Less Cash, Same Shadow?
Payment Trends and Informality in the European Union

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Abstract

In the context of accelerating digitalisation, the transition from cash to electronic payments is often perceived as an effective means of reducing the shadow economy. This study analyses the evolution of payment behaviour in the European Union as a whole between 2018 and 2022 and its relationship with two key indicators of tax compliance, the shadow economy and the VAT Gap. Based on data provided by the European Central Bank, the European Commission and the European Parliament, payment indicators are calculated and correlations are analysed. The results confirm a close link between the growth of digital payments and the reduction of the VAT Gap, but do not indicate a proportional decrease in the shadow economy. The study contributes to the literature by providing an integrated analysis at the level of the European Union as a whole and reinforcing the hypothesis that digitalisation is necessary but not sufficient to combat economic informality. Furthermore, possible adverse behavioural reactions to imposed digitalisation, which may contribute to the persistence of the shadow economy, are discussed.

Key words: digital payments, shadow economy, cash usage, VAT Gap, fiscal compliance
J.E.L. classification: E26, H26, O17, O33

1. Introduction

In recent decades, the digitalization of national economies has profoundly redefined the way in which individuals and companies conduct transactions. In particular in the European Union, the accelerated transition to electronic payments, through debit or credit cards, e-money and mobile applications, has been actively supported. This happened with the help of public policies, technological transformations and behavioural changes, generated by recent crises, such as the COVID-19 pandemic. In parallel, cash remains a relevant payment instrument, especially among vulnerable categories or in sectors of the shadow economy. The relationship between the structure of payments and the size of the shadow economy thus raises important economic and fiscal questions. To what extent does reducing the use of cash lead to a decrease in economic informality? Can the digitalization of payments be an effective tool to combat tax evasion or are complementary interventions needed?

This article investigates these issues through a quantitative analysis applied to the European Union. The main objective is to assess the link between citizens' payment behaviour and tax compliance indicators, such as the shadow economy and the VAT Gap. Starting from the specialized literature and using official data from the period 2018-2022, the study proposes a critical interpretation of the real influence of digitalization on economic informality. At the same time, it provides arguments for the formulation of more nuanced public policies.

Despite the increased attention paid to the relationship between the digitalization of payments and the shadow economy, little research provides a comparative quantitative analysis applied exclusively to the European Union in the post-pandemic period. The present study fills this gap by using harmonized official data and simultaneously analysing payment behaviour and tax compliance.

2. Literature review

Cash is often seen in public discourse and recent literature as a key enabler of tax evasion and a symbol of the shadow economy. This view has driven policies promoting digital payments and restricting cash use. However, such measures are sometimes seen as overly controlling, causing public resistance and slowing the adoption of digital tools. Despite tighter regulations, tax evasion and informal economic activity persist, highlighting the need for more flexible strategies (Aivaz et al., 2024a, p. 3; Munteanu et al., 2024, p. 4). Corruption, including bribery and influence peddling, adds further complexity (Florea & Aivaz, 2022b, p. 329). As digitalization accelerates, the debate over cash versus digital payments intensifies. While digital options expand, cash remains a staple for some. In the Netherlands, 7% of citizens use cash exclusively, and 28% say they cannot give it up, citing cost control and security (van der Cruijsen & Reijerink, 2023, pp. 2–6). However, its use also fosters hidden economic activities.

The shadow economy includes all economic activities that contribute to GDP but are deliberately hidden, to avoid taxes and regulations (Reimers et al., 2020, p. 8). While cash enables such activity due to its untraceability, eliminating it wouldn't end informality, as other untraceable methods may emerge (Reimers et al., 2020, p. 18). Seitz et al. (2020) empirically investigated the relationship between cash in circulation and the shadow economy in euro area countries. The authors concluded that only medium-value banknotes (50 and 100 euros) are significantly and positively correlated with the shadow economy and only in smaller economies. For high-value banknotes, the effect is insignificant or negative. For small ones, there is no clear relationship (Seitz et al., 2020, p. 17).

To measure tax evasion, as part of the phenomenon of the shadow economy, the VAT gap (the difference between the theoretical and the actual VAT collected) is frequently used, reflecting losses from tax non-compliance (Bohne et al., 2023, p. 2). The study done by Bohne et al. (2023, p. 14) shows that a 1 p.p. increase in e-money as a percentage of GDP reduces the VAT gap by 1.4 p.p. During the pandemic, a 5.5% increase in digital payments led to an 11.9% reduction in evasion. In addition, an 8% decrease in cash use was associated with a 31% reduction in the VAT gap (Bohne et al., 2023, p. 17). However, digitalization does not automatically guarantee a reduction in the shadow economy. In Poland, although electronic payments have increased significantly, the shadow economy has continued to grow after 2020, influenced by the COVID-19 crisis, the war in Ukraine and fiscal instability (Kowal-Pawul and Lichota, 2024, p. 138). The authors emphasize that digitalization is a necessary but not sufficient condition if it is not supported by institutional trust and coherent policies (Kowal-Pawul and Lichota, 2024, pp. 133, 139).

In South Asia, Syed et al. (2021, pp. 9–10) show that a 1% increase in mobile transactions and ATMs reduces the informal economy by 0.092% and 0.081%, respectively. As highlighted by Ahmad et al. (2024, p. 121), regional dynamics such as digital infrastructure maturity and levels of financial inclusion significantly influence the effectiveness of digital tools in improving tax revenue. In India, although electronic payments have increased, cash remains dominant due to precautionary reasons and limited access in rural areas (Panda and Priya, 2024, pp. 2080–2087). In the same context, Lawrence and Anand (2025, pp. 2–6) highlight that cultural resistance and perceived barriers can slow the adoption of new technologies. At the same time, among young people, the adoption of mobile payments is strongly influenced by factors such as perceived usefulness, social pressure, infrastructure and trust in digital services. A study conducted on a sample of young Indonesians shows that trust and perceived ease are decisive factors in the intention to use mobile payments (Nur and Panggabean, 2021, pp. 22–23).

Globally, Birigozzi et al. (2025, pp. 1, 6) show that a 1 p.p. increase in the adoption of digital payments can accelerate the GDP growth rate by 6–8%, through transparency and efficiency. In Yemen, weak digital infrastructure reduced the positive impact of these tools, despite existing adoption intentions (Alduais and Al-Smadi, 2022, pp. 8–10). In Pakistan, digital payments reduced the cash conversion cycle and increased spending frequency (Rehman et al., 2025, p. 134). In Hungary, lack of financial awareness slows down the transition to digital payments (Pintér et al., 2022, pp. 2–13), and in Jordan, electronic payments indirectly contribute to reducing informality by decreasing uncertainty (Alkhwaldi et al., 2023, pp. 19–20). In Indonesia, the use of digital subsidies can support transparency, but success depends on digital infrastructure and education (Wibowo and Hariadi, 2025, pp. 68–85). In conclusion, digital payments can help reduce the shadow economy, but

only as part of a broader effort that includes clear fiscal policies, a strong digital infrastructure, and increased trust in institutions.

Although the literature extensively analyses the relationship between payment digitization and the shadow economy in various regions of the world, there are few studies that address this link from a comparative and quantitative perspective, applied exclusively to the European Union as a whole, based on recent official data on the structure of transactions. The present study fills this gap through an integrated analysis that simultaneously tracks the evolution of payment behaviour and its impact on tax compliance indicators in the post-pandemic European context.

3. Research methodology

The study uses a descriptive-analytical approach to investigate the link between the digitalization of payments, the use of cash and the evolution of the shadow economy in the European Union. Given the article's aim to provide a synthetic EU-wide overview in the post-pandemic context, the time frame 2018 - 2022 is considered appropriate for highlighting key behavioural trends. The analysis is based on official data provided by the European Central Bank (for transaction volumes and values), the European Parliament (for estimates of the informal economy) and the European Commission (for reporting on the VAT Gap). Data processing and calculations were performed in Microsoft Excel.

Relevant indicators of payment behaviour were constructed, such as the share of cash in total transactions (Cash Share), the share of POS transactions (POS Share) and e-money transactions (E-money Share), as well as the average value per transaction for each type of payment instrument. In parallel, the evolution of the shadow economy and the VAT Gap were monitored to assess possible links between the digital transition and the level of tax compliance. Correlations between variables were measured using the Pearson coefficient, to identify positive or negative association patterns.

The Cash Share, POS Share and E-money Share weights were calculated individually, as ratios between the share of the total number of cash withdrawals (ATM and Over the Counter), the share of POS payments and the share of E-money payments and the total transactions made through all payment methods analysed (cash + POS + e-money). The Cash Share indicator is used as a proxy for *cash dependence* at the aggregate level and allows a coherent comparison with the dynamics of other forms of payment in the economy.

4. Findings

The empirical analysis highlights the contrast between the rapid development of digital payments in the European Union and the persistence of the shadow economy over the same period. Although the use of cash has decreased significantly and electronic instruments have become increasingly common, indicators of economic informality and the VAT collection gap do not reflect a proportional reduction. The results detail these trends and provide an integrated interpretation of the phenomenon. The first table (Table no. 1) highlights the gradual transition of payment behaviour in the European Union over the period 2018–2022.

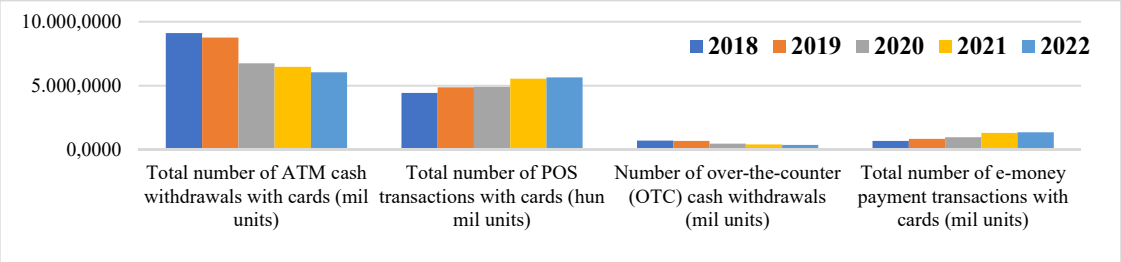
Table no. 1 EU number of Transactions by Payment Method (2018–2022)

EU (27)	Total Number of ATM cash withdrawals with cards (mil units)	Total Number of POS transactions with cards (hundred mil units)	Total Number of OTC cash withdrawals (mil units)	Total number of e-money payment transactions with cards (mil units)
2018	9,110.9700	4,426.3218	715.6790	669.7780
2019	8,755.5380	4,877.4829	679.5090	839.8000
2020	6,742.5910	4,911.8667	465.3590	971.5490
2021	6,481.7040	5,544.8538	405.0580	1,313.4930
2022	6,042.3540	5,649.0150	364.0350	1,362.3730

Source: Data from the European Central Bank (ECB), available at https://data.ecb.europa.eu

A steady decline in cash withdrawals from ATMs and over-the-counter (OTC) is observed, in parallel with a significant increase in the number of transactions made with cards at POS and those made through electronic money (e-money). These developments indicate a clear shift towards the digitalization of payments, which seems to have accelerated especially in the post-pandemic period.

Figure no. 1 Evolution of the number of Transactions by Payment Method in the EU (2018–2022)



Source: Data from the European Central Bank (ECB), available at https://data.ecb.europa.eu

The first chart (Figure no. 1) shows a clear shift in EU payment behaviour. From 2018 to 2022, ATM withdrawals fell by a third and counter withdrawals halved, indicating reduced cash use. Meanwhile, POS card transactions rose sharply, and e-money payments doubled, reflecting growing preference for digital methods, accelerated by the pandemic.

This evolution suggests a structural transformation in consumer preferences, increasingly favouring speed, convenience, and traceability. However, the fact that cash does not completely disappear from the transactional landscape indicates its residual function. A function possibly linked to high-value or less fiscally visible payments. Thus, the digitalization of the payment system reflects an important technological advance, but it remains to be seen to what extent this change actually contributes to reducing the shadow economy.

Table no. 2 Share of Cash, POS, and E-money in Total Transactions, Shadow Economy and VAT Gap (EU, 2018–2022)

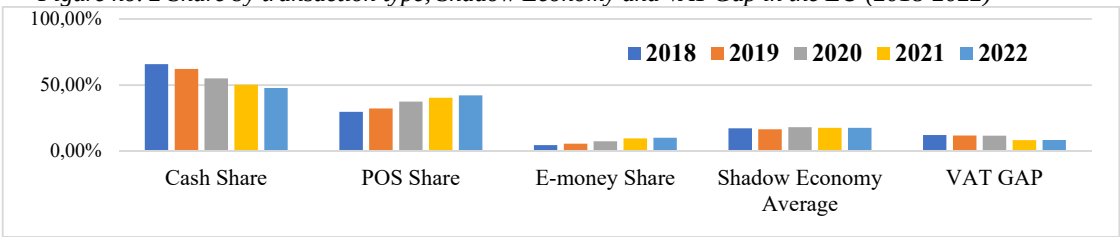
EU (27)	Cash Share	POS Share	E-money Share	Shadow Economy	VAT GAP
2018	65.85%	29.66%	4.49%	17.22%	12.13%
2019	62.27%	32.19%	5.54%	16.52%	11.79%
2020	55.06%	37.52%	7.42%	18.13%	11.53%
2021	50.10%	40.34%	9.56%	17.68%	8.29%
2022	47.75%	42.10%	10.15%	17.64%	8.35%

Source: Own calculations based on European Central Bank data; European Parliament; European Commission VAT Gap Report

The second table (Table no. 2) provides a synthetic picture of the evolution of the payment structure in the European Union and its relationship with two key indicators of tax compliance, the shadow economy and the VAT Gap. A constant decrease in the share of cash in total transactions is observed, from 65.85% in 2018 to 47.75% in 2022, in parallel with a visible increase in POS payments (from 29.66% to 42.10%) and e-money payments (from 4.49% to over 10%).

This change confirms the trends in the previous graph and supports the idea that digital payments are gaining ground at an accelerated pace. However, the size of the shadow economy remains relatively stable, with values between 16.5% and 18% of GDP, while the VAT Gap records a clearer improvement, decreasing from 12.13% in 2018 to 8.35% in 2022. These data suggest that digitalization indeed contributes to better VAT collection, but is not sufficient, in itself, to reduce the shadow economy in the European Union, which seems to be influenced by deeper factors such as trust in institutions, the state's control capacity and tax culture.

Figure no. 2 Share by transaction type, Shadow Economy and VAT Gap in the EU (2018-2022)



Source: Own calculations based on European Parliament; European Commission VAT Gap Report; European Central Bank

The second chart (Figure no. 2) summarizes the evolution of the shares of different payment methods in total transactions, along with the size of the shadow economy and the VAT collection gap over the period 2018–2022. A clear trend of replacing cash with digital payments is noticeable. The share of cash decreases by over 18 percentage points, while POS and e-money transactions are steadily gaining ground. In contrast, the shadow economy remains practically unchanged, despite digital progress, which suggests that economic informality is less influenced by means of payment and more by structural factors. The only indicator that responds sensitively to the increase in digitalization is the VAT Gap, which registers a visible decrease. This suggests that electronic payments clearly contribute to more efficient VAT collection, but are not a universal remedy for combating the shadow economy.

Table no. 3. Correlation Between Payment Method Shares, Shadow Economy, and VAT Gap

Correlation Pair	Cash Share vs Shadow Economy	POS Share vs Shadow Economy	E-money Share vs Shadow Economy	Cash Share vs VAT Gap	POS Share vs VAT Gap	E-money Share vs VAT Gap
Results	-0.6205	0.6393	0.5764	0.9052	-0.8869	-0.9393

Source: Own computations via Excel and ECB, European Parliament, and European Commission data

The third table (Table no. 3) provides an important statistical insight into the relationship between payment behaviour and indicators of tax evasion and economic informality in the European Union. While the correlations observed are based on a limited time frame, they are sufficiently robust to suggest relevant patterns in support of the article's exploratory objective.

First, we observe a very strong positive correlation between Cash Share and VAT Gap ($r = 0.9052$). This means that as cash use decreases, the VAT collection gap tends to decrease. This result supports the idea that the digitalization of payments has a real and measurable impact on tax efficiency, as electronic transactions are easier to track, report and control by tax authorities. Additionally, both POS Share ($r = -0.8869$) and E-money Share ($r = -0.9393$) show strong negative correlations with the VAT Gap, confirming that where digital payment methods are more widely used, more VAT is collected and with fewer losses.

In contrast, the relationship between the payment structure and the shadow economy is much more nuanced and even counterintuitive. For example, POS Share has a moderate positive correlation with the shadow economy ($r = 0.6393$). The correlation between shadow economy and E-money Share ($r = 0.5764$) shows a similar trend. This may suggest that the digitalization of payments is not a direct antidote to economic informality, as the shadow economy includes a much broader range of activities (undeclared employment, unbilled services, unreported income, etc.), which are not necessarily related to the payment method. A possible complementary explanation could be the rejection reaction from certain segments of the population, who perceive the forced transition to digital payments as a form of excessive control. In such cases, imposed digitalization without real social acceptance may cause a *retaliation* effect. In this case, taxpayers deliberately choose to avoid formal systems and take refuge in the shadow economy, thereby increasing participation in untraceable activities. Thus, despite the fact that people pay more by card, a significant part of economic activity may remain undeclared.

Moreover, the negative correlation between Cash Share and Shadow Economy (r = -0.6205) seems paradoxical at first glance. It would seem that, in the observed years, the decrease in cash use coincided with a slight increase in the shadow economy (e.g. 2020, pandemic context). This is where the importance of the institutional and socio-economic context comes in. In the absence of an efficient system of tax inspection, transparency, trust in authorities and real sanctioning, even the most advanced digital tools can be used for informal purposes.

Therefore, the conclusion that emerges is a balanced but profound one. Digitalization clearly contributes to reducing tax losses through VAT, but it does not guarantee the reduction of the shadow economy in the absence of coherent policies, a strong institutional framework and a high degree of voluntary compliance among taxpayers. This underlines the need to view the informal economy as a systemic phenomenon, not just as a cash issue.

Table no. 4 Total Value of Transactions by Type (EUR million, EU, 2018–2022)

EU (27)	Total value of ATM cash withdrawals with cards (mil Eur)	Total value of POS transactions with cards (mil Eur)	Value of over-the-counter (OTC) cash withdrawals (mil)	Total value of e-money payment transactions with cards (mil Eur)
2018	1,339,815.9780	1,630,589.0660	703,829.2230	25,134.1030
2019	1,340,277.7220	1,703,940.2010	732,819.1370	29,706.3320
2020	1,176,878.6990	1,695,390.9180	565,798.4920	35,452.9480
2021	1,195,893.2590	1,853,234.1620	533,624.3000	47,520.7710
2022	1,150,475.7430	1,975,354.8110	545,832.0830	40,899.8970

Source: European Central Bank, https://data.ecb.europa.eu

The fourth table (Table no. 4) completes the overall picture of payment behaviour in the EU, highlighting the evolution of the total value of transactions by type of instrument between 2018 and 2022. While the value of cash withdrawals (ATM and OTC) decreased moderately over the period, the value of POS payments increased steadily, exceeding EUR 1,975 billion in 2022. E-money payments, although still relatively small in total volume, experienced the most dynamic percentage growth, almost doubling the value from 2018. This evolution suggests that, although cash remains important in absolute terms, digital payments are also gaining ground in terms of the economic value transacted, not just frequency, thus consolidating their role in the formal economy.

Table no. 5 Average Value per Transaction by type of transaction (EUR, EU, 2018–2022)

EU(27)	Average Value Transaction ATM Withdrawal	Average Value Transaction POS	Average Value Transaction OTC Withdrawal	Average Value Transaction E-Money
2018	147,0553	368,3847	983,4426	37,5260
2019	153,0777	349,3483	1.078,4539	35,3731
2020	174,5440	345,1622	1.215,8323	36,4912
2021	184,5029	334,2260	1.317,4022	36,1789
2022	190,4019	349,6813	1.499,3945	30,0211

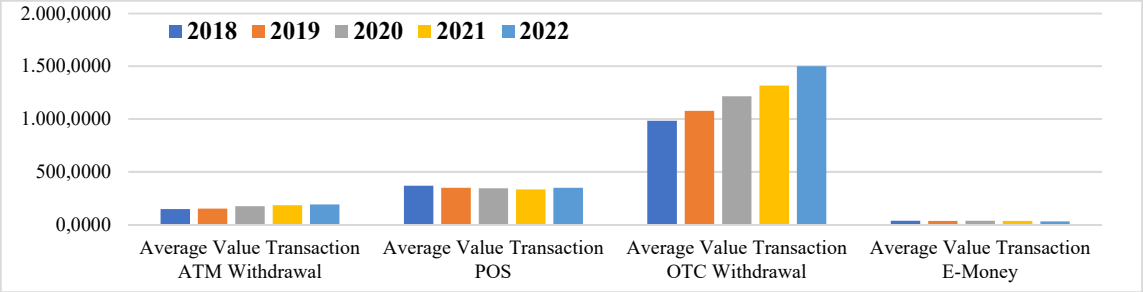
Source: Own calculations based on European Central Bank

The fifth table (Table no. 5) provides a revealing perspective on the evolution of the average value per transaction for the main payment methods in the EU. A consistent increase in the average value of cash withdrawals is observed, both at ATMs (from EUR 147 to EUR 190) and, especially, at counters (OTC), where an increase of over 50% was recorded, reaching almost EUR 1.500/transaction in 2022. In contrast, the average value of POS transactions remains relatively stable, and that of e-money payments even decreases slightly. This fact confirms the character of these instruments as preferred for fast, low-value payments, such as online services, transport or immediate consumption.

This variation in average transaction values suggests that each payment method serves distinct purposes, with cash retaining relevance in higher-value transactions. Thus, it is not the frequency of cash use that is relevant, but rather the context and value of the payments in which it is involved. In

a scenario where cash is used mainly for large and occasional transactions, suspicions of circumvention of official reporting systems may arise. This dynamic suggests that tax policies should target the typology of cash transactions rather than banning the means of payment per se.

Figure no. 3 Average Value per Cash Withdrawal vs. POS and E-money Payments (2018–2022)



Source: Own calculations based on European Central Bank

These trends (Figure no. 3) suggest that cash is being used less for everyday expenses and more for large-value payments, possibly outside the formal tax circuit. Therefore, the policy of reducing the use of cash needs to be nuanced. In this context, the problem is not necessarily the existence of cash in the economy or the number of cash transactions, but its use outside transparent channels. Fiscal policies aiming to eliminate cash entirely, risk unfairly penalizing citizens who are not involved in informal activities. All while sophisticated forms of evasion, operating with large amounts, could persist in the absence of effective institutional supervision.

5. Conclusions

The data analysed confirms an undeniable reality. The European Union is in an accelerated process of transition to digital payments. The use of cash is constantly decreasing, both in frequency and as a proportion of total transactions, while cards and electronic payments are becoming the norm. This transformation is visible in all the graphs and tables presented and reflects an increasingly modern economic behaviour, influenced by digitalization and convenience, with the help of public policies.

However, this *digital revolution* does not automatically translate into a significant reduction in the shadow economy. Although the VAT gap has clearly narrowed, indicating greater efficiency in tracking and taxing official transactions, the size of the shadow economy has remained virtually unchanged. Thus, the study shows that digitalization helps to collect taxes more efficiently, but does not eliminate the root causes of evasion and informality, such as undeclared work, institutionalized fraud or lack of trust in authorities. Digitalization must be accompanied not only by infrastructure, but also by effective public communication and measures that increase voluntary acceptance. Otherwise, it risks generating adverse reactions and informal behaviours as a form of resistance. This behavioural dimension, often ignored in tax policies, could pe part of the explanation to why, despite digital progress, the shadow economy does not decrease proportionally. Additionally, the COVID-19 pandemic created new vulnerabilities, as shown by the increase in economic crimes at the European level, requiring coordinated institutional responses (Florea & Aivaz, 2022c, p. 4). Thus, institutional pressure to eliminate cash, if not accompanied by social legitimacy, can fuel a downward spiral of distrust and tax avoidance. Moreover, the increase in the average value of cash transactions, especially those withdrawn over the counter, indicates a selective use of cash for large amounts, which could be associated with informal activities that are difficult to detect through simple automation of payment systems. Thus, the problem is not necessarily cash itself, but the context in which it is used.

The main conclusion of this article is therefore that the digitalisation of payments clearly contributes to reducing tax losses, but it is not a complete solution to combat the shadow economy. Sustainable tax compliance requires integrated policies, adapted to the institutional context of each country. These should also include investments in human capital, as education and professional development are key to fostering ethical behaviour and institutional engagement (Aivaz et al., 2024b,

p. 13). To truly combat the shadow economy, public policies should not focus exclusively on limiting the use of cash, but rather pursue strategic directions capable of discouraging systemic evasive behaviour. Instead of targeting the average citizen who uses cash for everyday needs, interventions should be calibrated to identify and control high-value, opaque transactions, often carried out outside the tax circuit. This requires strengthening administrative capacity, improving audit and reporting systems, and the selective application of smart tax policies, targeting areas with high risk of evasion, as illustrated by DGAF's structured approach to combating tax fraud through targeted audits and risk-based inspections in Romania (Aivaz et al., 2022c, p. 346; Florea & Aivaz, 2022a, p. 329; Aivaz et al., 2023, p. 944). Combating the shadow economy is ultimately a matter of governance, not just technology.

Therefore, the study achieved its objective of assessing the link between payment behaviour and tax compliance indicators in the European Union, providing an integrated analysis at the aggregate level and contributing to the nuanced understanding of the relationship between digitalization and economic informality. The results are in line with those presented by Bohne et al. (2023) and Syed et al. (2021), which confirm the positive impact of electronic payments on reducing the VAT Gap. At the same time, they support the conclusions of Reimers et al. (2020) on the complexity of the relationship between cash and the shadow economy. In contrast, the data partially contradict the hypothesis of a simple negative correlation between digitalization and informality, supported by Birigozzi et al. (2025), suggesting that the effects are much more dependent on the institutional context, as also indicated by the analysis carried out by Kowal-Pawul and Lichota (2024). Thus, the study contributes to the scientific literature by highlighting the limits of uniform policies and emphasizes the need for differentiated and sustainable interventions.

Although the European Union operates through a common framework of policies and regulations to which all Member States must adhere, it should not be ignored that each country remains, in essence, an autonomous entity, with its own economic particularities, successes and vulnerabilities. Thus, the overall picture of the Union is an average of these distinct national realities. Common policies often have to be calibrated according to the structural and institutional diversity of each Member State. Member States are positioned differently across the entire development spectrum, from those with high-performing systems aligned with European standards, to those in urgent need of reforms to improve efficiency and institutional coherence. To ensure coherent development across the European Union, comprehensive public policies should foster the growth of less developed states, supported by the more advanced ones (without impeding their own progress), within a solidarity-based framework that delivers for everybody mutual benefits. For future research, a disjunct analysis of Member States according to digital infrastructure and fiscal culture is recommended. This can help to identify more clearly the conditions under which the digitalisation of payments produces visible effects on the shadow economy. Also, the integration of indicators on institutional trust would help refine the explanations for the persistence of informality in certain regions of the Union.

In conclusion, while the transition to digital payments clearly enhances VAT collection efficiency across the EU, the persistence of the shadow economy underlines the need for multi-dimensional strategies, ones that extend beyond technology to address institutional trust, behavioural incentives, and structural vulnerabilities. This study offers a concise yet meaningful contribution to understanding the boundaries of digitalisation's impact on informality and highlights the importance of tailored, context-aware public policy design.

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