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MNB WORKING PAPERS 10
2011

MAGYAR NEMZETI BANK

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MNB Working Papers 2011/10

What drives cash demand? Transactional and residual cash demand in selected countries

(Tranzakciós és reziduális készpénzkereslet néhány európai országban)

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Published by the Magyar Nemzeti Bank

Publisher in charge: dr. András Simon, Head of Communications

8–9 Szabadság tér, H–1850 Budapest

www.mnb.hu

ISSN 1585-5600 (online)

* I am grateful to Róbert Lieli, Gábor Kézdi, István Kónya, Gábor Kátay, Balázs Világi, Barnabás Ferenczi and Anikó Bódi-Schubert for their useful comments. Any remaining errors are my own.

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Abstract

The goal of this study is to determine the reasons behind high cash demand in several Central European countries, especially Hungary. We distinguish between legal and illegal cash demand in an attempt to model the former. In our approach, legal cash demand can be explained by transactional and saving motives (hoarding). We apply both direct calculation and an econometric approach in order to isolate transactional demand. Regarding the econometric approach, a number of different models are estimated to eliminate, as far as possible, endogeneity bias. We examine transactional and residual cash stock (legal hoarding and illegal cash demand) of several Central European and Western countries that have their own currency (did not introduce euro). We find that transactional cash demand is strongly influenced by the level of improvement of the payment system. There are explicit signs that interest rates negatively influence non-transactional cash demand. However, we find examples where this is not the case. In these instances, the increase of non-transactional cash demand may be caused by illegal cash demand.

JEL: E26, E41, E42, C23.
Keywords: cash demand, shadow economy, payment system, panel econometrics.

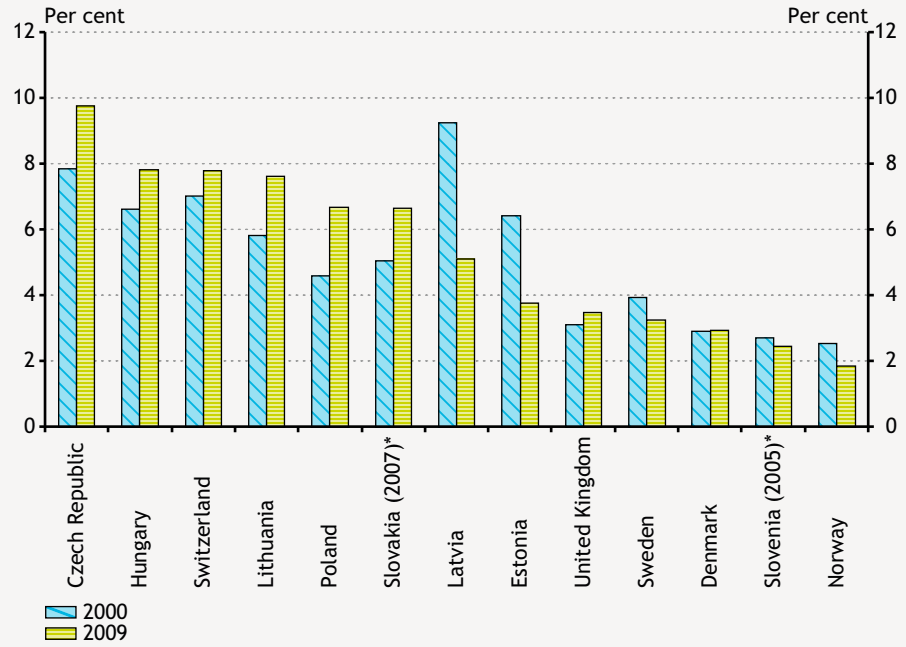
Összefoglalás

A tanulmány célja, hogy meghatározza a készpénzkereslet tényezőit néhány közép-európai országban, elsősorban Magyarországon. Megkülönböztetünk legális és illegális készpénzkeresletet, és kísérletet teszünk az előbbi ökonometriai modellezésére. Szemléletünk alapján a legális készpénzkereslet felbontható tranzakciós és megtakarítási célú összetevőkre. A tranzakciós kereslet elkülönítése érdekében elvégeztünk egy direkt kalkuláción és egy ökonometriai modellen alapuló becslést is. Az ökonometriai elemzés során több modellt is becsültünk, hogy amennyire csak lehetséges, kiszűrjük az endogenitásból fakadó torzításokat. Ezek után megvizsgáltuk néhány olyan nyugat-, illetve közép-európai ország tranzakciós és reziduális (megtakarítási célú, és illegális tevékenységhez köthető) készpénzállományát, ahol saját valutával fizetnek. Eredményeink alapján a tranzakciós készpénzállomány nagyságát erősen befolyásolja a fizetési rendszer fejlettsége. Egyértelmű jeleket találtunk arra, hogy a nem tranzakciós készpénzkeresletet a kamatláb negatívan befolyásolja. Habár találtunk példát ez utóbbi ellenkezőjére is. Ezekben az esetekben a reziduális készpénzkereslet növekedése összefüggésbe hozható az illegális tevékenységekhez köthető készpénzkereslettel.

1 Motivation

Compared to other countries, relative cash usage is remarkably high in Hungary. Its cash-to-GDP ratio is one of the highest in Europe, having increased considerably from the beginning of the millennium until the crisis. Similar patterns can be observed in other cash-intensive countries (Chart 1), such as the Czech Republic, Poland and Lithuania, while in two Baltic countries the cash-to-GDP ratio dropped significantly. Nevertheless, in the selected non-eurozone Western European countries (except for Switzerland), the analysed index was stable or decreasing. What could be the possible cause of such divergent processes? The answer is that currency demand depends on multiple factors.

Chart 1
Currency in circulation outside monetary institutions in relation to GDP



** Except for Slovenia and Slovakia because of euro introduction in 2006 and 2008, respectively.*

In a modern financial system, the central bank does not exert influence on the amount of currency in circulation. Commercial banks can withdraw cash from the central bank at any time, in order to satisfy the demand of their clients. Banks keep only the minimum currency stock required for logistical operations. Accordingly, currency stock is determined by the private sector's cash demand (Komáromi, 2007). For this reason, in this paper 'cash stock' refers specifically to currency in circulation outside of monetary institutions.

As mentioned above, demand for currency in circulation is based on different factors. First, it is necessary to distinguish between legal and illegal demand for cash. Illegal demand for cash is integral to shadow economies and cannot be observed directly. In contrast, legal cash demand can be derived from official national accounts (e.g. GDP, final consumption of households). There are two main reasons for legal cash demand:

– Transaction demand is for settling purchases goods and services. Transactional cash stock is positively influenced by income growth, but reduced by the spread of cashless payment instruments. In Estonia and Latvia, the considerable drop in cash intensity (cash stock to GDP) may be explained by the swift improvement of the payment system (Chart 1).

– The second motive behind legal cash demand is hoarding, when economic agents keep part of their savings in cash. This kind of demand increases as income grows, but it is reduced by rising opportunity costs (e.g. inflation, real interest rates). In countries characterised by a developed financial system (e.g. UK, Denmark, Slovenia and Norway), the ratio of cash within the savings portfolio of economic agents at the macroeconomic level is lower than in less developed ones (e.g. Czech Republic, Hungary, Lithuania). However, in the case of the most important currencies (euro, dollar, yen and Swiss franc), external demand can also influence how much cash is hoarded. This is especially apparent in the case of Switzerland (Chart 1), where the financial crises raised the stock of cash related to GDP by more than 1 percentage point in 2008. The reason for this is presumably that fear of depression drove external economic agents to hold their money in safe instruments. The main factor influencing hoarding is the nominal interest rate. The relationship between cash demand and interest rates is negative: in a higher interest rate environment, the opportunity cost of holding banknotes is higher, which encourages economic agents to hold their savings in interest-bearing instruments.

Cash is ideal for illegal economic activities. The anonymity of cash use, and the fact that such transactions can hardly be traced, makes cash very attractive for shadow economy transactions or as a means of hiding illegal income (Rogoff, 1998). The sizes of shadow economies are hard to measure, but according estimates (Schneider, 2004) the Central European countries are more affected than the Western ones. This suggests that economic agents use more cash in the former group of countries than in the latter group. Chart 1 supports this conclusion: in CCE (Central European) countries, the currency in circulation in relation to GDP is two or three times higher than in the selected Western European ones.

One must be careful when attempting to identify factors affecting the rise of shadow economies. Unfortunately, there is no consensus in the literature on the relevant explanatory variables. In the "classic" approach, the dominant causes are taxes, administrative burdens and labour market regulations (Schneider, 2000). Nevertheless, Thiessen (2010) claims that other factors are more significant. These include elements of direct democracy, social interaction effects, moral aspects, happiness, and the relative importance of specific institutions. In addition, a combination of factors may be important as well. On the one hand, higher tax rates raise the advantages of participation in an illegal economy. On the other hand, higher tax revenue may improve the efficiency of the bureaucracy, which in turn can raise the costs of the shadow economy. Correlations seem to be different not only over time, but also across countries. Analyses based on OECD countries show that Southern European countries have the largest shadow economies and the worst institutional environments, but relatively low tax burdens. Northern European countries have average-sized shadow economies, but extremely high tax burdens and top-notch institutions (Bovi, 2002). For this reason, this paper does not attempt to directly identify shadow economy cash demand.

The diversity of cash intensity in the analysed countries is caused by the fact that different factors behind demand affect cash stocks in different ways. The main question is to what extent these factors influence cash usage. In this paper, we try to separate the effects of transaction demand by taking consumption data as a starting point. We apply direct calculation and an econometric approach in order to separate transactional demand. We use modelling results to verify direct calculations. Regarding the econometric approach, we make several assumptions on the basis of omitted factors, and then examine how these influence the estimation of parameters. The similar results obtained from these two approaches seem to validate our assumptions regarding transactional cash demand.

After our analysis of transactional demand, we try to explain residual cash demand. Unfortunately, legal cash hoarding cannot be separated from illegal use of cash by means of modelling. At the end of the paper, we attempt to draw some conclusions about hoarding through the analysis of its main affecting factor: opportunity cost. In our view, if the behaviour of residual cash demand is inconsistent with the theoretically expected effect of the change of opportunity cost, a shadow economy can be seen as the reason for changes in residual cash demand. In addition, we use the results of several recently published papers that deal with the relationship of cash use and the shadow economy in Hungary.

2 Estimation of transactional cash demand

Transactional cash stock is determined by definition by point-of-sale[1] (POS) consumption, and it is influenced by the degree of development of the payment system. Thus, the spread of cashless payment instruments reduces the demand for cash use. Some papers base transactional cash stock on POS consumption data (Humphrey et al., 2000; Snellman et al., 2001). First, the value of cash POS transactions per year is estimated. Second, further approximation is needed to obtain the so-called frequency of banknote recirculation, because a banknote can be used more than one time in a period. This tells us how many times a banknote was used in POS cash transactions per year. Finally, the transactional cash stock is derived from the estimated value of cash POS transactions, dividing it by the frequency of banknote recirculation.

There are further methods of estimating transactional cash stock. An ECB working paper (Fischer et al., 2004) draws a correlation between the seasonal factor of banknotes in circulation and transactional cash stock. Gresvik and Haare (2008) obtain data on transactional cash stock via surveys in which individuals are asked about the value of cash POS transactions. The aggregated cash transactions are estimated from this, and transactional cash stock is derived by estimating the frequency of banknote recirculation, in line with the method described in the previous paragraph.

As stated above, transactional cash demand can be estimated using point-of sale consumption data. The first step is to estimate the value of cash POS transactions, because raw data is not available. There are two approaches to estimate cash POS transactions:

- The direct calculation approach, where cash POS transaction data is obtained by subtracting cashless payment data from total POS consumption.

- The econometric model, by means of which an estimate provides cash POS transaction data.

The second step is to approximate the frequency of banknote recirculation, as a single banknote or coin can be used several times in a given period. The quotient of cash POS transactions and the frequency of banknote recirculation is the transactional cash stock.

2.1 DIRECT CALCULATION APPROACH

In order to determine cash POS transaction data, we can use the following equation:

$$CASHTR_{it} + NCP_{it} = CONSPOS_{it} \quad (1)$$

where,

$CASHTR_{it}$	cash POS transaction in *i* country, *t* year
NCP_{it}	non-cash POS transactions in *i* country, *t* year
$CONSPOS_{it}$	POS consumption data in *i* country, *t* year

[1] A point-of-sale transaction is an exchange between a buyer and seller at a specific place (store, website, etc.).

Cashless and cash transactions result in total consumption at point-of-sale locations. Although POS consumption data is not available directly, there are several means of deriving it. According to papers published on this topic, data sources can include retail trade data or national accounts. We choose the latter approach, setting out from the final consumption of households. One reason for this is the availability of data at an international level. Another reason is the fact that use of cash is not limited to retail trade.

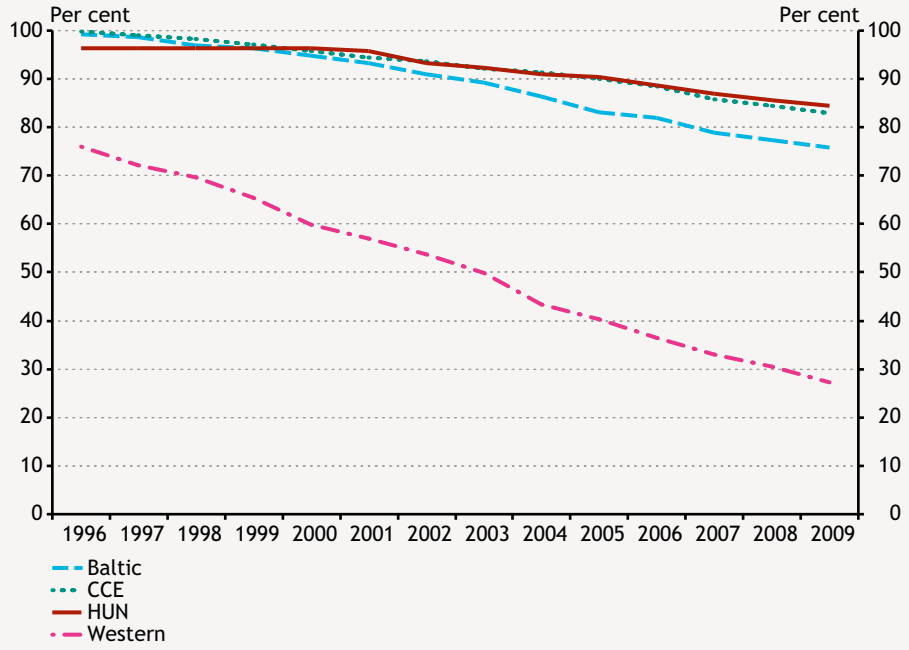
We calculated that part of final consumption of households where cash is likely to be used. We did not take into consideration types of consumption where payment is typically delayed (e.g. housing, health, education and financial goods and services). In other words, the calculated POS consumption data was derived from the total final consumption of households less expenditures on housing, health, education and miscellaneous goods and services (Eurostat classification). POS consumption data has been similarly calculated by authors of other papers (Humphrey et al., 2000; Paunonen and Jyrkönen, 2002; Guibourg and Segendorf, 2008).

Non-cash payments are approximated by card payments. The reason for not including check payments and other state-of-the-art payments methods (SMS, Internet, etc.) is a lack of reliable data and the fact that checks play a declining role in payments. The data source was ECB data collection (Blue book), BIS database (Red book) and the Eurostat database.

Cash payments can be approximated by subtracting card payments from calculated POS consumption data.

Chart 2
Cash POS transaction as portion of POS consumption

(direct calculation approach)



Note: The data on Western, Baltic and CCE countries is the weighted average of calculated POS consumption.[2]

We present the results as the share of calculated POS consumption (Chart 3). Cash transactions are calculated as follows:

$$\frac{CASHTR_{it}}{CONSPOS_{it}} = \frac{CONSPOS_{it} - CARD_{it}}{CONSPOS_{it}} \qquad (2)$$

[2] The data used are from Eurostat, BIS and ECB statistics, with nominal values in millions of euros. The estimated countries are the Czech Republic, Denmark, Estonia, UK, Hungary, Lithuania, Latvia, Poland, Slovakia, Slovenia, Sweden, Switzerland and Norway.

The cash ratio in consumption transactions in the Western European counties was approximately 75% in 1996; it steadily declined over the examined period to 30%. The improvement of the cashless payment instrument infrastructure manifested itself in the decline of cash payments in the Baltic countries, where the cash ratio fell from almost 100% to 75% on average. Nevertheless, this region is not homogenous: in Estonia the cash ratio stands at about 35%, while in Lithuania more than 70% of consumption is paid in cash. The opposite is also true: in certain Central European countries and Hungary, the popularity of cash has hardly decreased.

As the direct calculation approach only takes card payments (as non-cash POS transactions) into account, we assumed that this approach overestimates cash POS transactions. We elaborated an econometric model to estimate cash POS transactions, the rationale being that proven statistical significance of the relationship between cash payments and card payments would help validate the direct calculation.

2.2 ECONOMETRIC APPROACH

The model to be estimated uses a panel dataset, as the individual time series are too short to make a model for each analysed country. We assume that the transition from cash to cashless payments is affected by similar factors (e.g. POS terminal penetration, income) as in European counties, making panel estimation the right tool to analyse it. The model is based on the same equation (1) as the direct calculation approach, but it also makes use of the classic currency demand model. We use the same dataset as the direct calculation approach. As time series data of a number of different countries are used in the panel dataset, we write our model on first differences.[3] The starting equation is as follows:

$$\Delta CASHTR_{it} + \Delta CARD_{it} = \delta \Delta GDP_{it} + \varepsilon_{1it} \tag{3}$$

where,

$CARD_{it}$	card payments at nominal value in *i* country, *t* year
$CASHTR_{it}$	cash POS transaction at nominal value in *i* country, *t* year
GDP_{it}	gross domestic product at nominal value in *i* country, *t* year
ε_{1it}	error term

This equation (3) demonstrates that nominal cash payments and nominal card payments provide a portion of the nominal income.

The aim of the model estimation is to obtain δ and to calculate the nominal value of cash POS transactions thorough the equation:

$$\widehat{\Delta CASHTR}_{it} = \hat{\delta} \Delta GDP_{it} - \Delta CARD_{it} \tag{4}$$

As traditionally modelled, demand for real currency balances (CURR/P) is determined by real transaction demand for cash and the desire to hold interest-bearing transferable deposits whose interest rates vary with the nominal interest rate *(r)* (Sriram, 1999). According to this model, the stock of currency in circulation is determined by cash POS transactions (transaction motive) and opportunity cost (hoarding) (Snellman et al., 2001; Humphrey et al., 2004). We specify the money demand equation as:

$$\frac{CURR_{it}}{P_{it}} = \alpha_1 \frac{CASHTR_{it}}{P_{it}} + \alpha_2 r_{it} + \varepsilon_{2it} \tag{5}$$

where,

$CURR_{it}$	currency in circulation outside monetary institutions at nominal value in *i* country *t* year
P_{it}	GDP deflator in *i* country *t* year
r_{it}	money market nominal interest rate (3 month) in *i* country *t* year
ε_{2it}	error term of the level equation

[3] Unit root tests are presented in the appendix.

As $CASHTR_{it}$ should be expressed in nominal terms, it is rearranged (5) as follows:

$$CURR_{it} = \alpha_1 CASHTR_{it} + \alpha_2(r \cdot P_{it}) + \varepsilon_{3it} \tag{6}$$

The next step is to differentiate the level equation (6):

$$\Delta CURR_{it} = \alpha_1 \Delta CASHTR_{it} + \alpha_2 \Delta(r \cdot P_{it}) + \varepsilon_{4it} \tag{7}$$

Although we are interested in estimating the change of cash POS transactions $(\Delta CASHTR_{it})$, this can be done only indirectly. Solving (6) and (7) for $\Delta CASHTR_{it}$,

$$\Delta CASHTR_{it} = \delta \Delta GDP_{it} - \Delta CARD_{it} + \varepsilon_{1it} \tag{8}$$

$$\Delta CASHTR_{it} = \frac{1}{\alpha_1} \Delta CURR_{it} - \frac{\alpha_2}{\alpha_1} \Delta(r_{it} \cdot P_{it}) + \varepsilon_{4it} \tag{9}$$

making them equal to one another and expressing the result in terms of card payments $(CARD_{it})$, the following model is estimated (9):

$$\Delta CARD_{it} = -\frac{1}{\alpha_1} \Delta CURR_{it} + \delta \Delta GDP_{it} + \frac{\alpha_2}{\alpha_1} \Delta(r_{it} \cdot P_{it}) + \varepsilon_{1it} - \varepsilon_{4it} \tag{10}$$

Let $-\frac{1}{\alpha_1} = \beta$ then,

$$\Delta CARD_{it} = \beta \Delta CURR_{it} + \delta \Delta GDP_{it} - \alpha_2 \beta \Delta(r_{it} \cdot P_{it}) + \varepsilon_{1it} - \varepsilon_{4it} \tag{11}$$

As the substitution between cash and cashless payment is presumed to not be linear, the improvement of payment infrastructure (POS terminal per capita) is used to determine the relationship between these (12) (Humphrey, 2004).

$$\beta_{it} = \gamma_0 + \gamma_1 POSPOP_{it} \tag{12}$$

where,

$POSPOP_{it}$ POS terminals per capita
$ATMPOP_{it}$ ATM terminals per capita

Therefore, the first step to estimate cash POS transaction is the following model. Because both equations (11) and (12) should be jointly estimated, we replaced β_{it} with $\gamma_0 + \gamma_1 POSPOP_{it}$. Finally, a variable added to reflect availability of ATM terminals. After substitution, the following model (13) is estimated:

$$\begin{aligned} \Delta CARD_{it} = {} & \alpha_0 + \gamma_0 \Delta CURR_{it} + \gamma_1 \Delta POSPOP_{it} \cdot \Delta CURR_{it} + \\ & + \delta \Delta GDP_{it} - \alpha_2 \gamma_0 \Delta(r_{it} \cdot P_{it}) - \alpha_2 \gamma_1 \Delta POSPOP_{it} \Delta(r_{it} \cdot P_{it}) + \omega \Delta ATMPOP_{it} + \varepsilon_{1it} - \varepsilon_{4it} \end{aligned} \tag{13}$$

The final step is to use δ to approximate cash POS transactions:

$$\widehat{\Delta CASHTR}_{it} = \hat{\delta} \Delta GDP_{it} - \Delta CARD_{it} \tag{14}$$

Specification and tests of the model

Summarising the previous sections, the goal of the model estimation is to confirm the direct calculation of cash POS transactions. We estimated a number of specifications to see how robust the parameter δ is. The specifications differ in assumed unobserved heterogeneity. These specifications are as follows, while the results are presented in Table 1.

– First we directly estimate equation (13) by OLS. This assumes that all country-specific omitted factors that are potentially correlated with the explanatory variables are of form a_i, and hence are eliminated by using a model specification written in first differences. In other words, all time varying variables omitted from (13) are assumed to be uncorrelated with the explanatory variables.

– More realistically, however, there are relevant omitted variables of the form a_i+b_it. The reason for this is that these unobserved variables are country-specific time series (e.g. check payments), which could form a trend. The second and third estimation strategies reflect this assumption. If omitted variables are of the form a_i+b_it, then term bi still remains after first differences. The second model uses fixed effects and the third one second differences to eliminate b_i. The two methods should deliver similar results. The second and third column of Table 1 shows that the parameters of the significant variables are indeed close to one other. This suggests us that our assumption was appropriate and that the omitted factors do reflect a trend.

– It is still possible, however, that even second differencing (or first differencing and the fixed effects transformation) does not solve all endogeneity problems (i.e. unobserved factors are of the general form a_i+b_it with time variation that is not fully captured by a simple trend). In particular, card payments (CARD) and GDP might be correlated with such omitted factors. For example, cash and card payments reflect each other. To put it in another way, card payments can have an influence on cash payments. Hence, currency in circulation (CURR) could be endogenous in (13) due to other types of payment instruments that are omitted from the model. In addition, GDP could be endogenously determined in the model as well, because both GDP and CARD payments are affected by consumption. These omitted factors may exhibit time variation in addition to a trend.

Therefore, we also attempt to estimate the second differenced version of equation (13) by two-stage least-squares. To find acceptable IVs is a very hard proposition. First, they have to be correlated with the endogenous explanatory variable (CURR and GDP), but they must also be uncorrelated with the omitted variables (like check payments and consumption). We use lagged variables as instruments for the endogenous explanatory variables. This method was used by Deungoue S. (2008) in her paper, where she examined payment behaviour in the Economic and Monetary Union. Lagged variables are

Table 1
Relationship between card and cash payments
(model estimation)

1.	OLS (1)		OLS (2)		OLS (3)		TSLS (4)	
Difference	first difference		first difference		second difference		second difference	
Cross section fixed effects	without fixed effects		with fixed effects		without fixed effects		without fixed effects	
Parameter	value	std. err.	value	std. err.	value	std. err.	value	std. err.
α_0	−831.5	971.2	−625.8	660.1	468.6	459.9	413.5	621.3
γ_0	−0.84	0.72	−0.57	0.84	0.90	0.41**	3.83	1.79**
γ_1	1946.9	747.9**	1151.8	1155.4	−1104.5	758.8	−5810.1	2687.4**
δ	0.23	0.033***	0.21	0.013***	0.23	0.021***	0.22	0.031***
α_2	266.986	105.23**	197.5	226.6	152.2	121.01	82.83	18.1***
ω	76.26	32.4**	80.2	28***	61.7	25.89**	28.69	63.45
R^2	0.77		0.89		0.83		0.68	
Adj. R^2	0.76		0.88		0.83		0.66	
DW	0.74		1.76		2.47		1.71	
Normality	1427***		2229***		1031		141***	
Instruments							third lag of endogenous variables	

*Note: Significant at ***<1, **<5, *<10 level. Since we wished to compute standard errors that are robust to serial correlation (Arellano, 1987; White, 1980), we chose White's cross-section as the coefficient covariance method. The likelihood ratio test clearly rejected redundant cross-sectional fixed effects in the case of model 2. The LR test for cross-sectional fixed effects could not be rejected in the case of model 3. First order serial correlation of the error term seemed to be a problem in case of the first and third models (DW stat).*

commonly used for instrument consumption and income variables as well (Slacalek, 2009; Campbell and Mankiw, 1990).

We tested the instruments for weakness (using an F-test). In the case of both endogenous variables, the introduced instrumental variables appeared to be weak. This could be a problem, but we tried to eliminate this as much as possible: by differencing variables twice, those endogenous factors that are constant or have a trend are controlled. In other words, we allowed for $a_i + b_i t$ unobserved heterogeneity. (For example, the trend of GDP is controlled by the term $a_i + b_i t$, but fluctuation is not.) For this reason, our IVs have control over those endogenous factors that vary in time without having a trend. The most important coefficient is δ, because this is used by the calculation of cash POS transactions. The fact that this is quite robust, compared to the different estimation methods, strengthens our assumption that all endogenous factors are controlled. Given the currency in circulation-related coefficients (γ_0; γ_1), the value of the coefficient varies by a wide range.

We chose the results of model 4 to compute cash POS transactions. We calculated the nominal value of ΔCASHTR as follows:

$$(\Delta CASHTR)_{it} = 0.22 \cdot \Delta GDP_{it} - \Delta CARD_{it} \tag{15}$$

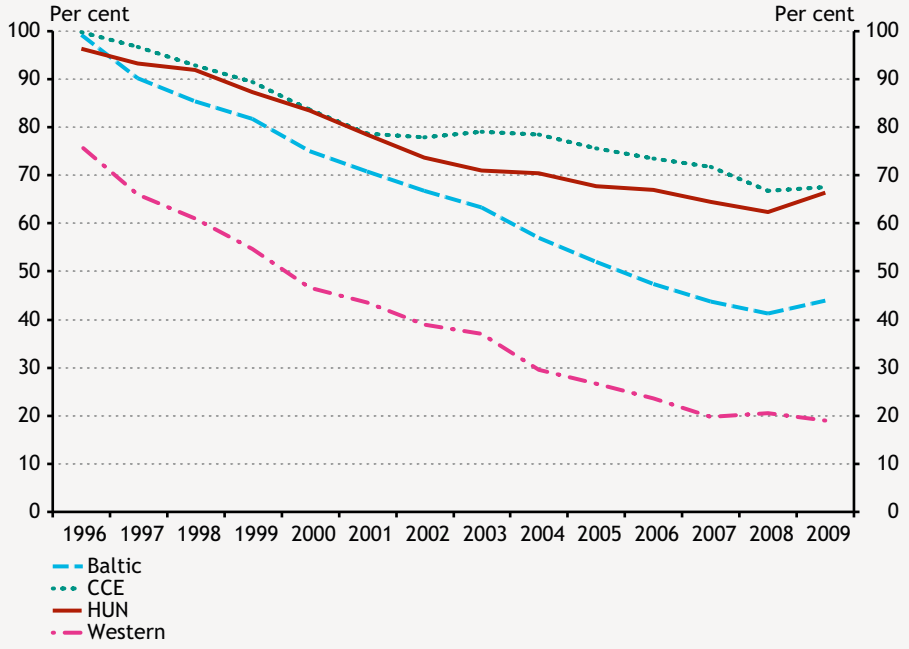
The change of cash POS transactions is consequently determined by GDP growth and the change in card payments. The first CASHTR data was calculated in the same way as direct calculation. The calculation of the share of cash POS transactions is as follows:

$$\frac{CASHTR_{it}}{CONSPOS_{it}} = \frac{CONSPOS_{i1996} - CARD_{i1996} + \Sigma_{1997}^{t}\Delta CASHTR_{it}}{CONSPOS_{it}} = \\ = \frac{CONSPOS_{i1996} - CARD_{i1996} + \Sigma_{1997}^{t}(0.22 \cdot \Delta GDP_{it} - \Delta CARD_{it})}{CONSPOS_{it}} \tag{16}$$

In the case of the Western countries, the decline of cash POS transactions is almost the same as in the direct calculation method. In the Central European and Baltic countries, the results of the econometric approach are significantly lower than

Chart 3
Cash POS transaction as portion of final consumption of households

(econometric approach)



Note: The data on Western, Baltic and CCE countries is the weighted average of calculated POS consumption.

the direct calculation method. This is due to the fact that we used δ to calculate the change in cash POS transactions, which represents the relation of GDP with card payments for all counties in the sample. The econometric approach thus underestimates cash POS transactions in the Eastern European countries, especially in the 1990s.

If the results of both approaches are compared, the first one overestimates and the second one underestimates cash POS transactions. It is our conclusion that the actual volume of cash POS transactions is found between these, and that both approaches are important for any calculation of transactional cash demand.

2.3 APPROXIMATION OF TRANSACTIONAL CASH STOCK

Estimated cash POS transactions represent the aggregated value of POS sales that are transacted in cash in a given year. However, the required volume of banknotes and coins is a fraction of this amount. The reason for this is that banknotes circulate in the economy between economic agents, so that a single banknote can be recycled several times in a year. (In this study we do not take the volume of coins into consideration, as they represent only a marginal part (about 2-3%) of the total value of cash in circulation.) Accordingly, if the stock of cash related to POS transactions is being analysed, the frequency of banknote recirculation must be estimated.

Banknotes circulate typically (in the case of legal transactions) from MFIs through households to trade institutions (to MFIs again). To arrive at the frequency of recirculation, we should pick one point of the circle and then measure the degree of recirculation. One way to obtain banknote recirculation frequency is to measure the number of cash withdrawals of households from MFIs per capita. However, if the total number of cash withdrawals is not available, they can be approximated with ATM cash withdrawals (Snellman et al., 2001; Humphrey et al., 2004). The reason for this is that ATM cash withdrawals comprise an increasing number of total number cash withdrawals. ATM cash withdrawals are divided by the number of payment cards with a cash function in order to approximate the banknote recirculation frequency of each country. Finally, the value of cash POS transactions is divided by the country-specific banknote recycling frequency to obtain transactional cash stock.

In analysing the results of the calculation described above, several problems must be taken into consideration. Firstly, because cash POS transactions cannot be observed, calculated POS consumption is used. Secondly, because the number of ATM cash withdrawals is a fraction of total cash withdrawals, the real banknote recirculation frequency may differ. For this reason, relative values (of time and place) should be in focus, rather than exact values, when analysing the results.

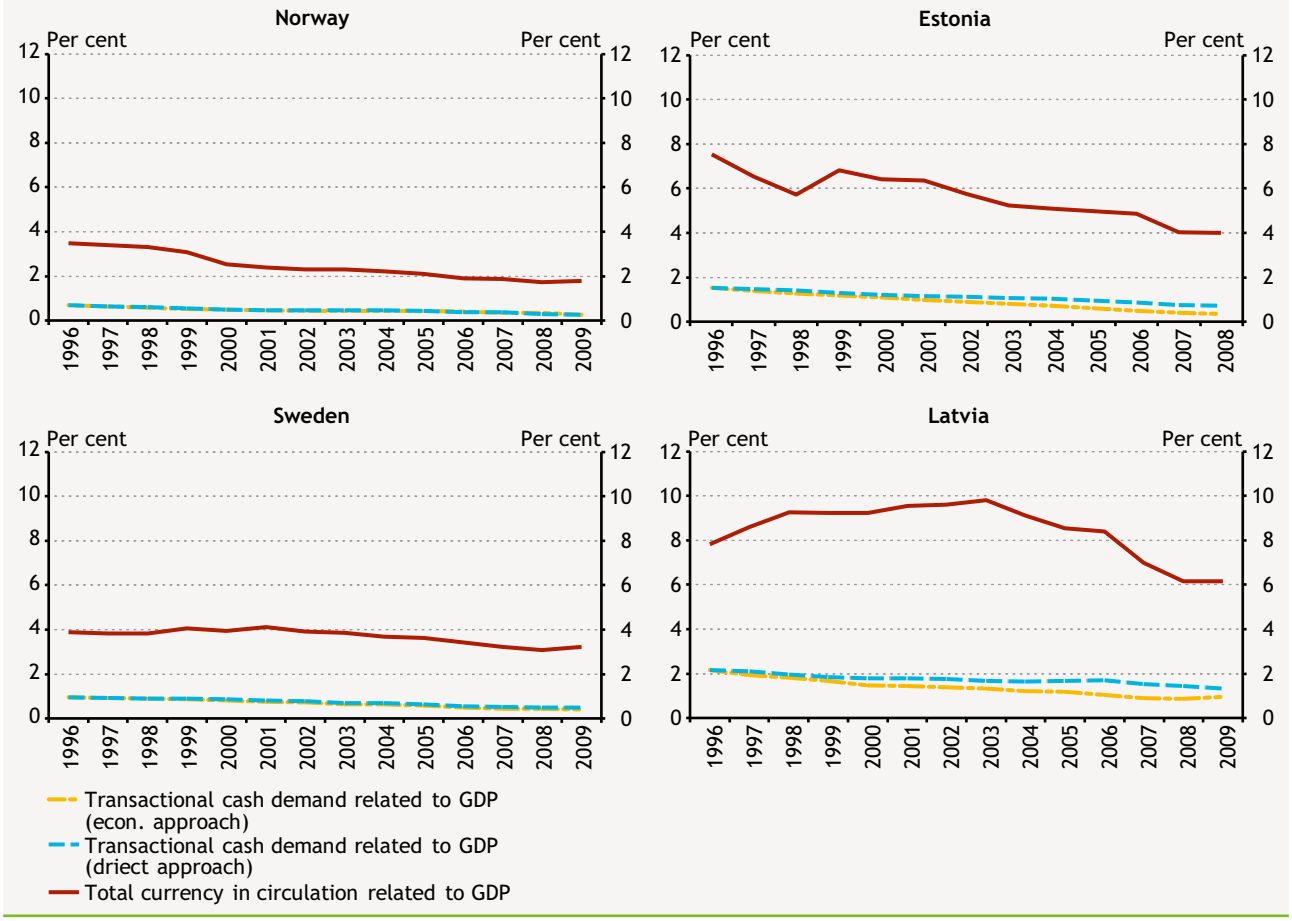
3 What drives cash demand in the analysed countries?

The previous sections examined the methodology of estimating transactional cash stock. Two approaches were presented as means of approximating cash POS transactions, and it was shown how transactional cash stock can be derived from these data. Given the aforementioned uncertainties about the level of transactional cash stock, the change and the relative level of transactional cash stock are brought into focus.

In order to make an international comparison of transactional cash stock, we compose three groups. These are based on the behaviour of the cash-to-GDP rate in the examined period.

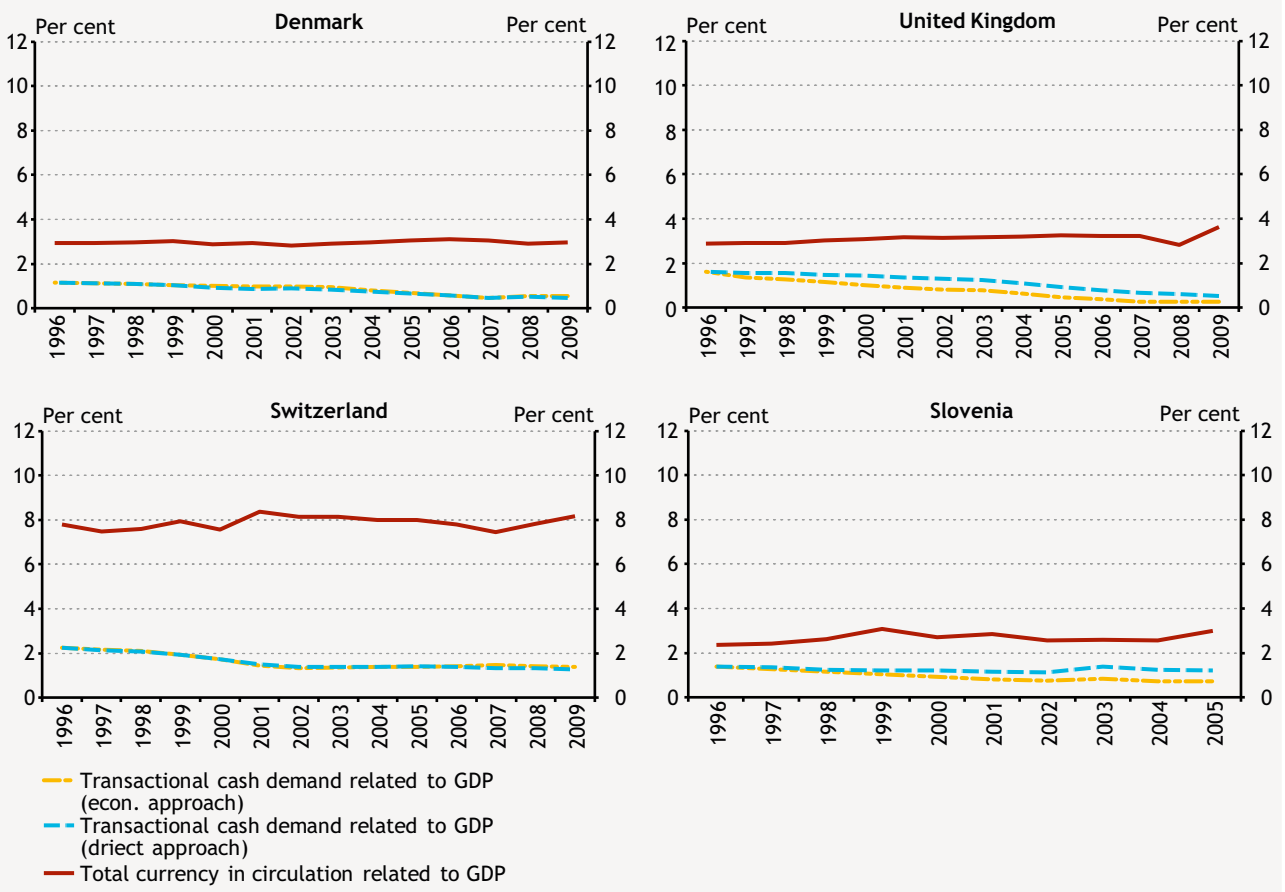
The first set of countries (Chart 4) reflects where the cash-to-GDP ratio (cash intensity) decreased. In these countries, the importance of transactional cash demand (GDP ratio) decreased slightly, while the nominal value of transactional cash stock increased. This means that the growth of income exceeded the growth of transactional cash demand. Only in the Baltic countries did a decrease of transactional cash stock contribute significantly to the decline of total currency in

Chart 4
Countries with deteriorating cash-to-GDP ratio



circulation (both as share of GDP). Whether illegal cash use or cash hoarding was the cause of the decline in residual cash stock, it is hard to determine. However, in the case of Latvia after 2007, the cash-to-GDP ratio dropped quickly from more than 8% to around 6%. The reason for this was probably the quick increase in opportunity costs: the three-month money market interest rate increased from 4% to 8% in 2007 (Bank of Latvia Annual Report, 2009).

Chart 5
Countries with stagnating cash-to-GDP ratio



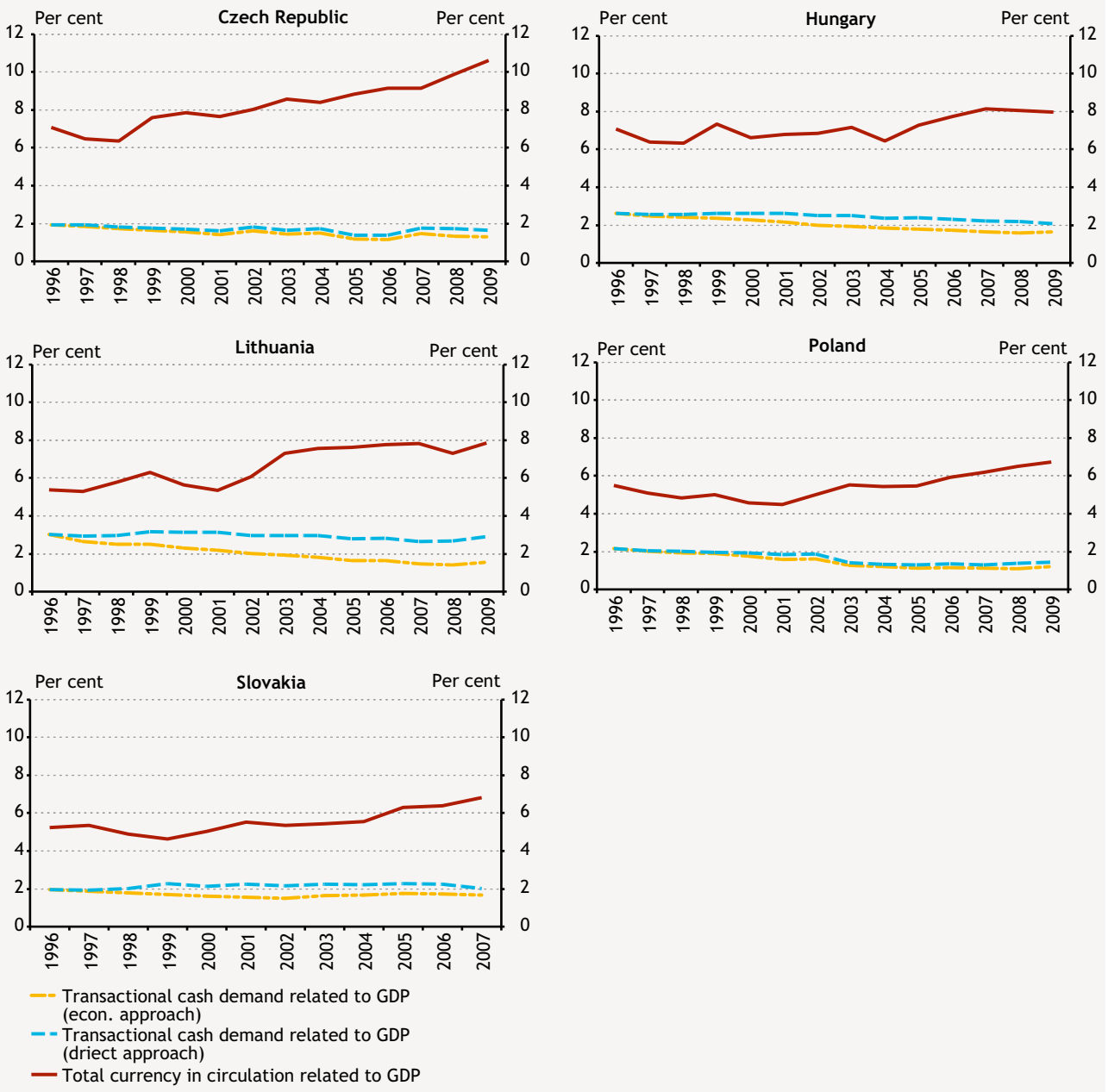
Note: In the case of Slovenia, the euro introduction shortened the examined period.

For the second set of countries (Chart 5), the cash-to-GDP ratio stagnated or changed slightly in the examined period, while the transactional cash stock was somewhat reduced. As a consequence, the ratio of transactional cash within the total currency in circulation decreased significantly. This means that the relative importance of hoarding and illegal cash demand grew in the examined period. In Denmark and the UK, the nominal value of transactional cash stock decreased as well. With relatively high cash intensity, Switzerland represents a special case. This is due to two factors. First of all, cash is used widely in payment transactions, so in terms of international comparisons transactional cash demand is high. Secondly, foreign cash demand for the Swiss franc is quite widespread; not only Swiss residents, but non-residents as well hold cash for hoarding purposes. Moreover, owing to the financial crises, the hoarding of Swiss currency rose significantly in 2008 and 2009. The historic low interest rates may have led to increased cash holding in 2009 in the UK.

The third group of countries (Chart 6) can be characterised by stagnating transactional cash intensity and an increase in total currency in circulation. In terms of an international comparison, the transactional cash demand of these countries is quite high. Regarding the development of payment systems, all of these countries are underdeveloped compared to most of the other selected countries: transactional cash demand is about 2% of GDP.

The relative importance of transactional cash demand reduced the proportion of transactional cash within total cash stock from 60-70% to 20-40%. The reason for this was not a decline in transactional cash intensity, but a rise in hoarding or illegal cash demand. As mentioned in the second section, it is impossible to separate these at a macroeconomic level. However,

Chart 6
Countries with increasing cash-to-GDP ratio



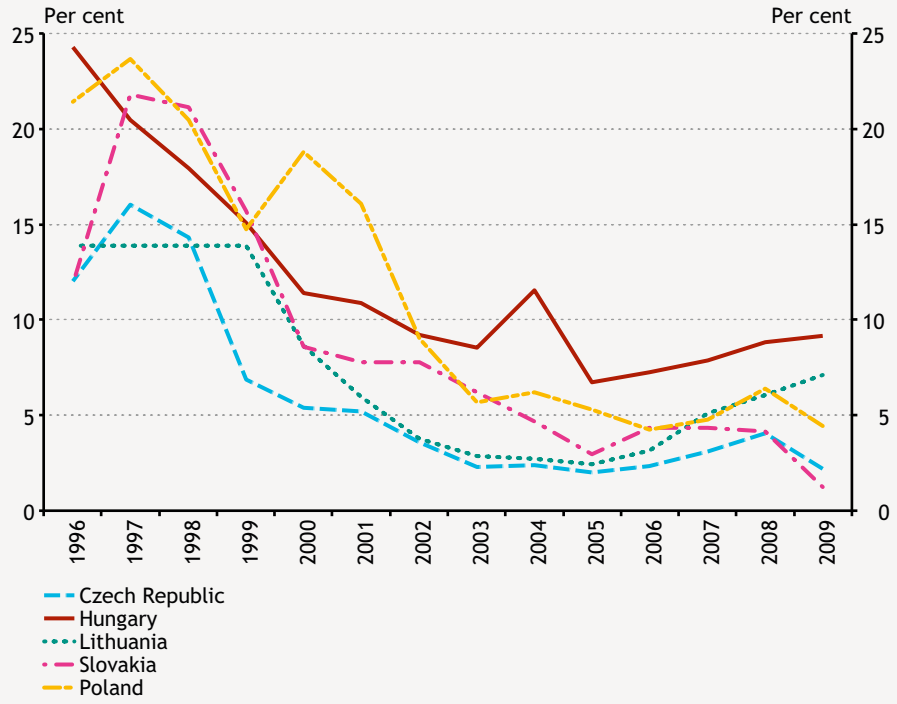
Note: In the case of Slovakia, the introduction of the euro shortened the examined period.

the examination of possibly influencing factors could provide a clue whether hoarding or shadow economy cash demand were behind the increase of relative currency in circulation. Because the factors behind shadow economies can be hard to quantify (as mentioned in the first section), the factor of hoarding (opportunity cost) is primarily examined.

Accordingly, we examine changes in interest rates. We also check the expected and current changes of non-transactional cash stock. As discussed in the first section, an increase in interest rates theoretically reduces demand for hoarding cash. If this is not the case, the influence of another factor such as illegal cash demand can be suspected.

In the last five years in Poland, the Czech Republic, Lithuania and Slovakia, residual cash demand relative to GDP has increased constantly (Chart 7). Interest rates declined until 2005 (Chart 8); the influence of this on residual cash stock is in line with our theoretical expectations. However, the significant increase of interest rates from 2007 to 2008 did not

Chart 7
Three-month money market interest rates in selected countries



Source: Eurostat.

decrease relative and nominal cash demand. The case of Hungary is very interesting. In 2004, the rise of interest rates influenced cash demand in an expected way; since then, however, the increase of residual cash stock and interest rates are seemingly in contradiction with each other. Although our method cannot prove whether illegal cash demand from the shadow economy is behind this phenomenon, there are several papers that deal with shadow economy cash demand in Hungary from other perspectives.

A paper published by Odorán and Sisak (2008) analyses the stylized facts in this topic. The authors found that the higher tax burden to reduce the budget deficit, as well as other austerity measures of the tax authority, might also increase illegal cash demand. It is important to highlight that this does not mean an increase in the extent of the shadow economy, but it could mean an increase of in the cash intensity of this sector.

A paper by Anikó Bódi-Schubert (2010) uses qualitative and in-depth interviews to explore the motivating factors behind domestic cash usage in Hungary. In the opinion of the experts interviewed, cash demand may be facilitated by the intensive cash need of the shadow economy, the traditional cash-oriented behaviour of the public administration, and a lack of trust in business-to-business transactions. The author found additional factors associated with shadow economy cash demand, such as grey and black employment and different tax evasion techniques. The paper showed that wealth audits could also contribute to an increase of cash holding.

These papers strengthen our suspicions that the role of the shadow economy could be crucial in the increase of cash demand in the middle of the previous decade in Hungary.

Conclusions

The question put forward in the title of this paper can be partially answered: while transactional cash demand can be isolated, the effect of hoarding and illegal cash demand cannot be expressed numerically. We use both direct calculation and an econometric approach to estimate cash POS transactions. Regarding the econometric approach, four different models are estimated to eliminate (as much as possible) biases of endogeneity and unobserved heterogeneity. Transactional cash stock is derived from the results of the models.

After the separation of transactional cash demand, we examine the results of several CEE and Western European countries that have their own currencies. We find that transactional cash demand is strongly influenced by the level of improvement of payment systems. In most cases that we examined, interest rates negatively influence non-transactional cash holding. However, we find examples where this was not the case. In these cases, the increase of non-transactional cash demand may be caused by illegal economic activities.

Appendix

Table 2
Panel unit root tests

Variables	Common unit root	Individual unit root	
	Levin, Lin & Chut	ADF	PP
ΔΔCARD	−6.192***	88.49***	95.36***
ΔCARD	−3.07***	49.33***	44.42***
ΔΔCURR	−11.13***	112.5***	132.7***
ΔCURR	−3.56434***	61.25***	52.25***
ΔΔGDP	−1.45*	54.7***	41.9**
ΔGDP	−6.13***	66.81***	57.45***
ΔΔINTR	−13.46***	121.7***	151.2***
ΔINTR	−4.32***	71.97***	62.2210***
ΔΔPOS/POP	−12.14***	131.86***	184.3***
ΔPOS/POP	−7.46***	78.1***	72.34***
ΔΔATM/POP	−17.42***	99.1***	116.8***
ΔATM/POP	−1.42*	48.6***	52.34***

*Note: The null is rejected at *** <1, ** <5, * <10 levels.*

References

Arellano, M. (1987), 'Computing Robust Standard Errors for Within-groups Estimators', *Oxford Bulletin of Economics and Statistics,* vol. 49 no. 4, pp. 431–434.

Bank of Latvia (2010), *Annual Report 2009,* Latvijas Banka.

Bódi-Schubert, A. (2010), 'Factors behind high cash usage in Hungary', *MNB Bulletin,* March.

Bovi, M. (2002), 'The nature of the underground economy – some evidence from OECD countries', *ISAE Working Papers,* no. 26, June.

Campbell, J. Y. and Mankiw N. G. (1990), 'Permanent Income, Current Income, and Consumption', *Journal of Business & Economic Statistics,* vol. 8 no. 3, July.

Deungoue, S. (2008), 'Will we pay in the same way?', *European Journal of Finance,* vol. 14 no. 1, pp. 49–67.

Fischer, B., P. Köhler and F. Seitz (2004), 'The demand for euro area currencies: past, present and future', *ECB Working Paper Series,* no. 330.

Gresvik, O. and H. Haare (2008), 'Payment habits at point of sale. Different methods of calculating use of cards and cash in Norway', *Staff Memo,* nr. 6, Norges Bank.

Guibourg, G. and B. Segendorf (2008), 'The Use of Cash and the Size of the Shadow Economy in Sweden 2007', *Sveriges Riksbank Working Paper Series,* no. 204.

Humphrey, D., A. Kaloudis and G. Øwre (2000), 'Forecasting cash use in legal and illegal activities', *Working paper,* Central Bank of Norway, Oslo.

Humphrey, D., A. Kaloudis and G. Øwre (2004), 'The future of cash: falling legal use and implications for government policy', *International Financial Markets, Institutions and Money,* vol. 14, pp. 221–233.

Komáromi, András (2007), 'The effect of the monetary base on money supply – Does the quantity of central bank money carry any information?', *MNB Bulletin,* June.

Mankiw, N. G. and Lawrence H. Summers (1986), 'Money Demand and the Effects of Fiscal Policies', *Journal of Money, Credit and Banking,* vol. 18 no. 4, November, pp. 415–429.

Murray M. P. (2006), 'Avoiding Invalid Instruments and Coping with Weak Instruments', *Journal of Economic Perspectives,* vol. 20 nr. 4, Fall, pp. 111–132.

Odorán, R. and B. Sisak (2008), 'Cash demand of the Hungarian economy – is the shadow economy still running smoothly?', *MNB Bulletin,* December.

Paunonen, H. and H. Jyrkönen (2002), 'Cash usage in Finland – How much can be explained?', *Discussion Papers,* 10, Bank of Finland.

ROGOFF, K. (1998), 'Blessing or curse? Foreign and underground demand for euro notes', *Economic Policy,* vol. 13. no. 26, pp. 263–303.

SCHNEIDER, F AND H. D. ERNSTE (2000), 'Shadow economies: Size, causes, consequences', *The Journal of Economic Literature,* vol. 38 no. 1, pp. 77–114.

SCHNEIDER, F AND H. D. ERNSTE (2004), *The shadow economy: An international survey,* Cambridge University Press.

SNELLMAN, J. S., J. M. VESALA AND D. B. HUMPHREY (2001), 'Substitution of non-cash payment instruments for cash in Europe', *Journal of Financial Services Research,* vol. 19 no. 2–3, pp. 131–145.

SLACALEK, J. (2009), 'Survey of Literature on Demand for Money: Theoretical and Empirical Work and financial wealth', *ECB Working Paper Series,* no. 1117.

SRIRAM S. (1999), 'Survey of Literature on Demand for Money: Theoretical and Empirical Work with Special Reference to Error-Correction Models', *International Monetary Fund Working Papers,* no. 99, May.

STOCK, JAMES H. AND MARK W. WATSON (2007), *Introduction to econometrics,* 2nd ed., Pearson Addison Wesley.

THIESSEN, U. (2010), 'The Shadow Economy in International Comparison: Options for Economic Policy Derived from an OECD Panel Analysis', *DIW Berlin Discussion Paper,* 1031, German Institute for Economic Research, Berlin.

WHITE, H. (1980), 'A Heteroskedasticity-Consistent Covariance Matrix and a Direct Test for Heteroskedasticity', *Econometrica,* vol. 48 no. 4, pp. 817–838.

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H–1037 Budapest, Csillaghegyi út 19–21.