscription model is contemplated. Thereby, participants agree to exchange a fixed amount of fiat currencies to the crypto currency for a fixed period of time. The subscriptions should be predetermined, including a maximum of possible subscriptions to prevent an overflow of the system. Furthermore, the amount of possible subscriptions should be adapted to the conditions inside and outside of the currency system. Third, if the total mining reward doesn't equal the amount of the withdrawn demurrage, the remaining coins have to be remitted into the system (if no inflation is present). One way to execute this distribution could be an equal payment for every participant. Regarding this option, it has to be mentioned that Gesell emphasized on the necessity of bringing money into circulation by buying commodities. He argues that for credits, it is not possible to withdraw the money from the system anymore

in case of a recession, thus limiting the possibilities to regulate the money supply. No credit is provided for the stated option, which renders it feasible. Nonetheless, this would eliminate the fixed withdrawal of money by the demurrage stated before, hindering the mediation of inflation. Therefore, and in reference to the idea of Gesell, another way of (re-)distributing money is to purchase commodities as donation for projects which are chosen by the network. This option was also implemented during the successful Freigeld experiment "the wonder of Wörgl". Besides the positive social impact, this would allow a higher margin of quantity control, which might be beneficial for a successful long term regulation of the money supply. It is therefore concluded that this would be a sufficient way to facilitate the emission of crypto currencies into the system. A precise calculation of the relations exceeded the extent of this thesis.

Regarding the exchange of fiat money for Freigeld crypto currencies, it is necessary to determine an exchange rate. This is a crucial question, especially if the Freigeld currency is designed as complementary currency (see section 2.3.2). In this regard, it has to be ensured that the variability of the conventional monetary system does not directly effect the value of the Freigeld crypto currency through the exchange rate. Neglecting other distorting impacts, it can be stated that, for a system which features more than one currency, the value of money can be held constant by adapting the exchange rate according to the market or the exchange rate can be held constant which will lead to an adaptation of the value of money. Thus, it was concluded that, in this particular example, the aspired constant money value demands a flexible exchange rate. One solution might be the comparison of the CPI of different currencies, whereat an existent inflation or deflation of the currency and (if available) a profound long term and short term outlook should be included in the calculation. Nonetheless, this is only a suggestion and should be answered by academic experts.

In reference to the elaboration provided it was concluded that under the premise of a correct implementation, the effective demand is applicable for crypto currencies.

It has to be acknowledged that a crypto currency named *Freecoin* already implemented parts of the Freigeld idea. [2] It was not possible to assess if the stated currency complies accurately with the theory of the effective demand, nor was it possible to assess if it is currently in use. A considerable amount of official information is provided online, but a balance as emphasized by the effective demand is not mentioned. The outlined circumstances were considered significant enough to elaborate the application of the effective demand on crypto currencies in more detail.

2.4.4 The circle coin - a local Freigeld crypto currency

As concluded in the previous chapter, it is theoretically possible to develop a crypto currency which resembles the ideas of Gesell's effective demand. Hence, on this basis a hypothetical *local Freigeld crypto currency* scenario was developed. Due to its assessment by a social survey, the information provided was kept very concise to minimize the risk of a response bias. Therefore, the concept of the *local Freigeld crypto currency* was split into three parts. The first part introduced the concept of crypto currencies (see fig. 2.7), the second part introduced the concept of Freigeld (see fig. 2.8) and the third part combined both concepts, enabling the description of the local Freigeld crypto currency named *circle coin* (see fig. 2.9).

The design of *circle coin* implemented the theory of effective demand as outlined in section 2.4.3 and agreed with the stated definitions of a complementary currency. Two attributes were added to the concept stated before:

1. The support of the local economy.
2. An incentive for private business who use the circle coin.

The decision to support the local economy originates from the goal to implement a complementary currency.

In detail, the *circle coin* encourages regionality by limiting its areal validity. Hence, it was contemplated that the valid area (50 - 100 km) for the coin holder is determined by the respective registered residence. Additionally, the coin can only be spent at registered partners. In general, only a few facilities were banned from being registered business partner. This includes facilities who provide basic needs such as water or electricity. These partners are presumably in no need of support by a complementary currencies and a registration of such partners would favor individuals living near the head office. The same goes for taxation bills. The circle coin follows the idea of Gesell: money for products.

The decision to provide incentives originates from the idea to increase the growth rate during the early stage of the regional crypto currency. Therefore, the scenario outlines a particular option for registered private businesses, which allows a beneficial exchange of fiat currencies for circle coin. To be precise, individuals who signed up to the circle coin community agreed to exchange 10 % of their salary into circle coin. Hence, to promote the use of circle coins and to lower the barriers for private business, the latter were allowed to exchange 9 % of the salary in conventional money for 10 % of circle coins. A more detailed concept of different subscriptions exceeded the time frame of the survey. The description of *circle coin* used for the survey is given in fig. 2.9.

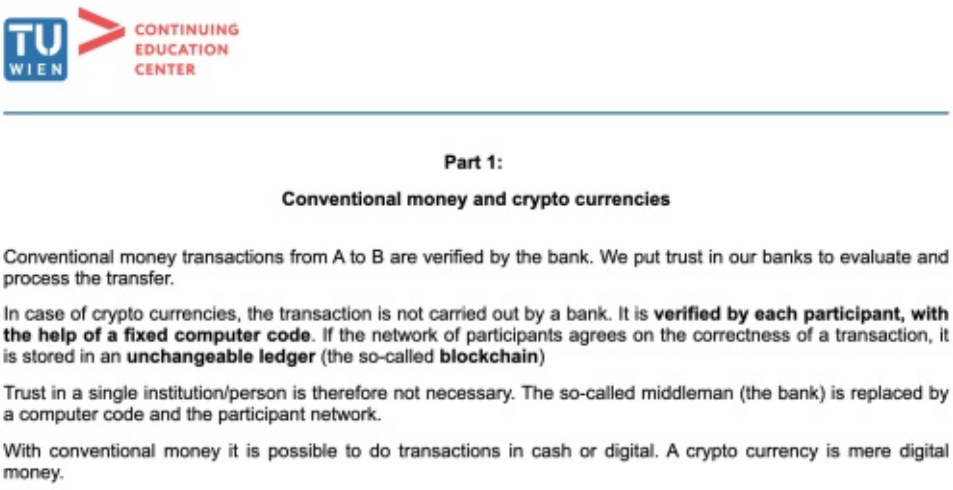
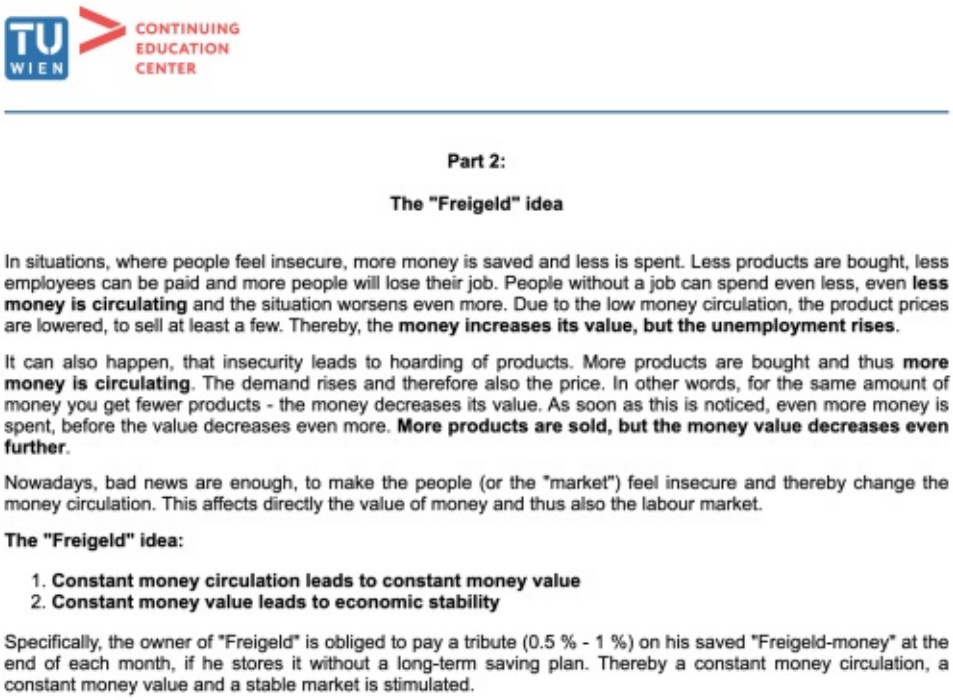


Figure 2.7: This figure shows the introduction of crypto currencies presented as first part of the conducted survey.



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Part 2:

The "Freigeld" idea

In situations, where people feel insecure, more money is saved and less is spent. Less products are bought, less employees can be paid and more people will lose their job. People without a job can spend even less, even **less money is circulating** and the situation worsens even more. Due to the low money circulation, the product prices are lowered, to sell at least a few. Thereby, the **money increases its value, but the unemployment rises**.

It can also happen, that insecurity leads to hoarding of products. More products are bought and thus **more money is circulating**. The demand rises and therefore also the price. In other words, for the same amount of money you get fewer products - the money decreases its value. As soon as this is noticed, even more money is spent, before the value decreases even more. **More products are sold, but the money value decreases even further**.

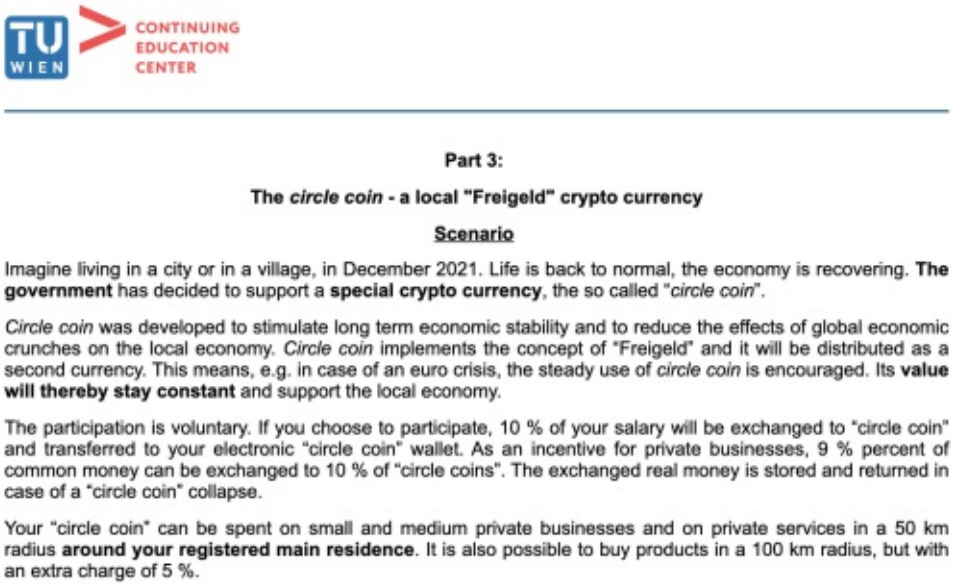
Nowadays, bad news are enough, to make the people (or the "market") feel insecure and thereby change the money circulation. This affects directly the value of money and thus also the labour market.

The "Freigeld" idea:

1. **Constant money circulation leads to constant money value**
2. **Constant money value leads to economic stability**

Specifically, the owner of "Freigeld" is obliged to pay a tribute (0.5 % - 1 %) on his saved "Freigeld-money" at the end of each month, if he stores it without a long-term saving plan. Thereby a constant money circulation, a constant money value and a stable market is stimulated.

Figure 2.8: This figure shows the introduction of Freigeld presented as second part of the conducted survey.



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Part 3:

The *circle coin* - a local "Freigeld" crypto currency

Scenario

Imagine living in a city or in a village, in December 2021. Life is back to normal, the economy is recovering. **The government** has decided to support a **special crypto currency**, the so called "*circle coin*".

Circle coin was developed to stimulate long term economic stability and to reduce the effects of global economic crunches on the local economy. *Circle coin* implements the concept of "Freigeld" and it will be distributed as a second currency. This means, e.g. in case of an euro crisis, the steady use of *circle coin* is encouraged. Its **value will thereby stay constant** and support the local economy.

The participation is voluntary. If you choose to participate, 10 % of your salary will be exchanged to "circle coin" and transferred to your electronic "circle coin" wallet. As an incentive for private businesses, 9 % percent of common money can be exchanged to 10 % of "circle coins". The exchanged real money is stored and returned in case of a "circle coin" collapse.

Your "circle coin" can be spent on small and medium private businesses and on private services in a 50 km radius **around your registered main residence**. It is also possible to buy products in a 100 km radius, but with an extra charge of 5 %.

Figure 2.9: This figure shows the Freigeld crypto currency scenario presented as third part of the conducted survey.

3 Methodology

3.1 Structure

Section 3.2 starts with a description of the sample design workflow, followed by the reviewed research objectives, the research questions and the tested hypotheses ('Survey objective').

Next, the 'Effectivity and efficiency' of a sample and the conducted core strategy of the sample design, named 'Total survey design' are determined. The latter aims to ensure a high quality sample by emphasizing on five crucial categories. Due to its extent, the category named 'The sampling design' is described in the subsequent section 3.3.

Section 3.2 ends with a concise elaboration of the following important notations:

1. The nature of 'Error and bias'
2. 'Representative samples'
3. 'Validity' of a sample

3.2 Sample design

3.2.1 Sample design workflow

The workflow for the developed sample design is based on the flow chart provided in Figure 3.1. Preceding to the stated workflow, the original research idea was repeatedly adjusted and specified according to findings from different scholarly literature. The intention was to establish a clearly defined and up-to-date research question. Experience showed that it was worth emphasizing on a clear definition, although adjustments were still necessary during the sample design process. Starting from the base of a clear research question, a target population, a *sample frame* (see section 3.2.4) and a possible *sampling technique* (see section 3.3) were derived. For each of these given steps a re-evaluation of the preceding steps was done to test for the lasting validity of design decisions previously made. (this is indicated in fig. 3.1 by the dashed lines). Necessary adjustments were made from top to bottom until a sampling design was found that matched the chosen *sample frame*, the target *population* and the research question. Afterwards, the sample size (see section 3.2.4) was determined and the data collected according to the selected *sampling technique*. The implemented design process ends with the assessment of the *response rate* (see section 3.2.4).

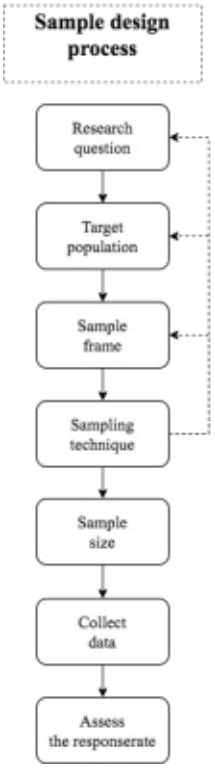

Figure 3.1: This figure shows the different stages of the executed sample design process. The dashed arrows indicate revision processes. Information taken from [Tah16, p. 19].

3.2.2 Survey objective

The general research objective was to assess the level of trust of individuals concerning crypto currencies and the readiness to use them. This was done by a sample survey. The target population were people living in Austria. The obtained sample aims for conclusions about the general acceptance of crypto currencies and whether a local "Freigeld" crypto currency influences the outcome. The following research objectives and questions are investigated.

Research Objective

The research objective of the survey was a preliminary investigation into ...

RO1: ... whether the acceptance of a crypto currency would change for a governmental support.

RO2: ... whether individuals would accept a crypto currency for everyday payments.

RO3: ... whether a local Freigeld crypto currency changes the acceptance of crypto currencies.

Research Question

Three research questions where derived from the stated research objectives.

RQ1: To what extent would a governmental support change the level of acceptance of crypto currencies?

RQ2: To what extent would individuals accept a crypto currency solution for everyday payments?

RQ3: To what extent does the availability of a local Freigeld crypto currency change the acceptance of crypto currencies?

Hypotheses

As a consequence of the stated research questions, three hypotheses are aimed to be tested during the evaluation of the obtained data.

H1: Governmental support increases the acceptance of a crypto currency.

H2: Individuals do not accept using crypto currencies for everyday payments.

H3: The local Freigeld crypto currency exceeds the acceptance of other crypto currencies.

3.2.3 Effectivity and efficiency

The goal of a sample survey is to gather data about the characteristics of a population. To achieve this goal, the quality of the collected data is crucial. This issue can be described by the terms *effectivity* and *efficiency*. Both are often used in business administration. Nonetheless, the definition of effectivity and efficiency allow an easy and overall classification of different sampling designs. Due to the common equivalent use of both terms, an exact definition is provided in eq. (3.1) and eq. (3.2).

$$\text{Effectivity} = \frac{\text{Result}}{\text{Goal}} \tag{3.1}$$

$$\text{Efficiency} = \frac{\text{Result}}{\text{Effort}} \tag{3.2}$$

The general goal in social research is to gather information about a population. If the research result sufficiently fulfills this goal, eq. (3.1) will show a result near 'one' and the design can be classified as effective. Leaving other biases aside, gathering information from each unit of the whole population will provide a perfect result. This means we truly know 100 % of the opinion or characteristics of a population. The goal is completed and in reference to eq. (3.1), an effectivity of 1 or 100 % is obtained. Nonetheless, gathering information from each individual will result in a very high effort. According to eq. (3.2), this leads to lower efficiency.

According to the definition of effectivity (eq. (3.1)) and efficiency (eq. (3.2), it can be said that a survey should provide the highest possible effectivity and additionally, efficiency should be kept as high as possible. This is aimed for by the use of samples.

Thus, sampling is an efficient way to derive information from a population. In case of a *"good" sample*, effectivity is kept high and *"good" results* are obtained. Thereby, it is possible to obtain

information and draw conclusions[1] about the target population. By choosing a suitable sampling technique, the effort for *sampling* is kept low, which keeps the efficiency high.

The key is the term "good" sample. A *"bad" sample* will provide results which are *less representative* for the population. In other words, in case of a *"bad" sample*, effectivity decreases and projections from the sample deviate from the actual target population. (see also Representative samples section 3.2.5, Validity section 3.2.7, Error and bias section 3.2.6)

To satisfy the key property of a high effectivity, a special emphasis has to be placed on the quality of the sample design. Nonetheless, finding a reasonable balance between sample effectivity and sample efficiency is one of the major challenges a researcher has to face.

3.2.4 Total survey design

The introduced *total survey design* is based on the model of Fowler F. J. described in the book "Survey research methods" (2013). [Fow13, p. 6 ff.] The author emphasizes that it is quite common to overlook critical issues during a sample design. He also stresses the necessity of high-quality procedures in "all salient areas" to minimize errors and biases of the obtained data. [Fow13, p. 5] Therefore, he proposed an assembly of "critical issues", whereby each of these issues is labeled "crucial" for a high-quality (effective) sample. This assembly is referred to as the *total survey design*. [Fow13, p. 6 ff.]

The total survey design includes:

1. The decision to implement a probability sample or not. (Probability sampling or non-probability sampling)
2. The sample frame
3. The sampling design
4. The sample size
5. The rate of response

Probability sampling or non-probability sampling

Sampling can be divided into two broad types:

1. probability sampling (also called: random sampling)
2. non probability sampling (also called: non-random sampling)

Before defining a sampling technique, a decision regarding which type is more suitable for the target population has to be made.

The distinction between probability sampling and non-probability sampling is done by a known or unknown selection probability from a finite population. The ultimately obtained sample is called

[1] The extent of reasonable conclusions is highly dependent on the sampling process.

probability sample for a known, or non-probability sample for a unknown selection probability. The terms *probability* and *random*, as well as *non-probability* and *non random*, are equivalent.

The denomination *finite population* can either refer to the target population or the sample frame (also sampling frame). [Fow13, p. 42] As stated in definition 3.4.8 (probability sampling), it is not necessary that each item has the same probability. However, if different probabilities are present, they need to be adjusted by weighting. [Fow13, p. 21]

Thus, a sample can only be described as *random* if the probability of selection is known. A sample is called *non-random*, if the probability is not known. This might seem contradictory in the first instance, which could be the reason for a tendency of the imprecise use of the term *random*.

Only for probability samples (see definition 3.4.8), it is possible to *"estimate accurately the relationship between the sample statistics and the population from which it was drawn"* [Fow13, p. 16]. With probability samples, it is also possible to minimize the personal bias through the random selection process and to draw conclusions about the target population.

For non-probability samples (see definition 3.4.10), it is only possible to describe the obtained data. Thereby, it has to be emphasized that non-probability samples feature presumably little to no statistical support for conclusions about the population. [Fow13, p. 2 f.]

Compared to probability sampling, non-probability sampling tends to be less time-consuming. Especially in social surveys, the effort of selecting individuals by a randomized sampling technique is considerably high. Hence, a tendency for a higher efficiency of non-probability samples is observable. In general, consulting individuals can be seen as a common bottleneck for social surveys. In probability sampling, only a few options are available to establish contact with individuals. Therefore, in specific scenarios, conducting a probability sample might not be feasible.

However, depending on the scenario, other biases than the personal bias might be more decisive, e.g. the accessibility of individuals. This may lead to better results with a non-probability sample design. Nevertheless, the general recommendation for scientific research is to implement a probability sample whenever possible. If substantial drawbacks occur, non-probability samples may also be evaluated. However, in the end, the specific scenario defines the best suited approach.

Figure 3.2 shows examples of common sampling techniques. A more detailed discussion of the specific techniques stated is given in the sections 'Probability sampling techniques' (section 3.3.1) and 'Non probability sampling techniques' (section 3.3.2).

The sample frame

The sample frame (also sampling frame) represents the set of people who have the chance to be sampled from a defined population. It provides a clear picture of the included and excluded units. A survey is only representative for the part of the population which is included in the sample frame. Inversely, the higher the deviation of the sample frame from the target population, the higher the introduced sample frame bias.

A narrowing of the sample frame tends to increase sampling efficiency, but also increases the extent of excluded units. Additionally, the boundaries of the sample frame are strongly influenced by available monetary funding and time frame. Considering all the given aspects, it can be said that the sample frame is very decisive for the final sampling design. [Fow13, p. 16]

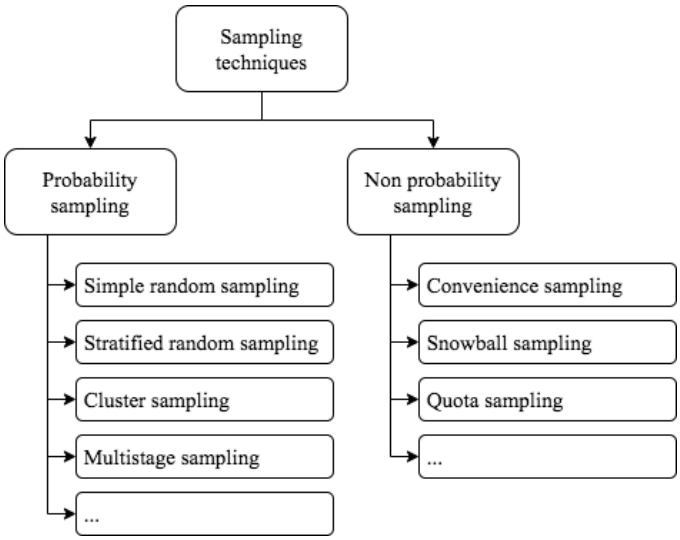

Figure 3.2: This figure shows examples of different sampling techniques, separated into two main types: probability sampling and non-probability sampling. Data taken from [Tah16, p. 20].

The sampling design

The sample design (or sampling technique) describes how the sample is drawn from the chosen population.

For social surveys, this can also be described as how people are grouped, contacted and ultimately sampled. Differences in e.g. survey duration, accessibility of participants or financial support may lead to different methods of choice.

More details about different techniques are given in Probability sampling techniques (section 3.3.1) and Non probability sampling techniques (section 3.3.2). Additional information concerning the selection procedure of a sampling technique is provided in the subsequent sections Representative samples, Error and bias and Validity (section 3.2.5, section 3.2.6 and section 3.2.7).

The sample size

The sample size can also be described as the total number of units chosen to be evaluated. It is not advised to define the total number of samples beforehand, especially without the consideration of the whole survey design. Numerous aspects (including the goal of the survey) influence the sample size and vice versa. In general, the sample size has a considerable effect on the sampling error and the *standard error of mean*. [Bry12, p. 196] Nonetheless, focusing on a pure minimization of both errors might increase other errors to a higher extent. [Fow13, p. 38]

The rate of response

The calculation of the response rate (or rate of response) was not strictly defined in the reviewed literature ([Bry12, ES10, Kel15, Fow13]). Equation (3.3) shows the definition, which was ultimately used to calculate the response rate. Thus, only usable data sets and people who have

been accessible are included into the calculation. Incomplete or evidently wrong data sets are rejected. Equation (3.3) is based on [Bry12, p. 199].

$$\text{rate of response} = \frac{\text{number of usable data sets}}{\text{selected units} - \text{unsuitable or unreachable units}} \tag{3.3}$$

The rate of response provides information about the proportion of units who didn't provide usable data sets. This includes participants who refused to provide information, or failed to correctly execute the questionnaire. If a significant part of the selected sample doesn't provide usable data, a significant amount of information is excluded from the sample. This systematic error is addressed by the nonresponse bias. (see 'Error and bias' and definition 3.4.19) For each rejected response, the nonresponse bias increases for the selected sample. This effects the *representativeness* of the sample and the *validity* of the conclusions - drawn from the sample about the target population - is likely to decrease. Hence, the response rate provides a key figure to evaluate the nonresponse bias of a sample. (see also 'Validity' and 'Representative samples') [Kel15, p. 170]

3.2.5 Representative samples

A representative sample is desired for every study. Nonetheless, the reasonings whether a sample is representative, are very versatile. A widespread main criterion for a representative sample is that a selected unit must have a known probability of selection. *Hence, under this premise, a representative sample can only be achieved by probability samples.* Although a probability sample is commonly referred to as necessary, it is *not sufficient*. Depending on other incorporated errors and biases, a sample may still not be representative. [Fow13, p. 38 f.]

In general, if the amount of errors and biases included in the sample increases, the representativeness of a sample decreases and the generalization from the sample to the population leads to wrong assumptions. This circumstance can also be described by the previously introduced sampling effectivity. If the effectivity of a sampling process declines, the obtained conclusions dissociate more and more from the true characteristics of the target population. Unfortunately, it is not possible to define a specific level of effectivity which guarantees a representative sample. It has to be said that, depending on other errors and biases, a non-probability sample might be even more representative than a probability sample, but since some of the errors and biases are just not measurable, this is not possible to verify. (see also Error and bias, section 3.2.6) Due to this fact, scientists sometimes choose to compare their studies with other similar studies, which claim to be representative. This may help to underline the representativeness of the own sample, but incorporates other drawbacks. Comparing samples to derive the representativeness is complex, since the whole sample design has to be included in the evaluation. (The sample size is not enough.) Other factors might be decisive such as the sampled population, the appearance of the corporation and many more. [Fow13, p. 38 f.]

To counter this problem and to ensure maximum efficiency, (standardized) strategies, approaches and process have been developed. One of them is the already introduced *total survey design*. Nonetheless, significant weight is put on the responsible scientist to ensure the representativeness of a sample and to *clearly* outline the limitations, allowing the correct interpretation of the obtained data.

3.2.6 Error and bias

As outlined, a sample survey generates statistics about a target population. The sample statistics are then used to draw conclusions about the characteristics of the target population. During the sample design and the evaluation of the data, different types of errors may occur. Hence, survey methodology is used to minimize and measure these errors (as far as possible). [Fow13, p. 8 ff.]

In general, two fundamental premises are of importance for a sample survey. [Fow13, p. 8 ff.]

1. The sample represents the characteristics of a target population. (see Representative samples, section 3.2.5)
2. The information gathered from the sampled units accurately describes the characteristics of the units.

The given fundamental premises lead to two fundamental sources of error. [Fow13, p. 8 ff.]

1. The distribution of units in the sample is not representing the target population.
2. The information gathered from the units is no accurate measure.

For social surveys, these fundamental errors can also be summarized by two main issues. [Fow13, p. 8 ff.]

1. How well the given answers measure the characteristics examined.

   Fowler (2014) describes this with the umbrella term: *errors associated with answers* (p. 11).
2. How closely the sample mirrors the population.

   Fowler (2014) describes this with the umbrella term: *errors associated with who answers* (p. 9).

The fundamental premises and their relation are summarized by Figure 3.3 .

The first main issue - *errors associated with answers* - covers the difference of what was intended to be measured and what was actually measured by the received data. [Fow13, p. 8 ff.]

Many possibilities exist to commit such errors. Compared to the nonresponse bias, units do try to provide information in the first place, but still fail to provide the requested data. To name a few examples for social surveys, this could be a misunderstanding of the question, not enough information to answer the question or a deceiving answer to look good. In general, this type of error is present in two different categories: objective facts and subjective states. In theory, it is possible to verify objective facts by measurement (e.g. the given height of unit). In practice this is often not feasible (e.g. the evaluation of how many cigarettes someone smokes). In contrast, there is no way to verify the subjective state of a unit (e.g. How many hours a person felt tired during the last days). This systematic difference between the obtained data from an individual and the "truth" is defined as response bias. [Fow13, p. 8 ff.]

The second main issue - *the error associated with who answers* - is related to the sampled population and how closely it mirrors the target population. [Fow13, p. 8 ff.] This issue features two distinctive categories:

Errors based on variation and errors based on systematic deviations. [Fow13, p. 8 ff.]

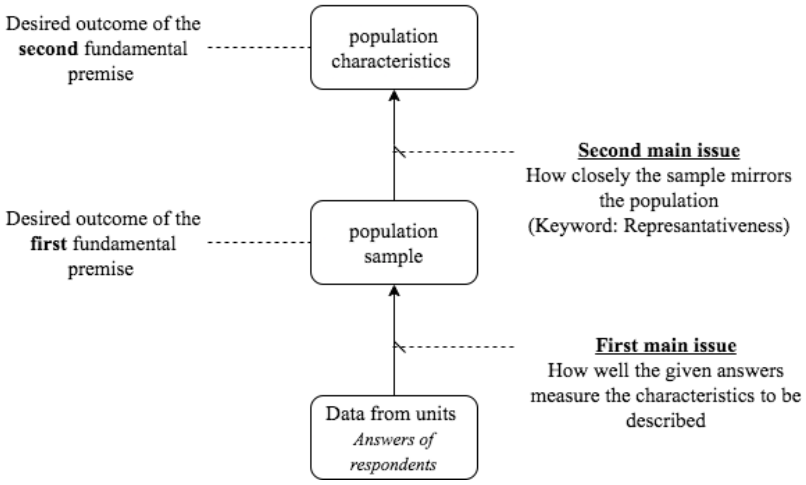

Figure 3.3: This figure shows the dependence of the two fundamental premises of social surveys in a flow chart. The two fundamental (possible) errors (or issues) are stated on the right. The flow chart itself shows the desired outcome of a sample. The information was taken from [Fow13, p. 8 ff.].

1. Errors based on variation.

   Independently of the sampling technique, there is a possibility that the sample characteristics randomly differ from the population. This is known as sampling error.

   For example, a population consists of 50 males and 50 females, from which a sample of 10 people is randomly drawn. The deviation of the sample proportion from the population proportion (50 % males and 50 % females) is the sampling error.

2. Errors based on systematic deviations.

   This category of errors is referred to as sampling bias.

   A *biased* sample leads to results, who on average, consistently differ from the target population. There are three possible ways a bias can be introduced: [Fow13, p. 10]

   (a) The sample frame bias

   If certain units of the target population are excluded by the present sample frame, the result will show a continuous deviation of the sample results from the actual characteristics of the population.

   (b) The selection bias

   An imperfect process of selection ultimately leads to a selection bias. Hence, every form of structuring or stratification is likely to introduce some amount of selection bias. This can be due to unknown connections in the process of grouping units or due to the use of non-probability samples. Depending on the design, especially non-probability samples tend to feature significantly higher selection bias compared to probability samples. [Fow13, p. 42]

   (c) The nonresponse bias

   The nonresponse bias describes units which are part of the defined sample frame, but due to the properties of some units it is not possible to collect the data. For social surveys, this might be the case, because units are unwilling to provide information.

> Another example might be that people just don't want to interact personally with the survey provider. If the non-responding units are different from the rest, a bias is introduced into the sample. The higher the rate of units without a response, the higher is the possibility of an included nonresponse bias. [ES10, p. 305]

Errors (arising from variations) and biases (arising from systematic deviations) are not necessarily related to each other. It is absolutely possible to obtain survey results with low sample variations, but a consistently high bias and vice versa. [Fow13, p. 11]

Given the stated definitions, it can be concluded that *unreachable* units are not part of the nonresponse bias. *Unreachable* units are systematically excluded from the sampled population and should, according to definition 3.4.17, be treated as sample frame bias.

3.2.7 Validity

The data obtained from a single unit (x_i) can be described as a value consisting of two factors: The true value of the data (t_i) and the deviation (d_i) introduced by a unit. [Fow13, p. 11]

$$x_i = t_i + d_i \tag{3.4}$$

The accumulated deviation can result in a random error, originating from individual data sets which sometimes indicate one direction and sometimes another. In this regard, the terms *less/low certainty or confidence* are used. Yet it might also be the case that the data sets continuously deviate in one direction from the true value. This is consequently referred to as bias. [Fow13, p. 11]

Both deviations, the random error and the continuous bias, are collectively represented by the *validity* of a sample. It is an indicator of how accurate the intended variables are measured. [ES10, p. 444]

Hence, all calculations concerning *validity* aim to assess how well the answers represent the value which is desired to be measured. The *validity* is then used to describe the relation between the received and the true value.

The larger the deviation d_i, the higher the chance that a unit will be in error. Vice versa, a high validity means a low deviation d_i and thus a low possibility that a unit deviates from the true value.

It should be noted that the validity of subjective states can't be assessed directly. Commonly, this circumstance is addressed by incorporating similar measures and comparisons. *Nonetheless, since it is not possible to assess the true value of a subjective fact, it is also not possible to assess the presumably accompanying systematic bias.*

3.3 Sampling techniques

3.3.1 Probability sampling techniques

Simple random sampling

The most basic sampling form is simple random sampling. It *"approximates drawing a sample out of the hat: Members of a population are selected one at a time, independent of one another and without replacement; once a unit is selected, it has no further chance to be selected."* [Fow13, p. 18]

To execute simple random sampling, it is essential to have a list of the examined population. If a list can't be provided, simple random sampling (as single technique) can't be executed. [Fow13, p. 18 ff.]

The process of selection has two features worth mentioning. First, the random selection process from a list almost entirely eliminates selection bias. Second, since the sampling is done from an existing list, the process does not depend on the immediate accessibility of the selected unit. [Bry12, p. 191 f.]

Especially in social surveys, the accessibility of units is an important factor. In a company for example, a list of all employees is readily available, but due to the holiday season, most of the employees are not accessible.

If no information of the constitution of a population is provided, it is often suggested to use simple random sampling. [Fli15, p. 101 f.]

Systematic sampling

In general, systematic sampling can be used in two ways. [Fow13, p. 18 ff.]

First, if a list exists and the total number of the population is known, the defined sample size can be used to calculate the step size of the systematic sampling process. This means that if the population is represented by a list of 1000 entries and the sample size is 100, every tenth person is picked from the list. (see eq. (3.5)) In doing so, two things have to be considered.

1. The list has to be randomized. A non-randomized list implies a preceding sorting or grouping process. Properly done, a sorting process might benefit the sample, but only if the conducted process is known and included in the calculation. [Fow13, p. 18 ff.]

2. The randomized starting point might cause an overflow. For example, for a list with 1,000 entries, the entry number 992 was randomly determined as starting point. With a step size of ten, the next selected number would be 1,002. Thus, the overflow is 2 and therefore the ultimately sampled unit is the second entry in the list. From there on, the sampling continues with the defined step size until the sample size is reached. An overflow can be avoided by setting the random starting point between the step size and zero. [Fow13, p. 18 ff.]

$$\text{step size} = \frac{\text{population}}{\text{sample size}} \tag{3.5}$$

Second, the units are directly selected from the sample frame. This facilitates the big advantage of generating a list while sampling.

Similar to a systematic sample from a list, it is important that this approach doesn't follow a previous sorting or grouping process that is not included in the sampling design. If a sorting or grouping is done, the probability of selection must be known and included in the succeeding calculations. Hence, a correct implementation retains the validity of a 'probability sample'. Generally, if more than one method is used, it is referred to as multi stage sampling, which is discussed in Section 3.3.3. One example for generating a list while sampling is the sampling of individuals in a shopping center. The shopping center has to be randomly selected, which includes a known probability. Next, e.g. every third customer (step size) who leaves the shopping center is selected for the sample. [Fow13, p. 18 ff.] (Note: If more than one exit is available, it has to be included in the probability calculation. [BHL96])

Stratified random sampling

The aim of stratified random sampling is to maximize the heterogeneity and representatives of the sample by grouping and/or sorting of the population prior to the sampling. The process itself is called stratification and thereby formed sub-populations are called stratum (pl. strata or stratums). Hence, to execute a stratification some characteristics of a population must be known. [Fow13, p. 18 ff.]

In simple random sampling or systematic sampling, the selection process is independent of the previous selections. This can either lead to sample characteristics which are equal to the population or to characteristics which differ from the population. Sampling 10 people from a group of 50 males and 50 females may contain 10 males and 0 females, or 0 males and 10 females. This potential sampling error is lessened or eliminated by stratification. [Fow13, p. 18 ff.]

The different groups obtained are sub-populations and ideally represent the different proportions of the total population. If a population is stratified for example by male and female, the result will be two groups of males and females. From each subgroup, (e.g.) a simple random sample is drawn. The combined sample of all sub-population will always feature the same proportions of males and females as the total population. Hence, information concerning minorities might be especially useful for stratification.

In general, a small degree of stratification is simple to implement and if done thoroughly, it might be beneficial for the sample. Nonetheless, due to the stratification, it is important to handle the selection probability properly. The latter has to be either equal for all sub-populations or adjusted by weighting. The latter may be used to minimize the sampling effort and thus increase efficiency. The different possibilities are subsequently discussed by two examples [Fow13, p. 18 ff.]:

Example A - Equal probabilities of selection: The population of students on a campus consists of 80 % males and 20 % females. A stratification has been done according to the given percentages, resulting in a male and female sub-population. For the stratified random sample, $\frac{1}{10}$ of each sub-population is randomly selected. Hence, the selection probabilities are equal for each subgroup and the combined sample obtained will feature the characteristics of the population. [Fow13, p. 18 ff.]

Example B - Different probabilities of selection: The population of students on a campus consists of 80 % males and 20 % females. The goal is to select at least 40 students from each group. A population of 1,000 students is sampled via stratified random sampling at a rate of $\frac{1}{10}$. This means that 100 students are selected from the population - 80 males and 20 females. To obtain the additional 20 female students, it is necessary to draw another 100 students from the population. Thereby, the goal of 40 female students is reached, but it also adds 80 males to the survey which wouldn't have been necessary for the survey goal. This process can be improved by different selection probabilities. In this case, one option is to double the sampling rate of female students - the group of male students is sampled at a rate of $\frac{1}{10}$, the group of female students at a rate of $\frac{2}{10}$. Thereby, 80 male and 40 female students are selected. In total, instead of 200 students, only 120 have to be sampled. The efficiency increases considerably. To combine samples of different selection rates, it is important to compensate for the different rates by weighting. In this particular case, since female students were sampled at a doubled selection rate, the weight of the female students has to be half the weight of the male students. [Fow13, p. 18 ff.]

Stratification with different selection probabilities can be used for particular variable groups. This oversampling may help to improve the overall result. For more details it is referred to Groves (2004) [Gro04]. Furthermore, stratification can be done with more than one criterion, for example for students: Gender and Faculty. Nonetheless, it is only feasible, if it is possible to identify and allocate the characteristics of a group. [Bry12, p. 192 f.]

3.3.2 Non probability sampling techniques

Convenience sampling

A convenience sample is selected based on the mere availability of participants. [Bry12, p. 201 ff.]

Typical sampling scenarios are events (e.g. concerts, sports), locations (e.g. shopping malls) or street selection. Another frequent approach is the selection based on social relations (e.g. family, colleagues, friends, ...). [VTS16, p. 328]

The high availability of participants has time and cost advantages and may also feature a very high response rate. Nonetheless, given the selection process, it is not possible to know the population of the sample. Therefore, it is not possible to generalize the results. [Bry12, p. 201 ff.]

Convenience samples are commonly used in specific situations, such as pilot testing, in situations where an outstanding sampling opportunity occurs or where any sample is better than no sample. [Bry12, p. 201 ff.]

Albeit these restrictions, convenience sampling plays a bigger role than often expected. The received data might not be representative, but it can be used as a first trail for further research or to show connections between different areas. [Bry12, p. 201 ff.]

Snowball sampling

The name snowball sampling originates from the graphical interpretation of the distribution and is shown in fig. 3.4 (picture taken from [1]). Each layer of distributors leads to an increasing number of sampled subjects. The resulting picture is known from a common avalanche type, which initially starts with a small snowball.

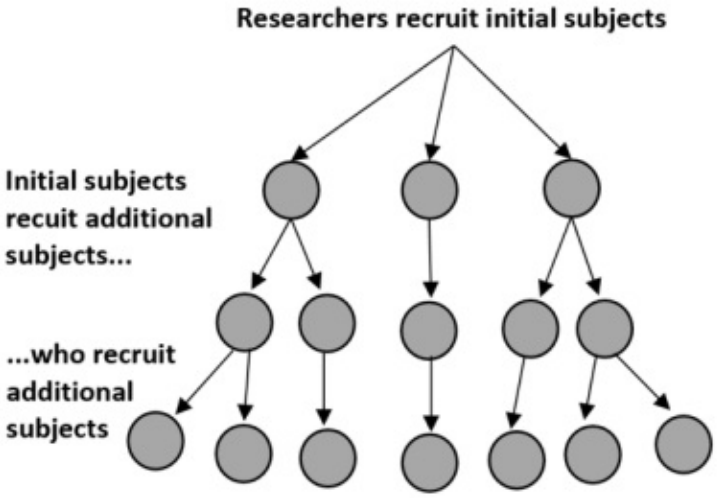

Figure 3.4: The selection process of units in snowball sampling. Each circle depicts a selected and sampled unit. Picture taken from [1].

In theory, the starting point for snowball sampling is randomly chosen. In practice, this is hard to achieve. Therefore the starting point is usually determined by convenience sampling and often the researcher himself starts to distribute the sample. Nevertheless, also for random starting points, snowball sampling is no probability sample since it is not possible to determine the selection probability of a unit. This compromises representativeness, especially for statistical evaluations of quantitative surveys. Therefore, snowball sampling is more present in the area of qualitative research. [BB12, p. 60]

Either way, the sample highly depends on the initial starting point and is biased towards the individual personal network and cooperative subjects. This selection bias can be lessened by strategies to limit the number of *"possible further distributions per subject"* (e.g. a limited number of coupons per person). However, an easy and fast distribution is one of the main benefits of snowball sampling and a decision to limit this benefit should be made carefully. [BB12, p. 60]

Atkinson and Flint (2001, p. 2) suggest that: *" [. . .] the problem of a selection bias may be partially addressed, firstly through the generation of a large sample and secondly by the replication of results to strengthen any generalizations."* [AF01, p. 2]

Besides the selection bias, other biases associated with the data collection such as, *sampling bias* (see definition 3.4.15), sampling bias and response bias arise. [BB12, p. 60] [Bry12, p. 202 f.]

Comparing a snowball sample with randomized samples of the same population can help to identify and tackle the mentioned error and to improve the representativeness (Witte et al., 2000). Nonetheless, the representativeness of a probability sample will never be reached since it is not possible to calculate the precise influence of the conducted measures on the representativeness. [BB12] [Bry12, p. 201 ff.]

All things considered, in a certain situation, snowball sampling still has its value. Especially if the population is hard to determine, snowball sampling may be the only feasible technique (e.g. as in studies about the usage of drugs). Commonly, snowball sampling is used in settings where respondents are hard to reach, hard to involve or few in numbers. Moreover, it is used in population where trust plays a major role or in studies where the aim is to show relations between respondents. [BB12, p. 60] [Bry12, p. 202 f.]

Quota sampling

Quota sampling uses a similar approach as stratified sampling. Its aim is to produce a sample that ideally shows the same proportions as the target population. Similar as to stratified sampling, the categories are defined preceding the sampling process. This also includes the number of sampled units for each category, e.g. 50 males, between 30 and 40 years with a master's degree and 50 females between 40 and 50 years and a doctoral degree. In this regard, the categories are also referred to as *quotas*. Unlike in stratified sampling, the selection of the units is not carried out randomly. The interviewer is liable to search for units who match the defined categories. This introduces convenience sampling into the quota sampling approach, which is the main difference to stratified sampling. For this reason, quota samples are classified as non-randomized samples. [Bry12, p. 203 f.]

Similar to snowball sampling, the selection bias strongly correlates with the interviewer. It is again biased towards the personal network and cooperative subjects, although in this case, even more weight may be placed on the personal network. [Bry12, p. 203 f.]

Due to its design, quota sampling includes common drawbacks of non-probability samples. The user of quota sampling has to argue against the low representativeness of the sample caused by personal bias and the under-representation of units who were not easy to reach. The judgmental influence of the interviewer also introduces the error of units assigned to wrong categories. It is also not feasible to calculate the standard error of mean for a quota sample since the population is not known (a non-random sample). [Bry12, p. 203 f.]

Quota sampling features the typical benefits of non-probability samples such as high efficiency and low cost. The main advantage of quota sampling is the low duration of the sampling process, especially compared to probability samples. [Bry12, p. 203 f.]

3.3.3 Single stage and multi stage sampling

In single stage sampling, only one technique is used to create a sample. [Fow13, p. 18] In multi stage sampling more techniques are used, which can either be the same in each stage (e.g. more layers of stratification) or different from stage to stage (e.g. a combination of stratification and systematic sampling). As long as more than one sampling layer is implemented, it is called multi stage sampling. [Bry12, p. 193 f.] [Fli15, p. 102 f.] [Fow13, p. 21]

Multi stage sampling is often used if the population is not available on a list and when it is particularly difficult to access the population. [Fow13, p. 21]

One example might be the population of all Austrian university students. A list of students might not be available and if so, driving through the whole country to sample the students is not very efficient. Hence, in multi stage sampling, a list of universities can be used to sample the universities in the first stage. In the second stage, the students are sampled from the universities selected. Compared to the initial sampling from the list, the efficiency is increased, whereby, when implemented correctly the effectivity is kept high.

In this regard, three terms are often used: cluster, cluster sampling and area sampling.

In account with definition 3.4.25 (stratum) and definition 3.4.29 (cluster), it can be said that groupings, clusters and strata of a population are synonyms. The same can be said for cluster sampling and stratified random sampling with more than one layer. Also, no definition omits the

		Probability of selection at stage 1 (universities)		Probability of selection at stage 2 (dormitories)		Overall sampling rate
a)	20 universities ($\frac{1}{5}$), and $\frac{1}{2}$ of the housing units are selected	$\frac{1}{5}$	x	$\frac{1}{2}$	=	$\frac{1}{10}$
b)	10 universities ($\frac{1}{10}$), and all belonging housing units are selected	$\frac{1}{10}$	x	$\frac{1}{1}$	=	$\frac{1}{10}$

Table 3.1: This table shows an example of area probability sampling (regional stratification). The effort of sampling case a) (20 universities) is considerable higher then the effort of case b) (10 universities). This results in a higher sampling efficiency for b). By adapting the selection probability of different stages, the overall sampling rate can be held constant, which enables a comparison of different sampling designs. Information taken from [Fow13, p. 21 ff.]

usage of the given terms in non-probability sample setting. Still, the term *strata* has a strong relation to stratified random sampling and therefore to probability sampling.

According to definition 3.4.30 (cluster sampling) and definition 3.4.28 (multi stage sampling), cluster sampling is a synonym for multi stage sampling. [ES10, p. 292] To simplify the terminology, *cluster sampling* and *cluster* are omitted and the term stratum (pl. strata or stratums) is only used for probability samples.

Another frequent sampling issue is the low accessibility of units due to a regionally widespread population. This is addressed by a multi stage sampling approach called *area probability sampling*. Similar to a stratification process, the target area is divided into subareas with clear boundaries. These subareas (or sub-populations) are then randomly selected until the last sub-population consisting of the target units is reached. These units are then sampled. Again, a demarcation to *regional stratification* or *area stratification* is not stated in the reviewed literature. ([Fow13, Fli15, Bry12, ES10]) It is therefore assumed, that area probability sampling is a synonym for regional stratification. Independent of the name, the overall selection probability is an important factor for comparing different area probability sampling designs. This is outlined in the example below. (Example C)

Example C - Area probability sampling: (This example is illustrated in table 3.1)
The goal is to sample the population of economic students which live in corresponding dormitories. A list of universities and respective dormitories is available. In total, 100 universities are sampled. Table 3.1 shows two sample designs with different probabilities of selection, but an overall equal sampling rate. Area probability sampling (or regional stratification) is thereby used to lower the overall sampling effort by lowering the necessity to travel. Approach b) shows the lowest travel effort. Depending on the diversity of the universities, approach a) is likely to have sample estimates of higher validity, since the attributes of students are likely to vary for each university. Moreover, not only different attributes, but also different sizes of universities and housing units have not been considered. This may have an effect on the validity of the sample although, as

stated in [Fow13, p. 21 ff.], samples tend to have a higher validity, if the last stage (here stage 2) features an equal number of units. The particular proceedings are case-specific, but especially if area probability sampling is included in the sample design, the issues given should be included in the evaluation.

Similar to clusters and cluster sampling, it was decided to omit the term area probability sampling and use regional/areal stratification from now on for reasons of simplicity.

3.3.4 Self administered online surveys

The conventional forms of self-administered questionnaires, or also referred to as self-completion questionnaires, are postal, mail or online questionnaires. Especially over the last 20 years, the method of self-administered online surveys increased its total share in self-administered questionnaires. [EM05]

Advantages

- Global reach and large sample size

  Due to widespread internet access especially in industrialized countries, online questionnaires have the advantage of a superior reach beyond the borders of nation states. This also enables the assembling of a large sample size with high efficiency.

- Flexibility

  Different formats and adapted versions of questionnaires, individually designed for respondents are possible. Common examples are language choice, order control of questions (or answers), the skipping of questions and the use of high question diversity such as multiple choice, scales, open-ended questions etc.

- Speed and timeliness

  Online surveys allow a time-efficient administration, which ultimately lowers the time needed to collect and process the data.

- Technological innovations

  Simplified options and more attractive presentations are possible, even for respondents with less expertise (e.g. instruction videos instead of texts)

- Convenience

  "respondents can answer at a convenient time for themselves;" [BB12, p. 62]

- Ease of data entry and analysis

  The collected data is directly stored in a database, which is easily accessible for subsequent evaluations.

- Low administration cost

  Personal interviewers are not required. It is moreover possible to outsource the whole process to specialized online questionnaire companies.

- Ease of follow-up

  An online follow-up of non-respondents is easier due to the low expense of an additional contact.

- Controlled sampling

  This refers to databases, or mailing lists, created by opt-in surveys. One prominent example is the feedback collection of customers, which also allows to enhance customer relationship. By gathering knowledge of respondents, it is also possible to conduct estimations about the characteristics of non-respondents (marketing research).

Disadvantages

- Perception as junk mail

  This also includes requests coming from trusted sources. Additionally, there is a possibility of rejections by pre-filters, such as mail servers. [BB12, p. 62 f.]

- Technological variations

  Problems and different user experiences due to different internet connections and technical set-ups, such as personal computers, smartphones, monitors, etc.

- Skewed attributes of the internet population

  The selection bias between the offline and online target population and their related attributes like gender, age, education level, etc. Nonetheless, due to the advancing digitalization, the gap between both sub-populations seems to decrease. [BB12, p. 63] [EM05, p. 209]

- Questions about sample selection and implementation

  Depending on the sample design, some selection methods might be based on *volunteer samples*, where participants e.g. go on a website and participate proactively. Others might be based on randomized selection with a self-administered survey during the last sampling stage. Due to this broad variety of sample selection and implementation in self-administered online questionnaires, many questions concerning representativeness and validity have to be answered during design.

- Ambiguous answering instructions

  Instructions must be extremely clear to all participants.

- Impersonal

  Brown et al. (2001) state that the potential for participants to pause and reflect is higher in telephone surveys than in online surveys. [BBM01]

- Privacy issues

  It has to be taken care of secure data transmission, data handling, data storage and data usage.

- Low response rate

  The stated disadvantages often lead to low response rates if no emphasis is laid on their moderation.

The outlined main advantages and disadvantages of online questionnaires were derived from the research of Evans and Mathur (2005). [EM05]

3.4 Definitions

Section: Sample design workflow

Definition 3.4.1 (sample)**.** "A selected subset of a population chosen by some process usually with the objective of investigating particular properties of the parent population." [ES10, p. 376]

Definition 3.4.2 (population)**.** "(...) the universe of units, from which the sample is to be selected." [Bry12, p. 187]

The term *unit* is the most general notation for objects of interest. [Bry12, p. 187] In social surveys the terms 'people', 'individuals' or 'subjects' are also commonly used. [Bry12, Fli15, Fow13]

Definition 3.4.3 (sampling)**.** "The process of selecting some part of a population to observe so as to estimate something of interest about the whole population." [ES10, p. 377]

Definition 3.4.4 (sampling design)**.** "The procedure by which a sample of units is selected from the population." [ES10, p. 377]

Definition 3.4.5 (sample design)**.** "The process which leads to the development and selection of a specific sampling design and the ultimately obtained sample." [ES10, p. 377]

According to definition 3.4.4, it is correct to equally use the terms *sampling design* and *sampling technique(s)*, as both refer to the actual selection strategy. To clarify, the *sample* is drawn by *sampling*, which is done according to the *sampling design* that is part of the *sample design*. All of them have influence on the characteristics obtained by the sample.

Section: Survey objective

Definition 3.4.6 (sample survey)**.** "A study that collects planned information from a sample of individuals about their history, habits, knowledge, attitudes or behaviour in order to estimate particular population characteristics." [ES10, p. 377]

Section: Effectivity and efficiency

Definition 3.4.7 (efficiency)**.** "A term applied in the context of comparing different methods of estimating the same parameter; the estimate with the lowest variance being regarded as the most efficient. Also used when comparing competing experimental designs, with one design being more efficient than another if it can achieve with fewer resources." [ES10, p. 149]

Section: Total survey design

Definition 3.4.8 (probability sampling)**.** "A sample obtained by a method in which every individual in a finite population has a known (but not necessarily equal) chance of being included in the sample." [ES10, p. 340]

Definition 3.4.9 (sample frame (also sampling frame))**.** "The portion of the population from which the sample is selected." [ES10, p. 377]

Definition 3.4.10 (non probability sampling)**.** A sampling method where the selection probability of an item is not known or the unequal probabilities can't be adjusted by weighting. [Bry12, p. 187]

Definition 3.4.11 (sample size)**.** "The number of individuals to be included in an investigation. Usually chosen so that the study has a particular power of detecting an effect of a particular size." [ES10, p. 376]

Definition 3.4.12 (response rate (or rate of response))**.** Refers to the proportion between the number of usable data sets and the number of eligible units of a selected sample. [Fow13, p. 42] [Bry12, p. 199]

Section: Representative samples

Definition 3.4.13 (representative sample)**.** "A sample reflecting the population so accurately that it is a microcosm of the population." [Bry12, p. 187]

Section: Error and bias

Definition 3.4.14 (response bias)**.** "The systematic component of the difference between information provided by survey respondent and the 'truth'." [ES10, p. 369]

Definition 3.4.15 (sampling error)**.** "The difference between the sample result and the population characteristic being estimated." [ES10, p. 377] Its origin lies in the random variation of the sampling process and the sole fact that the sample is only a small part of the population. It is therefore categorized as random (sampling) error. [Fow13, p. 10]

Definition 3.4.16 (sampling bias)**.** A systematic deviation of the relation between the sample and the population. [Fow13, p. 10] It is therefore categorized as non-random (sampling) error.

Definition 3.4.17 (sample frame bias)**.** A bias originating from the difference between the population and the sample frame. It is proportional to the excluded part of the target population. [Fow13, p. 10]

Definition 3.4.18 (selection bias)**.** The bias that may be introduced into all types of scientific investigations, whenever a selection is done by the involved unit or it is subject to constraints that go unobserved by the researcher. [Fow13, p. 42] [ES10, p. 386]

Definition 3.4.19 (nonresponse bias)**.** A failure introduced by units who are unable or refuse to provide relevant information. [Fow13, p. 42] [ES10, p. 305]

Section: Validity

Definition 3.4.20 (validity)**.** "The extent to which a measuring instrument is measuring what was intended." [ES10, p. 444]

Section: Probability sampling techniques

Definition 3.4.21 (simple random sampling)**.** "A form of sampling design in which n distinct units are selected form the N units in a *finite population* in such a way that every possible combination of n units is equally likely to be the sample selected. (...)" [ES10, p. 394]

Definition 3.4.22 (systematic sampling)**.** Systematic sampling provides an equal precision (*validity*) as simple random sampling. Thereby, a fixed step size and a random starting point is defined and the population (or the sample frame) is sampled by the defined step size. [Fow13, p. 18 ff.]

Definition 3.4.23 (stratified random sampling)**.** A stratified random sampling approach uses "the possibility of structuring the sampling process to reduce the normal sampling variation, thereby producing a sample that is more likely to look like the total population than a simple random sample." [Fow13, p. 18]

Definition 3.4.24 (stratification)**.** The process of grouping and/or sorting of a population, according to known characteristics of population, prior to a sampling process. [Fow13, p. 18 ff.]

Definition 3.4.25 (stratum)**.** Groups or sub-populations formed by stratification are also called stratum (pl. strata or stratums). [Bry12, p. 192 f.] [Fli15, p. 102 f.]

Section: Non probability sampling techniques

Definition 3.4.26 (snowball sampling)**.** "[...] a technique for finding research subjects. One subject gives the researcher the name of another subject, who in turn provides the name of a third, and so on. This strategy can be viewed as a response to overcoming the problems associated with sampling concealed hard to reach populations [...]" [AF01, p. 1]

Section: Single stage and multi stage sampling

Definition 3.4.27 (single stage sampling)**.** In single stage sampling, only one sampling technique is used to create a sample. [Fow13, p. 18]

Definition 3.4.28 (multi stage sampling)**.** Multi stage sampling combines multiple sampling techniques to improve the effectivity and efficiency of a sample. It isn't defined as one specific sampling technique - the mix of sampling techniques is adjusted according to the sampling scenario. [Bry12, p. 193 f.] [Fli15, p. 102 f.] [Fow13, p. 21]

Definition 3.4.29 (cluster)**.** In cluster sampling, the units of a population are arranged in groups. These groups are referred to as clusters. [ES10, p. 87]

Definition 3.4.30 (cluster sampling)**.** "With cluster sampling, the primary sampling unit (...) is not the units of population to be sampled but groupings of those units. It is the latter groupings or aggregations of population units that are known as clusters." [Bry12, p. 193]

Section: Self administered online surveys

Definition 3.4.31 (self-administered online surveys)**.** "Respondents answer questions by completing the questionnaire themselves." [Bry12, p. 232 ff.] The term online refers to the compelling necessity of a temporary or continuous internet access, which also implies the availability and correct use of electronics required.

4 Implementation

4.1 Original sample

The original sample design uses a multi stage sampling strategy to conduct a randomized sample of the Austrian population. Different stages of stratification are implemented and an emphasis was laid on effectivity and efficiency.

The approach samples the Austrian population via food retailers. The main idea was to utilize a presumed strong overlap of the population of *food-retailer-visitors* with the total Austrian population. Nonetheless, it has to be said that all the people who are not able to or refuse to go to food retailers are thereby omitted from the sampling process. This results in in a sample frame bias which is accepted by the execution of this approach. It can be said that this approach is quite common. The novelty of the developed sample design lies in the preceding multi stage stratification process. Hence, the following chapter presents a detailed description of the different stratification layers. It starts with the first stratification of the total sampled population and ends with the smallest obtained strata from which a systematic randomized sample (see 'Systematic sampling') is drawn.

4.1.1 Total survey design: Original sample

1. Probability sampling or non-probability sampling

   In reference to the outlined benefits of probability sampling (see section 3.2 and section 3.3), it was decided to implement a probability sample.

2. The sample frame

   The sample frame was set to people with their country of residence in Austria, who visit food retailers in Austria.

   The target population was set to people with their country of residence in Austria.

3. The sampling design

   A self-administered, systematic probability sampling approach, using different stages of stratification. A detailed description is provided in section 4.1.2.

4. The sample size

   The aspired sample size was set to 150 usable data sets.

5. The rate of response

   The rate of response is assessed by the number of approached individuals and the usable data sets ultimately received.

4.1.2 Sampling design: Original sample

Layer 1.1: Stratification of Austrian food retailers

In Austria, the market of food retailers is dominated by two corporations, the "Spar Österreichische Warenhandels-AG" and the "REWE International AG". This lowers the number of different retailers and simplifies the sampling process. [3]

Table 4.1 shows the different market shares of the top 10 food retailers (data was taken from [3]). The top retailers named "Billa", "Merkur", "Penny" and "ADEG" are part of "REWE International AG". [4] "Spar/Eurospar" and "Interspar/Maximarkt" are part of the "Spar Österreichische Warenhandels-AG". [5]

Market shares of Austrian food retailers		
#	Name	[%]
1	Spar/Eurospar	24.3
2	Hofer	19.3
3	Billa	17.4
4	Merkur	8.8
5	Interspar/Maximarkt	7.9
6	Lidl	7.0
7	Penny	4.1
8	M-Preis/T&G	3.7
9	Adeg	2.1
10	Unimarkt	1.3

Table 4.1: In this table, the top 10 Austrian food retailers are listed and ordered in terms of their market share (in %). The data was taken from [3].

By merging the retailers according to their superior cooperation, it is visible (see table 4.2) that four main companies reach a combined market share of 90.90 %. It was therefore decided to sample only from the four dominant companies. Based on the given market coverage, it was assumed that the effectivity loss is acceptable compared to the efficiency gain of the sampling process. Hence, initial stratification was done according to the given four dominant corporations depicted in table 4.2.

To ensure an integrated approach, three rules where established for stratification:

Definition 4.1.1 (first stratification rule)**.** The stratification aims to result in a minimum number of stores.

Definition 4.1.2 (second stratification rule)**.** If the first stratification rule leads to a distinctive situation, the result with higher relation to the original shares of the population is favored.

Corporation / Company	Market share	Number of stores	Number of stores (rounded)	Share
REWE International AG	32.40 %	4.63	5	36 %
Spar Österreichische Warenhandels-AG	32.20 %	4.6	5	36 %
Hofer	19.30 %	2.76	3	21 %
Lidl	7.00 %	**1**	**1**	**7 %**
Total	90.90 %	12.99	14	100 %

Table 4.2: This table shows the top 10 Austrian food retailers. The different retailers from table 4.1 were merged according to their superior corporation. The column "Number of stores" shows the intermediate stratification step, the column "Number of stores (rounded))" shows the result of the initial stratification of the Austrian food retailers.

Definition 4.1.3 (third stratification rule)**.** In cases where both rules are present, more weight is put on rule number one.

To optimize the sampling process, the goal was to find the minimum number of stores to be sampled and simultaneously ensuring a representative sample for the calculated four dominant corporations. In reference to this goal, the lowest number of stores to be sampled from a top corporation is *one*. Therefore, this number was assigned to the company with the lowest percentage rate from the top four dominant companies. In this case, the number one was assigned to the company called "Lidl". From then on, the proportions were extrapolated. The outcome is shown in table 4.2. The obtained numbers of stores to sample were rounded to a value without decimal points. The result is in line with both outlined rules for stratification. First, the number of stores is minimized by starting from the lowest shares. Second, no other proportion was found with less deviation as the shares given in table 4.2.

Concluding, the first layer of stratification results in 14 stores to be sampled, covering 90.90 % of the Austrian population that visits food retailers.

Layer 1.2: Stratification of corporations

As outlined above, the two main corporations are "Spar Österreichische Warenhandels-AG" and "REWE International AG". Both include different store types. Their stratification is shown in this sub-chapter.

Layer 1.2.1: Stratification of "REWE International AG"

The description of the following stratification is supported by table 4.3 and table 4.4.

Four stores (brands) of the "REWE International AG" are part of the top 10 food retailers (see table 4.2 and table 4.3). As obtained during the first level of stratification, five stores of the "REWE International AG" have to be sampled. Table 4.3 shows from left to right each store type of the REWE Group, their associated market shares and the number of stores to sample.

Stratification step one: If the store with the lowest share is sampled once, the rates lead to 15 stores to be sampled in total. This exceeds the maximum of five stores from the first stratification layer (see table 4.3). Thus, in reference to the first stratification rule, the element was set to zero.

Stratification step two: If the store with the second lowest share is sampled once, the total amount of stores to be sampled is seven. This again exceeds the maximum of five stores again. By following this method (based on first stratification rule), two possible outcomes are obtained. *Result A*, sampling three stores of "Billa" and two stores of "Merkur" or *Result B*, sampling four stores of "Billa" and one store of "Merkur".

Following the second stratification rule, Result A was determined as final stratification result. The confrontation of the different shares of Result A and Result B is depicted in table 4.4.

Rewe Group	Market share	Stores to sample	Stores to sample	Stores to sample	Stores to sample	Stores to sample	Stores to sample
Billa	17.40 %	8	4	2	4	3	4
Merkur	8.80 %	4	2	1	2	2	1
Penny	4.10 %	2	1	**0**	**0**	**0**	**0**
ADEG	2.10 %	**1**	**0**	**0**	**0**	**0**	**0**
Total	32.40 %	**15**	**7**	**3**	**6**	**5**	**5**

Table 4.3: The table shows the first step of the stratification process for sub-companies of the *REWE International AG*. The different market shares are derived from table 4.1. The goal was to find a distribution for a total number of five stores (see table 4.2). The calculation starts with the company with the lowest market share, setting its *"stores to sample count"* to one. The relative number of stores are then derived from the market share. If the total number of stores to sample exceeds the requested number (of five stores), the "stores to sample count" of the company with the lowest market share is set to zero for continuing calculation. In the end, this process resulted in two possible strata. The final comparison is depicted in table 4.4.

Rewe Group	Market share	Relative share	Result A	Relative Share A	Result B	Relative Share B
Billa	**17.40 %**	**66.41 %**	**3**	**60 %**	**4**	**80 %**
Merkur	**8.80 %**	**33.59 %**	**2**	**40 %**	**1**	**20 %**
Penny	4.10 %		0		0	
ADEG	2.10 %		0		0	
Total	32.40 %		5		5	

Table 4.4: This table shows the second stratification process of the "REWE International AG" corporation. The top results from table 4.3 are compared to the relative market share of the remaining companies (brands). As depicted, the relative share of *Result A* exhibits the highest overlap with the *relative share* of the remaining companies. According to the second stratification rule, Result A was determined as final stratification result.

Layer 1.2.2: Stratification of "Spar Österreichische Warenhandels-AG"

The stratification of stores from "Spar Österreichische Warenhandels-AG" follows the same procedure as the stratification of "REWE International AG". During the weighting process, two possible results where obtained. By following the second stratification rule, Result A was determined as the final stratification result. The process is shown by table 4.5, followed by table 4.6.

Spar Group	Market share	Stores to sample	Stores to sample
Spar/Eurospar	24,30 %	4	3
Interspar/Maximarkt	7,90 %	1	2
Total	**32,20%**	**5**	**5**

Table 4.5: First stratification process for sub-companies of the *"Spar Österreichische Warenhandels-AG"*, resulting in two possible outcomes. An illustration of the final comparison is provided in table 4.6

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Spar Groupe	Market share	Relative share	Result A	Relative share A	Result B	Relative share B
Spar/Eurospar	24,30 %	75,47 %	4	80 %	3	60 %
Interspar/Maximarkt	7,90 %	24,53 %	1	20 %	2	40 %
Total	32,20 %		5		5	

Table 4.6: Second stratification process of the "Spar Österreichische Warenhandels-AG". According to the second stratification rule, Result A was determined as final stratification result. (A more detailed description of the process is given in table 4.4.)

Result Layer 1: Stratification of Austrian food retailers

After the stratification of both layers, 14 stores are arranged to be sampled in total. During the whole process, the determined rules of stratification where followed. The distribution of the stores finally calculated is shown in table 4.7.

Stratification of Austrian food retailers	
Name	Stores to sample
Spar/Eurospar	4
Billa	3
Hofer	3
Merkur	2
Interspar/Maximarkt	1
Lidl	1
Total	14

Table 4.7: This table shows the final stratification result of Austrian food retailers.

Layer 2: Stratification of the urban and rural population

The demographics of Austria exhibit only six cities with over 100,000 inhabitants. "Vienna", the capital of Austria, has by far the biggest population of 1,911,191 inhabitants [6] , followed by "Graz" with 291,072 inhabitants [6]. Due to this population distribution, a stratification

between the urban and rural population of Austria can be considered reasonable. Additionally, it is considered not uncommon to find diverse opinions between rural and urban inhabitants in Austria, although no evidence can be provided to verify this claim.

For the given research topic, it was decided to stratify the Austrian population of 8,901,064 inhabitants [6] into two groups to minimize a possible sampling error. The first group are people living in cities, while the second group are people living in rural areas. Each municipality with 10,000 inhabitants or more was considered a city. The obtained result shows a population distribution where 52 % [1] of the Austrian population live in rural ares and 48 % [1] live in urban areas, with a considerable share of *Vienna* (21 % [1], see table 4.8). Data taken from [6].

	Headcount	Share [1]
Total Austrian population	8,901,064	100 %
Rural population	4,632,350	52 %
Urban population	2,357,523	26 %
Vienna	1,911,191	21 %

Table 4.8: Urban and rural population distribution of Austria. As outlined above, municipalities over 10,000 inhabitants were considered as cities and assigned to the urban population. Vienna exhibits an outstanding share within the Austrian urban population and was therefore specified as separate group.

It was therefore decided to stratify the 14 food retailers previously defined into two groups. According to the stratification rules stated before, 7 food retailers have to be sampled in urban areas and 7 food retailers in rural areas. As visible in table 4.8, the capital "Vienna" has a dominant weight in the urban area subgroup. It was therefore decided to additionally stratify the urban area into two strata. According to the given shares and in reference to the second stratification rule, 4 stores will be sampled in urban areas (excl. "Vienna") and 3 stores in "Vienna".

The detailed stratification of the food retailers and the Austrian population was done in two steps.

The first layer of stratification settles the distribution between rural areas (7 food retailers) and urban areas including Vienna (7 food retailers). The second layer stratifies the seven food retailers for the urban area between "Vienna" and the remaining urban areas.

Starting with the first layer of stratification, the even numbers of stores to be sampled were split up between the urban and rural areas. Stores with odd sampling numbers were then distributed in reference to the second stratification rule (weighting of shares). As visible in table 4.9 (column number 2), stratification conflicts for the companies "Hofer", "Billa", "Lidl" and "Interspar/-Maximarkt" had to be solved. "Billa" and "Interspar/Maximarkt" are part of the nationwide competing corporations "REWE Internationl AG" and "Spar Österreichische Warenhandels-AG". "Hofer" (part of the International corporation named "ALDI") and "Lidl" are both set up as competing discounters on an international level. Concerning the first competitors and in reference to the second stratification rule (weighting of shares), more weight was put on the market leader "REWE International AG". Thus, the company "Billa" will be sampled in the area with the higher population share, the rural area. Its counterpart, the company "Interspar/Maximarkt", will consequently be sampled in urban areas. The same strategy was used for "Hofer", which

[1] The numbers include rounding errors.

has the higher market share and will therefore be sampled in rural areas. Thus, "Lidl" will be sampled in urban areas. The result are shown in table 4.9, columns 3 and 4.

The second layer of stratification concerning the urban areas started again by distributing the even numbers of stores to be sampled. Next, the internal competitors named "Billa" and "Merkur" of "REWE International AG" were allocated. According to definition 4.1.2, the market-share-leader "Billa" will be sampled in the area with the higher population share, the urban area excluding "Vienna". "Merkur" will therefore be sampled in "Vienna". Similarly, "Hofer" will be sampled in the urban area excluding Vienna and "Lidl" in "Vienna". Since four companies in total have to be sampled in urban areas excluding Vienna, the company "Interspar/Maximarkt" will be sampled in the remaining urban area, as this area features a higher market share. (second stratification rule - weighting by shares). The final result is depicted in table 4.9 - columns 3, 5 and 6.

Strata of food retailers	Austria	**Rural area**	Urban area (incl. Vienna)	**Urban area**	**Vienna**
Spar/Eurospar	4	**2**	2	**1**	**1**
Billa	3	**2**	1	**1**	
Hofer	3	**2**	1	**1**	
Merkur	2	**1**	1		**1**
Interspar/Maximarkt	1	**0**	1	**1**	
Lidl	1	**0**	1		**1**
Total	14	**7**	7	**4**	**3**

Table 4.9: This figure shows the stratification process of food retailers in Austria between the rural population, the urban population excl. Vienna and Vienna. First, the 14 stores previously determined were stratified between the rural area and the total urban area (including Vienna). Next, the total urban area was stratified between Vienna the remaining urban areas. The whole process followed the stratification rules of definition 4.1.1 and definition 4.1.2.

Layer 3: Area probability sampling

As outlined in section 3.3.3, area probability sampling is commonly used to increase sampling efficiency. For the given research objective, different regional stratifications are possible.

The approach for this study uses the federal states of Austria to establish a regional stratification. In general, the nation state "Austria" exhibits nine federal states named "Burgenland", "Steiermark", "Wien" (Vienna), "Niederösterreich", "Oberösterreich", "Salzburg", "Tirol", "Vorarlberg", "Kärnten". Due to its weight, the capital Vienna was already determined in 'Layer 2: Stratification of the urban and rural population' as strata with 3 stores. Hence, a decision had to be made on how to sample the eleven remaining food retailers from the eight remaining federal states. In this regard, four options may be considered:

1. Sampling eleven stores from one federal state, *randomly* chosen from the eight remaining federal states.
2. Sampling eleven stores from two (or more) federal states, *randomly* chosen from the eight remaining federal states. Similar to the previous stratification layers, a stratification has to be done according to the stratification rules. Thus, a higher weight has to be placed on the federal state exhibiting a higher share of the Austrian population.

3. Sampling eleven stores from one federal state, *conveniently* chosen from the eight remaining federal states. This may be the federal state of e.g. the main residence or hometown of the researching person.

4. Sampling eleven stores from more than one federal state, *conveniently* chosen from the eight remaining federal states.

The positive impact of drawing a convenience sample from more than one federal state on effectivity is assumed to be insignificantly low. This strategy would only result in a *confirmed* efficiency loss. It is therefore not advised to draw a convenience sample from more than one federal state.

The decision between the remaining three options relies on the time available to the executing person and the significance of a randomized sample. In reference to section 3.2.4 and section 3.3.1, an emphasis should always be placed on establishing a probability sample. Still, the time is often a limiting factor. Including the decisive factor of time available, it was decided to choose option one. The reason is the preservation of a probability sample, combined with an agreeable degree of sampling efficiency.

Selection of food retailers and systematic randomized sampling

The sampling method ultimately conducted is called systematic random sampling. Thereby, it is possible to draw a randomized sample without the existence of a complete list of the target population. In detail, it was decided that every third person who leaves the selected food retailer is chosen for the sample. Thus, a list of the sampled target population is created simultaneously to the sampling process. The selected person is then asked to be part of the self-administered survey.

As emphasized by Sudman (1980, p. 426), the people are chosen from left to right in case of a tie or necessary sorting. This can happen e.g. if a group of people or a couple leaves the store simultaneously.

For food retailers with more than one entrance, a selection bias may occur. To be precise, if the opinion of visitors from one entrance differs from that of another entrance, the sampling time per entrance has to be adjusted in proportion to the visitor flow of each entrance. This may result in considerable effort. Different factors should be included in the consideration of the necessity of the outlined partitioning. If one combined parking area with only one road access exists for two entrances for example, an even split will most probably be sufficient. Additionally, experience showed that the majority of stores has only one entrance. Nonetheless, special cases might cause additional effort to keep the selection bias as low as possible. In this regard, the research of Bruwer et. al. (1996) might be particularly useful. [BHL96]

In general, the sample time per store was set to three hours, excluding arrival and set-up time. Thereby, it should be possible to sample two stores per day. Hence, 14 stores can be sampled evenly distributed over one week. Three time slots were determined - morning, noon and afternoon. The slots were randomly assigned under the premise of two sampling slots per weekday. Next, under the assumption of a successfully obtained list of stores, the stores are assigned to the weekdays in a two step process. In step one, the stores, which are categorized in federal states and brands, are randomly selected from the list according to the stratification calculated before (stores to sample). In step two, the stores selected are randomly assigned to time slots (and weekdays).

Setup of the self-administered survey

- An A2 flip chart (or similar) and a standing table are placed at a visible, but not disturbing position near the entrance of the food retailer. The poster should provide concise information about the planned selection of leaving visitors. Thereby, potentially chosen people have the chance to prepare to be selected. University logos (or similar) should be shown on the chart to underline the professional purpose and to increase the level of trust of the visitors.

- The survey was designed to be completed online or offline (on paper).

- The selected person is asked to either do the offline survey now, on the standing table, or online at a convenient point in time. If the participant chooses to do it online, a flyer with the login details is provided.

- Similar to the A2 flip chart, the flyer should feature important logos, the name and the link (also as QR-code) of the survey.

- Depending on the situation concerning the SARS-CoV-2 virus, gloves and a mask should be worn and new pencils and disinfectants should be provided.

- To assess the response rate, it is vital to count the number of all selected people. Combined with the total data set (online and offline), the response rate can then be readily calculated.

Note: The people with the main residence in Austria are filtered by a specific question during the self-administered survey.

A preliminary investigation during the afternoon opening hours showed that within 20 minutes, 27 visitors left the conveniently chosen food retailer. The frequency of visitors was considered moderate (two open cash registers, with an average of 2-3 visitors waiting for the check out). If 27 visitors leave a store per 20 minutes and every third is selected for the survey, 27 visitors are selected per hour. Three hours of sampling time per store leads to 81 selected units per store. Thereby, 162 units are selected per day and 1,134 per week. Including an estimated response rate of 25 %, a sample of 283 (rounded) visitors is obtained over the period of one week. It has to be noted that this calculation is very approximative and the number ultimately received is very likely to deviate from this estimation. Nonetheless, it was decided to include the given calculation to share initial considerations.

4.1.3 Summary: Original sample

The original survey design features a probability sample of the Austrian population. The sample is limited by the sample frame, which is defined by all people who are able and choose to go to Austrian food retailers. Different layers of stratification are used to maximize the efficiency of the sampling process. In the end, a randomized sample is drawn by systematic sampling. The data is collected online and offline by a self-administered survey to decrease personal contact.

4.1.4 Limitations: Original sample

The high level of sampling efficiency features a high risk of including an unforeseen selection biases. Due to the rejection of the original design, it was not possible to assess the response rate and consequently it was not possible to assess the non-response bias. Nonetheless, the research of (Bush & Hair, (1985, p. 165) shows that the non-response rate varies between 10 % and 50 %. This indicates the possibility of a considerable non-response bias.

In this particular example, the sample frame includes 90.90 % of all customers of Austrian food retailers. The target population were people with their main residence in Austria. In reference to the given description, it was assumed that the sample frame includes a large extent of the target population and therefore legitimates the general approach. It was also assumed that the opinion of people who do not go to main food retailers only lightly deviates from the opinion of people who do visit main food retailers. The sample frame bias was therefore considered insignificant. Nonetheless, this is only an assumption and up to now, it was not measured how closely the sample frame (visitors of food retailers with main residence in Austria) matches the target population (people with main residence in Austria). The same goes for the deviation of opinions between visitors of main food retailers and the remaining food retailers. Hence, no evidence can be provided to support both claims and further research is needed to verify these decisions.

The systematic random sampling method finally conducted features some additional drawbacks which have to be mentioned. First, frequent shoppers have a greater probability of being selected. Second, there is the possibility of a respondent unnoticeably avoiding selection. Third, due to different locations and selection times, the participants feature different probabilities of selection. This introduces a significant risk of a (time-based) selection bias. [BHL96]

4.2 Statement: Change of the survey design

The possibilities to contact the Austrian population for randomized sample design are limited. Options like random-digit dialing or random mail surveys presume the availability of and access to an exhaustive data base. The best (and presumable only) data base in this regard is the Austrian central population register (German: zentrales melderegister (ZMR)). Its access is very restricted and only allowed for certain institutions and/or individuals, excluding the TU Wien. It was also not possible to evaluate the integrity of public phone books, which were therefore classified insufficient. This left presumable only one possibility - the public approach of individuals, e.g. as outline in the original survey design. Irrespective of the contemplated arrangements, this option was not feasible due to the SARS-CoV-2 containment measures. Although an uprise in COVID-19 cases was expected, the low impact of the SARS-CoV-2 virus during the preceding (summer) months led to the conclusion of a rather unlikely second nationwide lockdown (severe contact restrictions). Unfortunately, during a press conference on 14th. November 2020, the second nationwide lockdown was announced by chancellor Sebastian Kurz. His statement “Meet nobody, every social contact is too much.” punctuated the former situation and finalized the decision to adapt the survey design. The change of the survey design increases different errors and biases considerably. Nevertheless, it was estimated that the expected tremendous non-response rate and low accessibility of individuals in the old study design excels the issues and drawbacks of the new design. Summarizing, the expected severe sample frame bias and low response rate, caused by the low accessibility was the main reason to adapt the sampling design.

4.3 Executed sample

4.3.1 Total survey design: Executed sample

1. Probability sampling or non-probability sampling

   In reference to the outlined issues of the original sampling design (see section 4.2), a non-probability sampling approach was chosen as sampling approach.

2. The sample frame

   The sample frame was set to people who are able to access the internet via a web browser and have their country of residence in Austria.

   The approximated target population was set to people who have their country of residence in Austria.

3. The sampling design

   A self-administered, web browser based online survey distributed by snowball sampling. A detailed description is provided in section 4.3.2.

4. The sample size

   The aspired sample size was 300 usable data sets.

5. The rate of response

   The rate of response was assessed by the number of individuals approached and the usable data sets ultimately received. A detailed description is provided in section 4.3.2.

4.3.2 Sample design: Executed sample

The adapted sample design uses snowball sampling to create a sample of the target population. The approach follows the principals described in section 3.3.2.

As already emphasized, a randomly chosen initial seed for snowball sampling is hard to implement. This is due to the considerable challenge of selecting a random seed unit. Furthermore, if a random selection was successful, the outcome relies strongly on the dedication of the selected seed unit. It was therefore decided that the initial seed will be conveniently selected and it was determined to be the researcher himself. The distribution of the survey was done exclusively digital. The survey was developed as web browser based, online self-administered survey. Thereby, it was possible to create a web link to access the survey, which complements the survey distribution of the chosen sampling technique.

The distribution of the survey was done in two ways.

First, friends, family members, colleagues, etc. were contacted with the request to participate in the survey. Individuals were approached solely by a personal message. The majority was contacted by the Facebook Messenger App, followed by WhatsApp. The link wasn't distributed to any Facebook groups, WhatsApp groups (or similar) by the initial seed. Other people who distributed the survey were allowed to post it in groups. In this regard, the headcount of the group was counted as individuals ultimately contacted. A very high percentage of all known people was contacted, with only three very low primary filters: 1. Individuals with internet were not asked

to fill in the survey. 2. Individuals with known little to no possibilities to use a smartphone or personal computer. 3. Individuals with a known country of residence different from Austria. The low pre-filter was established to prevent an additional personal bias.

Second, specific people were conveniently chosen to serve as an additional distributor, called *"helper"*. These people were asked to participate in the survey and to distribute it in their own personal environment. Additionally, it was emphasized to them that it would be very beneficial for the survey if *helpers* chose "two or three people" from their own personal network who can again function as *helper*. In this regard, associated people such as good friends or family members were given as an example. If the conveniently chosen *helpers* agreed to do so, further instructions were provided. This also included two prepared texts. One *short* text for the distribution of the survey in their own personal network and a *long* text to explain important distribution rules. The more detailed text was designed to provide a concise introduction to the *helpers of the helper*. All of the selected individuals were reminded to participate in the survey one-time and all of the helpers were reminded at least once to remind their own network to participate in the survey as well (including their *helpers*). All of the helpers were initially contacted by a personal phone call to avoid misunderstandings and stress the importance of their assistance. After the initial phone call, the texts were forwarded by the channel of their choice. The permission to alter the texts according to their requirements was given.

All helpers were advised to count the number of approached individuals. At the end of the survey period, all helpers were asked to collect the total number of people contacted from their helpers, add it their own number of contacted people and then forward the total number of their *branch* to their contact person. The aim of this procedure was to calculate an overall response rate of the survey. Nonetheless, this strategy has its limitations. Similar to the conducted snowball sampling strategy, the accuracy of the ultimately received number relies on the accuracy of the individuals to a high degree.

It has to be admitted that the following biases are thereby introduced in the calculated response rate:

- The bias originating from misconceptions during the introduction and the bias originating from imprecise operations concerning the counting of approached individuals and the distribution to groups.
- The personal bias to increase the number of approached individuals to satisfy the person the number is reported to.
- The bias introduced by people who have been counted twice. This is due to the design of the conducted snowball sampling strategy, which shows a considerable possibility of overlapping personal networks.
- The bias introduced by people who distribute the survey without being listed as helpers. Thereby, the approached individuals are not counted and reported a respective helper.

The following measures were conducted to limit the biases stated above:

- All helpers were approached by means of a personal and extensive phone call describing and answering questions about the distribution rules. An emphasis was placed on the topic of accurate counting by stressing the importance of exact measurements.

- Similar to item one, it was outlined during the introduction and right *before* the final collection of the total number that a manipulated number compromises the evaluation. It was also outlined that the general support of the helper is of very high value, regardless of the number of people approached finally reported.

- If someone reported that he/she already has participated in the survey, the helpers were instructed to subtract the respective people from their total number of approached individuals.

- The bias of survey redistribution without notice was considered reasonably small. It was assumed that people who make the effort of redistributing the survey will either ask for permission or at least mention their doing to receive acknowledgement for their effort. Nonetheless, no scientifically proven evidence can be provided for this claim. This results in an uncontrollable bias which directly influences the response rate.

It has to be admitted that there would have been a possibility to limit a considerable amount of the above-mentioned biases by implementing restricted access to the survey. Thereby, individual passwords would have been provided for each helper, sub-helper and so on. This would have allowed to monitor peculiar distribution patterns and in case of a confirmed error, the data of the respective branch could have been filtered. Nonetheless, it was decided to omit this option to keep the effort for the helpers as low as possible. Thereby, a better distribution and an increased range of the survey was anticipated. Additionally, this approach also increased the number of potential helpers.

To summarize, it was not possible to determine the extent of the total bias and therefore the calculated response rate should be considered a mere guide value. Albeit the outlined drawbacks, it was decided that a mere guide value is more beneficial for the evaluation of the survey than no response rate at all.

Prepared text - short:

Hey,
A friend of my mine does a survey for his master's thesis.
The topic is "digital money".
The duration is about 12 minutes.
Would you be so kind to fill in the survey?
https://www.soscisurvey.de/digitalesgeld/

Prepared text - long:

Hey,
A friend of my mine does a survey for his master's thesis.
The topic is "digital money" and he would need a little bit of support for the distribution.
Ideal would be, if you can fill in this survey and also send this link to some friends, relatives or just familiar people. Important for the analysis is, that you count the amount of people you've sent the link - I'll check in on you in a view weeks and ask for the number, that's it :)
WhatsApp-groups are similar are ok, but please no groups of 30 or more participants where no-one response.
Of course, the best would be a private message.
The survey duration is about 12 minutes, the deadline is 27.01.2021. Would you be so kind to help?
https://www.soscisurvey.de/digitalesgeld/

4.3.3 Summary: Executed sample

The sample ultimately executed is based on a convenient snowball sampling approach which is commonly used for populations hard to access. As outlined in section 4.2, the circumstances concerning the SARS-CoV-2 virus led to this kind of environment. Complementary to the chosen sampling technique, a web browser based self-administered questionnaire was developed to obtain the information aspired from the sampled individuals. As described in section 3.3.2, snowball sampling is based on cooperating individuals who help to redistribute the questionnaire. Those helpers were conveniently chosen and their redistribution carefully instructed. Additionally, these helpers were assigned to count and report the number of approached individuals. This allows an estimation of the response rate. The whole process was designed to feature no necessity of any personal contact.

4.4 Questionnaire design

4.4.1 Platform

To implement the self-administered, web browser based online survey, the platform of the German company named *"SoSci Survey GmbH"* was used. It features a very comprehensive amount of basic and advanced options to implement a professional questionnaire design. Additionally, the provider allows an unlimited and free of charge access for non-commercial research by university students. Unfortunately, it has to be mentioned that the page navigation for the questionnaire design was available only in German. However, a non functioning language button indicates development efforts.

4.4.2 General framework

The conducted self-administered online survey featured 13 pages, whereby three main parts named "*Conventional money and crypto currencies*", "*The 'Freigeld' idea*" and "*The circle coin - a local 'Freigeld' crypto currency (scenario)*" were presented to the participants.

The implemented page layout reflects the used framework. Therefore, a concise description of each page is given below. The complete questionnaire is provided in appendix A.1.

The whole questionnaire only allowed to continue to the next page if all of the questions presented have been answered. This decision was made to encourage complete data sets. The thereby potentially incorporated bias, introduced by frustration which may have led to wrongly executed questions, was considered as low and therefore accepted.

Excluding introductory questions and those regarding demographics, the same *Likert scale* was used in the whole questionnaire. The range of the scale was set from "fully disagree" (-3) to "fully agree (+3). It was decided to use this particular scale to enable the value four (4) for undecided or neutral participants. Thereby, it was possible to implement this option without the necessity of an additional (separated) checkbox. An example is given in fig. 4.1.

- Page 1: *Language*
  A mandatory choice between the German or English version of the survey.

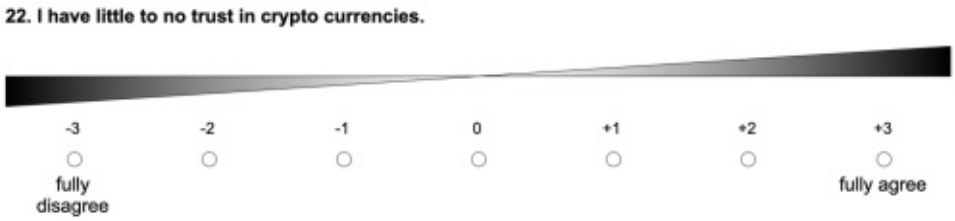


Figure 4.1: An example of the implemented Likert scale. The chosen approach features seven values, whereby the value four (middle) is intended to serve as neutral option.

- Page 2: *Author*
  Contact details and information about the liable institution of the master's thesis.

- Page 3: *general data protection regulation (GDPR)*
  Details and declarations concerning the GDPR.
  It was only allowed to continue the questionnaire, if the participant actively agreed to the presented GDPR rules.

- Page 4: *Introduction*
  The introduction included the aim, duration and structure of the survey as well as a brief description of its three main parts. It was only possible to continue to the next page if the participant agreed to fill in the survey by his "best knowledge and believe" and without "incomplete, nor consciously wrongly executed questions".

- Page 5: *Participant demographics*

  In total, the survey asked for four specifications:

  - Sex
  - Age
  - Country of residence
  - Highest education completed

- Page 6: *Part1: Conventional money and crypto currencies*
  First, a short introduction to outline the differences between conventional money and crypto currencies was given (see fig. 2.7), followed by the assessment of the participant's level of acceptance (levels of "readiness-to-use" and "trust") for crypto currencies. This included the assessment of the acceptance of crypto currencies with and without governmental support, as defined in the Core concept of the survey (see section 4.4.3).

- Page 7:
  An optional page for participants who had already purchased or obtained crypto currencies. For this particular subgroup, additional questions concerning trust and usage of crypto currencies were provided.

- Page 8:
  Continued the assessment of the acceptance for a governmentally supported crypto currency.

- Page 9: *Part 2: The Freigeld idea*
  This page was used to provide a concise introduction about the general Freigeld idea. (see fig. 2.8) Hence, the questions presented subsequently enquire the postulated features of the

Freigeld idea. These included the "monthly tribute" (the demurrage), the "constant money value" and a question concerning the satisfaction with our current monetary and economic system.

- Page 10:
  A short information about the remaining duration of the questionnaire was provided.

- Page 11: *Part 3: The circle coin - a local Freigeld crypto currency*
  A scenario describing the features of the local Freigeld crypto currency named *"circle coin"* was outlined. (see fig. 2.9) The acceptance of the *circle coin* was then assessed according to the Core concept (see section 4.4.3).

- Page 12:
  The questionnaire ended by presenting specific questions with the aim to assess the influence of different parameters which may have had a significant impact on the overall results. Therefore, general questions from Part 2 were expanded to the local Freigeld scenario. Additionally, the influence of *"regionality"* was included in the evaluation.

- Page 13:
  The last page presented a short acknowledgment and contact details. The German version included a reference for additional information concerning the Freigeld topic.

4.4.3 Core concept

According to the stated Research Objective and the derived Research Question the core issue was determined as the assessment of different levels of acceptance and the following concept was therefore developed.

To enable an incremental assessment of the subjective value of "acceptance", it was separated into two fractions. The "readiness-to-use" the presented currency and the belonging level of "trust".

The initial idea was: If someone decides to use a product, some amount of acceptance has to be present. The acceptance of the product rises with the level of usage, but no matter how high the level of usage is, the product will never be fully accepted as long as the user doesn't "(fully) trust" the product. Therefore, it was concluded that the acceptance of different currency scenarios has to be measured as the sum of the two parameters: The level of "usage" (or the "readiness-to-use") and the level of "trust".

The "readiness-to-use" crypto currencies

The readiness to use crypto currencies was assessed by presumable four incremental objectives.

1. I could imagine trying out crypto currencies for one day.
   Info: I'll get a test account and with it, I can try out transactions and the general functionality.

2. I could imagine trying out crypto currencies as an additional means of payment for one year.
   Info: I'll be introduced to the topic for one year and I'm able to test transactions with small amounts of money.

3. I could imagine settling a small part of my digital everyday payments with crypto currencies. *Info: For example instead of Debit/Credit card payments, Apple Pay, ...*
4. I could imagine receiving a small part of my salary in a crypto currency.

Hence, the four presumable incremental steps were named: "short try-out", "long try-out", "everyday payments" and "salary".

To summarize, the four presumable incremental steps enquire the following objectives of the participant:

1. The participant is ready for a *short try-out*.
2. The participant is ready for a *long try-out*.
3. The participant is ready to use the currency for *everyday payments*.
4. The participant is ready to receive a crypto currency *as part of his/her salary*.

The four objectives were enquired for every currency. Thus, the three presented scenarios (crypto currencies, governmental crypto currencies and a local Freigeld crypto currency) and the four presumable incremental objectives resulted in a 4x3 question matrix. The result is shown in table 4.10. Each element represents one objective and one currency scenario. The distinct question number belongs to the question of the implemented questionnaire. By transferring the outcome of each question into the question matrix, a two dimensional variable is obtained. This variable is then used to assess the "readiness-to-use" in a gradual manner over all scenarios and objectives.

The level of "trust" for crypto currencies

The level of "trust" was assessed by the Likert scale previously described. Similar to the assessment of the "readiness-to-use", the same question was presented for crypto currencies, governmentally supported crypto currencies and a regional "Freigeld" crypto currency. An example is shown in fig. 4.1.

Impacts of different factors

Supporting questions were provided to assess the reason for the individual level of "trust" and the "readiness-to-use" and why it may differ among the three given scenarios. Especially the Freigeld scenario introduced a considerable amount of new information. Therefore, the majority of the supporting questions related to the Freigeld scenario, with the aim to assess the influence of different parameters.

Question matrix	Crypto currencies	Governmentally supported crypto currencies	Local "Freigeld" crypto currency
Objective	Question number. Question		
"short try-out"	13. I could imagine trying out crypto currencies for one day.	18. I could imagine trying out a governmentally supported crypto currency for one day.	33. I could imagine trying out circle coins for one day.
"long try-out"	14. I could imagine trying out crypto currencies as additional means of payment for one year.	19. I could imagine trying out a governmentally supported crypto currency as additional means of payment for one year.	34. I could imagine trying out circle coins as additional means of payment for one year.
"for everyday payments"	16. I could imagine settling a small part of my everyday digital payments with crypto currencies.	20. I could imagine settling a small part of my everyday digital payments with a governmentally supported crypto currency.	35. I could imagine settling a small part of my everyday digital payments with circle coins.
"as salary"	17. I could imagine receiving a small part of my salary in a crypto currency.	21. I could image receiving a small part of my salary in a governmentally supported crypto currency.	36. I could imagine receiving a small part of my salary in circle coins.

Table 4.10: This figure shows the developed question matrix which was used to assess the level of "usage" for different currency scenarios. Therefore, the variable named "readiness-to-use" was split into four presumable incremental steps shown on the left, labeled as "Objective". The three currency scenarios were separated into three columns. The result is a matrix in which each element exhibits a distinct question number and the dedicated question of the implemented questionnaire. Additionally, each element represents one objective and one currency scenario. A gradual, two dimensional variable of the overall "readiness-to-use" for different crypto currencies was obtained by transferring the outcome of each question into the question matrix.

In detail, the following influencing variables were assessed.

1. The impact of the objective named 'long try-out"
2. The impact of governmental support of crypto currencies
3. The impact of the following different parameters introduced by the Local "Freigeld" crypto currency:
   - The impact of supporting the local economy
   - The impact of a constant money value and the satisfaction with the current monetary and economic system
   - The impact of the general idea of a local "Freigeld" crypto currency
   - The impact of the "Freigeld" tribute

4.4.4 Classification

By assembling the data of the conducted questionnaire, the separation of "acceptance" into "readiness-to-use" and "trust" previously done was used to classify the different scenarios and their belonging objectives. The initial classification idea can be described as follows:

- Maximum/Full acceptance:
  The participant *"fully agrees"* (+3 on the Likert scale) to receive a small part of his salary in the presented currency and also exhibits the highest level of trust (+3 on the Likert scale) for the said currency.
- Minimum/No acceptance:
  The participant *"fully disagrees"* (-3 on the Likert scale) to do a short try out of the presented currency and also exhibits the lowest level of trust (-3 on the Likert scale) for the said currency.

Following this concept, the range of the *acceptance* can be determined for each crypto currency.

In general, three values were assessed for every survey question: The mean value, the median and the mode.[2] Each question was classified from insignificant (neutral) to very significant, by the evaluation of the mean value, the median and the mode in reference to the obtained data. (The mode was only used to indicate strong insignificance). Figure 4.2 shows an example of data obtained by a survey question.

As indicated before, each question represents a matrix element. The obtained data is then transferred to table 4.10 which used to evaluate and illustrate the findings. (see for example fig. 5.15) Color coding was used to highlight the classification of matrix elements. (see table 4.11)

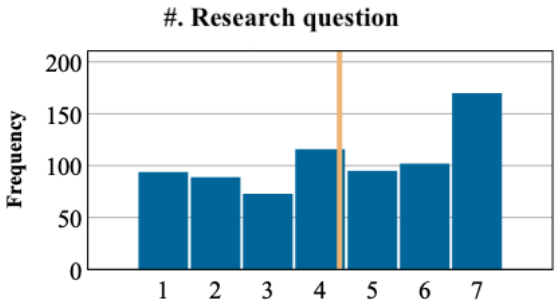


Figure 4.2: This figure shows an example of data obtained by a survey question. The numbers 1-7 refer to the options provided by the Likert scale (see fig. 4.1). The 'Frequency' depicts the quantity of votes for each option. Mean value: 4.37 (orange line); Median value: 4; Mode: 7;

Neutral, *insignificant* or *not significant* was defined as mean value bellow 4.5 and above 3.5, and a median of 4. This resembles a position of both values around the center of the Likert scale (see fig. 4.2). Additionally, if the mode features a value of 4, the data was categorized as *strongly neutral* or *strongly insignificant*.

Consequently, if at least one value exceeds the neutral definition, the data was categorized as significant. The exact nomination is given in table 4.11. Orange colors indicate a negative significance (a rejection), blue colors indicate a positive significance (an approval).

[2]The interquartile range (Q3 - Q1) was not included due to the limited range of the implemented Likert scale.

Different categories of significance

Value	Category	Mean	Median	Mode	Interquartile Range
0	Neutral (strong) no significants	3.5 to 4.5	4	4	-
0	Neutral no significance	3.5 to 4.5	4	-	-
-1	very low significance	2.5 to 3.5	4	-	-
-1	very low significance	3.5 to 4.5	3	-	-
-2	low significance	2.5 to 3.5	3	-	-
-3	significant	Mean < 2.5	3	-	-
-3	significant	2.5 to 3.5	Median < 3		
-4	very significant	Mean < 2.5	Median < 3	-	-
1	very low significance	4.5 to 5.5	4	-	-
1	very low significance	3.5 to 4.5	5	-	-
2	low significance	4.5 to 5.5	5	-	-
3	significant	5.5 < Mean	5		
3	significant	4.5 to 5.5	5 < Median	-	-
4	very significant	5.5 < Mean	5 < Median	-	-

Table 4.11: The nomination of different categories for the data sets obtained. The mode was included only for the verification of a strongly neutral position and the interquartile range was omitted, due to the limited range of the implemented Likert scale.

The presented different categories were used throughout the whole evaluation, assuring a consistent classification of all findings. In case of the necessity of an accumulation or merge of different categories, the assigned *"Value"* serves as basis for basic arithmetic operations.

5 Results

5.1 Timeline, sample size and response rate

The sampling period comprised 32 days. It started at 31st December 2020, 00:01 and ended at 31st January 2021, 23:59. A timeline of those individuals successfully contacted is shown in fig. 5.1. In total 940 data sets were obtained by the sampling process. On average, participants needed about 9 minutes 45 seconds to complete the survey. 774 (82 %) of all the individuals participating finished the questionnaire. The majority (77 %) of participants used the mobile version. A slightly higher completion rate was measured for participants that used the desktop version. The dropout rate was approximately evenly distributed rate between terminations during and after the introduction. The maximum was assessed for terminations during the introduction for the mobile version, but its extent was classified as insignificant. This is illustrated in table 5.1 and fig. 5.1.

The questionnaire provided two language options: German and English. 96 % chose the German and 4 % the English language. An evaluation of the dropout rate showed no significant difference between both languages. This is illustrated in table 5.2.

The obtained response rate was 40.8 %. Its calculation was done according to eq. (3.3). Hence, three variables had to be evaluated beforehand: The number of usable data sets, the number of selected units and the number of unreachable units. An illustration of this calculation and the included and excluded variables is provided in table 5.3.

The number of usable data sets features the following properties:

- The participant completed 100 % of the given questionnaire.
- The participant's country of residence is Austria.
- No extraordinary patterns were found during the evaluation of the data set.

As defined by the sample frame, only participants with their country of residence in Austria were selected for evaluation. Additionally, all data sets were tested by color coding. Each option of the implemented Likert scale (-3 to +3) was assigned to a specific number and color. Data sets with a low color variability or repetitive color patterns were selected for revision and subsequently rejected if necessary. The online platform also provided an additional variable which assessed the individual survey duration of participants. On this basis, the platform provided a means to

outline particularly fast participants, indicating an inferior data set. In total, 10 participants were categorised as inferior. Given the fact, that 14 of the selected *helpers* already completed the survey during the pretest phase, there was a high probability of a data set falsely identified as inferior. It was therefore decided to include all 10 inferior data sets albeit they showed a partially conspicuous color coding. The calculated number of data sets finally used for the subsequent evaluation was 739.

The number of units selected or contacted was determined by the sum of individuals contacted by helpers plus those individuals contacted the *researcher*. 35 selected individuals agreed to distribute the survey and serve as *helper*. Four out of these 35 *helpers* successfully recruited additional *helpers*. 1,345 individuals were contacted by helpers and 468 by the researcher. In total 1,813 individuals were contacted during the sampling process.

Units were defined as unreachable if the forwarded private message was neither marked as received, nor as read. This categorization was done only by the *researcher*. Hence, people were only classified as *unreachable* by the researcher and not by the *helpers*. This decision was made to lower the effort for the *helpers*, while accepting the integration of a bias and a lower response rate. As outlined in section 4.3.2, each selected unit was reminded *at least once* to participate in the survey.

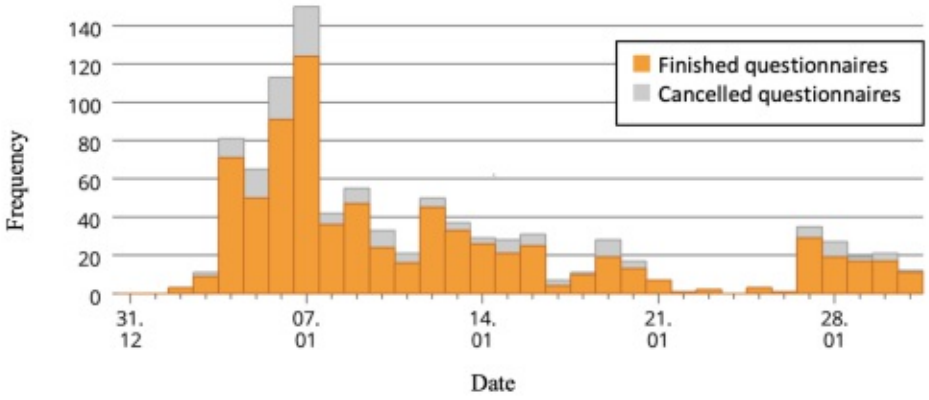


Figure 5.1: This graph shows the time line of successfully contacted individuals. The sampling process started at 31st December 2020, 00:01 and ended at 31st January 2021, 23:59.

	Both versions [#]	Both versions [%]	Mobile version [#]	Mobile version [%]	Desktop version [#]	Desktop version [%]
Total data sets	940	100 %	724	77 %	216	23 %
Finished data sets	774	**82 %**	584	**81 %**	190	**88 %**
Cancelled data sets	166	18 %	140	19 %	26	12 %
Total	940	*100 %*	*724*	*100 %*	*216*	*100 %*
Cancelled during introduction (page 1-3)	93	**56 %**	80	**57 %**	13	**50 %**
Cancelled after introduction (page 4-11)	73	44 %	60	43 %	13	50 %
Total	*166*	*100 %*	*140*	*100 %*	*216*	*100 %*

Table 5.1: This table illustrates the obtained total sample and elaborates the specific numbers and related fractions of canceled and completed data sets. The table is separated into three parts by twin lines. The first part shows the total amount of data sets. The second shows the numbers and proportions between finished and cancelled data sets. The third section shows a separation of terminations during and after the introduction of the questionnaire. For all parts, the numbers and shares are outlined for the mobile and the desktop version of the questionnaire.

	Total data sets [#]	Total data sets [%]	Finished data sets [#]	Finished data sets [%]
German	907	96 %	750	97 %
English	33	4 %	24	3 %

Table 5.2: This table shows frequencies and proportions regarding the chosen language options of the survey.

Usable data sets	
Total usable data sets	774
Country of residence: OTHERS	35
Country of residence: AUSTRIA	**739**
Individuals selected/contacted	
By the Researcher	468
By helpers	1,345
Total	**1,813**
Response rate	
Response rate	**40.8** %

Table 5.3: This table shows the number of usable data sets and the number of individuals ultimately contacted. It also shows the response rate, which was calculated according to eq. (3.3) and the defined sample frame (target population). To be precise, the response rate was calculated by dividing the number of usable data sets (Country of residence: AUSTRIA) by the total number of contacted individuals.

5.2 Demographics

This section shows the demographics of the sample obtained, which includes the following characteristics:

- Gender
- Age
- Highest education completed
- Country of residence

The sample obtained features an almost equal distribution between males (50.00 %) and females (49.95 %). This is also true for the separation of males and females by the highest education completed (fig. 5.7) and by the age (fig. 5.6). The majority specified their age between 16 and 30 years (55.21 %), followed by the category of 31 to 45 (20.57 %) and 46 to 60 years (20.43 %). For 32.12 % of the participants, the Leaving Certificate is the highest education completed. In total 50.84 % obtained a university degree, with almost equal shares between the Bachelor's (22.77 %) and the Master's degree (25.98 %). 14.66 % stated that their highest education completed is an apprenticeship. An illustration of the outlined demographics is provided by different figures below.

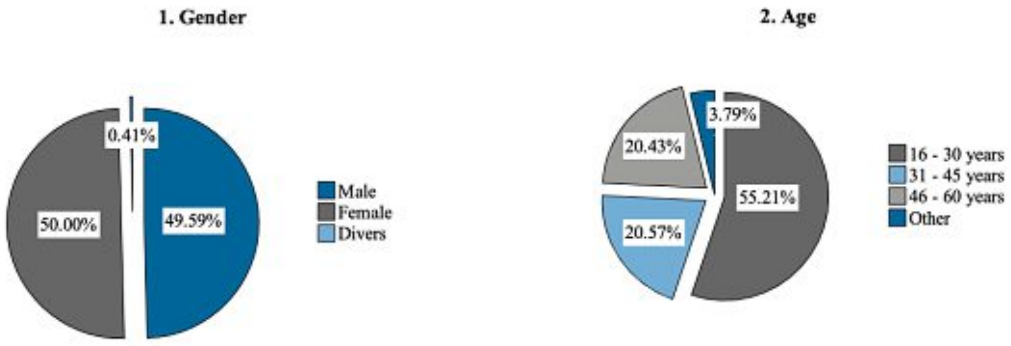


Figure 5.2: The sample characteristics of age and gender in percent

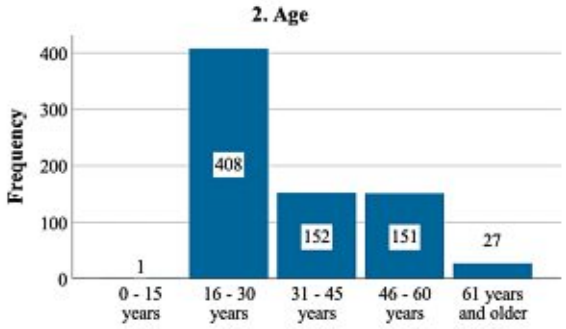


Figure 5.3: Bar chart depicting the specific frequencies of the age of participants

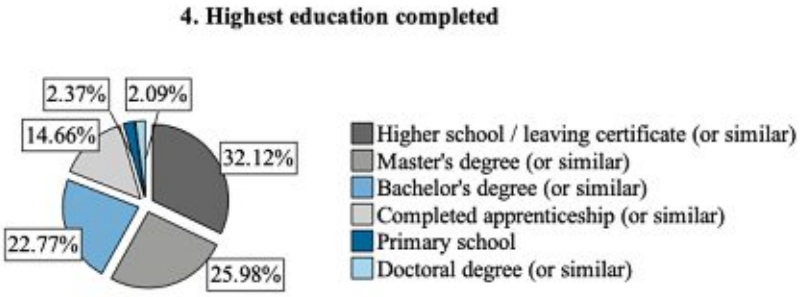


Figure 5.4: The sample characteristic of the highest education completed in percent

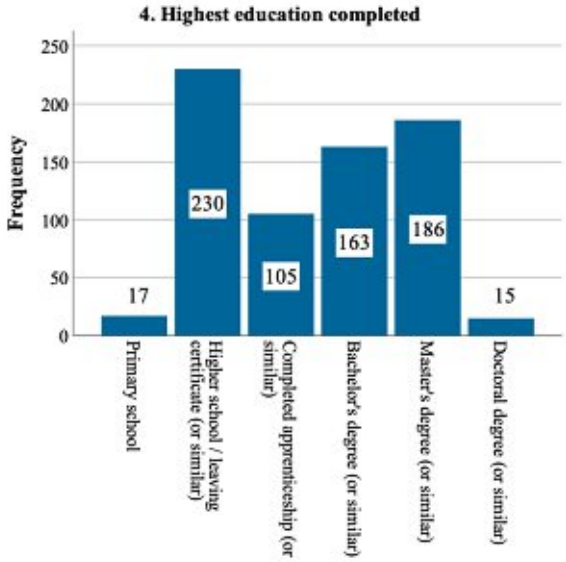


Figure 5.5: Bar chart depicting the categories of the highest education completed and the specific frequency of the sample

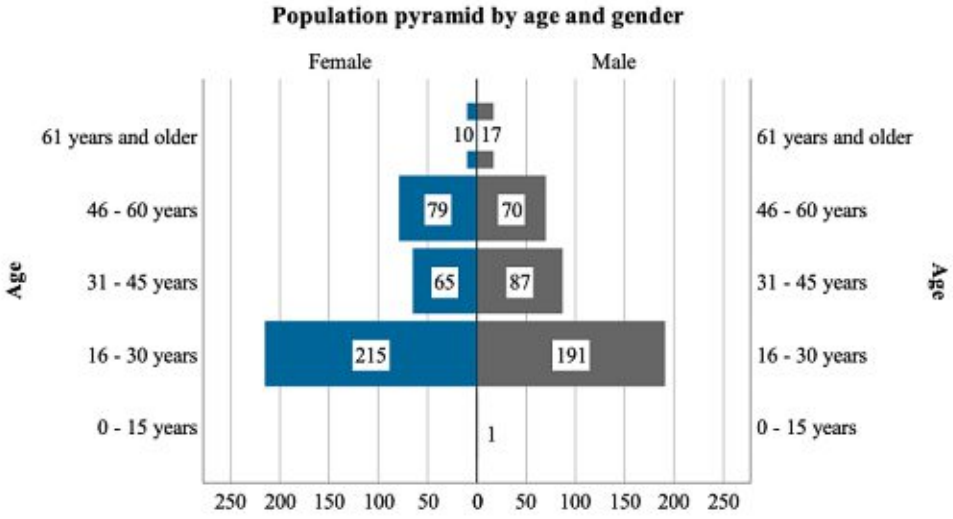


Figure 5.6: Population pyramid by age and gender

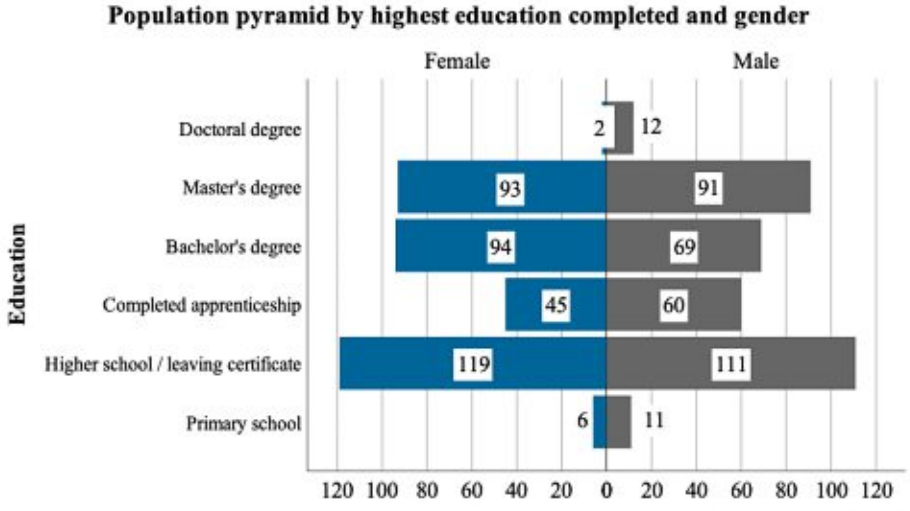


Figure 5.7: Population pyramid by highest education completed and gender

5.3 Findings concerning the use of electronic payments

The evaluation of the use of electronic payments showed that 61.98 % of all participants feature a positive tendency towards cashless payments. 16.78 % remained neutral, while only 21.25 % showed a negative tendency to use cashless payments (see fig. 5.8). 71.85 % of all participants us electronic payments several times per week and only 5.82 % barely or never use electronic payments. (see fig. 5.9)

92.21 % had heard about crypto currencies before this questionnaire, but only a minority of 24.23 % stated to understand or somewhat understand them. 18.13 % chose to remain neutral without a tendency towards a positive or negative understanding of crypto currencies (see fig. 5.10).

12.31 % of all participants have obtained or purchased crypto currencies. This specific group was additionally asked about their usage of crypto currencies. Data showed that the majority (73.91 %) uses their crypto currencies as assets and plans to sell them at a favorable point in time, whereat only 20.65 % have used their crypto currencies as means of payment. In the questionnaire, it was possible to choose either one, or both of the stated options (see fig. 5.12).

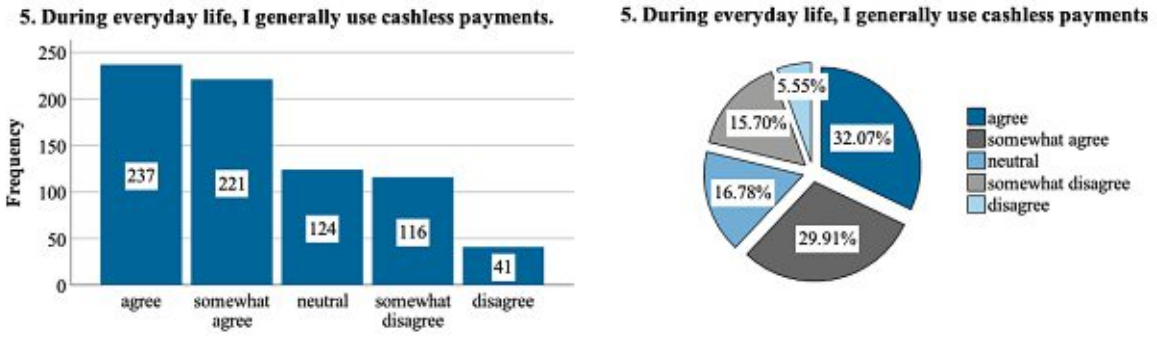


Figure 5.8: Frequency and percentages of the general "use of cashless payments in everyday life" .

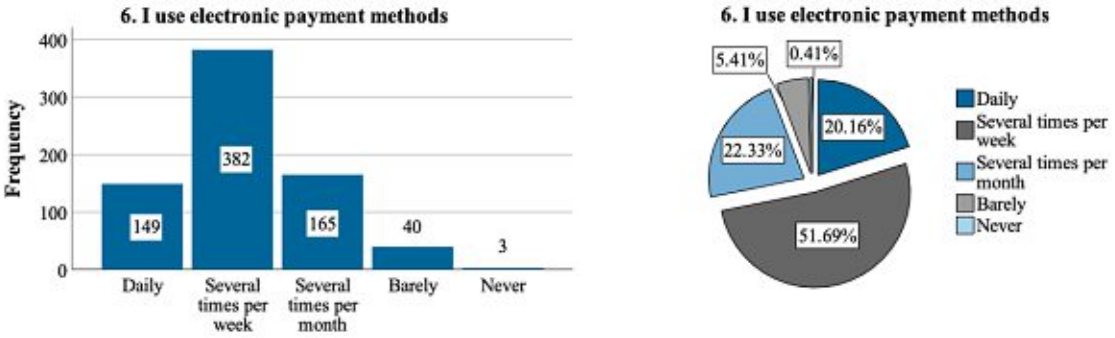


Figure 5.9: Frequency and percentages of the use of "electronic payments methods".

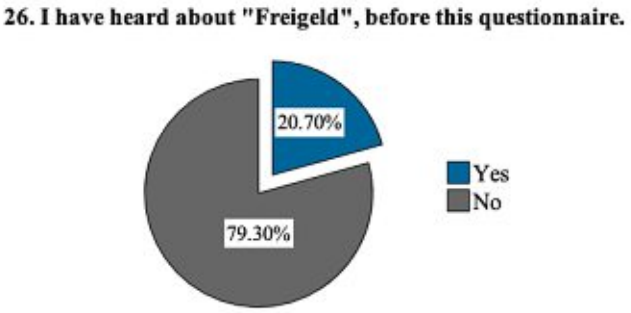


Figure 5.10: Proportions of participants who had heard about Freigeld before the questionnaire.

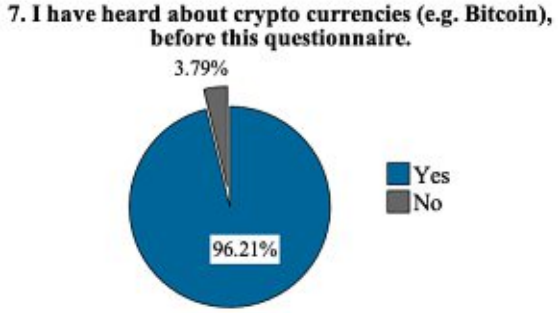


Figure 5.11: Proportions of participants who had heard about crypto currencies before the questionnaire.

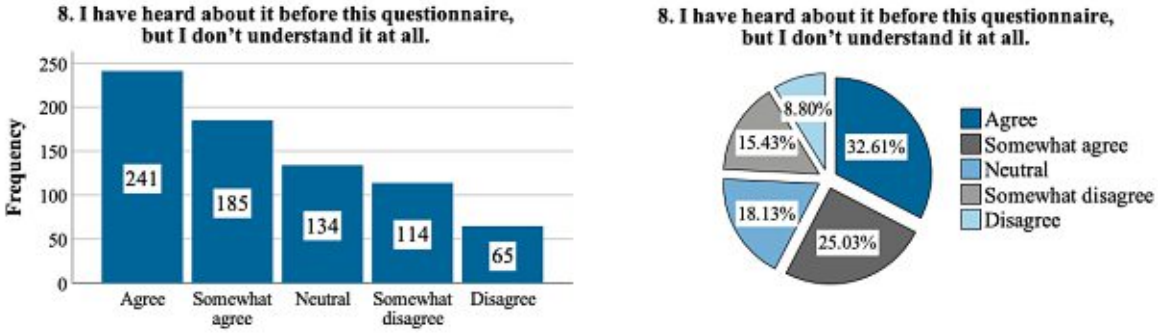


Figure 5.12: Crypto currencies and the stated level of understanding depicted in a histogram and a pie chart.

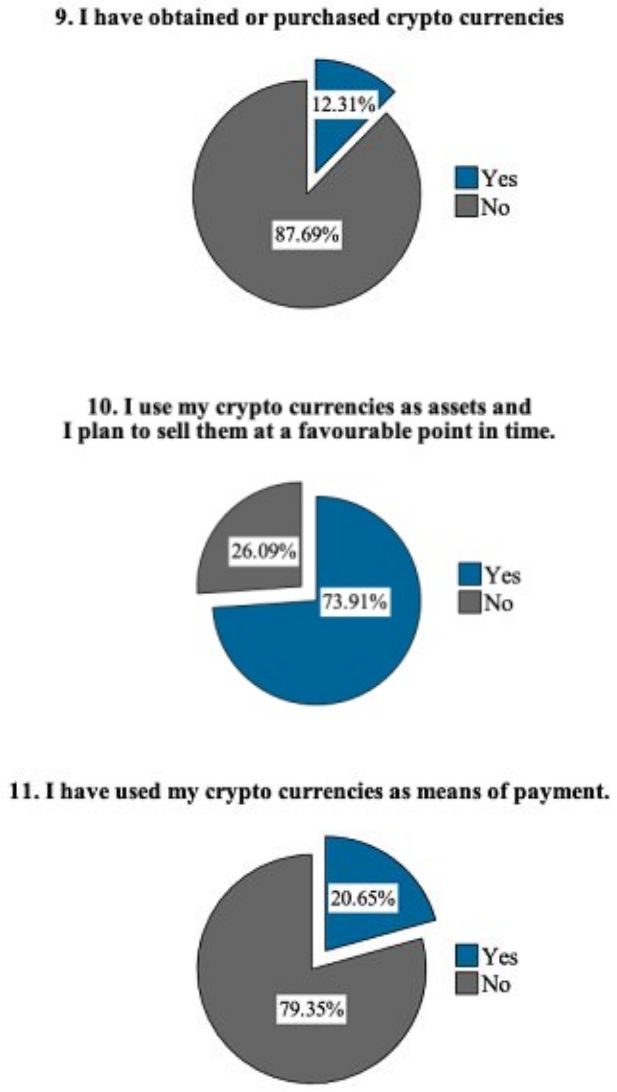


Figure 5.13: The proportion of participants who already had obtained or purchased crypto currencies is shown in the top pie chart. These participants were additionally asked about their usage of crypto currencies as an assets, a means of payments or both. The middle pie chart shows the proportions for the *use as asset*, the bottom pie chart shows the proportion for the *use as a means of payment*.

5.4 The acceptance of crypto currencies

5.4.1 The readiness to use crypto currencies

The variable *"readiness-to-use"* was evaluated by the question matrix previously presented (see Core concept and Classification). The results are shown in table 5.4. As illustrated, the level of the readiness to use the local Freigeld crypto currency exceeds that of crypto currencies and governmentally supported crypto currencies for *every objective*. Comparing crypto currencies and governmentally supported crypto currencies, all four objectives feature the same level of significance. By examining the total *significance comparison matrix* it is also visible that the majority of elements show a low to very low significant variation around the neutral level. Receiving crypto currencies and governmentally supported crypto currencies as salary are the only two objectives who shows a significant rejection.

Significance comparison matrix	Crypto currencies	Governmentally supported crypto currencies	Local "Freigeld" crypto currency
"short try-out"	very low significance	very low significance	low significance
"long try-out"	no significance	no significance	very low significance
"for everyday payments"	very low significance	very low significance	very low significance
"as salary"	significant	significant	no significance

Table 5.4: This matrix shows the different levels of "readiness-to-use" for the discussed crypto currencies. The matrix was derived by combining the findings of the mean comparison matrix (table 5.5), the median comparison matrix (table 5.6) and the mode comparison matrix (table 5.7) according to table 4.11.

Mean comparison matrix	Crypto currencies	Governmentally supported crypto currencies	Local "Freigeld" crypto currency
"short try-out"	4.44	4.35	4.94
"long try-out"	3.63	3.62	4.11
"for everyday payments"	3.63	3.28	4.14
"as salary"	2.9	2.51	3.66

Table 5.5: This matrix shows the mean comparison matrix. It was derived by transferring the survey data into the question matrix (see table 4.10). The matrix depicts the different mean values of the related questions. The results were color coded according to the classification given in table 4.11.

Median comparison matrix	Crypto currencies	Governmentally supported crypto currencies	Local "Freigeld" crypto currency
"short try-out"	5	5	5
"long try-out"	4	4	5
"for everyday payments"	3	4	5
"as salary"	2	2	4

Table 5.6: This matrix shows the median comparison matrix. It was derived by transferring the survey data into the question matrix (see table 4.10). The matrix depicts the different median values of the related questions. The results were color coded according to the classification given in table 4.11.

Mode comparison matrix	Crypto currencies	Governmentally supported crypto currencies	Local "Freigeld" crypto currency
"short try-out"	7	5	5
"long try-out"	1	1	5
"for everyday payments"	1	1	5
"as salary"	1	1	5

Table 5.7: This matrix shows the mode comparison matrix. It was derived by transferring the survey data into the question matrix (see table 4.10). The matrix depicts the different modes of the related questions. The results were color coded according to the classification given in table 4.11.

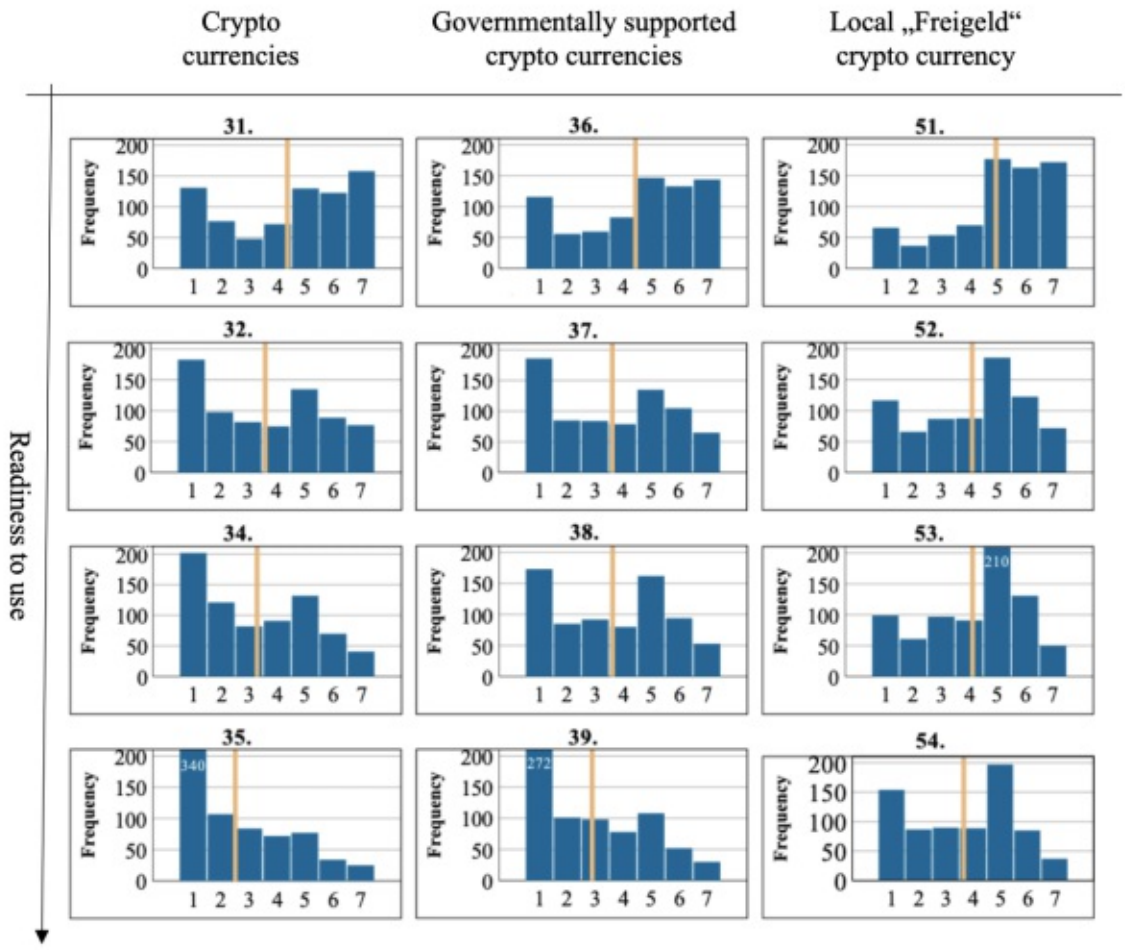


Figure 5.14: This matrix depicts the survey results concerning the "readiness-to-use" crypto currencies for three different scenarios. Each diagram represents a matrix element. Thus, the number above each diagram refers to a specific question in the survey. The related questions are given in table 4.10. The numbers 1-7 refer to the options provided by the Likert scale (see fig. 4.1). The 'Frequency' depicts the quantity of votes for each option. The arrow on the left (labeled "readiness-to-use") refers to the incremental objectives, starting with "short try-out" and ending "as salary" (see section 4.4.3). The findings derived from this matrix resulted in the mean, the median and the mode comparison matrix (see table 5.5, table 5.6, table 5.7. The ultimate findings are depicted in table 5.4.

5.4.2 The trust in crypto currencies

Question Nr.	Scenarios	Classification	Level of Trust Mean	Level of Trust Median	Mode
22	I have trust in crypto currencies.*	low significance	3.32	3	4
23	I have trust in a governmentally supported crypto currency.*	no significance (strong)	3.61	4	4
39	I would have trust in circle coin.*	no significance (strong)	4.4	4	4
12	I have trust in my crypto currencies	low significance	4.71	5	6

Table 5.8: This table shows the results for the different levels of trust for all discussed crypto currencies. Three out of four questions originally included the phrase "don't trust" (or similar). The scale was converted to increase the readability and phrase was changed to "trust". This is indicated by an '*' (asterisk). The results were color coded according to the classification given in table 4.11.

Table 5.8 illustrates the findings concerning the different levels of *"trust"*. The data was classified according to table 4.11. In addition to the three currencies previously stated, the level of trust was also evaluated for participants who had already purchased or obtained crypto currencies. This scenario features the phrase "My crypto currencies". To be precise, the scenario "Crypto currencies" includes the data of *all participants*, while the scenario "My crypto currencies" includes *only* participants who already purchased or obtained crypto currencies.

Participants who had already purchased or obtained crypto currencies feature the highest level of trust in *their* crypto currencies. Nonetheless, even *their* level of trust shows only a low positive significance. The *local Freigeld crypto currency* is ranked second, followed by the *governmentally supported crypto currency*, yet for both currencies, the variable trust shows no significant value, neither in positive nor in negative direction. The data obtained shows the lowest value of trust for *crypto currencies* and indicates a low significance towards no trust.

5.4.3 The acceptance of crypto currencies

As outlined in section 4.4.3, the total acceptance of crypto currencies is calculated as the sum of the variables *"readiness-to-use"* and *"trust"*. The former calculations led to two matrix variables with a different number of columns. A direct summation of both variables is therefore not possible. Hence, to calculate the acceptance from the previously outlined findings, the mean values were converted by the following steps:

- The Likert scale (featuring a scale from one to seven) was shifted by one to set the origin to zero.
- The scale was normed and converted to percent.
- For the summation, the total level of "readiness-to-use" (the four combined incremental objectives) was assigned the same weight as the level of "trust". Hence, to obey this defined weighting, the value of each of the four presumable incremental objectives was divided by four.
- The weighted variables of "readiness-to-use" and "trust" were then separately accumulated for each currency. The result is shown in fig. 5.15, depicting a comparable illustration of the acceptance of all crypto currencies presented.

The converted scale can now be interpreted as follows: 0 % equals “Fully disagree”, 16.67 % equals “disagree”, 33.33 % equals “Somewhat disagree”, 50 % equals “Neutral”, 66.67 % equals “Somewhat agree”, 83.33 % equals “Agree” and 100 % equals “Fully agree”.

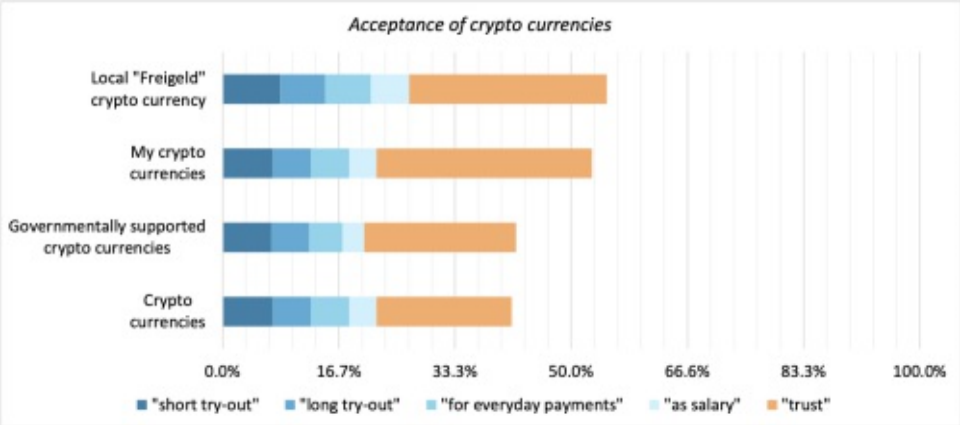


Figure 5.15: Overall acceptance of crypto currencies

The same calculation was done for the median values. Compared to the mean values, the result showed an average deviation of 3.7 % of the total acceptance of each currency discussed. This difference was considered as insignificant and therefore the median value was neglected for further evaluations.

This is illustrated in fig. 5.15 and also in table 5.9.

Participants showed a higher *readiness-to-use* governmentally supported crypto currencies (22.8 %) compared to regular crypto currencies (20.4 %). However, the participants showed a higher level of *trust* in regular crypto currencies (21.8 %) than in governmentally supported crypto currencies (19.3 %). The total *overall level of acceptance* for a governmentally supported crypto currency (42.1 %) and a regular crypto currency (41.4 %) shows only an insignificant difference.

The *acceptance* for the local Freigeld crypto currency (55.1 %) exceeds every other discussed currency. The *readiness-to-use* the currency (26.7 %) is higher then for every other currency presented, the level of *trust* is ranked second (28.3 %). Only participants who had already purchased or obtained crypto currencies feature a higher level of *trust* (28.3 %) in their obtained currencies.

Acceptance of crypto currencies	Crypto currencies	Governmentally supported crypto currencies	My crypto currencies	Local Freigeld crypto currency
short try-out	7.2 %	7.0 %	7.2 %	8.2 %
long try-out	5.5 %	5.5 %	5.5 %	6.5 %
for everyday payments	5.5 %	4.8 %	5.5 %	6.5 %
as salary	4.0 %	3.1 %	4.0 %	5.5 %
"trust"	19.3 %	21.8 %	30.9 %	28.3 %
Total	41.4 %	42.1 %	53.0 %	55.1 %

Table 5.9: This table shows the different percentages of acceptance for different objectives and crypto currencies.

5.5 Details concerning the acceptance of crypto currencies

5.5.1 The impact of the objective named "long try-out"

The implemented concept featured the objective named *long try-out* as part the of the *readiness-to-use* variable. It was not possible to assess beforehand if the participants generally refuse this option. Two possible reasons for such refusal are a low selectivity in regard to the objective called *short try-out* or the general refusal of yearlong try-outs.

Question 15 evaluated the attitude of participants concerning the stated objective. According the mean value of 4.37 and the median of 4 it was concluded that no significant general rejection of this objective was found. The different results of the survey (shown in table 5.5) also verify this claim.

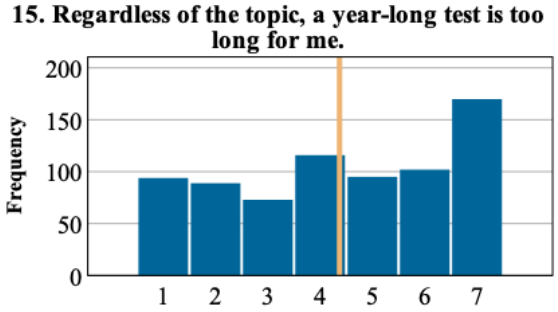


Figure 5.16: This figure shows the findings of the evaluation of the objective named "long try-out". According to a mean value of 4.37 (orange line), a median of 4 and a mode of 7.

5.5.2 The impact of governmental support on crypto currencies

The survey included four additional questions to verify findings concerning governmental support. The obtained data is illustrated in table 5.10 and shows *no significant impact* of government support on the level of trust in *crypto currencies* (Question 24) and on the personal preference

for crypto currencies (Question 25). For the *local Freigeld crypto currency* a *very low positive impact* of governmental support on the level of trust was found (Question 38) and a *very low positive significance* for the request of government support (Question 37).

The results indicate that governmental support has a very low to no impact on the personal preference of the participants and on the level of trust for all crypto currencies. The present results confirm the previous findings (see fig. 5.15 and related elaborations).

The impact of governmental support on crypto currencies: In general and on the local "Freigeld" crypto currency

Siginificants and Question	Mean	Median	Mode	Interquartile Range
24. Government support doesn't make a difference for my trust in crypto currencies.	**4.09**	**4**	3	4
25. I would prefer a governmentally supported crypto currency.	**4.05**	**4**	5	2
37. I would think it's good that the government supports circle coin.	**4.42**	**5**	5	2
38. I would have more trust in circle coin, because the government supports it.	**4.33**	**5**	5	3

Table 5.10: This table shows the supporting questions to validate the impact of governmental support on the local Freigeld crypto currency and on plain crypto currencies. The result was color coded according to the classification given in table 4.11.

5.5.3 The impact of different parameters introduced by the local Freigeld crypto currency

The parameters and conclusions, ordered from high impact to no significant impact, are as follows:

1. (Table 5.11) **The impact of involving the local economy**

   The data showed that for a *very significant* amount of participants, it is important to support the local economy (Question 45).

   A *significant* part of participants thinks that the *circle coin* would help support the local economy (Question 40). Additionally, a *significant* part of participants indicated an increased acceptance of the *circle coin*, caused by the promised support of the local economy (Question 40).

2. (Table 5.12) **The impact of a constant money value and the satisfaction with the current monetary and economic system**

   The constant value of money is important for a *very significant* part of all participants (Question 27). When inquired if the circle coin will succeed to offer a constant money

value, participants showed *(a strongly) neutral* position. (Question 44) Thus, the constant money value promised by the local Freigeld crypto currency showed no significant impact on the level of acceptance. The current monetary and economic system was classified as neutral (neither significantly good, nor significantly bad) (Question 28). Question 41 indicates a very low significance for rejecting additional currencies.

3. (Table 5.13) **The impact of the general idea of a local "Freigeld" crypto currency**

   Question 32 showed that participants had a tendency to "somewhat agree" (Likert scale) to the idea of a local Freigeld crypto currency. Nonetheless, according to table 4.11, the impact of this parameter had a very low significance for the overall acceptance of the local Freigeld crypto currency.

4. (Table 5.14) **The impact of the "Freigeld tribute"**

   The following variables, which may have influenced the position of the participants concerning the Freigeld tribute (the demurrage), were determined beforehand:

   - (Question 29) The tribute in regard to the promise of more economic stability.
     → insignificant
   - (Question 30) A general refusal of the tribute itself.
     → (strongly) insignificant
   - (Question 31) No preference regarding the tribute.
     → very low significance (negative)
   - (Question 42) More acceptance of the tribute due to more information provided by the scenario.
     → (strongly) insignificant
   - (Question 43) The local Freigeld crypto currency is better without the tribute.
     → (strongly) insignificant

The impact of involving the local economy

Siginificants and Question	Mean	Median	Mode	Interquartile Range
45. Supporting the local economy is important for me.	**6.04**	**6**	7	2
46. The support of the local economy increases my acceptance of circle coin considerably.	**4.94**	**5**	5	2
40. I think, the circle coin would help to support the local economy.	**4.94**	**5**	4 and 5 *(two modes)	2

Table 5.11: This table illustrates the impact of involving the local economy into the design of a crypto currency. As visible, the parameter "support of the local economy" had an significant impact on the acceptance of the local Freigeld crypto currency. The result was color coded according to the classification given in table 4.11.

The impact of a constant money value and the satisfaction with the current monetary and economic system

Siginificants and Question	Mean	Median	Mode	Interquartile Range
27. A constant money value is important to me.	**5.65**	**6**	6	2
44. I think, circle coin will succeed to offer a constant value.	**3.98**	**4**	4	2
28. I think, our monetary and economic system is good enough as it is.	**3.98**	**4**	3	2
41. I think, one currency (e.g. Euro or Dollar) is enough.	**4.56**	**4**	4	3

Table 5.12: This table depicts the findings concerning the importance of a constant money value and the satisfaction with the current monetary and economic system. It also indicates that both factors had a very low to no significant impact on the level of acceptance for the local Freigeld crypto currency. The result was color coded according to the classification given in table 4.11.

The impact of the general idea of a local "Freigeld" crypto currency

Siginificants and Question	Mean	Median	Mode	Interquartile Range
32. I think, the circle coin is a good idea.	**4.43**	**5**	5	2

Table 5.13: This table shows that the general idea of a local Freigeld crypto currency had a very low positive impact on its acceptance. The result was color coded according to the classification given in table 4.11.

The impact of the "Freigeld" tribute

Siginificants and Question	Mean	Median	Mode	Interquartile Range
29. For more economic stability, I would be willing to accept the "Freigeld" tribute.	**3.82**	**4**	5	2
30. The tribute is definitely no option for me.	**4.26**	**4**	4	3
31. The tribute makes little to no difference to me.	**3.41**	**4**	4	2
42. The scenario has improved my attitude about the "Freigeld" tribute.	**4.23**	**4**	4	1
43. The circle coin would be a better idea without the "Freigeld" tribute.	**4.14**	**4**	4	1

Table 5.14: This table shows different variables which may have influenced the position of participants concerning the tribute. Overall, it is observable that the introduction of the tribute had no significant impact. The result was color coded according to the classification given in table 4.11.

6 Discussion

6.1 The readiness to use crypto currencies

Based on the findings of table 5.4 the following conclusions were drawn about the "readiness-to-use" crypto currencies:

1. The "readiness-to-use" is equal for crypto currencies with and without governmental support.
2. The data showed a very low positive significance that participants would use a governmentally supported crypto currency or a *regular* crypto currency for a "short try-out", but showed no significant indication to use it beyond this objective.
3. The readiness to do a "short try-out" was positive with a low to very low significance for all crypto currencies presented.
4. The participants showed a very low significance to use the local Freigeld crypto currency up to the level of "everyday payments", but showed no significant indication to receive it "as a salary".

   Conclusion: The second hypothesis is false.

   Second hypothesis: Individuals do not accept using crypto currencies for everyday payments.

   Statement: As indicated by obtained survey data, the participants showed a very low but positive significance to use the local Freigeld crypto currency for everyday payments. Hence, the participants do not generally reject an increased inclusion of crypto currencies in society. Given the still emerging crypto currencies, the extent to use one of them up to the level of everyday payments is considerable. Furthermore, the participants featured an age, which was below the average and an education, which was above the average of the Austrian society. The data can therefore be interpreted as preliminary outlook on the thoughts of the next generation.

6.2 The trust in crypto currencies

The level of trust was assessed for three kinds of crypto currencies: regular crypto currencies, governmentally supported crypto currencies and a local Freigeld crypto currency. According to

table 5.8, the level of trust for a *governmentally supported crypto currency* and for the *local Freigeld crypto currency* showed no significance, neither towards trust, nor towards no trust.

The participants showed a low significance towards no trust for *regular crypto currencies*, but the opposite was found for individuals who already *obtained crypto currencies*. Such individuals showed a low significance towards trust for regular crypto currencies.

Conclusion: The influence of governmental support on the level of trust in crypto currencies is insignificant.

Statement: The level of trust differentiates significantly between the participants, but not between the crypto currencies. Given the difference of trust in regular crypto currencies between participants who already obtained and didn't obtain crypto currencies before, it can be said that the level of trust is either influenced by detailed technical attributes or by the personal environment of the individual. I personally hold the impression that both play a significant role and that a perfect technical solution might not be sufficient to achieve a high level of trust. Nonetheless, it has to be taken into account that only 12.33 % (fig. 5.13) of all participants have ever obtained crypto currencies. Due to this limited amount of data further research is necessary to verify this claim.

6.3 The acceptance of crypto currencies

Section 5.4.3 featured a detailed elaboration of the overall level of acceptance for governmentally supported crypto currencies (42.1 %) and regular crypto currencies (41.4 %). According to this elaboration, which was mainly based on fig. 5.15 and table 5.9, an insignificant difference between both currencies was determined.

Conclusion: The first hypothesis is false.

First hypothesis: Governmental support increases the acceptance of a crypto currency.

The acceptance of the local Freigeld crypto currency includes the highest level of "readiness-to-use" (26.7 %) and the second highest level of trust (28.3 %). Compared to every other crypto currency, this resulted in the highest level of acceptance (55.1 %) for the local Freigeld crypto currency.

Conclusion: The third hypothesis is true.

Third Hypothesis: The local Freigeld crypto currency exceeds the acceptance of other crypto currencies.

Statement: Compared to the other currencies, the local Freigeld crypto currency showed the highest level of acceptance. To allow a better evaluation, the acceptance was also assessed for the subgroup of participants who already obtained crypto currencies. This currency option was named "my crypto currency" and this particular subgroup featured a considerable higher level of acceptance for crypto currencies (with or without governmental support). Nonetheless, the local Freigeld crypto currency still slightly exceeded the acceptance of "my crypto currency". This underlines the considerable high level of acceptance of the local option, since the participants who already obtained crypto currencies can be categorized as a particularly positive subgroup.

6.4 Impacts on the level of acceptance of crypto currencies

1. The impact of the objective named "long try-out"

   The concern about the introduced response bias by the objective named "long try-out" was not confirmed by the obtained data (see fig. 5.16).

   The overall result of the assessment of this particular objective can be interpreted as follows: A year-long try-out is challenging but, in the end, it depends on the object to be tested.

   Conclusion: The objective "long try-out" did not result in a response bias.

2. The impact of a governmental support on crypto currencies

   The survey included additional questions to verify the findings of governmental support in more detail. The results were outlined in section 5.5.2.

   The verification of governmental support showed neither a positive nor a negative impact on the level of trust or preference of regular crypto currencies. In case of the local Freigeld crypto currency the impact changed to a very low positive attitude towards governmental support.

   Conclusion: The verification confirmed the very low to no significant impact of governmental support on the level of trust and the personal preference of the participants.

3. The following conclusions were drawn about the impact of different attributes introduced by the local Freigeld crypto currency:

   - (Table 5.11) The impact of supporting the local economy
     Conclusion: The parameter "support of the local economy" had a significant impact on the increased acceptance of the local Freigeld crypto currency.
   - (Table 5.12) The impact of a constant money value and the satisfaction with the current monetary and economic system
     Conclusion: The promised constant money value and the satisfaction with the current monetary/economic system showed very low to no impact on the level of acceptance of the local Freigeld crypto currency.
   - (Table 5.13) The impact of the general idea of a local Freigeld crypto currency
     Conclusion: The mere idea of the local Freigeld crypto currency had a very low positive significance for its overall acceptance.
   - (Table 5.14) The impact of the Freigeld tribute (demurrage fee)
     Conclusion: The introduction of the Freigeld tribute showed no significant impact on its resulting overall acceptance.

Statement: The assessment of the attributes introduced by the local Freigeld crypto currency showed that the promised support of the local economy was the only significant parameter. Hence it was therefore concluded that this attribute led to the high level of acceptance. In other words, compared to all the other presented crypto currencies, the local Freigeld crypto currency featured the highest level of acceptance, because it supported the local economy. The two other attributes of the local currency, namely a constant money value and a tribute (demurrage fee), had a very low to no impact on the acceptance. The same applies for a possible dissatisfaction with the current monetary/economic system or a general rejection of the local Freigeld crypto currency idea. Evidently, if a broad penetration of the society by crypto currencies is aspired, the support of the local economy identified itself as a considerable lever.

7 Conclusion

7.1 Introduction

The effective demand is part of the *Freigeld* theory developed around 1900 by the entrepreneur *Silvio Gesell*. If executed correctly, it postulates a constant value of money. This attribute was contemplated to suit the current period of time in two ways. Firstly, the stressed patience of the society in regard to the recent economic crises (boom and bust cycles) and secondly, the potential disruption of the banking sector and the monetary system by the development of DLTs. Under this premise, the balancing effect of a complementary stable currency combined with the features of crypto currencies meets the spirit of the time and was therefore chosen as research topic.

Based on Gesell's framework, the applicability of the *effective demand* on crypto currencies was evaluated and ultimately a basic local Freigeld crypto currency concept (named *circle coin*) was developed. Besides the assessment of this new currency, the survey also inquired the level of acceptance of regular crypto currencies and governmentally supported crypto currencies. This enabled to compare the findings of different currency set-ups and allowed to broaden evaluation.

7.2 Research Objectives

The thesis had two main objectives. Firstly, to assess the applicability of the theory of *effective demand* on crypto currencies. Secondly, to conduct a preliminary investigation of the crypto currency acceptance by the Austrian society - in general and in reference to the theory of *effective demand*.

Due to the considerable criticism of Silvio Gesell's theories it was decided to present his concept of effective demand to a high extent by his own original description and framework. The aim was to allow a clear classification of the original work, without any influence of different conclusions drawn over the last 100 years. This also took away the complexity of the present economic system which evolved over the 20^{th} century and narrowed the framework down to the former time.

The preliminary investigation of the acceptance of different crypto currencies was originally planned to be executed by a probability sample. This would have allowed to derive the findings to a major part of the Austrian society. Unfortunately, as outlined in section 4.2, the survey design had to be changed due to the SARS-CoV-2 containment measures. The new design featured a self-administered, web browser based, online survey which was distributed by snowball

sampling. Hence, since the new design prohibits any generalization, the survey objective had to be changed from gathering information of the Austrian society to only describing the data of Austrian people who participated at the survey. The following research objectives, research questions and hypotheses were aimed to be assessed by the social survey:

The research objective was a preliminary investigation into ...

RO1: ... whether the acceptance of a crypto currency would change for a governmental support.

RO2: ... whether individuals would accept a crypto currency for everyday payments.

RO3: ... whether a local Freigeld crypto currency changes the acceptance of crypto currencies.

Three research questions were derived from the stated research objectives.

RQ1: To what extent would a governmental support change the level of acceptance of crypto currencies?

RQ2: To what extent would individuals accept a crypto currency solution for everyday payments?

RQ3: To what extent does the availability of a local Freigeld crypto currency change the acceptance of crypto currencies?

As consequence of the stated research questions three hypotheses were determined to be tested.

H1: Governmental support increases the acceptance of a crypto currency.

H2: Individuals do not accept using crypto currencies for everyday payments.

H3: The local Freigeld crypto currency exceeds the acceptance of other crypto currencies.

7.3 Limitations

7.3.1 The effective demand

The evaluation of the applicability of *effective demand* on crypto currencies is based on the former framework outlined by Silvio Gesell. In this regard it has to be acknowledged that only the clear regulation of an economic subsystem, as possible for crypto currencies, justifies the implementation of the *effective demand* (based on the framework provided by Silvio Gesell) on crypto currencies. Conclusions drawn about the applicability of the effective demand outside of this limited framework and unrestricted deductions to the current economic system are not supported by this thesis.

7.3.2 The executed sample

The sample features the following attributes:

- Sample design: A self-administered, web browser based, online survey distributed by snowball sampling
- Sample frame: Individuals with internet access and with their country of residence in Austria
- Sample size: 739 (100 % complete data sets and revised)
- Response rate: 40.8 %
- Sampling period: 32 days (31st December 2020, 00:01 - 31st January 2021, 23:59)
- Average survey duration: 9 min 45 sec

The obtained data exhibits a very high risk of severe errors and biases, caused by the nature of the executed non probability sample. Therefore, a generalization from the sample statistics to a broader population is not supported by the design and the results should be seen as descriptive statistic.

Concluding, given the non probability sample design and the severe restriction of the Austrian population by the chosen sample frame, the presented results were categorized as preliminary investigation.

Limitations concerning the original sample design are provided in section 4.1.4.

7.4 Broad implications and future work

The further development of the monetary system is a delicate topic, since a high percentage of the entire human society relies on its operation. Hence, adaptations should be made with great caution and should ideally be approved by the scientific society. Nonetheless, the emerging DLT's continue to challenge the current monetary system, which renders it crucial for the scholarly society to proactively participate in this process.

The assessment of the theoretical applicability of the effective demand on crypto currencies showed that it is worth revising previously rejected concepts. The fast development of different economic theories over the last 100 years induced by the globalization of the economic system, shows a considerable potential for other reevaluations. Coming back to Silvio Gesell, the successful review of the *effective demand* supports a further assessment of his theories, their comparison to the intermediate theories of the 20th century as well as to the economic theories of our present time. I personally hold the impression that a general reevaluation of former thoughts would broaden the horizon of scholarly economics. Thus, if Ulanowicz R. et al. (2009) are correct with their interpretation, the thereby increased diversity in economic science would be benefiting not only for the scholarly society, but also for the monetary system and consequently for the human society. [UGLG09]

The obtained data of the developed local Freigeld crypto currency showed potential for an actual application within the society. Nonetheless, a considerable amount of research and development

is still required. In this regard, the development of an accurate mathematical theory to balance the emission and withdrawal of coins within the a crypto currency system is essential. This also includes the determination of subscription models and above all, the theoretical background for reasonable exchange rates. Considering the boom and bust cycles of our economy, the vast complexity of the general economy system and the volatile market of crypto currencies, this can be a considerable challenge.

Albeit the assessed insignificance of government support on the acceptance of crypto currencies (see chapter 6), it is assumed that a local currency would benefit from the support of the local authorities. Nevertheless, no scholarly evidence can be provided to support this claim. Hence, it is suggested to add this attribute to successive investigations. Additionally, it was not assessed if any incentives would increase the acceptance of a local crypto currency. Albeit the challenge of balancing such measures, it is suggested to also include this attribute for successive survey to verify the potential impact.

Overall, further investigations are necessary to support the stated claims. In reference to the present sample, it should subsequently be aimed for a representative sample to allow a generalization to the Austrian society. Investigation in different societies or countries might also be useful. If an actual application of a local Freigeld crypto currency is aspired, the suggested broader investigations would assist the determination of an optimal starting point.

7.5 Summary and closing

This thesis didn't find any constraints within the framework of Silvio Gesell which restrict the application of the *effective demand* on crypto currencies. This resulted in the development of a basic complementary local Freigeld crypto currency, named *circle coin*.

For the second main objective of this thesis, the acceptance of regular crypto currencies, governmentally supported crypto currencies and *circle coin* was assessed by a social survey.

The evaluation of the obtained survey data led to the following results:

H1: Governmental support increases the acceptance of a crypto currency.
H1 = FALSE;

RO1: Governmental support had an insignificant impact on the level of trust in crypto currencies and no impact on the participants to change their "readiness-to-use" it.

RQ1: In reference to the Core concept, which was used to derive the acceptance from the level of trust and the level of "readiness-to-use", it was concluded that the overall acceptance of a crypto currency is not influenced by governmental support.

H2: Individuals do not accept using crypto currencies for everyday payments.
H2 = FALSE;

RO2: The obtained data showed a very low positive significance to use the local Freigeld crypto currency up to the level of everyday payments. For crypto currencies with or without governmental support, the participants were only ready to do a short try-out. Four main attributes were determined beforehand as potential origin of an altered level of acceptance of the local Freigeld crypto currency. According to the evaluation, the

support of the local economy was the only attribute which had a significant impact on the increased acceptance of the *circle coin*. The other attributes namely, a constant money value, a tribute (demurrage fee) and a general rejection of the local Freigeld crypto currency idea featured a very low to no significance.

RQ2: Hence, the participants were ready to use the local Freigeld crypto currency for everyday payments under the premise of supporting the local economy.

H3: The local Freigeld crypto currency exceeds the acceptance of other crypto currencies.
H3 = TRUE;

RO3: As indicated above, the acceptance of the local Freigeld crypto currency was considerably higher than the acceptance of regular crypto currencies and governmentally supported crypto currencies. Additionally, the acceptance of crypto currencies was separately assessed for participants who already obtained or purchased crypto currencies. This currency option was named "my crypto currency". The level of acceptance of this particular subgroup was considerably higher than the general level of acceptance of crypto currencies (with or without governmental support). Nonetheless, the derived acceptance of *circle coin* excelled the acceptance of *my crypto currency* with a very low to no positive significance. In this regard, it has to be acknowledged that the level of acceptance of "my crypto currency" presumably represents a particular positive subgroup, but still didn't manage to excel the total level of acceptance of *circle coin*.

RQ3: It was therefore concluded that the mere availability of the local Freigeld crypto currency had a significant positive impact on the crypto currency acceptance of the participants.

The research showed that the support of the local economy is a significant lever for local currencies. In reference to the work of Ulanowicz R. et al. (2009), this is a vital information if the aspired goal is to stabilize our monetary system by increasing its diversity. [UGLG09] The outlined applicability of the effective demand on crypto currencies seems to enable a complementary currency which features:

- A constant money value
- A transparent regulation
- A decentralised approach, which rejects the influence of single entities
- The support of the local economy
- The support of charity projects
- A cost efficient administration
- And collectively, complementary currency as balance weight to our present monetary system

Nonetheless, as indicated in section 7.4 more research is necessary to facilitate an actual implementation of *circle coin*. Especially due to its digital nature an emphasis has also to be laid on lowering the barriers of accessibility. However, the participants of the survey featured an

age, which was below the average and an education, which was above average of the Austrian society. Hence, the data can therefore be interpreted as preliminary outlook on the thoughts of the next generation. I personally see this as a positive indicator for the potential of *circle coin* and of crypto currencies in general. I hope this thesis made valuable contribution to the further development of our monetary system.

A Appendix

A.1 Questionnaire

Figure A.1: Page 1: Language selection

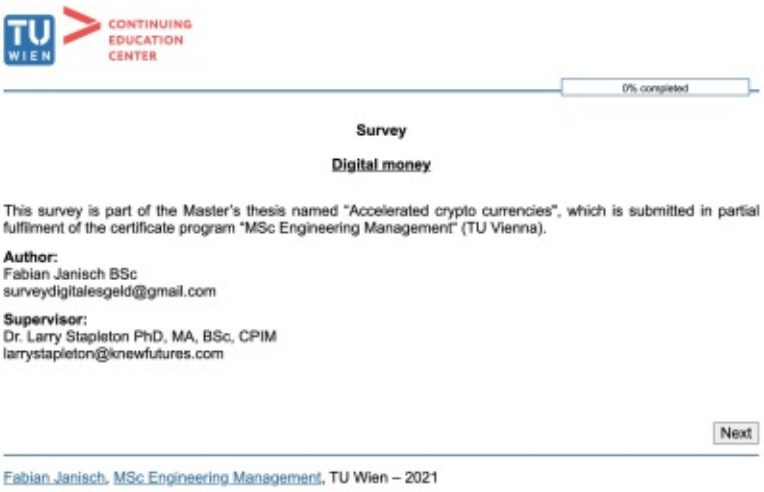


Figure A.2: Page 2: Contact details about the author and the supervisor. Information about the liable institution.

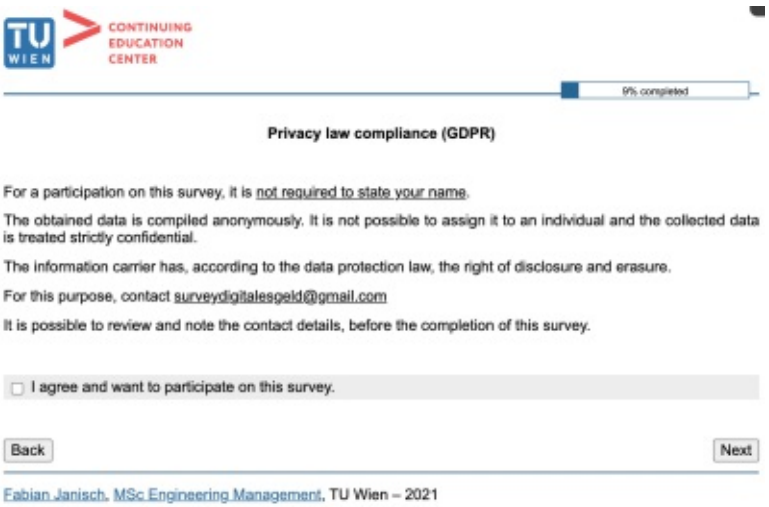


Figure A.3: Page 3: Details and declarations concerning the GDPR.

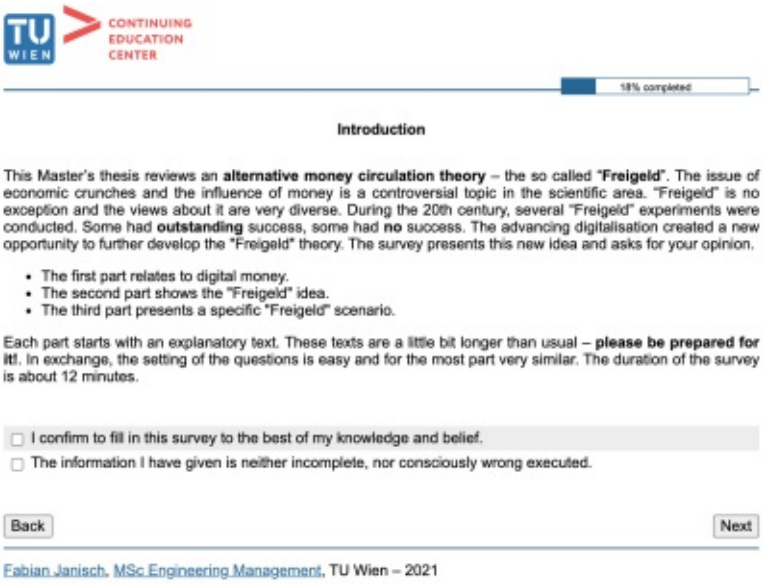


Figure A.4: Page 4: Introduction

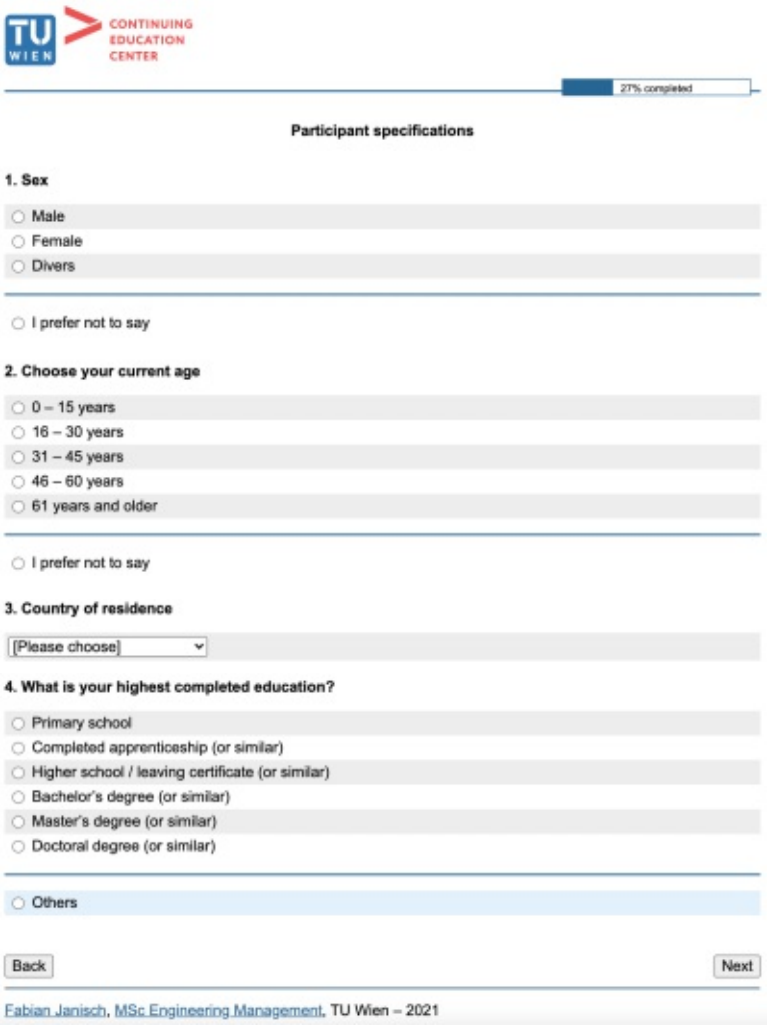
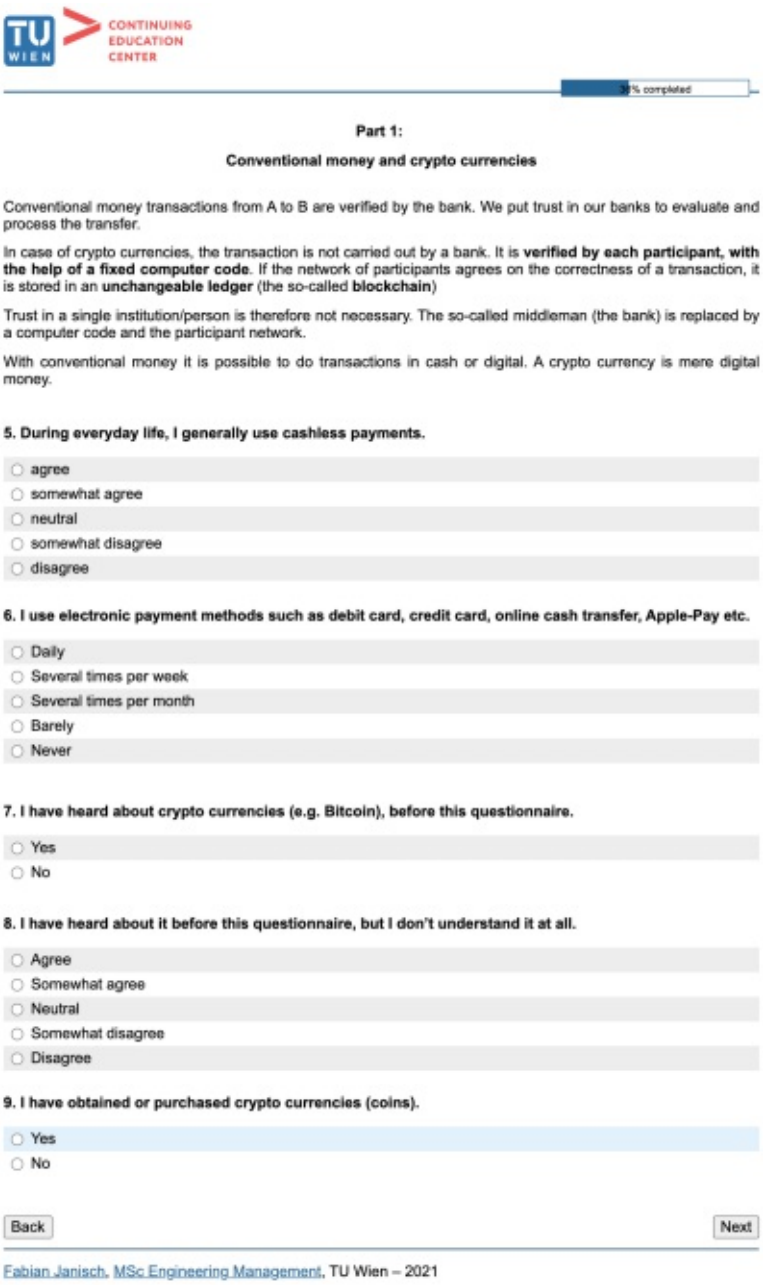


Figure A.5: Page 5: Participant demographics



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Part 1:

Conventional money and crypto currencies

Conventional money transactions from A to B are verified by the bank. We put trust in our banks to evaluate and process the transfer.

In case of crypto currencies, the transaction is not carried out by a bank. It is **verified by each participant, with the help of a fixed computer code**. If the network of participants agrees on the correctness of a transaction, it is stored in an **unchangeable ledger** (the so-called **blockchain**)

Trust in a single institution/person is therefore not necessary. The so-called middleman (the bank) is replaced by a computer code and the participant network.

With conventional money it is possible to do transactions in cash or digital. A crypto currency is mere digital money.

5. During everyday life, I generally use cashless payments.

- agree
- somewhat agree
- neutral
- somewhat disagree
- disagree

6. I use electronic payment methods such as debit card, credit card, online cash transfer, Apple-Pay etc.

- Daily
- Several times per week
- Several times per month
- Barely
- Never

7. I have heard about crypto currencies (e.g. Bitcoin), before this questionnaire.

- Yes
- No

8. I have heard about it before this questionnaire, but I don't understand it at all.

- Agree
- Somewhat agree
- Neutral
- Somewhat disagree
- Disagree

9. I have obtained or purchased crypto currencies (coins).

- Yes
- No

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Figure A.6: Page 6: Part1 - Conventional money and crypto currencies

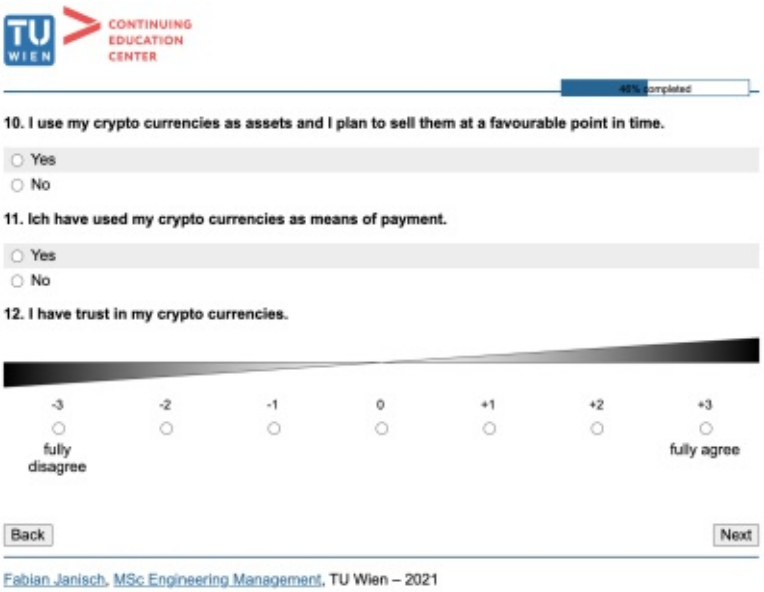


Figure A.7: Page 7: Part1 - An optional page, for participants who already purchased or obtained crypto currencies

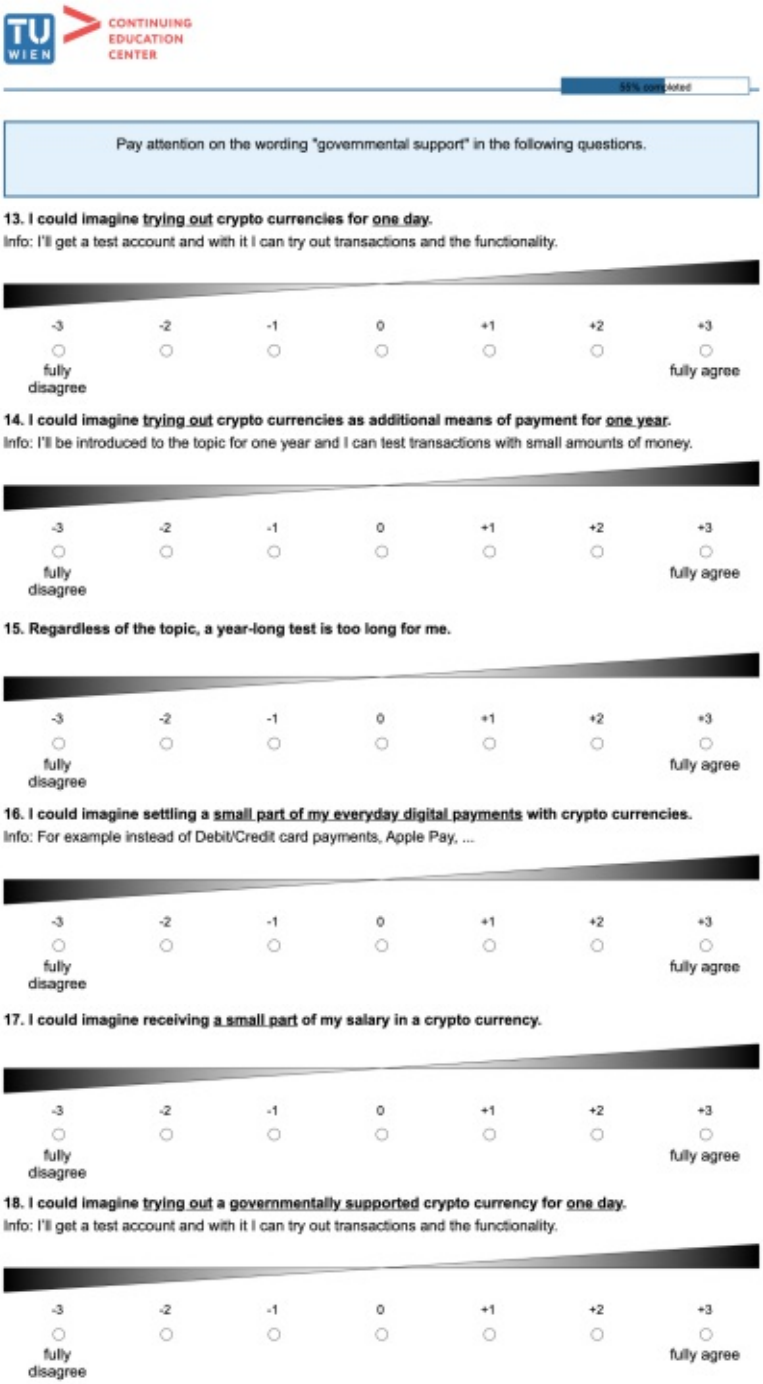


Figure A.8: Page 8: Part1 - Continued the assessment of the acceptance for a governmentally supported crypto currency

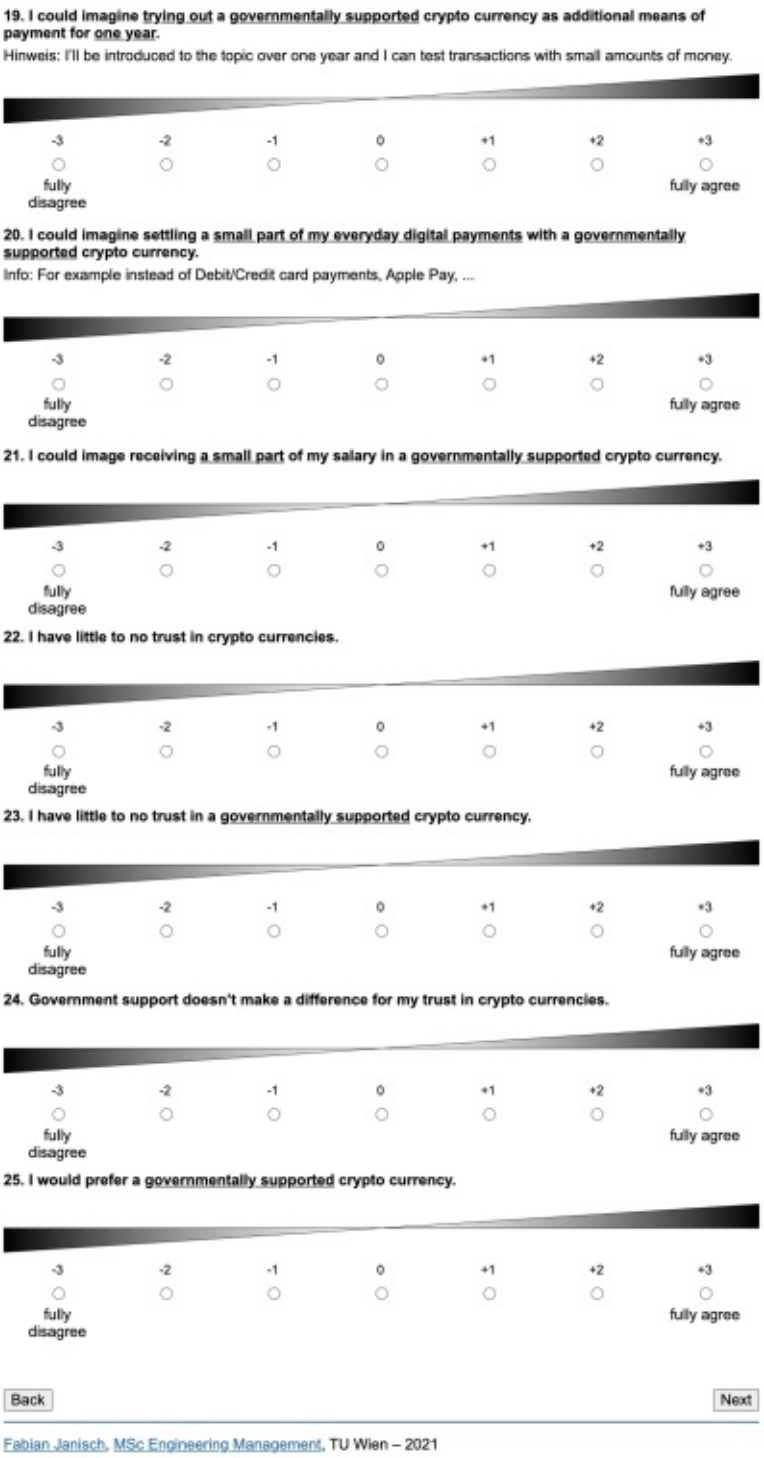
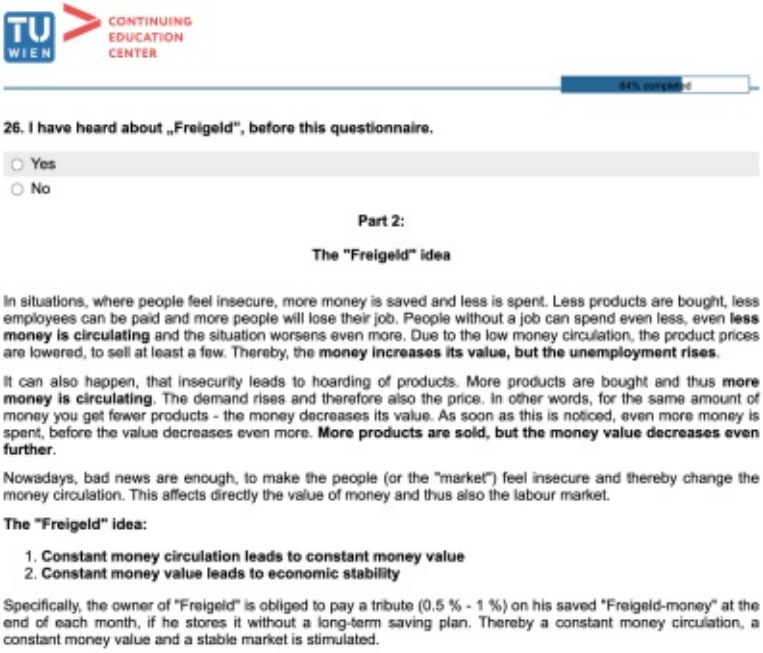


Figure A.9: Page 8 (2): Part1 - Continued the assessment of the acceptance for a governmentally supported crypto currency



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26. I have heard about „Freigeld", before this questionnaire.

- Yes
- No

Part 2:

The "Freigeld" idea

In situations, where people feel insecure, more money is saved and less is spent. Less products are bought, less employees can be paid and more people will lose their job. People without a job can spend even less, even **less money is circulating** and the situation worsens even more. Due to the low money circulation, the product prices are lowered, to sell at least a few. Thereby, the **money increases its value, but the unemployment rises**.

It can also happen, that insecurity leads to hoarding of products. More products are bought and thus **more money is circulating**. The demand rises and therefore also the price. In other words, for the same amount of money you get fewer products - the money decreases its value. As soon as this is noticed, even more money is spent, before the value decreases even more. **More products are sold, but the money value decreases even further**.

Nowadays, bad news are enough, to make the people (or the "market") feel insecure and thereby change the money circulation. This affects directly the value of money and thus also the labour market.

The "Freigeld" idea:

1. **Constant money circulation leads to constant money value**
2. **Constant money value leads to economic stability**

Specifically, the owner of "Freigeld" is obliged to pay a tribute (0.5 % - 1 %) on his saved "Freigeld-money" at the end of each month, if he stores it without a long-term saving plan. Thereby a constant money circulation, a constant money value and a stable market is stimulated.

Figure A.10: Page 9: Part 2 - The "Freigeld" idea

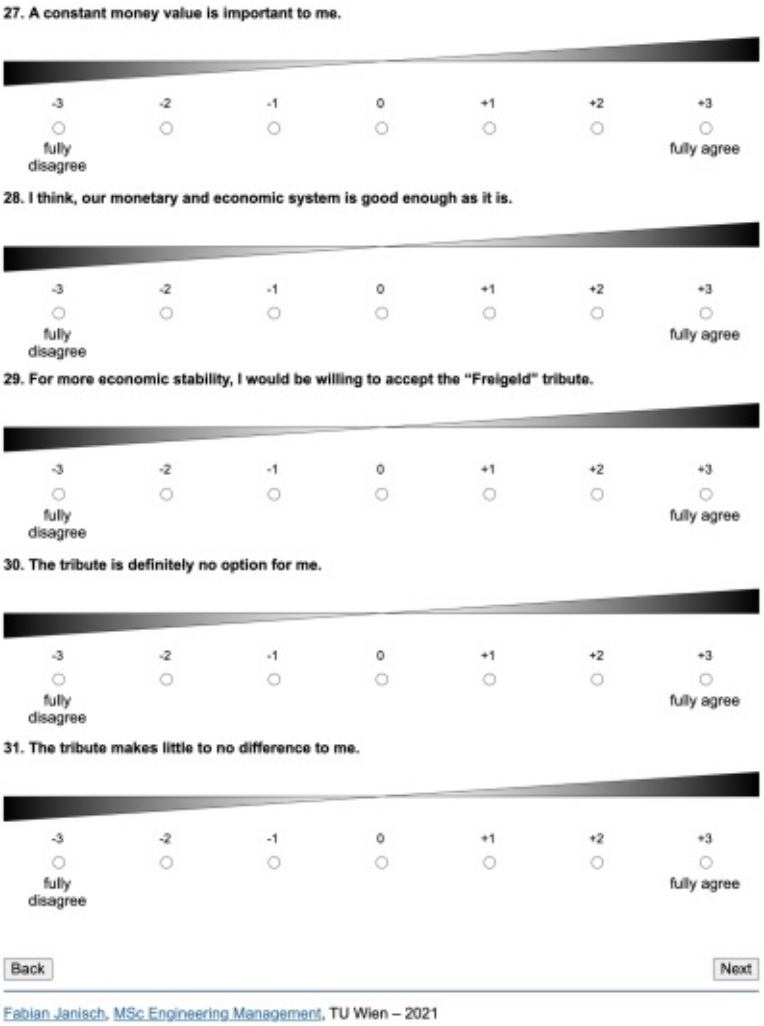
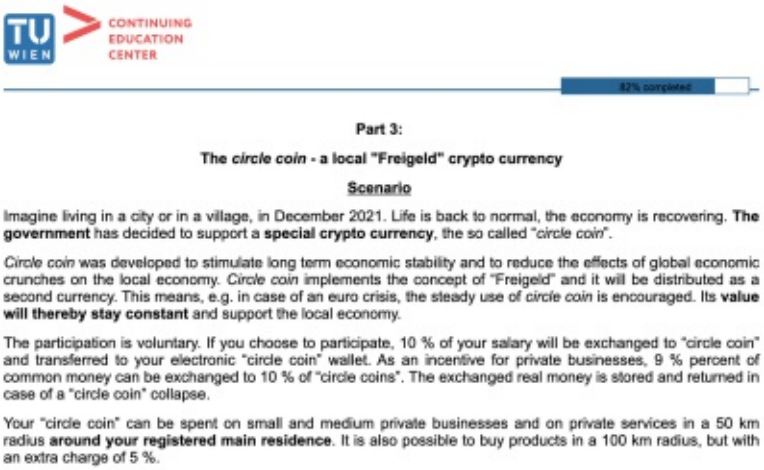


Figure A.11: Page 9 (2): Part 2 - The "Freigeld" idea

Figure A.12: Page 10: A short information was given about the remaining duration of the questionnaire



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Part 3:

The *circle coin* - a local "Freigeld" crypto currency

Scenario

Imagine living in a city or in a village, in December 2021. Life is back to normal, the economy is recovering. **The government** has decided to support a **special crypto currency**, the so called "*circle coin*".

Circle coin was developed to stimulate long term economic stability and to reduce the effects of global economic crunches on the local economy. *Circle coin* implements the concept of "Freigeld" and it will be distributed as a second currency. This means, e.g. in case of an euro crisis, the steady use of *circle coin* is encouraged. Its **value will thereby stay constant** and support the local economy.

The participation is voluntary. If you choose to participate, 10 % of your salary will be exchanged to "circle coin" and transferred to your electronic "circle coin" wallet. As an incentive for private businesses, 9 % percent of common money can be exchanged to 10 % of "circle coins". The exchanged real money is stored and returned in case of a "circle coin" collapse.

Your "circle coin" can be spent on small and medium private businesses and on private services in a 50 km radius **around your registered main residence**. It is also possible to buy products in a 100 km radius, but with an extra charge of 5 %.

Figure A.13: Page 11: Part 3 - The circle coin - a local "Freigeld" crypto currency

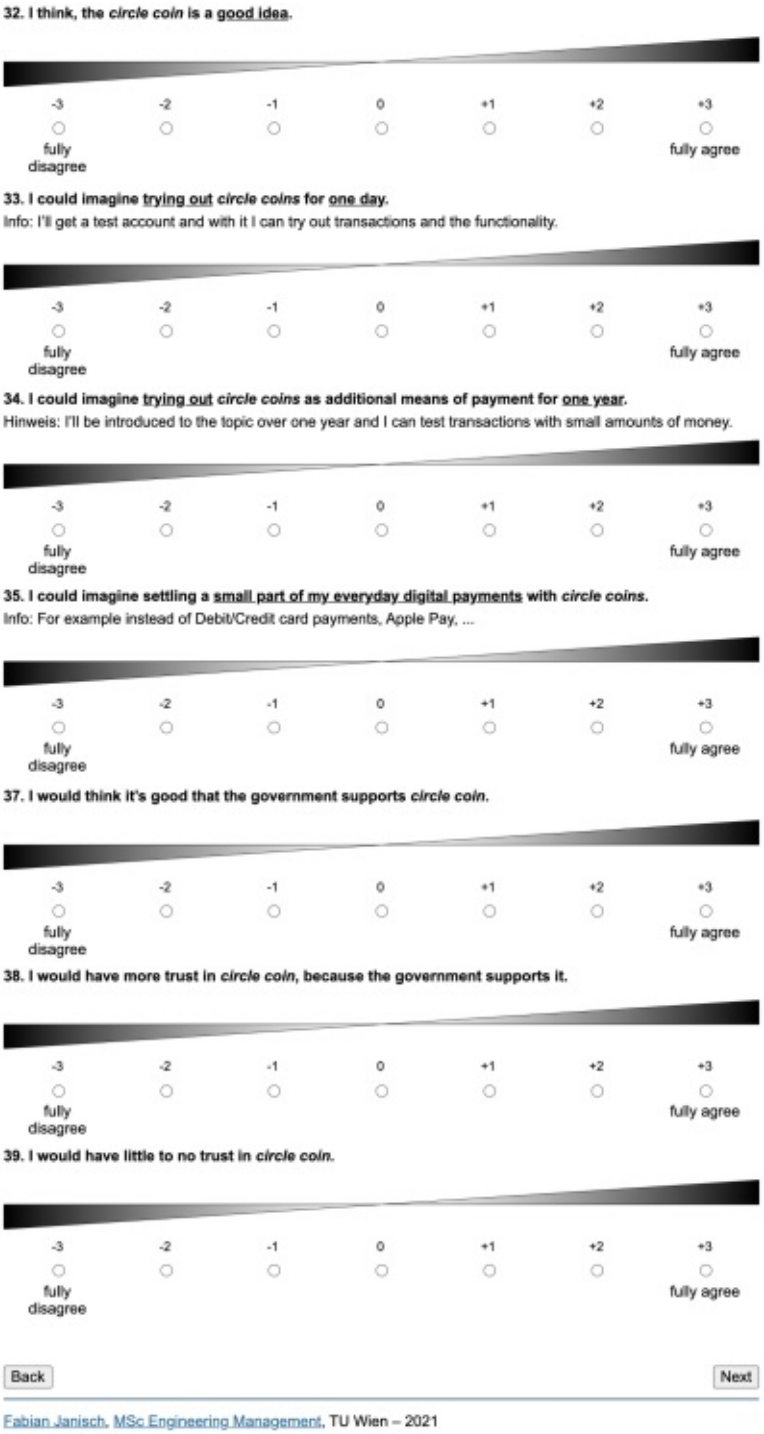

Figure A.14: Page 11 (2): Part 3 - The circle coin - a local "Freigeld" crypto currency

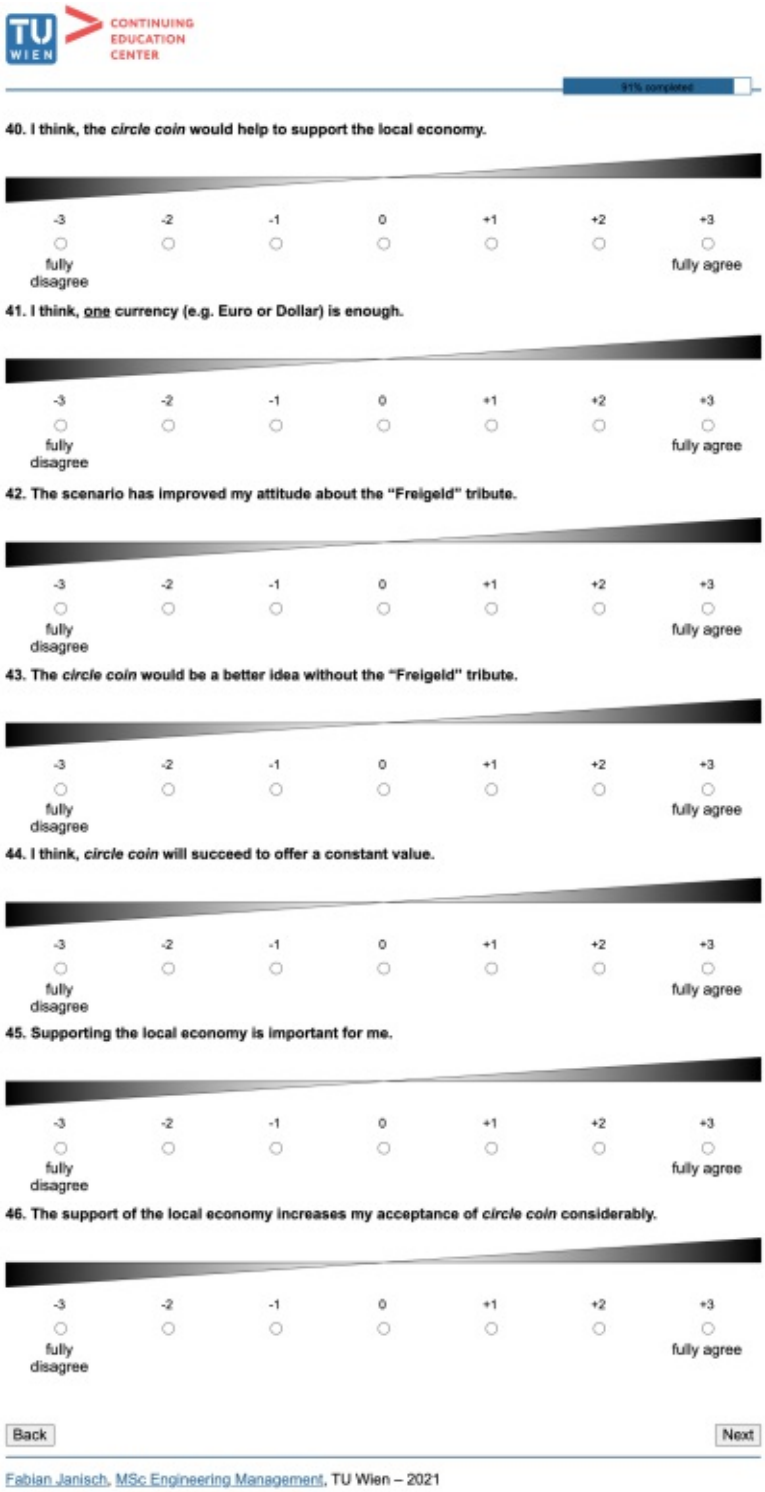

Figure A.15: Page 12: Specific questions with the aim to assess the influence of different parameters, which may have had a significant impact at the overall results

Figure A.16: Page 13: Last page - Acknowledgments and contact details

Literature

[AF01] Atkinson, R. ; Flint, J.: *Accessing hidden and hard-to-reach populations: Snowball research strategies*. 2001. – 1–4 S

[Atk98] Atkinson, B.: *Applied Economics*. CRC Press, 1998. – 368–385 S

[Aus19] Austrian Federal Ministry for Digital and Economic Affairs: *KMU im Fokus 2019 - Bericht über die Situation und Entwicklung kleiner und mittlerer Unternehmen der österreichischen Wirtschaft*. 2019. – 137 S

[BAI+18] Bambara, J. ; Allen, R. ; Iyer, K. ; Madsen, R. ; Lederer, S. ; Wuehler, M.: *Blockchain: A practical guide to developing business, law, and technology solutions*. McGraw Hill Professional, 2018. – 302 S

[BB12] Baltar, F. ; Brunet, I.: *Social research 2.0: virtual snowball sampling method using Facebook*. Emerald Group Publishing Limited, 2012. – 19 S

[BBM01] Bound, J. ; Brown, C. ; Mathiowetz, N.: *Measurement error in survey data / Handbook of econometrics*. Elsevier, 2001. – 3705–3843 S

[Ben96] Benjes, H.: *Wer hat Angst vor Silvio Gesell*. 1996. – 360 S

[BHL96] Bruwer, J. ; Haydam, N. ; Lin, B.: *Reducing bias in shopping mall-intercept surveys: The time-based systematic sampling method*. 1996. – 9–16 S

[Bla98] Blanc, J.: *Free Money for Social Progress: Theory and Practice of Gesell's Accelerated Money*. American Journal of Economics and Sociology, Inc., Wiley, 1998. – 469–483 S

[Bry12] Bryman, A.: *Social research methods*. Oxford university press, 2012. – 766 S

[CK96] Caprio, G. ; Klingebiel, D.: *Bank insolvencies cross-country experience*. World Bank Publications, 1996. – 52 S

[eco] Saving the system. In: *The Economist* . – published: 2008 October 11

[EM05] Evans, J. R. ; Mathur, A.: *The value of online surveys*. Emerald Group Publishing Limited, 2005. – 195–219 S

[ES10] Everitt, B. ; Skrondal, A.: *The Cambridge dictionary of statistics*. Cambridge University Press Cambridge, 2010. – 468 S

[Fis20] Fisher, H. G.: *The Purchasing Power of Money: Its Determination and Relation to Credit, Interest and Crises*. The Macmillan Company, 1920

[Fli15] Flick, U.: *Introducing research methodology: A beginner's guide to doing a research project*. Sage, 2015. – 295 S

[FM20] Fill, H.-G. ; Meier, A.: *Blockchain: Grundlagen, Anwendungsszenarien und Nutzungspotenziale*. Springer Verlag, 2020. – 379 S

[Fow13] Fowler, F. J.: *Survey research methods*. Sage publications, 2013. – 172 S

[Ges16] Gesell, Silvio: *Die natürliche Wirtschaftsordnung durch Freiland und Freigeld*. R.

Gesell, 1916

[Ges49] Gesell, S.: *Die natürliche Wirtschaftsordnung*. ed. 9. Lauf bei Nuernberg : Rudolf Zitzmann Verlag, Karl Walker (editor: .pdf by Florian Seiffert 2003), 1949. – 285 S

[Gro04] Groves, R. M.: *Survey errors and survey costs*. John Wiley & Sons, 2004. – 590 S

[Ilg15] Ilgmann, C.: *Silvio Gesell:"A strange, unduly neglected" monetary theorist*. Taylor & Francis, 2015. – 532–564 S

[KD20] Kim, S. ; Deka, G. C.: *Advanced applications of blockchain technology*. Springer, 2020. – 278 S

[Kel15] Keller, G.: *Statistics for Management and Economics*. Cengage Learning, 2015. – 909 S

[Ken11] Kennedy, Margrit: *Occupy Money: damit wir zukünftig ALLE die Gewinner sind*. J. Kamphausen Verlag, 2011. – 107 S

[Lie19] Lietaer, Beranrd: *Towards a sustainable world*. Delta Institue - Dietar Legat E.U., 2019. – 86 S

[P.11] P., Warren M.: *Fisher's "The Purchasing Power of Money"*. American Statistical Association, Taylor & Francis, Ltd., 1911. – 818–829 S

[Sch08] Schwarz, F.: *Das Experiment von Wörgl: Ein Weg aus der Wirtschaftskrise*. Synergia, 2008. – 89 S

[Swa15] Swan, Melanie: *Blockchain: Blueprint for a new economy*. O'Reilly Media, Inc., 2015. – 130 S

[Tah16] Taherdoost, H.: *Sampling methods in research methodology; how to choose a sampling technique for research*. 2016. – 18–27 S

[UGLG09] Ulanowicz, R. E. ; Goerner, S. J. ; Lietaer, B. ; Gomez, R.: *Quantifying sustainability: resilience, efficiency and the return of information theory*. Elsevier, 2009. – 27–36 S

[VTS16] Vehovar, V. ; Toepoel, V. ; Steinmetz, S.: *The Sage Handbook of Survey Methodology*. Sage, 2016. – 329–346 S

Internet References

[1] Z. Bobbitt. Snowball Sampling: Definition + Examples. https://www.statology.org/snowball-sampling/. (last access: 22 January 2021).

[2] M. Friedenbach and J. Timon. Freicoin. http://freico.in/. (last access: 03 March 2021).

[3] REGAL Verlagsgesellschaft m.b.H. Die Struktur des LEH für das Jahr 2019 (Regal 09-2020). https://regal.at/media/pages/marktdaten-studien/handel/regiodata-branchenkennzahlen-2020/a879f19c61-1601321118/leh-2019.pdf. (last access: 22 January 2021).

[4] REWE International AG. Sales formats in Austria. https://www.rewe-group.at/en/company/sales-formats-in-austria. (last access: 24 January 2021).

[5] SPAR Österreichische Warenhandels-AG. Konzernabschluss 2019 ifrs. https://www.spar.at/content/dam/spardam/at/spar-website/unternehmen/daten-fakten/spar-oesterreichische-warenhandels-ag-konzernabschluss-2019-ifrs.pdf. (last access: 24 January 2021).

[6] STATISTIK AUSTRIA. Statistik des Bevölkerungsstandes. http://www.statistik.at/wcm/idc/idcplg?IdcService=GET_PDF_FILE&RevisionSelectionMethod=LatestReleased&dDocName=123069. (last access: 05 February 2021).