Temporary Workers, Educational Mismatch and Firm Productivity*

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Abstract

The objective of this paper is to provide new evidence on the effect of over-education on firm productivity using a matched employer-employee dataset. To achieve this goal, we regress TFP on the fraction of educationally mismatched workers and a set of additional controls in a dynamic panel model at firm-year level controlling for industry and time effects. We also take advantage of institutional labour market reforms occurred in Italy in 2001 and 2003 to study the changes in the mismatch among workers hired on temporary contracts, which differ for their training content. We find that overall over-education has a negative effect on TFP, suggesting that the lower job satisfaction effect prevails over the higher skill effect. However, when looking at workers hired on temporary contracts, we find that there is no effect of over-education on TFP neither for short-term workers nor for apprentices.

Keywords: temporary contracts, skill mismatch, firm productivity.
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1 Introduction

Skills mismatch in the labour market concerns the extent to which people work in jobs which are not matched to their qualifications and skills (CEDEFOP, 2014). This phenomenon has been first highlighted by Freeman (1976) and since then has been extensively studied to evaluate the effects of higher participation rates in tertiary education observed in developed economies (McGuinness, 2006). The European policies aiming at increasing the supply of highly educated workers are based either on the premises that an excess demand for tertiary education exists and/or on the belief that firms employing more educated workers will improve their production techniques to take advantage of the higher skill level (McGuinness, 2006). However, in case of excess labour supply, there may be some "crowding out" effect, such that workers with tertiary education end up with jobs that could be occupied by less educated ones.

OECD reports that over-educated workers in OECD countries account for approximately 25 percent of the total workforce. As emphasized by McGuinness (2006), educational mismatch may be costly for the economy as a whole (e.g., a waste in tax revenues due to the financing of excessive levels of education), for firms (e.g., a loss in efficiency if over-educated workers are less productive than their adequately educated colleagues) and for individuals (e.g., over-educated workers may earn less than their former classmates doing jobs that match their education).

In the literature, the effects of educational mismatch on earnings are well documented and findings are quite consistent. Hartog (2000) and Leuven and Oosterbeek (2011) show that, in a given job with a specific level of required education, over- (under-) educated workers earn more (less) than those who have just the required education for the job (Battu et al., 1999, Dolton and Vignoles, 2000, Frenette, 2004, McGuinness, 2003, van der Meer, 2006). However, the effects of over- and under-education on firm productivity is ambiguous. A first strand of the literature relies on the human capital theory to infer the consequences of educational mismatch on productivity. As a result, productivity effects of over- and under-education are deduced from the latter's impact on wages. Other studies examine how educational mismatch influences job satisfaction and other correlates of workers' productivity, such as absenteeism, shirking, turnover or training (Robst, 1995; Sicherman, 1991; Sloane & Battu, 1999; Tsang & Levin, 1985, 1987).

The "human capital" and "job satisfaction" approaches lead to quite dif-

ferent results. While the former suggests that over- (under-) educated workers are more (less) productive than their adequately educated colleagues in similar jobs, the latter provides ambiguous predictions. Both approaches suffer from important methodological limitations, since the relationship between education, wages and productivity is likely to be much more complex. In addition, some empirical results provided by Judge et al., 2001 suggest that the correlation between job satisfaction and job performance is rather low. It could be therefore misleading to focus solely on job satisfaction to estimate the effects of educational mismatch on firm productivity. Finally, it is plausible to think that over- education affects productivity through other channels than job satisfaction. For instance, in line with the human capital theory, potentially negative effects on firm productivity of over-educated workers through their lower degree of job satisfaction could be compensated by their additional skills.

A recent European Commission working document (2012) reported that skill mismatch is particularly severe in Mediterranean Countries, characterized by more segmented labor markets, and younger male workers hired on non-standard contracts are predominantly affected. However, in the literature the relationship between mismatch and employment protection legislation seems to be ambiguous. In a recent work, Lazear & Gibbs (1998) show that when firms face barriers to laying off due to legal or other institutional impediments (e.g., powerful trade unions), this may compromise the quality of the workers that are eventually displaced. Brunello *et al.* (2007) also argue that employment protection legislation might increase the extent of skill mismatch by making it harder for individuals to obtain their first job and for firms to reduce staff due to hiring restrictions. However, Daly *et al.* (2000) find that schooling mismatch is not correlated with institutional issues such as labour market flexibility, in line with a universalistic view of labour markets. Finally, Verhaest & van der Velden (2013) fail to find a significant correlation between employment protection legislation and the incidence of over-qualification. On the other hand, predictions on the effects of temporary employment on workers effort and productivity are ambiguous. Boeri & Garibaldi (2007) find a temporary positive effect on employment and a permanent negative effect on productivity, while Ichino & Riphahn (2010) find a positive impact of effort and productivity when temporary jobs have a high probability to be transformed into permanent ones after the probation period. Similarly they find that the effects of skill mismatch on firm productivity are somewhat ambiguous.

Given the ambiguity in the results presented in the existing literature, there is a clear need for further research in the area. As claimed by (Kampelman & Rycx, 2012), it would be highly informative if we knew the effect of over- and under-education on productivity, rather than on wages, job satisfaction and related workers' attitudes and behaviours (such as absenteeism, shirking, turnover or training). The purpose of the paper is therefore to shed some light on the effect of mismatch (over-education) on firm productivity in the presence of temporary contracts, which may be associated with lower job satisfaction. Indeed, the empirical literature on temporary contracts and job quality shows that job (in)stability is the most serious cause of lower satisfaction for temporary employees (Bruno et al., 2013).

We focus our study on Italy, which is a particularly suitable country since after the implementation of several labor market reforms (1997, 2001 and 2003), the share of temporary contracts increased significantly (from approximately 5% in mid eighties to more than 13% in 2013). Indeed, by relaxing the EPL of temporary contracts, these reforms created important incentives for firms to substitute permanent with temporary workers (Tealdi, 2011a). Moreover, it has been shown that the magnitude of educational mismatch is in Italy one of the highest in Europe (Verhaest & van der Velden, 2013). According to McGuinness & Sloane (2011), the share of overeducated workers is approximately 23% at the time of their first job and of 13% five years after graduation. In addition, more in line with the European average, over-skilling in Italy equals 21% at the first job and 11% five years after graduation.

To study the relationship between over-education and firm productivity, we merge a longitudinal dataset for workers in the Italian region Veneto (PLANET), which provides information on the universe of worker flows in the private sector over the period 1998-2011, with the AIDA data set which provides information on the balance sheets of Italian corporate firms. We propose an econometric model, which aims to relate TFP to the net flows of temporary workers and the net flows of educationally mismatched workers. We regress TFP on the fraction of educationally mismatched temporary workers and a set of additional controls in a dynamic panel model at firm year level controlling for industry fixed effects and time effect. Within a GMM framework - having information only on the flows of workers - we are able to add some additional controls (such as occupation, sector, conversion rates). We can then take advantage of the institutional reforms occurred in 2001 and 2003 to study the way the mismatch among temporary workers have

affected the firm productivity before and after the reforms. We construct two-step dummy variables, which take the values 1 for the period after the reforms and zero before. The share of skill mismatched workers interacted with temporary workers and the reforms is then our key variable to identify this effect.

We focus on two types of temporary contracts: short-term and apprenticeship. This choice is driven by two main points: first, while the 2001 reform changed significantly the former type of contract, the 2003 reform made significant changes to the latter. To take into account that as a consequence of the above-mentioned reforms spillover effects on other types of temporary contracts maybe present, we control for collaboration contracts as well as vocational training contracts and other types of fixed-term contracts. Second, the two types of contract significantly differ for their training content: while the former does not involve any type of training for the worker, with the latter the employer is obliged to provide on the job training at its own expenses. This difference might have had a strong impact on the way these contracts are used by the employers and therefore an important effect on the worker's careers within the firms and ultimately on firm productivity.

We find that skill mismatch has increased since 1998 and while over-education has a significant negative effect on firm TFP, the effect of under-education is not significantly different from zero. When we look at the effect of educational mismatch among specific temporary workers, i.e., short-term employees and apprentices, we find that neither over-education nor under-education among both short-term workers and apprentices have any significant effect on TFP. These results seem to suggest that the strong diffusion of temporary contracts in Italy did not decrease the workers' mismatch phenomenon, which was already affecting firms before the wave of labour market flexibilization.

Our paper is organized as follows. Section 2 reviews the theoretical framework of educational mismatch. Section 3 presents an overview of the Italian institutional background. Section 4 describes the data and Section 5 presents the methodology and main descriptive statistics. Section 6 describes the results. Finally, Section 7 concludes the paper.

2 Overeducation and skills mismatch

Skills mismatch in the labour market concerns the extent to which people work in jobs which are not matched to their qualifications and skills (CEDEFOP, 2014). Freeman (1976) with his seminal work on over education was the first to bring this issue to the attention of researchers. Since then, many studies have been performed both at the theoretical and empirical level to evaluate its effects on the labour market.

Theoretically, there exists no accepted unified theory of skills mismatch. Theories that try to explain it range from two extreme perspectives: the human capital theory and the job competition model. According to the first, it is possible that workers are overeducated in the short run, while they are looking for a more appropriate job or while firms adjust their production processes to fully utilize the worker's human capital. However, a sufficient degree of wage flexibility should restore any imbalance between labour demand and labour supply, since wages always match the worker's marginal product, which is determined by the level of acquired human capital (Becker, 1964).

The job competition model suggests that job characteristics may be the only factor determining earnings. Based on the work of Thurow (1975), the model emphasizes the importance of a worker's relative position compared to other workers competing for jobs. Excess schooling is the consequence of the competition for jobs in presence of rigidity of demand for highly educated workers, which leads graduates to invest in education in order to increase their chances to get a job.

The assignment literature (Sattinger, 1993) offers a middle ground between the two theories. Like the job competition model, this theory assumes that the jobs available in the economy are limited and therefore earnings are job specific; like the human capital theory, it assumes that by investing in education individuals compete for the best jobs and therefore the wages are bound to be influenced by the human capital level of the workers. Thus, wages and earnings are determined both by the characteristics of the worker and of the job.

The search theory assumes that unemployment is largely voluntary: individuals accept jobs only when the offered wage is higher than their reservation wage. High skilled individuals have higher reservation wages and therefore tend to wait longer before accepting a position. Over education arises because low skilled workers due to their low reservation wage tend to accept the first offer they get.

Finally, career mobility theories predict that wages increase overtime together with the work experience accumulated by individuals. Therefore, matches of firms and workers tend to exhibit low earnings in the short run, but better prospects in the long run (Caroleo & Pastore, 2013).

Most of the empirical evidence comes from studies which estimate wage equations based on the decomposition of educational years acquired (McGuinness, 2006). They find that the returns to surplus education is positive and significant, but lower than required education. Most researchers have interpreted this result as evidence against the human capital theory that predicts equal returns for surplus and required education. Consistent with the job competition theory, Rumberger (1987) found no significant returns to surplus education in certain occupations. Vahey (2000) reported no lower returns to surplus education for overeducated Canadian females, but lower returns for overeducated Canadian males. Battu *et al.* (2000) examined the validity of the human capital theory by testing for the hypothesis that graduates jobs converge overtime, making over education a short term phenomenon. They find no evidence that overeducated graduates have been able to upgrade their jobs, suggesting that over education may be a phenomenon which persists in the long run. In support of the assignment model, McGuinness (2003) proved that both human capital and job characteristics are important determinants of wages.

Most of the empirical studies measure over education only in terms of level and not in terms of type of education. A number of economists have tried to address this issue by taking into account heterogeneity among individuals with the same level of education. Dekker *et al.* (2002) find that young workers are more likely to be overeducated: in their Dutch sample the proportion falls from more than 40% for the 15-19 age group to 27% for the 30-44 age group to 18% for the 49-64 age group. Renes & Ridder (1995) find that women need to have almost six month more work experience than men to be hired on the same job, which makes them overqualified. On the same line, Groot & Maassen Van Den Brink (2000) show that over education is more frequent among women than among men, but the opposite is true for under education. However, the likelihood of being overeducated is approximately the same for men and women. Finally ethnic minorities may also be more overeducated compared to ethnic majorities. Duncan & Hoffman (1981) find that 49% of black males were overeducated compared to 42% of the US male workforce. Similarly, Alpin *et al.* (1998) find that 30% of non-white graduates in the UK were overeducated compared to 27% of white

graduates.

3 Institutional background

In Italy, since 1942 open ended contracts associated with quite rigid EPL and high firing costs represented the traditional legal instrument to hire workers. These contracts are also characterized by the highest wedge between gross salary and labor costs, due to high labour taxes and social security contributions. Since the early 60s, short-term contracts were regulated. They share the same characteristics as the open-ended contracts, but for the limited duration established at stipulation (up to two years, with only one possibility of renewal). Due to strict rules for adoption, which limited significantly the scope for utilization, their percentage was small until the nineties. Two other types of quasi substitute fixed-term contracts were available since the 70s: apprenticeship and *Contratto di Formazione Lavoro* (vocational training contract). They were meant to train individuals to learn a profession and therefore, were specifically designed for young people below the age of 34.[1] They differed in the maximum length of the contract, however both required training to be provided by the employer. The apprenticeship contract was in general longer and demanded more training, compared to the vocational training contract. However, firms were entitled to a reduction in the labour taxes for the workers hired with an apprenticeship contract. Moreover, controls for training were much stricter for apprenticeship and were organized at both national and local levels.

On the wave of liberalization of the European labour markets, in the past two decades many reforms have been approved in Italy to relax the rules for the utilization of fixed-term contracts and several new types of employment contracts (with fixed duration) have been legislated.[2] The objectives of these interventions, in accordance with the European guidelines, were the reduction of unemployment, particularly among young people, the increase of labor force participation, and the boosting of employment. Indeed, employment, unemployment, and labor force participation in the nineties in Italy were significantly worse compared to other European countries. Young and long term unemployment rates were higher than the EU average (respectively 31% and

[1] Together they represented less than 10% of the total number of contracts.

[2] See Tealdi (2011b) for an extensive description of these reforms.

70% compared to 16% and 44%),[3] labor force participation and employment were among the lowest in Europe, particularly among women (44% and 36% compared to the average 54% and 49% among the EU countries).[4] In order to promote the utilization of these new forms of employment contracts, new government subsidies were provided to reduce the relative cost of fixed-term contracts (social security fees) compared to open-ended contracts. Moreover, the shorter and flexible length of fixed-term contracts and the possibility to dismiss the worker at expiration at no cost created additional incentives for their adoption by firms. The combination of more flexible and cheaper hiring/firing decisions, and the lower labor cost burden, was the recipe adopted to trigger a more competitive labor market.

Specifically, three were the major reforms implemented with the objectives of improving labor market flexibility. The first reform known as Legge Treu was approved in 1997. It represents a milestone in the history of the recent Italian labor market. Some of the major innovations brought by Law-196/1997 are the regulation of agency contracts and collaboration contracts and the relaxation of the rules for the utilization of fixed-term contracts and apprenticeships. Few years later, with Law-368/2001, the Italian legal system by implementing a 1999 EU Directive removed the strict rules for adoption of short-term contracts and allowed firms to use short-term contracts under many different circumstances according to organizational, productive and technical needs.[5] The most recent reform took place in 2003 with Law-30/2003. This law, known as Legge Biagi, introduced new additional forms of atypical contracts (such as job on call and job sharing) and introduced several modifications to the vocational training contract. However, the main novelty was the relaxation of the rules for the utilisation of apprenticeship contracts. Specifically, the age eligibility was extended and the possibility to perform on the job training within the firm (instead of outsourcing it to specific external institutions) was introduced. These changes were made in

[3]Average rate across 19 European countries. 15-24 years old cohort. Unemployment duration longer than 1 year. Year: 1990. Source: OECD.

[4]Average rate across 19 European countries. Year: 1990. Source: OECD.

[5]According to some scholars (Aimo, 2006; Cappellari *et al.* , 2012), the relaxation of these rules and the liberalization of short-term contracts created a sort of confusion among employers regarding the actual requirements for adoption. Specifically, it was not clear whether employers could use short-term contract also for activities which are not of temporary nature. Moreover, in case of court disputes, the applicability relied too much on the interpretations of the judges, causing delays and disincentives for the adoption of the contracts and therefore distorting the objective of the law.

order to make the apprenticeship contract more flexible and therefore more appealing for firms, promoting their utilisation.

The availability of several types of temporary contracts provides firms with more flexibility in choosing the arrangement that fits better with their labour force needs. For instance, employers might choose the apprenticeship over other forms of temporary contracts if they want to reduce their labour costs and invest in training to comply with the Italian regulations. A job contract characterized by lower labour costs but firm-provided training might allow firms to select the most motivated and career-oriented workers. On the other hand, employers might choose to hire workers on the basis of short-term contracts to screen workers' abilities, or whenever training is too costly, or whenever the economy is unstable and firms do not have incentives to invest in training (Picchio & Staffolani, 2013).

While the 2001 reform was meant to increase flexibility by relaxing the rules for the utilization of short-term contracts, its implementation was not immediate, but delayed due to technical aspects delegated for regulation to unions' collective agreements. Therefore, firms had to wait before being able to take advantage of the new legislation. (Cappellari *et al.* , 2012). Therefore, even though the 2001 and 2003 reforms were regulating different types of temporary contracts, their effect may have overlapped.

4 Data

We use employer-employee data from the Italian region Veneto (PLANET). The data set includes all workers who experienced a mobility episode, i.e., hiring, firing or job mobility. Once entered in the panel each worker is followed for the entire career, unless she moves outside the region Veneto. For each worker we have information on gender, age, place of birth and seniority within the firm. A valuable feature of this data set is that it includes detailed information on occupation (categorized by 4 digit code), education (8 categories) and different types of labor contracts. This allows us to construct measures of skill mismatch by contract. Unfortunately, no information on wages is provided. The data set includes also information on characteristics of the firm, such as industry, detailed geographic information, and the firm national tax number (*codice fiscale*); however no information on the stock of workers is available. Our balance sheet data are derived from standardized reports that firms are required to file annually with the Chamber of Com-

merce. These data are distributed as the database by Bureau van Djik, and are available from 1995 onward for firms with annual sales above 500,000 euros. All (non-financial) incorporated firms with annual sales above this threshold are included in the database. The available data include sales, value added, total wage bill, the book value of capital (broken into a number of subcategories), total number of employees, industry (categorized by five- digit code), total wage cost, and the firm tax number. The presence of detailed information on occupation and education allows us to identify skill mismatches quantifying to what extent the characteristics of the workers, in particular their schooling level, deviate from the one required to properly perform the tasks of the job. We focus our analysis on individuals aged 15 to 64, whose contract length is at least 3 months. We limit our time series to the period 1998-2007 since the effects of the 2008 economic crises is outside the scope of this paper and may provide confounding effects. Since we are aware of the issues related to the reliability of the information regarding the education of foreign workers, we conduct our analysis on a sample where we remove firms whose flows of foreign workers is above 6% (which corresponds approximately to 10% of the firms).[6]

5 Methodology

Three different measures, based respectively on job analysis, worker self-assessment and realised matches, have been proposed in the literature to estimate the required education for a job and the incidence of educational mismatch. Each measure has its own advantages and weaknesses (Hartog, 2010; Kampelman & Rycx, 2012). In this paper we follow the approach to calculate the modal qualification of workers in each occupation (Mendes de Oliveira & Kiker, 2000).[7] Specifically, we identify a worker as mismatched

[6] Additional robustness exercise are provided in the appendix.

[7] There are several approaches to measuring qualification mismatch in addition to the one we chose. One is to compare the qualification level of a worker according to the International Standard Classification of Education (ISCED) level and the required qualification level corresponding to his/her occupation code according to the International Standard Classification of Occupations (ISCO) (Chevalier, 2003). An alternative approach is based on workers' opinions on the match between their jobs and education (Battu & Sloane, 2000; Dorn & Sousa-Poza, 2005). This type of self-reported measures can be subject to biases due to the wording of the question or the impact of external variables, some of which may be country-specific (Dumont & Monso, 2007). However, they have the advan-

whether she is over- or under-qualified, i.e., her level of education is higher or lower compared to the mode of the workers within the same occupation. Workers are perfectly matched if their education level is the same as the mode of workers within the same occupation entering the market in a specific year. This definition based on flows rather than stocks allows us to capture the fact that the skills requirement for a specific type of job evolves and gets higher over time.

To examine the impact of educational mismatch on firm productivity, we start with a standard production function of the form

$$Y_{jt} = A_{jt}F(K_{jt}, L_{jt}), \tag{1}$$

where we use a specification that has been aggregated at the level of the firm (j). We follow a two-step estimation procedure. First, we estimate Equation 1 using data from the AIDA dataset. Since the above coefficients when estimated using the OLS method may be biased due to the potential correlation between the residuals and the input choices, two alternative methods have been developed in the literature to overcome this issue. The Olley and Peaks (1996) estimator controls for endogeneity and firm fixed heterogeneity by using the employer's investment decision as a proxy for unobserved productivity shocks (observations with zero investments have to be dropped).

The Levinsohn Petrin (2003) approach replaces investments with intermediate inputs (i.e., raw materials) as a proxy for unobserved productivity shocks. Since usually, firms report positive values for intermediate inputs, and therefore each year most observation can be included, we follow this last approach.

Then, we interpret the residuals as a measure of TFP:

$$TFP_{jt} \quad = \quad [\ln y_{jt} - \beta_1 \ln k_{jt} - \beta_2 \ln l_{jt} - \beta_3 \ln m_{jt}]$$

where y_{jt} denotes the value added, k_{jt} denotes capital, l_{jt} the stock of employees and m_{jt} denotes raw materials of firm j.

We then assume that the firm's TFP at time t is a function of the change in human capital (ΔE_t) between $t-1$ and t :

$$\Delta \log(TFP_{jt}) \equiv tfp_{jt} = \log\left(1 + \frac{\Delta E_{jt}}{L_{jt-1}}\right) \sim \frac{\Delta E_{jt}}{L_{jt-1}}.$$

tage of being job-specific rather than suffering from the caveats associated with the other measures.

Finally, in the second step we estimate the following equation:

$$\begin{aligned} tfp_{j,t} &= \beta_0 + \beta_1(tfp_{j,t-1}) + \beta_2\left(\frac{1}{n_{j,t-1}}\sum_{i=1}^{n} over_{i,j,t}\right) + \beta_3\left(\frac{1}{n_{j,t-1}}\sum_{i=1}^{n} under_{i,j,t}\right) \\ &+ \sum_{k=1}^{2}\beta_k\left(contract_{j,t}^{k} \times over_{i,j,t}\right) + \sum_{k=1}^{2}\beta_k\left(contract_{j,t}^{k} \times under_{i,j,t}\right) \\ &+ \beta_{10}X_{j,t} + \beta_{11}Z_{j,t} + \gamma_t + \epsilon_{j,t} \end{aligned} \tag{2}$$

The variables $over_{i,j,t}$ and $under_{i,j,t}$ describe the flow of workers (difference between exit and entry) in firm j at time t who are overeducated and undereducated, respectively, weighted by the number of workers employed one period before in the same firm ($n_{j,t-1}$). The variable *contract* identifies the number of employees who were hired in either of the two types of temporary contracts (short-term contract and apprenticeship) which were directly affected by the reforms approved in 2001 and 2003, short-term contract and apprenticeship. We consider then the interactions between temporary employees and the the two measures of mismatch, over- and under-education. Finally we include worker's characteristics (X), such as occupation, education and class of age as well as firm's characteristics (Z), such as sectors, age of the firm and its square. γ_t identifies a set of year dummies while $\epsilon_{j,t}$ is the error term.

Equation 2 describes the relationship between the two measures of mismatch (over and under) and temporary contracts, and the per worker productivity at firm level, controlling for time effects and firm and worker characteristics. By including the lagged dependent variable as a regressor we account for the state dependence of the firm productivity. We estimate the equation with ordinary least square with robust standard errors. We take advantage of the cross-section and longitudinal characteristics of the dataset, by exploiting the variability between firms and within firms over time. This approach has been heavily criticised (Aubert & Crepon, 2006) because of the potential heterogeneity bias due to the dependence of firm productivity on firm-specific, time-invariant characteristics which are not accounted for in micro-level data. Therefore, our estimated coefficients may suffer from spurious correlation since unobserved firm characteristics may affect simultaneously the firm's level of value added and its workforce average level of educational mismatch.

An additional problem is the potential simultaneity between firm productivity and educational mismatch. Gautier et al. (2002, p. 523) claim that there might be some cyclical "crowding out", that is a process by which during recessions highly educated workers take the jobs that could be occupied by less educated ones because of excess labour supply. This assumption suggests that over-education within firms may increase as a result of a lower labour productivity (and vice versa). Therefore, to control for endogeneity, in addition to state dependence of firm productivity and the presence of firm fixed effects, we estimate Equation 2 using the dynamic system Generalized Method of Moments (GMM) estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998).

This approach is standard in the literature regarding the productivity effects of labour heterogeneity (Gobel and Zwick, 2012, van Ours and Stoeldraijer, 2011). The main idea is to estimate a system of two equations (one in level and one in first differences) simultaneously and to rely on internal instruments to control for endogeneity. More precisely, mismatch variables in the differenced equation are instrumented by their lagged levels and mismatch variables in the level equation are instrumented by their lagged differences. The implicit assumption is that changes in productivity in one period, although possibly correlated with contemporaneous variations in mismatch variables, are uncorrelated with lagged differences of the latter. Moreover, changes in mismatch variables are assumed to be reasonably correlated to their past changes.

In order to find the correctly specified model, we start with the moment conditions that require less assumptions and increase the number of instruments progressively (Gobel and Zwick, 2012). To examine the validity of additional instruments, we apply the Hansen (1982) test of over-identifying restrictions. In addition, Arellano-Bond's (1991) test for serial correlation is used to assess the reliability of the estimates.

The inclusion of the lagged dependent variable in the OLS, fixed effects and system GMM specifications also provides an *ad hoc* test for the appropriateness of the latter. This test consists in checking whether the regression coefficient on the lagged dependent variable obtained with system GMM falls between the OLS and fixed effects estimates (Roodman, 2009).

5.1 Descriptive statistics

By analysing the data set described above, we provide some descriptive statistics regarding the share of temporary contracts and the skill mismatch over the time period 1998-2007. Note that we observe the flows of workers who enter and leave the firms and therefore each characteristic that we consider refers to the workers' flows and not to the workers' stock.

Table 1 reports the average age of entry per year and the share of female employees. It is interesting to notice that the share of females does not change significantly over the years. Table 2 shows the share of temporary workers according to contract type. The share of short-term contracts increased over the years with important jumps between 2001 and 2004. We can also notice a significant increase of other contracts and collaboration contracts. Looking at the apprenticeships, we detect instead an hump-shaped trend, decreasing until 2003 and increasing after.

Figure 1 shows the share of mismatched workers, over and under educated workers during the time frame considered. We can notice that all three measures show a positive trend particularly after 2001, year of the first reform considered.

6 Results

We first estimated Equation 2 by pooled OLS with robust standard errors. The results are presented in the second column of Table 3. The lagged difference in productivity, even if not shown in the table, has a negative and significant effect on its contemporaneous value. Regarding educational mismatch, we find that over-education per se has a significant negative influence on firm productivity, while under-education has no significant effect on firm TFP. When we interact over-education with the two types of temporary contracts we are considering, i.e., short-term contracts and apprenticeships, we find that over-education has a positive effect on firm TFP among apprentices, however the coefficient for short-term employees is not significantly different from zero.

However, these estimates are inconsistent due to the endogenous nature of the mismatch variables. To take into account this issue, we re-estimate Equation 2 using the dynamic system GMM estimator proposed byArellano & Bover (1995) and Blundell & Bond (1998). Variables in the differenced

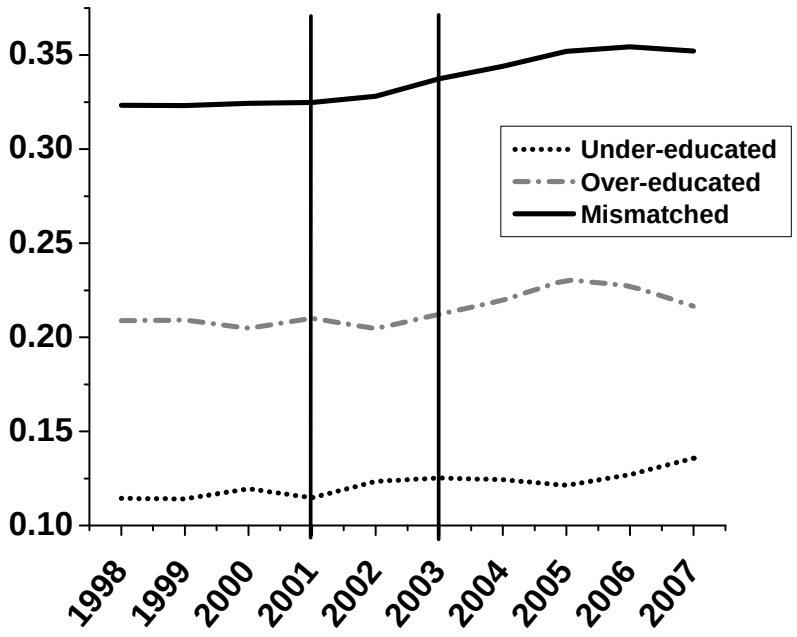

Figure 1. Mismatched, Over and Under Educated workers in Italy (1998-2007).

equation are thus instrumented by their lagged levels and variables in the level equation are instrumented by their lagged differences. Time dummies are considered as exogenous and we use first and second lags of other explanatory variables as instruments.

The results of our GMM estimation are reported in the second column of Table 3. To evaluate the reliability of this last estimation, we look at the Hansen test of over-identifying restrictions. As shown in Table 3, the test does not reject the null hypothesis of valid instruments.

First of all, we find a positive effect of the lagged difference in productivity on the current value, as in Dolado *et al.* (2013). Moreover, results regarding the productivity effects of educational mismatch are also somewhat similar to those obtained with the OLS estimator. They indicate that over-education have a significant negative influence on firms' TFP, while under-education has no significant effect. When we interact the measures of over-education

with the two types of temporary contracts, we consistently observe that both over-education and under-education within both short-term contracts and apprenticeships have no significant effect on firm's TFP. Moreover, the magnitude of the estimated effect of over-education within the GMM framework seems to be larger than that estimated with the OLS approach.

We interpret these results in light of the fact that job satisfaction is known and documented to be lower among over-educated workers, affecting the amount of effort exerted on the job and therefore firm TFP. This negative effect may be strong enough to overcome the positive effect of over-education on firm productivity due to the higher skill level of the employees. However, the two reforms incrementing flexibility in the labour market do not seem to have had any impact on the effect of mismatch on firm productivity.

7 Conclusions

The share of temporary contracts as well as the share of mismatched workers have increased significantly in the past decades. The aim of this paper is to shed some light on the relationship between over-education and firm productivity in economies characterized by dual labor markets. We focus on the two main temporary contracts which were significantly modified by two important labour market reforms approved in Italy in 2001 and 2003: short-term and apprenticeship. These contracts also significantly differ in their training content: while the former does not involve any training, with the latter the employer is obliged to provide on the job training at its own expenses. This feature may strongly affect the working careers of individuals within the firm and therefore have a significant impact on the productivity.

We propose an econometric model, which aims to relate TFP to the net flows of temporary workers and the net flows of educational mismatched workers. In order to estimate the impact of temporary workers via skill mismatch we regress TFP on the fraction of educational mismatched temporary workers and a set of additional controls in a dynamic panel model at firm year level controlling for industry fixed effects and time effect. Within a GMM framework - having information only on the flows of workers - we are able to add some additional controls (such as occupation, sector, conversion rates). Moreover, we are able to tackle two issues: the potential heterogeneity bias due to the dependence of firm productivity on firm-specific, time-invariant characteristics which are not accounted for in micro-level data and the poten-

tial simultaneity between firm productivity and educational mismatch. We find that skill mismatch has increased since 1998 and both over-education has a significant negative impact on firm's TFP. However, under-education has no significant effect on firm productivity. When we look at the effect of educational mismatch among specific temporary workers, i.e., short-term employees and apprentices, we find that neither over-education nor under-education among both short-term workers and apprentices have any effect on TFP. We interpret these results in light of the fact that job satisfaction is known to be lower among over-educated workers, and as such it affects directly the amount of effort exerted on the job and indirectly the TFP of the firm.

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Table 1. Descriptive statistics I

Year	Entry age	Female
1998	29.20592	.3881333
1999	29.54813	.4081517
2000	30.06818	.4247350
2001	30.71054	.4296478
2002	31.19702	.4327531
2003	31.79510	.4275731
2004	32.32720	.4298845
2005	32.53570	.4262953
2006	32.69415	.4231360
2007	33.03928	.4185897

Table 2. Descriptive statistics II

Year	Short-term contracts	Apprenticeships	Others	Collaborations
1998	.2192971	.1254002	.0015935	.0001870
1999	.2337442	.1290715	.0050931	.0001201
2000	.2191644	.1261393	.0134178	.0013692
2001	.2281794	.1255917	.0232963	.0028657
2002	.2551281	.1196359	.0448391	.0017003
2003	.2840365	.1147181	.0463885	.0026004
2004	.3101436	.1160990	.0549148	.0060265
2005	.3269091	.1329409	.0718390	.0119498
2006	.3198704	.1494199	.0896487	.0202104
2007	.3228437	.1322104	.1051673	.0319499

Table 3. Estimation results

Variable	OLS	GMM
Lag TFP	-0.143	0.221
	(0.004)	(0.064)
Over-education	-0.082	-1.474
	(0.030)	(0.676)
Under-education	-0.012	-0.879
	(0.038)	(0.618)
Over-education*stc	0.114	0.1566
	(0.064)	(1.170)
Under-education*stc	0.074	1.715
	(0.067)	(1.239)
Over-education*app	0.332	1.324
	(0.064)	(0.995)
Under-education*app	0.054	0.130
	(0.096)	(1.154)
Permanent	-0.001	0.863
	(0.024)	(0.409)
Short-term	-0.037	0.198
	(0.033)	(0.401)
Apprentice	-0.032	0.773
	(0.027)	(0.387)
Worker's characteristics[1]	Yes	Yes
Firm's characteristics[2]	Yes	Yes
Skills dummies	Yes	Yes
Education dummies	Yes	Yes
Age dummies	Yes	Yes
Year dummies	Yes	Yes
Sector dummies	Yes	Yes
Province dummies	Yes	Yes
R^2	0.0337	
Hansen test of overid. restrictions:		105.24
p value		0.584
Sargan test of overid. restrictions:		140.10
p value		0.024
Arellano-Bond test for AR(1) in first differences:		-5.55
p value		0.000
Arellano-Bond test for AR(2) in first differences:		-2.38
p value		0.017
# of observations	27570	27570

[1] Share of women, age.

[2] Firm's age and its square, total conversion rate, conversion rate of apprentices and short-term employees.