Financial Development and the Underground Economy

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Revised September 7, 2012

Abstract

We provide a theoretical and empirical study of the relation between financial development and the size of the underground economy. In our theoretical framework agents allocate investment between a low-return technology which can be operated with internal funds, and a high-return technology which requires external finance. Firms can reduce the cost of funding by disclosing part or all of their assets and pledging them as collateral. The disclosure decision, however, also involves higher tax payments and reduces tax evasion. We show that financial development (a reduction in the cost of external finance) can reduce tax evasion and the size of the underground economy. We test the main implications of the model using Italian microeconomic data that allow us to construct a micro-based index of the underground economy. In line with the model's predictions, we find that local financial development is associated with a smaller size of the underground economy, controlling for the potential endogeneity of financial development and other determinants of the underground economy.

Key words: Underground Economy, Financial Development.

JEL Classification: G32, H26

Acknowledgements. We thank the Editor, two anonymous referees, Salvatore Piccolo, Francesco Russo, seminar participants at the CSEF-IGIER 2012 Symposium on Economics and Institutions, and the Italian Ministry of Universities and Research for financial support.

1. Introduction

Recent estimates indicate that the underground economy represents 10-15% of GDP in developed countries and 30-40% in developing countries. In some countries, such as Panama and Bolivia, almost 70% of GDP is hidden (Schneider, 2007). Apart from ethical and political concerns, a large share of underground economy is a serious issue for governments and policy makers since it distorts investments, exacerbates income inequality, and hampers growth.[1]

Many factors explain the emergence and size of informal activities. A high level of taxation, a cumbersome legislation, high payroll taxes and labor costs are only some of the many factors which may push firms into informality. Among these factors, the availability of credit and its cost have received little attention. In this paper we study how the choice to operate underground (and to what extent) interacts with financial development. As in Ellul et al. (2012), the starting point of our analysis is that the ability to reveal and signal revenues reduces information frictions and the cost of credit. When firms or individuals operate underground their ability to signal revenues and assets is lower, and the cost of credit higher. As financial markets develop, more efficient intermediaries enter the market and the cost of credit falls, increasing the opportunity cost of continuing to operate underground. In short, financial market development is negatively correlated with the size of the underground economy.

To clarify our arguments, we propose a simple theoretical model in which agents choose between a low-return technology and a more advanced and rewarding technology. Investing in the low-return technology does not require a loan, while the high-return technology requires external funding. We posit that firms can reduce the cost of credit by pledging more collateral, as in Jappelli et al. (2005). Since contracts are not completely enforceable, part of the pledged resources can be lost in the case of a dispute, for example because of judicial costs and inefficiencies. Pledging more collateral, however, is costly because firms must disclose their revenues and assets to financial intermediaries and also to tax officials. Hence, agents choose how much to invest in the two technologies by trading off the reduced financial cost of supplying more collateral against the benefit of hiding revenues and operating with the low-return technology. The choice between the two technologies therefore is also a choice between the underground and the official economy. Financial development reduces the cost of credit and the

[1] The underground economy encompasses many activities. Many are legal, many others are criminal and illegal. The extent and variety of these activities is vast. In this paper we refer only to activities that per se are legal, but which are hidden to official statistics and authorities. We use the terms underground, informal, unofficial more or less synonymously.

incentives to operate underground, while making it more profitable to reveal the revenues from high-tech projects.

Our model adds two important insights to existing works. First, we take explicit account of the technological choice that is involved when entrepreneurs choose to operate underground. There is compelling evidence that the underground economy thrives in mature and non-competitive sectors, and that underground firms do not innovate, operate on a small scale, and implement low-return technologies.[2] In our model the choice to operate in the underground economy is driven by technological reasons, and the model implies that high-tech firms operate mainly in the formal economy, while low-tech firms operate mainly underground. Second, in our model agents can operate simultaneously in both sectors, because they choose the optimal levels of income and assets to disclose to the tax authorities. This is in line with empirical evidence showing that firms and individuals are seldom completely underground or completely transparent (Johnson et al. 2000).

In the second part of the paper we challenge the model's predictions with empirical evidence, exploiting the variability in local financial development across Italian regions. The data are drawn from the Bank of Italy's Survey of Households Income and Wealth (SHIW) to build an index of the underground economy based on individual-level data. The index measures the level of work irregularity among Italian workers from 1989 to 2006, and ranges from 0 (activity is only in the formal sector) to 1 (activity is completely hidden). We regress this index on an indicator of financial development and other individual and regional variables. The results show that the underground economy is strongly negatively correlated with financial development. We find also that more competitive and innovative sectors display lower levels of underground activity. Most importantly, in our empirical approach we control for the endogeneity of financial development using the indicator proposed by Guiso et al. (2004).

The paper is organized as follows. Section 2 reviews recent literature on the underground economy. Section 3 presents the theoretical model. Section 4 describes our indicator of job irregularity. Descriptive analysis and empirical estimates are presented in Sections 5 and 6, respectively. Section 7 concludes.

[2] See Loyaza (1996), Batra et al. (2003) and Farrel (2004).

2. Determinants of the underground economy

Because of the heavy burden on the economy, many studies have examined causes and consequences of underground activities. It is not easy to provide in-depth and exhaustive explanations for why firms and individuals evade taxes or operate irregularly and underground. High levels of taxation, cumbersome legislation and a tight regulatory system, often considered to be the main determinants of underground activities, provide only partial explanations.[3] Other factors play a role in shaping the underground sector, and among them the role of institutions is likely to be the most relevant.[4] Indeed, institutional failure such as poor contract enforcement, judicial inefficiency, complex and arbitrary regulation reduce the incentive for firms and individuals to reveal their revenues. In a recent work Schneider (2010) finds that the underground economy is rooted in a combination of factors such as a large burden of taxation and social security payments, stringent labor market regulation, poor quality of state institutions, and poor tax morale. The institutional setting can significantly affect the choice of informality because the efficiency of public institutions and the quality of public goods provision are important determinants of the opportunity cost to operate underground. For this reason lack of democratic participation, low level of tax morale, institutional distrust are all factors which affect positively the size of underground economy, see Dreher and Schneider (2010), Teobaldelli (2011), Cerqueti and Coppier (2011). These factors play a major role, and improvements in the quality of institutions might work much better in reducing the size of the underground economy than other measures of deterrence, see Feld and Schneider (2010).

Among the many institutions which have been linked to the underground economy, the degree of financial development has received relatively little attention. Yet informality is associated with a higher cost of credit, which is an important component of the overall opportunity cost to operate underground. To the extent that financial development reduces the cost of credit, it increases the opportunity cost of informality. Some papers explore such relation. Straub (2005) develops a model in which firms choose between formality and informality. Being formal involves higher entry costs but lower penalties for defaulting and lower financial costs since hidden incomes cannot be used as collateral. In Antunes and Cavalcanti (2007) entrepreneurs choose between a formal and an informal sector by trading off higher entry costs and tax obligations in the formal sector against higher financial costs in the informal sector. Pant

[3] See Friedman et al. (2000), Schneider and Enste (2000), Schneider (2005), Dabla Norris et al. (2005; 2008).
[4] See Loyaza (1996), Friedman et al. (2000), Johnson et al. (1998a; 1998b), Dreher et al. (2009).

et al. (2009) explore the relationship between employment, informal activities and financial intermediation. The idea is that formal employment can spur financial intermediation since workers with regular jobs tend to use more intensively the banking system as depositors. In Blackburn et al. (2012) entrepreneurs need external resources for investment and can reduce the level of information costs and the financial outlays by supplying more collateral. Supplying more collateral, however, involves a higher tax burden. Given the financial costs, entrepreneurs choose whether or not to evade taxes and to operate underground. Ellul et al. (2012) suggest that when firms choose accounting transparency, they trade off the benefits of access to more abundant and cheaper capital against the cost of a higher tax burden, and study this trade-off in a model with distortionary taxes and endogenous rationing of external finance.

On the empirical front, some papers study the relation between the underground economy and financial constraints. Dabla-Norris et al. (2008) use a survey of registered firms in 41 countries and find that financial constraints tend to induce informality among small firms but not among large ones. Beck et al. (2010) find that access to finance has a stronger impact on tax evasion for small firms, firms located in small cities, and firms in industries that rely more heavily on external finance. La Porta and Shleifer (2008) find that the underground economy is negatively associated with the availability of private credit and individuals' subjective assessment of their access to credit. Using cross-country data, Bose et al. (2008) find that bank development is negatively associated with the size of the underground economy. Ellul et al. (2012) use microeconomic data from Worldscope and from the World Bank Enterprise Survey and find that investment and access to finance are positively correlated with accounting transparency and negatively with tax pressure. They also find that transparency is negatively correlated with tax pressure, particularly in sectors where firms are less dependent on external finance, and that financial development encourages greater transparency by firms that are more dependent on external finance. Existing empirical studies, however, do not address the issue of endogeneity and the potential reverse causality argument that a large underground economy limits the growth of financial intermediaries.[5]

[5] Gatti and Honorati (2008) use Italian regional data and find that financial development is negatively affected by indicators of the underground economy.

3. The Model

We consider an economy with a large number of banks which lend to a continuum of risk neutral entrepreneurs, denoted by *i*. Banks have a positive and exogenous cost of issuing a unit of loan, $\bar{R}+\delta \equiv \tilde{R}$, which is the sum of the cost of raising funds, $\bar{R}$, and an intermediation cost δ. Each entrepreneur is endowed with an illiquid asset, A_i, which is uniformly distributed in the interval $[0,\bar{A}]$. The asset (or part of it) can be used as loan collateral. We denote the fraction of A_i disclosed to the bank and employed as collateral as γ_i, with $\gamma_i \in [0,1]$. Hence, banks observe $\gamma_i A_i$ but not γ_i or A_i separately. The fraction of the asset that is hidden, $(1-\gamma_i)A_i$, is not observed by any other agent or hence by government.

Each entrepreneur can undertake two types of investment, High-Tech and Low-Tech projects (HT and LT, respectively). HT projects are risky, require a loan and operate under a technology with constant returns to scale. LT projects do not require a loan but operate with a less rewarding, decreasing returns technology. The assumption that firms use simultaneously different technologies with different returns is not a new one. Learning costs, financial costs and other constraints may hamper the adoption of new technologies even when they are readily available. Since Mansfield's (1963) seminal contribution, economists have attempted to study not only the dynamics of inter-firm rates of diffusion (technology diffusion between firms) but also intra-firm rates of adoption of new technologies (technology diffusion within a firm). In the presence of frictions and constraints firms may use for a long period of time different technologies and tend to substitute old for new ones slowly.[6] Non-monotonicity in the dynamics of adoption of new technologies implies that within the same industry, and in a particular firm, more advanced and mature technology may coexist. Actually, the dynamics of adoption itself may affect the returns of technologies (Arthur, 1989). High rates of adoption lead to innovation and further improvements. The more the technologies are adopted, the more knowledge is gained from their use and the more they are improved upon, a process that Rosenberg (1982) describes as "learning by using". More competition between technologies can enhance this process, which is the reason why more dynamic and more competitive sectors tend to involve a prevalence of

[6] Mansfield (1963) provides the example of the diesel locomotive which, in the interwar period, substituted the power steam slowly. To give a more recent example, Hollenstein and Woerter (2008) analyze the case of E-commerce as a technology which coexists with traditional channels of trade. Recent work provides supporting evidence of slow technology diffusion, even within particular firms (Battisti and Stoneman 2003, 2005; Capasso and Mavrotas, 2010).

high returns technologies. The opposite applies to mature and stagnant technologies where lack of innovation and increasing costs lead to decreasing returns.

Following these arguments, we assume that LT projects operate in the underground economy, while HT projects operate in the formal sector. Indeed, we show that investment in LT projects involves tax evasion, while investment in HT projects requires entrepreneurs to reveal their revenues. The match between LT and HT projects and the formality of the economy accords also with the idea that operations in the underground economy rely on self-financing and more traditional projects. Firms engaged in the formal sector, in contrast, rely more heavily on external finance and implement more technologically advanced projects. In the remainder of this section we study the conditions under which entrepreneurs operate in the formal sector, in the underground economy, or in both. Next, we study how financial development affects these decisions and the level of investment.

3.1. The two projects

We assume that the LT project does not require a loan, and that it can be carried out using the illiquid asset A_i to purchase Low-Tech capital K_{LT}. If entrepreneurs undertake an LT project they operate with a decreasing returns to scale technology, according to the following production function:

$$Q_{LT} = \Phi K_{LT}^{\alpha} \tag{1}$$

LT projects are completely hidden to both lenders and government. Entrepreneurs invest in these projects the share of the illiquid asset which is not pledged as collateral. Hence, if $\gamma_i A_i$ is the fraction of the asset disclosed to the bank in order to obtain a loan to finance the HT project, the capital invested in the LT project is $K_{LT} = (1-\gamma_i)A_i$.

HT projects operate under constant returns to scale. They require a loan L_i and deliver $Q_{HT}=QL_i$ units of output with probability p and 0 unit of output with probability $(1-p)$. Each HT project has a positive net present value:

$$pQL_i > \tilde{R}L_i$$

There is no information asymmetry between borrowers and lenders, and banks can always observe whether projects succeed or fail. However, as in Jappelli et al. (2005), we assume that only part of the proceeds of the investment can be pledged against the loan. In particular, we assume that in case of success lenders can recover at most a fraction θ of output (QL_i), and a fraction φ of the collateral, with $\theta \in [0,1]$ and $\phi \in [0,1]$. The remaining fraction of output (1-θ) and collateral (1-φ) can be interpreted as the amount of resources required by the judicial system for its functioning. One can think of this loss as the cost of premature liquidation of the investment or, alternatively, as the cost of judicial efficiency.[7] Thus, in the case that the project succeeds lenders obtain $\theta QL_i + \varphi\gamma_i A_i$ units of output, while in the case of failure they obtain $\varphi\gamma_i A_i$.

We denote by $R_i \geq \tilde{R}$ the agreed repayment per unit of loan. This repayment is set after borrowers supply the collateral $\gamma_i A_i$. In a competitive credit market, banks' expected profits are zero and hence:

$$\tilde{R}L_i = pR_iL_i + (1-p)\min[R_iL_i, \varphi\gamma_i A_i] \tag{2}$$

Depending on the amount of collateral, the zero profit condition (2) determines three possible cases.

A first case (*Case A*) arises if the collateral is sufficient to repay the lender if the project should fail, that is $\varphi\gamma_i A_i \geq R_iL_i$. From equation (2) it is clear that the required interest rate is equal to the lowest possible rate; that is, the bank's cost of supplying the loan is:

$$R_i = \tilde{R} \tag{3}$$

Only borrowers with large endowments can access this contract. Recalling that $\gamma_i \in [0,1]$ and that the condition $\varphi\gamma_i A_i \geq R_iL_i$ must be satisfied, to access this contract the collateral required is $A_i \geq A_{Max}$, with $A_{Max} \equiv \tilde{R}L_i / \varphi$.

A second case (*Case B*) arises if the collateral would be insufficient to repay the lender were the project to fail ($\varphi\gamma_i A_i < R_iL_i$). Using equation (2) it is straightforward to show that the required interest rate is now:

[7] I.e., if borrowers dispute the claim, lenders can bring the case to court and recover a fraction of the output and collateral.

$$R_i = \frac{\tilde{R}}{p} - \frac{1-p}{p}\varphi\frac{\gamma_i A_i}{L_i} \tag{4}$$

In this case the interest rate is a decreasing function of the pledged collateral, and greater than in *Case A*.

The third case arises if the amount of the collateral is insufficient to repay the lender even were the project to succeed (*Case C*). This occurs if the collateral is insufficient to cover the bank's cost of funding. Let us denote by A_{min} the level of the endowment, A_i, below which the expected return on the project does not cover the cost of funding:

$$A_{\min} = \frac{\tilde{R}L_i}{\varphi} - \frac{p\theta QL_i}{\varphi} \tag{5}$$

In this case, potential borrowers with endowments $A_i < A_{\min}$ are excluded from credit (while borrowers with $A_i \geq A_{\min}$ can access the financial contract as in *Case B*). For simplicity, we rule out *Case A* and focus on a situation in which $\overline{A} < A_{Max}$, that is, no borrower has enough collateral to finance a HT project at the interest rate $\tilde{R}$. Thus, we assume that, regardless of the disclosed collateral $\gamma_i \in [0,1]$, all borrowers are financially constrained.

The problem of financially constrained borrowers is to choose the optimal level of the initial asset disclosed to the bank ($\gamma_i A_i$). This choice involves a trade-off. The higher the level of the pledged collateral $\gamma_i A_i$, the lower will be the cost of the loan (see equation(4)) and, in turn, the return on the HT project. However, by disclosing the asset, borrowers face two costs: a direct cost due to higher taxation, and a higher opportunity cost due to the income loss in operating the LT project on a smaller scale.

3.2. The disclosure choice

The optimal share of disclosed collateral, γ_i, depends on borrower's expected utility, which, in turn, depends on the available financial contract. We know from the discussion in the previous section that by pledging a sufficient level of collateral, $\gamma_i A_i \geq A_{\min}$, borrowers can obtain a loan (under the financial contract of *Case B*) and run the HT project. The remaining (and hidden) part of the asset can be alternatively invested in the LT project. Therefore, the optimal choice of collateral ultimately is a choice between the HT and LT projects. The implication is that if $\gamma_i = 1$

only HT projects are undertaken, if γ_i =0 that only LT projects are operated, and intermediate values of γ_i indicate investment in both projects.

We now determine the return on each project and each borrower's expected utility. We denote by *t* the tax rate levied on the disclosed asset and on the revenues generated by the HT project. The expected utility from running the HT project is:

$$E_{HT}(u) = (1-t)p[(Q-R_i)L_i + \gamma_i A_i] \tag{6}$$

The expression states that the project is successful with probability *p,* and delivers $(Q-R_i)L_i$ units of output. Revenues and the disclosed asset are observed by government and taxed at the rate *t*. In the opposite case, with probability 1–*p*, the project fails and produces no revenues. Since the interest rate is given by equation (4), the expected utility from running the HT project can be rewritten as:

$$E_{HT}(u) = (1-t)p[(pQ-\tilde{R})L_i + (1-p)\varphi\gamma_i A_i + p\gamma_i A_i] \tag{7}$$

The fraction of the asset not disclosed as collateral, $K_{LT} = (1-\gamma_i)A_i$, is invested in the LT project. Since the revenues from LT projects are not observed by government, no taxes are paid, and the expected utility is simply:

$$E_{LT}(u) = \Phi[(1-\gamma_i)A_i]^{\alpha} \tag{8}$$

Combining equations (7) and (8), we obtain the borrower's expected utility:

$$E(u) = E_{HT}(u) + E_{LT}(u) =$$

$$= (1-t)p[(pQ-\tilde{R})L_i + (1-p)\varphi\gamma_i A_i + p\gamma_i A_i] + \Phi[(1-\gamma_i)A_i]^{\alpha} \tag{9}$$

The optimal choice is determined maximizing equation (9) with respect to γ_i. The first order condition of the problem is:

$$A_i(1-\gamma_i) = \left[\frac{\alpha\Phi}{\Omega}\right]^{\frac{1}{1-\alpha}}, \tag{10}$$

where $\Omega = (1-t)[(1-p)\varphi + p]$. This condition defines the optimal γ_i as a function of A_i, i.e. $\gamma_i = \gamma(A_i)$.

It is straightforward to verify that, other things equal, a higher collateral increases disclosure, i.e. $\frac{\partial \gamma_i}{\partial A_i} > 0$. The result depends on the characteristics of the two projects. Borrowers choose how much to disclose ($\gamma_i A_i$), equating the marginal returns from the HT and LT projects. The LT project displays decreasing returns and, hence, there is a unique level of capital $K_{LT} = (1-\gamma_i)A_i$ that maximizes the project's return. This implies that borrowers with higher levels of asset endowment, A_i, will maximize returns by investing a lower share of the asset, γ_i, in the LT project and, correspondingly, a higher share in the HT project whose return is a linear function of the collateral. Hence, it could be argued that disclosure increases with the level of assets.[8]

The model shows that the optimal choice of collateral and, correspondingly, the extent to which borrowers invest in the LT project and hide their income, depends on the relative returns from the two projects. In the next section we study how financial market development (a reduction in the cost of credit) affects the relative return and the size of the underground economy. We focus below on the effects of improvements in judicial efficiency, tax reforms, and changes in the technology of underground activities.

3.3. Financial development

Financial development is a multifaceted phenomenon. It involves typically the emergence of new and thicker capital markets, the introduction of new financial instruments, and greater competition between intermediaries. Yet, in general, it is possible to argue that financial development entails a lower cost of raising funds. In our model we consider financial development as corresponding to a smaller intermediation cost δ and a lower cost of finance, $\bar{R} + \delta \equiv \tilde{R}$.

In this framework disclosure entails a trade-off. Disclosing collateral reduces the cost of accessing external funding, but increases the tax burden. Furthermore, once the collateral is

[8] To explain this result, recall that $A_i = K_{LT} + K_{HT}$, where $K_{HT} \equiv \gamma_i A_i$. Since the return on the LT project is maximized at a given level of invested capital, $\hat{K}_{LT} \equiv A_i(1-\gamma_i) = [\alpha\Phi/\Omega]^{1/(1-\alpha)}$, any further increase in A_i will be invested in the HT project. Hence, given $K_{LT} = \hat{K}_{LT}$, any increase in A_i will raise K_{HT} and imply a higher γ_i.

disclosed, it cannot be used in the LT sector, which reduces revenues from LT projects. Financial development reduces the size of the underground economy only if it relaxes the credit constraints, inducing more agents to borrow. Therefore agents with very low-endowment ($A_i < A_{\min}$) are not affected by financial development. To see this, recall that their expected utility is:

$$E(u) = E_{LT}(u) = \Phi[(1-\gamma_i)A_i]^{\alpha}. \tag{11}$$

The above expression implies that these entrepreneurs set $\gamma_i = 0$. Hence, any change in the cost of credit does not affect their investment decision. Instead, entrepreneurs whose assets are above $A_{\min}$ are able to access the credit market, set $\gamma_i < 1$ and run both projects. Moreover, for these entrepreneurs the choice of collateral is a monotonic and increasing function of their endowment, that is, the higher A_i, the higher γ_i. Figure 1 shows that the disclosure function $\gamma_i = \gamma(A_i)$ is a step function. For $0 \le A_i < A_{\min}$, the function coincides with the horizontal axis. For $A_{\min} \le A_i \le \bar{A}$, the function is determined by equation (10), and is therefore concave.[9] Since we assume that A_i is distributed uniformly over the interval $[0, \bar{A}]$, the area below the disclosure function measures total disclosed assets.[10]

Let us now see how financial development affects underground activities. We know from equation (5) that a reduction in $\tilde{R}$ reduces the threshold level of collateral $A_{\min}$ which allows borrowers to access credit. Figure 2 shows that also a reduction in $\tilde{R}$ reduces $A_{\min}$ to its new value $A'_{\min}$. Borrowers with $A'_{\min} \le A_i < A_{\min}$ who previously were credit constrained and operated only in the underground economy, now disclose part of their asset, obtain a loan, and run the HT project. The disclosure function $\gamma_i = \gamma(A_i)$ shifts accordingly: the concave portion of the curve shifts to the right, while the section lying on the horizontal axis shrinks, as does the activity in the formal economy. We summarize this result in the following proposition.

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[9] Differentiation of equation (10) shows that $\frac{\partial \gamma_i}{\partial A_i} > 0$ and $\frac{\partial^2 \gamma_i}{(\partial A_i)^2} > 0$

[10] Entrepreneurs with assets just above A_{min} have two options. One is to set γ_i higher than the optimal value as determined by equation (10) in order to supply enough collateral to access credit, i.e. $\gamma_i A_i \ge A_{\min}$. The alternative is to set $\gamma_i = 0$. The choice of these entrepreneurs ultimately depends on the relative return of the two technologies. It is possible to show that there exists a threshold level of asset $\hat{A} > A_{\min}$ below which these entrepreneurs will optimally set $\gamma_i = 0$, and that above such threshold their choice is dictated by equation (10). Redefining the threshold, however, does not change the shape of the disclosure function. Furthermore, since the threshold is a function of $A_{\min}$, to simplify exposition we focus on $A_{\min}$.

Proposition 1: *Other things equal, financial development increases the opportunity cost of tax evasion, lowers underground activity, reduces credit rationing, and stimulates investment in new technologies.*

Note that in our setting financial development also implies technological improvement; that is, more firms operate HT projects. This is in line with the empirical evidence showing that a reduction in the size of the underground economy is associated with more efficient use of resources and allocation of investments, see e.g. Loyaza (1996) and Farrel (2004).

A second implication of the model is that financial market development reduces credit rationing, but can never eliminate it even in the best scenario. This depends on our assumption that LT projects operate with decreasing returns. For low levels of assets - and, hence, for low levels of K_{LT} - LT projects always dominate HT projects. Using equation (10) it is easy to identify the minimum level of asset, A_{LT}, below which LT projects are always preferred to HT projects:

$$A_{LT} = \left[\frac{\alpha \Phi}{\Omega} \right]^{\frac{1}{1-\alpha}} \tag{12}$$

As shown in Figure 2 all agents with $0 \leq A_i \leq A_{LT}$ choose $\gamma_i = 0$ and run only the LT project, regardless of the cost of financial intermediation. Thus, financial development can reduce underground activity only if $A_i > A_{LT}$. The model also implies that the effect of financial development on the size of the underground economy is non monotonic and that it is stronger at low levels of financial development. This is because of the concavity of $\gamma(A_i)$, which measures the amount of disclosed asset.

3.4. Judicial efficiency

As with the cost of financial intermediation, any other factor that affects the relative returns of the two projects also affects the choice of collateral and, from equation (10), the choice of γ_i. This implies that an increase in the tax rate t reduces the expected return from HT projects and the optimal γ_i. For the same reasons, an increase in the productivity of LT projects (an increase in Φ) raises the profitability of the project and reduces γ_i. In graphical terms, as t increases and the expected return of HT projects falls, the disclosure function $\gamma(A_i)$ shifts downwards. This implies that each entrepreneur will disclose a lower share of assets as collateral.

Notice that in our model, taxation does not affect credit rationing because the tax rate does not enter equation (5) and therefore the value of A_{min}.

The model also suggests that changes in judicial efficiency may affect γ_i. To see this, recall that we interpret the terms $(1-\theta)Q_{HT}$ and $(1-\varphi)A_i$ as the amount of resources lost in the case of a legal dispute, and that an increase in θ or φ signals a more efficient judicial system.[11] These two parameters affect γ_i in two ways: (i) by reducing credit rationing, and (ii) by changing the relative return between HT and LT projects. The first channel operates because a better judicial system (an increase in θ or φ) reduces the threshold A_{min} (see equation (5)) and the region of credit rationing. Disclosed assets increase accordingly, and the underground economy shrinks. An increase in φ also raises the return on HT relative to LT projects. This increases also the incentive to disclose assets and to invest in the HT technology.[12]

Figure 3 shows how an improvement in judicial efficiency affects γ_i. The increase in θ or φ (the first channel) reduces $A_{\min}$ to the new value $A'_{\min}$. The increase in the return of HT projects (the second channel) shifts the $\gamma(A_i)$ function upwards. Hence, the new support of the disclosure function is $[A'_{\min}, \bar{A}]$. The size of the underground economy shrinks because, in the new equilibrium, entrepreneurs who previously were receiving credit, borrow more and disclose more assets, while those who previously were credit rationed obtain loans and disclose part of their assets.

Judicial efficiency also amplifies the impact of financial development on the size of the underground economy. Figure 3 illustrates also the interaction between financial development and judicial efficiency. An improvement in judicial efficiency shifts the disclosure function upwards, from $\gamma(A_i)$ to the new value $\gamma_1(A_i)$. The thresholds $A_{\min}$ and A_{LT} decrease to the new values $A'_{\min}$ and A'_{LT}. Hence, financial development (a reduction of $A_{\min}$ to $A'_{\min}$) has a larger impact on the underground economy when the judicial system is efficient. The reason is that when the courts are efficient, financial development induces entrepreneurs to disclose a larger fraction of their assets, so that the underground economy decreases by a larger amount.

We summarize the results of this paragraph in the following proposition:

[11] In keeping with the model simplicity, we assume that it is costless to increase judicial efficiency. In general, raising judicial efficiency might require public resources and therefore a higher tax rate. However, some reforms might increase the productivity of the judicial sectors even at the same level of expenditures. For instance, Coviello et al. (2010) show theoretically and empirically that "task juggling" (the spreading of effort across too many active trials) decreases the performance of Italian judges, raising the chances of long duration of trials and exploding backlogs. Better management of judicial districts (i.e., a reduction in task juggling) would increase the productivity of judges without raising public expenditures.

[12] This result can be verified by inspecting the first order condition (10).

Proposition 2: *Other things equal, an improvement in judicial efficiency reduces the size of the underground economy. Judicial efficiency also amplifies the impact of financial development on the size of underground economy.*

3.5. The technology gap

Empirical evidence shows that the size of the underground economy differs considerably across sectors, see Johnson et al. (2000), Batra et al. (2003) and Farrel (2004). For instance, in the construction industry underground activities are widespread, while the chemicals and drugs sectors are comprised mostly of formal enterprises. One of the reasons for this is due to labor market regulation, but most of the difference depends on the technologies involved in these sectors.

As we argue above, optimal investment and disclosure policies depend on relative returns (and their determinants) from the available technologies. The first order condition (equation (10)) shows that a decrease in the return of LT projects (Φ) increases disclosure at each level of A_i. On the other hand, a higher return of high tech projects (Q) does not affect investment in HT projects directly, but reduces credit rationing by lowering A_{min} (see equation (5)) and reducing the size of the underground economy. Therefore the size of the underground economy in each sector depends on the relative returns of investment projects and the degree of credit rationing. More dynamic and competitive sectors (e.g. the financial sector, or the chemicals industry) tend to have higher returns (Q) from their HT projects. Firms in these sectors tend to have lower rates of underground activities because they are less likely to be credit constrained. These sectors are more competitive, more technologically advanced, and are likely to exhibit a lower technological gap between HT and LT technologies. The opposite happens in less dynamic sectors (e.g. construction or retail), where new technologies are introduced at slower rates and firms can survive despite the implementation of mature technologies.

In our model, given the return from HT projects, the parameter Φ measures the technological gap between the two projects. A lower Φ indicates a larger gap and therefore is typical of less dynamic (backward) sectors while more dynamic (advanced) sectors feature a higher Φ. As shown in Figure 4, our model predicts that the impact of financial development is larger for backward sectors. Since Φ is lower, the disclosure function of the backward sector,

$\gamma^B(A_i)$, lies above the disclosure function of the advanced sector, $\gamma^A(A_i)$. For the same reason, credit rationing in the backward sector is larger (which features $A^B_{\min}$) than in the advanced sector ($A^A_{\min}$). This implies that in backward sectors the impact of financial development on the size of the underground economy is relatively stronger. We summarize the discussion in this paragraph in the following proposition:

Proposition 3: *The size of the underground economy depends on the technological gap between LT and HT projects. More mature and less dynamic sectors tend to display higher rates of underground activities. Other things equal, in these sectors the impact of financial development on the underground economy is larger.*

4. The data

To test the main implications of the model we use the Bank of Italy's SHIW, which allows us to construct an index of underground activities based on microeconomic information. SHIW is a biannual cross-section of about 8,000 households and 24,000 individuals, and provides detailed information on demographic variables, income, consumption, and wealth. Survey data are available from 1977, but the main variable of interest for this paper is available only in 1995, 1998, 2000, 2002 and 2004. We exclude individuals who do not report years of contributions, are not part of the labor force, or who work in the agricultural or public sectors. Our final sample includes 11,781 observations.

The SHIW is a representative sample of the Italian resident population. The sample design is similar to the Labor Force Survey conducted by ISTAT (the Italian national statistics agency).[13] Data are collected through personal interviews. Questions concerning the whole household are addressed to the family head or the person most knowledgeable about the family finances; questions about individual incomes are answered by individual household members wherever possible. The unit of observation is the family, which is defined to include all persons residing in the same dwelling who are related by blood, marriage, or adoption. Individuals selected as "partners or other common-law relationships" are also treated as families.

[13] Sampling is carried out in two stages: the first covers the selection of municipalities, the second the selection of households. Municipalities are categorized into 51 strata, defined by 17 regions and 3 classes of population size (over 40,000, 20,000-40,000, less than 20,000). All municipalities in the first group are included; those in the second and third groups are selected randomly with a probability proportional to their population size. In the second stage households are selected randomly from registry office records.

For obvious reasons, tax evasion and underground activities are difficult to detect and measure. Individuals and firms who evade taxes or operate irregularly tend to hide their income from the government, and hence, are unlikely to release information on their hidden activities. This makes it difficult to obtain direct data on underground activities and is the reason why economists have tried different indirect measurement methods, such as the currency demand approach, the gap between effective and potential electricity consumption, or the multiple indicators approach.[14] These methods are based on macroeconomic estimates of the size of the underground economy, and have at least two limitations: (i) they are subject to large measurement errors; and (ii) by construction, the resulting indicators of underground activities are strongly correlated with other macroeconomic variables.

We overcome some of these measurement problems by constructing an index of underground economy using microeconomic data. Of course, our survey includes no direct questions about the extent to which each individual evades in taxes or works irregularly. However, we can infer the degree of irregularity and evasion through the following two questions, which are posed to each individual interviewed: (1) "*How old were you when you started working?"* and *"For how many years, or months, did you or your employer not pay, social security contributions?*"[15]

From these two questions we can construct an index of irregular activities by dividing the number of years not covered by social security contributions by the length of the working life. There are several advantages to using these questions. First, they are directly related to evasion of social security contributions and irregular work, among the main signs of underground activity. Second, while respondents are unlikely to reply to direct questions about their jobs, they may be more inclined to report indirect information on contributions towards their pensions. Third, since our objective is to study the relation between the underground economy and financial development, it is straightforward to merge our index of irregular work with the index of financial development proposed by Guiso et al. (2004), which is estimated using the same data. Finally, and most importantly, our analysis exploits regional variability in the level of financial development in a single country. By focusing on the same jurisdiction, we overcome the problem

[14] According to this approach, a country's shadow economy is treated as a latent variable which is then imputed using several "indicators" and "cause" variables. This method provides the widest country coverage and therefore is used extensively in the macroeconomic literature, see Djankov et al. (2002), Loyayza et al., (2005) and La Porta and Shleifer (2008).

[15] The social security contribution rate is 33% of the gross wage for private and public employees and 20% in the case of self-employment.

that a relation between underground economy and financial development arises because both variables are correlated with other institutional and macroeconomic indicators.

However, our indicator also has some drawbacks. As with many microeconomic variables, an obvious source of concern is misreporting and recall bias. Another concern is that years not covered by social contribution might be years of unemployment rather than years of irregular work. For this reason, in our estimates we control for the local unemployment rate and per capita GDP at the provincial level.

We also construct an alternative measure of underground economy. Following a standard approach of the literature, we proxy underground activities by calculating the fraction of income received in cash. The idea is that informal activities give rise to cash transactions. As our first indicator, this variable is based on the following question available in the SHIW: *Last year, did you receive part of your (or your family) income in cash? and in which fraction?* As other proxies, this indicator has some limitations. One limitation is that it might be associated with different payment technologies, which may themselves be related to the level of local financial development. For this reason we use this variable only as a robustness check.

As already mentioned, the SHIW provides also an indicator of local financial development. This indicator, proposed by Guiso et al. (2004), measures the probability that households have access to credit, that is, that they are not credit constrained. The SHIW asks households to report whether, in the 12 months before the interview, they have been denied credit or did not apply for credit because they thought they would be turned down. Based on this information, and controlling for other relevant variables, Guiso et al. (2004) estimate the probability that a potential borrower is turned down for credit or discouraged from borrowing, controlling for a wide range of individual and regional variables. The regional dummies obtained from the regression model are then normalized to be equal to zero in the region with the maximum value of the coefficient of the regional dummy (Calabria is the least financially developed region, while March and Liguria the most developed), and therefore varies between zero and 1 (the highest value is 0.58).

Having collected indicators of irregular activities, financial development and judicial efficiency, we can test some of the implications of the model by estimating equations of the form:

$$U_{irs} = \alpha_1 X_{irs} + \alpha_2 FD_r + \alpha_3 JUD_r + \alpha_4 Z_r + \mu_s + \varepsilon_{irs} \qquad (13)$$

where U is an indicator of irregular activities for individual i in region r and sector s, X a set of socioeconomic indicators, FD the index of financial development, JUD a measure of judicial inefficiency (duration of trials, described in Section 6), Z a set of regional indicators, μ_s sector fixed effects, and ε an error term. Proposition (1) suggests $\alpha_1 < 0$, and proposition (2) $\alpha_2 > 0$ (because longer length of trails is associated with less judicial efficiency and an increase of underground activities). In the empirical section we also report separate estimates of equation (13) by sector to verify the implication of proposition (3) that α_1 and α_2 should be larger in more mature sectors.

Our analysis of the relation between financial development and the underground economy needs to address the issue of potential reverse causality and endogeneity of financial development FD in equation (13). In particular, an increase in underground activities (e.g. due to an increase in general taxation) reduces the demand for credit, hampering financial market growth. Similarly, low GDP growth might reduce the demand for loans and financial development, while at the same time increasing underground activities. This implies that simply observing that low financial development is associated with a high level of underground activities does not necessarily mean that low financial development actually causes more underground activities.

In our microeconomic data, we address the endogeneity of financial development relying on an instrument proposed by Guiso et al. (2004) which is correlated with financial development, but is not affected by the degree of underground economy. The instrument is based on the characteristics of the 1936 Banking Law, which over time has constrained the growth of the Italian banking system and is an exogenous determinant of the trajectories of local financial development. Following a period of frequent banking crises, in 1936 Italian legislators attempted to stabilize the financial system by strictly limiting in each region the number of banks and bank branches. In achieving this aim, the law has worked very well, as witnessed by the fact that the number of new branches in Italy after 1936 has expanded very little. Yet, in some regions and for some local credit institutions (such as savings banks and cooperative banks) the 1936 Banking Law has been less constraining. Therefore the 1936 Law explains a large part of the variability in local financial development even after 60 years. Guiso et al. (2004) test this hypothesis by estimating the correlation between the index of regional financial development and the characteristics of the banking system before the 1936 Law. They find that 1936 bank branches, local branches, saving banks and cooperative banks (each in per capita terms) explain 72% of the regional variation in credit supply in the 1990s. In our empirical estimates we use the same

instruments which is uncorrelated to underground economy to control for endogeneity in financial development.

5. Descriptive analysis

Our microeconomic indicator of irregular activities is consistent with macroeconomic estimates from different sources. Figure 5 plots the regional averages of the index of job irregularity against a similar index, produced by ISTAT but based on the Labor Force Survey. Despite the very different methods of elicitation, a strong correlation between the two measures is evident (the correlation coefficient is 0.87). Both indicators show that Southern regions feature the highest levels of underground economy. In particular, in Campania, Sicily, Sardinia, and other Southern regions the irregular job rate exceeds 30%, more than twice as high as the level of irregularity in Northern regions such as Friuli and Emilia-Romagna. The South is also much less developed in terms of per capita GDP, infrastructure, and human capital. It is characterized by more corruption, less efficient government, and higher levels of organized crime. Each of these factors potentially contributes to generating a large underground economy. Yet these regions also display relatively low levels of financial development, and we argue that this channel plays an important role in shaping the underground economy.

Figure 6 plots the relation between financial development and the size of the underground economy. We use regional averages for the period 1995-2004. The correlation is strongly negative (-0.81) and statistically different from zero at the 1% level. Figure 6 shows a strong geographical divide. For example, in Campania a high irregular job rate (36%) is coupled with an index of financial development of only 3%. In contrast, Lombardy (the richest region in the North) has a much lower irregular job rate (16%) but a much higher index of financial development (43%).

In Italy, as in many other countries, there are significant differences by sector in the level of underground activity. The index of job irregularity reaches 30.8% in the construction sector, 25% in the retail and tourism sectors, but is much lower (12% and 15% respectively) in the financial and manufacturing sectors. These differences clearly reflect structural and technological differences between sectors. Underground activities are more widespread in low value added sectors with relatively low competition and smaller firm sizes. Note that this is one of the predictions of the model, because firms operating in more mature sectors have fewer incentives to invest and lower opportunity costs of hiding revenue.

Descriptive statistics show also that the size of the underground economy depends on the nature of employment. Self-employed, professionals, and entrepreneurs are much more likely to work in the underground economy (the index of job irregularity in these occupations ranges from 24% for self-employed to 26% for professionals and entrepreneurs). For managers (8%), and clerks (12%) irregular activities are much less widespread. One reason for this is that, in Italy, employers deduct the tax before transferring wages to employees. This implies that it is much more difficult for employees to evade taxes and social contributions. Therefore hidden activities arise from extra work not supported by a formal employment contract. In the next section we present regressions for the relation between local financial development and the underground economy, controlling for possible sources of endogeneity and other factors (such as sector and occupation) which might influence the relationship.

6. Regression evidence

In our empirical estimates we regress the irregular job rate on the indicator of local financial development and a set of individual variables (gender, age, years of education, marital status, disposable income). Each regression also includes time dummies; some of the specifications include occupation or/and sector dummies. We also include an indicator to control for judicial inefficiency, using ISTAT data. This indicator measures the length of ordinary civil trials, that is, the time elapsing from the date of the initial recording of a trial to the sentence, for actions requiring adjudication of substantive rights concerning credit and commercial matters such as loans, sale of real estate or goods, rentals, negotiable and quasi-negotiable instruments, and insurance.[16] The enforcement cost is directly related to the length of the judicial process. A long trial increases the legal expenses and, for disputed loans, the interest income that is forgone when the collateral does not cover the judicial costs. Moreover, during the time of the trial, the creditor is exposed to the danger of asset substitution by the debtor and to unexpected changes in the value of collateral. Therefore we expect that judicial inefficiency is associated with more underground activities ($\alpha_2>0$ in equation (13)).

[16] A narrower classification of legal action (e.g., loans only) produces too few observations for each district-year cell to compute reliable indicators of judicial inefficiency. For the same reason we do not consider the length of appeals in civil cases and bankruptcy procedures.

We start our analysis by presenting the OLS regressions. Since some of the right-hand side variables vary only between provinces or regions (judicial inefficiency, local unemployment rate, financial market development), standard errors are adjusted for clustering at the provincial level. Table 2, column 1 presents our baseline model. The demographic variables explain a substantial part of the variability of the irregular job rate. In particular, we find that women and younger individuals with lower levels of education are more likely to work irregularly, while higher disposable income increases the likelihood of operating in the formal sector.

The main variable of interest is financial development. The coefficient of this variable is negative and statistically different from zero at the 1% level, which is consistent with the model's prediction ($\alpha_1<0$ in equation (13)). Its impact is sizable: raising financial development by 10 percentage points (approximately the distance between Tuscany and Emilia-Romagna) reduces the irregular job rate by 2.2 percentage points. Lower judicial efficiency is associated with a higher rate of irregular working (the coefficient is 0.083 and is statistically different from zero at the 1% level). Note that the model in Section 2 suggests that judicial efficiency may affect the size of the underground economy both directly and indirectly. Directly, judicial efficiency reduces the size of the underground economy by increasing the opportunity cost of hiding income. Indirectly, an improvement in judicial efficiency increases the value of collateral and reduces the cost of credit. Therefore, the effect of judicial efficiency is captured partly by the index of local financial development.

In Table 2, column 2 we add to the baseline model a dummy for the South and an indicator of social capital (fraction of the population participating in general elections in each province).[17] The coefficients of both variables are positive, but only the dummy for the South is statistically different from zero. Since Southern regions tend also to be the least financially developed and feature the highest judicial inefficiency, introducing this dummy attenuates the impact of financial development (coefficient is -0.184) and judicial inefficiency (0.038). Furthermore, while the coefficient of financial development is still statistically different from zero at the 1% level, the effect of judicial inefficiency is now less precisely estimated than in the regression in column 1.

The third specification in Table 2 repeats the estimation introducing sector and occupation dummies, and the results are essentially unaffected. The final specification in Table 2, column 4 adds the provincial unemployment rate to control for the fact that some of the irregular work might be due to spells of unemployment. The coefficient of this indicator is not statistically different from zero, and again the other coefficients are unaffected. Other regressions with

[17] Other common proxies for social capital (e.g., non profit organizations) deliver qualitatively similar results.

indicators of local labor markets conditions (such as provincial GDP per capita) and other regional or provincial variables (e.g. crime rates) provide similar results.

The impact of financial development on the level of the underground economy is sizable. Using the coefficients of column 2 in Table 2, we calculate the impact in a scenario in which financial development in each region is raised to the standards of the most developed region (Marche). The results are plotted in Figure 7, and indicate that in this hypothetical scenario the reduction in the underground economy is quite sizable in Calabria and Campania (10%), intermediate in Tuscany and Sardinia (4%), and lowest in the most financially developed regions (Emilia and Liguria).

Table 3 probes further in our results presenting two robustness checks. We re-estimate the model defining the number of working years used to compute the irregular job rate as the difference between current age and age when completed education. This measure is not subject to recall bias on the part of respondents and provides therefore a more objective measure of number of working years.[18] The new variable is not identical, but strongly correlated with the irregular job rate as previously calculated (the correlation coefficient is 0.83). The regressions results are reported in the first two columns of Table 3. All regressions coefficients are similar in size and significance to those reported in columns 3 and 4 of Table 2.

We also present regressions using our second proxy for the underground economy, i.e. the fraction of income received in cash. The results are reported in columns 3 and 4 of Table 3. The results are again aligned to those of Table 2. It is remarkable that the coefficients of financial development (-0.194 and -0.216) are quite similar to those obtained using the irregular job rate as the dependent variable in columns 3 and 4 of Table 2 (-0.189 and -0.186, respectively).

The next step is to tackle the issue of the potential endogeneity of financial development. In Table 4 we repeat the estimation using the same instruments as in Guiso et al. (2004): number of branches per capita in 1936, number of local branches in 1936, number of saving banks per capita in 1936, and number of cooperative banks per capita in 1936. These variable pass standard tests of validity of the instruments.[19] The IV regressions confirm the OLS results. Financial development negatively and significantly affects the level of the underground economy, and the results are robust under the different specifications. With the exception of the regression in column 1, the coefficient sizes are quite similar to those in the regressions in Table 2.

[18] We thank an anonymous referee for this suggestion.

[19] The F-test on the first-stage instruments reported in Table 4 indicates that the instruments are significant predictors of financial development. The Sargan test does not reject the hypothesis that the excluded instruments are valid. Except for the regression in column 1, the Wooldridge's (1995) robust score test does not reject the hypothesis that the variables are exogenous.

The mechanism behind our theoretical model is that firms have an incentive to move from low return technologies (LT projects) to more innovative technologies (HT projects). This shift in production occurs through credit markets, pledging more resources, and emerging into the formal sector. Technological gaps between LT and HT projects therefore are crucial for shaping the incentives to operate in the formal economy or in the underground sector. Since these gaps depend on the specificity of the production process, we want to check whether the effect of financial development is disproportionate in some sectors. We are especially interested in testing the prediction of the model that in mature sectors the impact of financial development on the underground economy is larger than in more dynamic sectors.

Tables 5 and 6 respectively present the OLS and IV regressions by sector. Figure 7 showed that the underground economy is much more widespread in the construction, retail, and transportation sectors. Our regression estimates show that it is precisely in these sectors that financial development has the strongest negative impact on the irregular job rate, regardless of the estimation method. In particular, in the OLS regressions the coefficient of financial development is -0.353 for the construction sector, -0.287 for retail and tourism and -0.198 for transportation, as opposed to -0.076 and -0.131 in the financial and manufacturing sectors, respectively. The other coefficients are broadly in line with the full sample estimates. Higher education and higher disposable income are generally associated with a lower rate of irregularity. The coefficients of the South dummy and of the indicator of judicial inefficiency are generally positive, but statistically different from zero only in the regressions for the financial sector (the dummy for South is also significant in the regressions for manufacturing). As in the full sample estimates, the IV estimates pass the standard tests of validity of instruments (except for the exogeneity test in the financial and real estate sectors).

7. Conclusions

The existence of a large underground economy represents a relevant burden on society. The underground economy can slow the investment rate, reduce the adoption of new technologies, and limit the ability of governments to raise sufficient resources to pay for public goods and for infrastructure. Eventually, it can affect the allocation of real resources and thwart economic growth. A high level of taxation, cumbersome and inefficient bureaucracy, and poor legal protection are among the factors that have been identified as the major causes of tax

evasion and a large underground economy. In this paper we focus on financial development, a factor that has received less attention from economists.

The main idea is that when individuals and firms hide all or part of their income, they pay less taxes, but they also face a higher cost of credit. Therefore, the choice of operating in the underground economy involves a trade-off. By reducing the cost of credit or by granting credit to previously credit constrained agents, financial development affects the trade-off, increasing the incentive to operate in the formal economy. We capture these ideas in a simple model in which agents choose to disclose their collateral in order to obtain credit for investment in a high-return project. The alternative is to operate in the informal sector in a low-return project using only internal funds. The choice to go underground therefore is also a choice between different technologies. The model predicts that financial development (a reduction in the cost of credit) induces firms to disclose more assets and to invest in a high-tech project, and that this effect is stronger in mature sectors. Furthermore, an improvement in judicial efficiency reduces the cost of credit and the size of the underground economy.

In the second part of the paper we test the main implications of the model using Italian microeconomic data. We build an index of job irregularity using the 1995-2004 Bank of Italy SHIW, and regress this index on an indicator of local financial development, judicial inefficiency, and other individual and regional variables. The results show that the underground economy is strongly negatively correlated with financial development, even when we control for financial development endogeneity. We find also that more competitive and innovative sectors display a lower level of underground activity, and that financial development has a stronger impact in mature sectors (such as construction, retail, tourism). The effect of judicial inefficiency is in line with the model's predictions, but the coefficient is not statistically different from zero if we control for other regional variables.

Our study implies that successful programs to reduce the extent of the underground economy should take into account the structure of credit markets, and implies also that financial market development has important spillover effects. By reducing the incentives to operate in the underground economy, financial market development can stimulate the adoption of new technologies, reduce the size of the underground economy, and increase tax collection levels.

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Figure 1

The disclosure function

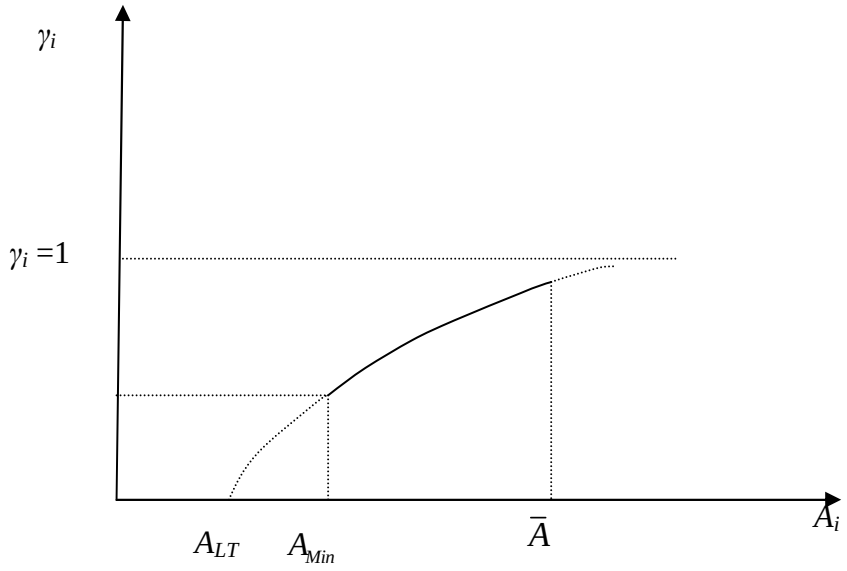

Figure 2

The effect of financial development on the underground economy

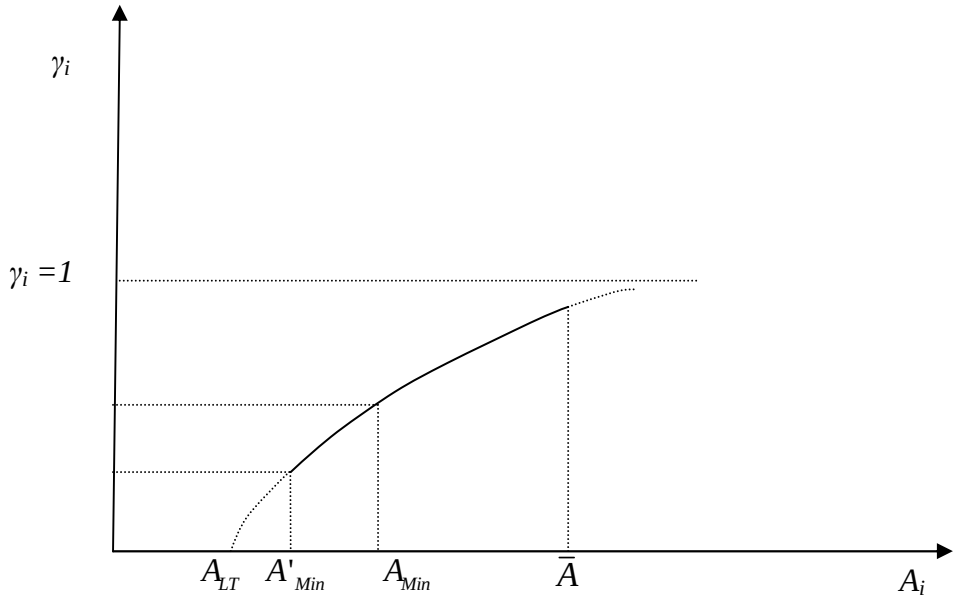

Figure 3
The effect of judicial efficiency on the underground economy

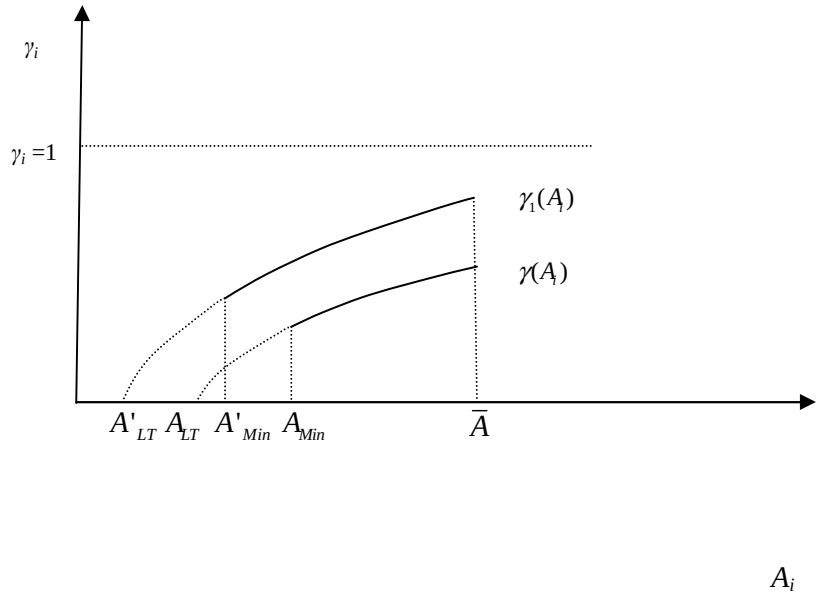

Figure 4
The effect of financial development in advanced and mature sectors

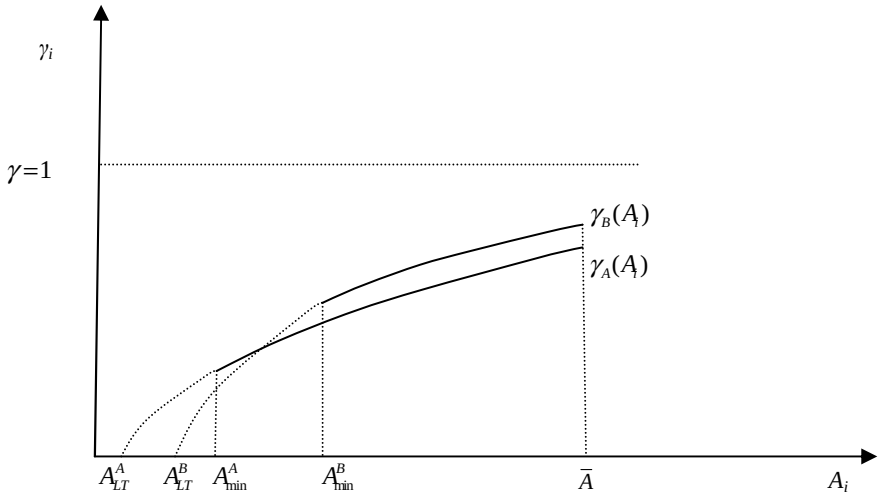

Figure 5
Irregular job rate: Comparison between ISTAT and SHIW

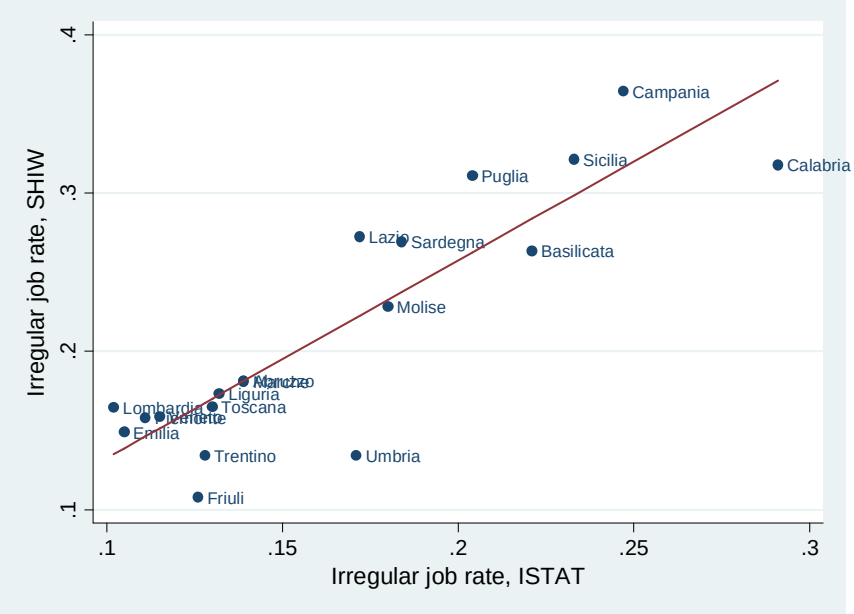

Figure 6
Irregular job rate and financial development

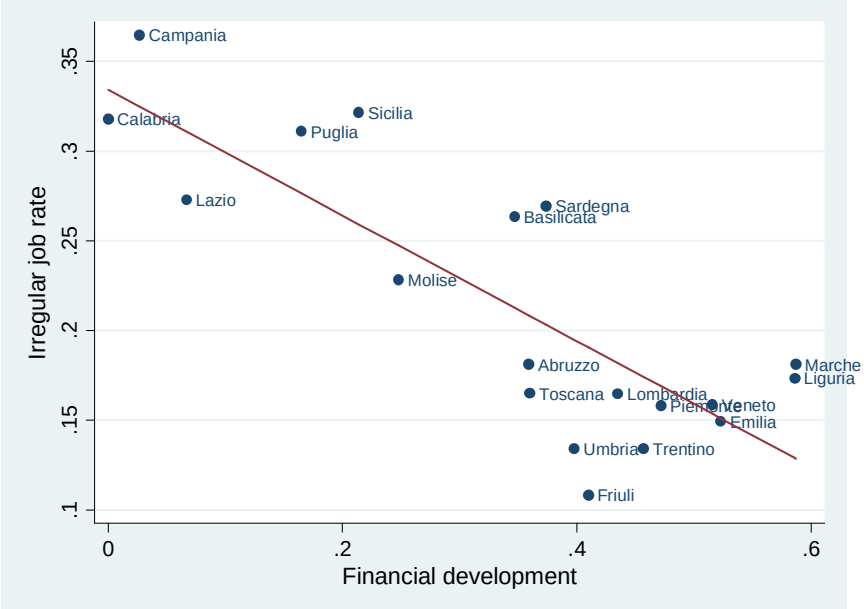

Figure 7
Financial development and the underground economy – Raising financial development to the standards of the most developed region

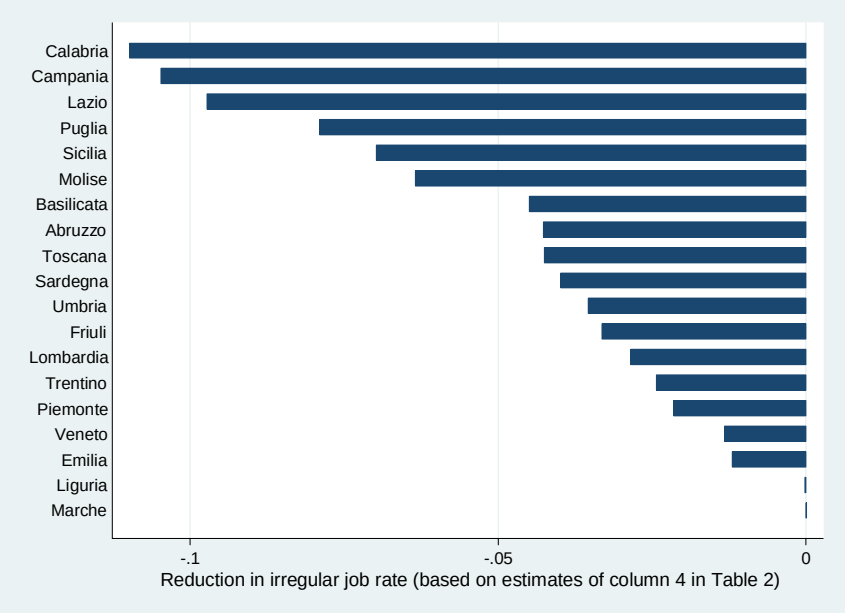

Table 1
Descriptive statistics

Variable	*Mean*	*Median*	*Standard deviation*
Irregular job rate	0.2038	0.0870	0.2735
Fraction of income received in cash	0.3100	0.0000	3999
Financial development	0.3689	0.4350	0.1753
Male	0.8523	1.0000	0.3548
Age	44.0546	44.0000	9.7390
Education	3.4128	3.0000	0.8801
Married	0.8041	1.0000	0.3969
Log disposable income	10.3357	10.3482	0.6222
Judicial inefficiency	1.2315	1.1494	0.2494
Social capital	0.8144	0.8378	0.0803
South	0.2401	0.0000	0.4271
Provincial unemployment rate	0.1078	0.0847	0.0684
Manufacturing	0.3988	0.0000	0.4897
Construction	0.1280	0.0000	0.3341
Retail and tourism	0.2414	0.0000	0.4280
Transportation	0.0766	0.0000	0.2659
Financial and real estate	0.1552	0.0000	0.3621
Operative	0.3770	0.0000	0.4846
Clerk	0.1985	0.0000	0.3989
Manager	0.0748	0.0000	0.2632
Professional	0.0722	0.0000	0.2588
Entrepreneur	0.0287	0.0000	0.1670
Self-employed	0.3770	0.0000	0.4846

Note. Data are drawn from the 1995-2004 SHIW. Sample statistics refer to the pooled sample of 11781 observations.

Table 2
Financial development and the underground economy - OLS regressions

	(1)	*(2)*	*(3)*	*(4)*
Financial development	-0.223	-0.184	-0.189	-0.186
	(0.037)***	(0.058)***	(0.056)***	(0.055)***
Male	-0.034	-0.035	-0.043	-0.044
	(0.012)***	(0.012)***	(0.012)***	(0.012)***
Age	-0.022	-0.022	-0.020	-0.020
	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Age square	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Years of education	-0.020	-0.020	-0.017	-0.017
	(0.007)***	(0.007)***	(0.008)**	(0.008)**
Married	-0.026	-0.030	-0.024	-0.023
	(0.009)***	(0.009)***	(0.009)***	(0.009)**
Log disposable income	-0.079	-0.076	-0.075	-0.075
	(0.008)***	(0.008)***	(0.008)***	(0.008)***
Judicial inefficiency	0.083	0.038	0.014	0.007
	(0.026)***	(0.028)	(0.031)	(0.038)
Social capital		0.093	0.069	0.085
		(0.127)	(0.130)	(0.149)
South		0.069	0.059	0.053
		(0.023)***	(0.022)**	(0.024)**
Provincial unemployment rate				0.085
				(0.215)
Constant	1.606	1.518	1.584	1.582
	(0.121)***	(0.145)***	(0.179)***	(0.187)***
Year dummies	YES	YES	YES	YES
Sector dummies	NO	NO	YES	YES
Occupation dummies	NO	NO	YES	YES
Observations	11781	11781	11779	11673
R-squared	0.12	0.13	0.17	0.17

Note. The sample refers to the 1995-2004 SHIW. Standard errors, adjusted for clustering at the provincial level, are reported in parenthesis. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Table 3
Financial development and the underground economy – robustness checks

	Irregular job rate		*Fraction of income received in cash*	
	(1)	(2)	(3)	(4)
Financial development	-0.171	-0.160	-0.194	-0.216
	(0.046)***	(0.041)***	(0.096)**	(0.093)**
Male	-0.054	-0.062	-0.029	-0.017
	(0.011)***	(0.010)***	(0.015)*	(0.012)
Age	-0.024	-0.023	-0.017	-0.006
	(0.002)***	(0.002)***	(0.004)***	(0.003)*
Age square	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)**
Years of education	-0.013	-0.014	-0.057	-0.043
	(0.005)**	(0.006)**	(0.009)***	(0.007)***
Married	-0.032	-0.026	0.005	0.004
	(0.007)***	(0.007)***	(0.013)	(0.013)
Log disposable income	-0.056	-0.057	-0.102	-0.099
	(0.005)***	(0.005)***	(0.011)***	(0.010)***
Judicial inefficiency	0.112	0.068	0.190	0.151
	(0.024)***	(0.029)**	(0.061)***	(0.067)**
Provincial unemployment rate		0.295		-0.236
		(0.148)**		(0.341)
Year dummies	YES	YES	YES	YES
Sector dummies	YES	YES	YES	YES
Occupation dummies	YES	YES	YES	YES
R^2	0.18	0.22	0.17	0.32
Number of observations	11,369	11,271	11,202	11,110

Note. In columns (1) and (2) the definition of irregular job rate is based on the difference between age and the age when completed education. In columns (3) and (4) the dependent variable is the fraction of income received in cash. The sample refers to the 1995-2004 SHIW. Standard errors, adjusted for clustering at the provincial level, are reported in parenthesis. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level

Table 4
Financial development and the underground economy. IV regressions

	(1)	*(2)*	*(3)*	*(4)*
Financial development	-0.311	-0.179	-0.187	-0.189
	(0.050)***	(0.059)***	(0.056)***	(0.055)***
Male	-0.036	-0.034	-0.043	-0.044
	(0.012)***	(0.012)***	(0.012)***	(0.012)***
Age	-0.022	-0.021	-0.020	-0.020
	(0.003)***	(0.003)***	(0.003)***	(0.003)***
Age square	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Years of education	-0.020	-0.020	-0.017	-0.017
	(0.007)***	(0.007)***	(0.008)**	(0.008)**
Married	-0.027	-0.030	-0.024	-0.023
	(0.009)***	(0.009)***	(0.009)***	(0.009)**
Log disposable income	-0.077	-0.076	-0.075	-0.075
	(0.008)***	(0.008)***	(0.008)***	(0.008)***
Judicial inefficiency	0.043	0.039	0.014	0.007
	(0.031)	(0.028)	(0.030)	(0.037)
Social capital		0.090	0.067	0.086
		(0.128)	(0.132)	(0.149)
South		0.070	0.059	0.053
		(0.023)***	(0.022)***	(0.024)**
Provincial unemployment rate				0.082
				(0.216)
Constant	1.672	1.518	1.592	1.575
	(0.124)***	(0.144)***	(0.175)***	(0.187)***
Year dummies	YES	YES	YES	YES
Sector dummies	NO	NO	YES	YES
Occupation dummies	NO	NO	YES	YES
Observations	11781	11781	11779	11673
F-test on first-stage instruments	29.91	47.01	47.35	70.50
Test of over-identifying restrictions (p-value)	0.54	0.78	0.66	0.42
Exogeneity test (p-value)	0.02	0.78	0.90	0.87

Note. The sample refers to the 1995-2004 SHIW. The instruments are: branches per capita in 1936, local branches in 1936, number of saving banks per capita in 1936, and number of cooperative banks per capita in 1936. Standard errors, adjusted for clustering at the provincial level, are reported in parenthesis. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Table 5
Financial development and the underground economy, by sector. OLS regressions

	Manufacturing	Construction	Retail and tourism	Transporta-tion	Financial and real estate
	(1)	(2)	(3)	(4)	(5)
Financial development	-0.076	-0.353	-0.287	-0.198	-0.084
	(0.039)*	(0.076)***	(0.088)***	(0.056)***	(0.086)
Male	-0.044	-0.001	-0.025	-0.012	-0.051
	(0.013)***	(0.077)	(0.018)	(0.030)	(0.028)*
Age	-0.023	-0.026	-0.014	-0.016	-0.020
	(0.005)***	(0.007)***	(0.006)**	(0.011)	(0.009)**
Age square	0.000	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)**	(0.000)	(0.000)*
Years of education	-0.024	-0.032	-0.027	-0.049	0.016
	(0.007)***	(0.013)**	(0.011)**	(0.014)***	(0.013)
Married	-0.008	-0.030	-0.029	-0.047	-0.052
	(0.011)	(0.029)	(0.018)	(0.031)	(0.024)**
Log disposable income	-0.074	-0.120	-0.063	-0.054	-0.056
	(0.009)***	(0.016)***	(0.011)***	(0.021)**	(0.019)***
Judicial inefficiency	0.017	-0.071	0.018	0.072	0.105
	(0.025)	(0.066)	(0.048)	(0.065)	(0.057)*
Social capital	0.005	-0.089	0.076	0.252	0.259
	(0.102)	(0.194)	(0.255)	(0.213)	(0.295)
South	0.083	0.034	0.046	0.030	0.055
	(0.025)***	(0.036)	(0.037)	(0.033)	(0.046)
Constant	1.514	2.506	1.362	1.174	0.982
	(0.137)***	(0.355)***	(0.301)***	(0.362)***	(0.292)***
Year dummies	YES	YES	YES	YES	YES
R2	0.13	0.20	0.12	0.12	0.09
Number of observations	4783	1482	2779	899	1836

Note. The sample refers to the 1995-2004 SHIW. Standard errors, adjusted for clustering at the provincial level, are reported in parenthesis. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.

Table 6
Financial development and the underground economy, by sector. IV regressions

	Manufactu-ring (1)	Construc-tion (2)	Retail and tourism (3)	Transporta-tion (4)	Financial and real estate (5)
Financial development	-0.103	-0.353	-0.274	-0.209	-0.001
	(0.043)**	(0.076)***	(0.087)***	(0.062)***	(0.104)
Male	-0.044	-0.001	-0.025	-0.012	-0.050
	(0.013)***	(0.076)	(0.018)	(0.030)	(0.028)*
Age	-0.023	-0.026	-0.014	-0.016	-0.020
	(0.005)***	(0.007)***	(0.006)**	(0.011)	(0.009)**
Age square	0.000	0.000	0.000	0.000	0.000
	(0.000)***	(0.000)***	(0.000)**	(0.000)	(0.000)**
Years of education	-0.024	-0.032	-0.027	-0.049	0.016
	(0.007)***	(0.013)**	(0.011)**	(0.014)***	(0.013)
Married	-0.008	-0.030	-0.029	-0.047	-0.052
	(0.011)	(0.029)	(0.017)*	(0.030)	(0.023)**
Log disposable income	-0.074	-0.120	-0.063	-0.054	-0.056
	(0.009)***	(0.016)***	(0.011)***	(0.021)***	(0.019)***
Judicial inefficiency	0.012	-0.071	0.021	0.069	0.119
	(0.026)	(0.065)	(0.047)	(0.067)	(0.056)**
Social capital	0.027	-0.089	0.068	0.257	0.207
	(0.108)	(0.191)	(0.256)	(0.214)	(0.274)
South	0.081	0.034	0.047	0.029	0.064
	(0.024)***	(0.036)	(0.037)	(0.033)	(0.047)
Constant	1.511	2.506	1.359	1.177	0.975
	(0.136)***	(0.352)***	(0.299)***	(0.361)***	(0.281)***
Year dummies	YES	YES	YES	YES	YES
Observations	4783	1482	2779	899	1836
F-test on first-stage instruments	56.31	38.03	55.30	45.80	37.89
Test of over-ident. restrictions (p-value)	0.97	0.73	0.58	0.75	0.31
Exogeneity test (p-value)	0.15	0.98	0.57	0.72	0.01

Note. The sample refers to the 1995-2004 SHIW. The instruments are: branches per capita in 1936, local branches in 1936, number of saving banks per capita in 1936, and number of cooperative banks per capita in 1936. Standard errors, adjusted for clustering at the provincial level, are reported in parenthesis. * significant at the 10% level, ** significant at the 5% level, *** significant at the 1% level.