

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

BY GUERINO ARDIZZI

Bank of Italy

CARMELO PETRAGLIA

University of Basilicata

MASSIMILIANO PIACENZA AND GILBERTO TURATI*

University of Torino

We contribute to the debate on how to assess the size of the underground (or shadow) economy by proposing a reinterpretation of the traditional Currency Demand Approach (CDA) *à la* Tanzi. In particular, we introduce three main innovations. First, we take a direct measure of the value of cash transactions—the flow of cash withdrawn from bank accounts relative to total non-cash payments—as the dependent variable in the money demand equation. This allows us to avoid unrealistic assumptions on the velocity of money and the absence of any irregular transaction in a given year, overcoming two severe critiques to the traditional CDA. Second, in place of the tax burden level, usually intended as the main motivation for non-compliance, we include among the covariates two direct indicators of detected tax evasion. Finally, we control also for the role of illegal production considering crimes like drug dealing and prostitution, which—jointly with the shadow economy—contributes to the larger aggregate of the non-observed economy and represents a significant component of total cash payments. We propose then an application of this “modified CDA” to a panel of 91 Italian provinces for the years 2005–08.

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

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1. INTRODUCTION

The Currency Demand Approach (CDA) is the most popular method to estimate the underground (or shadow) economy among the so-called indirect macroeconomic approaches. Originally suggested by Cagan (1958), the CDA was

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*Correspondence to: Gilberto Turati, University of Torino, Department of Economics and Statistics, Corso Unione Sovietica 218 bis, 10134 Torino, Italy (gilberto.turati@unito.it).

subsequently refined and applied by Tanzi (1980, 1983) to the U.S. economy, and has been (and still is) widely adopted in the literature.¹ The CDA measures the size of the shadow economy in two stages: the econometric estimation of an aggregate money demand equation, with a specific component related to cash transactions in the underground sector; and the computation of the value of these shadow transactions via the quantity theory of money. Schneider and Enste (2000, 2002) identify and discuss many substantial drawbacks of the CDA, pointing out three main criticisms of the basic assumptions of this methodology: the absence of any transactions in the underground economy in a given base year; the same velocity of money in both the official and the irregular economy; and the excessive tax burden as the only determinant of the shadow economy.

The aim of this paper is to contribute to the debate on the measurement of the underground economy by proposing a reinterpretation of the CDA that overcomes 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 the value of cash transactions (the flow of cash withdrawn from bank accounts relative to total non-cash payments) as the dependent variable in the money demand equation, which avoid making specific assumption on the velocity of money and the absence of irregular transactions in a given year. Second, in place of the tax burden level, we include among the covariates two direct measures of “detected” tax evasion, thus overcoming a serious problem of potential misspecification of the model due to the inability of considering all the relevant determinants of non-compliance. Finally, we also control for the influence of illegal production (considering crimes like drug dealing and prostitution), which represents a significant component of total cash payments and—jointly with shadow economy—contributes to the larger aggregate of non-observed economy (OECD, 2002). We then apply this “modified CDA” to Italy, a country where the size of the underground economy is remarkable compared to other Western countries. The use of panel data for Italian provinces observed over the period 2005–08 allows us to provide sub-national estimates of the two components of non-observed economy. To the best of our knowledge, this represents a further novelty of this work with respect to most of the current literature.²

The remainder of the paper is structured as follows. Section 2 provides a brief summary of the traditional CDA, and a discussion of the methodological innovations we introduce to reinterpret the traditional approach, showing how these help overcome (most of) the drawbacks highlighted by Schneider and Enste (2000, 2002). Section 3 deals with the theoretical considerations supporting our empirical model, introducing the key hypotheses to be tested in the estimations. In Section 4 we present the application of our “modified CDA” to Italy, discussing model specification and empirical results. We also propose a number of robustness checks to control whether our results are sensible to alternative model specifications.

¹Among the more recent contributions on this method, see Ahumada *et al.* (2007, 2008) and Ferwerda *et al.* (2010).

²Buehn (2012) propose disaggregated territorial estimates for German districts, but the work is limited to shadow economy and neglects the role played by illegal production.

Besides country level estimates, we provide disaggregated territorial estimates for country macro-areas. Section 5 contains brief concluding remarks.

2. REINTERPRETING THE TRADITIONAL CURRENCY DEMAND APPROACH

Following the classification used in Schneider (2010a, 2011), three main methodologies have been applied so far by researchers for the measurement of the shadow economy: (1) direct micro level procedures, such as surveys on firms and households;³ (2) indirect macro level procedures making use of aggregate data retrieved from national accounts, such as the CDA; and (3) models that use statistical tools to estimate the shadow economy as an “unobserved” variable, such as the Multiple-Indicators–Multiple-Causes (MIMIC) model.⁴

The CDA is by far the most popular within the above mentioned methodologies, carried out making a number of restrictive hypothesis though. Section 2.1 summarizes the empirical strategy of the traditional CDA and, provided that our empirical analysis concerns the Italian provinces, briefly review the main studies aimed at estimating the size of the shadow economy in Italy by using the CDA method. Section 2.2 discusses in detail the innovations of our methodology as compared to the traditional CDA.

2.1. *The CDA in a Nutshell*

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; and (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 level). 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).

³Direct micro methods use surveys either on firms or households aiming to assess the size of shadow economy in specific sectors and/or specific categories of tax payers. For an exhaustive discussion on advantages and limits, see Mogensen *et al.* (1995).

⁴The MIMIC assumes that the shadow economy remains an unobserved phenomenon (latent variable) whose causes and effects are observable but not directly measured. The MIMIC procedure produces only a ranking of the size and the development of the shadow economy, which implies the adoption of other methods in order to convert the relative index into estimates in percentage of official GDP. In particular, the CDA is used to calibrate the relative estimates into absolute ones. For further details on this estimation method, see Frey and Weck-Hannemann (1984), Giles (1999), Schneider and Enste (2002), Pickhardt and Sarda (2006), Buehn *et al.* (2009), Schneider (2010a, 2011), Pickhardt and Sarda (2011), and Buehn and Schneider (2012).

For instance, 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 (a proxy for the stock of liquid assets M in the Fisher equation). 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.⁵ First stage estimation of the money demand equation confirms this view. In the second stage, the estimate of the underground economy to GDP is obtained by exploiting the Fisher equation $M \cdot V = P \cdot T$, where M is the money supply (i.e., the stock of liquid assets available in the economy at a specific time), V is the velocity of money, and the right-hand side is the value of total transactions in goods and services. Since $P \cdot T$ is unknown, the implementation of the Fisher equation requires one to assume that the values of total transactions in goods and services is proxied by nominal GDP. Then, defining a base year in which the contribution of the underground economy to GDP is assumed to be zero, the velocity of money V is computed as the ratio between the official GDP and the stock of liquid assets. 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.

Although the issue is of great concern for policy makers, there is a scant number of empirical studies on the size and the development of shadow economy in Italy. The official figures are delivered by the Italian National Statistical Office (ISTAT). In particular, the estimates of employment and value added generated by the shadow economy are obtained by applying the so called “labor input method” pioneered by the ISTAT itself in the 1980s.⁶ The shadow economy is defined as that part of non-observed economy related to the legal production of goods and services hidden to Tax Authorities (ISTAT, 2010, p. 1). The exclusion of illegal economy from official figures is motivated by the difficulties and the resulting uncertainty of the estimate, which would make data from various countries little comparable. The latest figures are available for the period 2000–08. The value added produced in the underground economy is estimated to be in 2008 between a minimum of 16.3 percent (approximately 255 billion euros) and a maximum of 17.5 percent of GDP (about 275 billion euros). Overall, shadow activities seem to show a somewhat countercyclical pattern, with peaks reached in 2001 and 2008.

⁵Notice that this introduces a causality issue in the traditional CDA, which is the source of further econometric critiques to this methodology (e.g., Breusch, 2005a, 2005b). As will be discussed below, our reinterpretation reduces the CDA to a decomposition exercise in the spirit of, for example, Wagstaff *et al.* (2003), hence also avoiding these technical problems.

⁶As summarized by OECD (2002), the methods entails: (1) estimate the labor input underlying GDP estimates; (2) estimate the labor input based on household survey data; (3) convert the enterprise based (demand) and household based (supply) estimates of labor input into the same units of labor input; and (4) compare the two sets of estimates. A surplus of labor input derived from the household source over that from the enterprise source is an indication of non-observed production.

According to the results delivered by Schneider and Enste (2000, 2002)—perhaps the most known CDA studies delivering results for Italy—the shadow economy represents more than one-fourth of the officially measured GDP (above 25 percent from mid-1990s until 2000). More recent estimates obtained with the MIMIC approach provided by Buehn and Schneider (2012) are in line with these figures, showing a share of the shadow economy out of total GDP around 27 percent over the period 2000–07. A general weakness of both studies rests in neglecting the issue of illegal production.

This weakness has been discussed by Zizza (2002), who estimates the size and the evolution of the shadow economy in Italy, by introducing a variable that explicitly controls for the impact of criminal activities on the demand for cash payments among the regressors of the standard CDA approach *à la* Tanzi. Using a relatively small number of observations (68; 1984–2000 quarterly data), the aggregate money demand equation is estimated by regressing the currency-to-GDP ratio on a measure of tax pressure (the sole determinant of the shadow economy), the interest rate, and an indicator of crime. The tax burden measure is given by the ratio of the sum of direct taxes and social security contributions to GDP. The crime indicator is given by the share of thefts and robberies out of the total number of reported crimes. The author argues that her results are consistent with the official figures provided by ISTAT for the same years once one excludes the demand for cash linked to criminal activities (14–17 percent). This is an important point, since it suggests that not accounting for cash used in illegal activities can actually *bias* the estimates of the shadow economy. However, as we argue below, the indicator of crime based on the diffusion of thefts and robberies may not satisfactorily account for the use of cash in illegal transactions. Other indicators, together with a reinterpretation of the traditional CDA, are better suited to obtain more precise estimates of the underground economy.

2.2. Reinterpreting the CDA

The starting point of our reinterpretation of the CDA is the criticisms to most of the assumptions of the traditional CDA advanced by Schneider and Enste (2000, 2002). In particular, we focus here on three main issues: (1) the hypothesis of the absence of any transactions in the underground economy in a given base year, which is rather unrealistic; (2) the assumption of equality in the velocity of money for both the official and the irregular economy, which introduces a restriction in the estimation method not easily justifiable; and (3) the hypothesis of the excessive tax burden as the only determinant of the shadow economy, which is also quite restrictive, since other factors—such as market regulation (especially the regulation of labor markets), 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, in this study we introduce three innovations as compared to the traditional CDA *à la* Tanzi. First, instead of using the stock of liquid assets as the dependent variable in the money demand equation (M), here we take the flow of cash withdrawn from bank accounts with respect to total payments settled by instruments other than cash as a direct measure of cash transactions ($M \cdot V$). This is a substantial modification of the model, which

eliminates the need to make restrictive assumptions on the velocity of money V , and hence allows us to avoid the correction recently proposed by Ahumada *et al.* (2007). In particular, we are able to overcome critique (1), concerning the need to arbitrarily choose a base year for calculating the velocity of money, and critique (2), concerning the equality assumption of the velocity of money in both the official economy and the shadow sector. Another important point to be made concerns the variation over time in the velocity of money, which has apparently slowed down in recent years. 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 for countries in this area. A detailed discussion on the empirical merits of our direct measure of cash transactions with respect to the traditional money supply measures, together with some descriptive statistics, is in Appendix 1.

Second, in order to reply to critique (3), direct measures of *detected* tax evasion are included among the factors (positively) correlated with the amount of 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 shadow economy besides the level of tax burden, which is the key variable in the classic Tanzi approach. Other factors (like, for instance, market regulation and tax morale) may indeed affect the decisions of non-compliance (see, e.g., Ferwerda *et al.*, 2010; Schneider, 2010a, 2011; Buehn and Schneider, 2012). Looking directly at the final outcome of this process, we can circumvent the problem of an incomplete specification of the model resulting in biased estimates. Notice that the choice of considering detected evasion also shifts the interpretation of the model from a causal approach to a more simple decomposition exercise: in the traditional CDA, a higher tax burden *causes* a higher tax evasion; in our reinterpretation, a higher detected evasion would be simply associated with larger withdrawals of cash.

Finally, with reference again to criticism (3) and the issue of model misspecification, we argue that the shadow economy accounts for just one component of the total amount of cash payments. Indeed, according to the OECD (2002) classification, the activities contributing most to the so-called non-observed (cash-settled) economy in developed countries include both underground and illegal production: the former is defined as “those activities that are productive and legal but are deliberately concealed from the public authorities to avoid payment of taxes or complying with regulations,” while the latter mainly refers to “the production of goods and services whose production, sale, or mere possession is forbidden by law.” Hence, in order to avoid potential distortions in the estimation of the underground component of non-observed economy, the reinterpretation we propose also controls for the presence of illegal production. We consider, in particular, two criminal activities like drug dealing and prostitution, which represent illegal transactions typically regulated in cash and are classified by almost all scholars among the most important activities making up the illegal economy. Notice that the choices of the individuals operating in the two sectors of non-observed economy (underground and illegal production) depend on different motivations and incentive mechanisms, including the role played by deterrence actions. The two components also differ remarkably for their effects on public

finances and the implications in terms of law enforcement policies, since it is possible to identify potential revenues to be recovered through tax audits only for the shadow economy, while in the case of illegal production the goal is to suppress the criminal activity by relying on policing and imprisonment. Despite these relevant differences, the decomposition of total non-observed economy into underground and illegal production 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. Here we exploit crime indicators related to drug dealing and prostitution, with the purpose to provide a more precise estimate of the excess demand of cash transactions due to tax evasion, by disentangling the illegal component of non-observed economy and thus introducing a third innovation with respect to the traditional CDA.

3. AN APPLICATION OF THE “MODIFIED CDA”: THEORETICAL FRAMEWORK

Our assessment of the size of the shadow economy is based on the estimation of a model of demand for cash payments where the dependent variable is a *direct* measure of the value of transactions at the provincial level. In particular, the dependent variable in the estimated equation 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, checks, credit cards).

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 *underground* (or tax evasion) component, and the *illegal* (or crime) component. In the following—in line with, for example, Torgler and Schneider (2009) and Buehn and Schneider (2012)—we present our methodological approach by formulating testable hypotheses on the variables affecting each of the three mentioned components. Appendix 2 reports descriptive statistics for all covariates and information on data sources (see Tables A2 and A3).

3.1. *The Structural Component of the Demand for Cash Payments*

We identify four factors related to the structural demand for cash payments: the degree of local socio-economic development; the degree of spatial diffusion of banking activities; the technology of payments; and the interest rate.

The level of development of the economy is measured by per capita GDP at the provincial level (*YPC*). As suggested by several studies on shadow economy (e.g., Schneider and Enste, 2000; Schneider, 2011; Buehn and Schneider, 2012), per capita GDP has a negative expected impact on the use of cash: the higher the average living standard, the lower is the use of cash for payments (and the higher the demand for alternative payment instruments). The average income is highly correlated with education level (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 (Schiff and

Ozden, 2005; Ferwerda *et al.*, 2010). Accordingly, the related hypothesis to be tested is the following.

Hypothesis 1: The higher the average per capita income in a province, the lower is the structural (legal) demand for cash payments, *ceteris paribus*.

We also consider the rate of unemployment at the provincial level (*URATE*) as a second possible indicator for the level of economic development.⁷ In particular, to some extent this variable reflects differences in income distribution (see, e.g., Brandolini *et al.*, 2004), and thus in educational levels, and is expected to exert a positive impact on the use of cash for payments. For a given average value of per capita GDP, a higher unemployment rate corresponds to a more concentrated distribution of income favoring the rich, hence with a larger share of low-income (and poorly educated) people relying on the use of cash for their payments. We then formulate the following hypothesis:

Hypothesis 2: The higher the unemployment rate of a province, the higher is the structural (legal) demand for cash payments, *ceteris paribus*.

The number of per capita bank accounts (*BANK*) is included in the estimated equation as a proxy of the spatial diffusion of banking activities, thus controlling for the structural impact of the degree of bank branches' concentration in provincial economies on the demand for cash payments. The expected sign of *BANK* coefficient is negative, as a higher presence of current accounts reduces the need to withdraw cash from ATMs for payments. Thus, the hypothesis to be tested is the following:

Hypothesis 3: The higher the presence of banking activities in a province, the lower is the structural (legal) demand for cash payments, *ceteris paribus*.

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*. This 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. Thus, we put forward the following hypothesis:

Hypothesis 4: The higher the diffusion of electronic payments in commercial transactions, the lower is the structural (legal) demand for cash payments, *ceteris paribus*.

The interest rate on bank deposits (*INT*) is the fourth factor 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,

⁷We acknowledge an anonymous referee for pointing out this additional control.

which implies an ambiguous effect of the interest rate.⁸ Higher interest rates might even have a positive impact on flows, for instance, by pushing toward forms of cash raising alternatives 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 and we do not formulate testable hypothesis.

3.2. *The Underground Component of the Demand for Cash Payments*

We reinterpret the traditional CDA by considering measures of detected tax evasion instead of the variables usually adopted as proxies for the tax burden level, like the average income tax rate. Information on detected tax evasion is 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—are likely to influence the decision to escape Tax Authorities (market regulation, tax morale of citizens, efficiency of public administration, etc.), and each of these factors would need a proper proxy.⁹ Second, tax rates might be subject to a *reverse causality* argument: for a given amount of public spending, in a country with a higher tax evasion, statutory tax rates need to be set at a higher level to keep the budget balanced (see, e.g., Breusch, 2005a, 2005b). Third, to explore within-country variations in the shadow economy, one needs specific tax rates for each sub-area, which can be difficult to obtain in presence of even a minimal degree of tax decentralization and a number of layers of government. For instance, this is the case in Italy, where there are no data on the actual tax rate at the provincial level, and the calculation of some proxies for “fiscal pressure” is not a trivial task, since taxes are levied by different levels of government (including municipalities, provinces, and regions) on very different tax bases.

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. *EVASI* is defined by the number of *specific* tax audits¹⁰ in a given province divided by its sample mean (this is a measure of tax evasion intensity at the provincial level), and then weighed by a GDP concentration index.¹¹ This latter standardization allows us to compare provinces characterized by remarkable differences in the level of economic

⁸Several 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 interest rate on cash demand of buyers.

⁹For a discussion on the determinants of the decision to participate in the shadow economy, besides tax burden, see, among others, Friedman *et al.* (2000), Schneider and Enste (2000, 2002), Feld and Frey (2007), Dreher *et al.* (2009), Torgler and Schneider (2009), Dreher and Schneider (2010), Schneider (2010a), and Buehn and Schneider (2012).

¹⁰These 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).

¹¹The GDP concentration index is defined as the ratio of provincial GDP to its sample mean value.

development, thus avoiding attaching automatically 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 computed as the ratio of the number of *positive* audits on cash registers and tax receipts to the number of existing POS in the province.¹² 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.¹³ 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 underground component in the demand for cash payments. Thus, the hypothesis to be tested is the following:

Hypothesis 5: The higher the value of *EVAS1* and *EVAS2*, the higher is the demand for cash payments in the shadow economy, *ceteris paribus*.

3.3. *The Illegal Component of the Demand for Cash Payments*

An index of crime diffusion (*CRIME*) is included as a further innovation compared to the traditional CDA, in order to separate the illegal component of non-observed (cash-settled) economy from shadow production.¹⁴ *CRIME* is defined as the share of crimes violating the laws on drugs and prostitution over the total number of reported crimes in each province. In analogy with tax evasion variables, this indicator has also been weighted by a GDP concentration index. The normalization for the total number of crimes accounts for differences in crime specialization across provinces, which affect the use of cash: a province where we observe only crimes involving the use of cash is different from a province where crime is widespread, but only a small fraction of these crimes are related to the use of cash. The standardization using GDP is instead able to account for differences in the enforcement activity (hence, in detected crimes), which are reasonably guided by the level of economic development.

The selection of variables to estimate the size of the illegal production deserves a brief explanation. Our choice of drug- and prostitution-related offenses is motivated by the focus on criminal activities that—in line with the OECD (2002)

¹²Here *positive* stands for audits with detected evasion. The ratio is weighed for the GDP concentration index for the same reasons discussed above.

¹³The availability of POS can significantly affect the likelihood to evade taxes. Retailers are obliged to accept a payment with a credit/debit card when a customer exhibits one and a POS is available, and this makes more difficult to evade taxes because the payment is traced. Thus, dividing the number of positive tax audits by the number of POS in the province allows us to weight the *detected* irregularities for the *actual* opportunities to evade (smaller where the number of POS is higher), and to obtain a more precise indicator of the diffusion of evasion: for a given number of POS, the higher the number of positive tax audits, the greater will be the underlying propensity to adopt non-compliant behaviors.

¹⁴To the best of our knowledge, the unique previous attempt to account for the presence of criminal activities in the Italian context is provided by Zizza (2002). However, for the reasons discussed here, the crime indicator used in Zizza (2002) is inadequate to capture the excess demand for cash payments due to illegal production.

definition of illegal economy discussed above—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 “transfers of money” which do not follow an “agreement” between the thief, for instance, and the victim.¹⁵ 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 areas where more robberies occur—individuals will find it 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 due to a voluntary transactional motive. The hypothesis to be tested is then:

Hypothesis 6: The higher the value of *CRIME*, the higher is the demand for cash payments in the illegal economy, *ceteris paribus*.

3.4. The Complete “Modified CDA” Model

Equation (1) sums up the previous theoretical discussion, providing the complete model of the demand for cash payments to be estimated. We consider the three groups of variables discussed above, identifying the structural demand for cash reflecting the ordinary preference for liquidity, augmented by the two components related to the underground economy and the illegal production:

$$(1) \quad CASH_{it} = \alpha_0 + \alpha_1 YPC_{it} + \alpha_2 URATE_{it} + \alpha_3 BANK_{it} + \alpha_4 ELECTRO_{it} \\ + \alpha_5 INT_{it} + \alpha_6 EVAS1_{it} + \alpha_7 EVAS2_{it} + \alpha_8 CRIME_{it} + \varepsilon_{it}$$

Once we have obtained the parameter estimates of the model, we adapt and apply the original procedure proposed by Tanzi (1983) for the assessment of the underground economy. The size of the total (shadow plus illegal) non-observed production 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 separately the size of the two components of the non-observed 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 (underground production) and criminal activities (illegal production), respectively. Given our definition of *CASH*, the estimates obtained in this way are expressed in relation to total payments settled by

¹⁵We 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 (see, e.g., Schneider and Windischbauer, 2008; Schneider, 2010b).

instruments other than cash. In order to have measures comparable with previous studies, we then rescale our estimates of shadow and illegal economy, and express our results in terms of provincial GDP.

4. ECONOMETRIC ANALYSIS

4.1. *Baseline Model Specifications*

To illustrate our “modified CDA,” we depart from the existing literature on Italy, which has so far dealt with country-level data, and apply model (1) to a balanced panel of 91 Italian provinces observed from 2005 to 2008. The units included in the sample represent about 90 percent of all the Italian provinces (103), and are those for which complete information were available for all the variables included in equation (1).

Given the panel structure of the database and the distribution of our dependent variable, we use a Random Effects Tobit model to account for unobserved residual heterogeneity across provinces. This model has the advantage—as compared to a standard panel regression with individual random effects—to accommodate for the particular distribution of the dependent variable, which is censored at zero and can assume only positive values.¹⁶ In particular, we specify the error structure of equation (1) as $\varepsilon_{it} = u_i + e_{it}$, where u and e are provincial effects and the standard disturbance term, respectively.

Our baseline specifications are in Table 1. With respect to equation (1), Models A and B do not consider the unemployment rate, which is included in Models C and D. More important, Models A and C account only for the underground production as a component of the non-observed economy, while Models B and D consider both tax evasion and criminal activities, including the variable *CRIME*. Estimates are pretty much consistent across the four specifications, and coefficients show up the expected signs and are statistically significant at the usual confidence levels. For all the four 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 about 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 inclusion of *URATE* as a further control for the structural demand for cash reduces the magnitude of the per capita GDP, taking up a positive sign. As expected, the unemployment rate also interacts with the components of the underground economy (especially with the activity of retailers, which often make use of irregular workers), allowing for a better identification of the contribution of each to the demand for cash. In particular, while the magnitude of the coefficient for *EVAS1* is substantially unchanged when including *URATE* in the model, *EVAS2* increases from 0.010 to 0.018 (Model B vs. Model D).

Moreover, estimates in Table 1 confirm the importance of controlling for the presence of illegal activities (drug dealing and prostitution) in order to correctly

¹⁶See, for example, Wooldridge (2002). Notice that the theoretical distribution of *CASH* is between 0, if all transactions are carried out using payment methods different from cash, and infinity, if all transactions are carried out using cash.

TABLE 1
ESTIMATED DEMAND FOR CASH PAYMENTS (RANDOM EFFECTS TOBIT MODEL, 91 ITALIAN PROVINCES, 2005–08)^a

Regressors ^b	Model A	Model B	Model C	Model D
<i>YPC</i>	-0.030*** (0.003)	-0.026*** (0.004)	-0.023*** (0.004)	-0.017*** (0.005)
<i>URATE</i>	–	–	0.140*** (0.046)	0.091** (0.044)
<i>BANK</i>	-0.037*** (0.011)	-0.061*** (0.013)	-0.032*** (0.010)	-0.065*** (0.011)
<i>ELECTRO</i>	-0.005*** (0.001)	-0.005*** (0.001)	-0.004*** (0.001)	-0.006*** (0.001)
<i>INT</i>	-0.011*** (0.002)	-0.010*** (0.002)	-0.012*** (0.002)	-0.011*** (0.002)
<i>EVAS1</i>	0.006*** (0.002)	0.006*** (0.002)	0.009*** (0.002)	0.006*** (0.002)
<i>EVAS2</i>	0.027*** (0.005)	0.010* (0.006)	0.019*** (0.005)	0.018*** (0.006)
<i>CRIME</i>	–	0.286*** (0.063)	–	0.262*** (0.064)
Constant	0.220*** (0.006)	0.222*** (0.006)	0.182*** (0.012)	0.195*** (0.012)
Observations	364	364	364	364
Log-likelihood	959.08	963.96	961.26	965.61
McFadden's pseudo-R ²	0.13	0.14	0.13	0.14
Wald statistic (χ^2)	1969.51***	2563.29***	1700.19***	2413.28***
σ_u	0.022*** (0.001)	0.023*** (0.001)	0.026*** (0.001)	0.023*** (0.001)
σ_e	0.012*** (0.000)	0.012*** (0.000)	0.012*** (0.000)	0.012*** (0.000)
ρ	0.772 (0.019)	0.784 (0.017)	0.815 (0.018)	0.786 (0.018)

Notes:

^aDependent variable: *CASH*; Model A: equation (1) without unemployment rate ($\alpha_2 = 0$) and crime indicator ($\alpha_8 = 0$); Model B: equation (1) without unemployment rate ($\alpha_2 = 0$) but including crime indicator; Model C: equation (1) without crime indicator ($\alpha_8 = 0$) but including unemployment rate; Model D: equation (1) including both unemployment rate and crime indicator.

^bStandard errors in parentheses; ***statistically significant at 1%; **statistically significant at 5%; *statistically significant at 10%.

assess the extent of the underground economy. In fact, as suggested by LR tests (Model A vs. Model D, $p = 0.002$; Model C vs. Model D, $p = 0.003$), the inclusion of *CRIME* significantly improves the goodness of fit of the model. It also reduces the magnitude of the coefficients associated to *EVAS2* (especially when we do not account for *URATE*, $\alpha_7 = 0.027$ vs. 0.010) and *EVAS1* (when *URATE* is included, $\alpha_6 = 0.009$ vs. 0.006), thus lowering the total impact of tax evasion on the demand for cash and, eventually, the estimated size of the shadow production. Interestingly, considering illegal activities also impacts on the structural component of the demand for cash, reducing coefficients for *YPC* and *URATE*, and doubling the one of *BANK*. Though discomfoting, a likely interpretation is that the level of economic development could be (positively) associated to the demand of “criminal services.”

Before moving further, notice that the pattern of these results is broadly confirmed when substituting the Tobit model with an alternative Random Effects

TABLE 2
AVERAGE SIZE OF UNDERGROUND ECONOMY AND ILLEGAL PRODUCTION AS % OF GDP, RANDOM
EFFECTS TOBIT ESTIMATES

	Underground Economy (%)				Illegal Production (%)			
	Model A	Model B	Model C	Model D	Model A	Model B	Model C	Model D
Mean 2005–08	21.4	16.5	26.1	17.5	–	10.9	–	10.0
2005	17.9	14.5	22.7	14.8	–	10.2	–	9.3
2006	19.2	15.0	23.3	15.9	–	9.6	–	8.8
2007	23.9	18.0	28.4	19.3	–	11.3	–	10.3
2008	24.6	18.5	29.9	19.9	–	12.6	–	11.6

Notes: Outliers were identified using the Hadi (1992, 1994) method: estimates dropped are 28 in Model A, 26 in Model B, 21 in Model C, and 28 in Model D.

GLS specification, allowing for robust standard errors clustered at the provincial level (see Appendix 2, Table A4). Hence, one might expect that the size of the non-observed economy will also not be affected by the choice of a particular model to estimate the demand for cash.

Table 2 provides the average size of the non-observed economy derived from all the four models in Table 1. The values have been obtained by first computing for each province in each year, separate measures for the underground economy and the illegal production (when possible), and then identifying outliers using the Hadi (1992, 1994) method before calculating the averages. Interesting results emerge from the table. First, our estimates emphasize the need to control for cash used in criminal transactions in order to obtain a better representation of the underground economy. Indeed, when controlling also for criminal activities as a component of the demand for cash, the estimated size of the non-observed economy due to tax evasion (between 16.5 and 17.5 percent of GDP over the entire period 2005–08) is very close to the official figures provided by the Italian National Institute of Statistics (ISTAT, 2010), while, for example, Schneider and Enste (2000, 2002) and Buehn and Schneider (2012) report much higher values (above 25 percent from the mid-1990s until 2000 and stably around 27 percent from 2000 until 2007). 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 illegal production “value added” to GDP in 2007 is in line with the only available estimates provided by Eurispes (2008) for the same year (about 11 percent of GDP). The estimates of Models A and C—where the crime indicator is not included—confirm that neglecting the component of illegal economy in the application of the CDA leads to an *overestimation* of the underground production. For instance, Model C implies a higher value of the underground economy than Model D, 26.1 vs. 17.5 percent on average in 2005–08. Notice that this value is also slightly lower than the sum of the shadow economy and the illegal production estimated in Model D (27.5 percent). Hence, ignoring crime as a component of total cash payments brings about two possible measurement errors: on the one side, it muddles up tax evasion and illegal production; on the other side, it underestimates the total size of the non-observed economy. Notice that these results hold even when using the Random Effects GLS model (Table 3). Looking at the

TABLE 3
AVERAGE SIZE OF UNDERGROUND ECONOMY AND ILLEGAL PRODUCTION AS % OF GDP, RANDOM EFFECTS GLS ESTIMATES

	Underground Economy (%)				Illegal Production (%)			
	Model A	Model B	Model C	Model D	Model A	Model B	Model C	Model D
Mean 2005–08	25.7	17.9	26.6	18.9	–	10.1	–	9.7
2005	22.4	15.9	23.1	16.7	–	9.4	–	9.1
2006	23.0	16.4	23.8	17.3	–	8.9	–	8.6
2007	28.0	19.4	29.0	20.7	–	10.5	–	10.1
2008	29.5	19.7	30.5	20.9	–	11.6	–	11.2

Notes: Outliers were identified using the Hadi (1992, 1994) method: estimates dropped are 21 in Model A, 27 in Model B, 21 in Model C, and 27 in Model D.

more complete Model D, the estimated average size of the total non-observed economy is 28.6 percent of GDP in 2005–08, which is pretty close to estimates obtained with the Tobit model (27.5 percent). Also the decomposition is similar: in both cases, about one-third is attributable to crime, and the remaining two-thirds make up the underground economy.

Second, confirming previous studies (e.g., Fiess *et al.*, 2010; Loayza and Rigolini, 2011), the temporal dynamics of both components for all the four models suggests a link between non-observed economy and the economic cycle. For instance, considering the more complete Model D in Table 2, one can observe an increasing trend from 2005 to 2008 for both components, although the increase appears more marked for tax evasion (+5.1 percent) than for the criminal economy (+2.3 percent), with a sharp jump in the transition from 2006 to 2007 (+3.4 percent and +1.5 percent, respectively). Again, these trends are also confirmed when estimating the demand for cash with a Random Effects GLS model: from Table 3, the increase for tax evasion (+4.2 percent) is larger than for the illegal component of the demand for money (+2.1 percent), with much of the variation concentrated between 2006 and 2007. Such evidence may be, at least in part, due to the fact that the Italian economy in 2007, 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 consumption 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 labor market, and/or even to turn to illegal sectors of the economy (e.g., prostitution, drug dealing).¹⁷

The anti-cyclical behavior of the non-observed economy might suggest a change in the relationship between structural variables, the indicators for

¹⁷Notice 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 irregular sectors. This further supports the adoption of an estimation approach—such as the “modified CDA” proposed here—that overcomes the restriction of the velocity of money constant over time and identical between regular and non-observed economy.

underground economy and crime, and the demand for cash. We then checked the stability of the parameters in our model by defining the dummy variable $T2$ equal to 1 for the years 2007–08, and interacting this dummy with all the variables included in equation (1). The estimates of this augmented model (using both the Tobit and GLS specifications) are in Table A5 in Appendix 2. All the interactions and the coefficient for $T2$ itself turn out to be statistically insignificant. Unsurprisingly, a Wald test for the hypothesis that all interactions and the $T2$ coefficient are jointly insignificant does not reject the null.¹⁸ We then take the more complete Model D and the derived estimates of the non-observed economy as our baseline results, and check their robustness in a number of directions in what follows.

4.2. Robustness Checks

In this section we consider three robustness checks for our findings. A first robustness check is related to the clustering of illegal activities in certain areas. In particular, a well-known stylized fact is that crime rates are higher in large cities than in other urban contexts. One explanation of why it is so—pointed out by Glaeser and Sacerdote (1999)—is that pecuniary benefits for crime are larger in large cities as compared to small cities or rural villages. One may then wonder how robust our results are to the presence in our sample of provinces characterized by large urban centers, like Rome or Milan, with 2.7 million and 1.3 million citizens, respectively. To test for this we use jackknifing, and re-estimate the more complete Model D, with both the Random Effects Tobit specification and the Random Effects GLS specification, leaving out from the sample three subsets of observations: subset 1 considers the three provinces with the largest cities in the Center-North (Rome, Milan, and Turin); subset 2 considers the three provinces with the largest cities in the South (Bari, Naples, and Palermo); and subset 3 considers jointly the two previous groups. Estimates of these models are in Tables A6–A8 in Appendix 2. The signs, the magnitudes, and the statistical significance of almost all coefficients are largely confirmed. We only observe some minor changes in the magnitudes for coefficients of YPC , $URATE$, and $EVAS2$ when excluding from the sample the three Southern provinces. In particular, the (negative) impact of income becomes larger, while that of unemployment and that of tax frauds in sales by retailers approximately halves, likely because these three Southern provinces are also those with the highest per capita income *within* the Southern regions. More important, estimates of the size of non-observed economy and the relative weights of the underground economy and the illegal production are also broadly confirmed. For instance, from Table 4, considering the Tobit specification, the average size of the non-observed economy to be compared with the initial estimates of 27.5 percent in Model D is: 28 percent excluding the three Center-North provinces; 27.6 percent excluding those in the South; and 28.4 percent excluding both.

A second issue that might threaten the robustness of our findings is the use of the GDP concentration index to standardize our indicators of tax evasion $EVAS1$

¹⁸The p-value of the χ^2 statistic is 0.170 in the Random Effects Tobit model and 0.153 in the Random Effects GLS model.

TABLE 4
AVERAGE SIZE OF UNDERGROUND ECONOMY AND ILLEGAL PRODUCTION AS % OF GDP, MODEL D
WITH JACKKNIFING (MEAN 2005–08)

	Underground Economy (%)		Illegal Production (%)	
	Random Effects Tobit	Random Effects GLS	Random Effects Tobit	Random Effects GLS
Subset 1	17.9	19.0	10.1	9.5
Subset 2	15.7	17.1	11.9	9.9
Subset 3	16.4	17.2	12.0	9.8

Notes: Observations dropped from the estimation are: the three largest towns in the Center-North (Turin, Milan, and Rome) for all years in subset 1, the three largest towns in the South (Bari, Naples, and Palermo) for all years in subset 2, and the combination of the six largest towns in the Center-North and the South for all years in subset 3.

Before computing average values, outliers were identified using the Hadi (1992, 1994) method.

TABLE 5
AVERAGE SIZE OF UNDERGROUND ECONOMY AND ILLEGAL PRODUCTION AS % OF GDP, MODEL D
WITH *EVAS1*, *EVAS2*, AND *CRIME* WEIGHTED BY AN EMPLOYMENT CONCENTRATION INDEX

	Underground Economy (%)		Illegal Production (%)	
	Random Effects Tobit	Random Effects GLS	Random Effects Tobit	Random Effects GLS
Mean 2005–08	19.7	20.4	11.2	10.7
2005	16.8	17.8	10.4	9.9
2006	17.9	18.3	9.9	9.4
2007	21.6	22.5	11.7	11.2
2008	22.5	23.0	12.8	12.2

Notes: Outliers were identified using the Hadi (1992, 1994) method: estimates dropped are 25 in the Random Effects Tobit model and 23 in the Random Effects GLS model.

and *EVAS2* and the indicator for criminal activities *CRIME*. While the standardization itself is needed to compare provinces characterized by remarkable differences in the level of economic development (which can then imply a higher number of audits and inspections to fight crime in the richer areas), the use of income can bias the estimates since it is directly related to the use of cash and—more important—it includes an estimate of the shadow economy (ISTAT, 2010). We then re-estimate our previous Model D standardizing *EVAS1*, *EVAS2*, and *CRIME* with an employment concentration index, which accounts for differences in economic development but does not suffer the two drawbacks mentioned before. Estimates of this new model, both with the Tobit and GLS specifications, are in Table A9 in Appendix 2. As before, the signs, the magnitudes, and the statistical significance of almost all coefficients are basically confirmed. From Table 5, the size and the evolution of the non-observed economy, and the relative weights of underground and illegal production, are also broadly similar to our baseline estimates. Considering the Tobit specification, the average total non-observed economy is now 30.9 percent of GDP (compared to 27.5 percent obtained from Model D in Table 1), of which 19.7 percent is related to the underground economy and the remaining 11.2 percent is related to criminal

TABLE 6
AVERAGE SIZE OF UNDERGROUND ECONOMY AND ILLEGAL PRODUCTION AS % OF GDP, MODEL D
WITH DRUG SEPARATED FROM PROSTITUTION (MEAN 2005–08)

Underground Economy (%)		Illegal Production (%)			
		A—Drug		B—Prostitution	
RE Tobit	RE GLS	RE Tobit	RE GLS	RE Tobit	RE GLS
16.9%	18.3%	8.4%	8.6%	1.6%	1.6%

Notes: Outliers were identified using the Hadi (1992, 1994) method: estimates dropped are 36 in the Random Effects Tobit model and 37 in the Random Effects GLS model.

dealings.¹⁹ We also observe the large jump between 2006 and 2007 discussed above, which probably reflects the impact of the cyclical downturn.

Finally, we also check whether our findings are robust to splitting the variable *CRIME* in its two components, drug (*DRUG*) and prostitution (*PROST*). Estimates of this additional model, considering both Tobit and GLS specifications, are in Table A10 in Appendix 2. Drug related offences appear to be the criminal activity driving the results, with a coefficient statistically significant and approximately the same magnitude as *CRIME* in our baseline model. On the contrary, the coefficient for *PROST* picks up the expected positive sign, but it is not statistically significant at the usual confidence levels.²⁰ Estimates of the size of the non-observed economy from this additional model are in Table 6, and pretty much confirm previous findings. Considering the Tobit model, the underground economy makes up on average 16.9 percent of provincial GDP. As for the illegal production, drug trafficking is estimated to generate demand for cash equivalent to 8.4 percent of GDP, while prostitution generates only a mere 1.6 percent. The total estimated size of the non-observed economy is 26.9 percent, quite close to the baseline estimate of 27.5 percent of GDP.

4.3. Within-Country Disaggregated Estimates

In this section we look at disaggregated territorial estimates of the two components of the non-observed economy, a particularly interesting issue for the Italian case in the light of the marked regional differentials in the distribution of tax bases and in the concentration of the organized crime. At least two questions deserve to be explored: first, given the higher degree of economic and industrial development of the Central-Northern provinces with respect to the Southern

¹⁹It is worth noticing that the slightly higher values obtained for the two components of non-observed economy are likely to be the result of the lower variability in the sample of the number of employed people out of the total population compared to GDP per capita (the coefficient of variation is 0.14 for the former variable against 0.24 for the latter). This difference reflects the fact that the employment index, differently from GDP, does not reflect the variation in the nominal value of production due to the variation in input prices—especially in wages and between Center-Northern and Southern provinces—hence implying a less precise correction of our indicators of detected tax evasion and crime for the differences observed in the level of economic development across provinces.

²⁰As shown in Table A3 in Appendix 2, this result can be attributed to the fact that—compared to *DRUG*—*PROST* accounts for a minor share of total crime index (*CRIME*) and presents a low variability in the sample.

TABLE 7
AVERAGE SIZE OF UNDERGROUND ECONOMY AND ILLEGAL PRODUCTION AS % OF GDP IN SOUTHERN AND CENTRAL-NORTHERN ITALIAN PROVINCES, MODEL D (MEAN 2005–08)

	Underground Economy (%)		Illegal Production (%)	
	Random Effects Tobit	Random Effects GLS	Random Effects Tobit	Random Effects GLS
Center-North	19.0	21.2	11.5	11.2
South	14.0	13.7	6.7	6.5

Notes: Outliers were identified using the Hadi (1992, 1994) method: estimates dropped are 28 in the Random Effects Tobit model and 27 in the Random Effects GLS model.

TABLE 8
AVERAGE SIZE OF UNDERGROUND ECONOMY AND ILLEGAL PRODUCTION AS % OF GDP IN SOUTHERN AND CENTRAL-NORTHERN ITALIAN PROVINCES, MODEL D WITH JACKKNIFING (MEAN 2005–08)

	Underground Economy (%)		Illegal Production (%)	
	Random Effects Tobit	Random Effects GLS	Random Effects Tobit	Random Effects GLS
Subset 1				
Center-North	19.5	21.3	11.7	11.0
South	14.3	13.8	6.7	6.4
Subset 2				
Center-North	17.4	19.1	13.3	11.1
South	11.5	12.1	8.3	6.9
Subset 3				
Center-North	18.1	19.2	13.4	10.9
South	12.1	12.2	8.4	6.9

Notes: Observations dropped from the estimation are: the three largest towns in the Center-North (Turin, Milan, and Rome) for all years in subset 1, the three largest towns in the South (Bari, Naples, and Palermo) for all years in subset 2, and the combination of the six largest towns in the Center-North and the South for all years in subset 3.

Before computing average values, outliers were identified using the Hadi (1992, 1994) method.

ones, does the size of the underground production 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 the Southern regions to the formation of the illegal component of the non-observed economy? Or, instead, is it reasonable to expect minor territorial differences, due to the high mobility of criminal resources?

According to the results reported in Table 7, which are derived from estimates of Model D in Table 1 and Table A4, compared to Southern provinces, those in the Center-North exhibit a higher incidence of the non-observed economy on GDP. More important, this larger size is due both to a larger tax evasion (19 vs. 14 percent) and to a larger weight of criminal activities (11.5 vs. 6.7 percent). The finding is robust to the choice of the econometric specification (Table 7, Random Effects GLS), but also to the use of jackknifing and the exclusion from the sample of the provinces with the largest cities in terms of citizens (Table 8). Interestingly, excluding the three provinces with the largest Southern cities from the sample

TABLE 9
 AVERAGE SIZE OF UNDERGROUND ECONOMY AND ILLEGAL PRODUCTION AS % OF GDP IN SOUTHERN AND CENTRAL-NORTHERN ITALIAN PROVINCES—MODEL D WITH DRUG SEPARATED FROM PROSTITUTION (MEAN 2005–08)

	Illegal Production (%)					
	Underground Economy (%)		A—Drug		B—Prostitution	
	RE Tobit	RE GLS	RE Tobit	RE GLS	RE Tobit	RE GLS
Center-North	18.5	20.5	9.6	9.8	2.0	1.9
South	13.5	13.5	5.9	6.0	0.9	0.9

Notes: Outliers were identified using the Hadi (1992, 1994) method: estimates dropped are 36 in the Random Effects Tobit model and 37 in the Random Effects GLS model.

brings about a reduction in the relative weight of the underground economy, and an increase in the size of illegal production. The implication seems to be that—in these Southern provinces—the non-observed economy is much more related to the underground production than to criminal activities. We also confirm, in Table 9, that the illegal production is mainly due to drug trafficking, which accounts for 9.6 percent of GDP in Center-Northern provinces and 5.9 percent in Southern ones, as compared to 2 and 0.9 percent, respectively, for prostitution.

Despite being against the widespread opinion about the presence of a higher shadow economy and illegal production in the South of the country,²¹ such evidence of a significant gap between Center-North and South supports the results obtained by the few previous studies based on alternative estimation methodologies. Relying on time series data from the early 1980s to the late 1990s, Bovi *et al.* (2002) estimate a higher tax evasion in the North than in the South in several years. More recently, looking at more specific taxes (the Personal Income Tax IRPEF, and a tax on productive activities IRAP), Marino and Zizza (2008) and Pisani and Polito (2006) both conclude that in many cases tax evasion is higher in the Center-North than in the rest of the country. The results delivered in 2011 by the Working Group *Economia non osservata e flussi finanziari* (literally, “Non-observed 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 illegal component of the non-observed economy, the higher incidence observed for the Center-North is probably justified by the fact that the use of cash for 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

²¹This 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 Center-North. The descriptive statistics reported in Table A3 in Appendix 2 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 Center-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.

seems to suggest their ability to export illegal activities in the richest areas of the country.²²

Finally, as Figure 1 makes clear, notice that macro-area averages hide significant differences across provinces. It is clear that the size of the non-observed economy is smaller in Southern provinces than in Center-Northern ones. But the underground and the illegal production follow clustering patterns which are difficult to rationalize at first sight. A likely explanation is that these patterns are probably linked to geographical flows of people and goods across provinces in different regions. The likely presence of these flows suggests a potential drawback of using disaggregated estimates at the provincial level instead of macro-area averages—that is, the possibility that money has been withdrawn in one province to be spent in another one, or even abroad.

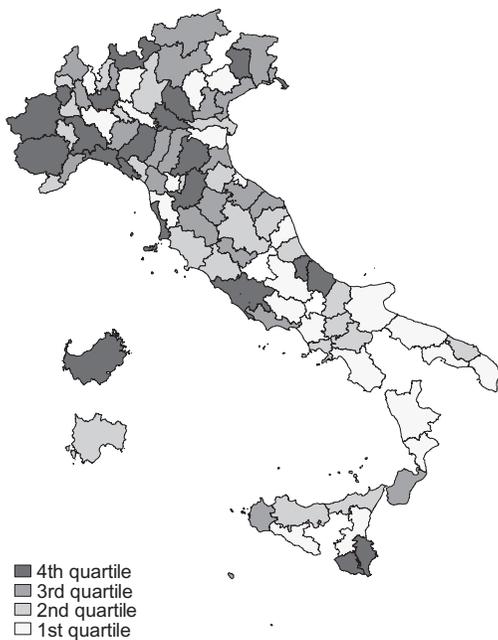
5. CONCLUSIONS

In this paper we contribute to the debate on assessing the size of the underground economy by providing a reinterpretation of the CDA *à la* Tanzi, which aims at overcoming its most relevant weaknesses as remarked in Schneider and Enste (2000, 2002). Our main contributions can be summarized as follows. First, we introduce a *direct* measure of the value 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 non-cash payments in substitution of the traditional money stock variable. This departure from the standard CDA makes it possible to avoid the unrealistic assumptions of the absence of underground production in a given base year, and of a common velocity of money in the official economy and the irregular sector. Second, instead of considering a causal model in which the tax burden is the main determinant of the decision to operate in the underground economy, we disentangle the “excess demand” for cash payments due to tax evasion by exploiting direct information on *detected* non-compliance, thus overcoming the problem of finding suitable proxies able to capture all the relevant causes of the phenomenon. Third, we control also for the role played by illegal production (considering crimes like drug dealing and prostitution), which—jointly with the shadow economy—contributes to the larger aggregate of the non-observed economy and represents a significant component of total cash payments.

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 2005–08. Our baseline results show an average value of the shadow economy of 17.5 percent of GDP, which is consistent with the recent estimates available from official statistical sources relying on microeconomic methods of measurement, but appears lower than the values obtained for Italy in the international literature (e.g., Schneider and Enste, 2000, 2002; Buehn and Schneider, 2012). We show that this discrepancy is likely to be due to the omission of illegal activities in the application of the traditional CDA *à la* Tanzi. Not

²²The ability of criminal organizations to “export” their businesses is discussed, for example in Varese (2011).

Underground economy



Illegal production

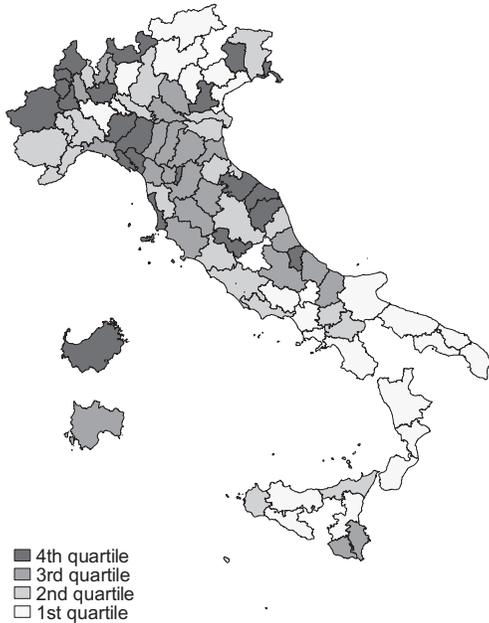


Figure 1. Geographical Distribution of Underground Economy and Illegal Production as % of GDP by Province (Random Effects Tobit estimates on 91 Italian provinces, mean 2005–08, Model D)

surprisingly, when the model does not account for the role played by criminal transactions, which amount, on average, to about 10 percent of GDP, our estimate of the underground economy increases up to 26.1 percent of GDP. This evidence is robust to a number of controls which includes: alternative econometric specifications; the use of jackknifing and the exclusion from the sample of those provinces with the largest cities; the use of different weights to take into account differences in economic development, which presumably drive both tax enforcement and law enforcement activities; and the definition of the crime indicators. A general conclusion stemming from our findings is that, ignoring illegal production, one could not only mistakenly attribute to the shadow economy the part of cash payments due to criminal transactions—for which it is not possible to implement enforcement policies in order to recover lost tax revenues—but also underestimate the total incidence of the non-observed economy (i.e., underground plus illegal production).

Given the availability of relevant information at a disaggregated territorial level, we also provide estimates of the shadow and illegal economy by macro-areas. This is an important step in the understanding of the non-observed 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 Center-North exhibit a higher incidence of both underground economy and illegal production relative to GDP. While the result on crime is likely to be related to the ability of criminal organizations to “export” illegal activities in the retail markets of the richest areas of the country, where demand of drugs and prostitution is presumably higher, the findings concerning tax compliance and the clustering of underground production in neighboring provinces stimulate further research on the determinants of this higher propensity to evade in the richest Northern part of the country.

As for the policy implications directed at reducing the size of the non-observed economy that can be drawn from our results, the general suggestion will be the introduction of measures that make cash more difficult and more costly to use relative to other instruments. Since we observe a positive correlation between the use of cash and the non-observed economy, limiting the use of cash is likely to also limit the non-observed economy. A measure recently undertaken by the Italian government goes exactly in this direction: it provides an upper limit of 1,000 euros for the value of cash transactions, and makes compulsory the use of traceable payment methods for all transaction above this threshold (see Article 12 of Law 201/2011, the so-called Law “Salva Italia”). A second (somewhat provoking) measure discussed in the political debate is the proposal to tax both withdrawals and deposits of cash over a certain threshold. However, the tax rate should be high enough to outweigh the economic advantages deriving from tax evasion and illegal activities in order to reach the proposed goal of reducing the size of the non-observed economy. As the interests at stake are high, the tax will reasonably remain just a proposal. Finally, a third group of measures is directed at favoring the use of instruments alternative to cash: these include, for instance, incentives for the diffusion of electronic payments, as well as public campaigns aimed at modifying the cultural bias toward the use of cash, especially in certain areas of the country. It could be difficult, but it seems worth it.

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SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article:

Appendix 1: Flows vs. Stocks in the Demand Equation of Cash Payments

Figure A1: Monetary Aggregates in Italy: Stocks vs. Flows (index numbers, first semester 2002 = 1)

Table A1: Pearson, Spearman, and Kendall tau-b Correlation Coefficients on Different Cash Usage Indicators

Appendix 2: Data and Robustness Check Estimates

Table A2: Data Description (definition of variables and data sources)

Table A3: Descriptive Statistics

Table A4: Estimated Demand for Cash Payments (Random Effects GLS model, 91 Italian provinces, 2005–08)

Table A5: Estimated Demand for Cash Payments, Model D with Controls for Time Period Effects

Table A6: Estimated Demand for Cash Payments, Model D with Jackknifing: Subset 1

Table A7: Estimated Demand for Cash Payments, Model D with Jackknifing: Subset 2

Table A8: Estimated Demand for Cash Payments, Model D with Jackknifing: Subset 3

Table A9: Estimated Demand for Cash Payments, Model D with *EVAS1*, *EVAS2*, and *CRIME* Weighted by an Employment Concentration Index

Table A10: Estimated Demand for Cash Payments, Model D with Drug Separated from Prostitution