

How do regulated and unregulated labor markets respond to shocks? Evidence from immigrants during the Great Recession*

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Abstract

This paper studies wage adjustment during the recent crisis in regulated and unregulated labor markets in Italy. Using a unique dataset on immigrant workers, we show that before the crisis wages in the formal/regulated and informal/unregulated sectors moved in parallel (with a 15 percent premium in the formal labor market). During the crisis, however, formal wages did not adjust down while wages in the unregulated informal labor market fell so that by 2013 the gap had grown to 32 percent. The difference is especially salient for workers in “simple” occupations where there is high substitutability between immigrant and native workers. Our results are consistent with the view that labor market regulation prevents downward wage adjustment during recessions.

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1 Introduction

The Great Recession has brought a substantial increase in unemployment in Europe. The unemployment rate in the euro area has grown from 8 percent in 2008 to 12 percent in 2014. Nonetheless, the change in unemployment has been very heterogenous. In northern Europe, unemployment did not grow substantially or even fell: in Germany, for example, unemployment rate has actually declined from 7 to 5 percent. At the same time, in Greece unemployment has picked from 8 to 26 percent, in Spain from 8 to 24 percent, and in Italy from 6 to 13 percent.

Why have unemployment dynamics been so different in European countries? The most common explanation is the difference in labor market institutions that prevents wages from adjusting downward. If wages cannot decline, negative aggregate demand shocks (such as the Great Recession) result in growth of unemployment. On the other hand, if wages can fall, labor markets reach a new equilibrium with unemployment rates returning to normal levels. Adjustment of nominal wages in response to macroeconomic shocks is especially important in the euro area where the labor markets cannot accommodate shocks through exchange rate depreciation or through internal labor mobility (migration among EU countries is much more limited than, for example, the labor mobility across US states).

While this argument is straightforward, it is not easy to test empirically. Indeed, cross-country studies of labor markets are subject to comparability concerns. The same problems arise in comparing labor markets in different industries within the same country. In order to construct a convincing counterfactual for a regulated labor market, one needs to study a non-regulated labor market in the same sector within the same country. This is precisely what we do in this paper through comparing formal and informal markets in Italy over the course of 2001-13. Indeed we consider informal employment as a proxy for unregulated counterfactual to the regulated formal labor market.

We exploit a unique dataset, a large annual survey of immigrants working in Lombardy carried out by the Foundation for Initiatives and Studies on Multi-Ethnicity (ISMU). Lombardy is the largest region of Italy in terms of population (10 million people, or one sixth of Italy's total) and GDP (one fifth of Italy's total GDP). It is also the region with the largest migrant population: in 2005, 23 percent of the entire migrant population legally residing in Italy were registered in Lombardy. It is also likely to be the largest host of undocumented migrants: in the last immigrants' regularization program in 2002, Lombardy accounted for 22 percent of amnesty applications. While Lombardy has higher GDP per capita and lower unemployment than Italy on average, it has also suffered from the recent crisis. Unemployment increased from 4 percent in 2008 to almost 9 percent in 2013. Recession started in 2009, it was followed by a weak recovery in 2010-11 and resumed in 2012; in 2012 real GDP was 5 per cent below its 2008 level.

Our data cover around 4000 full-time workers every year, a fifth of which works in the informal sector. The dataset is therefore sufficiently large to allow us comparing the evolution of wages in the formal and informal sector controlling for household characteristics, occupation, skills and other individual characteristics (age, gender, year of arrival to Italy and country of origin). We adopt a difference-in-differences methodology in order to test our main hypothesis that a severe recession in Italy (and

Lombardy) should have resulted in a larger decline of wages in the unregulated labor market (i.e. in the informal sector) compared to the regulated labor market (i.e. the formal sector).

Our main result is presented in Figure 1 which shows the wage trends in the formal and informal sectors controlling for occupation, gender, age, education, country of origin, and family characteristics. We do find that the wage differential between formal/regulated and informal/unregulated sectors has increased after 2008. Moreover, while wages in the informal sector decreased by about 20 percent in 2008-13, wages in the formal sector virtually did not fall at all. This is consistent with the view that there is substantial downward stickiness of wages in the regulated labor markets. Interestingly, before the recession, wages moved in parallel in the formal and informal sectors — confirming the validity of the parallel trends assumption required for a difference-in-differences estimation and showing that both regulated and unregulated labor markets have a similar degree of upward flexibility of wages.

The conventional wisdom relates the downward stickiness of wages to the minimum wage regulation. Unfortunately, it is impossible to carry out randomized control trials to test this relationship directly; nor we are aware of natural experiments that exogenously change minimum wages in differential ways within the same industry and the same country. We thus construct sector-specific minimum wages using information from collective bargaining contracts at the industry level. We find that the effect in Figure 1 is similar in occupations where the average wage is close to the minimum wage and in those where the average wage is far above the minimum wage. Therefore minimum wages do not seem to explain the downward stickiness of wages in the formal labor market.

We then test whether the effect is stronger in “simple” rather than “complex” occupations. The formers require only generic skills and allow for greater substitutability between workers (in particular, between natives and immigrants) within occupations and across occupations. In such jobs we should expect a greater downward adjustment in the absence of regulation. On the contrary, in complex occupations workers need specific skills and are harder to replace; therefore even in unregulated labor markets wages may not decline during the recession. Our estimates confirm this hypothesis: the increase in wage differential between formal and informal sectors during the recession is stronger in simple than in complex occupations.

Our paper contributes to several strands of the economic literature. First, we bring new evidence on the labor markets’ reaction to recessions and the respective channels of adjustment. The seminal contribution by Blanchard & Katz (1992) studies the response of the US economy to regional shocks and points at inter-state labor mobility as the major channel of adjustment in the long run. For instance, after several years local economies adjust to aggregate demand shocks in terms of labor force participation and unemployment rates, whilst the workers who cannot find jobs in the depressed states move out to other states. Decressin & Fatas (1995) carry out a similar analysis for European regions, but find that different adjustment mechanisms are in place in Europe. Indeed, European workers are less mobile than their American counterparts, and adjustment mainly occurs through reduced labor force participation.

Mauro & Spilimbergo (1999) consider the case of a single European country, Spain, focusing on the

heterogeneity of the adjustment mechanisms across skills groups. Their results suggest that high-skilled Spanish workers respond with out-migration from the depressed provinces while the low-skilled drop out of the labor force or remain unemployed. The analysis of the heterogeneity of the workforce and therefore of the labor market adjustments has greatly benefited from the development of measures of skill content of occupations by Autor *et al.* (2003), Peri & Sparber (2009), Goos *et al.* (2009), and Goos *et al.* (2014). We also adopt these measures to disaggregate the channels of adjustment in our data. Another study of the labor market adjustment during the Great Recession is Elsby *et al.* (2016), who analyze the experience of the US and the UK. They find that nominal wage rigidity did play a role in the US during the Great Recession but not in the UK. Nevertheless, despite of different previous experiences, a recent contribution by Beyer & Smets (2015) suggests that declining interstate migration in the US since the 1980s and rising migration in Europe over the last 25 years are gradually leading to a convergence of the adjustment processes in the US and Europe.

We also contribute to a large literature using the difference-in-differences approach to analyze the impact of labor market institutions on employment. In particular, the seminal paper by Card & Krueger (1994) compares the employment evolution in New Jersey after a 20 percent increase in the minimum wage with neighboring Pennsylvania (where the minimum wage did not change). The recent surveys of this literature by Neumark *et al.* (2014) and Neumark (2014) conclude that minimum wages do have a negative impact on employment.

In addition, our paper brings new evidence on the recent literature on dual labor markets in Europe. Bentolila *et al.* (2012) compare labor market institutions in France and Spain to explain the strikingly different evolution of unemployment during the Great Recession in the two countries. In fact unemployment rate was around 8 percent in both France and Spain just before the Great Recession, but by 2011 it has increased up to 10 percent in France and to 23 percent in Spain. The authors explain the differential with the larger gap between firing costs in permanent and temporary contracts, and the laxer rules on the use of the latter in Spain. The issue of the dual labor market in Europe is discussed in detail by Boeri (2011), who provides a comprehensive survey of the literature on the impact of recent labor market reforms in Europe. Our paper also considers dual labor markets, although we study the duality of formal/regulated versus informal/unregulated markets rather than the duality between permanent and temporary contracts.

Meghir *et al.* (2015) develop a model with endogenous selection of firms and workers into the formal and informal sectors and calibrate it using Brazilian data. They show that on average firms in the formal sector are more productive and pay higher wages (which is consistent with our findings). Since we do not have data on informality at the firm level, we assume that the recession has a similar effect on the labor productivity in the formal and in the informal sector (controlling for industry and worker characteristics).

Since our data include only immigrants, a direct comparison of the effects of the recession on immigrant and native workers is not possible. However, we use the insights from the literature on the impact of immigration on wages and employment of natives and on the evolution of labor market outcomes of

immigrants versus natives through the business cycle. Orrenius & Zavodny (2010) compare the impact of the Great Recession on Mexican-born immigrants and native US workers with similar characteristics. They find that immigrants' employment and unemployment rates are particularly affected by the recession; the impact is especially strong for low-skilled and illegal immigrants. The authors also argue that one of the major channels of adjustment is a great reduction of the inflow of Mexican immigrants during the recession. Cadena & Kovak (2016) show that Mexican-born immigrants help to equalize spatial differences across local US labor markets. Interestingly, this takes place in both high-skilled and low-skilled segments of the labor market. Low-skilled immigrants turn out to be very responsive to labor market shocks which helps to equilibrate local labor markets even though low-skilled natives are not mobile. Cortes (2008), Manacorda *et al.* (2012) and Ottaviano & Peri (2012) study the impact of immigration on the wages of natives and find that immigrant and native workers are imperfect substitutes. Using data on fifteen Western European countries during the 1996-2010 period, D'Amuri & Peri (2014) find that an inflow of immigrants generates a reallocation of natives to occupations with a stronger content of complex abilities. This reallocation is more salient in countries with low employment protection and for workers with low education levels. D'Amuri & Peri (2014) also show that this process remained significant—even if it slowed down—during the first years of the Great Recession.

The rest of the paper is structured as follows. Section 2 presents background information on the Italian labor market. Section 3 discusses our empirical methodology. Section 4 introduces the data. Section 5 presents the results. Section 6 concludes.

2 Background information on the Italian labor market

The Italian formal labor market has centralized collective bargaining institutions. After the abolishment of the automatic indexation of wages to past inflation (the so-called *scala mobile*) in 1992, Italy created a two-tier bargaining structure where wages are determined both at plant-level and industry-level/centralized negotiations. However, as Boeri (2014) documents, the percentage of firms relying on the two-tier bargaining decreased over time, down to less than 10 percent in 2006: employers in Italy prefer following the wages set by industry agreements, rather than through further negotiations at the plant level.

The Italian formal labor market is also characterized by relatively high levels of employment protection, and relatively low levels of both unemployment benefits and active labor market policies (such as training programs, job search assistance, counseling, etc.). According to the 2013 OECD indicators of employment protection, Italy ranks 30 out of the 34 OECD members in terms of protection of permanent workers against individual and collective dismissals, and 27 out of 34 in terms of regulation on temporary forms of employment.¹ These features make the Italian context different for instance from the flexicurity of Scandinavian countries. However, over the last decades, and similarly to other European countries, several reforms aimed at introducing various types of temporary contracts and increasing labor market

¹These indicators rank OECD members from countries with least restrictions to those with most restrictions.

flexibility.²

Importantly, Italy has a large informal labor market. Independently from the Great Recession, in the 2001-2013 period both left- and right-wing governments adopted several pieces of legislation to reduce informality. Nonetheless, these policies have not been particularly effective in tackling the issue of informal employment. In fact, according to recent estimates the Italian underground economy accounts for about 25 percent of the GDP (Orsi *et al.* (2014)). As Capasso & Jappelli (2013) describe, industries differ in terms of level of informality: measures of job informality are as high as 31 percent in the construction sector and 25 percent in the retail and tourism sectors and as low as 12 and 15 percent in financial and manufacturing ones, respectively. Capasso & Jappelli (2013) also document that informal labor markets are particularly well-developed in sectors with relatively low levels of competition and small firm sizes.

The large size of the informal labor market implies that immigrants who reside in Italy without a regular residence permit (we will refer to these as “undocumented” immigrants) have a relatively high probability to find a job. Given that they are not entitled to work in the formal sector, illegal immigrants might prefer to locate in countries like Italy with a large shadow economy. In terms of labor market outcomes, both documented and undocumented immigrants lag behind natives with similar levels of education. For instance, Accetturo & Infante (2010) show that returns to schooling for immigrants are much lower than the ones for native Italians. Moreover, immigrants residing in Italy are likely to work in occupations that are not appropriate to their level of education. As the OECD (2008) report suggests, one of the reasons why immigrants’ over-qualification occurs is that Italy is a relatively new immigration country. Given that an appropriate match between jobs and immigrants’ qualifications takes time—because for instance immigrants do not have well-developed professional networks in the host country or they lack complementary skills such as the knowledge of the host country language—upon arrival immigrant workers are likely to accept unskilled jobs with the hope of upward professional mobility as their stay in Italy continues.

3 Methodology

We use a difference-in-differences methodology. We evaluate the differences in behavior of wages in the formal and informal sectors before and after the crisis by estimating the following equation:

$$W_{iocpt} = \alpha Informal_i + \beta Crisis_t Informal_i + \gamma X_i + \delta_o + \delta_c + \delta_p + \delta_t + \varepsilon_{iocpt} \quad (1)$$

Here W is the logarithm of after-tax wage of a full-time employed worker i from country of origin c working in occupation o and residing in province p at the time of the interview t ($t = 2001, \dots, 2013$).³

²Examples of these reforms are the law no. 196/1997 (“Treu law”), decree law no. 368/2001, law no. 30/2003 (“Biagi law”) and law 78/2014 (“Poletti decree”). See Ichino & Riphahn (2005), Kugler & Pica (2008), Cappellari *et al.* (2012), Leonardi & Pica (2013), and Cingano *et al.* (2016) for works on the effects of changes in employment protection legislation. For empirical evidence on the consequences of temporary work employment on subsequent labor market outcomes, see Booth *et al.* (2002), Ichino *et al.* (2008), and Autor & Houseman (2010).

³Conditioning on full-time employment, the estimated coefficient of the interaction term does not include the differential effect of informality during the crisis through changes in labor supply. In Table 6 we show regressions where we use

We include dummy variables δ_o , δ_c , δ_p , and δ_t for occupations, countries of origin, provinces of residence and year fixed effects, respectively. Furthermore, control variables X_i include gender, age, age squared, years in Italy, education, married dummy, children abroad and children in Italy. We cluster the standard errors by province of residence, by low/high skilled occupation dummy and by before/after crisis dummy; we end up with 44 clusters (11 provinces times 2 types of occupations times 2 time periods).

Our main variables of interest are $Informal_i$ (dummy for employment in the informal sector) and $Crisis_t Informal_i$ — the interaction term of $Informal_i$ and $Crisis_t$. The latter is a dummy for years after 2009: $Crisis_t = \mathbf{1}(t \geq 2009)$.⁴ As the informal labor market is unregulated, we should expect $\beta < 0$ — during the crisis wages in the informal sector should adjust downward to a greater extent than wages in the regulated formal sector.

Following Donald & Lang (2007), we carry out a two-stage procedure as well, where in the first stage we regress wages on individual characteristics (gender, age, age squared, education, family status, children in Italy, children in the home country, years in Italy, dummies for country of origin and province of residence) controlling for pre-crisis occupation-specific linear trends. In the second stage, instead, we regress the residuals on informal sector dummy and $Crisis_t Informal_i$ interaction term (controlling for year dummies, occupation dummies, province dummies).

In order to understand what drives the wage adjustment or the lack thereof, we also investigate the heterogeneity of treatment effects. First, we distinguish between occupations where the minimum wage is likely to be binding and those where wages are safely above the minimum wage. For each profession we calculate the average pre-crisis wage in 2007 and divide it by the occupation-specific minimum wage. We then rank occupations by the ratio of average wage to minimum wage and check whether results differ for professions above and below the median of this ratio. More precisely, we estimate a difference-in-difference-in-differences specification similar to equation (1), including three additional interaction terms: the interaction of high average wage to minimum occupation dummy with crisis time dummy $Crisis_t High\ avg.\ wage/min.\ wage_o$, the interaction of high average wage to minimum occupation dummy with informal employment dummy $Informal_i High\ avg.\ wage/min.\ wage_o$, and the triple interaction $Crisis_t Informal_i High\ avg.\ wage/min.\ wage_o$. The coefficient of interest in these specifications is the one associated with the former interaction term. If the minimum wage prevents downward adjustment of wages in the formal sector, we should find a positive sign for $Crisis_t Informal_i High\ avg.\ wage/min.\ wage_o$, i.e. a stronger effect of the crisis on the wage differential between formal and informal employment for those occupations where wages before the crisis were not too far from the minimum wages.

We also distinguish between simple and complex occupations. Since simple occupations involve generic skills, there is a greater extent of substitutability between workers (including immigrant and native workers) within such occupations — as well as across such occupations. Therefore in the absence of regulation, such occupations should undergo a more substantial downward wage adjustment during recession. On

information on individuals who are employed on part-time basis.

⁴In section 5.1, we show that the crisis significantly affected labor market outcomes from 2009 onwards. However, we find qualitatively similar results, but smaller magnitudes, when we consider an alternative proxy for $Crisis$ using $Crisis_t = \mathbf{1}(t \geq 2008)$ (i.e., assuming that the crisis started a year before).

the other hand, in complex occupations, skills are more specific and workers are less substitutable. In these complex occupations even unregulated labor markets may not see large drops in wages in times of recession and high unemployment. To check this, in a specification similar to (1), we include three additional interaction terms: $Crisis_t Informal_i Simple\ occupations_o$, $Crisis_t Simple\ occupations_o$ and $Informal_i Simple\ occupations_o$. In this difference-in-difference-in-differences specification, the coefficient of $Crisis_t Informal_i$ allows to quantify the effect of the recession on the wage differential between formal (regulated) and informal (unregulated) employment for complex professions. We expect to find a stronger effect for simple rather than complex occupations, i.e. a negative sign of the coefficient of the variable $Crisis_t Informal_i Simple\ occupations_o$.

4 Data

Our main database comes from the annual survey of immigrants undertaken by an independent Italian non-profit organization called Foundation for Initiatives and Studies on Multi-Ethnicity (ISMU). This survey provides a large and representative sample of both documented and undocumented immigrants residing in Lombardy and working in both formal and informal sectors. The ISMU survey adopts an intercept point sampling methodology, where the first step involves listing a series of locations typically frequented by immigrants (such as religious sites, ethnic shops, or healthcare facilities), while in a second step both meeting points and migrants to interview are randomly selected. At each interview, migrants are asked how often they visit the other meeting points, which permits to compute ex-post selection probabilities into the sample. This approach allows the ISMU survey to produce a representative sample of the total immigrant population residing in Lombardy.⁵

Table A1 in the Appendix presents descriptive statistics on immigrants working in the formal sector (regular workers) and the informal sector (irregular workers) as well as on legal (documented) and illegal (undocumented) immigrants.⁶ Approximately 10 percent of legal immigrants work in the informal sector. The informal sector accounts for around 19 percent of the overall (documented and undocumented) foreign-born workforce.

In our main regressions we focus on full-time workers to abstract from changes in labor supply (we show robustness of our findings to including part-time employment as well). Specifically, we consider full-time employment the following categories of workers: full-time permanent and fixed-term regular workers, irregular workers in stable employment, regular self-employment, and irregular self-employment. Conversely, part-time employment includes the following three categories: regular part-time workers, irregular workers in unstable employment, and subaltern employment (e.g. collaborations). Adopting this classification, there are about 4,000 full-time-employed respondents in each year. Respondents also provide information about their occupation, country of origin, year of arrival to Italy, monthly earnings,

⁵See Fasani (2015) and Dustmann *et al.* (2016) for more detailed description of these data.

⁶Throughout the paper we refer to those employed in the formal sector as “regular workers” and those employed in the informal sector as “irregular workers”. Similarly, we use “illegal” and “undocumented” interchangeably to denote immigrants residing in Italy without a regular residence permit.

family status etc. Summary statistics are in Table A2 in the Appendix. Table A3 in the Appendix presents the breakdown of the sample by occupations, as well as formal and informal employment for each occupation. The table also includes average wages in the formal and informal sector and the minimum wage for each occupation.

There is no national minimum wage in Italy, despite Article 36 of the Constitution states that salaries must be high enough to provide a decent subsistence for the worker and his family. Instead in the highly centralized Italian system, minimum wages are set upon collective bargaining agreements between employers associations and trade unions. In particular, national collective contracts impose minimum salaries for employees at different skill levels in numerous economic activities, covering both unionized and non-unionized workers (Manacorda (2004)). We collect and reconstruct minimum wages from over 140 nationwide collective contracts in effect in 2007, just before the start of the crisis. We then aggregate minimum wages in order to match the professions included in the ISMU dataset (see Table A3 in Appendix). To our knowledge, there has been no previous study attempting to collect so many collective bargaining agreements and compute occupation-wide minimum wages for Italy.

In order to time the beginning of the recession, we use official macroeconomic data on Lombardy and its eleven provinces.⁷ Figure 2 plots quarterly data on unemployment rate in Lombardy at regional level for the period considered in the regression analysis (2001-2013). Clearly the increase in unemployment during the Great Recession started in at the beginning of 2009 in Lombardy. Figure 3 presents the evolution of unemployment rates in Lombardy’s provinces. This information disaggregated by province is available only since 2004. While there is substantial heterogeneity in levels and dynamics of unemployment, most provinces have experienced sharp increase in unemployment since 2009.

We adopt several definitions of simple versus complex occupations. Following Peri & Sparber (2009) and D’Amuri & Peri (2014), we exploit the US Department of Labor’s O*NET abilities survey to gain information on the abilities required by each occupation. This database estimates the importance of 52 employee’s skills required in each profession. We merge information from the ISMU survey with the O*NET values and select 23 O*NET variables which are believed to give a correct picture of simple/complex jobs (Peri & Sparber (2009) carry out a similar procedure). In particular, we distinguish between two types of skills: manual (or physical) skills represent limb, hand and finger dexterity, as well as body coordination, flexibility and strength; conversely, communication (or language) skills include oral and written comprehension and expression.

Once the 23 variables have been selected (see the Table A4 in the Appendix), we normalize them to [0,1] scale. Importantly, we invert the scale for the four communication skills (oral comprehension, written comprehension, oral expression, written expression) and then calculate the average of the 23 variables. The resulting index ranks the professions in the order of complexity where a profession with a high communication skill intensity is considered as “complex”, whilst high levels of manual skill intensity

⁷The province of Monza e della Brianza was officially created by splitting the north-eastern part from the province of Milan on May 12, 2004, and became fully functional after the provincial elections of June 7, 2009. For consistency with pre-2009 data, we consider the newly-created province of Monza e della Brianza as part of Milan province.

refer to “simple” jobs. Finally, we compute the median value for the index and distinguish between simple and complex occupations (i.e. jobs whose values are above the median are considered simple, and vice versa).

5 Results

5.1 Placebo tests

The identifying assumption of our difference-in-differences specification is that wages of workers in the formal and informal sectors would have to follow the same time trend in the absence of the Great Recession. If this parallel trends assumption holds, our empirical strategy allows to control for all unobserved differences between formal and informal workers that remain constant over time.

Figure 1 has already provided visual support to the main identifying hypothesis, showing that wages moved in parallel in formal and informal sectors before the recession. For further verification of the common trends assumption, we run several placebo tests. The rationale behind these checks is to use only data before the recession and create a placebo treatment that precedes the crisis. This exercise also allows to provide additional confirmation on the timing of the beginning of the crisis in Lombardy—2009 rather than 2008—a finding that is consistent with the evolution of unemployment over time in Figure 2.

In the first two columns of Table 1 we use data from 2001 to 2007. The placebo treatment variable *Placebo* is equal to 1 for the year 2007 in column 1 and for the years 2006 and 2007 in column 2. In the last three columns of Table 1 we use data from 2001 to 2008. The *Placebo* variable is equal to 1 for the year 2008 in column 3, for the years 2007 and 2008 in column 4, and for the years 2006, 2007 and 2008 in column 5.

Importantly, the estimation results in Table 1 also show the absence of an “Ashenfelter’s dip” (see Ashenfelter (1978)), that is the wage differential does not change just prior to the crisis, which would invalidate our measurement of the treatment effect. No estimated coefficient at the interaction term $Placebo_t Informal_i$ is statistically significant, providing additional confirmation to the validity of our identification strategy.

5.2 Main results

Our main results are presented in Table 2. The first column reports the estimation of specification (1), considering 2009 as the beginning of the crisis. Results are in line with our hypotheses: the wage differential between formal and informal sector is 15 percent before 2009, while it raises by 12 percentage points to 27 percent during the crisis (the difference is statistically significant).

In order to measure the wage differential between formal and informal sector in every year, in the second column we include interaction terms of the dummy for the informal sector with year dummies. Coefficients of these interaction terms are not significant before the crisis but become significant after the crisis. The wage differential increases by 6 percentage points in 2009 relative to 2008 (also not significant);

the wage differential grows to 11 percentage points in 2010, 14 percentage points in 2011, 15 percentage points in 2012, and 17 percentage points in 2013 (all statistically significant).

In the third column, we approximate the wage differential with piecewise-linear function of time allowing for a discontinuous shift at 2009 and a change in the slope afterwards. Once again, we find that in 2009 the wage differential between formal and informal sector increases by 6 percentage points and then increases by 2.5 percentage points every year. In the last column of Table 2 we assume that the crisis started in 2008 rather than in 2009. Results are qualitatively similar, but the magnitude of the coefficient of interest is smaller: a 9-percentage point increase in the wage differential between formal and informal workers during the crisis, which is smaller than the 12-percentage point increase in the main specification.

Controls are statistically significant and with the expected sign. Holding other things equal, women earn 17 percent less than men. The effect of age is positive and non-linear: an additional year increases earnings by 1 percent at the age of 18 but has negative effect after the age of 43; at the age of 55, an additional year of age decreases earnings by about 0.5 percent. Each year spent in Italy raises wages by 1.1 percent. Completion of compulsory school increases wages by 2.2 percent (relative to no schooling), higher education by another 5 percent. Such low returns to education are not surprising given that most immigrants are employed in low-skilled and middle-skilled jobs. Married workers earn wages that are 2 percent higher than those of other workers.

Table 3 reports the results of our two-stage procedure. We run regressions separately with and without sample weights. We also check whether the results are similar if we group the data into occupation-province cells (for each year and for formal and informal sector separately) or whether we use individual data (in the latter case we cluster standard errors by province, occupation, year and informal sector dummy). The results are similar. Before the crisis, the wage differential between formal and informal sector is 14-21 percent; after the crisis it increases by additional 12-15 percentage points.

As discussed in Section 3, in order to analyze the role of the minimum wage regulations, we estimate a difference-in-difference-in-differences specification similar to (1), but where we allow for a differential effect between occupations in which average wage in the formal sector is close to the occupation-specific minimum wage and occupations where average wage is substantially higher than the minimum wage. For each of the 18 occupations we calculate the average pre-crisis wage in 2007 (in the formal sector only) and divide it by minimum wage. Estimates in column 3 of Table 4 show that our findings do not differ according to whether this ratio is below or above the median (the coefficient at the interaction term $Crisis_t Informal_i High\ avg.\ wage/min.\ wage_o$ is not statistically different from zero). Therefore the minimum wage is not an important driver of our results. This finding is confirmed by the first two columns of Table 4 where we estimate our baseline specification for the subsample with high average-to-minimum wage ratios and for the subsample with low average-to-minimum wage ratios; the coefficient at the $Crisis*Informal$ interaction term is the same in the two regressions.

We also rank occupations according to complexity. As discussed in the Section 4 above, we refer to

occupations with high intensity of communications skills and low intensity of manual skills as “complex” and the others as “simple”.⁸

We also run two checks: the regressions for subsamples of simple and complex occupations (columns 4 and 5 of Table 4) and difference-in-difference-in-differences specification (column 6). We find that our main result is driven by simple occupations (where the effect is both large and statistically significant). In the subsample of complex occupations (column 5) the coefficient of the Crisis*Informal interaction term is not statistically significant. The results from the difference-in-difference-in-differences specification are similar. A possible reason for the larger downward wage adjustment during the recession in simple occupations is that they involve generic skills, which may imply a larger degree of substitutability between workers (including immigrant and native workers).

5.3 Selection

Our results are not biased as long as unobserved omitted differences between formal and informal workers remain constant over time. If this assumption holds, then—conditional on all control variables in our difference-in-differences specifications—immigrants do not self-select into informal work status depending on their unobserved characteristics, and therefore immigrants can be considered exogenously assigned to the treatment group. We illustrate this identifying assumption with an example. Suppose that workers choose between formal and informal jobs depending on some unobserved factors, such as their level of risk aversion. For instance, more risk-averse workers might be more likely to prefer employment in the formal sector. Our difference-in-differences estimates remain unbiased if differences in risk aversion between formal and informal workers remain similar before and after the crisis. To check whether our findings are due to changes that occurred after the crisis in the composition of the immigrant population with respect to their risk aversion, in Table 5 we show that results remain similar when control variables are added sequentially. We include observables such as gender, age and education, which are important correlates of the level of risk aversion, as previous literature shows (see for instance Barsky *et al.* (1997), Guiso & Paiella (2008), and Borghans *et al.* (2009)). Estimates of the interaction term of $Informal_i$ and $Crisis_t$ in Table 5 are remarkably similar across all specifications.

The table also reports a test in the spirit of Altonji *et al.* (2005).⁹ After estimating the equation using a restricted set of control variables—as in columns 1-5, where we choose to exclude observed variables that are good predictors of the unobserved risk aversion—denote the estimated coefficient of interest (i.e. the coefficient of the interaction term) as β_r . The value of the test is then calculated as the absolute value of $\beta_f/(\beta_r - \beta_f)$, where β_f is the coefficient of the interaction term in column 6 of Table 5, i.e. from the estimation that includes the full set of covariates. The median value of the test is 12: considering that age, gender and education are variables that are highly correlated with risk aversion—as previous literature shows—selection on unobserved risk aversion would have to be at least 12 times greater than

⁸The “simple” occupations include unskilled workers, building workers, farm workers, cleaners, craftsmen, and truck workers.

⁹See Bellows & Miguel (2009) and Nunn & Wantchekon (2011) for examples of works that use a similar test to assess the bias from unobservables using selection on observables.

selection on observables to attribute the entire difference-in-differences estimate to selection effects. This check provides some indirect confirmation that the *Crisis* dummy is orthogonal to the individuals' risk aversion, i.e. that the composition of formal and informal workers with respect to risk aversion remained very similar before and after the crisis, which is an important identifying assumption in our regressions.

Another potential source of selection is the effect of the Great Recession on return migration. However it is worth stressing that this effect would only strengthen our results. By definition, immigrants are the most mobile category of workers. If during the crisis the least successful informal workers are more likely to go back to their home country, then the coefficient of the interaction term in equation (1) would *underestimate* the true magnitude of the wage reduction for informal workers. To check whether this may represent an issue in our context, in Table A5 in the Appendix we run regressions similar to our main specification, except that we use the information we have on the immigrants' intentions to return to their origin country. More precisely, the dependent variable in these regressions is a dummy equal to 1 if the immigrant intends to return to her home country. This question is only available in the 2010, 2011, 2012 and 2013 waves of our survey. Therefore we focus on the coefficient of the *Informal_i* variable, while we cannot add the interaction term between the *Informal_i* dummy and the *Crisis_t* variable. Given that long permanence in host countries is likely to affect intentions to return (Yang, 2006), we investigate whether results from this check differ according to the length of stay in Italy: in column 1 of Table A5 there is no restriction on residence in the host country, column 2 includes individuals whose permanence in Italy is equal to or less than 30 years (as our benchmark regressions), 25 years in column 3, 20 years in column 4 and 15 years in column 5. In all specifications the coefficient of interest is not statistically significant. This finding suggests that selection into return migration does not represent an issue in our context.

5.4 Robustness checks

Our main results are obtained for the sample of documented and undocumented immigrants in full-time employment. Table 6 presents the first set of robustness checks. Column (1) excludes illegal immigrants. In column 2 we focus only on part-time workers, and in column 3 on both full-time and part-time employment simultaneously. Results are similar to our benchmark specification. Before 2009 documented immigrants in the informal sector appear to receive 23 percent lower wages than documented immigrants in the formal sector. The crisis, however, increases this gap up to 36 percent. The wage differential after the recession remains similar to the benchmark results when we consider part-time workers (-0.136, see column 2) or both part-time and full-time workers (-0.152, see column 3).

In our benchmark specifications we restrict the estimation sample to immigrants whose length of stay in Italy does not exceed 30 years. This choice is motivated by Figure A1, which shows that the distribution of permanence in Italy is much more skewed toward the left for informal workers. This restriction has aimed to ensure common support for the distributions of formal and informal workers. In columns 4-7 of Table 6 we show that our results remain very similar when we do not consider any restriction on length of

stay in Italy (column 4) or when we consider different maximum permanence durations: 25 years (column 5), 20 years (column 6) and 15 years (column 7). The results are similar across all specifications.

In Table 7 we present additional checks. In column (1) we estimate a specification similar to column (1) of Table 2, but we exclude the year 2002. This check is particularly meaningful because in 2002 there was a large immigrant regularization program that legalized about 700,000 immigrants residing in Italy without a regular residence permit. In column (2) of Table 7 we exclude the year 2005, while in column (3) we consider an estimation sample from 2006 to 2013 (rather than from 2001 to 2013 as in the benchmark regressions). Results are very similar across specifications.

In all specifications in Tables 6 and 7 we control for personal characteristics; we also add interaction terms of personal characteristics with the Crisis dummy thus allowing the returns to personal characteristics to vary before and after 2009. Coefficients at most of these interaction terms are not significant; the returns to personal characteristics — including age and education — do not change after 2009.¹⁰ The only exception is gender. The gender gap actually decreases by 3-4 percentage points after 2009.

5.5 Employment in the formal and informal sectors

Our results above describe only one channel of the labor market adjustment to the aggregate demand shocks, namely the decline in wages. A relevant question is whether this decrease in wages in the informal sector affects employment rates in both formal (regulated) and informal (unregulated) sector.

In Table 8 we present regressions where the dependent variables are employment in the formal sector (first two columns) or employment in the informal sector (last three columns). In the second and fourth columns we condition on labor force participation, while in the fifth column we condition on employment.

We report and discuss the coefficients of the year dummies (where 2008 is the omitted category). We find that for all specifications the coefficients at the year dummies are never significantly different from zero before the beginning of the recession. The first column of Table 8 shows that during the crisis the employment rate in the formal sector decreases by 2 percent in 2009, 4 percent in 2010, 12 percent in 2011, 15 percent in 2012 and 16 percent 2013 (relative to 2008). Results conditional on labor force participation (column 2) are similar except that the significant decrease in the employment rate in the formal sector starts in 2011.

Conversely, columns 3 and 4—the latter presenting estimates conditional on labor force participation—show that the employment rate in the informal sector does not fall (it actually *increases* by about 2 percent in 2012 and 2013, relative to 2008). With regard to the estimates that condition on employment, the last column of the table shows an increase in the informal employment rate by 3 percentage points in 2012 and 2013.

These results suggest that the immigrant labor market undergoes a multi-faceted adjustment. Notwithstanding the increase in unemployment rate documented by Figure 2, the large fall in informal wages during the crisis creates a reallocation from the formal (regulated) to the informal (unregulated) sector,

¹⁰We have also checked whether the coefficient at the Crisis*Informal interaction term depends on age. We have found no significant difference.

and also generates an increase in the employment rate in the latter sector.

6 Conclusions

In this paper we study the process of wage adjustment in formal and informal labor markets in Italy. We show that despite substantial growth of unemployment in 2009-13, wages in the regulated formal labor market have not adjusted. Conversely, wages in the unregulated informal labor market have declined dramatically. The wage differential between formal and informal market that has been relatively constant at 15 percent in 2001-08 has grown rapidly after 2009 and reached 32 percent in 2013. We show that the wage adjustment in the informal sector takes place along with a shift from formal to informal employment.

These results are consistent with the view that regulation is responsible for the lack of wage adjustment and increase in unemployment during the recessions. Our findings are based on data on immigrants rather than the general labor force. However, we also find that our results are more pronounced for individuals in simple jobs. These are the occupations with relatively easy substitutability between immigrants and natives. This allows us to speculate that our findings can be generalized for low-skilled natives as well.

While we do find that in unregulated labor markets wages adjust down during the recession, the 2009-13 period does not provide an exhaustive answer with regard to the speed and nature of this adjustment. Figure 1 and Table 2 show that wages in the informal sector continue to fall throughout the period. We cannot yet judge whether this continuing decrease in wages is the delayed response to the initial one-off shock or every subsequent decrease is a reaction to the next round of aggregate demand decline. In order to address this important question, we need to collect data on both formal and informal labor market for several years after the economy starts to recover.

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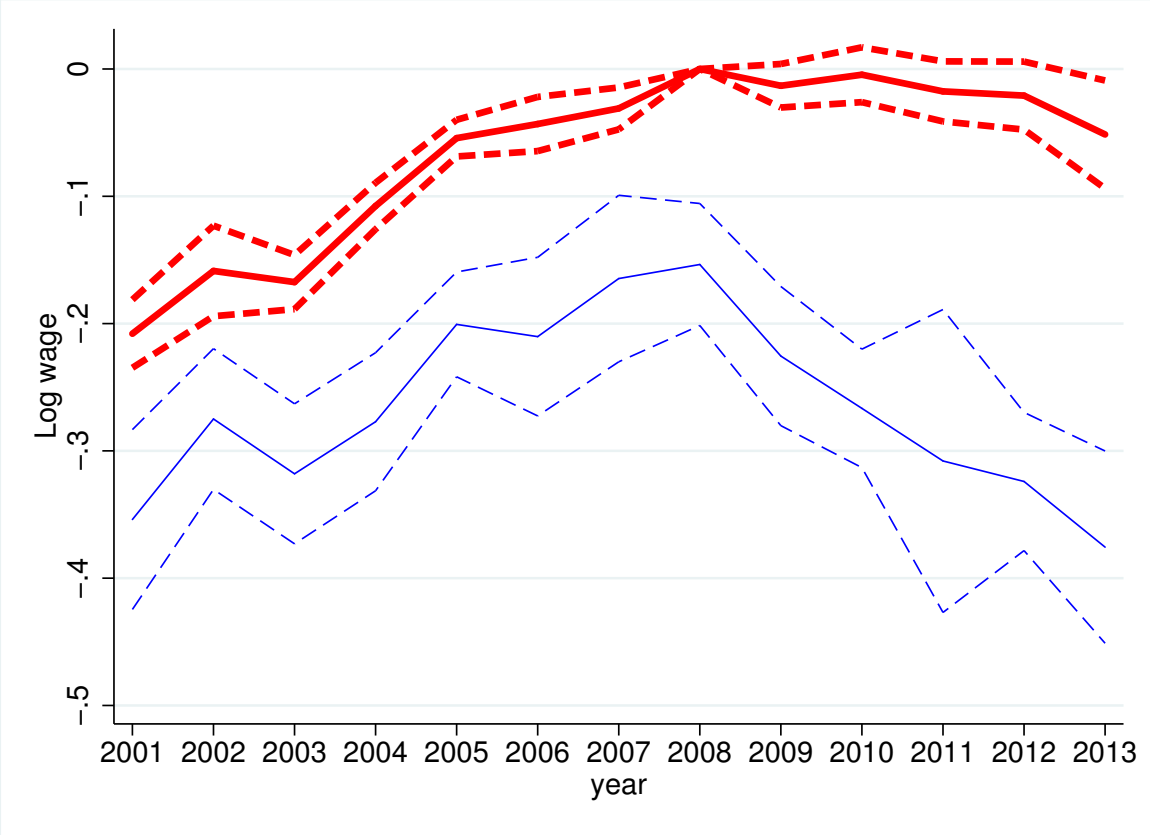
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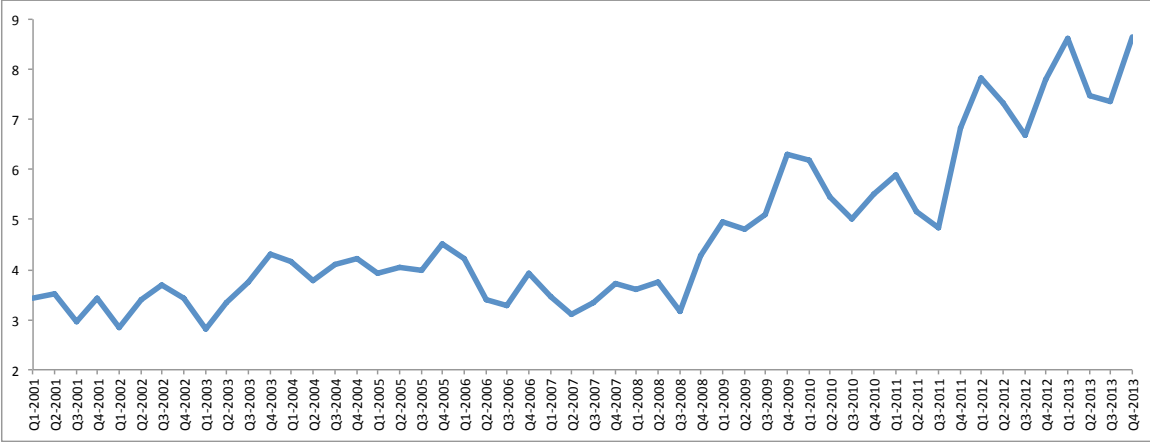
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Figure 1: Wages in formal and informal sector in Lombardy.



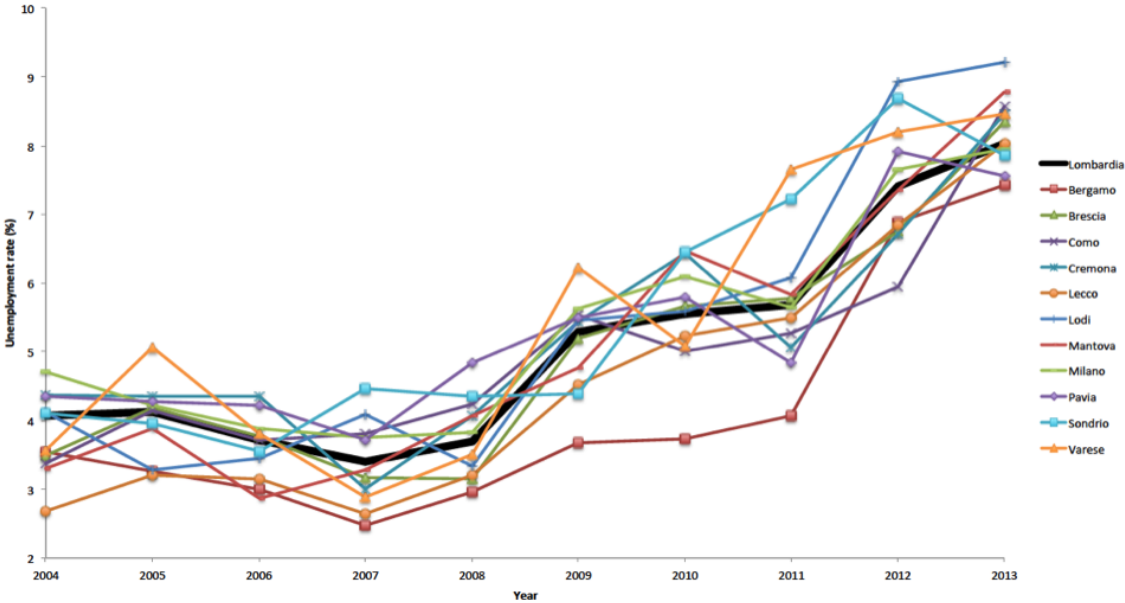
Logarithm of wages (relative to formal sector in 2008) controlling for sector of employment, gender, age, education, country of origin, family characteristics, occupation dummies, provinces of residence dummies. Thick red line: formal sector. Thin blue line: informal sector. Dashed lines: 95% confidence interval. Source: ISMU survey, authors' calculations.

Figure 2: Unemployment rate in Lombardy by quarters (2001-2013).



Source: ISTAT.

Figure 3: Unemployment by province within Lombardy.



Source: ISTAT.

Table 1: Timing the start of the crisis, verifying the validity of the difference-in-differences strategy and checking the absence of an “Ashenfelter’s dip”. Placebo tests.

Estimation sample	(1)	(2)	(3)	(4)	(5)
	2001-2007 Placebo=2007	2001-2007 Placebo \geq 2006	2001-2008 Placebo=2008	2001-2008 Placebo \geq 2007	2001-2008 Placebo \geq 2006
Placebo X Informal	0.0056 (0.043)	-0.017 (0.037)	-0.013 (0.033)	-0.0015 (0.034)	-0.015 (0.032)
Informal sector	-0.16*** (0.016)	-0.15*** (0.015)	-0.15*** (0.019)	-0.15*** (0.016)	-0.15*** (0.014)
Female	-0.17*** (0.016)	-0.17*** (0.017)	-0.17*** (0.011)	-0.17*** (0.015)	-0.17*** (0.016)
Age	1.32*** (0.41)	1.32*** (0.34)	1.48*** (0.41)	1.48*** (0.34)	1.48*** (0.27)
Age squared	-1.52*** (0.48)	-1.52*** (0.38)	-1.71*** (0.44)	-1.71*** (0.39)	-1.71*** (0.29)
Years in Italy	0.011*** (0.0011)	0.011*** (0.0011)	0.010*** (0.0012)	0.010*** (0.0011)	0.010*** (0.0010)
Compulsory school	0.015* (0.0080)	0.015 (0.011)	0.016** (0.0064)	0.016** (0.0071)	0.016* (0.0091)
High school	0.025* (0.012)	0.025** (0.0092)	0.024*** (0.0088)	0.024** (0.011)	0.024*** (0.0080)
Tertiary education	0.067*** (0.014)	0.066*** (0.011)	0.068*** (0.0089)	0.068*** (0.012)	0.068*** (0.0097)
Married	0.013* (0.0069)	0.013* (0.0070)	0.011 (0.0073)	0.011* (0.0062)	0.011* (0.0066)
Children abroad	-0.00091 (0.0017)	-0.00091 (0.0018)	-0.00098 (0.0023)	-0.00099 (0.0019)	-0.00099 (0.0020)
Children in Italy	0.0020 (0.0015)	0.0020 (0.0015)	0.0026 (0.0016)	0.0026 (0.0016)	0.0026 (0.0016)
Observations	28912	28912	33857	33857	33857
R^2	0.304	0.304	0.322	0.322	0.322

Notes: Robust standard errors in parentheses, clustered by province times simple occupations dummy times before/after crisis dummy. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Data are from the ISMU survey. We restrict the sample to immigrants with permanence in Italy equal to or less than 30 years. The sample includes full-time workers only. The dependent variable is the logarithm of after-tax wage. We use data before the crisis (2001-2007). The Placebo variable is equal to 1 for the year 2007 in column 1 and for the years 2006 and 2007 in column 2. The Placebo variable is equal to 1 for the year 2008 in column 3, for the years 2007 and 2008 in column 4, and for the years 2006, 2007 and 2008 in column 5.

Table 2: Wage differential between formal (regulated) and informal (unregulated) sector. Difference-in-differences estimations.

	(1) Crisis \geq 2009	(2) Crisis \geq 2009	(3) Crisis \geq 2009	(4) Crisis \geq 2008
Informal X Crisis	-0.119*** (0.0346)		-0.0590* (0.0344)	-0.0893*** (0.0218)
Informal	-0.145*** (0.0169)	-0.154*** (0.0245)	-0.150*** (0.0176)	-0.144*** (0.0170)
Informal X Year2001		0.00763 (0.0293)		
Informal X Year2002		0.0373 (0.0415)		
Informal X Year2003		0.00296 (0.0324)		
Informal X Year2004		-0.0159 (0.0312)		
Informal X Year2005		0.00727 (0.0201)		
Informal X Year2006		-0.0134 (0.0255)		
Informal X Year2007		0.0199 (0.0323)		
Informal X Year2009		-0.0588 (0.0362)		
Informal X Year2010		-0.109*** (0.0359)		
Informal X Year2011		-0.137** (0.0662)		
Informal X Year2012		-0.150*** (0.0357)		
Informal X Year2013		-0.171*** (0.0438)		
Informal X max{Year – 2009, 0}			-0.0248*** (0.00727)	
Female	-0.167*** (0.00816)	-0.167*** (0.00808)	-0.165*** (0.00801)	-0.167*** (0.00824)
Age	1.659*** (0.330)	1.649*** (0.329)	1.601*** (0.321)	1.658*** (0.334)
Age squared	-1.936*** (0.373)	-1.923*** (0.370)	-1.843*** (0.358)	-1.938*** (0.377)
Years in Italy	0.0103*** (0.00107)	0.0103*** (0.00109)	0.0103*** (0.00108)	0.0102*** (0.00107)
Compulsory school	0.0220*** (0.00740)	0.0220*** (0.00737)	0.0204*** (0.00750)	0.0216*** (0.00746)
High school	0.0327*** (0.00754)	0.0324*** (0.00755)	0.0319*** (0.00750)	0.0323*** (0.00758)
Tertiary education	0.0729*** (0.00818)	0.0728*** (0.00832)	0.0713*** (0.00800)	0.0729*** (0.00823)
Married	0.0167** (0.00765)	0.0168** (0.00764)	0.0146* (0.00802)	0.0164** (0.00762)
Children abroad	-0.00132 (0.00252)	-0.00133 (0.00250)	-0.00150 (0.00253)	-0.00125 (0.00251)
Children in Italy	0.00454** (0.00187)	0.00457** (0.00187)	0.00450** (0.00185)	0.00456** (0.00186)
Observations	49193	49193	49193	49193
R^2	0.333	0.333	0.342	0.332

Notes: Robust standard errors in parentheses, clustered by province times simple occupations dummy times before/after crisis dummy. All regressions include year dummies, occupation dummies, dummies for country of origin, province dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Data are from the ISMU survey (2001-2013). We restrict the sample to immigrants residing in Italy for at most 30 years. The sample includes full-time workers only. The dependent variable is the logarithm of after-tax wage.

Table 3: Wage differential between formal (regulated) and informal (unregulated) sector. Two-stage difference-in-differences estimation.

	Individual data		Province-occupation cells	
	Unweighted (1)	Weighted (2)	Unweighted (3)	Weighted (4)
Crisis X Informal	-0.12*** (0.025)	-0.15*** (0.041)	-0.15*** (0.037)	-0.14*** (0.042)
Informal	-0.16*** (0.012)	-0.21*** (0.021)	-0.18*** (0.017)	-0.14*** (0.020)
Observations	60322	60322	1960	1960
R^2	0.492	0.424	0.284	0.207

Notes: In the first stage, we estimate the relationship between the logarithm of after-tax wage and individual characteristics (gender, age, age squared, education, family status, children in Italy, children in the home country, years in Italy, pre-crisis linear trends, dummies for country of origin, occupation-specific pre-crisis time trends, province dummies). In the second stage, we regress the residuals on informal sector dummy and CrisisXInformal interaction term (controlling for year dummies, occupation dummies, province dummies). Robust standard errors in parentheses. In the first two columns, standard errors are clustered by province times occupation times year times informal sector dummy. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Data are from the ISMU survey (2001-2013). We restrict the sample to immigrants residing in Italy for at most 30 years. The sample includes full-time workers only.

Table 4: Heterogeneity of the impact of the crisis on the wage differential between formal (regulated) and informal (unregulated) sector. Difference-in-differences estimations.

	(1) Low avg./min.wage	(2) High avg./min.wage	(3) Full sample	(4) Simple	(5) Complex	(6) Full sample
Crisis X Informal	-0.11** (0.049)	-0.11*** (0.031)	-0.097*** (0.028)	-0.18*** (0.039)	-0.072 (0.050)	-0.078** (0.035)
Informal	-0.17*** (0.027)	-0.13*** (0.013)	-0.18*** (0.021)	-0.092*** (0.0077)	-0.18*** (0.026)	-0.17*** (0.016)
Crisis X Informal X X High avg./min.wage			-0.014 (0.043)			
Crisis X High avg./min.wage			-0.054*** (0.016)			
Informal X High avg./min.wage			0.048** (0.023)			
Crisis X Informal X X Simple occupations						-0.095* (0.050)
Crisis X Simple occupations						0.013 (0.018)
Informal X Simple occupations						0.054*** (0.021)
Female	-0.16*** (0.0076)	-0.18*** (0.027)	-0.17*** (0.011)	-0.17*** (0.016)	-0.15*** (0.0084)	-0.17*** (0.011)
Age	1.52*** (0.23)	1.74*** (0.44)	1.64*** (0.26)	1.21*** (0.29)	2.23*** (0.31)	1.67*** (0.26)
Age squared	-1.70*** (0.30)	-2.07*** (0.50)	-1.91*** (0.31)	-1.53*** (0.35)	-2.55*** (0.38)	-1.95*** (0.31)
Years in Italy	0.010*** (0.00057)	0.010*** (0.0021)	0.010*** (0.00095)	0.013*** (0.00083)	0.0074*** (0.00069)	0.010*** (0.00095)
Compulsory school	0.015 (0.011)	0.027** (0.012)	0.021*** (0.0080)	0.025*** (0.0085)	0.014 (0.012)	0.021*** (0.0081)
High school	0.026** (0.010)	0.036*** (0.011)	0.032*** (0.0086)	0.041*** (0.0096)	0.023** (0.0091)	0.032*** (0.0085)
Tertiary education	0.075*** (0.013)	0.069*** (0.010)	0.073*** (0.0096)	0.057*** (0.010)	0.076*** (0.010)	0.072*** (0.0095)
Married	0.020*** (0.0059)	0.0087 (0.015)	0.015** (0.0073)	0.044*** (0.0065)	-0.0099* (0.0054)	0.017** (0.0074)
Children abroad	-0.0024 (0.0027)	0.00097 (0.0042)	-0.0013 (0.0018)	-0.0020 (0.0041)	0.0024 (0.0032)	-0.0013 (0.0019)
Children in Italy	0.0043 (0.0029)	0.0048*** (0.0015)	0.0045*** (0.0016)	0.0078** (0.0036)	0.0013 (0.0015)	0.0046*** (0.0017)
Observations	26755	22438	49193	28356	20837	49193
R^2	0.300	0.374	0.335	0.311	0.317	0.333

Notes: Robust standard errors in parentheses, clustered by province times simple occupations dummy times before/after crisis dummy in subsamples, by province times occupation in columns 3 and 6. All regressions include year dummies, occupation dummies, dummies for country of origin, province dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Data are from the ISMU survey (2001-2013). We restrict the sample to immigrants residing in Italy for at most 30 years. The sample includes full-time workers only. The dependent variable is the logarithm of after-tax wage.

Table 5: Wage differential between formal (regulated) and informal (unregulated) sector. Difference-in-differences estimation. Regressions with gradual inclusion of control variables. Altonji et al.'s (2005) test.

	(1)	(2)	(3)	(4)	(5)	(6)
Crisis X Informal	-0.081** (0.033)	-0.085*** (0.030)	-0.088*** (0.033)	-0.077** (0.033)	-0.088*** (0.030)	-0.093*** (0.028)
Informal	-0.21*** (0.016)	-0.20*** (0.016)	-0.18*** (0.016)	-0.20*** (0.016)	-0.18*** (0.015)	-0.15*** (0.018)
Female		yes			yes	yes
Age			yes		yes	yes
Age squared			yes		yes	yes
Years in Italy						yes
Compulsory school				yes	yes	yes
High school				yes	yes	yes
Tertiary education				yes	yes	yes
Married						yes
Children abroad						yes
Children in Italy						yes
Altonji test	7.75	11.63	18.60	5.81	18.60	
Observations	49193	49193	49193	49193	49193	49193
R^2	0.282	0.306	0.302	0.285	0.327	0.344

Notes: Robust standard errors in parentheses, clustered by province times simple occupations dummy times before/after crisis dummy in subsamples, by province times occupation in columns 3 and 6. All regressions include year dummies, occupation dummies, dummies for country of origin, province dummies. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Data are from the ISMU survey (2001-2013). We restrict the sample to immigrants with permanence in Italy equal to or less than 30 years. The sample includes full-time workers only. The dependent variable is the logarithm of after-tax wage. In columns 1-5, we exclude observed variables that are good predictors of the unobserved risk aversion. We denote the estimated coefficient of interest (i.e. the coefficient of the interaction term) in these specifications as β_r . The value of the Altonji et al.'s (2005) test is then calculated as the absolute value of $\beta_f/(\beta_r - \beta_f)$, where β_f is the coefficient of the interaction term in column 6, i.e. from the estimation that includes the full set of covariates. Whenever covariates are included, we also include their interaction with the "after crisis" dummy.

Table 6: Wage differential between formal (regulated) and informal (unregulated) sector. Difference-in-differences estimation. Robustness checks.

Estimation sample	(1) Legal migrants	(2) Part-time workers	(3) Part-time + Full-time w.	(4) No restriction Years in Italy	(5) Years in Italy ≤ 25	(6) Years in Italy ≤ 20	(7) Years in Italy ≤ 15
Crisis X Informal	-0.0968** (0.0432)	-0.119*** (0.0347)	-0.115*** (0.0249)	-0.0696** (0.0282)	-0.0908*** (0.0283)	-0.0875*** (0.0295)	-0.0823*** (0.0295)
Informal	-0.214*** (0.0328)	-0.198*** (0.0221)	-0.212*** (0.0110)	-0.174*** (0.0174)	-0.149*** (0.0177)	-0.148*** (0.0182)	-0.144*** (0.0179)
Personal characteristics	yes	yes	yes	yes	yes	yes	yes
Crisis X Personal characteristics	yes	yes	yes	yes	yes	yes	yes
Year dummies	yes	yes	yes	yes	yes	yes	yes
Occupation-specific trends	yes	yes	yes	yes	yes	yes	yes
Province dummies	yes	yes	yes	yes	yes	yes	yes
Country of origin dummies	yes	yes	yes	yes	yes	yes	yes
Observations	42,700	10,245	59,438	49,285	48,918	47,838	44,129
R-squared	0.341	0.231	0.346	0.337	0.343	0.338	0.333

Notes: Robust standard errors in parentheses, clustered by province, simple occupations dummy, crisis dummy. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Data are from the ISMU survey (2001-2013). In the first three columns, we restrict the sample to immigrants with permanence in Italy equal to or less than 30 years. The dependent variable is the logarithm of after-tax wage.

Table 7: Wage differential between formal (regulated) and informal (unregulated) sector. Difference-in-differences estimation. Robustness checks.

	(1) 2001-2013 except year 2002	(2) 2001-2013 except year 2005	(3) 2006-2013
Crisis X Informal	-0.0921*** (0.0285)	-0.0928*** (0.0281)	-0.0944*** (0.0305)
Informal	-0.151*** (0.0192)	-0.150*** (0.0180)	-0.146*** (0.0216)
Female	-0.174*** (0.0108)	-0.176*** (0.0111)	-0.189*** (0.0128)
Age	1.539*** (0.310)	1.609*** (0.396)	1.717*** (0.369)
Age squared	-1.800*** (0.331)	-1.891*** (0.406)	-1.945*** (0.371)
Years in Italy	0.0107*** (0.00104)	0.0103*** (0.00158)	0.00967*** (0.00140)
Married	0.0130* (0.00763)	0.00496 (0.00850)	0.0121 (0.0127)
Children abroad	-0.000539 (0.00241)	-0.000276 (0.00333)	-0.000127 (0.00315)
Children Italy	0.00259 (0.00171)	0.00482 (0.00344)	0.00342 (0.00353)
Compulsory school	0.0126* (0.00671)	0.00476 (0.00696)	0.0115 (0.0128)
Superior school	0.0245*** (0.00745)	0.0120 (0.00872)	0.0276*** (0.00747)
University	0.0644*** (0.00876)	0.0577*** (0.00931)	0.0730*** (0.0107)
Crisis X female	0.0311** (0.0149)	0.0329** (0.0152)	0.0371** (0.0164)
Crisis X age	0.00199 (0.00565)	0.00122 (0.00609)	0.000129 (0.00604)
Crisis X age squared	-2.42e-05 (6.64e-05)	-1.44e-05 (6.99e-05)	-1.27e-05 (6.85e-05)
Crisis X years in Italy	-0.00160 (0.00157)	-0.00123 (0.00191)	-0.000436 (0.00185)
Crisis X married	-0.000802 (0.0177)	0.00738 (0.0181)	0.00124 (0.0204)
Crisis X children abroad	0.00353 (0.00430)	0.00345 (0.00489)	0.00253 (0.00500)
Crisis X children in Italy	0.0258*** (0.00499)	0.0235*** (0.00582)	0.0261*** (0.00573)
Crisis X compulsory school	0.0393 (0.0267)	0.0483* (0.0267)	0.0358 (0.0288)
Crisis X superior school	0.0469* (0.0249)	0.0611** (0.0255)	0.0368 (0.0254)
Crisis X university	0.0412 (0.0252)	0.0503* (0.0257)	0.0241 (0.0266)
Year dummies	yes	yes	yes
Occupation-specific trends	yes	yes	yes
Province dummies	yes	yes	yes
Country of origin dummies	yes	yes	yes
Observations	45,098	45,452	29,977
R-squared	0.343	0.346	0.324

Notes: Robust standard errors in parentheses, clustered by province, simple occupation dummy, Crisis dummy. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Data are from the ISMU survey (2001-2013). We restrict the sample to immigrants with permanence in Italy equal to or less than 30 years. The sample includes full-time workers only. The dependent variable is the logarithm of after-tax wage.

Table 8: Employment in the formal (regulated) and informal (unregulated) sector.

	(1) Employment in formal sector	(2) Employment in formal sector	(3) Employment in informal sector	(4) Employment in informal sector	(5) Employment in informal sector
Year2001	-0.0197 (0.0168)	-0.0104 (0.0143)	0.00838 (0.0144)	0.0108 (0.0147)	0.0107 (0.0147)
Year2002	-0.000447 (0.0151)	-0.00118 (0.0155)	0.00480 (0.0158)	0.00510 (0.0159)	0.00467 (0.0158)
Year2003	-0.00467 (0.00635)	0.00131 (0.00641)	-0.000361 (0.00646)	0.000636 (0.00635)	0.000343 (0.00637)
Year2004	0.00902 (0.0103)	0.00758 (0.0105)	-0.00886 (0.0109)	-0.00906 (0.0109)	-0.00912 (0.0109)
Year2005	0.0133* (0.00728)	0.00992 (0.00688)	-0.00821 (0.00647)	-0.00864 (0.00654)	-0.00876 (0.00657)
Year2006	-0.00722 (0.00799)	-0.00731 (0.00936)	0.00762 (0.00951)	0.00762 (0.00943)	0.00766 (0.00944)
Year2007	-0.00944 (0.0159)	-0.0150 (0.0153)	0.0155 (0.0154)	0.0148 (0.0156)	0.0148 (0.0155)
Year2009	-0.0275*** (0.00882)	-0.00902 (0.00969)	0.00625 (0.00952)	0.00845 (0.00921)	0.00852 (0.00927)
Year2010	-0.0351*** (0.00943)	-0.0145 (0.0101)	0.00953 (0.0101)	0.0124 (0.0100)	0.0129 (0.00995)
Year2011	-0.115*** (0.0198)	-0.0983*** (0.0214)	0.00570 (0.0175)	0.00789 (0.0176)	0.0177 (0.0191)
Year2012	-0.147*** (0.0154)	-0.136*** (0.0146)	0.0175* (0.00989)	0.0195* (0.00998)	0.0328*** (0.0109)
Year2013	-0.160*** (0.0256)	-0.149*** (0.0262)	0.0165 (0.0122)	0.0186 (0.0121)	0.0315** (0.0150)
Female	-0.0434*** (0.00577)	-0.0435*** (0.00479)	0.0379*** (0.00482)	0.0386*** (0.00506)	0.0397*** (0.00510)
Age	2.383*** (0.403)	1.246*** (0.236)	-0.790*** (0.223)	-0.966*** (0.241)	-1.024*** (0.245)
Age squared	-2.774*** (0.444)	-1.526*** (0.278)	0.958*** (0.276)	1.157*** (0.293)	1.235*** (0.296)
Years in Italy	0.00335*** (0.000844)	0.00455*** (0.000731)	-0.00383*** (0.000622)	-0.00375*** (0.000630)	-0.00399*** (0.000648)
Married	-0.00272 (0.00574)	-0.00868 (0.00630)	0.00348 (0.00561)	0.00306 (0.00568)	0.00374 (0.00581)
Children abroad	-0.00330*** (0.00113)	-0.00249** (0.00114)	0.00215* (0.00118)	0.00226* (0.00118)	0.00235* (0.00118)
Children Italy	-0.00321** (0.00146)	-0.00282* (0.00147)	0.00311** (0.00139)	0.00320** (0.00139)	0.00322** (0.00141)
Compulsory school	0.0273*** (0.00602)	0.0271*** (0.00617)	-0.0267*** (0.00629)	-0.0265*** (0.00625)	-0.0273*** (0.00643)
Superior school	0.0279*** (0.00669)	0.0355*** (0.00730)	-0.0331*** (0.00680)	-0.0318*** (0.00671)	-0.0329*** (0.00696)
University	0.0385*** (0.00760)	0.0514*** (0.00699)	-0.0536*** (0.00691)	-0.0522*** (0.00692)	-0.0533*** (0.00718)
Year dummies	yes	yes	yes	yes	yes
Occupation dummies	yes	yes	yes	yes	yes
Province dummies	yes	yes	yes	yes	yes
Country of origin dummies	yes	yes	yes	yes	yes
Observations	57,061	56,208	57,061	56,208	54,945
R-squared	0.103	0.094	0.083	0.085	0.088

Notes: Robust standard errors in parentheses, clustered by province, simple occupation dummy, Crisis dummy. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Sample is limited to documented migrants. Estimates in columns 2 and 4 are conditional on labor force participation. The specification in column 5 is conditional on employment.

Table A1: Irregular workers by legal status and gender

	Legal migrants	Illegal migrants	Male	Female
Regular workers	41,097	114	26,067	15,208
Irregular workers	4,764	4,919	5,335	4,367
Total	45,861	5,033	31,402	19,575

Table A2: Summary statistics.

Variable	Mean	Standard Deviation
Log earnings	6.89	0.43
Labor force participation	0.86	0.35
Employment	0.76	0.43
Unemployment	0.10	0.30
Illegal	0.10	0.30
Female	0.45	0.50
Age	33.9	9.1
Years in Italy	7.06	4.38
Married	0.56	0.50
Children abroad	0.38	2.33
Children in Italy	0.93	4.23
Compulsory school	0.37	0.48
Superior school	0.41	0.49
University	0.14	0.35

Notes: Log(earnings) are the net monthly wages as provided directly by the interviewed. Illegal is a dummy being 1 if the migrant reports having no residence permit. Data source: ISMU survey data, 2004-2012.

Table A3: Number of workers by occupation and monthly wages.

	Regular workers	Irregular workers	Total	Minimum wage	Average wage regular	Average wage irregular			
Unskilled workers	8 063	16.3%	523	1.1%	8 586	17.4%	958	1 125	1 025
Skilled workers	1 680	3.4%	155	0.3%	1 835	3.7%	1 218	1 345	1 250
Building workers	3 535	7.2%	968	2.0%	4 503	9.1%	1 129	1 343	1 099
Farm workers	2 707	5.5%	898	1.8%	3 605	7.3%	948	1 210	966
Cleaners	1 723	3.5%	417	0.8%	2 140	4.3%	1 088	981	800
Warehouse custody workers	1 624	3.3%	258	0.5%	1 882	3.8%	1 022	1 128	902
Clerical workers	910	1.8%	45	0.1%	955	1.9%	1 020	1 125	821
Sales workers	1 332	2.7%	250	0.5%	1 582	3.2%	983	1 122	832
Trade workers	1 618	3.3%	897	1.8%	2 515	5.1%	946	1 526	757
Food and beverage workers	4 322	8.8%	767	1.6%	5 089	10.3%	1 056	1 152	903
Craftsmen	2 495	5.1%	613	1.2%	3 108	6.3%	916	1 365	1 053
Truck workers	1 284	2.6%	135	0.3%	1 419	2.9%	1 095	1 494	1 295
House helpers (FT)	1 388	2.8%	666	1.3%	2 054	4.2%	590	898	906
Home-based caregivers	1 969	4.0%	738	1.5%	2 707	5.5%	590	878	809
Baby sitters	474	1.0%	143	0.3%	617	1.2%	590	939	719
Social assistance operators	897	1.8%	27	0.1%	924	1.9%	1 043	1 098	833
Medical and paramedical	878	1.8%	75	0.2%	953	1.9%	1 296	1 439	
Intellectual professions	735	1.5%	131	0.3%	866	1.8%	1 081	1 561	807
Sex workers	2	0.0%	28	0.1%	30	0.1%		3 000	2 500
Sport workers	19	0.0%	3	0.0%	22	0.0%		1 000	
Other workers	557	1.1%	240	0.5%	797	1.6%		1 310	2 200
Total	40 031	81.1%	9 355	18.9%	49 386	100.0%		1 250	938

Notes: Wages are in euros per months, calculated only for the full-time workers.

Table A4: Skill types and variables from O*NET

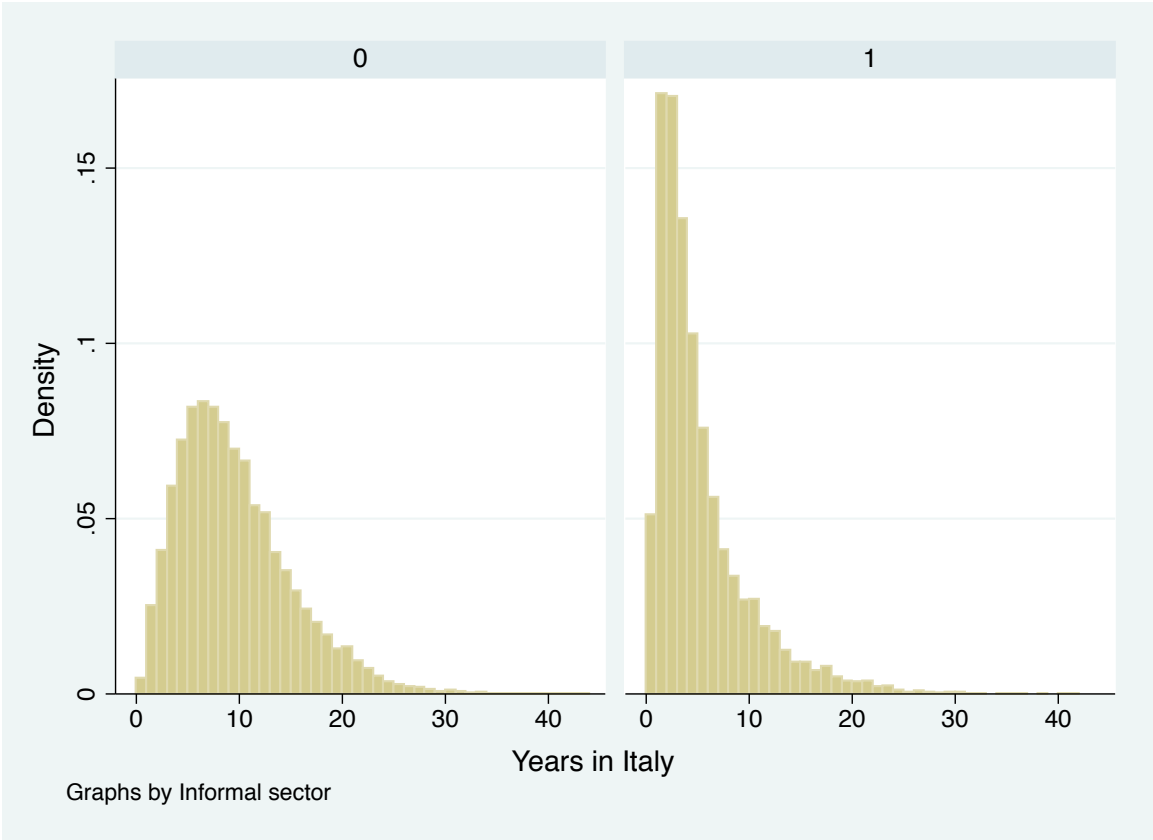
Type of skill	Skill sub-type	O*NET variables
Manual	Limb, hand and finger dexterity	Arm-hand steadiness Manual dexterity Finger dexterity Control precision Multilimb coordination Response orientation Rate control Reaction time Wrist-finger speed Speed of limb movement Extent flexibility
	Body coordination and flexibility	Extent flexibility Dynamic flexibility Gross body coordination Gross body equilibrium Explosive strenght Dynamic strength Trunk strenght Stamina
Communication	Oral	Oral comprehension Oral expression
	Written	Written comprehension Written expression

Table A5: Intentions to return to the origin country

Dependent variable:	(1)	(2)	(3)	(4)	(5)
	Intentions to return to the origin country	Intentions to return to the origin country	Intentions to return to the origin country	Intentions to return to the origin country	Intentions to return to the origin country
Informal	0.0207 (0.0164)	0.0211 (0.0166)	0.0213 (0.0166)	0.0190 (0.0186)	0.0178 (0.0196)
Female	0.00994 (0.00782)	0.0102 (0.00784)	0.0105 (0.00800)	0.0125 (0.00874)	0.0154 (0.00994)
Age	-0.00148 (0.00218)	-0.000978 (0.00232)	-0.00113 (0.00226)	-0.00152 (0.00242)	-0.00207 (0.00253)
Age squared	3.21e-05 (3.07e-05)	2.53e-05 (3.19e-05)	2.71e-05 (3.15e-05)	3.41e-05 (3.30e-05)	4.41e-05 (3.47e-05)
Years in Italy	-0.000541 (0.000621)	-0.000603 (0.000676)	-0.000453 (0.000679)	-0.000660 (0.000766)	-0.000232 (0.000795)
Married	-0.00205 (0.00578)	-0.00238 (0.00556)	-0.00228 (0.00552)	-0.00241 (0.00521)	-0.00278 (0.00552)
Children abroad	0.0104*** (0.00178)	0.0105*** (0.00179)	0.0105*** (0.00192)	0.00902** (0.00308)	0.00688* (0.00365)
Children in Italy	-0.00743 (0.00504)	-0.00729 (0.00485)	-0.00743 (0.00503)	-0.00864 (0.00525)	-0.0109** (0.00485)
Compulsory school	-0.0398** (0.0136)	-0.0383** (0.0144)	-0.0376** (0.0135)	-0.0324** (0.0142)	-0.0389** (0.0158)
High school	-0.0427** (0.0140)	-0.0412** (0.0151)	-0.0410** (0.0141)	-0.0351** (0.0152)	-0.0415** (0.0175)
Tertiary education	-0.0476** (0.0178)	-0.0475** (0.0193)	-0.0470** (0.0189)	-0.0437* (0.0234)	-0.0505* (0.0272)
Year dummies	yes	yes	yes	yes	yes
Occupation dummies	yes	yes	yes	yes	yes
Province dummies	yes	yes	yes	yes	yes
Country of origin dummies	yes	yes	yes	yes	yes
Observations	11,477	11,422	11,285	10,570	9,285
R-squared	0.047	0.047	0.047	0.048	0.051

Notes: Robust standard errors in parentheses, clustered by province. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Estimation sample of column 1: no restriction on immigrant's permanence in Italy. Column 2: we restrict the sample to immigrants with permanence in Italy equal to or less than 30 years. Column 3: permanence in Italy equal to or less than 25 years. Column 4: permanence in Italy equal to or less than 20 years. Column 5: permanence in Italy equal to or less than 15 years. Data are from the ISMU survey. The information on the intentions to return to the origin country is available for the years 2010-2013.

Figure A1: Informal employment and permanence in the host country: Density of years in Italy by formal (0) and informal (1) workers.



Source: ISMU survey (2001-2013)