Undeclared Work and Wage Inequality

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Abstract

In this paper we study how undeclared work affects the wages of undeclared and declared workers and in particular the declared wage inequality. Using individual data on Italy in the years 2000-2004, we compute a cross and own labor demand elasticity for undeclared and declared work. We provide an identification strategy relying on Italian amnesty tax laws in 2002. Such laws have changed the shape of Italian undeclared sector causing a quick emersion of undeclared workers. Our results based on a set of 2SLS regressions suggest that undeclared work: 1) decreases declared wages, 2) adversely affects undeclared wages and 3) raises wage inequality in the declared sector. Undeclared work competes more with least skilled jobs, while do not affect high skilled jobs. We found complementarity between undeclared workers and medium skills jobs. As a consequence reducing undeclared work decreases wage inequality as well as it decreases the earnings in medium skill sectors. This result suggests that undertaking reducing undeclared labor-policy might encounter resistance because of welfare loss of the medium class of workers.

Keywords: elasticity of labor demand, undeclared labor, wage inequality.
JEL classification: H26, J23, J31.

1 Introduction

Tax evasion is a matter widely reported since the antiquity. Always difficult to be examined on either theoretical or empirical ground. From one side, theoretical economic models based on taxpayer rationality have shown to be unable

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to describe properly the behaviour of an agents involved in the tax evasion setting. If one applies standard game theory or any rational choice approach to the problem of tax compliance, the level of penalties and enforcement that we observe would appear insufficient in explaining the degree of compliance with the tax law. As a consequence, in the last 15 years behavioral and experimental economists have started to address the problems of traditional economist correcting assumptions and evaluating the variety of psychological reasons affecting the motivation of paying taxes, e.g. honesty, fear, sense of group membership (Chorvat 2006, Alm et al. 1992).

On the empirical side, the lack of reliable data on evasion has always recalled concerns on the validity of the results achieved by applied economists. Typical data on evasion comes from administrative audit databases, which usually are strongly selected data and not always provide sufficient information to deal with such a selection. This happens mainly because audit authorities try to maintain secrecy on their audit strategies. Some advances in this field are made during the last years using ad hoc surveys (Saez, 2011 WP, Lemieux et al. 1994) and/or relying on individual audit data in which the source of information is enough detailed to propose a proper selection model (Di Porto, 2011 and Di Porto et al. WP)[1].

This paper focus on undeclared labor, which is a particular kind of evasion. As reported in Di Porto 2011, undeclared work is nothing more than the evasion of labor taxes perpetrated by an employer against a Public Institutions collecting social contribution. In countries like Italy, France or Germany employer collects the social contributions for its workers. There are other countries in which the employee is in charge for this payments. In both cases evading this payment is just as under declaring a part of the hours worked. Therefore evading social contributions is the the same that working in the undeclared sector. As other types of tax evasions, the topic of undeclared work have difficulties to find a wide space in economic literature, motivations for that, are related to what reported before, anyway undeclared work is, in terms of size, one of the main issues of contemporaneous labor markets. In line with a recent study of OECD we can assert that out of a global working population of some 3 billion workers, nearly two-thirds (1.8 billion) are undeclared workers (Jutting and Laiglesia 2009). Schneider (2000) estimated that in the European area the number of persons working in the unofficial economy doubled within the two decades from 1978 to 1998. Italian undeclared work is employing in the last 10 years more than 15% of the labor force. The same applies, to U.S., in which more that 18 million people are estimated to be illegal migrants (Justice 2005). BRIC (Brazil, Russia, India, China) nations and eastern European countries are involved with similar percentages too.

Although a large share of the more developed labor markets in the world is constituted by this type of labor, economists knows relatively little about how undeclared work affects economy and about which plans has to be undertaken

[1]In the case of Di Porto (2011) the dataset includes information on both audited and non-audited taxpayers allowing for comparison between the two groups.

in order to let undeclared labor emerge. To be noticed that economists still concerns about whether an increment of undeclared work would be considered a sign of health or of decline for labor market (see C.C. Williams, 2010 for a review of the main economic views on undeclared labor partecipation). The problems of undeclared work comes more and more important in a period of globalization and in a period of mass migration as the one we live. Migrant workers are indeed those that in majority are employed in such a market.

This paper faces the challenge of building a reliable analysis on undeclared work, estimating a short run labor demand elasticity for undeclared and declared work in Italy. The aim of this paper is to study the effect of undeclared work on wage inequality. This is a microeconometric analysis, and as far as we know it doesn't exist anything of this kind in literature.

Putting together undeclared work and inequality seems to be a really interesting exercise for several reasons: 1) We usually study inequality relying only on the *declared sector*[2], for instance, doing that for Italy leads to leave out from the analysis the 15% of the real labor force at work. For some southern Italian regions undeclared sector covers almost 30% of the working relations (i.e. Calabria). It would be important to ask ourselves which kind of analysis could be undertaken forgetting 30% of the sample! 2) We are not just forgetting a big part of the labor force, we are usually forgetting that part of labor force that is less qualified (Boeri et al. 2002, Cappariello and Zizza, 2010) and much more socially excluded. Intuitively, forgetting undeclared work in an inequality analysis leads to a sure underestimation of the phenomenon. It is worth noticing that till now, we didn't mention about the consequences of such large share of undeclared labor is at work on the whole economy. What happens when a big part of these emerge? Or conversely submerge? Does emersion policy affect *real* wage inequality (the one computed considering declared and undeclared workers), or *declared* wage inequality (the one usually taken in consideration in the economic literature)? In addition, it seems to be very interesting to understand which kind of workers is more affected by this *emersion/immersion effect.*

Our estimations based on a set of 2SLS regressions lead to the following conclusions, Undeclared Work: 1) decreases declared wages, 2) adversely affects undeclared wages and 3) raises wage inequality in the declared sector. Undeclared work competes more with least skilled jobs, while do not affect high skilled jobs. We found complementarity between undeclared workers and medium skills jobs. As a consequence reducing undeclared work decreases declared wage inequality as well as it decreases the earnings for medium skilled workers.

The paper proceed as follows: section two explains the institutional setting in which we develop our analysis, in particular we focus on the effect of amnesty tax law on undeclared work. This is useful to identify supply change in undeclared sector (we explain in a following section (4.2) how to use a shock in the undeclared work supply (produced by the amnesty policy) to build instruments for our labor demand function). Section three describes the theoretical

[2]All the databases normally used for Labor market analysis reports individuals that are declared working to the authorities: Labor force surveys, employers-employees datasets etc

framework in which we move. Section four shows the empirical analysis and the identification strategy. Section five displays the empirical results. Section six concludes.

2 Institutional settings: The amnesty tax law

Look at figure 1! It is shown the full time equivalent (FTE) undeclared work trend in Italy together with the FTE declared work trend, the curves are log transformations of the data while the source is the Italian institute of Statistics ISTAT[3]. The pattern of the two curves is similar (years 1990-2001) except for the variation that starts in 2002 and end in 2003 in which the two curves restart their trend. This shock was caused by 3 different amnesty tax laws decided by Italian government in the year 2002. In particular we talk about:1) Law n. 189, 30-July-2002; 2) Law n. 222 9-October-2002, 3) Law 383/2001.

These laws were planned in order to amnesty evasions on social security contribution payments. The first two were scheduled in order to let emerge migrant undocumented workers employed in the undeclared sector and were part of a much bigger law package known as Bossi-Fini law. The third was aimed in order to stimulate emersion of any type of undeclared worker native or not. In all the cases the mechanism for the amnesty was simple and similar. The employer in charge for the contribution had to declare the months worked by its workers without compliance of the labor tax payments (with an obliged minimum of 3 months of under-declaration to be reported in order to be taken in consideration for the emersion). A lump sum tax based on the number of months evaded[4] was the fee to be paid in order to let the worker emerge. In the case of migrants a big incentive to the emersion was provided by the promise of providing residential documents to all of those workers that declared theirselves for the emersion. Therefore in this case the economic incentive for the employer, produced by a reduced payments of contribution, adds to the strong social incentive for the workers. Being recognized as resident solve several practical problems either reducing stigma or open at the possibility of calling for the provision of public services (i.e. healthcare, housing etc). For native workers the mechanism of evasion was leaved just on the economic incentive for the employer and for a supposed stigma reduction. Government promoted its campaign of emersion strongly by the mean of media, advertisement and using social security auditor to inform firms and workers.

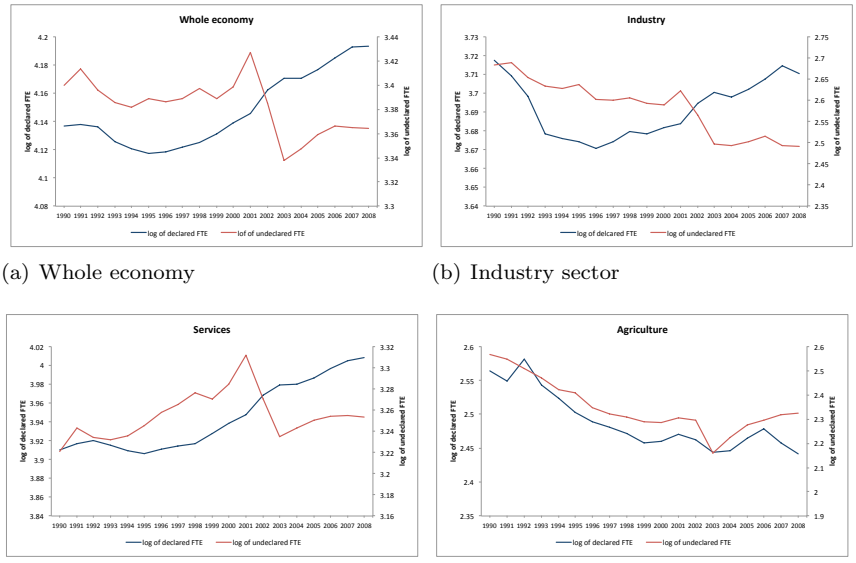
The dynamic induced by these laws is pretty clear from the table, a labor market in which the ratio between FTE declared and declared remains almost the same for several years, it inverts for a very short period his trend. Undeclared work reduces in the short run, provoking an expansion on the declared sector,

[3]ISTAT undeclared work indicator is an indicator provided by ISTAT together with other source on shadow economy in Italy, it is considered the most reliable indicator from OECD and it is based on a very complex computation of various source of information either from the household side or from the firm side.

[4]For the detail on the payments see Stame (2004) or Anastasia et al. (2005)

to be noticed that anyway in terms of FTE the expansion do not balance the reduction in the other sector. Undeclared workers enters just partially in the declared sector and those that emerge remains for a very short time in it. As noticed in Anastasia et al. (2005) 70% of the undeclared emerged disappears before 2004 from the market. This dynamics reveals a very simple picture. A competitive labor market producing in equilibrium at a certain point manages to return very quickly at the same point if all of the production factors remain unaltered. To be noticed, that those laws were just aimed to recover some evasion through the mechanism explained, nothing was planned in order to maintain this new supply of labor at work in the long run. Italian market is pretty slow in his adjustment and during the period 2002-2004 showed the same characteristics in term of productivity, labor costs, wages etc. Some of the emerged workers simply never start working in the declared sector, or they do it just for a very short term. Migrant satisfied for their new residential status find simply a way of "returning in the shadow" or take advantage of their new status for new destination in Europe[5]. The result is a supply shock that do not alter anything else in the labor market. We use this setting and this shock induced by the amnesties of 2002 to carry out a causal analysis on the implication of undeclared work on inequality.

Figure 1: Evolution of declared and undeclared full time equivalent workers, 1990-2008.



(a) Whole economy

(b) Industry sector

(c) Services sector

(d) Agriculture sector

[5]It is well-known that Italian labor market is a first landing for migrants arriving from middle East and Africa. Those usually try to go in central Europe (i.e. France or Germany) which is a more strong welfare magnet.

3 Theoretical settings

In this section we briefly sketch the theoretical implications of increased undeclared work supply. The aggregate production function we use is the very common and popular Cobb-Douglas aggregation:

$$Y = AK^{\alpha}N^{1-\alpha} \tag{1}$$

where A is exogenous total factor productivity, K is the physical capital and N is a CES aggregate of two different types of labor, undeclared and declared. The labor aggregate is defined as:

$$N = [\theta_U N_U^{\rho} + \theta_D N_D^{\rho}]^{1/\rho} \tag{2}$$

where ρ is a function of the elasticity of substitution σ_{DU} between the two type of labor ($\rho = 1 - 1/\sigma_{DU}$), θ_U and θ_D are the share parameters summing to 1. Competitive market imposes that all factors are paid their marginal product, then the undeclared and declared wages are given by

$$\ln w_U = \ln \left[A \left(\frac{K}{N} \right)^{\alpha} (1-\alpha) \right] + \ln \theta_U + \frac{1}{\sigma_{DU} - 1} \ln \left[\theta_U + \theta_D \left(\frac{N_D}{N_U} \right)^{\rho} \right] \tag{3}$$

and

$$\ln w_D = \ln \left[A \left(\frac{K}{N} \right)^{\alpha} (1-\alpha) \right] + \ln \theta_D + \frac{1}{\sigma_{DU} - 1} \ln \left[\theta_U \left(\frac{N_D}{N_U} \right)^{-\rho} + \theta_D \right] \tag{4}$$

Given those equations it is then straightforward to show the effects of an increase of undeclared employment on declared and undeclared wage. Taking partial derivative of 3 and 4 we obtain the effect of an increase of undeclared employment on undeclared and declared wages. The resulting expressions are as follows

$$\frac{\partial \ln w_U}{\partial \ln N_U} \equiv \frac{1}{\sigma_U} = -\alpha S_U - \frac{1}{\sigma_{DU}}(1 - S_U) \tag{5}$$

$$\frac{\partial \ln w_D}{\partial \ln N_U} \equiv \frac{1}{\sigma_D} = -\alpha S_U + \frac{1}{\sigma_{DU}} S_U \tag{6}$$

where $S_U = w_U N_U / w_U N_U + w_D N_D$ is the share of overall wages paid to undeclared workers. In order to discuss these expressions we need to take into account the supply of physical capital, that is, whether it is supplied fixed or perfectly elastically. First consider the case in which capital is fixed. Increased supply of undeclared workers reduces both declared and undeclared wages by lowering the capital-labor ratio of the economy. Further, if undeclared and declared labor are perfect substitute ($\sigma_{DU} \to \infty$), declared and undeclared

wages decreases by the same amount αS_u. Whereas, if undeclared and declared labor are imperfect substitute (or q-complements), there will also be a positive effect on declared wages operating by the term $\frac{1}{\sigma_{DU}} S_u$. Which of the two effects on declared wages prevails is an empirical matter. Let consider now that capital is supplied perfectly elastically, so that $\alpha \to 0$. As the capital can adjust freely to the changes of labor, undeclared supply does not affect the capital-labor ratio and if the two labor input are perfect substitute no changes in wages occur. While if we consider imperfect substitutability undeclared wages lowers and declared wages increase. For the empirical exercise we carry out in the following sections we focus on the short-run labor demand elasticities, as we consider exogenous variation in the supply of undeclared workers which only applies in the short-run. So, the case of perfectly elastic capital can be ruled out, and the simple model outlined above fairly predicts a drop in wages for both type of labor.

The previous production function considers declared and undeclared labor as homogenous input. We can relax this assumption by taking into account different broad education groups of the workforce. In doing so, we allow for labor input to be comprised of high-skill declared workers and the aggregate between undeclared and low-skill declared workers. The choice of considering undeclared labor as an aggregate is merely practical, because in the empirical part we exploit a source of exogenous variation only in the total full-time equivalent undeclared workers. The aggregate production function is still described by (1), while N is a CES aggregate of high-skill declared labor and the composite input and it is defined as:

$$N = [\theta_H N_H^{\gamma} + \theta_A N_A^{\gamma}]^{1/\gamma} \tag{7}$$

where γ is a function of the elasticity of substitution σ_{HA} between the two types of labor ($\gamma = 1 - 1/\sigma_{HA}$), θ_H and θ_A are the share parameters summing to 1. Further we assume that the labor composite N_A is itself the CES subaggregate of undeclared labor and low-skill declared labor and it is defined as:

$$N_A \quad = \quad [\theta_U N_U^{\eta} + \theta_D N_{LD}^{\eta}]^{1/\eta} \tag{8}$$

where η is a function of the elasticity of substitution σ_{U-LD} between undeclared and declared low-skilled workers. θ_U and θ_D are the corresponding relative efficiency parameters.

In competitive market the marginal product for each labor supply equates to the corresponding wage. Then the ratio of the wage rate of high-skill declared workers to the wage of low-skill declared workers equates to the ratio of the corresponding marginal products satisfying the following equation:

$$\ln\left(\frac{w_H}{w_{LD}}\right) = \ln\frac{\theta_H}{\theta_{LD}} + (\gamma - 1)\ln N_H - (\rho - \eta)\ln N_{LD} - \ln\theta_D - (\eta - 1)\ln N_{LD} \tag{9}$$

Differentiating equation 10 with respect to N_U we obtain the effect of an increase of undeclared employment on the declared wage inequality. The resulting expression is

$$\frac{\partial \ln(w_H/w_{LD})}{\partial N_U} = \left(\frac{1}{\sigma_{HA}} - \frac{1}{\sigma_{U-LD}}\right)\frac{S_U}{1-S_H} \tag{10}$$

where S_U is the share of overall wages paid to undeclared workers and S_H is the share of overall wages paid to the high-skill declared workers. An increase in undeclared labor increases the declared wage skill premium if undeclared workers compete more with low-skill declared than high-skill declared workers, that is, when $\eta > \gamma$ or equivalently when the elasticity of substitution between undeclared and declared low-skill workers is higher than the elasticity of substitution between the high-skill declared and the aggregate labor input.

4 Empirical analysis

4.1 Empirical model

We use two stage least square instrumental variable (2SLS IV) estimator to estimate the models 5 and 6 reported below.

$$\ln w_{irt} = \alpha_r + \zeta_{2004} + b_i + X'_{irt}\beta^b_t + \gamma \ln\left(\frac{U_{rt}}{D_{rt}}\right) + \delta b_i \ln\left(\frac{U_{rt}}{D_{rt}}\right) + \varepsilon_{irt} \tag{11}$$

A strategy close to the one we use can be found in Acemoglu et al. 2005. In model 5 w_{irt} is our dependent variable and represents the hourly net wage of Italian individual workers drawn by two different wave of cross sections for the year 2000 and 2004. The data we use are derived by two sources: SHIW which is a Bank of Italy survey on households and ISTAT non observed economy indicators, the source from which we obtained the graphs in figure 1. Both of the sources will be explained in details in 4.3. w_{irt} varies among individuals in 20 italian regions and two periods, one before and one after the policy shock of 2002. On the right side, we introduce α_r a regional fixed effect, ζ_{2004} a time dummy and a matrix X'_{irt} of covariates aimed to control for the individual worker characteristics. We choose these covariates selecting on what are usually called pre-choice characteristics, so determinants belonging to the worker before the choice of the jobplace[6]. b_i is a dummy to identify undeclared workers, this information is present in the SHIW survey (see section 4.3). γ and δ are the coefficients of major interest for our research. γ is the coefficient of $\frac{U_{rt}}{D_{rt}}$ which

[6]These are job experience and its square, educational level, the interaction between experience and educational level, a dummy for part time job, a dummy for migrants and a dummy selecting workers living in urban areas. All these variable are interacted with a dummy for undeclared worker and the time dummy for 2004.

is the ratio between regional undeclared work supply and regional declared work supply, these is expressed in log of FTE. δ is the coefficient of the interaction term b_i times the log of $\frac{U_{rt}}{D_{rt}}$. These last two covariates are derived by the indicator of FTE workers provide by ISTAT. A variable of such kind represents the equilibrium between supply and labor demand in the market. As we said, we will estimate a set of short run labor demand elasticities, therefore to do that we need to solve a classical problem of identification. We suggest the identification strategy in 4.2 in which we explain how to use the policy shock induced by the 2002 amnesty tax laws in order to build a reliable set of instruments. Once identification problem is solved we could read the coefficients γ and δ as follows. γ represents a variation of the wages of declared workers induced by a variation of the relative supply $\frac{U_{rt}}{D_{rt}}$. The sum of γ and δ represents the inverse of the own wage elasticity for undeclared labor, therefore it describe how a change in the relative supply of undeclared workers affect undeclared workers wages. δ is the inverse cross elasticity, so describes how a change in relative supply affect the wage gap between undeclared and declared workers.

$$\begin{aligned} \ln w_{irt}^{D} &= \alpha_r + \zeta_{2004} + h_i + X'_{irt}\beta_t^h + \pi \ln\left(\frac{U_{rt}}{D_{rt}}\right) + \lambda h_i \ln\left(\frac{U_{rt}}{D_{rt}}\right) + \\ &\quad \theta \ln\left(\frac{H_{rt}}{L_{rt}}\right) + \lambda h_i \ln\left(\frac{H_{rt}}{L_{rt}}\right) + \varepsilon_{irt} \end{aligned} \tag{12}$$

Model 6 is very similar to model 5 but here we use individual data on the declared side of the labor force, thus just declared workers. w_{irt}^{D} is the wage of an individual declared worker in one of the 20 italian regions, in 2000 and 2004. We still have regional, time fixed effect dummies and a matrix of pre-choice covariates equal to the previous one. h_i represents a dummy for the highest skill group of workers. π and λ are our coefficients of interest. Following the same reasoning for the previous model once we have solved for the identification problem via 2SLS, π represents a variation of the wages of low skill declared workers induced by a variation of the relative supply. The sum of π and λ represents the inverse of the wage elasticity for high skill labor while λ is a measure of inverse cross elasticity, so describes how a change in relative supply affect the wage gap between low and high skill declared workers. Finally, the ratio between the two cross elasticities $(\pi + \lambda/\pi)$ tells us which education group undeclared labor supply is closer substitute for. Specifically if $\pi + \lambda/\pi < 1$ it implies that undeclared labor has a larger wage impact on high school (less than high school) graduates; so undeclared workers are closer substitutes for high school (less than high school) than for college declared workers, and the opposite holds if $\pi + \lambda/\pi > 1$.

4.2 Identification strategy

We identify our labor demand function using the policy shock provided by the amnesty tax laws in 2002. As mentioned before this event induced an exoge-

nous contraction in the undeclared sector. In the short run we can easily assume no salary adjustment, to be remembered that the contraction of undeclared labor is not perfectly compensated in the declared sector, this is accompanied by a very short permanence of the emerged worker in the declared sector. This induce to think that labor market in the short run do not adjust, saving its peculiarity in terms of capital, production, factors productivity and so on. Emerged workers cannot be taken in a market that maintains this old equilibrium and therefore undeclared workers: 1) never enters in the declared sector or 2) are quickly rebounded by the declared sector into the undeclared one.

What we need to identify our labor demand is an instrument $Z_{r,t}$ for the relative supply, so we can be sure that 5 and 6 describes movement on the demand curve. An instrument of this kind have to be correlated with the log of $\frac{U_{rt}}{D_{rt}}$ and have to be exogenous, implying: $E(\varepsilon_{irt}|Z_{i,t}) = 0$. Model 5 and 6 are interaction models, so given a reliable instrument $Z_{r,t}$ for $\frac{U_{rt}}{D_{rt}}$, it follows that $b_i * Z_{r,t}$ is a reliable instrument for $b_i * \frac{U_{rt}}{D_{rt}}$.

We set

$$Z_{r,t} = \zeta_{2004} * A_{r,2004} \tag{13}$$

where $A_{r,2004} = (FTE^*_{und} - FTE_{und})_{r,2004}$. We compute $A_{r,t}$ starting from the series of FTE data provided by ISTAT, using a simple AR(1) model we predict the value of FTE undeclared in 2004 FTE^*_{und}. This has to be seen as a sort of synthetic counterfactual value, which is the percentage of undeclared FTE workers in the market if no policy shock had been taking place[7]. In fact this is computed just taking information before 2002. We subtract this predicted value to the actual value of FTE in 2004 so we obtain a proxy of the people that have registered for the amnesties. We multiply this proxy for a dummy which is one in 2004 obtaining our instrument $Z_{r,t}$.

4.3 Data

We used two source of data: two individual cross sections by SHIW, the survey provided by the bank of Italy, some summary stats of these data are summarized in Table 2. We have around 2700 individual per each year. SHIW survey provides information on labor tax evasion and are extensively used in the last years in order to get micreconometric evaluation on undeclared sector (for an example see Cappariello and Zizza, 2010). We define undeclared workers individuals negatively replying to the following question: *Considering the lifetime work experience of... (name), did he/she ever pay, or his/her employer pay, pension contributions, even for a short period (and even if long ago)?* If an individual replies negatively stating and, at the same time, he or she has been working, this means he or she has been working in the undeclared sector. Moreover we add to those individuals who even though reply positively at the question they did not pay social contributions for most of their working career.

[7] Card 2010 use predicted values of migrants in a very similar setting in order to instrument relative supply of migrants versus native workers in US.

Undeclared workers shows to be less educated than declared; a greater share of non-native workers are employed in the undeclared sector then natives. Data on FTE declared and undeclared labor where taken directly from ISTAT non observed economy indicators. These are regional data provided by ISTAT every year, the trend of such data stands clear in table 1.[8] The methodology to determine the FTE undeclared work indicator is fairly complicated and need the use of many different source of data from the side of households and firms (see for a detailed explanation OECD, 2004).

Table 1: Main descriptive statistics of the sample .

	2000		2002	
	Declared	Undeclared	Declared	Undeclared
log of hourly wage	2.03	1.71	2.05	1.83
	(0.40)	(0.51)	(0.4)	(0.51)
Tertiary education	7%	5%	6%	6%
Secondary education	42.4%	25%	44%	29%
Primary education	50.6%	70%	50%	65%
Years of potential experience	20	14	20.3	15.4
	(12.1)	(11.4)	(12.1)	(12.2)
Non-native	2.9%	9%	7%	16%
North	51%	24%	50%	28%
Centre	21%	14%	23%	20%
South	28%	62%	27%	52%
No of observations	2703		2606	

5 Results

5.1 Main findings

In this section we show the results of the empirical models outlined above. Table 2 depicts results from OLS estimates of equation 7. The point estimates in the first two rows of table 2 corresponds to γ and δ of equation 7. The estimated models I-V differ from each other for the covariates we control for. Model in column I is the baseline estimate; it only allows for the relative supply of undeclared workers, time and regional fixed effects. Models in column II and III include a set of human capital and social characteristics covariates, and interactions with an undeclared worker dummy. Models IV and V add interactions of the covariates with a year 2004 dummy. Furthermore, in order to take into account some regional variation, models III and V allow for 2000 regional share

[8] OECD considers ISTAT non-observed economy indicators a good practice of quantifying underground economy, and it encourage the statistical offices of the other OECD countries to adopt a similar strategy (OECD 2004).

of declared migrant, 2000 regional share of declared prime age workers, 2000 regional average education interacted with 2004 dummy. Summing γ and δ to obtain an estimate of the inverse elasticity of undeclared labor demand, we find that a 10% increase in the relative supply of undeclared lowers declared wages by 9-19%. At the same time, the wage effect of relative supply on declared wage is not significantly different from zero. Furthermore, taking the inverse of the coefficient δ, it seems that there does no exist substitutability between the two type of labor whatsoever. Even tough informative, OLS estimates are biased owing to identification issue as discussed above. From this reason we do not consider highly reliable the findings in table 1.

Table 2: OLS estimates of elasticities of demand and substitution between undeclared and declared workers.

	I	II	III	IV	V
$\ln(\frac{U}{D})$	-.01 (.04)	-.03 (.03)	.06 (.06)	.07*(.04)	.07 (.06)
$\ln(\frac{U}{D})*$Undeclared	-.12*(.07)	-.16**(.07)	-.16**(.07)	-.15*(.07)	-.15*(.07)
No of observations	5309		5289		

** Significant at 5%, * Significant at 10%. Standard errors (in parentheses) account for clustering on region and year of observation. Model I is a baseline estimates; it controls for time effect and regional fixed effect. Models in column II and III include a set of human capital and social characteristics covariates all interacted with an undeclared worker dummy. Models IV and V add interactions of the covariates with a year 2004 dummy. Further models III and V allow for 2000 regional share of declared migrant, 2000 regional share of declared prime age workers, 2000 regional average education interacted with 2004 dummy.

To obtain reliable estimates we estimate equation 7 by two stage least square (2SLS) using as instrument the difference between predicted and actual FTE undeclared workers as discussed in section 4.2. Table 3 shows the 2SLS estimates of the empirical model 7. At the bottom of table 3 are also reported the customary F-test and partial R^2 to check the reliability of the chosen instrument. The F statistics is fairly greater than the threshold value of 10, and the partial R^2 takes values from 0.17 to 0.36. Taking together theses checks prove that the instruments are highly significant in explaining the variance of the endogenous variables. The point estimate of the parameter δ is in all cases negative and significantly different from zero. The point estimate of γ is negative and significantly different from zero in the models of column III and V, our preferred specifications. Summing γ and δ we obtain the effect of an increase of the relative supply of undeclared workers on undeclared wage.[9] Then a 10% increase in relative supply lowers undeclared wages by 5-5.8%. This wage effect is consistent with an own labor demand elasticity between 1.7 and 2 in absolute value. They are quite similar with the findings in Fortin et al. (1994), who obtain a wage effect of undeclared working hours equals to 0.70-0.72, corresponding to an elasticity of 1.3-1.4. The rise in relative supply of undeclared

[9] Wald test of the joint significance of δ and γ always rejects the null hypothesis that the two parameters are jointly equal to zero.

Table 3: 2SLS estimates of elasticities of demand and substitution between undeclared and declared workers.

	I	II	III	IV	V
$\ln(\frac{U}{D})$	-.19 (.17)	-.23 (.19)	-.27**(.13)	-.24 (.15)	-.28**(.13)
$\ln(\frac{U}{D})$*Undeclared	-.31**(.14)	-.31**(.16)	-.31*(.17)	-.28*(.16)	-.29*(.16)
$\sigma_U = 1/\gamma + \delta$	2	1.85	1.72	1.92	1.75
$\sigma_{DU} = 1/\delta$	3.22	3.22	3.22	3.57	3.45
F-test	2.25; 43.13	1503.69; 405.82	872.03; 387.91	612.53; 386	848.86; 377.35
Partial R^2	.17; .20	.36; .13	.25; .13	.19; .13	.24; .12
No of observations	5309		5289		

** Significant at 5%, * Significant at 10%. Standard errors (in parentheses) account for clustering on region and year of observation. Relative supply of undeclared labor is instrumented by the difference between predicted and actual FTE undeclared workers multiplied by a 2004 dummy. Model I is a baseline estimates; it controls for time effect and regional fixed effect. Models in column II and III include a set of human capital and social characteristics covariates all interacted with an undeclared worker dummy. Models IV and V add interactions of the covariates with a year 2004 dummy. Further models III and V allow for 2000 regional share of declared migrant, 2000 regional share of declared prime age workers, 2000 regional average education interacted with 2004 dummy.

workers also affects the declared wages; however the impact is less negative. A 10% increase in relative supply lowers the undeclared wages relative to declared wages by 2.8-3.1%. This value corresponds to an estimates of the elasticity of substitution σ_{DU} of 3.22-3.57, implying that declared and undeclared labor is highly but not perfectly substitutable. Fortin et al. (1994) find a smaller value of the cross wage elasticity even tough not significantly different from 1. The difference is likely explained by the different approach of Fortin et al. (1994); specifically, they focus on a sample of Canadian workers employed in both regular and non-regular sector, and they are mainly interested in understanding the individual choice of supplying also non-regular hours of work in response to changes in labor tax rate. Our sample, while likely including also this kind of workers, is comprised of people been stuck with high probability in the underground sector. Moreover, considering the large share of undeclared workers in total employment in Italy, it is reasonable to assume, at least in principle, a higher degree of substitutability between the two labor input.

5.1.1 The effect of undeclared work on regular wage inequality

Estimates in table 3 have shown that changes in undeclared labor supply affect the average wage of declared workers by a remarkable amount. However, the wage effect may interest different segments of the declared wage distribution. If undeclared workers are closer substitute for declared workers at the bottom of the wage distribution, greater undeclared labor supply raises declared wage inequality. We explore this issue by estimating equation 8. We ask how increase

in relative supply of undeclared labor affect declared wage distribution at different educational levels. We split our declared workers sample in three broad education groups: college (CLG), high school (HS) and less than high-school (LHS). Specifically, college are all those individuals who get a college or higher education degree; high school are workers with a high school diploma; and less than high school are all those workers with a primary education degree and or no education. Then, we run separate estimates for the CLG-HSC and HS-LHSwage premium. College-high school (high school-less than high school) labor supply also directly affects the relative declared college (high-school) wage, thus, in estimating equation 8 we need to take into account those relative supplies. As results, we also control for college (high-school) relative supply in models of column I, II, and VI of table 3. treating it as exogenous. Furthermore, we consider the case of no correlation between college (high school) relative supply and the instrumented undeclared relative supply. Models of column III, IV, VII and VIII of table 3 takes such approach. Table 4 shows results for the high school graduates and people with less education. Growth in undeclared relative supply exerts a negative wage effect on LHS workers and a positive effect on the HS-LHS wage inequality. Specifically, a 10% increase in undeclared relative supply drops LHS wages by 2.6-3.8%, consequently it raises the HS-LHS wage ratio by 2.8-4.4%. By taking the ratio of the cross elasticities of undeclared labor for high-school and less than high school, in all cases we obtain a value less than 1, implying that undeclared labor is a closer substitute for workers with less education. Table 5 displays analogous estimates of equation 8 for college-high school differential wage premium. Although the point estimates reveal negative wage effects on wage differentials they are not significant different from zero, suggesting that undeclared labor is not a substitute for these types of labor. In conclusion, the effect of an increase of undeclared labor seems to affect more the less than high school declared workers relative to high school graduates. As a results, an upsurge of the aggregate undeclared labor inflates wage inequality between these two groups; furthermore, given that we do find any significant wage effects on the college-high school sample we can infer that wage inequality between the top and the bottom of the education distribution also increase.

Table 4: 2SLS estimates of the impact of undeclared work on regular wage inequality

	I	II	III	IV	V	VI	VII	VIII
	High school-Less than high school							
$\ln(\frac{U}{D})$	-.31 (.37)	-.37*(.21)	-.25 (.21)	-.36*(.21)	-.33 (.21)	-.38*(.22)	-.26 (.33)	- .37*(.22)
$\ln(\frac{U}{D})$*High school	.37**(.16)	.36**(.16)	.28**(.12)	.28**(.13)	.44**(.17)	.35**(.18)	.33**(.13)	.33**(.13)
$\ln(\frac{HS}{LHS})$	.003 (.04)	.016 (.05)			-.008 (.05)	.005 (.05)		
$\ln(\frac{HS}{LHS})$	.17**(.08)	.16*(.09)			.21**(.09)	.20**(.09)		
$\sigma_{HS/LHS}=\pi + \lambda/\pi$	-0.19	0.02	-0.12	0.22	-0.33	0.08	-0.27	0.11
F-test	535.11; 117.71	588.48; 111.06	486.66; 119.79	584.55; 116.92	530.13; 104.39	578.24; 97.76	481.4; 108.47	574.03; 105.75
Partial R^2	.19; .05	.21; .05	.18; .05	.21; .05	.19; .04	.21; .04	.18; .05	.21; .04
No of observations	4476							

** Significant at 5%, * Significant at 10%. Standard errors (in parentheses) account for clustering on region and year of observation. Relative supply of undeclared labor is instrumented by the difference between predicted and actual FTE undeclared workers multiplied by a 2004 dummy. Models in column I, II, III and IV include a set of human capital and social characteristics covariates all interacted with a high school dummy. Models V, VI, VII and VIII add interactions of the covariates with a year 2004 dummy. Further, models II, IV, VI and VIII allow for 2000 regional share of declared migrant, 2000 regional share of declared prime age workers, 2000 regional average education interacted with 2004 dummy.

Table 5: 2SLS estimates of the impact of undeclared work on regular wage inequality

	I	II	III	IV	V	VI	VII	VIII
					College-High school			
$\ln(\frac{U}{D})$	-.99*(.55)	-1.78 (1.18)	-.55 (.35)	-.44 (.36)	-1.10*(.57)	-1.95 (1.24)	-.63*(.36)	-.50 (.37)
$\ln(\frac{U}{D})$*College	-.53 (.50)	-.53 (.50)	-.62 (.68)	-.61 (.68)	-.50 (.50)	-.50 (.50)	-.58 (.69)	-.57 (.69)
$\ln(\frac{CLG}{HS})$	-.15*(.08)	-.28 (.18)			-.16**(.08)	-.30 (.19)		
$\ln(\frac{CLG}{HS})$	-.04 (.07)	-0.05 (0.07)			-.04 (.07)	-.05 (.07)		
$\sigma_{CLG/HS}=\pi + \lambda/\pi$	1.53	1.29	2.12	2.38	1.45	1.25	1.92	2.14
F-test	195.28; 19.8	58.13; 19.92	220.29; 10.30	238.47; 10.26	183.31; 19.21	53.33; 19.34	207.69; 9.92	222.68; 9.84
Partial R^2	.14; .016	.05; .02	.16; .01	.17; .01	.013; .016	.04; .016	.15; .01	.16; .01
No of observations	2392							

** Significant at 5%, * Significant at 10%. Standard errors (in parentheses) account for clustering on region and year of observation. Relative supply of undeclared labor is instrumented by the difference between predicted and actual FTE undeclared workers multiplied by a 2004 dummy. Models in column I, II, III and IV include a set of human capital and social characteristics covariates all interacted with a college dummy. Models V, VI, VII and VIII add interactions of the covariates with a year 2004 dummy. Further, models II, IV, VI and VIII allow for 2000 regional share of declared migrant, 2000 regional share of declared prime age workers, 2000 regional average education interacted with 2004 dummy.

6 Policy implications: the emersion/immersion effect

Policy makers has often debated on how to obtain the emersion of undeclared labor. However, as we asserted before undeclared activity flourished and as noted by Boeri et al. 2002 or Shnenider 2002, in the last years we have assisted to an increase of the shadows activities, this can lead to think that shadows activity are at certain extent tolerated. The picture is probably more complicated and this paper gives a contribution to better understand the difficulties of inducing an emersion. We should probably ask, anyway, what is emersion? and consequently what is immersion? Even if we have often listened about that in political debates, it is probably good practice to try to give an economic definition of this phenomenon. We define *emersion from undeclared sector as a passage from a worker (or many) from a state of activity in the undeclared sector to a state of activity in the declared sector.* Obviously, the opposite applies for immersion.

Given this definition, an emersion scheme should be seen as a contraction in the undeclared work supply, which is balanced by similar expansion in the declared work supply. In such framework the elasticity of the labor demands in both the market plays a crucial role in the consequence that emersion have on wages. Our results can help to explain about emersion/immersion effects at least in the short run.

However, it is probably better to ask ourselves something else, in the light of the evidence shown by our paper and by some others.

In fact, given the evidence debated in our analysis, a shift in supply from a market (undeclared) followed by a consequent similar shift in the other (declared), it is a myth! As noticed in Boeri et al. 2002, in a search and matching model framework, a repression of shadows activities, induces a contraction in undeclared activities but increase as well unemployment leading to an expansion of the declared sector that can be partial or not existing. In our case the contraction in undeclared labor is obtained by an amnesty tax, standing repression constant. Anyway, as we have seen from table 1 a contraction in the undeclared sector is not followed by a similar adjustment of the declared counterpart. This is explained in our framework by several issues, as remembered from an economic point of view the amnesty was conduced without being accompanied by any active labor market policy. It is possible to assert that a labor market in equilibrium have rebounded out very quickly the new and more costly declared workers. In addition, the new status of migrants have provided to them the possibility to move to other locations in search for better jobs, as a consequence emersion was just partial. The two pictures defined by Boeri et al. 2002 and our analysis seems to integrate each other, leading to believe that, at least in the short run, *pure emersion*, as defined before, can be very difficult to be achieved. Almost impossible, if a campaign of undeclared labor supply contraction is not accompanied by any other policy supporting demand in the declared sector.

Our analysis however tells more in this *partial emersion framework* (that is

a contraction in undeclared sector partially or not followed by an expansion in the declared counterpart). We have shown that reducing undeclared labor supply, when leaving unchanged declared labor supply, induce important changes in wages and inequality. First ameliorates undeclared wages and low skill declared wages given non perfect substitutability. But and considerable, decreases medium skill job wages given imperfect complementarity.

It is worth to notice that, this group of workers is the most widespread in developed labor markets, as a consequence to induce a partial emersion conflicts with their interests. Emersion policies are difficult to be developed, Boeri et al. 2002 suggested because they can lead to unemployment, we add to their result that, before this, politicians might be aware of the welfare loss induced by the emersion, even the partial one, against an important group of workers/voters.

Anyway, we cannot ignore that partial emersion ameliorates inequality, either declared inequality or real inequality. A policy maker might take care of that, since this can create a significant trade off with the medium skills welfare loss.

Intuitively our findings remains unchanged even in a pure emersion framework standing the fact that $\frac{U_{rt}}{D_{rt}}$ decreases (even in this case) given an increment of the denominator[10], even if we believe that more work would be suitable in order to discuss this case, in principal the sign of our inverse elasticity wouldn't change conducing to the same conclusions that in the partial emersion framework.

7 Conclusion

In this paper we study how undeclared work affects the wages of undeclared and declared workers and in particular the declared wage inequality. Using individual data on Italy in the years 2000-2004, We compute an own and cross labor demand elasticity for undeclared and declared work. Such empirical investigation requires a source of variation in undeclared labor that is able to identify the labor demand we aim at estimating. We provide an identification strategy relying on Italian amnesty tax laws in 2002. Those have changed the shape of Italian undeclared sector causing a quick emersion of undeclared workers. Our results based on a set of 2SLS regressions are that Undeclared Work: 1) decreases declared wages, 2) adversely affects undeclared wages and 3) raises wage inequality in the declared sector. Undeclared work competes more with low skilled jobs, while do not affect high skill jobs. We found complementarity between undeclared workers and medium skills jobs. As a consequence reducing Undeclared Work decreases wage inequality but decrease as well the earnings in medium skill sectors (emersion effect). This result could suggest why policy against undeclared work might be difficult to be undertaken leading to a welfare loss of this medium class of workers.

[10] In a pure emersion framework the undeclared labor supply contracts expanding declared labor supply this lead as well $\frac{U_{rt}}{D_{rt}}$ to decrease.

In addition we tried to add to our paper a number of new defintion in order to clarify some economics concepts which are usually confused in literature, we hope that to define *(un)declared wage inequality* and/or *emersion (pure or partial)* might help to conduce future work on this new concepts. Given the widespread diffusion of the phenomenom of undeclared work in the contemporaneous years, an increased interest of economic analysis in this field seems to be necessary.

References

[1] Acemoglu D., Autor D. L., Lyle D, (2004), Women, War, and Wages: The Effect of Female Labor Supply on the Wage Structure at Midcentury, Journal of Political Economy, 112(3): 497-551.

[2] Alm J., McClelland G. and Schulze W.,(1992),Why do people pay taxes, Journal of Public Economics 48(1): 21-38.

[3] Bertrand M., Duflo E. and Mullainathan S., (2004). "How Much Should We Trust Differences-in-Differences Estimates?," The Quarterly Journal of Economics, MIT Press, vol. 119(1), pages 249-275, February

[4] Boeri T., Garibaldi P., (2002) Shadow Activity and Unemployment in a Depressed Labour Market, CEPR Discussion Papers 3433.

[5] Boeri T., Garibaldi P., (2007), Shadow Sorting, in Frankel J., Pissarides C. (eds.), NBER International Seminar on Macroeconomics 2005, MIT press.

[6] Cappariello R., Zizza R., (2010) Dropping the Books and Working Off the Books, LABOUR, 24(2):139-162.

[7] Card D., (2009), Immigration and inequality, American Economic Review: Papers & Proceedings, 99(2):1-21.

[8] Chorvat T.,(2006), Trust and taxation in Behavioral public finance, Mc Caffrey E. and Slemrod J., Russel Sage Foundation, pages 206-232

[9] Di Porto E., (2011) Undeclared Work, Employer Tax Compliance, and Audits, Public Finance Review, 39(1):75-102

[10] Di Porto E., Persico N. and Sahuguet N.,(2011) Decentralized deterrence, with an application on labor tax audit, mimeo

[11] Justice R., Ng B.,(2005), The undergraound labor force is rising to the surface, Bear Stern Asset Managment.

[12] Jutting, J. P. and Laiglesia, J. R. (2009) 'Employment, poverty reduction and development: What's new?', in J. P. Ju¨tting and J. R. Laiglesia (eds), Is Informal Normal? Towards More and Better Jobs in Developing Countries, Paris: OECD, pp. 17 /26.

[13] Lemieux T., Fortin B. and Frechette P., (1994) The Effect of Taxes on Labor Supply in the Underground Economy," American Economic Review, 84(1):231-254, March.

[14] Schneider, F. 2000. "The Increase of the Size of the Shadow Economy of 18 OECD Countries: Some Preliminary Explanations." CESifo Working Paper no. 306.

[15] Williams C., Round J., (2010), Explaining parteciaption in undeclared work, European Society, 12(3) 391-418 July.