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

by Guerino Ardizzi*, Carmelo Petraglia**, Massimiliano Piacenza*** and Gilberto Turati***

Abstract

We contribute to the debate on how to assess the size of the underground or shadow economy with a reinterpretation of the traditional Currency Demand Approach (CDA) à la Tanzi. We introduce three main innovations. First, we take as dependent variable in the money demand equation a direct measure of the value of cash transactions: the flow of cash withdrawn from current accounts relative to total non-cash payments. This avoids use of the Fisher equation and so overcomes two severe criticisms of the traditional CDA. Second, instead of the tax burden, usually taken as the main motive for non-compliance, we include among the covariates two direct indicators of detected tax evasion. Finally, we also control for the role of illegal economic activity, such as drug dealing and prostitution, which – jointly with the shadow economy – contributes to the larger aggregate of the unobserved economy and represents a significant component of total cash payments. We then propose an application of this "modified CDA" to a panel of 91 Italian provinces for the years 2005-2008.

JEL Classification: E26, E41, H26, K42, O17.
Keywords: underground economy, Currency Demand Approach, cash transactions, tax evasion, illegal production.

Contents

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1. Introduction[1]

The Currency Demand Approach (CDA) is the most widely used of the so-called indirect macroeconomic approaches to estimating the underground or shadow economy. Originally suggested by Cagan (1958), the CDA was subsequently refined and applied by Tanzi (1980, 1983) to the U.S. economy and has been commonly used 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 motive for underground economic activity is avoiding a high tax burden. The CDA involves estimating the aggregate demand for cash, including among the regressors both the standard explanatory variables of the preference for liquidity (such as the interest rate on deposits) and specific variables identifying the determinants of the shadow economy (such as the level of 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).

More precisely, in the Tanzi (1980, 1983) application of the CDA to the U.S. economy, the dependent variable in the money demand equation is the ratio of cash to money supply. This ratio is regressed on three variables identifying the determinants of money demand for regular transactions (the share of national income consisting in wages paid in cash, the interest rate on savings deposits, and per capita income), plus the average tax rate on personal income, posited as the sole determinant of shadow transactions. Since a basic assumption of the CDA is that a heavier tax burden prompts more tax evasion, increasing the

[1] We wish to thank Fabio Bagliano, Domenico Depalo, Michael Pickhardt, Alessandro Santoro, Paolo Sestito, Jordi Sardà, Brigitte Unger, Roberta Zizza, and all seminar participants at the *52nd Annual Conference of the Italian Economic Association* (Roma Tre University, 2011), the *2011 Conference on Shadow Economy, Tax Evasion and Money Laundering* (Münster University, Germany) and the *Lunch Seminar* held at the Bank of Italy (Roma, 2011), for their helpful comments. The usual disclaimers apply.

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 ratio of the underground economy to GDP is obtained by exploiting the Fisher equation. In particular, Tanzi defines a base year in which the contribution of the underground economy to GDP is assumed to be zero, and computes the velocity of money as the ratio of the official GDP to the stock of liquid assets. Assuming then that this velocity is the same for the regular economy and the shadow sector, the size of the shadow economy is obtained by multiplying V by 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 its basic assumptions[2]: *i)* no underground economy transactions in the base year; *ii)* equal velocity of money in the official and the irregular economy; *iii)* no determinant of the shadow economy except the excessive tax burden. Our aim here is to contribute to the debate on measuring the underground economy with a proposed revision of the CDA that overcomes all three drawbacks. Our "modified CDA" makes three main innovations: first, our dependent variable in the money demand equation is a direct measure of cash transactions (the flow of cash withdrawn from current bank and postal accounts relative to total non-cash payments), which obviates the need for the Fisher equation; second, rather than the level of the tax burden, 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 to consider all the relevant determinants; and third, we also control for the influence of illegal economic activity (such as drug dealing and prostitution), which together with the shadow economy contributes to the larger aggregate of the unobserved economy and represents a significant component of total cash payments (OECD, 2002). We then propose an original application of this "modified CDA" to Italy, where the underground economy is considerably larger than in many other Western countries.

The remainder of the paper is structured as follows. Section 2 discusses our innovations to the CDA and shows how they overcome most of the drawbacks highlighted by Schneider and Enste (2000, 2002). Section 3 applies our "modified CDA" to Italy, discussing model specification and empirical results. Section 4 sets out some brief concluding remarks.

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

2. Reinterpreting the Currency Demand Approach

We start from the criticisms advanced by Schneider and Enste (2000, 2002) of most of the assumptions of the traditional CDA. We focus here on three debatable assumptions: (1) the absence of any transactions in the underground economy in the base year, which is unrealistic; (2) the equality in money velocity in the official and the irregular economy, which places a hardly justifiable restriction on the estimation method; and (3) an excessive tax burden as the sole determinant of the shadow economy, which is also quite restrictive, since other factors – such as market regulation (especially the regulation of labour markets), trust in political institutions, and the citizens' tax morale – can substantially affect the decision to engage in underground economic activity.

To address these criticisms, we make three innovations 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, we take a direct measure of cash transactions: the *flow of cash* withdrawn from current (bank and postal) accounts with respect to total payments settled by instruments other than cash. This is a substantial modification of the model, dispensing with the need for the quantity theory of money and the Fisher equation. In this way, we overcome the first weakness, i.e. the need for an arbitrary base year for calculating the velocity of money, and the second, namely the assumption of equal velocity of money in the official economy and the shadow sector. Notice that the cash withdrawal variable also helps to deal with the problematic measurement of the stock of liquid assets in each country following the introduction of the euro, which can severely limit the application of the traditional CDA.

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 escape the need to identify a set of variables that can adequately capture all the relevant determinants of the shadow economy, apart from the tax burden which is the crucial variable in the classic Tanzi approach and excludes any other factors in noncompliance (e.g., Ferwerda *et al.*, 2010; Schneider, 2010). We look directly at the final outcome of this process – so as to circumvent the problem of incomplete specification of the model – and investigate the relationship between the number of detected cases of tax evasion and the use of cash in transactions.

Finally, with reference again to criticism (3) and the issue of model misspecification, we argue that shadow economy is only one component of the total amount of cash payments. Indeed, according to the OECD (2002) classification, the activities that contribute most to the so-called unobserved (cash-settled) economy in developed countries include not only underground but also 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 unobserved economy (as emphasized by Zizza, 2002), the CDA methodology we propose also controls for the presence of *illegal production*. We consider, in particular, two criminal activities – drug dealing and prostitution – that represent illegal transactions typically settled in cash and that are universally considered as the most important activities within the illegal economy.[3] Notice that the choices of the individuals operating in the two sectors of the unobserved economy (underground and illegal) stem from different motivations and incentive mechanisms, including the role of deterrence. The two components also differ significantly in their effect on the public finances and their implications for law enforcement, since one can identify potentially recoverable revenues (through tax audits) only for the shadow economy, whereas in the case of illegal production the goal is to suppress the criminal activity outright through police work and imprisonment. Despite these significant differences, the literature rarely investigates the disaggregation of total unobserved economy into underground and illegal production, mainly because delineating the boundaries of the analysis is quite difficult and reliable information is lacking.[4] Here we exploit crime indicators related to drug dealing and prostitution to make a more precise estimate of the excess demand

[3] See the classification originally proposed by Lippert and Walker (1997), supplemented by Schneider and Enste (2000, 2002) and Schneider (2010), and the discussion in OECD (2002), chapter 9.

[4] For a comprehensive survey of the estimates of the unobserved economy in different countries with a discussion of the contribution of the two components, see Thomas (1992). See also Rogoff (1998) for an interesting analysis of the problem of large banknotes in circulation and the relationship between currency velocity, tax levels and crime rates in OECD countries. A recent application that takes into account the role of illegal production and relies on the traditional CDA is Ferwerda *et al.* (2010), which in order to reply to criticism (3) raised by Schneider and Enste (2000, 2002) propose some changes to the Tanzi approach, by including in the model several proxies alternative to the income tax rate for the determinants of the shadow economy. However, the results are judged unsatisfactory, since none of the proxies significantly explains the underground economy as measured by excess demand for cash. The authors conclude that other variables more closely related to the decision to operate in the shadow sector still need to be found.

for cash transactions due to tax evasion, by isolating the illegal component of the unobserved economy; this represents our third innovation with respect to the traditional CDA.[5] This will also provide additional insights with respect to the official figures provided by the Italian National Institute of Statistics (Istat) since unlike tax evasion illegal activities are not included in the national accounts estimates.

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, then its determinants. As to demand, we depart from the standard CDA and 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 provincial level. In particular, our dependent variable in the estimated equation of the demand for cash payments ($CASH$) is the ratio of the value of cash withdrawn from current accounts to the value of total payments settled by instruments other than cash. This represents a measure of the demand for untraced payments per euro of traceable payments (i.e., bank transfers, cheques, credit cards).

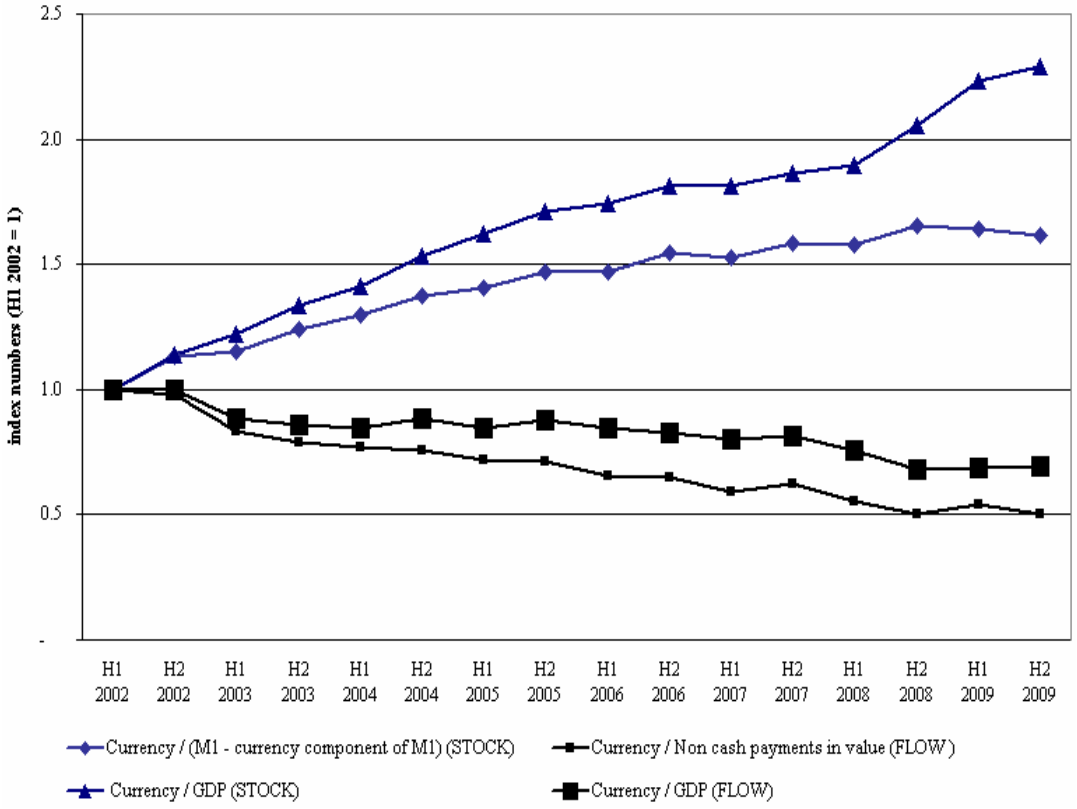
The transactions theory of money demand counts liquid assets as such (e.g., M1), not the concept of payment. The latter necessarily implies a cash flow and precise technical and organizational procedures by which the flow circulates. Even with reliable statistics, however, stock indicators can be highly 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 since the cash changeover in 2002; b) a certain amount of money can be held for purposes other than transactions (traditional theories posit, for instance, the "speculative motive"); and c) the velocity of money is assumed to be constant with respect to several GDP components, including the informal sector, without taking into account such factors as trade in intermediate goods and services. Hence, there may be compensatory phenomena within the same stock of banknotes in circulation, both between different motives for holding cash

[5] Ardizzi *et al.* (2011) survey studies on the assessment of underground economy in Italy using the CDA, which include Bovi and Castellucci (2001), Zizza (2002), Schneider and Enste (2000, 2002), and Chiarini and Marzano (2004).

reserves, and between the formal and the informal sector. This is confirmed by the recent trend in currency-to-GDP ratios in the G10 and Eurosystem countries: the ratio has remained stable or even risen since 2004 in the countries that should have been most affected by the replacement of banknotes with digital money. Similar considerations hold for other stock-based indicators of currency demand, such as M1 (currency and sight deposits). Notice that while an increase in a stock-based monetary aggregate is a signal of greater liquidity preference, it is not informative about the motives, which may include portfolio re balancing, the adjustment of liquidity buffers, the need to hide transactions (either for tax evasion or illegal activity). The European Central Bank has noted that, on the occasion of the cash changeover, the stock of euro banknotes in circulation increased (even compared to M1 or M2) more than the previous circulation of national currencies would have suggested (ECB, 2008). According to the ECB, "this is reasonable, in particular, in an environment of low interest rates and low inflation expectations", not to mention that an estimate of up to 20 percent of the banknotes outstanding are outside the euro area. As a consequence, it is difficult if not impossible to estimate the component of cash held to settle payments within the underground economy from data on stocks. This is why researchers need to select monetary indicators more directly related to the transaction motive.

To clarify this issue, Figure 1 shows the divergence in recent trends of the currency-to-GDP and the currency-to-M1 ratios as compared to their respective flows in Italy: stocks rise while flows decline. The increasing trend of stocks is explained by the ECB clarification cited above. The decreasing trend of flows is consistent with the spread of electronic payment instruments in commercial transactions, which allow some substitution between alternative instruments in the formal economy. Furthermore, the common trend of the two flow-based indicators confirms the greater consistency of these indicators with the transaction motive for cash demand. The combined evidence of such a "substitution effect" of cash flows and the growing trend of the stock of banknotes suggests a slowdown in the overall velocity of circulation of legal money for liquidity needs that are not purely transactional. All these considerations lend force to the criticisms of the traditional CDA based on the quantity theory of money.

Figure 1. Monetary aggregates in Italy: stocks vs. flows



Sources: Based on Bank of Italy and Istat data

The direct link between flow-based indicators of currency demand and the transaction motive for holding cash is also underscored by micro-data on cash purchases collected by the Bank of Italy in its Survey of Household Income and Wealth. Table 1 illustrates the correlation matrix of two different (macro) currency ratios (based on cash withdrawals divided by other payment transactions) and the percentage ratio of cash purchases to total expenditures declared by the survey sample households in the period 2006-2008 (nearly the same period considered in this study). The correlation coefficients are positive and significant in all cases. As one would expect, the "ATM cash withdrawals to POS card transactions" ratio shows a higher correlation with the "Cash expenditure share by Italian households" than does the ratio of "Total cash withdrawals value flows to total non-cash payments". In other words, the closer the monetary indicator is to the "point of sale", the stronger the

correlation with household cash expenditures.[6] Nevertheless, the broader indicator of cash use – "Total cash withdrawals value flows to total non-cash payments" – better accounts for the behaviour of all the economic agents (private firms and the public sector as well as households), which makes it more appropriate for our purposes.

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

Cash use indicator	Total cash withdrawals value flows over total non-cash payments [b]	ATM cash withdrawals over POS card transactions [c]	Cash expenditure share by Italian households [d]
		Pearson correlation	
Total cash withdrawals value flows over total non-cash payments	1		
ATM cash withdrawals over POS card transactions	0.663	1	
Cash expenditure share by Italian households	0.717	0.848	1
		Spearman correlation	
Total cash withdrawals value flows over total non-cash payments	1		
ATM cash withdrawals over 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 over total non-cash payments	1		
ATM cash withdrawals over 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).

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

3.2. Defining the determinants of cash payments

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

3.2.1. The structural component of the demand for cash payments

Drawing on the literature (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, the payment technology and the interest rate. Economic development is measured as per capita GDP at the provincial level (*YPC*). As several authors suggest (e.g., Schneider and Enste, 2000; Schneider, 2010), the expected sign of this variable is negative: the higher the standard of living, the lower the relative use of cash and the greater the demand for alternative payment instruments. Income is closely correlated with education (both general education and "financial literacy"), and more education usually leads to less use of cash, since more educated individuals have greater trust in alternative payment instruments (World Bank, 2005; Ferwerda *et al.*, 2010).

We use the per capita number of current accounts (*BANK*) as a proxy for the diffusion of banking, thus controlling for the structural impact of the degree of bank branch diffusion on the demand for cash payments. The expected sign of the *BANK* coefficient is negative, in that where there are more current accounts there is less need to withdraw cash from ATMs to make payments.

A number of studies (e.g., Drehmann and Goodhart, 2000; Goodhart and Krueger, 2001; Schneider, 2009) emphasize the importance of the payment technology, with special reference to electronic payment instruments. In our model, the structural determinants of *CASH* include the variable *ELECTRO*, the value of transactions settled by electronic payments in proportion to provincial GDP. Since a higher share of electronic transactions (via POS and internet banking) implies fewer cash transactions, the expected sign of *ELECTRO* is negative.

The interest rate on current deposits (INT) is the fourth determinant of the structural component of $CASH$. Based on standard economic theory, it is expected to have a negative effect on the demand for money, insofar as a higher interest rate increases the opportunity cost of holding cash instead of interest-bearing assets. However, our model deals with cash flows rather than stocks of liquid assets, which implies an ambiguous effect of the interest rate.[7] Higher interest rates might even have a positive impact on flows, for instance, by fostering the raising of cash outside the banking channel. However, given the standard "speculative" motive, we cannot exclude the possibility that a higher interest rate on bank deposits may also diminish the propensity to withdraw cash as an alternative to other payment instruments. Thus, the expected sign of the INT coefficient is ambiguous.

3.2.2. The underground component

We revise the traditional CDA by using measures of detected tax evasion in lieu of the standard proxies for the tax burden, such as the average income tax rate. Data on detected tax evasion are retrieved from a dataset on law enforcement inspections carried out by the Italian finance police (*Guardia di Finanza*). This information is particularly relevant for two reasons. First, many factors in addition to the tax and social security burden are likely to influence the decision to evade the surveillance of the tax authorities (market regulation, citizens' tax morale, the efficiency of government, etc.), and each of these factors would need its own proxy.[8] Second, there are no available data on the actual tax rate at the provincial level in Italy, and the calculation of some measures of the tax burden at that level is not simple, since taxes are levied by different levels of government.

To overcome these problems, we selected two variables that provide a direct measure of the diffusion of the economic activities not fully known to the tax authorities at the provincial level. $EVAS1$ is the number of *targeted* tax audits[9] in a given province divided by its sample mean (this is a measure of tax evasion intensity at the provincial level) and then

[7] Studies on the role of innovative payment systems in the cash demand of Italian households (e.g., Ardizzi and Tresoldi, 2003; Lippi and Secchi, 2008; Alvarez and Lippi, 2009) have found that progress in transaction technology can actually reduce (or even eliminate) the impact of the interest rate on buyers' demand for cash.

[8] For a discussion of these other determinants of the decision to operate in the shadow economy see, among 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).

[9] These audits are *targeted* in the sense that they imply inspections of firms based on information of fraud within a particular operation (e.g., payment of salaries) and/or related to a single item of the tax base (e.g., income taxes or social security contributions).

weighted by a GDP concentration index.[10] This latter standardization allows us to compare provinces characterized by large differences in level of economic development, and so to avoid automatically attaching higher levels of tax evasion to provinces with an above-average number of audits. The second variable ($EVAS2$) takes account of irregularities detected by the finance police in inspections of retailers. It is modeled as the ratio of the number of positive audits on cash registers and tax receipts to the number of existing POS terminals in the province.[11] The standardization for the number of POS terminals is necessary because of the very great inter-provincial variability in their number, which is likely to affect the opportunity for evasion (which will be lower where the number of terminals is higher). Both $EVAS1$ and $EVAS2$ are included in our model, in that the former refers to inspections that may relate to any *assumed* fiscal irregularity (evasion of income and indirect taxes or social security contributions) in any type of business, whereas 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 of the demand for cash payments.

3.2.3. The illegal component

A further innovation with respect to the standard CDA is an index of the crime rate, in order to separate the illegal component of unobserved (cash-settled) economy from shadow economic activity.[12] Our *CRIME* indicator is defined as the ratio of drug and prostitution offenses to the total number of crimes reported in the province. Like the tax evasion variables, this indicator has been weighted by a GDP concentration index. The selection of the variables used to estimate the size of the illegal economy needs 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) definition of the illegal economy – imply an exchange between a seller and a buyer relying on a mutual agreement and a voluntary cash payment. Accordingly we excluded crimes that depend on violence (burglary, extortion, etc.)

[10] The GDP concentration index is defined as the ratio of provincial GDP to its sample mean.

[11] Here "positive" means audits that detected some evasion. The ratio is weighted for the GDP concentration index, for the same reasons discussed above.

[12] To the best of our knowledge, the only previous attempt to account for the presence of criminal activities in Italy is Zizza (2002), where the indicator is the share of thefts and robberies in the total number of reported crimes. However, as we argue below, this indicator is not adequate to capture the excess demand for cash payments due to illegal activity.

and therefore imply payments that do not follow an agreement (as between thief and victim.[13] We also excluded those offences with possible ambiguous effects on the volume of cash withdrawals. This is the case of thefts, for instance, which might diminish our *CASH* variable because in areas where robbery is more common people may find it too dangerous to hold cash. In essence, our choice is consistent with the model to be estimated, which exploits information on cash withdrawals from current accounts due to a voluntary transactional motive.

3.3. Estimating the demand for cash payments

Equation [1] provides the complete model of the demand for cash payments to be estimated, which comprises the structural demand reflecting the ordinary preference for liquidity augmented by the components relating to the underground economy and illegal economic activity:

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

We depart from the existing CDA literature on Italy, which has so far dealt with country-level data, and apply model [1] to a balanced panel of the 91 Italian provinces (out of 103) for which complete information was available for all the variables included in Equation [1]. The observation period is 2005 to 2008.

Given the panel structure of the database, we use a random-effects Tobit model to account for unobservable residual heterogeneity across provinces (Wooldridge, 2002). Unlike the standard panel regression with individual random effects, this model can accommodate the particular distribution of the dependent variable, which is censored and has a concentrated mass of positive values very close to zero.[14] In particular, we specify the error

[13] We do not consider money laundering, since this is a crime that follows from other predicate offenses and amplifies the impact of organized crime on both the regular and the irregular economies in a cumulative way. The definition of the crime implies that the proceeds of the predicate crime must be "laundered" through some legal channel (e.g., bank transactions) in order to lower the chances of the criminal's being caught. After this, the "laundered" funds can be reinvested in legitimate activities.

[14] The sample mean of *CASH* is 0.11 (median = 0.10), with a minimum of 0.01 and a maximum of 0.24; 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*-panel variability is dominated by *between*-panel

structure of Equation [1] as $\varepsilon_{it} = u_i + e_{it}$, where u denotes individual effects and e the standard disturbance term.[15]

After obtaining the parameter estimates of the model, we adapt and apply the procedure originally proposed by Tanzi (1983) to gauge the size of the underground economy. The size of total (shadow plus illegal) unobserved transactions is given by the "excess demand" for cash payments – the portion not explained by structural factors. This excess demand is obtained as the difference between the fitted values of *CASH* from the full model [1], and the predicted values from a restricted version of Equation [1] setting $EVAS1 = EVAS2 = CRIME = 0$. To evaluate the size of the two components of the unobserved economy separately, we then proceed in a similar manner, alternately imposing the restrictions $EVAS1 = EVAS2 = 0$ and $CRIME = 0$, and calculating the excess demand for cash payments due to tax evasion (underground economy) and criminal activities (illegal economy), respectively. Given our definition of *CASH*, the estimates so obtained are expressed in relation to total payments settled by instruments other than cash. To get measures that are comparable with previous studies, we then rescale our estimates of the shadow and illegal economy and express the results in terms of provincial GDP.

variability. 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.

[15] We also tested a model including time effects in addition to provincial individual effects. However, apart from the year 2007, for which the estimated coefficient was negative and significant, no other time effect was statistically significant; and the estimates of the other coefficients in equation [1] and the assessment of both the dynamics and the geographical variations of the underground economy were practically unaffected.

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] including crime indicator.

[b] Standard errors in parentheses; *** statistically significant at 1%; ** statistically significant at 5%; * statistically significant at 10%.

Table 2 reports the estimation results. The first column shows the estimates for a reduced version of Equation [1], taking account only of underground production as a component of the unobserved economy (MODEL A). The second column reports results for a complete model considering both tax evasion and criminal activity (MODEL B). All the estimated coefficients have the expected sign, and all except one are statistically significant at the 1% level. Moreover, the LR test (H_0: MODEL A = MODEL B) confirms the importance of controlling for

the presence of illegal activity in assessing the extent of the underground economy: the inclusion of *CRIME* significantly improves the model's fit ($\chi^2_{(1)} = 9.76$, p-value = 0.002) and also reduces the magnitude of the coefficient associated to *EVAS*2 from 0.027 to 0.010, thus lowering the total impact of tax evasion on the demand for cash and, possibly, the estimated size of the shadow economy.[16] 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, underscoring the importance of using panel techniques to control for unobserved heterogeneity due to province-specific idiosyncratic random shocks.

3.4. Assessing the unobserved economy

The size of the total unobserved economy for each province in each year has been estimated by the most comprehensive specification of Equation [1] (MODEL B), which allows us to obtain separate measures for the underground and the illegal economy. Before computing average values (reported in Table 3), we discarded 26 outliers identified using the Hadi (1992, 1994) method.

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

	Underground economy	**Illegal economy**	**Total unobserved 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.

Several interesting results emerge from Table 3. First, the estimated size of the unobserved economy due to tax evasion (16.5% of GDP over the entire period 2005-2008) is

[16] Results are robust to an alternative crime indicator defined as the ratio of drug and prostitution offences in a province divided by its sample mean value (weighted by a GDP concentration index).

very close to the official figures provided by Istat (2010), while Schneider and Enste (2000, 2002) report much higher values (above 25% from the mid-1990s to 2000). As suggested by Zizza (2002), this discrepancy is likely to reflect the role of criminal activities. Indeed, the ratio of the illegal economy's "value added" to GDP in 2007 is in line with the only available estimates provided by Eurispes (2008) for that year (about 11% of GDP). The estimates of MODEL A – where the crime indicator is not included – confirm that neglecting the illegal component leads to an overestimation of underground output: MODEL A implies a larger estimate of the underground economy than MODEL B (21.4% on average in 2005-2008), not far from the estimates presented by Schneider (2010) but lower than the sum of the shadow economy and illegal output estimated in MODEL B (27.4%).[17] Hence, ignoring crime as a component of total cash payments may cause two possible measurement errors: confusing tax evasion with illegal economic activity and underestimating the total size of the unobserved economy.

As to temporal dynamics, both components increase between 2005 and 2008. The increase is sharper for tax evasion (4 percentage points) than for the criminal economy (2.4 percentage points), and there is a jump between 2006 and 2007 (3 and 1.7 percentage points respectively). This may be due at least in part to the onset of the cyclical downturn in 2007 in Italy as in the rest of the euro area consequent to the world financial crisis, with an abrupt slowdown in consumption and investment and a marked deterioration in firms' confidence (Bank of Italy, 2007). The negative expectations of citizens and firms may have led to increased concealment of taxable income, greater resort to the underground labour market, and possibly even a movement into the illegal economy.[18] It is worth noticing that the upward revision in the estimated size of the unobserved economy, as we include illegal activities, does not mechanically translate in the final estimate of GDP. Indeed the latter results from an extensive and balanced process combining different inputs coming from both

[17] The average incidence of the underground economy estimated by Schneider (2010) in the years 2005-2007 was 23.3% of GDP. However, since the estimates for the more recent years were derived from a combination of the MIMIC method with the CDA, in this case the comparison 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).

[18] Note that these cyclical changes are likely to involve 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 our modified CDA – that overcomes the constraint of money velocity being constant over time and the same in the regular and the unobserved economy.

the demand and the supply side of the economy, with our estimate of illegal activity potentially providing a further ingredient.

4. Conclusions

This paper takes its place in the debate on the size of the underground economy with a reinterpretation of the standard currency demand approach *à la* Tanzi, which aims at overcoming the drawbacks criticized by Schneider and Enste (2000, 2002). Our 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, instead of the traditional money stock variable we use the flow of cash withdrawn from current accounts as a ratio to total non-cash payments. This innovation enables us to dispense with the Fisher equation and its unrealistic assumptions of zero underground production in the base year and equal velocity of money in the official and the irregular economy. Second, instead of taking tax burden as the key determinant of the decision to operate in the underground economy, we capture 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 for all the relevant causes. Third, we also control for the role of illegal economic activity (in our case, drug dealing and prostitution), which – jointly with the shadow economy – contributes to the larger aggregate of the unobserved economy and accounts for a significant portion of total cash payments.

We apply this "modified CDA" to original data on monetary variables, tax evasion and reported illegal activities for the Italian provinces over the period 2005-2008. Our results estimate the shadow economy at an average of 16.5% of GDP, which is consistent with the recent estimates available from official statistical sources relying on microeconomic methods but lower than the values 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 illegal activities in the application of the standard CDA. This indicates that if one ignores illegal economic activity one may not only mistakenly attribute to the shadow economy a part of the cash payments due to criminal transactions but also underestimate the total incidence of the unobserved economy (namely underground plus illegal economic activity). It is worth noticing that the upward revision in the estimated size of the

unobserved economy, as we include illegal activities, does not mechanically translate in the final estimate of GDP. Indeed the latter results from an extensive and balanced process combining different inputs coming from both the demand and the supply side of the economy, with our estimate of illegal activity potentially providing a further ingredient.

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., Petraglia, C., Piacenza, M. and Turati, G. (2011), "L'economia sommersa fra evasione e crimine: una rivisitazione del Currency Demand Approach con una applicazione al contesto italiano, Econpubblica Working Paper n. 155.

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. and Castellucci, L. (2001), "Cosa sappiamo dell'economia sommersa in Italia al di là dei luoghi comuni? Alcune proposizioni empiricamente fondate", *Economia Pubblica*, 6, 77-119.

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.

Chiarini, B. and Marzano, E. (2004), "Dimensione e dinamica dell'economia sommersa: un approfondimento del currency demand approach", *Politica Economica*, 3, 303-334.

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.

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

Pickhardt, M. and Sardà 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.

Rogoff, K. (1998), "Blessing or curse? Foreign and underground demand for euro notes", *Economic Policy*, 13(26), 261–303.

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.

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.

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, No. 463, December.

Appendix. The data

This study uses an original dataset on a balanced panel of 91 Italian provinces in the period 2005-2008. The dataset merges four different sources: Bank of Italy (BI), the Italian finance police (*Guardia di Finanza*, GdF), the Italian National Institute of Statistics (Istat), and Eurostat. All monetary variables are provided by the Bank of Italy. Data on provincial GDP come from Eurostat. The proxies for tax evasion are computed using data from GdF fiscal inspections for the period 2005-2008. The crime index uses information on criminal offenses from Istat's website 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 current (bank and postal) accounts to the value of total payments settled by instruments other than cash	BI
Structural factors		
YPC	Provincial GDP per capita	Eurostat
BANK	Per capita number of current accounts	BI
ELECTRO	Ratio of the value of transactions settled by electronic payments to GDP	BI and Eurostat
INT	Rate of interest on current deposits	BI
Tax evasion		
*EVAS*1	Number of targeted 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 POS terminals in the province (weighted by a GDP concentration index)	GdF and Eurostat
Criminal economy		
CRIME	Share of crimes violating laws on drugs and prostitution in total reported crimes (weighted by a GDP concentration index)	Istat and Eurostat

Table A2. Descriptive statistics [a]

Variable	Mean	Standard Deviation			Min	Max
		Total	*Between*	*Within*		
CASH	0.108	0.048	0.046	0.013	0.010	0.236
YPC ($\times 10^4$ €)	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

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

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2010

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V. DI GIACINTO, G. MICUCCI and P. MONTANARO, *Dynamic macroeconomic effects of public capital: evidence from regional Italian data*, Giornale degli economisti e annali di economia, v. 69, 1, pp. 29-66, **TD No. 733 (November 2009).**

F. COLUMBA, L. GAMBACORTA and P. E. MISTRULLI, *Mutual Guarantee institutions and small business finance*, Journal of Financial Stability, v. 6, 1, pp. 45-54, **TD No. 735 (November 2009).**

A. GERALI, S. NERI, L. SESSA and F. M. SIGNORETTI, *Credit and banking in a DSGE model of the Euro Area*, Journal of Money, Credit and Banking, v. 42, 6, pp. 107-141, **TD No. 740 (January 2010).**

M. AFFINITO and E. TAGLIAFERRI, *Why do (or did?) banks securitize their loans? Evidence from Italy*, Journal

of Financial Stability, v. 6, 4, pp. 189-202, **TD No. 741 (January 2010).**

S. FEDERICO, *Outsourcing versus integration at home or abroad and firm heterogeneity*, Empirica, v. 37, 1, pp. 47-63, **TD No. 742 (February 2010).**

V. DI GIACINTO, *On vector autoregressive modeling in space and time*, Journal of Geographical Systems, v. 12, 2, pp. 125-154, **TD No. 746 (February 2010).**

L. FORNI, A. GERALI and M. PISANI, *The macroeconomics of fiscal consolidations in euro area countries*, Journal of Economic Dynamics and Control, v. 34, 9, pp. 1791-1812, **TD No. 747 (March 2010).**

S. MOCETTI and C. PORELLO, *How does immigration affect native internal mobility? new evidence from Italy*, Regional Science and Urban Economics, v. 40, 6, pp. 427-439, **TD No. 748 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap spread changes before and during the subprime financial turmoil*, Journal of Current Issues in Finance, Business and Economics, v. 3, 4, pp., **TD No. 749 (March 2010).**

P. CIPOLLONE, P. MONTANARO and P. SESTITO, *Value-added measures in Italian high schools: problems and findings*, Giornale degli economisti e annali di economia, v. 69, 2, pp. 81-114, **TD No. 754 (March 2010).**

A. BRANDOLINI, S. MAGRI and T. M SMEEDING, *Asset-based measurement of poverty*, Journal of Policy Analysis and Management, v. 29, 2 , pp. 267-284, **TD No. 755 (March 2010).**

G. CAPPELLETTI, *A Note on rationalizability and restrictions on beliefs*, The B.E. Journal of Theoretical Economics, v. 10, 1, pp. 1-11,**TD No. 757 (April 2010).**

S. DI ADDARIO and D. VURI, *Entrepreneurship and market size. the case of young college graduates in Italy*, Labour Economics, v. 17, 5, pp. 848-858, **TD No. 775 (September 2010).**

A. CALZA and A. ZAGHINI, *Sectoral money demand and the great disinflation in the US*, Journal of Money, Credit, and Banking, v. 42, 8, pp. 1663-1678, **TD No. 785 (January 2011).**

2011

S. DI ADDARIO, *Job search in thick markets*, Journal of Urban Economics, v. 69, 3, pp. 303-318, **TD No. 605 (December 2006).**

F. SCHIVARDI and E. VIVIANO, *Entry barriers in retail trade*, Economic Journal, v. 121, 551, pp. 145-170, **TD No. 616 (February 2007).**

G. FERRERO, A. NOBILI and P. PASSIGLIA, *Assessing excess liquidity in the Euro Area: the role of sectoral distribution of money*, Applied Economics, v. 43, 23, pp. 3213-3230, **TD No. 627 (April 2007).**

P. E. MISTRULLI, *Assessing financial contagion in the interbank market: maximun entropy versus observed interbank lending patterns*, Journal of Banking & Finance, v. 35, 5, pp. 1114-1127, **TD No. 641 (September 2007).**

E. CIAPANNA, *Directed matching with endogenous markov probability: clients or competitors?*, The RAND Journal of Economics, v. 42, 1, pp. 92-120, **TD No. 665 (April 2008).**

M. BUGAMELLI and F. PATERNÒ, *Output growth volatility and remittances*, Economica, v. 78, 311, pp. 480-500, **TD No. 673 (June 2008).**

V. DI GIACINTO e M. PAGNINI, *Local and global agglomeration patterns: two econometrics-based indicators*, Regional Science and Urban Economics, v. 41, 3, pp. 266-280, **TD No. 674 (June 2008).**

G. BARONE and F. CINGANO, *Service regulation and growth: evidence from OECD countries*, Economic Journal, v. 121, 555, pp. 931-957, **TD No. 675 (June 2008).**

R. GIORDANO and P. TOMMASINO, *What determines debt intolerance? The role of political and monetary institutions*, European Journal of Political Economy, v. 27, 3, pp. 471-484, **TD No. 700 (January 2009).**

P. ANGELINI, A. NOBILI e C. PICILLO, *The interbank market after August 2007: What has changed, and why?*, Journal of Money, Credit and Banking, v. 43, 5, pp. 923-958, **TD No. 731 (October 2009).**

L. FORNI, A. GERALI and M. PISANI, *The Macroeconomics of Fiscal Consolidation in a Monetary Union: the Case of Italy*, in Luigi Paganetto (ed.), Recovery after the crisis. Perspectives and policies, VDM Verlag Dr. Muller, **TD No. 747 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap changes before and during the subprime financial turmoil*, in Barbara L. Campos and Janet P. Wilkins (eds.), The Financial Crisis: Issues in Business, Finance and Global Economics, New York, Nova Science Publishers, Inc., **TD No. 749 (March 2010).**

A. LEVY and A. ZAGHINI, *The pricing of government guaranteed bank bonds*, Banks and Bank Systems, v. 6, 3, pp. 16-24, **TD No. 753 (March 2010).**

G. GRANDE and I. VISCO, *A public guarantee of a minimum return to defined contribution pension scheme members*, The Journal of Risk, v. 13, 3, pp. 3-43, **TD No. 762 (June 2010).**

P. DEL GIOVANE, G. ERAMO and A. NOBILI, *Disentangling demand and supply in credit developments: a survey-based analysis for Italy*, Journal of Banking and Finance, v. 35, 10, pp. 2719-2732, **TD No. 764 (June 2010).**

G. BARONE and S. MOCETTI, *With a little help from abroad: the effect of low-skilled immigration on the female labour supply*, Labour Economics, v. 18, 5, pp. 664-675, **TD No. 766 (July 2010).**

A. FELETTIGH and S. FEDERICO, *Measuring the price elasticity of import demand in the destination markets of italian exports*, Economia e Politica Industriale, v. 38, 1, pp. 127-162, **TD No. 776 (October 2010).**

S. MAGRI and R. PICO, *The rise of risk-based pricing of mortgage interest rates in Italy*, Journal of Banking and Finance, v. 35, 5, pp. 1277-1290, **TD No. 778 (October 2010).**

M. TABOGA, *Under/over-valuation of the stock market and cyclically adjusted earnings*, International Finance, v. 14, 1, pp. 135-164, **TD No. 780 (December 2010).**

S. NERI, *Housing, consumption and monetary policy: how different are the U.S. and the Euro area?*, Journal of Banking and Finance, v.35, 11, pp. 3019-3041, **TD No. 807 (April 2011).**

V. CUCINIELLO, *The welfare effect of foreign monetary conservatism with non-atomistic wage setters*, Journal of Money, Credit and Banking, v. 43, 8, pp. 1719-1734, **TD No. 810 (June 2011).**

A. CALZA and A. ZAGHINI, *welfare costs of inflation and the circulation of US currency abroad*, The B.E. Journal of Macroeconomics, v. 11, 1, Art. 12, **TD No. 812 (June 2011).**

I. FAIELLA, *La spesa energetica delle famiglie italiane*, Energia, v. 32, 4, pp. 40-46, **TD No. 822 (September 2011).**

R. DE BONIS and A. SILVESTRINI, *The effects of financial and real wealth on consumption: new evidence from OECD countries*, Applied Financial Economics, v. 21, 5, pp. 409–425, **TD No. 837 (November 2011).**

2012

A. ACCETTURO and G. DE BLASIO, *Policies for local development: an evaluation of Italy's "Patti Territoriali"*, Regional Science and Urban Economics, v. 42, 1-2, pp. 15-26, **TD No. 789 (January 2006).**

FORTHCOMING

M. BUGAMELLI and A. ROSOLIA, *Produttività e concorrenza estera*, Rivista di politica economica, **TD No. 578 (February 2006).**

F. CINGANO and A. ROSOLIA, *People I know: job search and social networks*, Journal of Labor Economics, **TD No. 600 (September 2006).**

S. MOCETTI, *Educational choices and the selection process before and after compulsory school*, Education Economics, **TD No. 691 (September 2008).**

P. SESTITO and E. VIVIANO, *Reservation wages: explaining some puzzling regional patterns*, Labour, **TD No. 696 (December 2008).**

P. PINOTTI, M. BIANCHI and P. BUONANNO, *Do immigrants cause crime?*, Journal of the European Economic Association, **TD No. 698 (December 2008).**

F. LIPPI and A. NOBILI, *Oil and the macroeconomy: a quantitative structural analysis*, Journal of European Economic Association, **TD No. 704 (March 2009).**

F. CINGANO and P. PINOTTI, *Politicians at work. The private returns and social costs of political connections*, Journal of the European Economic Association, **TD No. 709 (May 2009).**

Y. ALTUNBAS, L. GAMBACORTA, and D. MARQUÉS-IBÁÑEZ, *Bank risk and monetary policy*, Journal of Financial Stability, **TD No. 712 (May 2009).**

G. BARONE and S. MOCETTI, *Tax morale and public spending inefficiency*, International Tax and Public Finance, **TD No. 732 (November 2009).**

I. BUONO and G. LALANNE, *The effect of the Uruguay Round on the intensive and extensive margins of trade*, Journal of International Economics, **TD No. 835 (February 2011).**

G. BARONE, R. FELICI and M. PAGNINI, *Switching costs in local credit markets*, International Journal of Industrial Organization, **TD No. 760 (June 2010).**

E. COCOZZA and P. PISELLI, *Testing for east-west contagion in the European banking sector during the financial crisis*, in R. Matoušek; D. Stavárek (eds.), Financial Integration in the European Union, Taylor & Francis, **TD No. 790 (February 2011).**

S. NERI and T. ROPELE, *Imperfect information, real-time data and monetary policy in the Euro area*, The Economic Journal, **TD No. 802 (March 2011).**

M. AFFINITO, *Do interbank customer relationships exist? And how did they function in the crisis? Learning from Italy*, Journal of Banking and Finance, **TD No. 826 (October 2011).**

O. BLANCHARD and M. RIGGI, Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices, Journal of the European Economic Association, **TD No. 835 (November 2011).**

R. CRISTADORO and D. MARCONI, *Households Savings in China*, Chinese Economic and Business Studies, **TD No. 838 (November 2011).**