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Cryptocurrencies: An empirical view from a tax perspective

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JRC TECHNICAL REPORT

Cryptocurrencies: An empirical view from a tax perspective

*JRC Working Papers on
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Andreas Thiemann

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Cryptocurrencies: An Empirical View from a Tax Perspective*

Andreas Thiemann[‡]

August 2, 2021

Abstract

This paper sheds light on the scarce empirical evidence on cryptocurrency users and use types. Based on the only available empirical estimate, shared by Chainalysis, this paper simulates the revenue potential from taxing Bitcoin capital gains in the EU. Total estimated Bitcoin capital gains in the EU amount to 12.7 billion EUR in 2020, including 3.6 billion EUR of realized gains. Applying national tax rules on capital gains from shares to those from Bitcoin yields a simulated tax revenue of about 850 million EUR in 2020. This paper is the first to empirically assess the tax revenue potential of capital gains from Bitcoin in the EU. While most of the empirical cryptocurrency literature is based on time-series data, this paper relies on dis-aggregated country-level data. The findings show that revenue from taxing cryptocurrencies is non-negligible and will be if the market of cryptocurrencies continues to grow.

Keywords: Capital gains taxation, cryptocurrencies, Bitcoin.

JEL Codes: G19, G23, H24.

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Executive summary

Cryptocurrencies, and in particular Bitcoin, have grown enormously in recent years, mainly driven by Bitcoin’s impressive price surge. With a unit value of less than EUR 1,000 EUR in early 2017, the price of Bitcoin skyrocketed to more than 50,000 EUR in April 2021, and fell again to 35,000 EUR until mid-May 2021. Similarly, the market capitalization of total cryptocurrencies reached two trillion EUR (the equivalent of Italy’s GDP), at least for a few days, in May 2021.

We know very little on who really owns cryptocurrencies, about their capital gains and how they are distributed. Based on the only available empirical evidence, shared by Chainalysis¹, a company offering blockchain analytics, this paper assesses the revenue potential of taxing capital gains from Bitcoin in the EU and analyzes the existing empirical evidence on crypto user.

The main use of cryptocurrencies is investment, but there are also merchants who accept bitcoins as means of payment. Further, El Salvador announced in June 2021 that Bitcoin would become an official legal tender, which suggests that cryptocurrencies could become an alternative to fiat currencies in particular for countries with an unstable currency. Other use types are illicit activities. However, their share is estimated to be less than 1% of total transactions (Grauer and Updegrave, 2021). Finally, cryptocurrencies may be considered as a new type of tax haven since users are (pseudo-)anonymous and they operate in no specific tax jurisdiction (Marian, 2013).

Total crypto users have increased from 5 million in 2016 to at least 100 million in 2020. But the empirical evidence on who owns cryptocurrencies is scant. Official tax data is also limited, as tax authorities do not yet possess comprehensive information on crypto-activities of their taxpayer. A large scale online survey finds that crypto users are predominantly male (95%), young (average 35 years), and about half consider crypto investing as a means of income (Binance Research, 2021).

¹<https://www.chainalysis.com>.

Chainalysis estimates capital gains from Bitcoin by distributing transactions, recorded on the blockchain, according to web traffic data of each country to the websites of service providers. To refine their estimate, Chainalysis uses time zone analysis of a platforms' cryptocurrency activity, the most popular fiat currency pairs, the website language options, and the headquarters locations. Total estimated capital gains amount to 12.7 billion EUR in the EU in 2020, including 3.6 billion EUR of realized gains. In terms of total realized gains, Germany ranks highest (500 million EUR), followed by France (480 million EUR) and Spain (380 million EUR). Relative to GDP, Central and Eastern European (CEE) countries benefit most, which suggests a large share of early adopters of cryptocurrencies.

To assess the revenue potential of realized Bitcoin capital gains taxation in 2020, two scenarios are simulated: (A) a uniform tax rate of 25% and (B) applying national capital gains tax rates according to shares. The simulated tax revenue in the EU amounts to 900 million EUR (0.0068% of GDP) in scenario (A) and to 844 million EUR (0.0063% of GDP) in scenario (B). For a more intuitive interpretation, we can express the estimates as percentage of total tax revenue from property taxation in the EU. Then, scenario (A) would yield about 0.31% and scenario (B) 0.29%. Given the methodological uncertainties, these estimates should be considered as an upper bound. Nevertheless, should the market of cryptocurrencies continue to rise, so will capital gains.

1 Introduction

Over the past years, the price of a bitcoin, the most important cryptocurrency, has performed an impressive price surge. With a unit value of less than EUR 1,000 EUR in early 2017, the price of Bitcoin skyrocketed to more than 50,000 EUR in April 2021, and fell again to 35,000 EUR until mid-May 2021. Similarly, the market capitalization of total cryptocurrencies reached two trillion EUR (the equivalent of Italy’s GDP), at least for a few days, in May 2021. The soaring value of cryptocurrencies together with their increased targeting as financial investment, including by mainstream financial institutions, raise important policy questions. In particular, it challenges the public sector’s (including government and central banks) role over the money supply, the banking system and tax raising capacity.²

This paper aims to shed light on the economic importance of cryptocurrencies and the empirical evidence on crypto users. Based on the first empirical estimates of capital gains from Bitcoin, shared by Chainalysis, a company providing blockchain analytics, this paper assesses the revenue potential of taxing capital gains from Bitcoin in the EU. Capital gains accrue when the price of a cryptocurrency exceeds the price at the time of purchase.

To date there is no commonly agreed definition of ‘crypto-assets’. According to the Financial Action Task Force³, a ‘virtual asset’ serves “as a digital representation of value that can be digitally traded or transferred and [that] can be used for payment or investment purposes” (FATF, 2019; OECD, 2020). The OECD defines crypto-assets as digital financial assets that use cryptography and rely on distributed ledger technology. These assets are classified into payment tokens, utility tokens and security tokens. While security tokens are considered as tradeable assets held for investment purposes, and classified as security, utility tokens typically provide access to specific goods and services (for instance access to a specific peer-to-peer network). Payment tokens or cryptocurrencies are most similar to fiat currencies and aim to operate as unit of account and means of payment (OECD, 2020, p.9).

²Robert Armstrong “Unhedged: bitcoin is equity, not money”, Financial Times, 21st May 2021. <https://www.ft.com/content/b6a08390-75fe-4f1d-9e5b-3c446b06ad08>.

³<https://www.fatf-gafi.org/home/>.

The empirical literature on the taxation of income from cryptocurrencies is still in a nascent stage due to the scarcity of available data. Furthermore, the taxation of income from cryptocurrencies is a challenge to tax authorities. Bal (2015) provides an excellent introduction to the most common taxation problems related to cryptocurrencies. She suggests that tax authorities should provide clear guidance to taxpayers on their tax obligations resulting from cryptocurrencies to improve tax compliance. One challenge is the classification of cryptocurrencies as currency or property (Wiseman, 2016; Ram, 2018; OECD, 2020). Currently, most OECD countries seem not to consider cryptocurrencies being equivalent to currencies of sovereign nations, but as a type of intangible property. However, there are still several OECD countries that do not provide a clear tax guidance. The OECD (2020) provides a good overview of the tax treatment of income from cryptocurrencies across OECD countries. The report shows that, to date, even the definition of taxable events differs substantially across countries. For instance, while an exchange of crypto-to-crypto triggers a taxable event in many OECD countries, this is not the case in France, where only transfers of crypto-to-fiat may cause a tax obligation. In Italy, Netherlands or Portugal no tax is due on the realization of capital gains from cryptocurrencies unless they are deemed speculative (Italy). The OECD’s cryptocurrencies taxation summary shows that there is still a lack of harmonization and concrete guidance. In particular, policy makers should provide clear guidelines that explain how cryptocurrencies fit into the existing tax framework.

Apart from the tax perspective, taken in this paper, there are excellent literature reviews on other economic aspects of cryptocurrencies. First, Halaburda et al. (2020) survey the microeconomic literature on cryptocurrencies, in particular focusing on the drivers of supply, demand, trading prices and competition of cryptocurrencies. While they provide an good introduction to the technology underlying cryptocurrencies, they also discuss how economic incentives, inherent in the crypto market, impact market participants and competition. Second, Corbet et al. (2019) conduct a systematic review of the empirical literature based on the main features of the market for cryptocurrencies. They argue that success of cryptocurrencies to become a credible investment class and legitimate of value depends on the ability to deal

with three interrelated issues: Prevalence of pricing bubbles, regulatory oversight, and the use of cryptocurrencies for illicit activities. The paper also documents that, to date, a vast majority of empirical papers on cryptocurrencies has been relying on time series data on the price or market size of cryptocurrencies.

This paper is largely motivated by the gap of empirical knowledge on the tax implications of cryptocurrencies. We know very little on who really owns cryptocurrencies, their capital gains and how they are distributed. The main contribution of this paper is twofold: First, I analyze the economic importance of cryptocurrencies, and investigate the existing empirical evidence on users and use types. Second, I assess the revenue potential of taxing capital gains from Bitcoin in 2020 in the EU based on the unique new data by Chainalysis. In doing so, this paper is among the few papers that provides empirical insights on the Bitcoin market, relying not on aggregate time-series data, but on dis-aggregated data on the estimated capital gains from Bitcoin by country in 2020.

Chainalysis estimates capital gains from Bitcoin by distributing transactions, recorded on the blockchain, according to web traffic data of each country to the websites of service providers. To refine the estimates, Chainalysis also exploits time zone analysis of a platforms' cryptocurrency activity, the most popular fiat currency pairs, the website language options, and the headquarters locations to refine the estimates.

To assess the revenue potential of realized Bitcoin capital gains taxation in 2020, I simulate two scenarios: (A) a uniform tax rate of 25% and (B) applying national capital gains tax rates according to shares. The simulated tax revenue in the EU amounts to 900 million EUR (0.0068% of GDP) in scenario (A) and to 844 million EUR (0.0063% of GDP) in scenario (B). We can express the estimates as percentage of total tax revenue from property taxation in the EU for a more intuitive interpretation: Then, scenario (A) would yield about 0.31% and scenario (B) 0.29%. Given the methodological uncertainties, these estimates should be considered as an upper bound. Nevertheless, should the market of cryptocurrencies continue to rise, so will capital gains.

Note that this paper assumes readers to have a basic understanding of the functioning of a blockchain. For an introduction to blockchain mechanics, see for instance

Nascimento et al. (2019). The remainder of this paper is as follows, the next section discusses the economic size of the cryptocurrencies market, followed by an analysis of the different usages in section 3. Section 4 focuses on the empirical evidence on cryptocurrency users, while section 5 provides an assessment of the revenue potential of taxing capital gains from Bitcoin in 2020.

2 Market size of cryptocurrencies

To evaluate the size of the cryptocurrencies market, we consider the estimated total market capitalization, which capitalizes all coins by its EUR price. In May 2021, there are about 9,000 different cryptocurrencies⁴, with a market capitalization of almost 2 trillion EUR, driven mainly by Bitcoin, the most popular cryptocurrency (Figure 1a). To put the market size of Bitcoin into perspective, we can compare it with the market capitalization of the largest companies in the world. In May 11, 2021, the market capitalization of Bitcoin (about EUR 850 billion) ranks as the sixth largest, higher than Facebook Inc. (about EUR 700 billion) and lower than Alphabet Inc. (about EUR 1,250 billion).⁵ Bitcoin, the first cryptocurrency (Nakamoto, 2008), has been dominating the cryptocurrency market since its creation in 2009 (Figure 1b). However, while Bitcoin maintained very high market shares in the early years, its relative importance shrank lately because of the increasing importance of other new cryptocurrencies, such as Ethereum or Tether. In May 11, 2021 Bitcoin's market share was about 43%, followed by Ethereum (19%). However, according to Chainalysis about 20% of total bitcoins are lost for various reasons.⁶

Cryptocurrencies tend to be extremely volatile. Figure 1a shows how market capitalization of cryptocurrencies has evolved over time, largely driven by the evolution

⁴According to coinmarketcap.com (accessed in May 11, 2021). Coinmarketcap defines a cryptocurrency as a digital currency that uses cryptographic technologies to secure their operation.

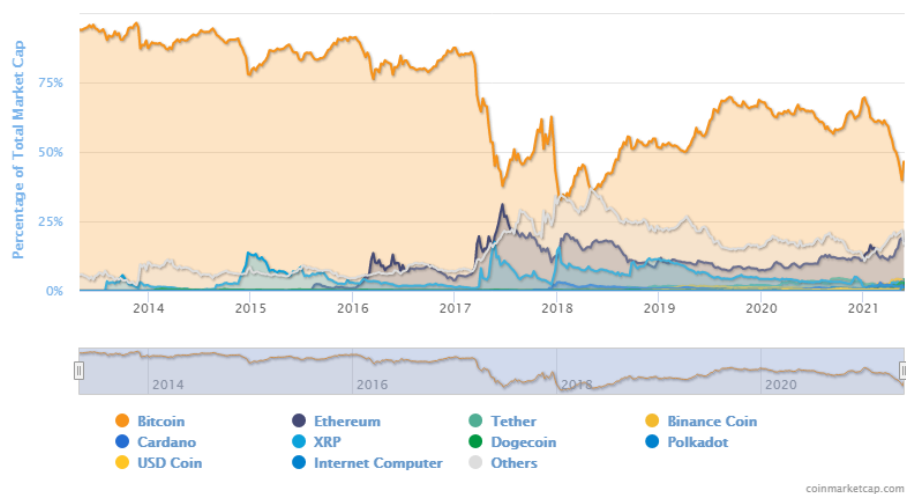
⁵<https://coinmarketcap.com/de/largest-companies/> (accessed on May 11, 2021).

⁶<https://blog.chainalysis.com/reports/bitcoin-market-data-exchanges-trading>. Chainalysis considers any bitcoin lost if it has not been moved from its current set of addresses in five years or longer. Other experts estimate that 3% of all bitcoins are lost, however without providing an empirical foundation. (<https://3commas.io/blog/distribution-of-wealth-in-bitcoin-and-other-cryptocurrencies>).

Figure 1: Market capitalization and dominance of cryptocurrencies



(a) Total market capitalization of cryptocurrencies



(b) Relative importance of cryptocurrencies (dominance)

Note: Graph based on the online tool by coinmarketcap.com, accessed on May 11, 2021.

of the Bitcoin price. Cryptocurrencies did not play an important quantitative role until mid-2017, when market capitalization began to rise, peaking in January 2018 at 600 billion EUR, followed by a period of decline and stagnation. The collapse in 2018 and the following media coverage of speculative investors having lost large amounts of money triggered a narrative, in which the viability of cryptocurrencies was questioned (Rauchs et al., 2018). However, since about mid-2020, the total market capitalization of cryptocurrencies has been on a positive trend until the second half of May 2021, mainly driven by the large increase in the Bitcoin price that rose from less than 10,000 EUR in January 2020 to about 45,000 EUR in early May 2021. But, during the second half of May, the total market capitalization plummeted again to 1.4 trillion EUR (as of May 27, 2021).

3 Use of cryptocurrencies

There is no straightforward way of identifying and quantifying the use of cryptocurrencies given their nature. For instance, Corbet et al. (2019, p. 197) state that the evaluation of cryptocurrencies based on their use, rather than just their financial performance is one of the gaps in literature. The importance of each type of use remains an empirical question, which, however, is difficult to answer. This section discusses the potential use types of cryptocurrencies.

The natural use of cryptocurrencies is as means of payment. Cryptocurrencies are becoming more accepted as a form of payment amongst retailers (examples: cheapair.com, Microsoft store or Virgin Galactic). However, Jonker (2018) conducted a survey among online retailers in the Netherlands (sample size = 768) on the potential use cryptocurrencies as means of payment. The study argues that the most serious barrier for crypto appeared to be the lack of consumer demand. One of the largest barriers for cryptocurrencies to become widely accepted as means of payment, is its high price volatility. Baur and Dimpfl (2021) show that volatility of Bitcoin prices is about 10 times higher than the volatility of major exchange rates. They conclude that Bitcoin could not function as a medium of exchange. Nevertheless, El Salvador

announced in June 2021 to accept Bitcoin as a legal tender from September 2021.⁷ This suggests that cryptocurrencies could become an alternative to fiat money, in particular for countries with an unstable currency.

Most cryptocurrency holders, however, see cryptocurrencies as a form of investment. Corbet et al. (2019) argue that cryptocurrencies continue to develop both, as a product and a traded-market. An analysis based on the record of past bitcoin transactions by Chainalysis argues that about 60% of all bitcoins are held for investment purposes, i.e. by entities who never sold more than 25% of the bitcoins they have ever received.⁸

Another use of cryptocurrencies concerns illicit activities. Cryptocurrencies allow for peer-to-peer transactions, eliminating the need for a bank or other intermediaries to facilitate financial transactions and therefore, removing de facto any tracing by tax authorities, which is particularly attractive for money laundering (Albrecht et al., 2019; Houben and Snyers, 2018). Grauer and Updegrave (2021) illustrate money laundering based on cryptocurrencies. Their report describes in detail how organized crime carries out money laundering using cryptocurrencies, illustrated by several case studies.

Furthermore, cyber criminality uses cryptocurrencies for their activities. In particular, as means of payment they are linked to different types of crimes: “facilitating marketplaces for: assassins; attacks on businesses; child exploitation (including pornography); corporate espionage; counterfeit currencies; drugs; fake IDs and passports; high yield investment schemes; sexual exploitation; stolen credit cards and credit card numbers; and weapons”. When the FBI shut down Silk Road, an online black market for selling drugs (operating February 2011 – October 2013), it estimated that Silk Road accounted for about 5% of the total Bitcoin economy (Corbet et al., 2019). However, according to Chainalysis, about 0.34% of all cryptocurrency transactions was associated with illicit activity in 2020, an amount likely to be smaller to amount of illicit funds in traditional finance (Grauer and Updegrave, 2021). Fur-

⁷<https://www.asamblea.gob.sv/node/11282>, accessed on July 15, 2021.

⁸<https://blog.chainalysis.com/reports/bitcoin-market-data-exchanges-trading>, accessed on January 14, 2021.

ther, public authorities are increasingly capable of recovering ransom payments from cyberattacks. As a result, public cryptocurrencies that allow for effective tracing of funds, such as Bitcoin, are likely to lose attractiveness for ransom payments. For instance, the US Department of Justice has seized about 64 bitcoins in June 2021, allegedly representing a large share of ransom payments to a group of cybercriminals, called DarkSide, who attacked the Colonia Pipeline infrastructure (US Department of Justice, 2021).

Finally, cryptocurrencies might also be used as tax haven. Marian (2013) argues that cryptocurrencies offer two most important characteristics of tax haven: No tax jurisdiction in which they operate and (pseudo-)anonymity and; transactions are peer-to-peer. To what extent cryptocurrencies as used as tax haven of course remains an unanswered and challenging empirical question. Demirhan (2019) suggests using the blockchain technology, underlying cryptocurrencies, to actually improve tax collecting since it offers transparent and secure transactions and provides immediate access to real time information.

4 Who owns cryptocurrencies?

This section aims to shed some light on the characteristics of cryptocurrency users. From a tax perspective, it is particularly important to know who owns cryptocurrencies if related capital gains are taxable. In the following, I address this issue separately by different data sources that might provide insights.

4.1 Blockchain data

Open or public blockchains, such as Bitcoin, provide a record of all past transactions in a transparent way (Nascimento et al., 2019). As a result, each transaction on the blockchain is public and audible. Table 1 illustrates the distribution of addresses by sizes classes in May 2021.

The distribution of bitcoins by addresses exhibits an extreme concentration: Accordingly more than 95% of all bitcoins are controlled by the top 3% of addresses.

Table 1: Bitcoin distribution (May 2021)

Balance (BTC)	Addresses	in %	cum. %	BTC coins	in %	cum. %
(0 - 0.001)	19,598,865	51.60%	51.60%	4,051	0.02%	0.02%
[0.001 - 0.01)	9,404,856	24.76%	76.36%	35,995	0.19%	0.21%
[0.01 - 0.1)	5,769,332	15.19%	91.55%	186,593	1.00%	1.21%
[0.1 - 1)	2,398,981	6.32%	97.86%	751,992	4.02%	5.23%
[1 - 10)	665,742	1.75%	99.61%	1,697,589	9.08%	14.31%
[10 - 100)	130,581	0.34%	99.96%	4,250,164	22.72%	37.03%
[100 - 1,000)	13,968	0.04%	99.99%	3,941,799	21.07%	58.10%
[1,000 - 10,000)	2,079	0.01%	>99.99%	5,111,918	27.33%	85.43%
[10,000 - 100,000)	84	<0.01%	>99.99%	2,224,514	11.89%	97.32%
[100,000 - 1,000,000)	3	<0.01%	100.00%	501,390	2.68%	100.00%
Total	37,984,491	100.00%		18,706,005	100.00%	

Source: <https://bitinfocharts.com/top-100-richest-bitcoin-addresses.html>; accessed on 13/05/2021.

While the distribution of addresses is informative in itself, it does not allow drawing meaningful conclusions regarding the distribution of bitcoins at the entity level (individuals or firms), since service providers, such as Binance or Coinbase, typically own and control a large share of addresses to manage the funds of their customers. Due to the nature of cryptocurrencies, we do not know the actual owners of addresses, unless they are made public. We usually refer to pseudo-anonymity in the context of cryptocurrencies since there are several approaches to identify users behind addresses.⁹ Actually, Bitcoin users can be identified by observing their transactions over time and analysing patterns (Monaco, 2015; Fujiwara and Islam, 2021). Juhász et al. (2019) identify IP addresses of users, which can be linked to geographical locations. Their probabilistic approach exploits the time duration between messages sent to the network and received by participating computers. In combination with publicly announced transactions, they can identify IP addresses of the entities making transactions in the period under analysis.

While the blockchain is a rich data source, however, it is impossible to capture off-chain transactions, since they are not reported on the blockchain, but instead settled ‘off-chain’. This includes transactions of users who have accounts at the same

⁹Firms providing blockchain analysis, like Chainalysis or Elliptic, often not only rely on the public record of transactions, but cooperate also with law enforcement authorities to identify wallets with illicit funds. E.g., Chainalysis collaborates with the U.S. Department of Justice or Europol, which improves their capabilities of detecting illicit funds.

payment service provider. All transfers of payment service providers in their internal computer system are aggregated and the blockchain is only used as a settlement mechanism for netting outstanding transfers. This in turn reduces also the number of transactions that need to be recorded on the blockchain. (Rauchs et al., 2018, section 2).

4.2 Official tax statistics

To date, official statistics on the total cryptocurrency (or crypto asset) users or taxpayers, holding cryptocurrencies, is scant. In fact, the US Internal Revenue Service (IRS) was recently seeking information on US citizen who own cryptocurrencies via so-called ‘John Doe Summonses’. A John Doe Summon is an investigative tool that allows the IRS to gather information about unnamed taxpayer from a third party. In a concrete case, the IRS filed several John Doe Summonses requesting information about US citizen who conducted transactions of cryptocurrencies between 2016 and 2020, where the total annual value exceeded 20,000 USD (Ferreira et al., 2021).

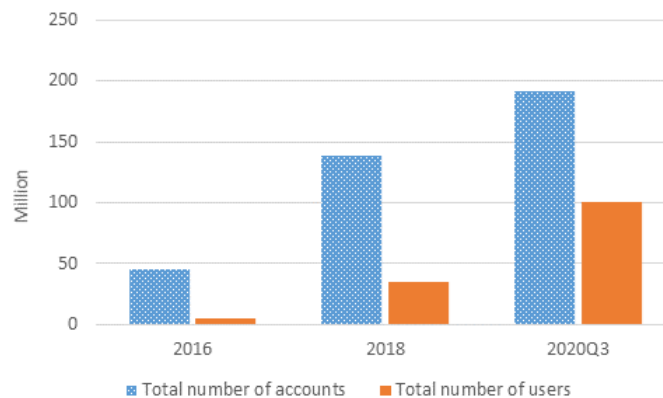
Moreover, the extent to which national tax auditors can request data on transactions, involving cryptocurrencies, from national service providers determines the quality of the tax data. For instance, if a national tax authority has no legal right to request transaction-by-transaction data from national exchanges, it cannot crosscheck declared capital gains from cryptocurrencies by their taxpayers, owning an account in national exchanges. Furthermore, individuals can have multiple accounts in different exchanges, located in different tax jurisdictions. In absence of a coordinated and automated exchange of information on cryptocurrency-related capital gains among countries, it is rather difficult for a single tax authority assessing if the taxable capital gains from owning cryptocurrencies are correctly reported by a taxpayer. Further, for EU citizen there is - at least - anecdotal evidence that they often do not only have accounts at national service providers, but also at the large foreign competitors.

4.3 Other sources

Given the nature of cryptocurrencies, there is sparse information on cryptocurrency users. Early surveys among cryptocurrency users suffer from selectivity or small samples (see, for instance, Polaski et al. (2015) or Jonker (2018)), questioning to what extent their findings are representative.

Furthermore, crypto users may use the underlying blockchain payment systems without having an account with a service provider, which until recently did not require users to prove thoroughly their identity (Rauchs et al., 2018). In addition, inferring the number of crypto-asset users from the number of registered accounts at service providers is challenging because an individual can hold multiple accounts. Blandin et al. (2020) estimate that the number of ID-verified accounts has increased from 5 million in 2016 to 101 million in 2020 (Q3), which is argued to be a lower bound estimate (Figure 2).

Figure 2: Increase in crypto asset users between 2016 and 2020



Source: Blandin et al. (2020).

Note: The estimates are lower bounds.

Rauchs et al. (2018) investigate if crypto users are private individuals, businesses or undefined. According to survey data, collected from service providers, users are overwhelmingly individuals, for example hobbyists, consumers or retail investors. Among service providers that operate in multiple segments (exchange, storage and

payment), about 78% of all users are individuals, while only 16% are business clients. Among specialized service providers, operating in a single segment, the share of clients being individuals always remains highest.

A study on behalf of Binance Research (2021), offers insights based on a large-scale online survey among more than 60,000 crypto users across 178 countries and regions. It finds that crypto users are predominantly male (95%) and typically rather young (average is 34 years). About half do not consider crypto investing as a hobby, but as a means of income (15% primary source of income, 36% additional source of income). Among the reasons to buy crypto-assets, most people (55%) report to own crypto assets as part of a long-term investment strategy (Binance Research, 2021).

Finally, there seems to be a growing interest among institutional investors for crypto assets. A study among American and European institutional investors by Fidelity Digital Assets, finds that more than a third of investors have already invested in crypto assets (Blandin et al., 2020). Further, in May 2021, the Goldman Sachs Group, one of the leading players in investment banking, analysed the potential of Bitcoin as a new asset class (Nathan et al., 2021). This first report takes a rather positive stance towards cryptocurrencies. Nevertheless, in June 2021 the investment bank published another report that appears to be more sceptical towards cryptocurrencies (Mossavar-Rahmani et al., 2021). It concludes that "cryptocurrencies [were] not a viable investment for [their] clients' diversified portfolios".

5 Distribution of capital gains and tax simulation

This section sheds light on the actual distribution of capital gains from Bitcoin across EU countries and its tax revenue potential. In general, capital gains accrue when the price of a cryptocurrency exceeds the price at the time of purchase. When an investor sells her coins, she realizes the gain, which then amounts to the difference between the selling price and the purchase price. Because of the decentralized and cryptographic nature of cryptocurrencies, the empirical evidence on the distribution of capital gains is scant. Yet, to ensure an adequate taxation, it is essential to know how capital gains from Bitcoin (and other cryptocurrencies) are distributed across

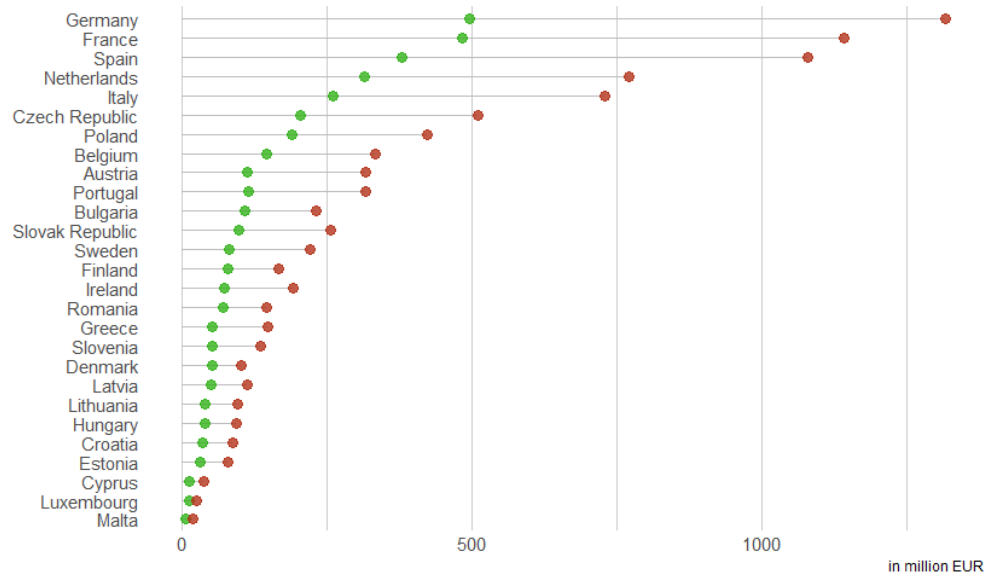
countries.

5.1 Distribution of capital gains from Bitcoin in the EU

Using the only existing estimate there is, this section analyses the distribution of capital gains from Bitcoin across EU Member States in 2020. In particular, I rely on estimates of realized and unrealized capital gains, shared by Chainalysis. All transactions, being recorded on the blockchain, are distributed to countries according to web traffic data to each platform’s website. To refine this country breakdown, Chainalysis further relies on time zone analysis of a platforms’ cryptocurrency activity, the most popular fiat currency pairs, the website language options, and the headquarters locations. Since this approach has several limitations, for example the use of Virtual Private Networks (VPNs) to hide the real location of crypto users, the blockchain analytics company performed several crosschecks to validate the results (Chainalysis, 2020). Ideally one would calculate realized (unrealized) capital gains from Bitcoin as the difference between the selling price (current price) and the purchase price, separately for each individual investor. However, since currently not even tax authorities have access to comprehensive data on the crypto activities of taxpayer in their own jurisdiction (see section 4.2), the corresponding capital gains need to be estimated. Chainalysis approximates both buying and selling prices to derive capital gains based on the available blockchain data. While their approach allows estimating aggregate capital gains in 2020 across EU countries, it is not possible to directly infer the underlying distribution of crypto users.

Figure 5 shows total estimated capital gains from Bitcoin, both realized and unrealized, across EU countries in 2020, ranked by realized capital gains. In 2020, total realized capital gains by EU citizen amount to 3.6 billion EUR and the total unrealized capital gains are 9.1 billion EUR. In terms of total realized capital gains from Bitcoin in 2020, Germany ranks highest (500 million EUR), followed by France (480 million EUR) and Spain (380 million EUR). Figure 4 puts the Bitcoin capital gains of each country into perspective by relating them to GDP, ranked by the share of realized gains. Central and Eastern European (CEE) countries rank highest, Bulgar-

Figure 3: Estimated capital gains from Bitcoin in 2020 across EU countries, realized (green) and unrealized (red)



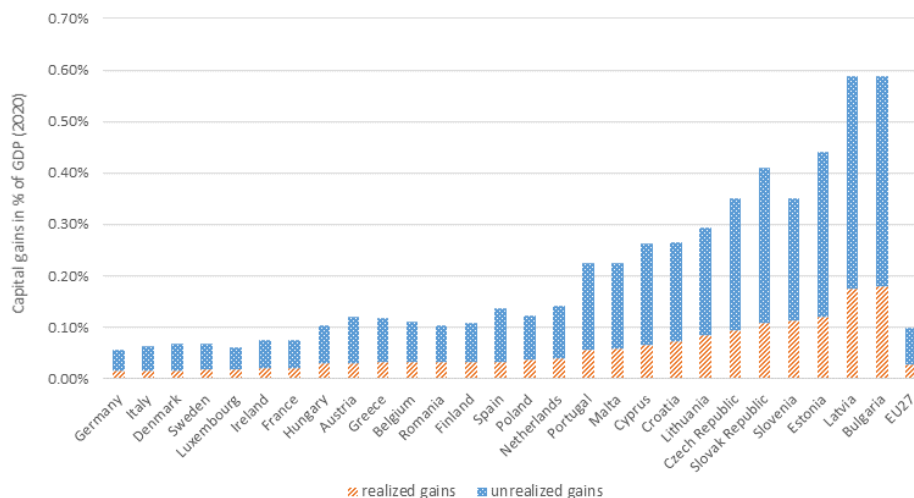
Source: Own calculations based on the data, shared by Chainalysis.

Note: Flows are attributed to individual countries relying on country-based web traffic statistics, time-zone analysis of platforms' cryptocurrency activity, most popular fiat currency pairs, and additional information (see Chainalysis, 2020); exchange rate as of May, 25, 2021 (1 EUR = 1.2212 USD).

ian and Latvia being at the top (0.6% of GDP). At the other end of the distribution, Germany ranks lowest (below 0.1% of GDP) in contrast to its leading position in absolute terms. In fact, the largest EU economies are located at the lower end of the Bitcoin capital gains distribution in 2020 relative to GDP. CEE countries seem to benefit from a larger fraction of early crypto adoptors, which might explain their strong relative position.

A sizeable fraction of capital gains has not been realized yet (as of 2020). The realization share, i.e. realized capital gains divided by total gains, ranges between 24% in Spain and 32% in Slovenia. These findings suggest that investors could realize a sizable amount of capital gains in the coming years. Of course, predicting future

Figure 4: Estimated capital gains from Bitcoin in 2020 in the EU (in % of GDP)



Source: Own calculations based on the data, shared by Chainalysis.

Bitcoin capital gains depends on the unit price of a bitcoin, which remains highly volatile.

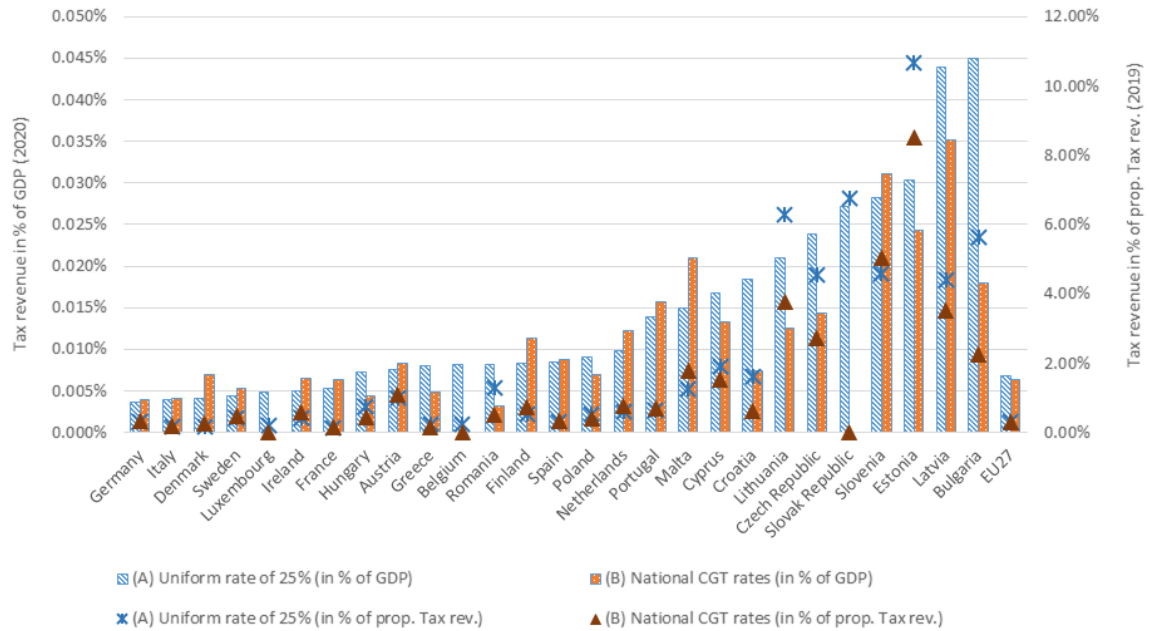
5.2 Capital gains tax simulations

To assess the revenue potential of taxing realized capital gains from Bitcoin in 2020, I simulate two different scenarios: The first scenario (A) applies a uniform tax rate of 25% on realized capital gains from Bitcoin across all Member States of the EU. In contrast, the second scenario (B) replicates the tax rules Member States apply to realized capital gains from shares that are held at least for one year, which implies that some countries grant a complete exemption (see Table A1). Both scenarios do not consider any personal tax exemption nor tax credit, which might be applied actually in scenario (B). Hence, the tax simulation is equivalent to employing a single tax rate to aggregate realized capital gains. Whenever capital gains are subject to different personal income tax (PIT) rates, I apply the top marginal rate (in Malta and Spain). Note that scenario (B) not necessarily reflects the actual tax treatment

of capital gains from Bitcoin. First, it does not take into account tax exemptions nor tax-credits. Second, the realization of capital gains from Bitcoin does not necessarily trigger a taxable event in all countries (OECD, 2020). Nevertheless, scenario (B) provides a reasonable estimate of the revenue potential if countries apply their tax treatment from shares-related capital gains to the Bitcoin context.

Estimation uncertainty, in both scenarios, arises naturally from the data on capital gains from Bitcoin, which is an estimation itself. Further, I do assume full tax compliance, which currently cannot be enforced since tax authorities still lack comprehensive data on total crypto activities of their taxpayer. Considering all assumptions together, the simulated potential tax revenue is likely to be an upper bound.

Figure 5: Simulated revenue from Bitcoin capital gains taxation (CGT) in the EU in 2020 (lhs: in % of GDP; rhs: in % of property tax revenue)



Source: Own calculations based on the data, shared by Chainalysis.

Figure 5 illustrates the simulated revenue from the Bitcoin capital gains taxation (CGT) across countries and scenarios, relative to GDP (left vertical axis) and as

percentage of total property tax revenue (right vertical axis).¹⁰ The ranking of the EU countries according to the simulated tax revenue under scenario (A) is identical to their ranking by realized capital gains as in Figure 4 (both relative to GDP). Hence, particularly CEE countries benefit from tax scenario (A) as they accumulate more realized capital gains, relative to GDP. However, when applying national CGT rates in scenario (B), the pattern is less clear. Latvia benefits most, applying a 20% rate on capital gains, while there are several countries that apply a zero rate (Luxembourg, Belgium and the Slovak Republic). Total revenue in the EU amounts to 904 million EUR or to 0.0068% of GDP under scenario (A) and to 843 million EUR or 0.0063% of GDP according to scenario (B).

To provide a more intuitive interpretation, the right vertical axis of Figure 5 expresses total Bitcoin CGT revenue in terms of total revenue from property taxes. Under scenario (A) total Bitcoin CGT revenue in the EU amounts to 0.31% of total property tax revenue of 2019¹¹ and under scenario (B) to 0.29%. However, this ratio varies a lot across countries. When applying a uniform rate of 25% in scenario (A), CGT revenue relative to the one from property taxes ranges between 0.12% in France and 10.7% in Estonia. Under scenario (B), it ranges between 0.14% in France and 8.5% in Estonia, among Member States that impose CGT. These findings suggest that taxing capital gains from Bitcoin can yield a notable share of total tax revenue from property taxation.

6 Conclusion

The creation of Bitcoin in 2009 established the new cryptocurrencies market, which has grown enormously since. The already large and growing body of empirical literature on cryptocurrencies has mainly used time-series data on Bitcoin and other cryptocurrencies due to the lack of more dis-aggregated data. This paper is largely

¹⁰Table A2 provides the detailed results. Property tax revenue is total revenue from recurrent taxes on immovable property and other property taxes, for instance taxes on wealth transfers or on net wealth (see DG TAXUD, 2021, p. 270).

¹¹To deal with the different reference years - 2019 and 2020 -, I compare revenue from Bitcoin CGT to tax revenue from property taxes, both in terms of GDP of the corresponding years.

motivated by the gap of empirical knowledge on the tax implications of cryptocurrencies. We know very little on who really owns cryptocurrencies, their capital gains and how they are distributed. Based on the only available empirical evidence, shared by Chainalysis, I analyze the distribution of capital gains from Bitcoin in 2020 across the EU. Total gains amount to 12.7 billion EUR in 2020, including 3.6 billion EUR of realized gains. These findings have to be seen in light of the limitations: Since capital gains are estimated, naturally they face estimation uncertainty. Further, the tax modelling assumes full tax compliance, which currently cannot be enforced, as tax authorities lack comprehensive data on crypto activity of their taxpayer. Considering all limitations together, they should be seen as an upper bound.

Future research should focus more on the existing country experience from taxing cryptocurrencies. The effort by the US Internal Revenue Service (IRS) is likely to lead to more comprehensive data on crypto activity of US taxpayers, which could provide a source for further research. Data collection on crypto activity could be improved by implementing a separate section on income from crypto assets in tax declarations.

The simulated revenue potential of taxing capital gains from Bitcoin in 2020 amounts to about 840 to 900 million EUR, which corresponds to about 0.3% of total tax revenue from property taxation in the EU. The future economic importance of cryptocurrencies is uncertain, however, should the market of cryptocurrencies grow further, so will capital gains. Particularly, the decision by the Parliament of El Salvador to adopt Bitcoin as a legal tender as of September 2021 is an interesting experiment, which might increase demand for Bitcoin and propagate the use of cryptocurrencies not only as an investment asset, but also as means of payment.

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Appendix

Table A1: Capital gains taxation scenarios

	A) Uniform TR	B) National capital gains taxation TR	Comments
Austria	25%	28%	Separate taxation of capital income.
Belgium	25%	0%	Not taxable, unless being professional income.
Bulgaria	25%	10%	Subject to PIT.
Croatia	25%	10%	12% before 1 January 2021.
Cyprus	25%	20%	-
Czech Republic	25%	15%	Subject to PIT.
Denmark	25%	42%	27% up to the amount of DKK 56,500 (in 2021) and at 42% on any excess.
Estonia	25%	20%	Subject to PIT.
Finland	25%	34%	34% on excess above 30,000 EUR; 30% below.
France	25%	30%	12.8% tax and 17.2% Social assistance.
Germany	25%	26%	Separate capital income taxation, including solidarity surcharge.
Greece	25%	15%	-
Hungary	25%	15%	-
Ireland	25%	33%	-
Italy	25%	26%	Separate taxation of capital income.
Latvia	25%	20%	-
Lithuania	25%	15%	-
Luxembourg	25%	0%	No tax applies to the sale of shares held for more than 6 months.
Malta	25%	35%	Subject to PIT (max. rate = 35%; above 60,000 EUR).
Netherlands	25%	31%	I assume a 31% tax rate, which is the maximum tax rate on the deemed return from capital.
Poland	25%	19%	-
Portugal	25%	28%	-
Romania	25%	10%	-
Slovak Republic	25%	0%	Exempt from capital gains tax if they were held for more than one year.
Slovenia	25%	28%	If shares held for 20+ years, capital gains are exempt.
Spain	25%	26%	Rates vary between 19% and 26% (<i>Base imponible de ahorro</i>).
Sweden	25%	30%	-

Notes: PIT refers to personal income tax. TR refers to the tax rate. Note that in these scenarios the tax rate equals the average tax rate.

Both capital gains tax scenarios disregard any basic exemption, which might lower the tax base. The national capital gains taxation scenario (B) is based on the tax rates that are applied to realized gains from the disposal of shares, being held for at least one year. Any specific exemption is disregarded.

Source: IBFD Tax Research Platform (accessed on July 2, 2021).

Table A2: Simulated revenue from Bitcoin capital gains taxation (2020)

Country	Realized gains in mio EUR	Tax revenue by capital gains tax scenario					
		(A) Uniform rate (25%)			(B) National CGT rates		
		in mio EUR	in % of GDP	in % of property tax rev.	in mio EUR	in % of GDP	in % of property tax rev.
Germany	497	124.3	0.004 %	0.316 %	131.1	0.004 %	0.333 %
Italy	261	65.2	0.004 %	0.167 %	67.8	0.004 %	0.173 %
Denmark	52	13.0	0.004 %	0.163 %	21.8	0.007 %	0.275 %
Sweden	83	20.7	0.004 %	0.406 %	24.9	0.005 %	0.487 %
Luxembourg	12	3.1	0.005 %	0.202 %	0.0	0.000 %	0.000 %
Ireland	73	18.3	0.005 %	0.441 %	24.1	0.007 %	0.582 %
France	484	120.9	0.005 %	0.116 %	145.1	0.006 %	0.140 %
Hungary	40	9.9	0.007 %	0.741 %	5.9	0.004 %	0.445 %
Austria	115	28.7	0.008 %	0.986 %	31.5	0.008 %	1.085 %
Greece	53	13.3	0.008 %	0.239 %	8.0	0.005 %	0.143 %
Belgium	147	36.7	0.008 %	0.231 %	0.0	0.000 %	0.000 %
Romania	71	17.8	0.008 %	1.306 %	7.1	0.003 %	0.522 %
Finland	80	19.9	0.008 %	0.538 %	27.1	0.011 %	0.732 %
Spain	379	94.8	0.008 %	0.329 %	98.6	0.009 %	0.342 %
Poland	190	47.5	0.009 %	0.540 %	36.1	0.007 %	0.410 %
Netherlands	316	79.0	0.010 %	0.617 %	97.9	0.012 %	0.765 %
Portugal	113	28.3	0.014 %	0.634 %	31.7	0.016 %	0.711 %
Malta	8	1.9	0.015 %	1.259 %	2.7	0.021 %	1.763 %
Cyprus	14	3.5	0.017 %	1.892 %	2.8	0.013 %	1.514 %
Croatia	36	9.1	0.018 %	1.600 %	3.6	0.007 %	0.640 %
Lithuania	41	10.3	0.021 %	6.283 %	6.2	0.013 %	3.770 %
Czech Republic	206	51.4	0.024 %	4.556 %	30.8	0.014 %	2.733 %
Slovak Republic	100	24.9	0.027 %	6.756 %	0.0	0.000 %	0.000 %
Slovenia	52	13.1	0.028 %	4.577 %	14.4	0.031 %	5.035 %
Estonia	33	8.2	0.030 %	10.656 %	6.6	0.024 %	8.525 %
Latvia	51	12.9	0.044 %	4.417 %	10.3	0.035 %	3.533 %
Bulgaria	109	27.2	0.045 %	5.646 %	10.9	0.018 %	2.259 %
EU27	3,615	903.7	0.007 %	0.310 %	847.0	0.006 %	0.290 %

Notes: CGT abbreviates Capital Gains Tax. Scenario (A) applies a uniform rate (25%), while scenario (B) applies the CGT rates being applied to capital gains from shares (see Table A1). Property tax revenue based on DG TAXUD (2021). It includes revenue from recurrent taxes on immovable property and other property taxes, for instance on wealth transfers or on net wealth. GDP based on EUROSTAT (nama_10_gdp), accessed on July 5, 2021.

Source: Own calculation, based on the capital gains estimates by Chainalysis.

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