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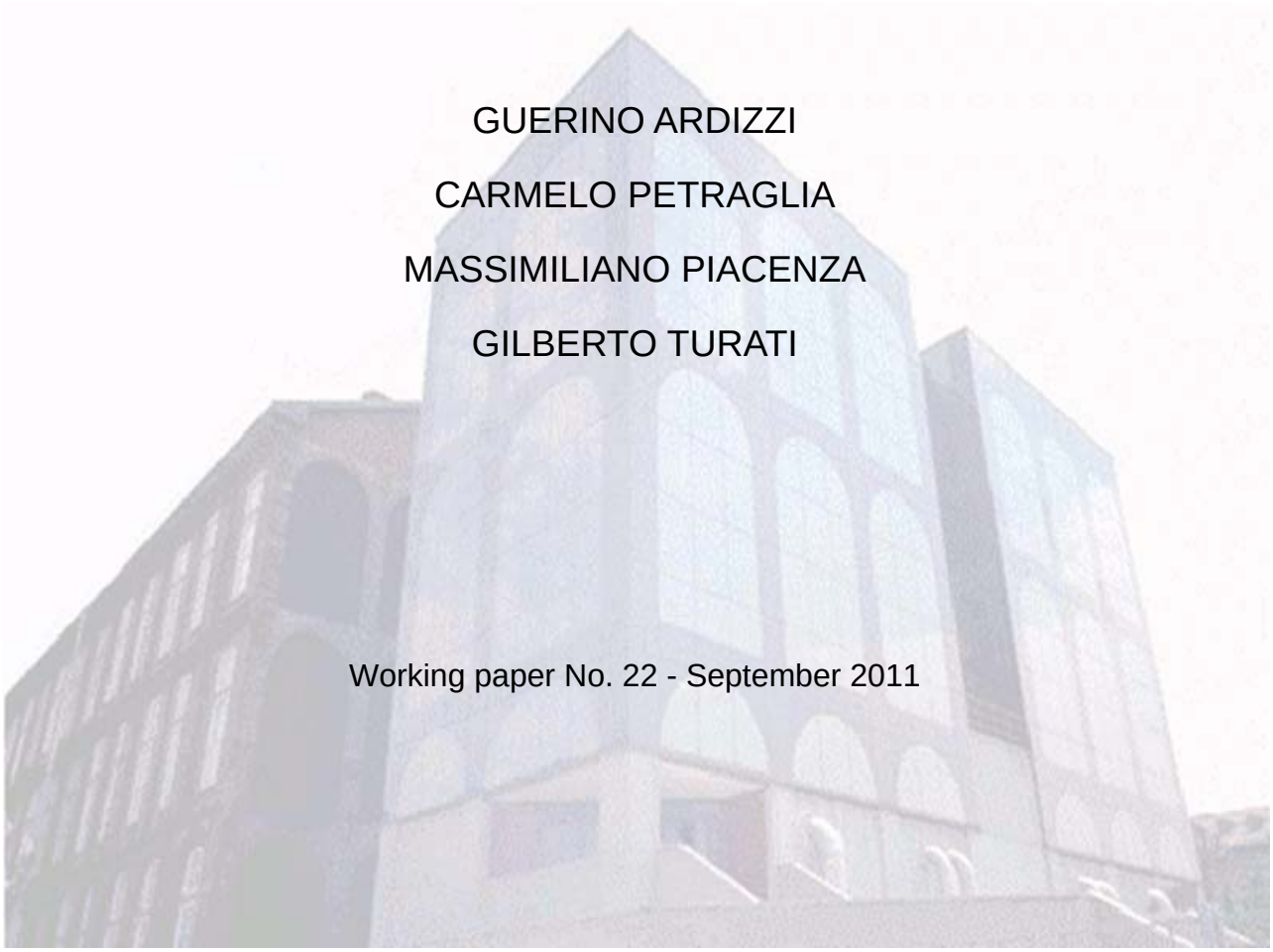
MEASURING THE SHADOW ECONOMY WITH THE CURRENCY DEMAND APPROACH A REINTERPRETATION OF THE METHODOLOGY, WITH AN APPLICATION TO ITALY



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Measuring the Shadow Economy with the Currency Demand Approach
A Reinterpretation of the methodology, with an application to Italy [§]

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Abstract

We contribute to the debate on how to assess the size of the shadow economy by proposing a reinterpretation of the traditional Currency Demand Approach (CDA) *a là* Tanzi. In particular, we introduce three main innovations. First, we take a direct measure of cash transactions (the flow of cash withdrawn from bank accounts relative to total noncash payments) as the dependent variable in the money demand equation. This allows us to avoid using the Fisher equation, overcoming two severe critiques to the traditional CDA. Second, we include among covariates two distinct measures of 'detected' tax evasion, in place of the tax burden level. Finally, we control also for a new 'criminal' component of the shadow economy, considering money demand for illegal activities like drug dealing and prostitution. We propose an application of this 'modified – CDA' to a panel of 91 Italian provinces for the years 2005-2008.

Keywords: Shadow economy, Currency demand approach, Cash transactions, Evasion, Crime

JEL classification: E26, E41, H26, K42, O17

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1. Introduction

The Currency Demand Approach (CDA) is the most popular method to estimate the shadow economy among the so-called indirect macroeconomic approaches. Originally suggested by Cagan (1958), the CDA was subsequently refined and applied by Tanzi (1980, 1983) to the U.S. economy, and has been (and still is) widely adopted in the literature (among the more recent contributions, see Ferwerda *et al.*, 2010). The CDA measures the size of the shadow economy in two stages: 1) the econometric estimation of an aggregate money demand equation, with a specific component related to cash transactions in the underground sector; 2) the computation of the value of these shadow transactions via the quantity theory of money. The key assumptions for the first-stage estimation are that shadow transactions are settled in cash to avoid traceability, and that the main cause of the underground economy is a high tax burden. The CDA involves estimating the aggregate cash demand including among the regressors both standard explanatory variables of the preference for liquidity (like the interest rate on deposits) and specific variables identifying the determinants of the shadow economy (like the tax burden). The demand for cash associated with shadow transactions is then computed as the difference between the estimated demand for cash in the full model and the demand obtained by setting to zero all the determinants of the underground economy (i.e., the demand for cash motivated only by regular transactions).

In the Tanzi (1980, 1983) application of the CDA to the U.S. economy, the dependent variable in the money demand equation is the cash to money supply ratio. This ratio is regressed on three variables identifying the determinants of money demand for regular transactions (the share of wages paid in cash on the national income, the interest rate on savings deposits, and the average income per capita), plus the average tax rate on personal income, which is considered to be the sole determinant of the shadow transactions. Since a basic assumption of the CDA is that a higher tax burden stimulates a higher evasion, which in turn causes an increase in the demand for cash, the expected sign on the income tax rate is positive. First stage estimation of the money demand equation confirms this view. In the second stage, the estimate of the shadow economy to GDP is obtained by exploiting the Fisher equation $MV = PT$ (where M is the stock of liquid assets, V is the velocity of money, P is the price level, and T the volume of transactions). In particular, Tanzi defines a base year

in which the contribution of the shadow economy to GDP is assumed to be zero, and computes the velocity of money as the ratio between the official GDP (PT) and the stock of liquid assets (M). Assuming then that this velocity is the same for the regular economy and the shadow sector, the value of the latter is obtained by multiplying V for the estimated 'excess demand' for cash.

Schneider and Enste (2000, 2002) identify and discuss many substantial drawbacks of the CDA, pointing to three main criticisms of the basic assumptions of this methodology:[1] the absence of any transactions in the shadow economy in a given base year; the same velocity of money in both the official and the irregular economy; the excessive tax burden as the only determinant of the shadow economy. Our aim here is to contribute to the debate on the measurement of the shadow economy by proposing a revision of the CDA that overcome all these three drawbacks. In particular, we propose a 'modified – CDA' introducing three main innovations to the traditional methodology: first, we take a direct measure of cash transactions (the flow of cash withdrawn from bank accounts relative to total noncash payments) as the dependent variable in the money demand equation, which avoid using the Fisher equation; second, we include among covariates two distinct measures of 'detected' tax evasion, in place of the tax burden level; finally, we also control for a new 'criminal' component of the shadow economy, considering money demand for illegal activities like drug dealing and prostitution. We then propose an original application of this 'modified – CDA' to Italy, a country where the weight of the shadow economy is remarkable compared to other Western countries.

The remainder of the paper is structured as follows. Section 2 discusses the innovations we introduce in the CDA, and how these help overcome (most of) the drawbacks highlighted by Schneider and Enste (2000, 2002). In section 3 we present the application of our 'modified – CDA' to Italy, discussing the model specification and the estimation results. In particular, besides country level estimates, we examine also disaggregated territorial estimates for country macro-areas. We finally include here a comparison with the estimates obtained in other studies on Italy. Section 4 provides brief concluding remarks.

[1] Ahumada *et al.* (2007) and Breusch (2005) point to critiques specifically related to econometric issues, partly addressed by Pickhardt and Sarda (2010) within the standard CDA approach.

2. Reinterpreting the Currency Demand Approach

Our starting point are the criticism to most of the assumptions of the traditional CDA advanced by Schneider and Enste (2000, 2002). We focus here on three main issues: (1) the hypothesis of the absence of any transactions in the shadow economy in a given base year is rather unrealistic; (2) the assumption of equality in the velocity of money for both the official and the irregular economy introduces a restriction in the estimation method which is not justified on reasonable grounds; (3) also considering the excessive tax burden as the only determinant of the shadow economy is a quite restrictive assumption, as other factors – such as markets regulation (especially the labour market regulation), the trust in political institutions, and the citizens' tax morale – can substantially affect the decision to participate in the underground sector.

To avoid these critiques, we introduce three innovations in this study as compared to the traditional CDA *a là* Tanzi. First, instead of using the stock of liquid assets as the dependent variable in the money demand equation, here we take a direct measure of cash transactions: the *flow of cash* withdrawn from bank accounts with respect to total payments settled by instruments other than cash. This is a substantial modification of the model, which eliminates the need to rely on the quantitative theory of money and the Fisher equation. In this way, we are able to overcome the critique (1), concerning the need to arbitrarily chose a base year for calculating the velocity of money, and the critique (2), concerning the equality assumption of the velocity of money in both the official economy and the shadow sector. Notice that the cash withdrawals we refer to also help to deal with the problematic measurement of the stock of liquid assets in each country of the EMU zone after the introduction of the euro, which can severely limit the application of the traditional CDA.

Second, in order to answer critique (3), direct measures of *detected tax evasion* are included among the factors determining the (irregular) transactions settled in cash. In this way, we remove the need to identify a set of variables that can adequately capture all the relevant determinants of the phenomenon besides the level of tax burden, which is the key variable in the classic Tanzi-approach and does not take into account the presence of other possible factors underlying the decisions of noncompliance (e.g., Ferwerda *et al.*, 2010; Schneider, 2010).

Finally, with reference again to criticism (3), we argue that evasion is just one component of the shadow economy. Hence, the methodology we propose also controls for the presence of *criminal transactions*. These are shadow transactions not motivated by a high tax burden or other reasons which could lead a taxpayer to carry out legal productive activities usually object of revenue collection by Tax Authorities in an irregular way. We consider in particular two criminal activities like drug dealing and prostitution, which are illegal transactions typically regulated in cash. Almost all scholars agree in classifying these among the activities that make up the underground economy.[2] According to the definition proposed, among others, by Smith (1994, p. 18), «*the shadow economy includes any market-based production of goods and services, whether legal or illegal, that escapes detection in the official estimates of GDP*». Notice that these transactions identify a second important component of the shadow economy, with distinct origins and different implications in terms of law enforcement policies. The choices of individuals operating in the two sectors of the underground economy (evasion and crime) are affected by different motivations and incentive mechanisms, including the role played by deterrence actions. The two components also differ remarkably in terms of their effects on public finances, as it is possible to identify potential revenue subtracted to Tax Authorities only for shadow economy due to evasion. Despite these differences, the decomposition of total shadow economy in tax evasion and crime is an issue rarely investigated in the literature, mainly because of the difficulty in delineating the boundaries of the analysis and the lack of reliable information.[3] Here we focus on crime indicators related to both drug dealing and prostitution, defining more precisely the excess demand of money due to evasion and that due to crime, and introducing a third innovation with respect to the traditional CDA.

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[2] See the classification originally proposed by Lippert and Walker (1997) and subsequently integrated by Schneider and Enste (2000, 2002) and Schneider (2010).

[3] For a comprehensive analysis of the shadow economy in different countries with a discussion of the contribution of the two components, see the study by Thomas (1992). A recent application that takes into account the role of criminal activities and relies on the traditional CDA is Ferwerda *et al.* (2010). In particular, to reply to criticism (3) raised by Schneider and Enste (2000, 2002), the authors propose some modifications to the Tanzi-approach, by including in the model several proxies for the determinants of the shadow economy in substitution of the income tax rate. The variables considered are unemployment rate, government expenditure indicators, crime indicators, and measures of the degree of education and social inequality. However, the results are judged unsatisfactory by the authors, since none of the proxies adopted significantly explains the shadow economy as measured by excess demand for cash. The authors conclude therefore by highlighting the need to identify variables more closely related to the decision to operate in the underground sector. Our contribution goes just in this direction and also tries to disentangle the criminal component of the shadow economy.

3. An application of the 'modified – CDA'

3.1. Defining the demand for cash payments

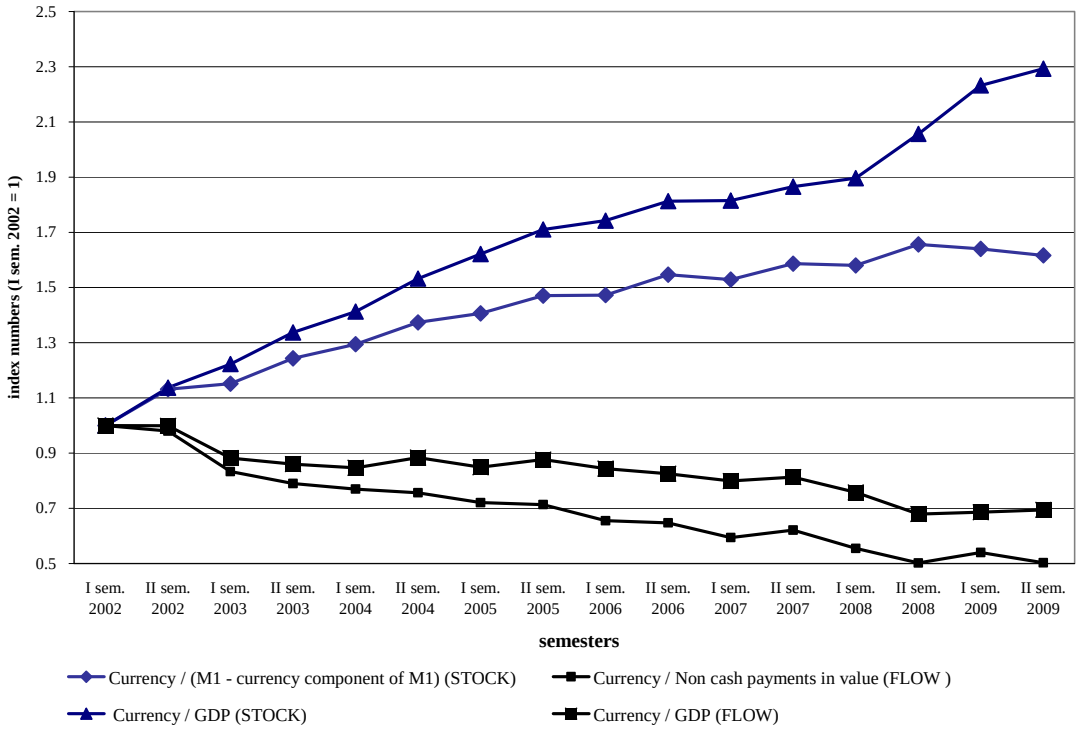
In this section of the paper we provide a first application of the 'modified – CDA' to a balanced panel of 91 Italian provinces observed from 2005 to 2008. We first need to discuss the definition of the demand for cash payments, and then its determinants. As for the demand of cash payments, departing from the standard CDA, we exploit information on the *flow* of cash rather than the *stock* of liquid assets. Hence, we base our assessment of the size of the shadow economy on a *direct* measure of the value of transactions at the provincial level. In particular, the dependent variable in the estimated equation of the demand for cash payments is the ratio of the value of cash withdrawn from bank accounts to the value of total payments settled by instruments other than cash (*CASH*). This represents a measure of the demand for untraced payments per euro of traceable ones (i.e., payments settled by bank transfers, cheques, credit cards).

The transactions theory of money demand relies on liquid assets as such (e.g., M1) rather than on the concept of payment, the latter necessarily implying a cash flow and precise technical and organizational procedures by which these flows circulate in the economy. However, even in the presence of reliable statistics, stock indicators can be highly inaccurate for three reasons: a) quantifying the level of national currency used outside national borders is problematic, and this is particularly true in the Euro area after the euro entered circulation in 2002; b) a certain amount of money can be held for purposes other than transactions: traditional theories of money demand discuss, for instance, the 'speculative motive' for holding money reserves; c) the velocity of money is assumed to be constant with respect to several GDP components, including the informal sector, without taking into account, *inter alia*, trade in intermediate goods and services. Hence, there may be compensatory phenomena within the same stock of banknotes in circulation, both between different purposes for holding money reserves, and between the use of cash in the formal and the informal sector. This is confirmed by the recent trend of the currency-to-GDP ratio in the countries belonging to the G10 and to the Eurosystem: the ratio has remained stable or even increased since 2004 in those countries that should have been more affected by the replacement of banknotes with digital money. Similar considerations hold for other stock-based indicators of currency demand, such as the stocks of M1 (currency and deposits repayable on demand). Notice that –

although being a signal of a higher preference for liquidity – an increase in a stock-based monetary aggregate is not informative about the underlying reasons, including for instance the rebalancing of portfolio assets, the adjustment in liquidity buffers, the need to hide transactions (whether for evading taxes or because they are illegal). The European Central Bank has noted that, on the occasion of the so-called cash changeover, the stock of euro banknotes in circulation has increased (even compared to M1 or M2) more than the previous circulation of national currencies would have suggested (ECB, 2008). According to he ECB, «*this is reasonable, in particular, in an environment of low interest rates and low inflation expectations*», not to mention that an estimate up to 20% percent of banknotes in circulation is held outside of the Euro area. It then becomes difficult – if not impossible – to estimate the component of cash held to settle payments within the underground economy using stock infomation. This is the reason why researchers need to select monetary indicators more directly related to the transaction motive.

In order to better clarify this issue, Figure 1 shows the recent trends of the currency-to-GDP and the currency-to-M1 ratios as compared to their respective flows in Italy. Two diverging trends can be observed: the stocks show a rising trend, while the flows are declining. An explanation of the increasing trend of stocks is given by the above mentioned explanation provided by the ECB. The decreasing trend of flows is instead consistent with the diffusion of electronic payment instruments in commercial transactions, which allow some substitution between alternative instruments, at least in the formal economy. Furthermore, the common trend of the two flow-based indicators confirms the higher coherence of these indicators with the transaction motive of the demand for cash. The combined evidence of such a 'substitution effect' of cash flows and the growing trend of the stock of banknotes suggests a slowing down of the overall velocity of circulation of legal money in order to meet liquidity needs other than purely transactional ones. All these considerations seem to support the criticisms raised to the traditional CDA based on the quantity theory of money and the Fisher equation.

Figure 1. Monetary aggregates in Italy: stocks vs. flows (index numbers, first semester 2002 = 1)



Source: own elaboration on Bank of Italy and ISTAT data.

The direct link between flow-based indicators of currency demand and the transaction motive of the demand for cash can also be highlighted by looking at micro-data on cash purchases collected by the Bank of Italy through the *Survey on Household Income and Wealth*. Table 1 illustrates the correlation matrix of two different (macro) currency ratios (based on bank cash withdrawals flows divided by other payments transactions) and the percentage of cash purchases on total expenditures declared by the Italian households sample in the period 2006-2008 (nearly the period considered in this study). The correlation coefficients are positive and significant in all cases. As one would expect, the 'ATM cash withdrawals on POS card transactions' ratio shows a higher correlation with the cash expenditure share by Italian households than the 'Total cash withdrawals value flows to total non cash payments' ratio. That is to say, the closer is the monetary indicator to the 'point of sales', the higher is the

correlation with the household cash expenditures.[4] Nevertheless, the wider indicator of cash usage 'Total cash withdrawals value flows to total non cash payments' better accounts of the behaviour of the economic operators as a whole (households, firms, public sector), which makes it more appropriate for our purposes. Hence, as described in detail in the next section, our empirical model will consider as dependent variable *CASH*, that is, the ratio of the value of cash withdrawals from bank accounts to the value of total payments settled by instruments other than cash.

Table 1. Pearson, Spearman and Kendall tau-b correlation coefficients on different cash usage indicators [a]

Cash usage indicator	Total cash withdrawals value flows on total non cash payments [b]	ATM cash withdrawals on POS card transactions [c]	Cash expenditure share by Italian households [d]
		Pearson correlation	
Total cash withdrawals value flows on total non cash payments	1		
ATM cash withdrawals on POS card transactions	0.663	1	
Cash expenditure share by Italian households	0.717	0.848	1
		Spearman correlation	
Total cash withdrawals value flows on total non cash payments	1		
ATM cash withdrawals on POS card transactions	0.695	1	
Cash expenditure share by Italian households	0.690	0.793	1
		Kendall tau-b correlation	
Total cash withdrawals value flows on total non cash payments	1		
ATM cash withdrawals on POS card transactions	0.490	1	
Cash expenditure share by Italian households	0.490	0.590	1

[a] Each correlation index is based on data for the 20 Italian Regions. All correlation indexes are statistically significant at 1%.
[b] Bank of Italy, banking statistics 2006-2008 (average annual value).
[c] Bank of Italy, banking statistics 2009.
[d] Bank of Italy, *Survey on Household Income and Wealth*, 2006-2008 (average annual value).

[4] Exhaustive data on ATM cash withdrawals and POS transactions at regional level are fully available from 2009. Nevertheless, the stability of payment behaviours over time makes the correlation analysis consistent even in the presence of a different period covered by data on cash expenditures.

3.2. Defining the determinants of cash payments

In line with the discussion in Section 2, we classify the determinants of *CASH* in three groups, thus identifying three components of the demand for cash payments: the *structural* component, the *tax evasion* component, and the *crime* component. A description of the variables affecting each of the three components is provided below. The Appendix reports descriptive statistics and information on data sources (see Tables A1 and A2).

3.2.1. The structural component of the demand for cash payments

Drawing from the literature on the demand for cash (e.g., Goodhart and Krueger, 2001), we identify four conventional determinants of the structural demand for cash payments: the level of economic development; the degree of spatial diffusion of banking activities; the technology of payments; the interest rate. The level of development of the (formal) economy is measured by per capita GDP at the provincial level (*YPC*). As suggested by several authors (e.g., Schneider and Enste, 2000; Schneider, 2010), *YPC* has a negative expected sign: the higher the living standard, the lower the use of cash (and the higher the demand for alternative payment instruments). Income is highly correlated to education (both general education and 'financial literacy'), and more education usually leads to a lower use of cash, since more educated individuals show greater confidence in alternative payment instruments (World Bank, 2005; Ferwerda *et al.*, 2010).

We use the number of per capita bank accounts (*BANK*) as a proxy of the spatial diffusion of banking activities, thus controlling for the structural impact of the degree of bank branches diffusion in provincial economies on the demand for cash payments. The expected sign of *BANK* coefficient is negative, as a higher diffusion of current accounts reduces the need to withdraw cash from ATMs for payments.

Several studies (e.g., Drehmann and Goodhart, 2000; Goodhart and Krueger, 2001; Schneider, 2009) emphasize the importance of the technology of payments, with a particular reference to the supply of electronic instruments. We account for available technology by including the variable *ELECTRO* among the structural determinants of *CASH*. *ELECTRO* measures the ratio of the value of transactions settled by electronic payments to provincial GDP. Since a higher share of electronic transactions (via POS and internet banking) implies a lower number of cash transactions, the expected sign of the *ELECTRO* coefficient is negative.

The interest rate on bank deposits *INT* is the fourth determinant of the structural component of *CASH*. Based on standard economic theory, the interest rate is expected to have a negative effect on the demand for money, via its role of opportunity cost of holding cash in alternative to interest-bearing assets. Notice, however, that our model deals with cash flows rather than stocks of liquid assets, which implies an ambiguous effect of the interest rate.[5] Higher interest rates might even have a positive impact on flows, for instance, by pushing towards forms of cash raising alternative to the banking channel. However, due to the usual 'speculative' motive, we can not exclude that the interest rate on bank deposits may also negatively affect the propensity to withdraw cash in alternative to the use of other payment instruments. Thus, the expected sign of the *INT* coefficient is *a priori* unclear.

3.2.2. The tax evasion component of the demand for cash payments

We innovate the traditional CDA by considering measures of detected tax evasion instead of the usual variables proxying for the tax burden, like the (average) income tax rate. Information on detected tax evasion are retrieved from a dataset concerning inspection activities with law enforcement purposes by the *Guardia di Finanza* (the Italian tax police). The availability of such information is particularly relevant for two reasons. First, as already discussed above, many factors – beyond the burden of taxes and social security contributions – would be likely to influence the decision to escape Tax Authorities (market regulation, tax morale of citizens, efficiency of public administration, etc.), and each of such factors would need a proper proxy.[6] Second, since we aim at providing disaggregated territorial estimates of the shadow economy, there are no data on the effective tax rate at the provincial level in Italy, and the calculation of some measures of fiscal pressure for Italian provinces is not a trivial task, as taxes are levied by four different levels of government. In order to overcome these problems, we selected two variables that provide a direct measure of the diffusion of the productive activities (partially or totally) unknown to Tax Authorities at the provincial level.

[5] Several studies investigating the role of innovative payment systems in cash demand of Italian families (e.g., Ardizzi and Tresoldi, 2003; Lippi and Secchi, 2008; Alvarez and Lippi, 2009) point out that the progress in transaction technology may substantially reduce (or even eliminate) the impact of the interest rate on the cash demand of buyers.

[6] For a discussion on the determinants of the agents' decision to participate in the shadow economy, besides the fiscal burden, see, among the others, Friedman *et al.* (2000), Schneider and Enste (2000, 2002), Feld and Frey (2007), Dreher *et al.* (2009), Torgler and Schneider (2009), and Dreher and Schneider (2010).

$EVAS1$ is defined by the number of *specific* tax audits[7] in a given province divided by its sample mean value (this is a measure of tax evasion intensity at the provincial level) and then weighed by a GDP concentration index.[8] This latter standardization allows us to compare provinces characterized by remarkable differences in the level of economic development, thus avoiding attaching higher levels of tax evasion to provinces with a number of audits above the sample mean. The second variable ($EVAS2$) accounts for irregularities detected by the *Guardia di Finanza* during inspections to retailers. $EVAS2$ is given by the ratio of the number of positive audits on cash registers and tax receipts to the number of existing POS in the province.[9] The standardization for the number of POS is made necessary by the high variability in the presence of POS across provinces, which is likely to affect the opportunity to evade (lower where the number of POS is higher). Considering the number of tax frauds per unit of POS (instead of their absolute value) seems a proper way to control for these differences at the provincial level. The inclusion of both $EVAS1$ and $EVAS2$ in our model is motivated by the fact that the former refers to inspections which may relate to any *assumed* fiscal irregularity (evasion of income and indirect taxes or social security contributions) in any type of business, while the latter *certainly* detects only tax frauds in sales by retailers (VAT and income tax evasion). Thus, $EVAS1$ and $EVAS2$ are expected to jointly provide a more comprehensive evaluation of the tax evasion component of shadow economy.

3.2.3. The criminal component of the demand for cash payments

We introduce another innovation in the traditional CDA by computing an index of crime ($CRIME$) to account for the illegal component of the shadow economy. $CRIME$ is defined as the share of crimes violating the laws on drugs and prostitution over the total number of reported crimes in each considered province.[10] The selection of the appropriate variables to estimate the size of the criminal component of the shadow economy deserves a brief explanation. Our choice of drug- and prostitution-related offenses is motivated by the focus on illegal activities which – in line with the definition of both the shadow economy discussed

[7] These audits are *specific* in the sense that they imply inspections to firms based on ex-ante information about frauds that occurred within a particular operation (e.g., payment of salaries) and/or are related to a single item of the tax base (e.g., income taxes or social security contributions).
[8] The GDP concentration index is defined as the ratio of provincial GDP to its sample mean value.
[9] Here *positive* stands for audits with detected evasion. The ratio is weighed for the GDP concentration index for the same reasons discussed above.
[10] In analogy with tax evasion variables, also this indicator has been weighed by a GDP concentration index.

above (e.g., Smith, 1994) and the illegal economy provided by the OECD (2002) – imply an exchange between a seller and a buyer relying on a mutual agreement and a voluntary cash payment. Therefore, we excluded all those crimes which, to some extent, are based on the use of violence made to persons or properties (burglary, extortion, etc), and then imply 'payments' which do not follow an 'agreement' between the thief, for instance, and the victim.[11] We also excluded those offences with possible ambiguous effects on the size of cash withdrawals. This is, for instance, the case of thefts, which could also have a negative impact on *CASH* due to the fact that – in an area were more robberies occur – individuals will find too dangerous to hold money in cash. In essence, our choice is consistent with the model to be estimated, which exploits information on cash withdrawals from bank accounts motivated by a voluntary transactional motive.

3.3. Estimation methodology and results

Equation [1] provides the complete model of the demand for cash payments to be estimated, that is, the structural demand reflecting the ordinary preference for liquidity augmented by the two components of the shadow economy, evasion and crime:

$$CASH_{it} = \alpha_0 + \alpha_1 YPC_{it} + \alpha_2 BANK_{it} + \alpha_3 ELECTRO_{it} + \alpha_4 INT_{it} + \alpha_5 EVAS1_{it} + \alpha_6 EVAS2_{it} + \alpha_7 CRIME_{it} + \varepsilon_{it} \quad [1]$$

We apply model [1] to a balanced panel of 91 Italian provinces observed from 2005 to 2008. By this, we depart from the existing CDA literature on Italy, which has so far dealt with country-level data. The units included in the sample represent about 90% of all the Italian provinces (103), and are those for which complete information were available for all the variables included in Equation [1].

The panel structure of the database allows us to account for the existence of unobservable residual heterogeneity across provinces. To this end, we used a random-effects Tobit model (Wooldridge, 2002). This model has the advantage – as compared to a standard panel regression with individual random effects – to accommodate for the particular distribution of

[11] We do not account for money laundering in our analysis, since this is a criminal offense which results from other underlying criminal activities that amplifies in a cumulative way the impact of organized crime on both regular and irregular economies. The definition of recycling implies that the income stemming from a crime needs to be 'cleaned up' through the legal channel (e.g., bank transactions) in order to lower the likelihood for the criminal agent of being caught. After this, the 'cleaned up' money can be reinvested in legal activities.

the dependent variable, which is censored and has a concentrated mass of positive values very close to zero.[12] In particular, we specify the error structure of Equation [1] as $\varepsilon_{it} = u_i + e_{it}$, where u and e are individual effects and the standard disturbance term, respectively.[13]

Once obtained the parameter estimates of the model, we adapt and apply the original procedure proposed by Tanzi (1983) for the assessment of the shadow economy. The (absolute) size of the underground economy is given by the 'excess demand' for cash payments unexplained by structural factors. This excess demand is obtained as the difference between the fitted values of $CASH$ from the full model [1], and predicted values obtained from a restricted version of Equation [1] setting $EVAS1 = EVAS2 = CRIME = 0$. To evaluate the size of the two components of the shadow economy, we then proceed in a similar manner, by imposing alternatively the restrictions $EVAS1 = EVAS2 = 0$ and $CRIME = 0$, and calculating the excess demand for cash payments due to tax evasion and illegal activities, respectively. Given our definition of $CASH$, the estimates obtained in this way are expressed in relation to total payments settled by instruments other than cash. In order to have measures comparable with previous studies, we need to express our estimates of the shadow economy as shares of GDP. Hence, we first multiply the relevant excess demand by the denominator – in order to obtain the absolute value of cash transactions attributable to the shadow economy – and then we divide the result by the level of provincial GDP.

[12] The sample mean of $CASH$ is 0.11 (median = 0.10), with a minimum of 0.01 and a maximum of 0.24. Furthermore, 75% of the observations show values below 0.14. Before considering the censored nature of $CASH$ and adopting the Tobit specification, we estimated our model by both LSDV and GLS panel tecniques. The Hausman test did not reject the GLS model. Indeed, Cameron and Trivedi (2005) argue that one of the weaknesses of the LSDV model is the high degree of inaccuracy of the estimates when the *within* variability is dominated by the *between* variability of the panel. Looking at table A2 in the Appendix, it is clear that this is the case for all variables of our model (except INT). In light of this, we decided to adopt a random-effects Tobit specification.

[13] We also experimented with a model including time effects in addition to provincial individual effects. However, apart from the year 2007, for which the estimated coefficient resulted negative and significant, no other time effect was statistically significant, while maintaining virtually unaffected the estimates for the other variables.

Table 2. Estimated demand for cash payments (random-effects Tobit model – Italian provinces, 2005-2008) [a]

Regressors [b]	**MODEL A**	**MODEL B**
YPC	-0.030***	-0.026***
	(0.003)	(0.004)
BANK	-0.037***	-0.061***
	(0.011)	(0.013)
ELECTRO	-0.005***	-0.005***
	(0.001)	(0.001)
INT	-0.011***	-0.010***
	(0.002)	(0.002)
*EVAS*1	0.006***	0.006***
	(0.002)	(0.002)
*EVAS*2	0.027***	0.010*
	(0.005)	(0.006)
CRIME	-	0.286***
		(0.063)
Constant	0.220***	0.222***
	(0.006)	(0.006)
Observations	364	364
Log-likelihood	959.08	963.96
Wald statistic (χ^2)	1969.51***	2563.29***
σ_u	0.022***	0.023***
	(0.001)	(0.001)
σ_e	0.012***	0.012***
	(0.000)	(0.000)
ρ	0.772	0.784
	(0.019)	(0.017)

[a] Dependent variable: *CASH*; MODEL A: equation [1] without crime indicator ($\alpha_7 = 0$); MODEL B: equation [1] with crime indicator.
[b] Standard errors in round brackets; *** statistically significant at 1%; ** statistically significant at 5%; * statistically significant at 10%.

Table 2 reports the estimation results. The first column show the estimates for a reduced version of Equation [1], accounting for tax evasion only as a component of the shadow economy (MODEL A). The second column report results for a complete model considering both tax evasion and criminal activities (MODEL B). All the estimated coefficients have the expected sign, and are statistically significant at the 1% level in all cases expect one. Moreover, the LR test (H_0: MODEL A = MODEL B) confirms the importance of illegal activities

(drug dealing and prostitution) for assessing the overall extent of shadow economy based on the CDA, as the inclusion of *CRIME* significantly improves the goodness of fit of the model ($\chi^2_{(1)}$ = 9.76, p-value = 0.002). Finally, for both specifications the coefficient ρ – which measures the proportion of total residual variance explained by individual effects (u) in relation to the proportion explained by noise (e) – is close to 0.80, highlighting the importance of using panel techniques, in order to control for the presence of unobserved heterogeneity due to provincial-specific idiosyncratic random shocks.

The size of the shadow economy for each province in each year has been assessed relying on the most comprehensive specification of MODEL B, which allows us to obtain separate measures for tax evasion and crime. After estimating the size of the shadow economy and its two components, the outlier detection analysis by Hadi (1992, 1994) led to eliminate 26 observations, all characterised by implausibly high values. The average values reported in Table 3 were then obtained using the 338 remaining observations.

Table 3. Size of the shadow economy as % of GDP (Italian provinces, 2005-2008)[a]

	Tax evasion	Criminal economy	Shadow economy
2005	14.5%	10.2%	24.7%
2006	15.0%	9.6%	24.6%
2007	18.0%	11.3%	29.3%
2008	18.5%	12.6%	31.1%
Average 2005-2008	*16.5%*	*10.9%*	*27.4%*

[a] 26 outliers were dropped using the Hadi (1992, 1994) method.

It is worth highlighting that the estimated size of shadow economy due to tax evasion (16.5% of GDP over the entire period 2005-2008) is very close to the official figures provided by the Italian National Institute of Statistics (Istat, 2010), while Schneider and Enste (2000, 2002) report much higher values (above 25% from mid-90s until 2000). As already suggested by Zizza (2002), this discrepancy is likely to be attributable to the role played by criminal activities. Indeed, the ratio of the criminal economy 'value added' to GDP reached 11.3% in 2007, a figure which is in line with the results provided by Eurispes (2008) for the same year (175 billion euros, 11.4% of GDP). The estimates of MODEL A – where the crime indicator is not

included – confirms that neglecting the component of the criminal economy in the application of the CDA leads to overestimate shadow economy related to tax non-compliance: when compared with MODEL B, MODEL A leads to higher values, 21.4% on average in 2005-2008, not far from the estimates presented by Schneider (2010), but below the sum of tax evasion and criminal economy estimated in MODEL B (27.4%).[14] Hence, ignoring crime as a component of the shadow economy brings about two possible measurement errors: muddling up tax evasion and illegal behaviours, on the one side, and under-estimating the total size of the shadow economy, on the other.

With reference to the temporal dynamics, one can observe an increasing trend from 2005 to 2008 for both components, although the increase appears more marked for tax evasion (+4%) compared to the criminal economy (+2.4%), with a sharp jump in the transition from 2006 to 2007 (+3% and +1.7%, respectively). Such evidence may be, at least in part, due to the fact that in 2007 the Italian economy, like other countries in the euro zone, began to suffer the cyclical downturn caused by the severe world financial crisis, with a sharp slowdown in consumptions and investments and a strong deterioration in firms' trust indicators (Bank of Italy, 2007). The negative expectations of the operators may then have led to an increased subtraction of taxable income to Fiscal Authorities, and a more marked use of the black labour market, and/or even to turn to illegal sectors of the economy (e.g., prostitution, drug dealing).[15]

Finally, the assessment of the two components of the underground economy is of particular interest in the Italian case. In the light of the marked regional differentials in tax bases and the concentration of the organized crime in specific regions, at least two questions deserve to be explored. First, given the higher degree of economic and industrial development of the Central-Northern regions, does the size of shadow economy from tax evasion differ between the North and the South of the country? Second, does the prevalent localization of the 'headquarters' of criminal organizations in the South of Italy imply a higher contribution of

[14] The average incidence of the shadow economy estimated by Schneider (2010) in the years 2005-2007 amounted to 23.3% of GDP. However, it is worth remarking that - as the estimates for the more recent years were derived from a combination of the MIMIC method with the CDA - the comparison in this case is more difficult than for the values computed up to 2000 and presented in Schneider and Enste (2000, 2002). For additional details, see Schneider (2010).

[15] Note that these changes in the economic cycle involve likely variations in the velocity of money, which presumably fell in the official economy and increased in the underground sector. This further supports the adoption of an estimation approach – such as the 'revised – CDA' proposed here – that overcomes the restriction of the velocity of money constant over time and identical between regular and underground economy.

the Southern regions to the formation of the illegal component of the shadow economy? Or, instead, is it reasonable to expect minor territorial differences, due to the high mobility of criminal resources?

Table 4. Size of the shadow economy as % of GDP in Southern and Central-Northern Italian provinces (2005-2008)[a]

	Tax evasion	Illegal economy	Shadow economy
CENTRE-NORTH			
2005	16.6%	11.5%	28.1%
2006	16.6%	11.0%	27.6%
2007	19.9%	13.0%	32.9%
2008	20.8%	14.6%	35.4%
Average 2005-2008	*18.5%*	*12.5%*	*31.0%*
SOUTH			
2005	9.7%	7.2%	16.9%
2006	11.3%	6.3%	17.6%
2007	13.6%	7.4%	21.0%
2008	13.6%	8.2%	21.8%
Average 2005-2008	*12.0%*	*7.3%*	*19.3%*

[a] 26 outliers were dropped using the Hadi (1992, 1994) method.

According to results reported in Table 4, compared to Southern provinces, those in the Centre-North seem to exhibit a higher incidence of the shadow economy on GDP, both for tax evasion (18.5% vs. 12%) and for criminal activities (12.5% vs. 7.3%). Despite being against the widespread opinion about the presence of a higher shadow economy in the South of the country,[16] such an evidence of a significant gap between Centre-North and South supports the results obtained by the few previous studies based on alternative estimation

[16] This opinion largely relies on the fact that in Southern regions payments are settled by instruments other than cash to a lower extent than in the Centre-North. The descriptive statistics reported in Table A2 in the Appendix clearly show that the use of cash is higher in the South than in the rest of the country (the mean values of *CASH* are 0.09 and 0.15 in the Centre-North and in the South, respectively). However, far from being in contrast with our results, these statistics provide evidence that in less advanced regions, because of the lower degree of financial development, a higher share of transactions in the official economy are settled in cash.

methodologies. Relying on time series from the early 80s to the late 90s, Bovi *et al.* (2002) find several periods with higher tax evasion in the North (either North-East or North-West, depending on the years) than in the South. More recently, looking at data on personal income taxation (IRPEF) and productive activities taxation (IRAP), Marino and Zizza (2008) and Pisani and Polito (2006) both conclude that in many cases tax evasion is higher in the Centre-North than in the rest of the country. The results delivered in 2011 by the Working Group *Economia non osservata e flussi finanziari* (literally, 'Unobserved economy and financial flows') – established by the Ministry of Economy and chaired by the President of the Italian Statistical Office – go in the same direction. Finally, a recent survey by one of the three biggest unions shows the significant increase in the diffusion of irregular workers in the Northern regions (UIL, 2011). As for the criminal component of the shadow economy, the higher incidence observed for the Centre-North is probably justified by the fact that the use of cash for illegal transactions related to criminal activities is higher where the 'retail markets' for goods and services such as drug and prostitution are more lucrative. Hence, despite criminal organizations having their 'headquarters' predominantly localized in the South, our evidence seems to suggest their ability to export illegal activities in the richest areas of the country.[17]

4. Conclusions

In this paper we contribute to the debate on assessing the size of the shadow economy by providing a reinterpretation of the CDA *a là* Tanzi, which aims at overcoming its most relevant weaknesses highlighted in Scheider and Enste (2000, 2002). Our main contributions can be summarized as follows. First, we introduce a *direct* measure of cash transactions as the dependent variable in the money demand equation. In particular, we use the flow of cash withdrawn from bank accounts with respect to total noncash payments in substitution of the traditional money stock variable. This departure from the standard CDA has made possible to avoid using the Fisher equation, and the associated unrealistic assumptions of a common velocity of money in both the regular and the irregular sectors. Second, instead of considering the tax burden as the only determinant of a multi-faceted behaviour, we capture the 'excess

[17] The ability of criminal organizations to 'export' their businesses is not new in the literature. It has been discussed, e.g., in Varese (2011).

demand' for cash payments due to tax evasion by using two measures of *detected* tax non-compliance, thus avoiding finding suitable proxies able to capture all the relevant causes of the phenomenon. Third, besides evasion, we identify a criminal component of the shadow economy, by introducing an appropriate determinant of the demand for money due to crime.

We present an application of this 'modified – CDA' exploiting original data on monetary variables, tax evasion and reported illegal activities for the Italian Provinces over the period 2005-2008. Our results show an average value of the shadow economy due to evasion up to 16.5% of GDP, which is consistent with the recent estimates available from official statistical sources relying on microeconomic methods of measurement, but appears to be lower than the values obtained for Italy in the international literature (e.g., Schneider and Enste, 2000, 2002 and Schneider, 2010). We show that this discrepancy is likely to be due to the omission of criminal activities in the application of the traditional CDA. Not surprisingly, when the model accounts for shadow criminal transactions, our estimates of the shadow economy increase by about 11% of GDP. This evidence points out that, ignoring illegal activities, one could not only mistakenly attribute to evasion a part of the shadow economy due to criminal transactions – for which it is not possible to implement law enforcement policies to recover lost tax revenues –, but could also underestimate the total value of underground economy.

Given the availability of relevant information at a disaggregated territorial level, we also provide estimates of the shadow economy by macro-areas. This is an important step in the understanding of the underground economy and its size, because of the marked North-South divide in the level of economic development, institutional quality and social capital in Italy. The evidence we provide suggests that, compared to Southern provinces, those in the Centre-North exhibit a higher incidence of the shadow economy relative to GDP, both for tax evasion and crime. While the result on crime provides fresh insights on the ability of criminal organizations to 'export' illegal activities (especially prostitution and drug dealing) in the richest areas where the demand is presumably higher, the finding concerning tax evasion stimulates future research on the determinants of this higher propensity to evade in the North of the country.

References

Ahumada, H., Alvaredo, F. and Canavese, A. (2007), "The Monetary Method and the Size of the Shadow Economy: A Critical Assessment", *Review of Income and Wealth*, 53(2), 363-371.

Alvarez, F. and Lippi, F. (2009), "Financial Innovation and the Transactions Demand for Cash", *Econometrica*, 77(2), 363-402.

Ardizzi, G. and Tresoldi, C. (2003), "Spunti di riflessione sull'uso del contante nei pagamenti", *Banca Impresa Società*, 2, 153-188.

Bank of Italy (2007), *Relazione Annuale*, Rome.

Bank of Italy (various years), *Survey on Household Income and Wealth*, Rome.

Bovi, M., Hermann, A., Pappalardo, C. and Sica, F. (2002), "Il sommerso: cause, intensità territoriali, politiche di regolarizzazione", in ISAE (a cura di), *Rapporto Trimestrale – Priorità nazionali: trasparenza, flessibilità, opportunità*, n. 9, 55-100.

Breusch, T. (2005), *Fragility of Tanzi's Method of Estimating the Underground Economy*, Working Paper, School of Economics, Australian National University: Canberra.

Cagan, P. (1958), "The Demand for Currency Relative to Total Money Supply", *Journal of Political Economy*, 66, 303-328.

Cameron, A.C., and Trivedi, P.K. (2005), *Microeconometrics: Methods and Applications*, Cambridge University Press, New York.

Dreher, A. and Schneider, F. (2010), "Corruption and the Shadow Economy: An Empirical Analysis", 144(2), *Public Choice*, 215-238.

Dreher, A., Kotsogiannis, C. and McCorriston, S. (2009), "How Do Institutions Affect Corruption and the Shadow Economy?", *International Tax and Public Finance*, 16(4), 773-796.

Drehmann, M. and Goodhart, C.A.E. (2000), *Is Cash Becoming Technologically Outmoded? Or Does it Remain Necessary to Facilitate Bad Behaviour? An Empirical Investigation into the Determinants of Cash Holdings*, Financial Markets Group Research Centre, Discussion Paper 358, LSE.

Eurispes (2008), *Rapporto Italia 2008*, Istituto di Studi Politici Economici e Sociali, Rome.

European Central Bank (2008), *Economic Bulletin*, special edition, May.

Feld, L. and Frey, B.S. (2007), "Tax Compliance as the Result of a Psychological Tax Contract: The Role of Incentives and Responsive Regulation", *Law and Policy*, 29(1), 102-120.

Ferwerda, J, Deleanu, I. and Unger, B. (2010), *Revaluating the Tanzi-Model to Estimate the Underground Economy*, Tjalling C. Koopmans Research Institute, Discussion Paper 10-04, Utrecht School of Economics, February.

Friedman, E., Johnson, S., Kaufmann, D. and Zoido-Lobatón, P. (2000), "Dodging the Grabbing Hand: The Determinants of Unofficial Activity in 69 Countries", 76(3), *Journal of Public Economics*, 459-493.

Goodhart, C. and Krueger, M (2001), *The Impact of Technology on Cash Usage*, Financial Markets Group Research Centre, Discussion Paper 374, LSE.

Hadi, A.S. (1992), "Identifying Multiple Outliers in Multivariate Data", *Journal of the Royal Statistical Society*, Series B, 54, 761-771.

Hadi, A.S. (1994), "A Modification of a Method for the Detection of Outliers in Multivariate Samples", *Journal of the Royal Statistical Society*, Series B, 56, 393-396.

Istat (2010), "La misura dell'economia sommersa secondo le statistiche ufficiali. Anni 2000-2008", *Conti Nazionali – Statistiche in Breve*, Istituto Nazionale di Statistica, Rome.

Lippert, O. and Walker M. (1997), *The Underground Economy: Global Evidences of its Size and Impact*, Vancouver: The Frazer Institute.

Lippi., F. and Secchi, A. (2008), *Technological Change and the Demand for Currency: An Analysis with Household Data*, Bank of Italy, Temi di Discussione, Nr. 697, Roma.

Marino, M.R. and Zizza, R. (2008), *L'evasione dell'Irpef: una stima per tipologia di contribuente*, mimeo, Bank of Italy, Rome.

OECD (2002), *Measuring the Non-Observed Economy – A Handbook*, Paris.

Pickhardt, M. and Sarda J. (2010), *The Size of the Underground Economy in Germany: A Correction of the Record and New Evidence from the Modified-Cash-Deposit-Ratio Approach*, Institute of Spatial and Housing Economics, Working Paper 201036, University of Münster.

Pisani, S. and Polito C. (2006), *Analisi dell'evasione fondata sui dati IRAP – Anni 1998-2002*, Ministero dell'Economia e delle Finanze, Agenzia dell'Entrate, Documenti di lavoro dell'Ufficio Studi.

Schneider, F (2010), "The Influence of Public Institutions on the Shadow Economy: An Empirical Investigation for OECD Countries", *Review of Law and Economics*, 6(3), 441-468.

Schneider, F. (2009), *The Shadow Economy in Europe. Using Payment Systems to Combat the Shadow Economy*, A.T. Kearney Research Report, September.

Schneider, F. and Enste D.H. (2000), "Shadow Economies: Size, Causes and Consequences", *Journal of Economic Literature*, 38(1), 77-114.

Schneider, F. and Enste, D.H. (2002), *The Shadow Economy: Theoretical Approaches, Empirical Studies, and Political Implications*, Cambridge University Press, UK.

Smith, P. (1994), "Assessing the Size of the Underground Economy: The Canadian Statistical Perspectives", *Canadian Economic Observer*, 7(5), May.

Tanzi, V. (1980), "The Underground Economy in the United States: Estimates and Implications", *Banca Nazionale del Lavoro Quarterly Review*, 135(4), 427-453.

Tanzi, V. (1983), "The Underground Economy in the United States: Annual Estimates 1930-1980", *IMF Staff Papers*, 30(2), 283-305.

Thomas, J.J. (1992), *Informal Economic Activity*, LSE Handbooks in Economics, London: Harvester Wheatsheaf.

Torgler, B. and Schneider F. (2009) "The Impact of Tax Morale and Institutional Quality on the Shadow Economy", *Journal of Economic Psychology*, 30(2), 228-245.

UIL (2011), *2° Rapporto UIL sul lavoro sommerso*, Servizio Politiche del Lavoro e della Formazione, Rome.

Varese, F. (2011), *Mafias on the Move: How Organized Crime Conquers New Territories*, Princeton University Press, Princeton.

Wooldridge, J.M. (2002), *Econometric Analysis of Cross Section and Panel Data*, MIT Press, Cambridge, Massachusetts.

World Bank (2005), *International Migration, Remittances, and the Brain Drain*, M. Schiff and C. Ozden (eds.), Washington, D.C.

Zizza, R. (2002), *Metodologie di stima dell'economia sommersa: un'applicazione al caso italiano*, Bank of Italy, Temi di Discussione, Nr. 463, December.

Appendix. The data

This study uses an original dataset on a balanced panel of 91 Italian provinces observed over the period 2005-2008. This dataset merges information of four different sources: Bank of Italy (BdI), *Guardia di Finanza* (GdF, the Italian Tax Police), Istat (the Italian National Statistical Office), and Eurostat (the Statistical Office of the European Union). All monetary variables are provided by BdI. Data on provincial GDP are provided by Eurostat. The proxies for tax evasion are computed using data on GdF fiscal inspections for the period 2005-2008. The crime index uses information on criminal offences downloaded at http://giustiziaincifre.istat.it.

Table A1. Data description (definition of variables and data sources)

Variable	Definition	Source
CASH	Ratio of the value of cash withdrawn from bank accounts to the value of total payments settled by instruments other than cash	BdI
Structural factors		
YPC	Provincial GDP per capita	Eurostat
BANK	Per capita number of banking accounts	BdI
ELECTRO	Ratio of the value of transactions settled by electronic payments to GDP	BdI and Eurostat
INT	Rate of interest on bank deposits	BdI
Tax evasion		
*EVAS*1	Number of specific tax audits in a province divided by its sample mean value (weighted by a GDP concentration index)	GdF and Eurostat
*EVAS*2	Ratio of the number of positive audits on cash registers and tax receipts to the number of existing POS in the province (weighted by a GDP concentration index)	GdF and Eurostat
Criminal economy		
CRIME	Share of crimes violating laws on drugs and prostitution over the total number of reported crimes (weighted by a GDP concentration index)	Istat and Eurostat

Table A2. Descriptive statistics

Variable	Mean	Standard Deviation			Min	Max
		Total	*Between*	*Within*		
			ITALY [a]			
CASH	0.108	0.048	0.046	0.013	0.010	0.236
YPC (×10⁴ €)	2.491	0.596	0.590	0.099	1.235	3.908
BANK	0.584	0.193	0.189	0.042	0.236	1.177
ELECTRO	2.100	1.728	1.598	0.672	0.538	16.638
INT	1.247	0.488	0.265	0.410	0.472	2.909
EVAS1	1.151	0.594	0.575	0.159	0.222	3.839
EVAS2	0.204	0.215	0.207	0.063	0.001	1.233
CRIME	0.023	0.020	0.019	0.004	0.001	0.116
			CENTRE-NORTH [b]			
CASH	0.090	0.041	0.039	0.012	0.010	0.204
YPC (×10⁴ €)	2.823	0.335	0.318	0.110	2.061	3.908
BANK	0.684	0.129	0.125	0.036	0.304	1.177
ELECTRO	2.399	1.962	1.802	0.800	0.538	16.638
INT	1.299	0.504	0.261	0.432	0.472	2.909
EVAS1	1.067	0.522	0.507	0.136	0.221	2.746
EVAS2	0.149	0.186	0.178	0.059	0.001	1.233
CRIME	0.022	0.021	0.021	0.003	0.001	0.115
			SOUTH [c]			
CASH	0.148	0.038	0.036	0.016	0.063	0.236
YPC (×10⁴ €)	1.703	0.216	0.210	0.062	1.234	2.218
BANK	0.347	0.077	0.057	0.053	0.236	0.581
ELECTRO	1.390	0.478	0.479	0.077	0.806	2.723
INT	1.122	0.423	0.235	0.355	0.474	2.480
EVAS1	1.350	0.699	0.678	0.205	0.387	3.839
EVAS2	0.335	0.224	0.215	0.0718	0.037	0.983
CRIME	0.025	0.016	0.015	0.006	0.003	0.095

[a] Figures based on a balanced panel of 91 provinces observed in 2005-2008 (364 total observations).

[b] Figures based on a balanced panel of 64 provinces observed in 2005-2008 (256 total observations).

[c] Figures based on a balanced panel of 27 provinces observed in 2005-2008 (108 total observations).

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