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Penetration of Digital Payments in Greece after Capital Controls: Determinants and Impact on VAT Revenues

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Abstract

The use of payment cards in Greece more than tripled in value between 2014 and 2017. Their penetration lifted off with the imposition of capital controls in 2015 and then remained on an uptrend, aided further by the measures of law 4446/2016. According to the findings of the study: (i) the law had a statistically significant, positive impact on card usage, especially in the second half of 2017, controlling for the effects of macroeconomic factors and capital controls and (ii) the penetration of electronic payments had a significant positive impact on tax compliance. Nevertheless, the average level of card use in Greece has remained lower than the EU average, while it presents significant heterogeneity across sectors and geographical areas. In conclusion, more targeted measures are warranted in order to enhance further the penetration of electronic payments, which would yield even greater fiscal benefits. (JEL codes: G28, H26, H27).

Key words: tax revenues, digital payments, tax evasion, government policy and regulation

1. Introduction

Greece is a revealing case study of the fiscal effects that a rapid expansion of digital payments might have in a predominantly cash economy. Cash has traditionally prevailed as a means of payment in Greece. According to data collected with payment diary surveys in late 2015 and early 2016, the share of cash in the total value of transactions at point of sale

in the country stood at 75% (Esselink and Hernandez 2017). Greece topped the Eurozone ranking in terms of this indicator, while in terms of the share of cash in total number of transactions, Greece came joint second in the Euro area with Cyprus (88%), behind Malta (92%).

In this cash-dominated environment, following a bank run in the early summer of 2015, the Greek authorities imposed capital controls to prevent a collapse of the banking system on June 28, including cash withdrawal caps. Despite the relatively quick relaxation of the restrictions on cash withdrawals, the use of cards and other electronic payments continued their rapid growth that was triggered with the imposition of capital controls. Between June 2015 and December 2017, the number of transactions with payment cards increased 6-fold, while their transaction value more than tripled. In order to prevent a weakening of their momentum and recognizing their potential fiscal benefit, the Hellenic Parliament legislated a series of measures (Law no. 4446/2016) aimed at promoting the use of digital payments, as an indirect measure of strengthening tax compliance and public revenues. The measures are being implemented gradually, albeit with some delays. Assessing their impact is helpful to identify any scope for improvements and potentially boost tax collection, for example, by targeting digital payment incentives to sectors or regions with greater potential of reducing undeclared activity.

In this context, this article contributes to answering two related research questions. Did the measures legislated to promote digital payments have an impact on the number and value of such transactions, after controlling for the effects of macroeconomic factors and capital controls? Did the growth of digital payments have an impact on VAT revenues, after controlling for changes in tax policy and other macroeconomic factors?

In relation to the first question, we find that the law had a statistically significant, positive impact on card usage, especially in the second half of 2017, after controlling for macroeconomic factors and capital controls. Nevertheless, the average level of card use in Greece has remained lower than the EU average, while it presents significant heterogeneity across sectors and geographical areas. In relation to the second question, we find that the penetration of electronic payments had a significant positive impact on tax compliance. The results suggest that at least one in every nine new digital transactions (or one in every seven euros in new digital transaction value) observed in Greece during 2015–2017 correspond to economic transactions that used to be undeclared previously. In conclusion, more targeted measures are warranted in order to enhance further the penetration of electronic payments, which would yield even greater fiscal benefits.

In the remaining three parts of the introductory section, we provide some background on the Greek capital controls and present in more detail the adopted legislative measures and related current findings from the literature. In Section 2, we present data on digital payments and their trends over the past few years. Section 3 examines the impact of the policy measures on digital payments, while the impact of digital payments on tax revenues is investigated in Section 4. The article concludes with a discussion of the policy implications that stem from the analysis.

1.1 Withdrawal restrictions' imposition in Greece

In response to a bank run, the Greek authorities imposed capital controls to prevent a collapse of the banking system on 28 June 2015. The measures included restrictions on cash

withdrawal and on outgoing cross-border transfers. The bank branches (with few exceptions, catering to special categories of bank customers and transactions, such as paying pensions to retirees) were closed for the public for a 3-week period. The aim of the measures was to halt the deposit flight from the domestic banking system as a whole, thus no restrictions were imposed on digital payments within Greece.

The very restrictive environment for cash transactions did not last long. A process of gradual relaxation of the cash withdrawal restrictions began immediately after the end of the 3-week bank holiday. The cash withdrawal limit per bank account was increased from €60 per day to €420 per week in July 2015, €840 per fortnight in July 2016, €1800 per month in September 2017, €2300 per month in March 2018, and €5000 per month in May 2018. The restrictions on cash withdrawals were lifted from 1 October 2018, while the remaining controls on the transfer of funds abroad were removed from 1 September 2019.

1.2 Legislative measures to promote digital payments in Greece

The measures to promote digital payments, adopted with Law no. 4446/2016, included both disincentives for the use of cash and incentives for the use of payment cards and other digital payment instruments. The measures were directed at consumers (demand side), businesses (supply side), and the public administration.

On the demand side, the main change was the introduction of a tax break linked to the use of digital payments. Essentially, the obligation to collect payment receipts, in force until 2014, was replaced with the obligation to make digital payments. A minimum threshold of expenditure through digital payments, growing progressively with annual taxable income, was introduced (10% for annual income up to €10,000, 15% for annual income of €10,000–€30,000, and 20% for income exceeding €30,000), with a limit at €30,000. In case that a taxpayer's expenditure with digital payments falls short of the threshold, a penalty of 22% is levied on the shortfall amount. The implementation of the measure began from fiscal year 2017.

In addition, a lottery was introduced in late 2017. Card payments generate lots that automatically enter monthly draws. Every month, 1000 lots earn €1000 each. The programme was launched in late November 2017 for the October card payments, while lotteries for transactions undertaken in the previous months of 2017 were conducted *en bloc* in late December of the same year.

On the supply side, the most important measure was the introduction of mandatory acceptance of digital payments, to be implemented gradually across all sectors within 3 years (that is, until the end of 2019). Acceptance of payment cards became mandatory for 85 professions and subsectors (including certain retail stores, bars and restaurants, car rental, pharmacies, lawyers, doctors, and architects) in late July 2017. Additional 58 merchant categories (construction works, additional retail store categories, transportation, real estate, sports facilities, repairs, dry cleaners, and other services) were included in the second phase of the measure from 11 March 2018.

Additional administrative measures were also introduced. The limit on transactions with cash was lowered from €1500 to €500. The law also envisaged the establishment of bank and payment account registries. Another very important measure was the interconnection of cash tills with the IT system of the tax authorities. The gradual implementation

of a plan for electronic invoicing, which will enable the tax authorities to digitally monitor the business-to-business transactions as well, is an equally important measure of the law.

1.3 Previous research

There is extensive international literature that studies the determinants of VAT revenue. In this context, the present study uses as a reference the results of a World Bank empirical study in 34 countries (Bogetic and Hassan 1993), which highlights three main drivers of VAT revenue: tax base, tax rates, and the dispersion of tax rates. According to the study, the VAT revenues are positively affected by an expanding tax base and higher tax rates, and negatively affected by wider dispersion between high and low VAT rates for different categories of goods and services. Slemrod (2016) provides a global overview of recent findings in relation to tax compliance and enforcement, while Pomeranz (2015) highlights the effects of paper trail on VAT compliance.

Empirical studies have analysed the links between electronic payments and tax compliance. Immordino and Russo (2018) find European evidence of a negative relationship between VAT evasion and the use of card payments. Slemrod et al. (2017) focus on US sole-proprietorships and find that sales with electronic payments significantly increase reported income. Madzharova (2018) examines explicitly the potential impact of card transactions on VAT collection efficiency, using EU country-level data over the period 2001–2010.

In the case of Greece, recent studies have highlighted additional factors that affect VAT revenues. For example, there are indications that the reduction of the VAT rate for food services in 2013 positively influenced tax compliance, so much so that it almost completely offset the revenue loss from the lower rate (Artavanis 2018). In addition, the economic cycle and the degree of tax evasion also seem to influence the effectiveness of VAT revenue collection (Tagkalakis 2014). From a theoretical perspective, Petroulakis et al. (2017) argue that shocks similar to the one induced by capital controls in Greece shift part of informal consumption to the formal sector.

The boost of card use in Greece under capital controls cannot be explained by macroeconomic factors alone. After a cumulative decline of real GDP by about 26% from 2008 to 2013, the Greek economy entered a period of stagnation until 2017, when the quarterly GDP growth rate strengthened to consistently positive rates. The unemployment rate soared to a peak of 27.7% in mid-2013, falling since then by about 1.5–2.0 percentage points per year. Evidently, other unobservable factors, such as network effects and habit formation, also played a role in sustaining the strong growth rates of card use (IOBE 2015).

Two recent studies examined the relationship between digital payments and VAT revenue in Greece. In the first year of capital controls, the National Bank of Greece estimated that the spread of digital payments had a positive impact on GDP growth, with a potential to generate additional fiscal revenue of €1.5 billion between 2015 and 2020 (National Bank of Greece 2016). Correspondingly, a Bank of Greece study, covering the period from 2002 to the first year of capital controls, concluded that a one-point increase in the value of payment card transactions as a percentage of private consumption leads to approximately 1% increase in VAT revenue due to better tax compliance (Hondroyiannis and Papaoikonomou 2017). The study also showed that reductions in tax rates might occasionally raise VAT revenues. Among the variables affecting VAT revenues, the study stressed the role of the composition of consumption, such as the share of durable goods in total consumption.

2. Data and Descriptive Analysis

2.1 Data sources

The analysis on the use of payment cards, e-banking, and m-banking draws on a unique dataset collected for this study by the Hellenic Bank Association (HBA) from the four major domestic banking institutions in Greece (Alpha Bank, Eurobank, National Bank of Greece, and Piraeus Bank), which account for more than 95% of the total Greek banking system assets. The dataset covers the period 2014–2017. It contains monthly figures on the total number and value of transactions carried out with payment cards issued in Greece by the four systemic banks. The data are available per payment card type (debit, credit, and prepaid cards). The data from some of the banks include a breakdown of card transactions by sector of economic activity and ZIP code.

The dataset also contains monthly figures on the total number of active users of e-banking and m-banking services. A user is considered 'active' if she has made at least one monetary transaction in a particular month.

For the analysis of the impact of digital payments on tax revenue, we use data on gross VAT revenues from the Independent Authority for Public Revenue (AADE). Finally, the data on macroeconomic controls, such as GDP and private consumption, was downloaded from the Eurostat database. The Appendix contains two tables presenting the variable definitions, sources, and some descriptive statistics.

2.2 Descriptive analysis

2.2.1 *Payment cards*

The imposition of capital controls in the summer of 2015 triggered an impressive spread of payment card usage. Since then, the number of transactions with payment cards has increased 6-fold, while the value of transactions has more than tripled (Figure 1). As a result, the average transaction value declined approximately by a third, from €67.4 in July 2015, to about €43.1 in December 2017, indicating a more widespread use of payment cards for lower value transactions.

The percentage growth rates peaked during the first year of capital controls, yet they continued to be quite high at a time when the macroeconomic figures, such as private consumption, were relatively flat. In particular, the annualized percentage change of the value of transactions soared from single-digit figures during the first half of 2015, to three-digit figures during the first year after the imposition of the capital controls (Figure 2). The percentage growth rate slowed in the second year after the imposition of the capital controls, yet it remained high, close to 45% in terms of value and 75% in terms of number of transactions.

In terms of absolute year-on-year (y/y) changes, the incremental use of digital payment instruments did not decline after 2015. Especially in the case of debit cards and the number of active m-banking users, the absolute y/y changes strengthened in 2017.

The increase in both the number and the value of transactions came mainly from debit cards (Figure 3). Between 2014 and 2017, the number of transactions with debit cards increased by a factor of 13, while the value of such transactions increased 9-fold. In contrast to the debit cards, the spread of credit cards over the same period was much weaker,

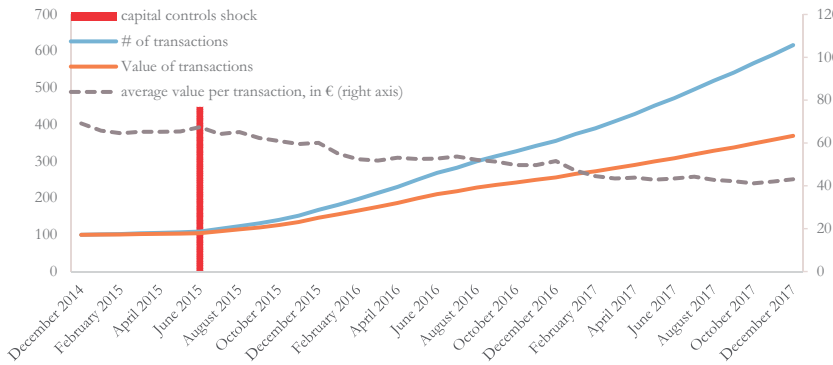

Figure 1. Use of payment cards in Greece, 12-month rolling index 2014 = 100.

Note: Prepaid cards are not included.

Sources: Member banks of HBA, Data Analysis: ΙΟΒΕ.

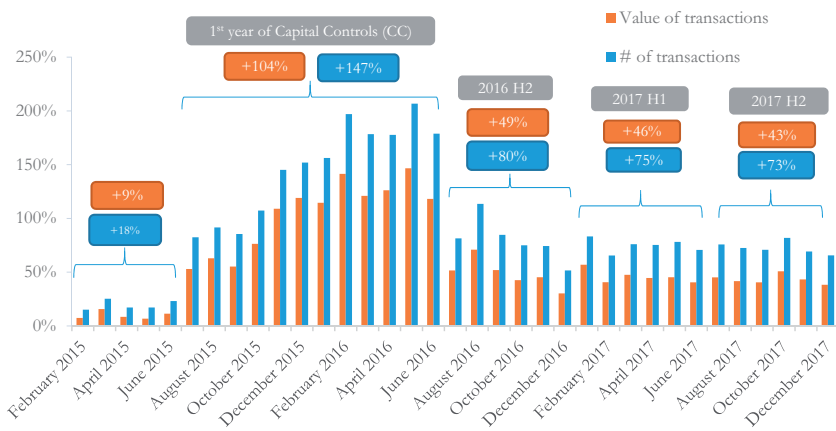

Figure 2. Use of payment cards in Greece, y/y percentage change.

Note: Prepaid cards are not included.

Sources: Member banks of HBA, Data Analysis: ΙΟΒΕ.

as the number of transactions increased cumulatively by 83%, while the value of transactions expanded by 38%.

The share in card use increased most notably in certain sectors with limited risk of tax evasion, such as betting shops, post offices, petrol stations, and supermarkets (Figure 4). Higher penetration of digital payments in particular transactions compared to others, translates into the respective sectors' share in total card use being higher than the same sectors' share in private consumption. Indicatively, fuel stations' share in total card use was twice as high as their share in private consumption in 2017.

In sectors with heightened risk of tax evasion, card transactions also increased but remained less frequent than what the share of these sectors in private consumption would suggest. Indicatively, in spite of some convergence achieved since 2014, the level of use of payment cards has remained low in food services and in free-lance professions, as the ratio

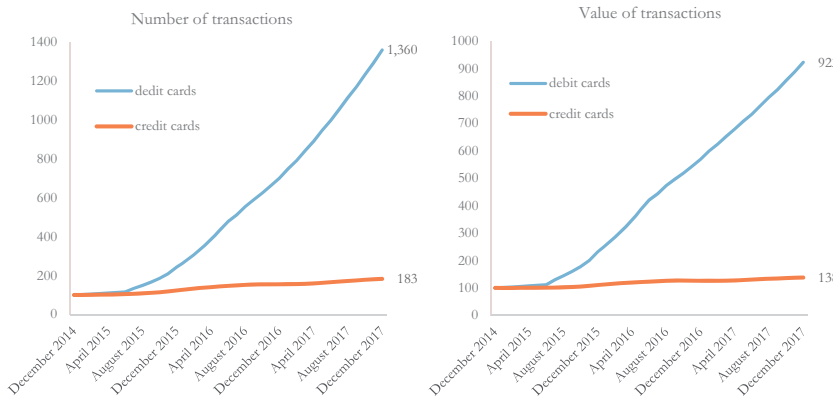

Figure 3. Number and value of transaction per card type, 12-month rolling index, 2014 = 100.

Note: Prepaid cards are not included.

Sources: Member banks of HBA, Data Analysis: ΙΟΒΕ.

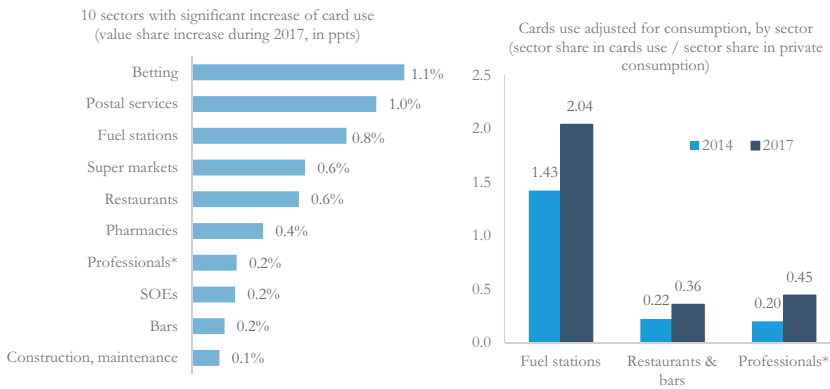

Figure 4. Card penetration in indicative sectors in Greece.

**Note:* 'Professionals' include doctors, lawyers, engineers, tax consultants, accountants, nurses, and psychologists. The sectoral analysis is based on data from two systemic banks.

Source: Member banks of HBA, Eurostat, Data Analysis: IOBE.

of their share in the total volume of card transactions over their share in private consumption were well below parity at 0.36 and 0.45, respectively, in 2017.

The geographical spread of the use of cards is similarly heterogeneous. The use of payment cards increased faster outside Greece's two major cities (Figure 5). In particular, the value of card transactions in the islands and in the continental regions outside Athens and Thessaloniki increased between 2014 and 2017 by a factor of 4.3 and 3.8, respectively, compared with 2.7 times in the two major urban areas. Nevertheless, the share of the two regions outside Athens and Thessaloniki in card use has remained low, compared to their share in GDP. In particular, the ratio of the share of the islands in card use over their share in GDP was far below parity, at 0.66 in 2017, with the corresponding indicator for 'Other continental Greece' standing slightly higher at 0.77.

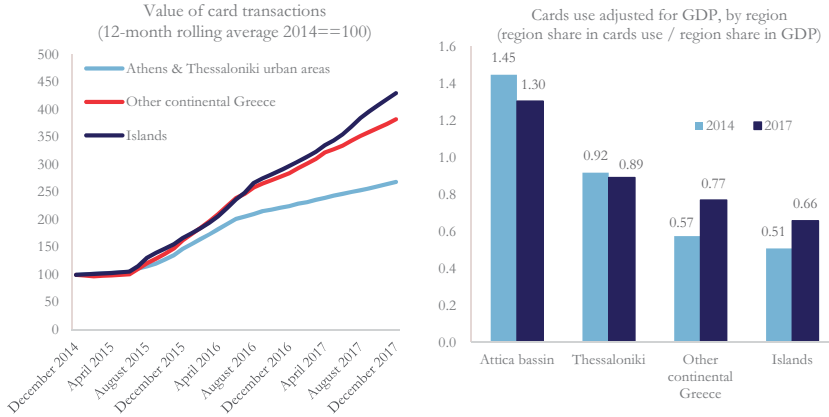

Figure 5. Card penetration in the major metropolitan centres, the islands, and rest of Greece.

Source: One member bank of the HBA, Elstat, Data Analysis: IOBE.

Despite the fast growth since the imposition of the capital controls, the use of payment cards in Greece has remained low compared to the EU average (Figure 6). The value of transactions with cards as percentage of private consumption in Greece increased dramatically, from 7.0% in 2015 to 17.4% in 2017. Nevertheless, despite Greece's convergence with the EU during this period, this indicator has remained lower by 9.9 and 18.3 percentage points than the average of the Euro area and the EU, respectively.

2.2.2 *E-banking and other electronic means of payment*

As in the case of payment cards, the use of other digital payment instruments and channels, such as e-banking, m-banking, and direct debits, also increased rapidly between 2014 and 2017. In particular, it seems that the number of active e-banking users grew cumulatively by a factor of 2.5 between 2014 and 2017, based on monthly data from the four major Greek banks (Figure 7). However, the growth rate in the second half of 2016 and in 2017 was slower than in the first year of capital controls.

2.2.3 *VAT rate and revenues*

Over the same period (2015–2017), the annual revenue from VAT rose by about two billion (almost 20%). Meanwhile, Law no. 4336/2015 introduced changes in VAT rates from 1 June 2016, including an increase of the standard rate from 23% to 24% and reduction of categories that fall under the reduced VAT rate. In addition, excise taxes increased in both 2016 and 2017, which boosted the indirect tax burden indicator.[1] For these reasons, the tax rate followed an upward trend since mid-2015. Over the same period, nominal private consumption and the tax base (defined as the sum of private consumption and public intermediate consumption) fell by more than €5 billion from the start of 2015 until the fourth quarter of 2016, yet they partially bounced back in 2017 (Figure 8). More information on the variable definitions, sources, and descriptive statistics are presented in the Appendix.

1 We construct a monthly indirect tax rate index, which is based on the difference between Eurostat's headline harmonised inflation index and its respective sub-index at constant sales taxes.

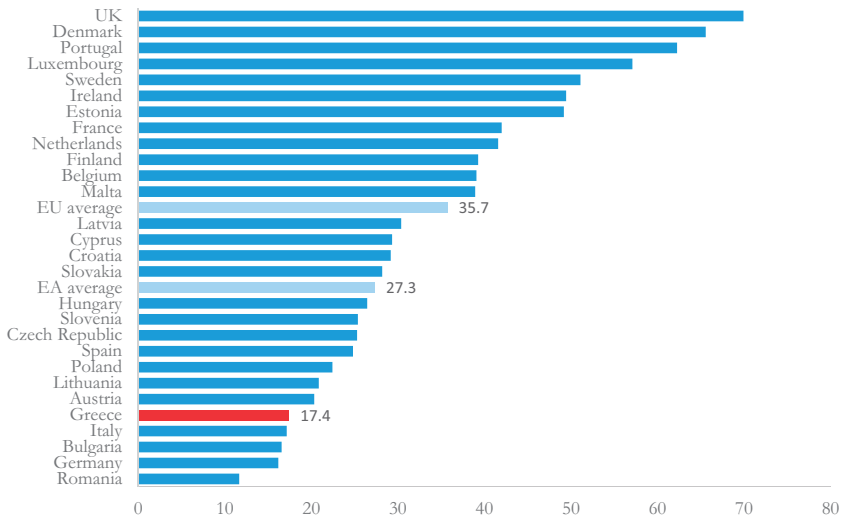

Figure 6. Value of card transactions across the EU, as percentage of private consumption, 2017.

Sources: ECB, Eurostat.

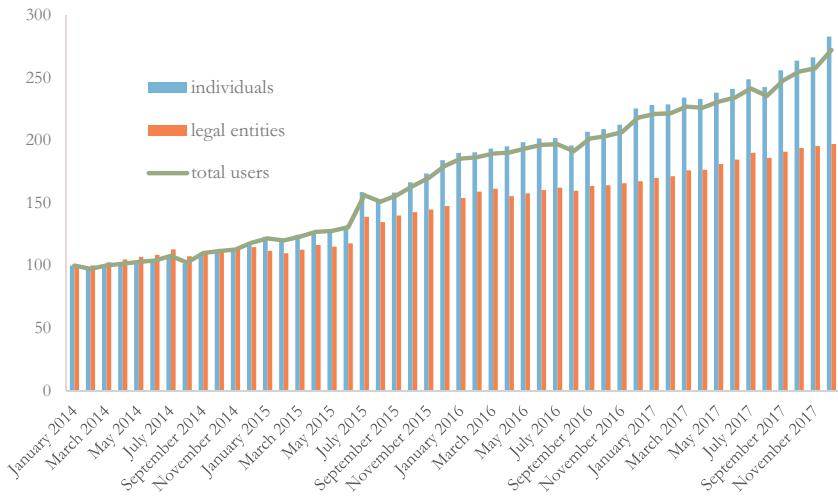

Figure 7. Number of active e-banking users, index 2014 January = 100.

Sources: Member banks of HBA, Data Analysis: ΙΟΒΕ.

3. Drivers of Digital Payments' Penetration

3.1 Model

Using econometric techniques, we examined the question whether the measures of law 4446/2016 had an impact on the use of electronic means of payment (EMP), controlling for the effects of the restrictions on cash withdrawals and macroeconomic trends. Three key

Figure 8. Evolution of VAT revenues and its macro-fiscal drivers, 2015–2017.

Note: Variable definitions are presented in the Appendix.

Sources: Independent Authority for Public Revenue, Eurostat, Data Analysis: ΙΟΒΕ.

factors had an impact on the evolution of digital payments in Greece between 2014 and 2017: (i) the imposition of restrictions on cash withdrawals at the end of June 2015, as part of the broader package of capital controls, aimed at stabilizing the banking system; (ii) the macroeconomic environment, which showed signs of stabilization during that period, after a deep and prolonged recession; and (iii) the regulatory measures introduced by law 4446/2016 with the aim of strengthening the use of EMP.

To quantify the impact of these factors, we estimated the following reduced-form econometric model:

$$\text{EMP use}_t = f(\text{EMP}_{t-1},\ \text{macro base}_t,\ \text{capital controls 1st year},\ \text{law implementation}).$$

We used as proxies for EMP use the growth rates of the value and number of card transactions and the number of active e-banking users. The macroeconomic base is proxied by nominal private consumption for the case of nominal card use and real GDP for the case of e-banking users.[2] For the impact of the capital controls during the first year of their

2 The number of active e-banking users (individuals and companies) would be more related to the overall level of economic development, for which real GDP is a broader and more adequate proxy,

implementation, we used a dummy variable, taking the value of one between July 2015 and June 2016. For the impact of the measures included in law 4446/2016, we used two dummy variables, corresponding to the first and second half of 2017. This choice of dummies is substantiated by the fact that the implementation of the mandatory acceptance of cards in certain sectors began in July 2017.

With the exception of the dummy variables, all other variables are expressed in terms of a rolling 12-month index, to correct for seasonality and other data irregularities.[3] The observations have a monthly frequency, with the exception of GDP and private consumption, which are available on a quarterly frequency. The quarterly data were converted into monthly time series through linear interpolation.

The estimation includes 36 monthly observations, from January 2015 to December 2017. ARIMA(1, 1, 0) model, with an autoregressive component and one lag of the dependent variable, was selected based on the Akaike and Hannan–Quinn information criteria. Stationarity tests were performed on the variables used in each estimation. Tests on the presence of multicollinearity and autocorrelation of the residuals were also carried out. The model was estimated with maximum-likelihood techniques (Berndt–Hall–Hall–Hausman algorithm).

The methodological approach followed here relies on time dummies, which implies that the corresponding coefficients might also pick up effects from unobserved concurrent developments (for example, changes in the intensity of tax audits, network effect). One possible remedy for this issue is to use data more directly linked to the implementation of the law, such as number of points of sale that have transitioned from cash-only operation to having card terminals. Unfortunately, such data are not presently available.

3.2 Results

The econometric analysis reveals that the legislative measures had a positive effect on EMP use, with a varying strength across EMP categories. In particular, the law had a positive and statistically significant effect on the use of cards, with a stronger impact in the second half of 2017, when the mandatory card acceptance measure came in force in certain sectors (Table 1).

The legislated measures had a statistically significant, positive effect for all card types, albeit weaker than that of the capital controls. In particular, the introduction of the capital controls is associated with a boost in the y/y growth rate of card transaction value by 6.9 percentage points, while the impact of the law measures is estimated at 2.2 percentage points and 3.0 percentage points for the first and second half of 2017, respectively. Both the legislative measures and the capital controls had a stronger effect on the use of debit rather than credit cards. In contrast to the cards, the law does not seem to have had a statistically significant effect on the number of active e-banking users. As for the macroeconomic

rather than private consumption per se. Results do not change substantially if we use private consumption as a control for e-banking use.

3 As a robustness check, we also ran the estimations using y/y changes rather than rolling 12-month indices. The estimated coefficients do not change substantially, yet there seems to be more noise left in the data. This may be due to data irregularities that go beyond seasonal effects, such as small businesses filing their VAT forms on a quarterly basis, while the VAT revenue data is made available on a monthly basis. The noise from such data irregularities seems to be addressed more effectively through rolling 12-month indices, rather than y/y changes.

Table 1. Estimation results on the determinants of EMP growth

	Total card payments		Debit cards		Credit cards		E-banking
	Value of transactions	Number of transactions	Value of transactions	Number of transactions	Value of transactions	Number of transactions	Number of active users
Law 4446, H1	0.02***	0.04***	0.04**	0.05**	−0.01	0.01**	−0.01
Law 4446, H2	0.03***	0.05***	0.05***	0.06***	0.01**	0.02***	0.01
CC first year	0.07***	0.09***	0.12***	0.13***	0.03***	0.04***	0.02***
Private consumption	4.42**	7.47***	2.68***	6.25***	4.76***	5.30***	
GDP							0.93*
Model	ARIMA(1, 1, 0)	ARIMA(1, 1, 0)	ARIMA(1, 1, 0)	ARIMA(1, 1, 0)	ARIMA(1, 1, 0)	ARIMA(1, 1, 0)	ARIMA(1, 1, 0)
Adjusted R^2 (%)	88.1	92.0	88.2	90.2	58.2	72.6	97.5
Observations	36	36	36	36	36	36	36

Note: The sample refers to the period 2014–2017. The statistical significance of the coefficients is denoted with ***, **, and * for significance at the 1%, 5%, and 10% level, respectively. The value of transactions is expressed in current prices. Private consumption is expressed in current prices in the regressions on value, in constant prices when estimating the number of transactions. GDP is expressed in constant prices. For all variables, with the exception of the time dummies, we use the difference of logarithms of their 12-month rolling value.

controls, the expansion in private consumption and GDP affect positively the use of EMP—one percentage change in nominal private consumption is associated with an increase in the value of card transactions by 4.4%, while a similar change in GDP is associated with an increase in the number of active users of e-banking by 0.9%.

The size of the coefficients show that the law boosted the value of card payments by about €3 billion on an annual basis until December 2017. The corresponding annualized impact on the number of transactions is estimated at 110 million.

As a robustness check, we ran the estimations for total cards and debit cards of Table 1 with the addition of an independent variable proxying for the degree of credit card penetration. The intuition was that due to tight credit conditions in the studied context, the increased use of credit cards reflects to a great extent the opportunity to use it in more places, hence can proxy for the network effect.[4] The additional variable has indeed a positive and significant effect on EMP penetration. The rest of the results do not change substantially other than slightly reducing the impact that can be attributed to the legislated incentives.

The reduction of the legislation's impact may stem from the fact that some of the legislated measures (for example, the obligatory installation of POS terminals) explicitly aim at expanding the card network. The effect of these measures are captured in the robustness check through the network proxy, rather than through the legislation indicators, as in the main results. Nevertheless, the coefficients on the legislation indicators under the new specification remain significant (albeit with lower degree of statistical significance in some cases), which indicates that the legislated measures that are not linked to network expansion (such as the tax incentives and the lottery) also seem to have a positive impact. Results are reported in the Appendix.

3.3 Out of sample robustness test

As a robustness check, we also estimated a specification of the model without dummy variables for the legislative measures, covering the period before their implementation (2014–2016). The remaining elements of the analysis, such as the choice of ARIMA specification, the performance of multicollinearity and autocorrelation tests, and the use of the maximum-likelihood Berndt–Hall–Hall–Hausman estimation algorithm, were kept unchanged.

After fitting this model, we made out-of-sample predictions for the use of EMP in 2017, controlling for the effects of the macroeconomic trends. We then compared the predictions of the fitted model with the actual EMP use observed after the adoption of the law. Ceteris paribus, the difference between the actual and the forecasted values from the model can be attributed, in part at least, to the effect of the measures included in law 4446.

This approach confirms the findings presented previously. The law had a positive effect on card use, compared with an alternative scenario without legislative measures (Figure 9). The positive effect appears statistically significant in most proxies of card use. The law had a positive and statistically significant effect on the total value and number of transactions with cards, and on the number (but not the value) of transactions with debit and credit cards when the card types are examined separately. Applying the same approach at sectoral or regional level, we can see that the law did have a positive and statistically significant

4 We thank an anonymous referee for suggesting this robustness check.

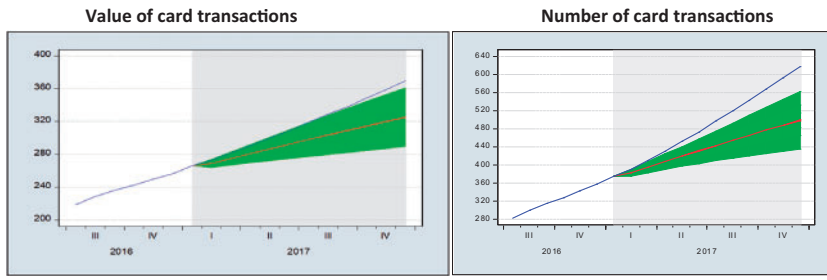

Figure 9. Out of sample projections on EMP growth without law 4446, 12-month rolling index 2014 = 100.

Model forecast with no measures: Red line.

Actual values: Blue line.

Confidence interval 30%, 60%, and 90% with bold, average, and light green shade, respectively.

impact on the use of cards in the sectors where the first phase of mandatory card acceptance was introduced, such as in food services and in geographical areas where digital penetration was relatively low, such as outside the Attica region. As shown with the dummy variable approach, the effect of the law on the number of active e-banking users was not statistically significant.

4. Impact of Card Payments on Tax Compliance

4.1 Model

A key question addressed by the study is whether the spread of the use of cards affected VAT revenues by improving tax compliance. There is a strikingly high positive correlation between VAT revenues (before tax returns) and EMP use, expressed in either number or value of card payments in Greece (Figure 10). In particular, the linear correlation between VAT revenues and the number of card payments approaches 0.98, while the linear correlation between VAT revenues and the value of card payments exceeds 0.98.

The linear correlation does not control for the impact of other factors that may have changed over the same period, such as the tax rates and the tax base. To control for these effects, we could try estimating the below reduced-form regression:

$$\text{VAT revenues}_t = f(\text{tax base}_t, \text{tax rate}_t, \text{tax rate dispersion}_t, \text{EMP use}_t).$$

The first three independent variables included in this regression consider the effect of the tax base, the rates of indirect taxation, and their dispersion, as suggested by a World Bank study (Bogetic and Hassan 1993). The definitions, sources, and descriptive statistics of the selected variables are presented in the Appendix. Estimating the above model, however, suffers from multicollinearity problems, as the implicit VAT rate and the EMP use metrics are highly correlated (linear correlation of 0.97 or 0.98 between the implicit VAT rate index and the number or value of card payments, respectively), as both increased sharply between June 2015 and December 2017.

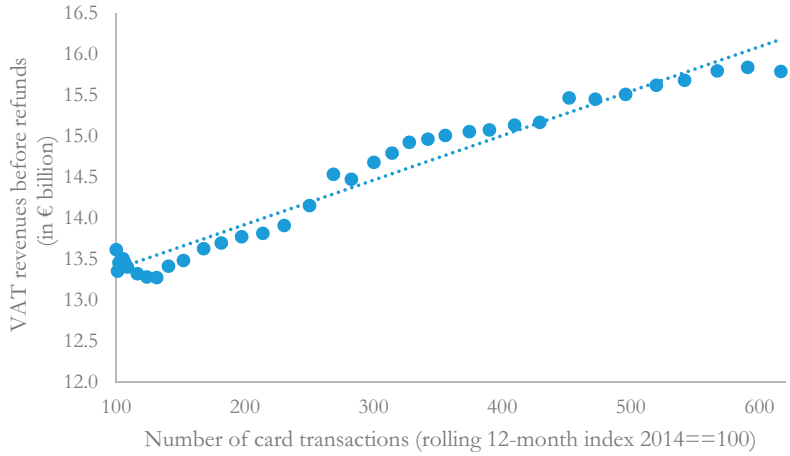

Figure 10. VAT revenues and number of card transactions, 2014–2017.

Sources: Independent Authority for Public Revenue, HBA, Data Analysis: ΙΟΒΕ.

In order to overcome the multicollinearity problem, we applied orthogonalization techniques adopted in the literature on assessing business exposure to foreign exchange risk (Bodnar and Wong 2003; Bris et al. 2004). In particular, we performed the following 2-step estimation:

- Step 1: Isolate variations e_t in the use of EMP, which are not attributed to macroeconomic factors or changes in tax policy

$$\text{EMP}_t = a_0 + a_1 \text{tax base}_t + a_2 \text{tax rate}_t + a_3 \text{dispersion}_t + \boldsymbol{e_t}$$

The variations e_t (essentially the residuals obtained from fitting the above regression) refer to the degree of EMP penetration that comes from the legislative measures on promoting EMP use and other unobserved factors, such as network effects and changes in preferences and habits.

- Step 2. We estimate the impact of four variables on VAT revenues

$$\text{VAT revenues} = b_0 + b_1 \text{tax base}_t + b_2 \text{tax rate}_t + b_3 \text{dispersion}_t + b_4 \hat{e}_t + \varepsilon_t.$$

The estimated coefficient $\boldsymbol{b_4}$ of the fourth variable can be interpreted as the degree of enhancing tax compliance through EMP penetration that is not related to fiscal and macroeconomic factors.

With the exception of the dummy variable that captures the changes in VAT rate dispersion, introduced with law 4389/2016 from 1 June 2016, for all other variables we use the difference of logarithms of their 12-month rolling value (see Appendix for definitions). The estimations are performed with least squares methods. The estimates are checked with tests for autocorrelation and heteroscedasticity.

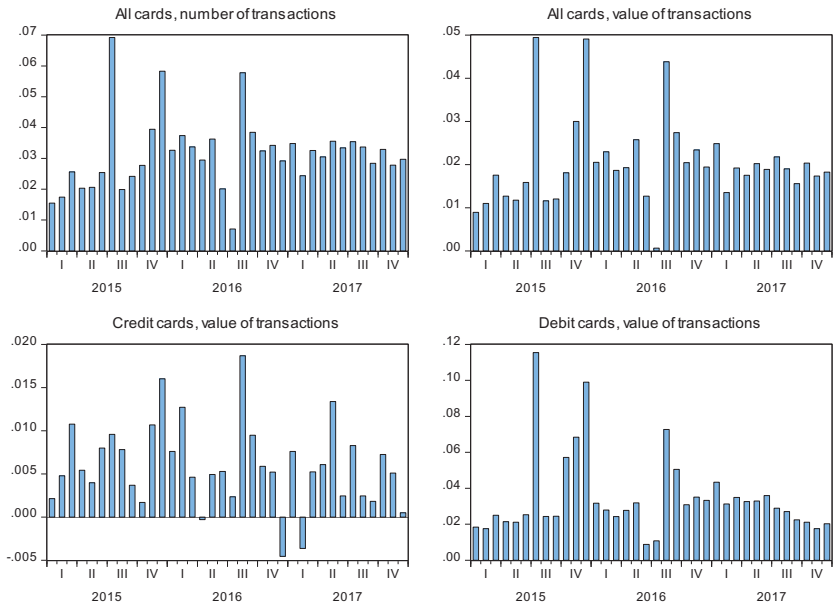

Figure 11. Step 1 estimation results—growth of card payments, orthogonal to macroeconomic and fiscal variables, monthly changes of 12-month rolling index.

4.2 Results

The results from the econometric investigation suggest that the growth of card use had a positive and statistically significant impact on the revenues from indirect taxation. Figure 11 presents the orthogonal component of card use growth, augmented with the constant term, as estimated in step 1. The orthogonalized growth rate (augmented with the secular component coming from the constant term) was positive throughout the 3-year period for total cards, in terms of both number and value of transactions, with an average monthly rate of 3.1% and 2.0%, respectively. Debit cards were the main source of growth, with an average monthly rate of 3.5%, in contrast to the credit cards, which had an average monthly orthogonalized growth rate of 0.6%. The first month with capital controls (July 2015) was expectedly the month with the greatest spike in orthogonalized growth. Significant othogonalized increase was also observed in December 2015 and in August 2016, while in 2017 the orthogonalized growth rates were consistently positive among the total and debit card transactions.

The step 2 estimations revealed that a 1% increase in the value and number of card payments that is not due to macroeconomic or fiscal developments results in higher VAT revenues by 0.21 and 0.16 percentage points, respectively (Table 2). The estimated impact is greater in the case of credit cards, yet we should note that their growth was significantly weaker during the examined period, and thus this finding has relatively weak economic significance.

At the same time, it should be noted that the control variables have the impact found in previous studies (Bogetic and Hassan 1993), even though in some cases they are not statistically significant. In particular, in relation to the effect of macroeconomic developments, it seems that the broadening of the tax base had a positive impact on VAT revenues, with

Table 2. Step 2 estimation results—determinants of VAT revenues

	VAT revenues			
	I	II	III	IV
Value of transactions, all cards	0.21**			
Number of transactions, all cards		0.16*		
Value of transactions, debit cards			0.03	
Value of transactions, credit cards				0.52**
Tax base	0.31	0.31	0.31	0.31
Tax rate	4.37***	4.37***	4.37***	4.37***
Dispersion rate	0.01	0.01	0.01	0.01
Adjusted R^2 (%)	26.2	25.4	19.5	29.8
Observations	36	36	36	36

Notes: The sample refers to the period 2014–2017. The statistical significance of the coefficients is denoted with ***, **, and * for significance at the 1%, 5%, and 10% level, respectively. The card use variables are expressed in terms of growth rates, orthogonal to macroeconomic and fiscal factors, as estimated in step 1. For all variables, with the exception of the dispersion dummy, we use the difference of logarithms of their 12-month rolling value.

0.31 elasticity, which, however, was not statistically significant. Such weak evidence may be due to the particular sample's time span and location, and is in line with findings by Hondroyiannis and Papaoikonomou (2017) who apply time-varying coefficient estimation and present tax base elasticities for Greece close to zero during 2012–2014, and occasionally even negative, in their robustness test where they use a pre-tax measure of the tax base.[5] As regards fiscal policy, the results reveal that increases of indirect taxation rates boosted VAT revenues in a statistically significant way, while the June 2016 tax reform that reduced the dispersion of the VAT rate had a positive, but not statistically significant effect on VAT revenues.

Results should be interpreted with caution due to the relatively short time-period that is covered by the available data. Furthermore, the observed effects may not extend to jurisdictions, where variations in card use are limited to sectors with low risk of tax evasion.

A future research could study this relationship in a panel-data setup, where the digital payments and VAT revenues are traced both over time and across branches of economic activity. Such a setup would explicitly take into account the likely heterogeneity of the impact of card use on VAT collection across sectors. It would also provide significantly more data variance that could help identify the underlying relationship with a greater degree of robustness.

4.3 Robustness check

As a robustness check, we applied an alternative approach of treating highly correlated and potentially endogenous explanatory variables. In particular, we used two-stage least

5 As a robustness check, we have re-ran the estimations of section 4 using a pre-tax measure of the tax base, where we subtract VAT revenues from the tax base proxy. The elasticity remains insignificant, yet exhibits a negative sign, as in the case of Hondroyiannis and Papaoikonomou (2017). One explanation they offer for the weaker link between the tax base and tax revenues during the Greek crisis is a possible 'shift of households' consumption away from high-tax durables towards lower-tax necessities'.

Table 3. Impact of card use on VAT revenues, two-stage least squares estimation

	VAT revenues					
	I	II	III	IV	V	VI
Value of transactions, all cards	0.14***					
Number of transactions, all cards		0.11***				
Value of transactions, debit cards			0.07***			
Value of transactions, credit cards				0.44***		
Card value as share of GDP					2.02***	
Card value as share of private consumption						1.40***
Instrumental variables	Tax base, tax rate, dispersion rate					
Adjusted R^2 (%)	17.6	15.9	4.3	14.7	22.7	22.3
Observations	36	36	36	36	36	36

Notes: The sample refers to the period 2014–2017. The statistical significance of the coefficients is denoted with *** for significance at the 1% level. For all variables, with the exception of the dispersion dummy, we use the difference of logarithms of their 12-month rolling value.

squares specification, where macroeconomic developments (GDP) and fiscal policy (tax rate, proxy for tax dispersion) were used as instrumental variables to examine the effect of EMP use on VAT revenue. Following Hansen's *J*-test, we cannot reject the null hypothesis that there are no over-identifying moment conditions, hence the set of orthogonality conditions is valid. In addition, following Cragg–Donald's *F*-test for the joint significance of the instruments used in the two-stage process, we reject the hypothesis of weak instruments at the 95% confidence interval.

This method confirms that there is positive and statistically significant effect of card use on tax revenue in Greece. Between 2015 and 2017, a 1% increase in the value or number of card transactions led to an increase in VAT revenue by 0.14 and 0.11 percentage points, respectively (Table 3). Note that the estimated elasticities of VAT revenue with respect to the use of cards under this approach are somewhat smaller, compared with the orthogonalization presented previously, but in line with the evidence of positive impact through the channel of increased tax compliance. The results suggest that at least one in every nine new digital transactions (or one in every seven euros in new digital transaction value) observed in Greece during 2015–2017 correspond to economic transactions that used to be undeclared previously. Another finding linking VAT compliance with card use as a share of private consumption suggests that an increase of the latter by 1 percentage point leads to an increase in VAT revenues by 1.4%.[6]

6 Hondroyiannis and Papaoikonomou (2017) estimate that 1 ppt increase of card use as a share of private consumption increases VAT revenues by circa 1% through increased compliance. The estimates variation between the two papers is likely due to distinct methodological approaches and data filters. They use a longer dataset which allows them to estimate time-varying elasticities, while their sample differs from the one in this article in that it mostly covers the period prior to capital controls, it uses lower frequency and it does not disentangle domestic from foreign card payments. Our methodology and specification concurs to some extent with their findings with respect to the link between card use and tax compliance, and their weak evidence on tax revenues' elasticity with respect to the tax base, yet we find a significantly positive tax rate elasticity.

In relation to policy implications, fitting these (more conservative) estimated coefficients in the regressions reveals that total card use penetration contributed almost €400 million in terms of VAT revenues in 2017, which amounts to about 50% of the total annual increase of VAT revenues that year. As a result, we estimate that the legislative measures seems to have contributed to about 1/3 of the total annual VAT revenue growth in 2017, or by about €205 million and €315 million in absolute terms (depending on the regression specification). Note that the total fiscal benefit of the growing EMP use might be even greater, as this analysis does not quantify the additional revenue from income tax and social security contributions, related to transactions that would have remained undeclared were it not for the digital payment growth.

The level of card use converged closer to EU28 average in 2017, yet it remains relatively low compared with international practice and heterogeneous across sectors and regions. Hence, there is room for greater fiscal benefit from continued growth of EMP use. Using the fitted coefficients, we can estimate the potential for increase of VAT revenues if the EMP use in Greece converges to international best practice or becomes more homogenous across sectors and regions.

Indicatively, the annual VAT revenue could potentially increase by up to 21% (€3.3 billion) if the card use rates in Greece converges fully to the EU average. If Greece reaches the level of card use of Portugal (one of the countries with the highest use), the VAT revenues could increase by 54% (€8.5 billion). Correspondingly, the VAT revenues could increase by 25% (€3.9 billion) if the share of the Food Services sector in card use reached the sector's share in private consumption. At the regional level, VAT revenues could increase by 8% (€1.3 billion) or 5.9% (€930 million) if the share in card use of mainland Greece outside Athens and Thessaloniki and the islands, respectively, approached their share in GDP.

5. Conclusions and Policy Recommendations

Both the imposition of capital controls and the legislation of policy measures provided a significant and lasting boost to the use of EMP in Greece between 2015 and 2017, when the number of card transactions increased 6-fold and the value of card payments more than tripled. The econometric analysis showed that the impact of the legislated measures on EMP use and in turn the effects of EMP penetration on VAT revenues were statistically significant and sizable.

The level of card use converged closer to EU28 average in 2017, yet it remains relatively low compared with international practice and heterogeneous across sectors and regions. In addition, the estimated VAT gap in Greece remains among the highest in the EU (CASE 2018). Hence, there is room for greater fiscal benefit from continued growth of EMP use. For this reason, there is scope for further measures to boost EMP use. The fiscal impact of these measures could be strengthened with better targeting at sectors and regions with lower EMP use. Their effectiveness can be enhanced with a better balance between 'carrot and stick' incentives.

The currently legislated measures do not provide strong incentives for further growth of EMP use by consumers who have already adopted such payment instruments in their transactions. In addition, the existing measures do not provide incentives to businesses to promote the EMP use by their customers. As a result, a significant number of newly installed POS terminals remain inactive. Finally, the currently adopted lottery model, where the

draw is conducted behind closed doors and the winners are notified individually by e-mail, while all prizes have an equal value, has unrealized potential for more publicity and promotion of EMP use.

A number of additional measures could be adopted in Greece to strengthen EMP use and fiscal revenues. On the consumer side, part of the value of transactions in targeted sectors with moderate or high risk of tax evasion or regions could be returned to the consumers in the form of cash or income tax rebates. Limits of the total rebate per household could be set to contain the cost of this measure. Incentives could also be provided for reporting businesses that refuse to accept EMP.

On the side of businesses, the list of indicative measures includes a separate lottery for professionals in sectors with higher propensity for tax evasion,[7] tax breaks for small businesses that achieve goals for EMP use and full compliance with the obligations to implement electronic invoicing and the registry of business bank accounts. There is also scope for further administrative measures, such as stronger information system interconnection so that the tax administration can utilize better the EMP use records and introduction of further disincentives to cash use, such as reduction of the threshold for cash transactions.

In conclusion, the EMP use in Greece gained strong momentum after the imposition of capital controls, which did not wane with the gradual easing of the cash withdrawal restrictions, to some extent due to the legislated measures to promote digital payments. The growth of EMP use seems to have had strong positive effects on fiscal revenues. As there is still large potential for further growth of EMP use in Greece, the adoption of additional policies that provide adequate incentives to consumers and businesses could maintain and strengthen the EMP momentum, with significant benefits for the country's public finances.

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Appendix

Table A1. Variable definitions and sources

Variable[a]	Proxying for	Definition	Source
I. EMP use			
Total cards	EMP use	Value and number of transactions	HBA members
Debit cards	EMP use	Value and number of transactions	HBA members
Credit cards	EMP use	Value and number of transactions	HBA members
Cards share over GDP	EMP use	Value of card transactions/nominal GDP	Computed
Cards share over private consumption	EMP use	Value of card transactions/private consumption	Computed
E-banking	EMP use	Number of active e-banking users	HBA members
II. Law 4446 effect			
Law 4446, H1	Law effect	Dummy equals 1 during the first half of 2017	Constructed
Law 4446, H2	Law effect	Dummy equals 1 during the second half of 2017	Constructed
CC first year	Capital controls	Dummy equals 1 during the first year of capital controls, starting in July 2015	Constructed
Private consumption	Card use base	Nominal consumption by households	ELSTAT
GDP	E-banking base	Real GDP (2010 prices)	ELSTAT
III. Tax compliance			
VAT revenues	Tax revenues	Total VAT revenues before refunds	IAPR (AADE)
Tax base	Tax base	Private consumption + intermediate consumption by general government	ELSTAT
Indirect taxation index	Tax rate	100[a] (HICP/HICP at constant taxes)	Eurostat, authors calculations
VAT reform	Tax dispersion	Dummy equals 1 during the first year of implementation of law 4389, starting 1/6/2016	Constructed

[a]All variables, except dummy indicators, are computed on a rolling 12-month basis, at a monthly frequency.

Table A2. Descriptive statistics of variables during December 2014–December 2017

Variable[a]	Unit[a]	Mean	Median	Maximum	Minimum	Standard deviation
Value of transactions, all cards	% change	3.6	3.2	8.4	0.4	1.9
Value of transactions, debit cards	% change	6.2	4.5	14.7	1.6	3.8
Value of transactions, credit cards	% change	0.9	0.8	3.1	−1.0	0.9
Value of transactions as a share of private consumption, all cards	%	11.6	11.8	20.1	5.4	4.8
Number of transactions, all cards	% change	5.1	4.8	9.8	1.0	2.2
Number of transactions, debit cards	% change	7.3	6.0	14.8	2.1	3.6
Number of transactions, credit cards	% change	1.7	1.6	4.4	−0.7	1.1
Number of active E-banking users	% change	2.3	1.9	3.7	1.4	0.8
GDP	% change	−0.01	−0.03	0.2	−0.3	0.2
Private consumption	% change	−0.05	−0.04	0.2	−0.4	0.2
VAT revenues	% change	0.4	0.3	2.7	−1.9	0.8
Tax base	% change	−0.04	−0.01	0.2	−0.4	0.2
Tax rate	% change	0.08	0.06	0.2	−0.04	0.07

[a]We use the 12-month rolling values for each variable, on which we compute the first difference of its logarithm between two successive periods (months).

Table A3. Robustness checks on the determinants of EMP growth

	Total card payments	
	Value of transactions	Number of transactions
Law 4446, H1	0.01*	0.03***
Law 4446, H2	0.02***	0.04***
CC first year	0.06***	0.08***
Private consumption	5.55**	5.76***
Credit card degree of use	0.27***	0.18*
Model	ARIMA(1, 1, 0)	ARIMA(1, 1, 0)
Adjusted R^2 (%)	91.8	93.1
Observations	36	36

Note: The sample refers to the period 2014–2017. The statistical significance of the coefficients is denoted with ***, **, and * for significance at the 1%, 5%, and 10% level, respectively. The value of transactions is expressed in current prices. Private consumption is expressed in current prices in the regressions on value, in constant prices when estimating the number of transactions. Credit card degree of use is proxied by the ratio of the value of credit card transactions over nominal private consumption. For all variables, with the exception of the time dummies, we use the difference of logarithms of their 12-month rolling value.