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INFORMALITY AND PRODUCTIVITY: DO FIRMS ESCAPE EPL THROUGH  
SHADOW EMPLOYMENT? EVIDENCE FROM A REGRESSION DISCONTINUITY  
DESIGN

*Giuseppina Gianfreda*      *Giovanna Vallanti*

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LUISS Guido Carli

Viale Romania 32, 00197, Rome -- Italy

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# Informality and productivity: do firms escape EPL through shadow employment? Evidence from a regression discontinuity design\*

Giuseppina Gianfreda<sup>†</sup>                      Giovanna Vallanti<sup>‡</sup>  
Università della Toscana and LLEE      LUISS "Guido Carli" and LLEE

## Abstract

Compliance with labour law has costs and benefits which may depend on the institutional environment in which firms operate. Although several studies have documented a negative effect of informality on firms' productivity and growth it is a fact that firms may resort to undeclared employment to escape excessive tax or regulatory burden. We argue that firms may respond to strict employment protection legislation through accrued informality thus (partially) offsetting the negative effect of informality on productivity. We exploit the Italian dismissal legislation imposing higher firing costs for firms with more than 15 workers and show that informality reduces the turnover of formal jobs for firms above the 15 workers threshold; furthermore, while the overall effect of informality on firms' productivity is negative, the differential effect for firms above the threshold as compared to smaller firms is positive and significant.

Key words: tax evasion, EPL, productivity, firm size, RD estimation

JEL Classification: D02; D22; D24

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<sup>†</sup>Giuseppina Gianfreda, Università della Toscana, DISUCOM, via Santa Maria in Gradi, 4. Phone: +390761357887. Email: ggianfreda@unitus.it.

<sup>‡</sup>Corresponding author: Giovanna Vallanti. Università LUSS "Guido Carli", Department of Economics and Finance, viale Romania 32, Rome 00197, Italy. Phone: +390685225910. Email: gvallanti@luiss.it.

## 1 Introduction

Shadow economy is a common phenomenon in both developing and developed countries. It accounts for 10% to 20% of GDP in most OECD countries, 20% to 30% in Southern European OECD countries and in Central European transition economies (Schneider and Enste, 2000). The extent of the shadow economy is closely related to the existence of an informal labour market. Even in the more advanced countries where the shadow economy mostly assumes the form of underreporting of income to the tax authorities, it involves a large use of undeclared (informal) labour.<sup>1</sup> Informal work is the norm in most-middle income countries, and it is also sizable in some high-income economies (OECD, 2004, 2009). Thought in the latest group, informal employment generally takes the form of under-declared work,<sup>2</sup> nevertheless in some OECD countries (as Southern European and transition countries) and, within countries, in some industries the share of wholly-undeclared workers may be substantial.

Against the pervasiveness of the shadow economy, most empirical evidence shows that going informal is detrimental for firms' productivity even when it is just partial. This may occur for a number of reasons. Informal firms have a limited access to capital markets (Cull et al., 2007) and to market support institutions and law enforcement (World Bank, 2007). Moreover, they tend to invest less both in physical and human capital (Gandelman and Rasteletti, 2013). If operating informally implies costs for firms in terms of lower productivity, on the other side firms often resort to informality to escape excessive regulatory pressure on their activity.<sup>3</sup> Among the others, high labour adjustment costs induced by rigid labour market regulation (e.g. employment protection legislation) give incentives for firms to create (and destroy) jobs in the informal sector to avoid severance costs and increase flexibility (Di Porto et al, 2016). As a consequence, in an overregulated labour market, the added flexibility resulting from the use of informal workers may enable firms to adjust more in response to business cycle fluctuations (Bosch and Esteban-Pretel, 2012) and operate more efficiently (Almeida and Carneiro, 2012).

The coexistence in many economies of formal and informal labour markets allows firms to hire

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<sup>1</sup>In this paper we refer as informal employment as workers who are engaged in the production of legal goods and services and are not officially registered, are excluded from social security benefits and the protection afforded by formal labour market contracts. Analogously, we follow Schneider et al. (2010) and define informal economy as comprising of market-based legal production of goods and services deliberately hidden from public authorities to avoid paying taxes, social security, contributions, and to meet legal obligations/requirements and market standards.

<sup>2</sup>Under-declaration is the situation where employers declare only part of the wages that are paid to employees (OECD, 2009).

<sup>3</sup>Ultimate causes of underground economy may thus be found within the institutional framework in which firms operate as, for example, the level of taxation and fiscal regulations (Loayza, 1996; Friedman et al., 2000; Loayza et al., 2005; Packard et al, 2012), the strictness of labour and product market regulations (Botero et al, 2003; Djankov et al., 2002; Loayza et al., 2005; Packard et al, 2012), poor institutions in general (Friedman et al., 2000; Schneider, 2000; Loayza et al., 2005; Packard et al, 2012). Furthermore, formality implies costs which go beyond the burden of taxes, such as compliance with legal requirements or rent seeking bureaucracy (Sarte, 2000).

and dismiss workers in both the regulated (formal) and unregulated (informal) sector.<sup>4</sup> The decision of firms to adjust in the formal or informal sector (and the extent of such an adjustment) depends on the trade-off between the costs associated to formal and informal employment. Formal contracts have to abide with employment protection legislation (EPL) and other labour taxes. Informal jobs avoid labour regulation, but they imply costs in terms of exclusion from certain public goods and services (e.g., social infrastructure, property rights and the justice system), together with fines and other non-monetary costs (e.g. loss of reputation, social stigma, etc.) in case of detection.

In this paper we analyze the effect of informality on turnover of formal jobs and productivity of firms which are subject to different degree of labour market regulation (EPL). We claim that, in presence of high firing costs, firms with an easier access to informal sector may benefit from greater flexibility in their employment and production decisions which, in turn, lead them to operate more efficiently and increase productivity. As a result, the negative effect of informality on productivity may be relatively lower for firms facing higher firing costs.

From the empirical side, the extent of underground activities and informal economy is difficult to detect and measure. Since workers and firms who operate irregularly are unlikely to provide information on their hidden activities, this makes it difficult to obtain direct data on informality at firm level. Nevertheless, a number of reliable indicators has been produced in order to measure the informal economy at a more aggregate level. In our analysis we use tax evasion estimated at the province level as a proxy of the costs for firms and workers of going informal in that particular local market. The low degree of tax compliance is related to a large dimension of the informal labour market, which implies lower searching and hiring costs in the informal sector for firms, as well as, in general, to a more positive attitudes towards informality.

The impact of informality on firms' productivity is then analyzed by means of a regression discontinuity design (RDD) that exploits the variation in EPL across Italian firms below and above an employment size threshold (15 employees), the EPL provisions being more stringent for firms above the 15-employee threshold. The discontinuous change in legislation at the threshold should result in a discontinuous effect of informality on firms' behavior. We use this idea to study two related aspects. First we consider whether in presence of a large share of informality, firms' job reallocation in the formal labour market drops just above the threshold, implying that the presence of an informal sector reduces turnover of formal (regulated) jobs when firing costs are higher since firms have an incentive to hire workers in the informal sectors.<sup>5</sup> Second, we analyze whether the

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<sup>4</sup>Although we acknowledge that there are industries/sectors that are essentially formal (such as the public sector), we follow Bosch and Esteban-Pretel (2012) and argue that firm's decision on adjusting in the formal and informal sectors concerns jobs with similar characteristics.

<sup>5</sup>There is a large empirical and theoretical literature which shows that strict EPL has a negative effect on both job creation and job destruction, reducing the overall turnover of regular jobs (Bertola et al, 1999; Blanchard and

negative effect of informality on the productivity of firms just above the threshold is relatively abated as compared to the impact below the threshold.

To this purpose we use firm level detailed balance sheet data for a sample of small firms around the 15 workers threshold. Focusing on small firms has two main advantages: i) the sample of firms is homogenous enough as to preserve comparability between the treatment and the control group; ii) the incidence of informality is higher for small firms. One reason is that as the marginal cost of informality increases with firms' size due to concealment efforts (Fortin et al. 1997; Carfora et al.) which may cause firms to operate below the optimal size to avoid the attention of fiscal authorities (OECD 2004).

In order to identify the impact of informality proxied with tax evasion on firm's labor adjustments and productivity we have to tackle the problem of endogeneity. Indeed it may be that propensity to tax compliance, labor adjustments and productivity are driven by local factors such as for example the quality of institutions, cultural factors, etc.; in addition our results could be biased by reverse causality, as tax compliance may be influenced by labor market conditions and firms' performance. We address endogeneity in two ways: i) we include firm's fixed effects; ii) we identify two instruments for tax evasion, namely the judges' turnover in civil courts and the timing of local (province) elections. Both instruments are used separately and jointly.

As far as judges' turnover within judicial districts is concerned, it is well known that tax compliance depends on the level of the enforcement of legislation, which in turn is related to courts' efficiency. One of the determinants of Courts' internal organization has been shown to be the turnover rate of the judges (Guerra and Tagliapietra, 2005). Judges' turnover is not related to our depend variables nor it is determined by local factors; indeed the transfer of a judge is the result of independent decisions taken from different agents and approved on the bases of objective circumstances provided for by the law. It is then exogenous with respect to our empirical model.

As to the timing of local (province) level elections, the impact of the occurrence of elections on the probability of auditing is a well-established result in the literature (Besley et al. 2014; Skouras and Christodoulakis, 2013); a change in the (local) ruling coalition can represent a shock to local entrenched powers and by this way influence the enforcement of tax regulation. Although Italian provinces have no tax competence (as most taxes are established at the central Government level while local taxes are decided upon and collected by municipalities) tax auditing and collection is carried out a province level, within the same boundaries of province constituencies. In addition, province elections occur at intervals which are established by law (i.e. every 5 years), therefore the timing of election is exogenous.

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Portugal, 2001; Hijzen et al, 2013; Vindigni et al, 2015).

The panel dimension of our data also allows to control for unobserved heterogeneity among sectors and provinces via fixed effects. Therefore, our main results are not driven by cross-sectional differences among provinces, such as cultural, economic and social characteristics that may impact on both labour market adjustments, firms' productivity and informality decisions. Finally, our results are also robust to the inclusion of province-specific time dummies, which captures any time and province variant omitted factors - such as local economic development and informal institutions - which could influence both productivity and informality.

Our results show that lower costs of informality reduces labor reallocation rates in the formal sector for firms facing higher firing costs confirming that they tend to adjust more on the informal sector. Moreover, firms with higher firing costs experience productivity gains from informality resulting from the opportunity to adjust in the unregulated sector. In other words, while the overall effect of informality on productivity is still negative – in line with the literature – the incremental effect of informality on labor productivity for firms facing higher firing costs (i.e. firms above the 15 workers' threshold) is positive. A quantification of our results suggests that moving from the 90th to the 10th percentile of the informality distribution (i.e. from the province of Avellino to Gorizia in our sample), would lead to a 10 percentage points decrease in the turnover of formal employment (more than 50 percent of the average turnover) for firms above the threshold relative to smaller firms and an increase of productivity of about 16 percent.

The rest of the paper is organized as follows. The next section discusses the theoretical framework. Section 3 illustrates the institutional background and discusses the instruments. Section 4 presents the main characteristics of the data. Section 5 sets out the empirical methodology. The main results of the article are presented in Section 6. In Section 7 we provide some robustness checks and Section 8 concludes.

## **2 Informality, labour regulation and firm productivity**

Three strands of literature contribute to explain the relationship between informality and firms' productivity in presence of firing costs: (i) the literature studying the linkage between the informal economy and the formal institutional and regulatory environment; (ii) the literature on the effects of informality on firms' outcome; (iii) the literature focusing specifically on the effects of labor market regulations on firms' outcome.

### **2.1 Informality and institutions**

Institutions influence the decision of firms to go underground for two main reasons. First, the compliance to official rules implies excessive costs to firms, for example because of high tax rates, overregulation, excessive bureaucracy or strict labour legislation; second, institutions are weak, as

in presence of corruption or bad legal environment. Both types of reasons may coexist, and often do, as shown by a large body of empirical literature.

Focusing on Latin America Loayza (1996) shows that the size of the informal sector depends positively on the tax burden and on labour market restrictions and negatively on the quality of government institutions such as the quality of bureaucracy, corruption and the rule of law. In a study concerning 69 countries, Friedman et al. (2000) provide evidence that over-regulation, weak legal environment and corruption determine the size of the informal sector, undermining public finance and the capacity of the state to enforce property rights. Considering 21 high developed OECD countries. Schneider (2011) finds that tax policies and the social security burden are among the main determinants of the shadow economy, followed by tax morale and the quality of state institutions.

Restricting to the ambit of the labour market, the effect of taxes, labour regulations and social security is often analyzed with respect to the substitution between the regulated and unregulated employment (Schneide and Enste, 2000). Lemieux et al. (1994) show a negative elasticity of the hours worked in the shadow (untaxed) economy with respect to the net wage rate in the official sectors; Botero et al. (2004) provide evidence that protective collective relation laws are associated with a larger shadow economy. Using a moral hazard framework with credit rationing, Straub (2005) demonstrates that labour market rigidities push firms to remain informal and reduce employment in the formal sector. More recently, Di Porto et al. (2015) have documented a positive relationship between labour market rigidities and the size of the shadow economy in around 30 countries.

Following this literature, we assume that in presence of high firing costs firms tend to adjust more in the informal sector. However we take a step further and analyse the impact of firms' decision to adjust informally - in order to avoid strict EPL - on productivity.

## **2.2 Informality and firms' outcome**

Informality entails several types of costs: i) direct costs related to punishment or concealment costs in case of unreported activities are detected; ii) constraints on firms' dimension as to the optimal scale or to optimal capital intensity; iii) limited access to market supporting institutions and law enforcement services. The latter ranges from poor protection by the juridical system against crime to a reduced capacity to enforce contracts and property rights, which also impairs firms' access to capital markets

Loayza (1996) shows that the size of the public sector negatively affects economic growth by increasing the number of activities which do not use public services or use them less efficiently. Several studies show that firms' size is negatively related to tax evasion (Dabla Norris et al. 2008); one reason is that as the marginal cost of tax evasion increases with firms' size due to concealment

efforts (Fortin et al. 1997; Carfora et al.) which may cause firms to operate below the optimal size to avoid the attention of fiscal authorities (OECD 2004). Focusing on developing countries, La Porta and Schleifer (2008) provide evidence that unregistered firms are far less productive than formal firms because of the reduced ability of their managers, higher cost of capital, and insufficient scale.

Although going informal entails important drawbacks for firms, it also allows to escape costs and constraints related to the institutional environment. Therefore the final effect of firms' productivity may be ambiguous. Tax evasion may be a way for smaller firms to get financing, so that smaller firms tend to increase tax evasion when they have a limited access to financial markets (Beck. et al., 2005; 2010). Sarte (2000) shows that when the informal sector arise as a response against predatory and rent-seeking bureaucracy, it may be efficient for firms to locate economic activity in this sector. Almeida and Carneiro (2009) show that reduced informality caused by a stricter enforcement of employment regulation constraints firms' size in Brazil and reduces productivity.

Our results conciliates the two views; we show that while the overall effect of informality on firms' productivity is negative, the productivity loss is smaller for those firms facing higher firing costs

### **2.3 Labour regulation, job turnover and productivity**

Since the seminal contribution by Mortensen and Pissarides (1994), labour reallocation is considered crucial in determining labour market outcomes through the capacity of the firm to quickly adjust to exogenous shocks. In a world where agents (firms and workers) are heterogeneous and the matching process between vacancies and workers is costly, when a shock hits the economy the desired allocation of jobs among firms and sectors changes, leading to job destruction on the one hand and to the creation of new vacancies on the other. Firms' capacity to reallocate labour depends on the strictness of employment protection legislation (EPL); a higher degree of workers protection has been shown to unambiguously reduce both job creation and job destruction (Hopenhayn and Rogerson 1993; Mortensen and Pissarides 1994; Pissarides 2000).

A more controversial issue is how this effect translates into changes in productivity at firm level. On the one hand, in a standard search and matching model, the presence of dismissal costs will reduce the productivity threshold at which workers and firms decide to terminate their relationship, and this causes a decrease in firms' average productivity. On the other, given that the worker-vacancy match implies the presence of quasi-rents, which are typically allocated between workers and firms through a Nash bargaining mechanism, an increase in firing costs reduce firms' outside options.<sup>6</sup> This induces a rise in the reservation productivity (below which firms do not hire) and potentially

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<sup>6</sup>When a firm is bargaining the wage with a continuing employee, the threat point in the bargaining process is the value of an unfilled vacancy minus the firing cost that the firm must pay if the negotiation is not successful.

increases firm's average productivity since less productive matches are not realized (Lagos 2006; Autor 2007).

There are other channels through which the presence of dismissal costs can impact firms' productivity. When firing is costly, the firm has a lower incentive to undertake risky investments with high returns and high risk of failure in order to minimize the likelihood of paying firing costs. In this respect, Bartelsman and Hinlopen (2005) find that EPL has a significant negative effect on investments in ICT. Analogously, Saint-Paul (2002) argues that high firing costs may induce secondary innovation that improves existing products rather than introducing more innovative ones. Capital accumulation is another channel through which the extent of firing costs may affect productivity. Again, an increase in firing costs has an ambiguous effect on capital to labour ratio. On the one hand, stricter dismissal rules may induce a substitution effect from labour to capital (Besley and Burgess 2004). On the other hand, EPL strengthens workers' bargaining power and exacerbate hold-up problems related to the investment activity, resulting in less investment and capital stock per worker (Bertola 1994; Garibaldi and Violante 2005). Finally, dismissal costs influence productivity since it affects employees' behaviour and incentives. Belot, Boone and Van Ours (2007) show that an increase in the stability of the employment relationship induces to invest in productivity-enhancing human capital, which would otherwise be suboptimal because of the hold-up problem. Conversely, by using a standard model of efficiency wages Ichino and Riphahn (2005) claim that when firing become more costly for the firm workers tend to exert less effort since there is less threat of layoff in response to shirking.

### **3 The institutional background and the identification strategy**

#### **3.1 Employment protection legislation and the 15 employees threshold**

According to Italy's Statuto dei Lavoratori, passed in 1970, an individual dismissal is legal only when it satisfies a just cause, e.g. it can be justified by an objective reason (concerning the production activity for example) or subjective reasons, which are mainly related to misconduct on the part of the worker. The worker has always the right to appeal the firm's decision and the final outcome ultimately depends on the court's ruling on the specific case. If the worker does not appeal the firing decision, or if the dismissal is ruled fair, the legislation does not impose any severance payment to the firm.<sup>7</sup> Conversely, when the dismissal is ruled unfair, the judge imposes a specific compensation on the firm.

The maximum compensation to which unlawfully fired workers are entitled to varies with firm size in two important dimensions. For firms with less than 16 employees, the unfairly dismissed

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<sup>7</sup>When the layoff is ruled fair, a common practice in Italy is that the labour union pays all the legal costs.

worker must be compensated with a fixed severance payment that varies between 2.5 and 6 months of salary independently on the length of judicial procedure and with no obligation of reinstatement of the dismissed worker. Conversely, for firms with more than 15 employees, to which Article 18 of the Statuto dei Lavoratori applies, the worker is entitled to a compensation equal to forgone wages, social security and health insurance contributions for a period from the date of the dismissal to the judicial settlement of the case (with a minimum of 5 months and with no upper limits). Moreover he/she can choose either to be reinstated in the firm or to be paid an additional financial compensation of 15 months of salary.<sup>8</sup> This implies that: (a) firing costs for firms above the 15 employees threshold are always higher than those for smaller firms; and (b) the cost of unfair dismissals increases with the duration of the labour trial only for firms with more than 15 employees .

A number of papers have exploited the discontinuity in EPL at the 15 employees threshold in Italy. These studies are mainly focused on identifying the overall effect of EPL on firm’s employment decisions and productivity.<sup>9</sup> Differently, our empirical strategy allows us to identify the extent to which informality affects firms’ productivity in different firing costs regimes. More specifically, our identification scheme is based on the idea that the costs of informality are different for firms below and above the threshold, i.e. firms subject to a stricter EPL may benefit more from hiring in the informal sector. The discontinuity in firing legislation at the 15-employees threshold should allow us to isolate the effect of interest (the differential impact of informality on productivity) from other (unobserved) factors such as the degree of local economic development, quality of (local) institutions, that may affect all firms within the same location.

### 3.2 The instrumental variables

In order to corroborate our results and control for the potential endogeneity of the indicator of judicial inefficiency, we also present two-stage least squares (2SLS) estimates using two instruments for the duration of labour trials: (1) the judges’ turnover in judicial districts and (2) the timing of the local (province) elections.

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<sup>8</sup>The recent reform of the Italian labour market, in force since July 18, 2012, has changed some of the rules related to the termination of the employment relationship. In particular, also for firms with more than 15 employees, it has been restricted reinstatement to certain specific cases of unfair or unjustified dismissal and introduced an upper limit up to 24 months’ salary to the compensation a firm has to pay in case of unfair dismissal. The change in legislation does not affect our estimates, since our data covers the period 2006-2010.

<sup>9</sup>Boeri and Jimeno (2005) study the effect of employment protection on lay-off probabilities by comparing small and large firms. Garibaldi et al (2004), and Schivardi and Torrini (2008) assess the effects of employment protection on the size distribution of Italian firms, by looking at the probability of firm size adjustments around the 15 employee threshold. Similarly, Hijzen et al (2013) analyse the effect of different EPL provisions on the composition of workforce, worker turnover and productivity of firms above and below the 15 employees threshold. All these papers identify the effect of employment protection by exploiting the fact that Italian firms with fewer than 15 employees are subject to lower dismissal costs than firms with more than 15 employees. Other studies exploit both the discontinuity in EPL at the 15 employees threshold as well as the temporal variation in the legislation, in order to assess the effect of reforms on job flows (Kluger and Pica, 2008), wages (Leonardi and Pica, 2013), productivity and capital deepening (Cingano et al, 2015). Gianfreda and Vallanti (2017) show that stricter EPL due to labour trial delays reduce job reallocation rates and productivity for firms above the 15 workers threshold.

### 3.2.1 Judges' turnover

Tax compliance depends on the level of enforcement of legislation (detection and fines), which in turn is related to the efficiency of civil courts. It has been show that judges' turnover has a quite strong impact on the efficiency of Courts' internal organization (Guerra and Tagliapietra, 2005). Therefore this instrument is correlated with the extent of local informality through the efficiency of judicial courts and also satisfies the exclusion restriction as the transfer of judges from one office to another is the result of a number of decisions taken by agents at different levels of the judiciary hierarchy who respond to different sets of incentives. The transfer generally follows a three-step procedure: i) the publication of vacant positions to be filled ii) the request of the judge who is willing to be transferred and occupy the vacant position; iii) the approval by the self-governing body of the judiciary, the Consiglio Superiore della Magistratura (CSM). Judges' turnover rate within each districts depends on the number of vacant positions available which in turn is related to career advancements or retirement. Once a vacant position is created, the judge who is willing to be transferred has to apply to the CSM; as a general rule, judges cannot be transferred to a different assignment or district without their consent.<sup>10</sup> Once applications are received, the CSM decides on the basis of a competitive procedure among candidates. The criteria for the CSM collegial decision are the following: competence, which is assessed on the basis of the functions so far carried out and the judge's capacities; the judge's health status and his/her family members' (offsprings, spouse, parents and brothers/sisters if leaving with the judge, in some cases relatives and relatives-in-law); family ties; merit (which also depends on the fact that in the past the judge has occupied vacancies for which an urgent procedure had been set up or vacancies for which no application had been received); seniority.<sup>11</sup> Therefore, the complexity of the transfer procedure, to which the decisions taken by different agents contribute, is such that the turnover rate in each district ends up to be independent from (local) factors that might also affect firm-level outcomes.

### 3.2.2 Local political elections

The influence of electoral cycle on fiscal choices has been widely investigated since Nordhaus (1975). Recent literature on this topic follows two main approaches. A strand of contributions build on models based on information asymmetries between voters and politicians following Rogoff and Sibert

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<sup>10</sup>An important feature of the Italian judicial system is the principle of "inamovibilità", according to which a judge can be transferred to a different Court or to a different assignment only upon his/her consent. The principle of "inamovibilità" is a constitutional provision aiming at assuring the independence of the judiciary, which could be undermined should a judge be compelled to quit his/her activity for suspension or transfer. There are some exceptions namely the need to cover vacancies in cases established by law, as disciplinary actions or for reasons of "incompatibilità ambientale", i.e. the judge is considered incompatible with the workplace. The judge can appeal the CSM decision in all cases.

<sup>11</sup>See the "Circolare 15098 of November 30, 1993 and subsequent amendments. Health status and family ties are not taken in consideration for top positions, such as for example the Supreme Court.

(1988) and Rogoff (1990): according to this line, politicians manipulate budgetary instruments to signal their competency in electoral and pre-electoral periods. Another strand of literature focus on tax choices as a tool to increase the probability of re-election; in this framework not only tax setting but also the probability of auditing and controls can be influenced by the occurrence of an election. On the empirical ground, focusing on German municipalities Foremny and Riedel (2014) show that the growth rate of local business taxes is significantly lower in election periods while Skouras and Christodoulakis (2013) find that around election audit activity by tax collector is reduced and underreporting increases in Greece; Ronconi (2009) show that the occurrence of a political election influence actual enforcement of labour legislation. In addition, other studies focus on the ruling coalition attitude toward tax compliance of as a determinant of tax evasion: a change in the (local) ruling coalition can represent a shock to local entrenched powers and by this way influence the enforcement of tax regulation (Besley et al, 2014). Fantozzi and Raitano (2015) investigated tax compliance in Italy as a result of a change in ruling parties and found an increase in self-employed underreporting under centre-right coalition.

Building on these contributions, we instrument the tax gap at province level with a dummy indicating the occurrence of a province election in the year. There are several reasons for choosing province level elections. On the administrative point of view, the Italian territory is organized in regions, provinces and municipalities.<sup>12</sup> Although the Italian provinces have no a direct tax competence (as most taxes are established at the central Government level while local taxes are decided upon and collected by municipalities),t a tax auditing and collection is carried out a province level, within the same boundaries of province constituencies (by the so called “Direzioni Provinciali”). Therefore, we interpret the occurrence of a province election as a potential shock to the local established powers. Elections can bring a switch in the local ruling coalition, which may influence firms’ expectation about the severity of tax enforcement and by this way tax compliance. In addition, province elections occur at intervals which are established by law (i.e. every 5 years),<sup>13</sup> therefore the timing of election is exogenous and the time of elections is different across provinces.<sup>14</sup>

<sup>12</sup>From the administrative point of view, the Italian territory is organized in regions, provinces and municipalities. Provinces have administrative tasks in province areas and in inter municipality territory; they have coordination tasks and are in charge of the implementation of public works in various sectors, including the economic, productive, trade sectors; they carry out programming activity for the provincial territory.

<sup>13</sup>In the period under study the legislation regulating the election and the tasks of province level representatives was the Testo Unico, G.U. n. 227 del 28 settembre 2000, s.o. n. 162/L. The legislation was reformed in 2014. Between 2007 and 2010 elections occurred before the end of the natural term only in 13 provinces. In most cases anticipation was due to the resignation of the President motivated by the choice to campaign in the Parliament election.

<sup>14</sup>In our sample period there are 98 elections episods: 8 in 2007, 20 in 2008, 68 in 2009 and 8 in 2010.

## 4 Data sources and descriptive statistics

### 4.1 Firms data

Firm level data are drawn from AIDA (Analisi Informatizzata delle Aziende Italiane) produced by Bureau van Dijk (BvD). BvD collects balance sheet data from the national Chambers of Commerce. The version of Aida used in our analysis includes all Italian firms that have reported their financial statement to the national Chamber of Commerce in the period 2007-2010, for a total of more than 800,000 Italian firms operating in all productive sectors. Apart from balance sheet data, Aida provides a wide range of financial and descriptive information (industry and activity codes, firm age, etc.) and the number of employees. Moreover, AIDA gives information on the location of firms at a municipality level, allowing the match of firms' data with the courts' database.

The Aida database has a drawback, as it does not allow to distinguish between newly created firms and firms that simply enter the sample at a given period  $t$  but were already operating in the period before; similarly, it is not possible to identify firms' closures from firms that exit the sample for other reasons. Therefore, we have restricted the analysis to continuing firms, e.g. firms that are in the sample for at least two consecutive periods.<sup>15</sup> Given this limitation and after cleaning the database from outliers and missing information, our final sample consists of around 160,000 private firms operating in both the manufacturing and non manufacturing sectors.<sup>16</sup> Observations are annual and cover the period from 2007 to 2010. We define job reallocation at firm level as the absolute value of the change in employment between two consecutive periods divided by the average employment between the two periods (see Capellari et al. 2011; Kugler and Pica, 2008, Autor et al, 2007):

$$JT = \frac{|n_{ft} - n_{ft-1}|}{\frac{1}{2}(n_{ft} + n_{ft-1})}$$

Labour productivity is obtained as the log of value added per worker. To preserve comparability between treatment and control groups, we further restrict the sample to firms within the interval 10–20 employees, yielding a sample size of slightly more than 50,000 observations (19464 firms). Tables 3 shows the descriptive statistics.

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<sup>15</sup>Our sample is therefore unbalanced and potentially includes entry and exit firms. In section XXX we provide some results obtained by using a balanced sample which includes only firms that are continuously observable every year from 2007 and 2010.

<sup>16</sup>The sectors are: (1) Agriculture, forestry and fishing; (2) Mining and quarrying; (3) Food, beverages and tobacco; (4) Textiles; (5) Wood products; (6) Paper products, publishing and printing; (7) Refined petroleum, nuclear fuel and chemical products; (8) Rubber and plastic products; (9) Other non-metallic products; (10) Basic metals and fabricated metal products; (11) Machinery and equipment; (12) Electrical and optical equipment; (13) Transport equipment; (14) Other manufacturing sectors; (15) Electricity, gas and water supply; (16) Construction; (17) Wholesale and retail trade, Repairs; (18) Hotels and restaurants; (19) Transport and communications; (20) Other services. The financial and public sectors are excluded from the analysis.

TABLE 1 AROUND HERE

In our sample the average firm has a value added per worker of around 61 thousands euros and employs 14 workers. The average rate of job reallocation is around 19 percentage point.

Our identification strategy relies on the assumption that firms do not endogenously sort in or out of treatment. Figure 1 displays the distribution of firms between 10 to 20 workers. If any significant manipulation occurred because of increased firing costs the graph should display a dip on the 15 workers threshold, which is not observed; rather density smoothly declines with the increase in the number of workers.<sup>17</sup> In addition, while the inclusion of firm fixed effect in our estimations should capture all time-invariant unobserved factors that may affect firms' propensity to self-select above or below the threshold, the issues of firms' sorting and of the measurement of the threshold will be more specifically addressed in section 6.2.

FIGURE 1 AROUND HERE

## 4.2 Informality and tax gap data

The extent of underground activities and informal economy is difficult to detect and measure. Since workers and firms who operate irregularly are unlikely to provide information on their hidden activities, this makes it difficult to obtain direct data on informality at firm level. Nevertheless, a number of reliable indicators has been produced in order to measure the informal economy at a more aggregate level. We use tax evasion estimated at the province level as a proxy of the costs for firms and workers of being informal in that particular area.<sup>18</sup> We claim that firms operating in provinces with a higher level of tax evasion, face lower costs of accessing the informal sector and, therefore, can more easily use irregular workers as a buffer stock for the regulated formal employment.<sup>19</sup>

Data on tax evasion for Italian provinces are provide by the Italian Revenue Agency (Agenzia delle Entrate). The dataset contains data on the expected as well as the actual financial revenue reported to fiscal authorities in the 107 Italian provinces from 2007 to 2010. The novelty of the database relates to the methodology used to estimate tax gap based on an integration of the top-down approach, based on the comparison and cross-checking (matching) between national accounts and administrative fiscal data, and the bottom-up approach, based on results from fiscal audits

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<sup>17</sup>The same pattern is observed also in other studies on the Italian EPL, so that our graphical results on the of significant manipulation are in line with a body of empirical analysis focusing on the effects of the discontinuity in dismissal costs in Italy (Boeri and Jimeno, 2005; Schivardi and Torrini, 2008; Leonardi and Pica, 2013, Cingano et al. 2014).

<sup>18</sup>Clearly, employment informality and firm informality are different concepts. Nevertheless, one would expect employment informality and firm informality to be highly correlated, as tax authorities could detect inconsistencies between output and employment levels. We therefore decide to use tax gap in a given province as a proxy for informality opportunity for firms set in that particular geographical area.

<sup>19</sup>Tax evasion, and, more genereally, the extent of the shadow economy is related to the expected costs of being informal. Typically this costs are specified in terms of exclusion from certain public goods and services (e.g., social infrastructure, property rights and the justice system), together with the possibility of fines and other punishments.

(Carfora et al., 2015). The indicator of tax evasion ( $tax\_gap$ ) has been constructed as the relative difference of the expected and the reported revenue, i.e.

$$tax\_gap = \frac{(expected\ revenue - reported\ revenue)}{expected\ revenue}.$$

Table 2 reports some descriptive statistics concerning the tax gap over the sample period 2007 to 2010 for the 107 Italian provinces, which are ranked from the most to the least tax compliant.

TABLE 2 AROUND HERE

The data show great territorial heterogeneity in the extent of tax evasion; for example, the differences of the tax gap between the province at the 10th (Avellino) and 90th (Gorizia) percentile of the tax compliant distribution is around 0.26 percentage points. The standard deviation across provinces is quite large, being more than one third of the average. The within-province time-series variation of tax gap is also substantial: the standard deviation normalized on the mean ranges from 0.03 (in Grosseto) to 0.21 (in Firenze), with a sample average of around 0.10. This descriptive evidence suggests considerable heterogeneity in informality both cross-sectionally and over time.

Descriptive evidence of the link between informality and productivity around the 15-employees cut-off is provided in Figure 2, which plots labour productivity just below and above the threshold cut-off in the two provinces, corresponding to the 10th and 90th percentiles of the tax gap distribution respectively.

FIGURE 2 AROUND HERE

Figure 2 clearly shows a significant downward jump of productivity at the 15 employees threshold in Gorizia where firms facing stricter EPL (firms above the threshold) cannot easily adjust in the informal labour market. Conversely, the discontinuity around the threshold is smaller and not statistically significant in Avellino, one of the province with the highest presence of informality in Italy. A tentative interpretation of this visual evidence suggests that in the neighborhood of the 15-employees threshold labour productivity seems to respond less to changes in firing costs when firms can more easily adjust their workforce using informal (not regulated) workers.

In the next sections, we will provide more rigorous evidence of the causal relationship between informality and productivity by controlling for firms' characteristics, a number of fixed effects and using instruments to address the potential endogeneity of our proxy for informal sector.

### 4.3 Data on judges turnover and elections

We draw data on the number of judges allocated to each judicial districts as well as on the number of inbound and outbound judges from 2006 to 2010 from courts' self regulating body (CSM) database. Judges turnover at district level is calculated as in Guerra and Tagliapietra (2015) according to the

following formula:

$$Turnover = \frac{100x(\text{number of outbound judges} + \text{number of inbound judges})}{\text{number of expected judges}}$$

Data on elections at province level are published on the site of the Italian Ministry of the Interior (Historical archive of the elections). From 2006 to 2010 there have been 110 province level elections; table 3 shows the province where elections took place in every year.

TABLE 3 AROUND HERE

## 5 Empirical specification

We estimate the effect of informality on the turnover of formal jobs and labour productivity using firm level data. At firm level, the size of firms plays a significant role in moderating the impact of informality on firms adjustments and productivity. In our analysis, we exploit the discontinuity of firing legislation at the 15-employees threshold to identify the causal effect of informality on productivity.

The model specification is as follows:

$$y_{ft}^r = \beta_1 tax\_gap_t^r + \beta_2 size_f^r + \beta_3 (tax\_gap_t^r \times size_f^r) + \beta_4 income_t^r + X_{fst}^r \gamma + \mathbf{D}\boldsymbol{\eta} + \eta_f + u_{ft}^r \quad (1)$$

where the dependent variable  $y_{ft}^r$  is either the job turnover or productivity (log of value added) depending on specification;  $tax\_gap_t^r$  is the informality index (*in log*);  $size_f^r$  is a dummy variable which takes value 1 for large firms i.e. firms with number of employees larger than 15, and zero otherwise;<sup>20</sup>  $X_{fst}^r$  are a set of other controls which include a polynomial of a third degree in firm size,  $\eta_f$  stands for firm fixed effects which "absorb" any time-invariant unobservable attributes at firm level, and in particular the effect of the different (time-invariant) EPL regime that applies to firms above and below the 15 employees threshold. The indices  $r$  and  $t$  refer to provinces and year respectively.  $D$  is the matrix of dummies that includes, depending on the specification considered, province-by-year<sup>21</sup> and industry-by-year dummies while  $u_{rt}$  is the error term. The coefficient on  $tax\_gap_t^r$  gives the common effect of informality on small and large firms, while the interaction term  $tax\_gap_t^r \times size_f^r$  captures the differential effect of informality induced by the more strict EPL

<sup>20</sup>We define firms as small if they have less than 15 employees in all years and large if they have more than 15 employees in all years of the sample period. We also check the robustness of our results to a different threshold definition (see section 7.3) and to the inclusion in the sample of firms which move above and below the threshold over the sample period. Results are available upon request.

<sup>21</sup>The inclusion of province-by-year dummies allows to control for all province-specific time-varying characteristics (for example, the quality of local infrastructure) which have the same effects across firms.

regimes on large firms productivity. The variable  $tax\_gap_t^r$  is instrumented with the judges' turnover in judicial districts and the timing of local (province) elections, while the interaction  $tax\_gap_t^r \times size_f^r$  is instrumented by interacting each instruments with the dummy  $size_f^r$ .

The two instruments will be used in the IV regressions both separately and jointly, thus producing three sets of estimates. The results are remarkably robust to every specification. Moreover, in all regressions we control for differences in the economic development at region level by including among the regressors region per capita income (GDP).

Given that (time variant) differences in the regional underlying economic conditions (as GDP per capita) may not necessarily capture all the factors affecting firm productivity (e.g. those factors related to the institutional environment at large), in section 6.2 we show that our results are also robust to the inclusion of a full set of province-year and sector-year dummies. In this way, we can rule out any possible source of bias arising from (time and province variant) omitted factors - not already captured by the regional income per capita - which could influence both informality and productivity, thus yielding further support to our identification strategy.

## 6 Results

### 6.1 Baseline model

In Table 4 we report the effect of informality on the reallocation of formal (regulated) jobs at firm level estimated as in equation 1, using all sets of instruments shown so far. As the variable measuring informality varies both across provinces and time, we are able to control for any time-invariant unobserved firm characteristics by the use of firm fixed effects, thus fully exploiting the firm level dimension of the dataset.

TABLE 4 AROUND HERE

Tax evasion has no significant effect on labour adjustments for firms under the 15 workers threshold while it has a negative impact for firms employing more than 15 workers. The coefficient of the interaction term is always negative and significant and the overall coefficient estimated for large firms is around 0.31 when both instruments are used in the estimation. Based on the coefficients reported in column 3, the estimated differential effect for firms above the 15 employees threshold is -0.405. This implies that moving from the 10th to the 90th percentile of the informality distribution (i.e. from the province of Gorizia to Avellino in our sample), would lead to a 10 percentage points decrease in the turnover of formal employment for firms above the threshold to smaller firms.

In all cases the two instruments are relevant, as the null that the equation is underidentified is always rejected, while the F statistics is well above the rule of thumb threshold of 10 in all cases. Furthermore, the overidentification test does not reject the null that the instrument are uncorrelated

with the error term. First stage regressions are displayed in table 6, while table 7 shows findings from OLS estimates.<sup>22</sup>

Table 5 shows the effect of informality on firms' labour productivity.

TABLE 5 AROUND HERE

In all cases the overall effect of tax evasion on firms' productivity is negative and significant; this result is in line with previous literature. However, the interaction coefficient is positive and significant. This implies that in presence of a stricter employment legislation (firms above the threshold), firms react by adjusting in the informal sector. This mitigates the negative impact of informality on productivity.

Based on the coefficients reported in column 3, the estimated differential coefficient for firms above the 15 employees threshold is 0.609, which implies that reducing the informality rate of Avellino to the rate of Gorizia, would lead to a decrease of the average value added per worker in firms above the threshold by around 16%.

## 6.2 Robustness

### 6.2.1 The inclusion of province/sectors by year dummies

The differential impact informality on job reallocation and productivity for firms above and below the 15-employees threshold is remarkably robust to the inclusion of province-by-year dummies, as shown in table 8. In this specification the main effect ( $tax\_gap$ ) is not included because it is absorbed by the province-year dummies, which also capture all time variant and province specific factors that may affect simultaneously the extent of informality and firms' productivity.<sup>23</sup> The stability of the coefficient on the  $tax\_gap \times size$  interaction term when adding province-year dummies provides further reassurance that the estimated differential effect is not driven by any possible source of bias arising from province-time variant omitted factors. The coefficients in columns 2 and 4 show that our results are also robust to the inclusion of sector specific year dummies, implying that the estimated effect is not driven by any industry specific time varying conditions.

TABLE 8 AROUND HERE

### 6.2.2 Robustness to different sample size and threshold specification

In Table 9 we check the robustness of our main results by widening the sample to include firms within the size interval 6-25 employees. Our results are robust to the change in the size range (column 1 and 4): the estimated coefficients on the interaction ( $tax\_gap \times size$ ) are similar to those in Tables

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<sup>22</sup>The coefficients of the first stage regressions show that both instruments are correlated with our endogenous regressors confirming the relevance of our instruments.

<sup>23</sup>In this set of regressions the identification of the effect comes entirely from the differential in the EPL provisions for firms above and below the threshold.

4 and 5, confirming the relative negative effect of informality of the turnover rate of regulated jobs and the positive effect on productivity in the firms facing higher firing costs.

TABLE 9 AROUND HERE

An additional concern may be that the 15-employees threshold is imprecisely estimated at firm level due to the complex calculation of the workforce, in particular because of presence of part-time workers (see for a discussion Hijzen et al., 2014)<sup>24</sup>. In order to address this problem, we check the robustness of our results to the exclusion of firms between 14/15 and 16/17 employees from the sample. We therefore compare the effect of informality on labour adjustment and productivity of firms between 5 and 13/14 employees (control group) and firms between 17/18 and 25 employees (treatment group). Those firms are sufficiently above and below the threshold to avoid the problem of measurement error in the estimation of the size cut-off. Results are remarkably robust to this change (columns 2, 3, 5, 6).

### 6.2.3 Firm growth regressions

The validity of the RDD rests on the assumption that firms do not self select above or below the threshold; in other terms we have to exclude that firms may manipulate the number of workers in order to escape strict EPL or that informality influences firms manipulation. As in Schivardi and Torrini and Hijzen et al. (2008)<sup>25</sup>, we check for the potential sorting induced by informality by estimating the following linear probability model for the probability of growth of firms around the threshold:

$$g_{ft} = \mathbf{S}_{ft}\boldsymbol{\gamma} + (\mathbf{S}_{ft} \times tax\_gap_t^r)\boldsymbol{\delta} + \mathbf{X}_{ft}\boldsymbol{\beta} + D\varphi + \eta_f + u_{ft}^r \quad (2)$$

where  $g_{ft} = 1$  if firm  $f$  in year  $t$  has a larger size than in  $t - 1$ . The term  $\mathbf{S}_{ft}$  denotes a set of size dummies for firms with 13, 14 and 15 employees and  $tax\_gap_t^r$  is our variable for informality at province level. The matrix  $\mathbf{X}_{ft}$  includes a set of controls at firm level such as a third-degree polynomial in firm size. Finally, we also include firm fixed effects to account for firm-specific time-invariant factors that may affect firms' propensity to grow. We instrument the interactions ( $\mathbf{S}_{ft} \times tax\_gap_t^r$ ) with the two instruments (interacted with the size dummies) already used in our baseline specifications (e.g. judges' turnover rates and a dummy for local elections). The results are reported in Table 10.

<sup>24</sup>As in Schivardi and Torrini (2008), Garibaldi et al. (2004) and Gianfreda and Vallanti (2017) our measure of firm size does not distinguish between full and part time workers. However, the problem of misclassification due to partimers have been shown to be relatively negligible if the interval in firm size is not too short, ranging from 2.7 to 5.8% from 5-25 to 11-20 firms size (Hijzen et al. 2013).

<sup>25</sup>The result that EPL provisions do not affect firms propensity to grow is not new in the empirical literature. See among the others, Cingano et al (2015), Leonardi and Pica (2013) and Schivardi and Torrini (2005) which examine the effect of EPL on firms' size distribution below and above the 15 employees-threshold in Italy.

## TABLE 10 AROUND HERE

Column 1 shows that the probability of expansion of firms just below 15 employees is not significantly different from that of other firms.<sup>26</sup> Moreover, all the interaction terms are not significant, implying that informality do not affect such a probability. Columns 2- 4 report the results obtained splitting the sample in different productivity percentile and once again the growth probability for firms just below the threshold is not significantly affected by informality in any of the sub-samples. These results confirm that informality does not affect significantly the propensity to grow in the formal sector around the 15-employee threshold and therefore self-selection of firms into treatment/control.

## 7 Conclusions

We assess the impact of informality on labour market adjustments and then firm's productivity. We argue that in presence of high firing costs, informality may allow firms greater flexibility in their employment and production decisions which, in turn, can lead them to operate more efficiently and increase productivity.

Exploiting the variability of the extent of tax compliance across Italian provinces and the discontinuity of the firing legislation at the 15-employees threshold, we show that informality significantly reduces the reallocation rate of regulated jobs. This provides some evidence of the substitution between formal (regulated) jobs and jobs created in the informal sector for firms in operating in a stricter EPL regime. Moreover, while the overall effect of informality on productivity is negative – in line with the literature – the incremental effect of informality on labor productivity for firms facing higher firing costs (i.e. firms above the 15 workers' threshold) is positive. This last result suggests that firms operating in a highly regulated environment may get some benefit in terms of productivity from adjusting in the informal sector.

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<sup>26</sup>This result is in line with that in other empirical studies for Italy on the effect of EPL discontinuity at the 15 employees – threshold (see for example Schivardi and Torrini, 2008).

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Table 1: Descriptive statistics on firm variables

	Mean	St. Dev.	p10	p50	p90
Whole sample (11-20)					
VA per worker (000)	61.01	103.18	26.63	47.62	97.28
Flows	0.19	0.25	0	0.10	0.44
Firm size	14.35	2.64	11	14	18
Small firms (11-15)					
VA per worker (000)	61.36	105.7	27.077	47.75	97.91
Flows	0.18	0.25	0	0.09	0.44
Large firms (16-20)					
VA per worker (000)	60.25	97.38	25.75	47.25	95.6875
Flows	0.19	0.26	0	0.11	0.46

Source: AIDA database and authors' calculations.

Figure 1: Firm size distribution

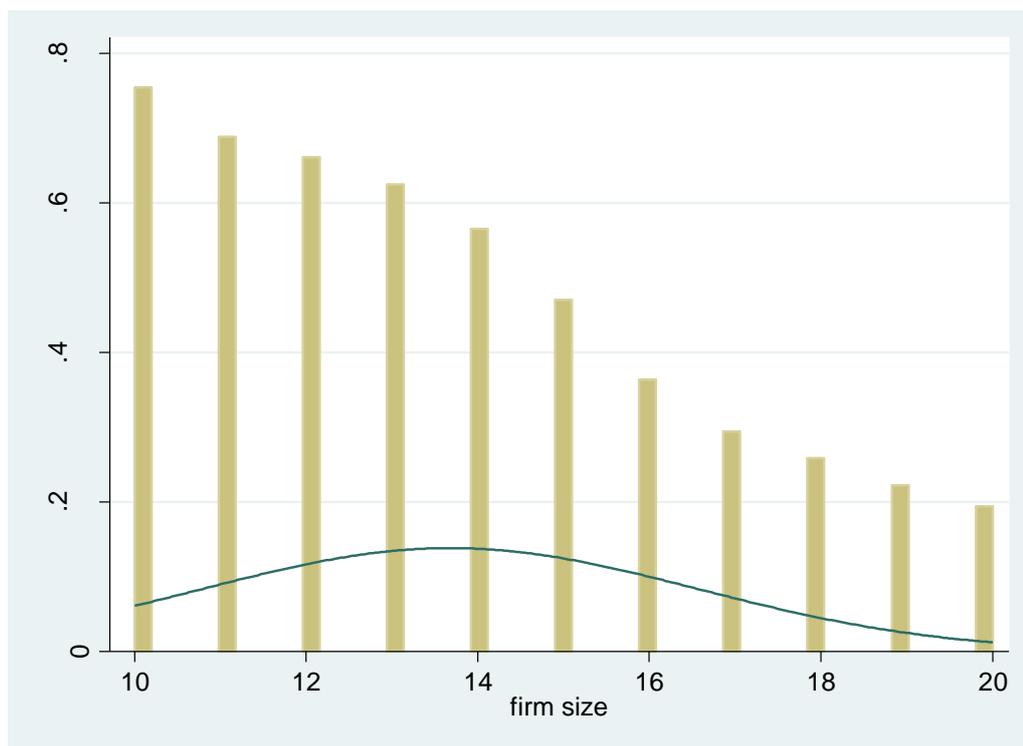
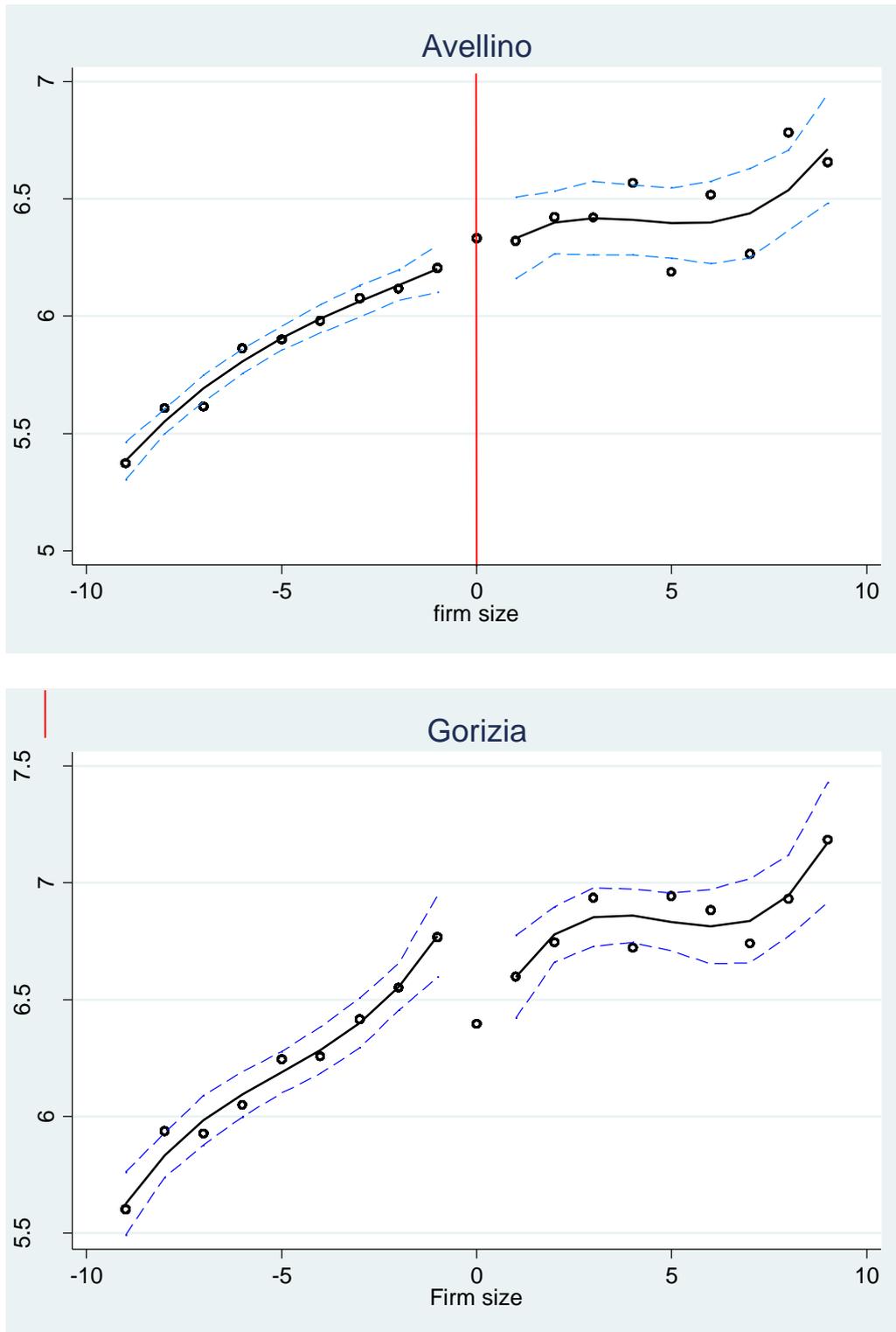


Table 2: Descriptive statistics on Tax Gap

Name	tax gap	st. dev	Name	tax gap	st. dev	Name	tax gap	st. dev
Roma	0.116	0.021	Pisa	0.280	0.043	Pesaro U.	0.477	0.086
Trieste	0.118	0.024	Lecco	0.280	0.045	Pavia	0.482	0.064
Monza	0.125	0.012	Cagliari	0.292	0.029	Asti	0.495	0.038
Bologna	0.128	0.018	Napoli	0.303	0.012	Brindisi	0.499	0.036
Milano	0.136	0.011	Venezia	0.305	0.031	Verbania	0.509	0.046
Parma	0.163	0.024	Savona	0.310	0.025	Barletta	0.517	0.024
Genova	0.166	0.020	Treviso	0.314	0.044	Biella	0.537	0.069
Bolzano	0.182	0.005	Vicenza	0.318	0.051	Reggio C.	0.584	0.055
Trento	0.191	0.005	Cremona	0.319	0.024	Pistoia	0.595	0.077
Chieti	0.194	0.034	Varese	0.328	0.049	Latina	0.623	0.033
Torino	0.200	0.035	Vercelli	0.330	0.040	Imperia	0.624	0.043
Gorizia	0.200	0.028	Mantova	0.350	0.080	Campobasso	0.625	0.038
Siena	0.206	0.028	Lucca	0.354	0.054	Trapani	0.628	0.056
Fermo	0.206	0.014	Palermo	0.365	0.036	Grosseto	0.628	0.026
Firenze	0.207	0.056	Ferrara	0.369	0.068	Frosinone	0.631	0.069
Pordenone	0.215	0.046	Sassari	0.371	0.011	Caserta	0.635	0.037
Novara	0.233	0.034	Perugia	0.391	0.034	Nuoro	0.643	0.137
Reggio E.	0.234	0.054	Taranto	0.392	0.080	Oristano	0.650	0.021
Modena	0.234	0.059	Belluno	0.399	0.063	Ragusa	0.671	0.037
Udine	0.236	0.050	Cuneo	0.402	0.024	Salerno	0.683	0.014
Como	0.240	0.026	Rovigo	0.402	0.075	Caltanissetta	0.700	0.072
La Spezia	0.242	0.027	Foggia	0.406	0.021	Viterbo	0.703	0.056
Bergamo	0.245	0.048	L'Aquila	0.413	0.076	Potenza	0.713	0.053
Ravenna	0.251	0.043	Alessandria	0.414	0.036	Avellino	0.726	0.062
Messina	0.255	0.042	Bari	0.415	0.023	Agrigento	0.727	0.035
Aosta	0.256	0.016	Massa	0.430	0.072	Isernia	0.733	0.201
Pescara	0.258	0.037	Terni	0.432	0.034	Ascoli P.	0.781	0.077
Livorno	0.260	0.060	Catania	0.432	0.038	Benevento	0.805	0.050
Ancona	0.265	0.032	Prato	0.434	0.058	Lecce	0.834	0.027
Forlì	0.266	0.030	Arezzo	0.438	0.039	Cosenza	0.854	0.063
Piacenza	0.266	0.056	Lodi	0.452	0.088	Enna	0.904	0.034
Brescia	0.270	0.057	Catanzaro	0.455	0.042	Rieti	0.969	0.091
Padova	0.271	0.041	Rimini	0.471	0.046	Matera	0.998	0.078
Sondrio	0.274	0.043	Teramo	0.474	0.057	Crotone	1.073	0.090
Siracusa	0.274	0.033	Macerata	0.476	0.055	Vibo V.	1.184	0.039
Verona	0.275	0.025						
Mean				0.430				
Between-group st. dev.				0.226				
Whitin-group st. dev.				0.046				

Source: Agenzia delle Entrate database and authors' calculations.

Figure 2. Productivity and firm size



Notes. The dots are the observed (log) productivity averaged over the sample period. The solid line is a fitted regression of (log) productivity on a third-degree polynomial in firm size, performed separately on either side of the threshold

Table 3 - Province Elections	
Year	Province
2006	Campobasso; Gorizia; Imperia; Lucca; Mantova; Pavia; Ravenna; Reggio Calabria; Trapani; Treviso; Trieste; Udine
2007	Ancona; Como; Genova; La Spezia; Ragusa; Varese; Vercelli; Vicenza
2008	Agrigento; Aosta; Asti; Benevento; Bolzano; Caltanissetta; Catania; Catanzaro; Enna; Foggia; Massa; Messina; Palermo; Roma; Siracusa; Trapani; Trento; Udine; Varese; Vibo Valentia
2009	Alessandria; Arezzo; Ascoli Piceno; Avellino; Bari; Barletta; Belluno; Bergamo; Biella; Bologna; Brescia; Brindisi; Chieti; Cosenza; Cremona; Crotone; Cuneo; Fermo; Ferrara; Firenze; Forlì; Frosinone; Grosseto; Isernia; Latina; Lecce; Lecco; Livorno; Lodi; Macerata; Materna; Milano; Modena; Monza; Napoli; Novara; Padova; Parma; Perugia; Pesaro Urbino; Pescara; Piacenza; Pisa; Pistoia; Pordenone; Potenza; Prato; Reggio Emilia; Rieti; Rimini; Rovigo; Salerno; Savona; Siena; Sondrio; Taranto; Teramo; Terni; Torino; Venezia; Verbania; Verona
2010	Cagliari; Caserta; Imperia; L'Aquila; Nuoro; Oristano; Sassari; Viterbo

Table 4: The effect of informality on firms' labor reallocation - selected results

Instrument(s)	Judges' Turnover	Election	Judges' Turnover and Election
tax gap	0.317 <i>0.398</i>	-0.023 <i>0.5</i>	0.197 <i>0.32</i>
tax gap x size	-0.381 *** <i>0.155</i>	-0.518* <i>0.282</i>	-0.406*** <i>0.143</i>
size	0.083*** <i>0.032</i>	0.112* <i>0.059</i>	0.088*** <i>0.03</i>
gdp	0.065 <i>0.13</i>	-0.034 <i>0.152</i>	0.033 <i>0.116</i>
r2	0.068	0.061	0.065
Obs.	53643	53643	53643
Number of firms	19464	19464	19464
<i>First stage statistics</i>			
Underid Test <sup>a</sup>	708.094	317.353	906.185
chi-sq (1) P-value	0.000	0.000	0.000
Weak id Test	480.768	201.456	371.012
Hansen J stat.			0.518
Chi-sq(2) P-value			0.7717

(\*\*\*) (\*\*) (\*) refer to 1%, 5%, 10% significance levels. Robust standard errors (in italics) are clustered at firm level. All estimates are fixed effects; year dummies are always included; a) Kleibergen-Paap rk LM statistic; b) Cragg-Donald Wald F statistic; Instruments: *turnover*, *elections* and interacted terms.

Table 5: The effect of informality on firms' productivity - selected results

Instrument(s)	Judges' Turnover	Election	Judges' Turnover and Election
tax gap	-1.720*** <i>0.506</i>	-3.384*** <i>0.752</i>	-2.260*** <i>0.422</i>
tax gap x size	0.563*** <i>0.230</i>	0.746* <i>0.400</i>	0.609*** <i>0.220</i>
size	-0.123*** <i>0.049</i>	-0.161* <i>0.085</i>	-0.133*** <i>0.047</i>
gdp	-0.112 <i>0.201</i>	-0.660** <i>0.294</i>	-0.292 <i>0.184</i>
r2	0.08	0.053	0.074
Obs.	88829	88829	88829
Number of firms	30345	30345	30345
<i>First stage statistics</i>			
Underid Test <sup>a</sup>	762.605	269.008	995.078
Chi-sq (1) P-value	0.000	0.000	0.000
Weak id Test	560.747	196.645	364.745
Hansen J stat.			3.697
Chi-sq(2) P-value			0.1575

(\*\*\*) (\*\*) (\*) refer to 1%, 5%, 10% significance levels. Robust standard errors (in italics) are clustered at firm level. All estimates are fixed effects; year dummies are always included; a) Kleibergen-Paap rk LM statistic; b) Cragg-Donald Wald F statistic; Instruments: *turnover*, *elections* and interacted terms.

Table 6. First stage statistics - selected results

	TG	TG x size	TG	TG x size	TG	TG x size
turnover	-0.0005272*** <i>0.0000209</i>	-0.0004529*** <i>0.0000402</i>			-0.0005233*** <i>0.0000207</i>	-0.0004292*** <i>0.0000403</i>
turnover x size	0.0000409** <i>0.00002</i>	0.0012491*** <i>0.0000482</i>			0.0000504** <i>0.0000202</i>	0.0011777*** <i>0.0000481</i>
election			0.00053*** <i>0.00025</i>	-0.0033249*** <i>0.0003108</i>	0.003933*** <i>0.0002442</i>	-0.0021035*** <i>0.0003033</i>
election x size			-0.000438 <i>0.0003251</i>	0.0129232*** <i>0.0005804</i>	-0.0005784* <i>0.0003168</i>	0.0095177*** <i>0.0005523</i>
F	335.60	407.18	148.32	309.75	241.96	270.08
p-value	0.00	0.00	0.00	0.00	0.00	0.00
(Weak id) SW <sup>a</sup>	676.37	747.50	298.92	649.66	326.60	374.26
p-value	0.00	0.00	0.00	0.00	0.00	0.00

(\*\*\*) (\*\*) (\*) refer to 1%, 5%, 10% significance levels. Robust standard errors (in italics) are clustered at firm level. All estimates are fixed effects; year dummies are always included. a) Sanderson-Windmeijer F statistics.

Table 7 - OLS and reduced form selected results

	labour reallocation				firms' productivity			
	1	2	3	4	5	6	7	8
tax gap	0.255*** <i>0.063</i>				-0.399*** <i>0.073</i>			
tax gap x size	-0.06 <i>0.038</i>				0.067* <i>0.036</i>			
turnover		0 <i>0</i>		0 <i>0</i>		0.001** <i>0</i>		0.001** <i>0</i>
turnover x size		-0.001** <i>0</i>		-0.001** <i>0</i>		0.001** <i>0</i>		0.001** <i>0</i>
election			0.002 <i>0.003</i>	0.001 <i>0.003</i>			-0.016*** <i>0.003</i>	-0.015*** <i>0.003</i>
election x size			-0.008* <i>0.004</i>	-0.007 <i>0.004</i>			0.011** <i>0.005</i>	0.01* <i>0.005</i>
size	0.016* <i>0.009</i>	0.02** <i>0.009</i>	0.006 <i>0.005</i>	0.021** <i>0.009</i>	-0.019* <i>0.01</i>	-0.023** <i>0.01</i>	-0.008 <i>0.006</i>	-0.023** <i>0.01</i>
gdp	0.084 <i>0.091</i>	0.009 <i>0.094</i>	0.025 <i>0.091</i>	0.005 <i>0.095</i>	0.26** <i>0.118</i>	0.45*** <i>0.119</i>	0.31** <i>0.118</i>	0.373*** <i>0.121</i>
r2	0.068	0.068	0.068	0.068	0.082	0.082	0.082	0.082
N	72928	72928	72928	72928	108941	108941	108941	108941

(\*\*\*) (\*\*) (\*) refer to 1%, 5%, 10% significance levels. Robust standard errors (in italics) are clustered at firm level. All estimates are fixed effects; year dummies are always included.

Table 8. The effect of tax gap on firms' labour adjustment and productivity - province x year and sector x year interactions - selected results

	Labour adjustment		Firms productivity	
tax gap x size	-0.426*** <i>0.144</i>	-0.436*** <i>0.144</i>	0.583** <i>0.221</i>	0.595** <i>0.22</i>
size	0.091*** <i>0.03</i>	0.093*** <i>0.03</i>	-0.129** <i>0.047</i>	-0.131** <i>0.047</i>
gdp	-15.292*** <i>4.518</i>	-12.778** <i>4.581</i>	-14.93*** <i>2.79</i>	-13.89*** <i>2.808</i>
province x year	yes	yes	yes	yes
sector x year	no	yes	no	yes
r2	0.079	0.086	0.091	0.101
N	53643	53643	88829	88829

(\*\*\*) (\*\*) (\*) refer to 1%, 5%, 10% significance levels. Robust standard errors (in italics) are clustered at firm level. All estimates are fixed effects.

Table 7: The effect of tax gap on firms' labour reallocation and productivity (6-25 workers sample) - selected results

	labour adjustment			firms' productivity		
	whole sample	5-14 & 17-25	5-13 & 18-25	whole sample	5-14 & 16-25	5-13 & 18-25
	1	2	3	4	5	6
TG	0.408*	0.330	0.433	-1.822***	-1.745***	-1.661***
	<i>0.234</i>	<i>.256</i>	<i>0.28</i>	<i>0.292</i>	<i>0.316</i>	<i>0.344</i>
TG x size	-0.542***	-0.541***	-0.673***	0.602***	0.563**	0.55*
	<i>0.122</i>	<i>.147</i>	<i>0.176</i>	<i>0.194</i>	<i>0.244</i>	<i>0.299</i>
size	0.124***	0.146***	0.219***	-0.137***	-0.134**	-0.147**
	<i>0.025</i>	<i>0.031</i>	<i>0.039</i>	<i>0.041</i>	<i>0.053</i>	<i>0.066</i>
gdp	0.005	0.030	0.082	-0.062	-0.027	-0.024
	<i>0.086</i>	<i>0.093</i>	<i>0.101</i>	<i>0.13</i>	<i>0.14</i>	<i>0.15</i>
Obs	122647	107794	34507	207550	183893	160478
No firms	42687	39038	93110	67426	62243	55876
Firm FE	YES	YES	YES	YES	YES	YES

(\*\*\*) (\*\*) (\*) refer to 1%, 5%, 10% significance levels. Robust standard errors (in italics) are clustered at firm level. All estimates are fixed effects; year dummies are always included. Instruments: *turnover* and *elections* and interacted terms.

Table 8: Probability of growth around the threshold and tax gap

	Whole sample	Percentiles		
		25	50	75
size13	-0.07	0.133	0.149	0.082
	<i>0.086</i>	<i>0.191</i>	<i>0.132</i>	<i>0.101</i>
size14	-0.16	0.082	0.007	-0.004
	<i>0.097</i>	<i>0.232</i>	<i>0.154</i>	<i>0.111</i>
size15	-0.068	0.223	0.011	-0.04
	<i>0.102</i>	<i>0.193</i>	<i>0.147</i>	<i>0.12</i>
Tax gap x size13	0.236	-0.656	-0.775	-0.482
	<i>0.418</i>	<i>0.81</i>	<i>0.588</i>	<i>0.471</i>
Tax gap x size13	0.628	-0.556	-0.167	-0.132
	<i>0.471</i>	<i>0.989</i>	<i>0.685</i>	<i>0.519</i>
Tax gap x size13	0.338	-0.91	-0.028	0.194
	<i>0.491</i>	<i>0.811</i>	<i>0.645</i>	<i>0.554</i>
Obs.	52562	9704	23322	37772
Firms	19043	3784	8733	13920
Firm FE	YES	YES	YES	YES

Notes: Robust standard errors in parenthesis. The dependent variable is a dummy that takes the value of 1 if employment at time t is larger than employment at time t-1, and 0 otherwise. Firms between 11 and 20 workers are included. All specifications include a polynomial of firm size. Interactions of *Tax gap* are instrumented with the interactions of *Election* and *Turnover*.