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The More the Gloomier: development of informal employment and its effect on wages in Turkey

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The More the Gloomier: development of informal employment and its effect on wages in Turkey

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Abstract

Various studies found wage gaps between formal and informal sector workers even after controlling for a number of individual and firm level characteristics. It has also been shown that earnings differentials across these sectors are quite stable over the years. While there is limited amount of research considering the same issues focusing on Turkish labor market, the development of wage gap between formal and informal employment has not been examined. In our paper, we carry this analysis for Turkey and estimate the wage gap between formal and informal sector workers by utilizing the Household Labor Force Survey (LFS) for the period of 2005 and 2019. There are three main findings; first, decline in informal employment is not uniform and especially after 2012 there is a slight increase in the share of informal jobs at the lower end of wage distribution. Second, we demonstrate that returns to informality vary significantly across quantiles even after a matching technique through inverse probability treatment weights are considered. While at the upper end of the distribution, the penalty is extremely small and stable over the years, at the bottom end, the informal sector considerably reduces wages, and the effect becomes larger over time. The negative and increasing penalty is observable well before the refugee inflows. The last part of our analysis looks at the occupational composition within formal and informal sectors over time and points out that the rise of white collar low skilled service (WCLS) jobs among informal employment is mainly responsible for the increasing wage gap for the workers at the bottom end.

JEL Classification: J31, C31, O17, J46

Keywords: wage gap, quantile regression, informal sector, compensation, skills, occupation

1. Introduction

One of the common features of labor markets in developing countries is the considerable size of the informal sector employment. According to the World Employment and Social Outlook Report, 61% of all jobs in the world are informal, and informality among wage and salaried workers is nearly 40% (ILO, 2021). Beside its substantial volume, it is also observed that the informal sector is persistent in the developing world. In low-income countries, the change in informal employment between 1994 and 2019 was merely 4.1% (ILO, 2021). Similarly, in Turkey, informal employment is a significant source of income for a considerable number of people. As of 2019, 3.5 million workers were employed in the informal sector, and if one considers all the household members of these workers, more than 10 million are dependent on the wages of those workers employed informally.

Traditionally, the informal sector has been seen as inferior compared to the formal sector in terms of wages, security and protection from exploitation regarding labour standards. For instance, as the informal sector is free of regulation, wage offers can be below the minimum wage level, the standards regarding age, length and time of working hours can be ignored, and workers may have to work in risky environments with unsafe equipment. Moreover, employment benefits such as social security and compensation do not apply to informal employment due to its unrecorded nature. Hence, job seekers are more likely to prefer working in the formal sector as these jobs offer better non-material benefits as well as higher wages on average. Given the shortage of formal jobs they may end up supplying their labor in the informal sector. On the other hand, informal employment can be a desirable alternative based on people's rational evaluation of the relative costs and benefits of entering the formal system (De Soto, 1989). Given their characteristics, people may voluntarily choose informal employment if they think that they have a comparative advantage in the informal sector. Thus, for some workers informality may even be a better option as they can evade formal costs of employment such as employment taxes and social security contributions. In more recent studies, heterogeneity of informal jobs is commonly acknowledged where the lower tier employees have only constrained choice and the upper tier employees voluntarily select into these positions (Fields, 2005; Maloney, 2004).

Overall, the relationship between informal sector jobs and wages are an empirically open question given the contrasting theoretical expectations. The first goal of our paper is to analyze the existence of wage gaps between formal and informal employees in Turkey, and how these differ along the distribution. Since selection into the informal sector might not be random, we

construct IPTW (Inverse Probability of Treatment Weights) to generate pseudo-populations to compare the earnings of formal and informal workers only with comparable characteristics. Then, we estimate unconditional quantile regressions to identify the potentially distinct effects of informality on low/high paid workers. Our second goal is to explore the development of formal-informal sector wage differences over the years. To our knowledge, there are no studies discussing the changes in the pay gap in Turkey despite the relatively large and uneven reductions in informal employment since the mid-2000s.

We argue that the decrease in the size of unregistered work might have opposing consequences for wage determination. If the informal employees become scarcer the earnings could go up, however, if high productivity and voluntary workers move due to the smaller size of the sector, there can be more pressure on the wages of bottom earners. Moreover, the decline in informal employment did not occur evenly across occupations. The share of the informal sector among white collar low skill (WCLS) jobs went down at a much slower pace than the other occupational categories. Consequently, the informal sector in Turkey has become predominantly a sector hosting more and more low skilled workers in the service sectors. Our findings support these propositions. There is a substantial informal sector wage penalty in Turkey, which is not uniformly distributed. Informality reduces the earnings for the bottom quantile and the negative effect has gone up from over the years. Contrarily, informal sector workers at the highest quantile do not suffer any declines in their wages, and the effect got even smaller. The uneven development of informal employment and different occupational compositions across sectors are responsible for the diverse outcomes.

2. Related Literature

There are two main strands of views on the informal sector, exclusion and exit. These views also generally map into the structuralist and the neoclassical frameworks, respectively. The first view argues that informal sector employment is a residual category. The rationed workers from the formal sector have no other options but to be employed in the informal sector. Hence, lack of enough jobs in the formal sector pushes individuals to seek employment in the subsistence economy. Once the country develops and the formal sector is able to provide jobs to everyone, informality is assumed to be disappearing (Perry et al., 2007). In this view, people unwillingly work in the informal sector given the poor labor conditions and greater insecurity. The second view on the other hand claims that the choice of informal sector employment is voluntary given the preferences, endowment, technology, and labor market institutions. This

approach stresses the voluntary nature of informality and affirms that owners of micro-entrepreneurs choose the sector in order to function outside of the regulatory framework (de Soto, 1989). These two models have distinct expectations about the socio-economic consequences of informality. While the exclusion view argues that wages and working conditions in the formal sector is superior, the exit view suggests that the informal sector can offer higher earnings and benefits to its participants.

Fields (2005) and Maloney (2004) argue that the different segments of the informal sector exhibit different properties. They assert that, in the “upper-tier” segment, or the “voluntary” segment as Maloney (2004) puts it, given their individual characteristics, workers voluntarily choose the informal sector expecting relatively high earnings. On the other hand, the “lower-tier” or the “involuntary” segment is seen as the last resort of employment by the workers who are rationed out from the formal sector. Both the existence and consequences of diversity in the informal work have been documented, yet there is no agreement on the degree of wage gap across sectors and criteria to distinguish the informal segments (Chen, 2012; De Vreyer and Roubaud, 2013; Kanbur, 2017).

Similar to the theoretical debates, the empirical research is also not clear if there is a positive wage gap between formal and informal employees. In El Salvador and Peru, sizable wage premiums are found for the formal sector workers, but the opposite result has been obtained for Mexico (Marcouiller et al., 1997). Various other studies also documented conflicting findings where formal-informal wage difference changes across countries and estimation methodology. For example, in Colombia, the average pay gap is measured to be between 30% and 60% while in Tajikistan, informal workers have higher earnings (Daza and Gamboa, 2013; Staneva and Arabshaibani, 2014). Moreover, it has been shown that the wage differences are not equal across the distribution indicating heterogeneity. In Russia, workers in the lower quantiles are penalized for informal employment whereas the wages are comparable at the upper quantiles across sectors (Lehmann and Zaiceva, 2013). The evidence from Madagascar, also points out to the heterogeneity of the informal sector given the earnings are higher for self-employed and workers at the upper quantiles (Nordman et al., 2016). Hence, the empirical analysis of formal-informal wage gap is still inconclusive, and the findings change depending on the sample used and econometric methodology. But it is clear that informal sector is not homogenous and there are significant differences between types of unregistered work.

More recently, panel data estimations also provide different and often conflicting results. Depending on the country there exist either positive or negative earnings gaps across sectors. Negative and bigger gaps for the bottom quantile in Brazil, Mexico and S. Africa are

documented whereas workers at the lower end of distribution in Egypt enjoy a positive gap (Bargain and Kwenda, 2014; Tansel et al., 2019). However, it should be noted that either wage penalty disappears or gets much smaller once unobservable worker characteristics are controlled for with FE estimations (Bargain and Kwenda, 2014). Badaoui et. al. (2008) finds that 75% of the informal wage gap can be explained by the observable worker and job characteristics. Furthermore, once they control for time-invariant unobservables by employing propensity score matching with a difference-in-difference approach they find that the informal wage gap declines dramatically from 37% to 18% at the mean.

The research focusing on Turkish informal labor market is limited, and most of them only consider wage differences at the mean. Informality is argued to reduce the earnings significantly on average even after controlling for self-selection and a series of individual, firm and occupational variables. Human capital endowment, location and gender are explanatory for being employed in the informal sector (Tansel, 2000; Baskaya and Hulagu 2011). In the later studies that utilize non-parametric techniques and quantile regression methods, it has been revealed that the effect of informality in wages is not uniform along the distribution. Besides, informality is found to raise the wages at the upper end suggesting that the sector is diverse (Tansel and Acar, 2016). Yet, some of the features that are used to define lower and upper ties of informal work, such as self-employment, do not capture the heterogeneity accurately in the Turkish context. For example, informal self-employment does not have a statistically significant impact on wages along the distribution and a very significant majority of informal employees both salaried and self-employed would be better paid if they are in the formal sector (Tansel and Acar, 2016; Ben Salem and Bensidoun, 2012). Besides, in Turkey, transition rates are quite low, and employees are stuck with precarious jobs throughout their career without any prospects of moving to well-paid and secure jobs (Tansel and Acar 2017).

In Turkey, the wage setting process and the institutional setting can also be different in the informal sector compared to the formal sector. For instance, Baltagi et. al. (2013) finds that wage curves for the informal sector workers are strikingly different than the formal sector workers. They estimate that the negative response of the wages to the regional unemployment rates in the informal sector is 6 times as high as the response of the wages in the formal sector. This finding relates to the fact that informal sector workers can have much less bargaining power compared to the formal sector workers even facing the same unemployment rates. In a related study that focuses on the institutional differences in the informal sector, Balkan and Tümen (2016) study the impact of firm size on wages across formal and informal sectors. Their findings indicate that although firm size is positively associated with earnings for all workers,

size premium is larger for informal employees. They try to control selection bias by using propensity score matching and Heckman selection models. If the number of firms at the bottom size distribution had increased disproportionately during the 2005-2019 era, their findings can also shed light on our findings that the bottom quantile informal wage gap has widened while the upper quantile informal wage gap has not.

The only study that compares the informal sector wage gaps in two periods is Kahyalar et. al. (2018). The authors estimate the informal wage gap for the years 2004 and 2009. Their findings with a matching method point out that the informal wage gap increases very little in the 5-year period, from 0.33 log points to 0.36 log points. The more important findings are estimations of the heterogenous informal wage gaps across quantiles. The informal wage gap is highest for the bottom decile at a level of 0.57 log points and is lowest for the top decile at 0.17 log points in 2009. The authors claim that most of the wage gap between the two sectors is explained by characteristics of workers. According to the study the most important factors explaining the informal wage are education and experience. The explanation provided for the increase in the informal wage gap within the time period is rapid urbanization (Kahyalar et.al., 2018). They argue that rural-to-urban migration limited wage gains in the informal sector and thus could increase the informal wage gap. However, the argument lacks the supporting information that urbanization rate really increased significantly in 2009 compared to in 2004. Exactly the opposite is expected as 2009 was an economic crisis year and there was much of a return to rural areas as the unemployment skyrocketed in urban areas.

From the mentioned studies, it can be deduced that empirical analysis of formal-informal wage gap is still inconclusive, and the findings change depending on the sample used and econometric methodology. Although these studies in general, and the ones focusing on Turkey in particular, vastly contribute to our understanding of informality and its outcomes, none of them examine the developments for the period under consideration. Despite the relatively large decrease in the share of informal employment in Turkish labor market, the results of this change are not well studied, and before we move on to the empirical analysis, in the next section we briefly review informal employment and its evolution in Turkey.

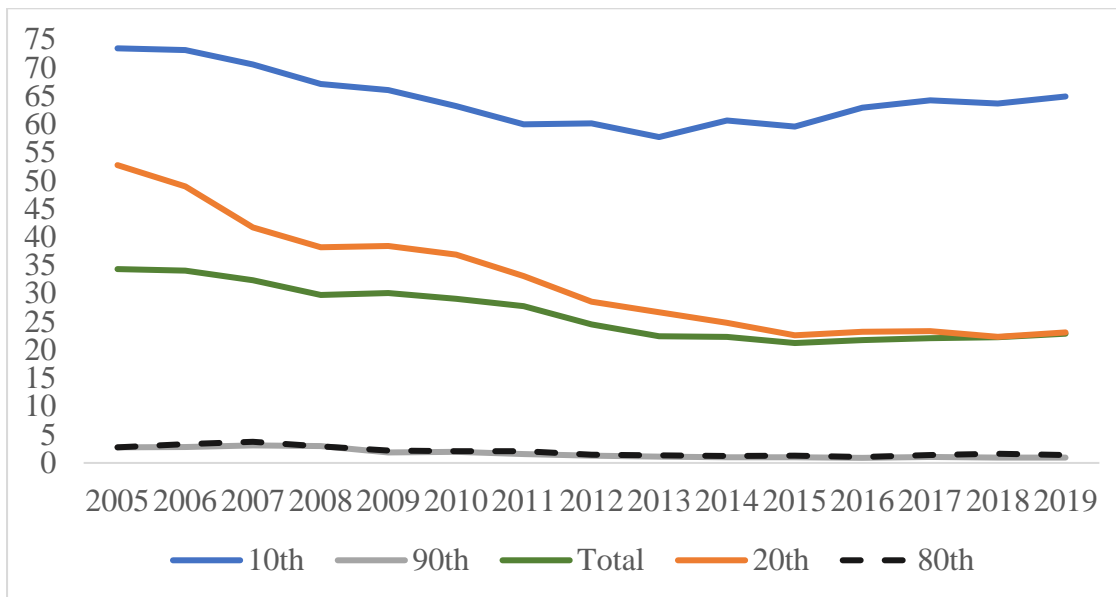
3. Informal Employment and Its Evolution in Turkey

The definition and measurement of informal employment is an open question and there is no agreement in the existing studies about which features represent informality. Precise descriptions are vital to understand the risks and opportunities informal sector workers

experience, and to develop suitable policies to increase wages and productivity of these jobs. The two most widely utilized conceptualizations of informality are either based on the attributes of enterprises or on the legal status of employees. According to the enterprise definition, anyone who works in a firm that operates in the informal sector regardless of the employee or job characteristics. Later on, this kind of portrayal is revised to involve informal jobs that are not subject to national labor legislation and regulations (Chen, 2007). The legal or social security-based approach puts the employees at the center, and regards informality to contain individuals without a contract, who are not subject to labor legislation and who are not covered by social protection (Husmanns, 2005). Originally, informality was defined by the size, legal and residency status of the companies in Turkey but legalistic definition has been adopted later on. Currently, informal employment is recognized as employment without social security in the main job during the reference week by the Turkish Statistical Institute (TÜİK).

In our paper, the legalistic (social security) approach is used where the share of informal employment is measured by considering the wage earners who are not covered by social security. It has been argued that social security criterion better captures informality in Turkey than enterprise criterion, and it is able to explain the relationship between the likelihood of informal sector employment, individual and job characteristics (Tansel and Acar, 2016). Like many other developing countries, informality is a noticeable characteristic of Turkish labor market. In 2019, almost 23% of non-agricultural employment was in the informal sector, while the ratio was estimated to be over 86% in agriculture (TÜİK, nd). Figure 1 presents the share of informal employment over the years in Turkey in non-agricultural sectors. As can be seen, there is considerable decline since the beginning mid-2000s. Starting from more than 34% in 2005, there was a steady reduction until 2015 to 21.23% and then a slight upward movement. While this ratio is above the developed country averages, it is lower than a number of developing economies such as Egypt and Mexico with 45% and 43% of informality, respectively, using the social security definition (Tansel et al., 2019).

Figure 1. Share of Informal Sector Employment (%)



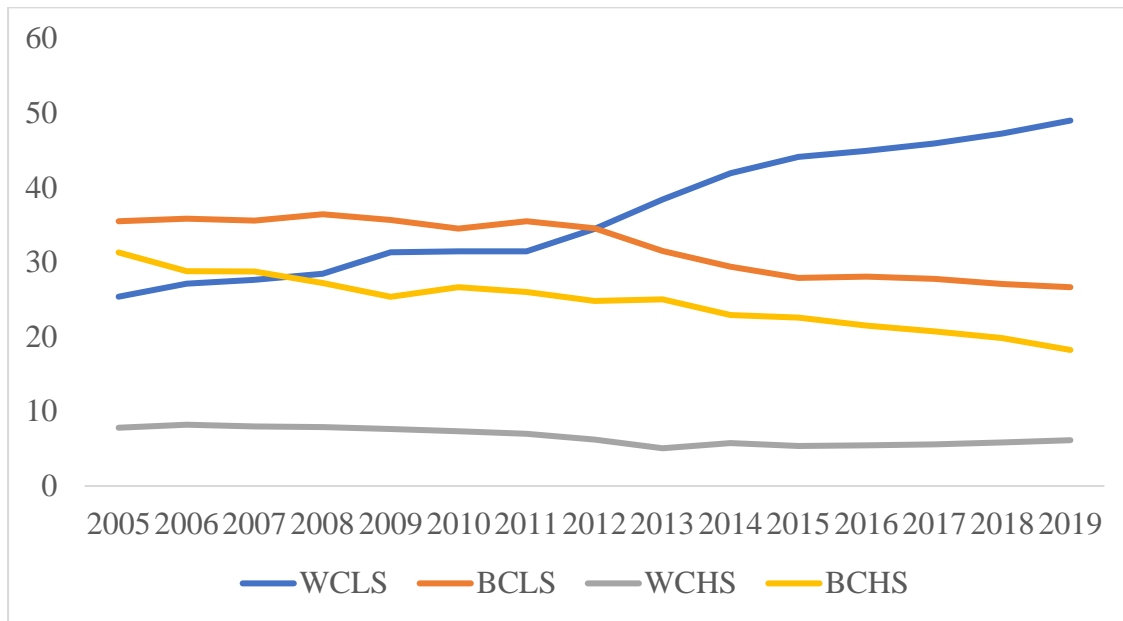
Source: Total informal employment is taken from TUIK, quartile employments are authors' calculations based on LFS data.

Moreover, as can be seen from the figure above, informality is heavily concentrated among the lower end of wage distribution. In Turkey, informal employment at the upper end has been already low, around 3% in 2005 and went even further down in 2019. A similar trend can be discerned for the second highest quartile as well. In contrast, informal employment at the bottom end has been much higher, around 73.4% at the 10th quartile and nearly 53% at the 20th. Over time, informality decreased and hit its lowest figure in 2013 for the low paid workers with 57.7%, and then started to rise again to almost 65% in 2019. It should be also noted for the 20th quartile, reduction was more dramatic but slowed down after 2014. All in all, Figure 1 suggests that changes in informal employment in Turkish labor market have not been uniform across the wage distribution, and even increased slightly for the lower end in the most recent years.

In addition to the movements of informal employment, in Figure 2 we examined the occupational composition and traced it over the period. We divide the jobs into four categories according to ISCO-08 and ISCED classifications. These are white collar low skilled (WCLS: clerks, service workers, and shop and sales workers), blue collar low skilled (BCLS: plant and machine operators and assemblers and elementary occupations), white collar high skilled (WCHS: legislators, senior officials and managers, professionals, technicians and associate professionals) and blue collar high skilled (BCHS: skilled agricultural and fishery workers, and craft and related trade workers). Focusing on the trajectory of WCLS jobs in Figure 2, we find an increasing trend across time. In 2005, the share of WCLS was 25.5% which jumped to 49%

in 2019. These are mostly service sector jobs that require very little qualification and suspect to command lower wages. Moreover, these jobs have been taken predominantly by female workers in the informal sector, for which the wages are already lower for the gender gap. WCHS jobs' share was relatively stable at low levels ranging from 8% to 6%.

Figure 2. Occupational Composition of Informal Employment (%)



Source: Authors' calculations based on LFS data.

Interestingly, at the beginning of the period the share of BCHS (Blue Collar High Skill) jobs in the informal sector was 31.2% constituting the second biggest group in terms of employment share in the informal sector. At the end of the period, the share of BCHS jobs declined dramatically to 18.2%. These jobs have the potential to command comparatively higher wages in the informal sector, and hence, the reduction of job opportunities in this category could have depressed the real wage increases in the informal sector throughout the period. This is the mirror image of the process in which the relative composition of white-collar jobs turns predominantly low-skilled as we have explained above. The relative shift towards more low skilled jobs among white collar workers in the informal sector is expected to limit the overall wage growth prospects in the informal sector, leading to higher informal wage gaps especially for the bottom deciles along the wage distribution.

Given the alterations in the occupational composition of informal sector and uneven shares along the wage distribution, it is fundamental to inspect the pay gap over the years and by quantiles. A smaller informal sector could raise the earnings of workers due to scarcity,

however, it can also be a sign of a formal sector attracting the high productivity workers and lower wages in the remaining informal jobs. We claim that the reduction in the share of informal employment in Turkey makes it harder to hire productive workers, and more generous wage scales need to be offered to attract such individuals at top deciles. In line with the existing research, we argue that informal workers at the higher end of earnings distribution would be receiving higher wages. Moreover, we propose that obstinately large share of informal employment at the bottom end and relative increase in WCLS jobs among informal sector jobs would raise earnings penalty on average and especially for the bottom deciles.

4. Data and Methodology

4.1 Data Description

The main data source of this study is Household Labor Force Statistics (HLFS) collected by the Turkish Statistical Institute. A pooled dataset is formed for the period between 2005 and 2019, which includes all the survey years that have questions on all relevant variables. The survey annually covers nearly 150,000 households and 500,000 individuals reporting a long list of demographic and detailed labor market characteristics. In total, the pooled dataset has more than 6 million observations covering all the regions in Turkey. Since we are interested in the wage differentials between formal and informal employees, we exclude unpaid family workers, self-employed individuals, and individuals stated as employers in the survey. For the hourly wages we divide the net monthly earnings by the total hours worked in a month. In the estimations we transform hourly wages to their natural logarithm and calculate the real wages for each year using GDP deflator. These steps left us with 1,303,054 individuals out of which 21% are not covered by social security whom we assign informal sector status. Hence, we have sufficiently large samples in each segment of informal and formal work, and significant differences between mean wages across sectors.

Reported summary statistics in Table 1 are for the non-agricultural wage workers in our sample covering both the formal and informal sectors. Summary statistics are reported in Table A1 in the Appendix. Female workers only account for 25%. The mean age of a worker is 34 with a standard deviation of 10. Thus, the overwhelming majority of the workers are within 24-44 years of age. The average experience is 6.5 years with a standard deviation of 7.6 years. The educational attainment of the workers points to the relatively low level of human capital. The share of workers with high school or lower status is 74%. The share of part-time workers

and temporary workers are small, respectively at the levels of 3.3% and 8.5%. Formal and informal sectors are very similar in terms of gender compositions if one considers the averages in the whole period under consideration. However, in terms of human capital based on educational attainment levels, the formal sector has a distinct advantage. The share university graduates in the formal sector is 31.4% in contrast to the share in the informal sector which is 4.4%. Primary school is the predominant form of educational attainment for the informal sector as its share is the highest, at 41%.

Table 1. Summary Statistics

	Formal	Informal
Gender		
Male	74.5	73.6
Female	25.5	26.4
Education		
Less than primary	1.6	11.4
Primary	23.7	41.0
Secondary	15.4	26.8
High	27.8	16.6
University and higher	31.6	4.4
Firmsize		
Less than 10 emp	23.1	74.6
10-50 emp	31.6	17.9
More than 50 emp	45.3	7.5
Work Type		
Fulltime	97.9	91.2
Part-time	2.1	8.8
Contract Type		
Permanent	95.1	75.7
Temporary	4.9	24.3
(mean) Age	35.7	34.7
(mean) Experience	7.3	3.2
(mean) Nominal Wage	1613.3	745.2
(mean) Real Wage	665.7	341.0
(mean) Weekly Working Hours	48.7	53.8
(mean) Real Hourly Wage	3.5	1.6
N	1036538.0	235409.0

Informal sector jobs are mostly found in the small firms employing less than 10 workers. Almost 75% of all jobs in the informal sector are in small firms. In contrast, about 45% of formal sector jobs are in the large firms employing more than 50 workers. Although at a low level, at 8.8% workers in the informal sector have more part-time jobs compared to the formal

sector in which the share of temporary jobs is only 2.1%. More importantly, almost 25% of the informal sector employment is temporary. Even though the average ages of the workers are very similar in the formal and in the informal sector, the experiences are significantly different; 7.3 years in the formal sector whereas 3.1 in the informal sector. Reported weekly working hours in the informal sector are also higher compared to the formal sector; 53.8 in the informal sector and 48.7 in the formal sector. As expected, both the nominal wages and the real wages are higher in the formal sector. In terms of real wage, the ratio is closer to two. The picture is even bleaker if one considers the hourly real wage comparisons. The formal informal hourly real wage ratio is 2.18.

In order to better gauge the changes in the relative wage determination across time and across sectors we construct a table summarizing over time changes in key variables. As Table 2ⁱ reveals, over time the relative improvement in terms of hourly real wages is slightly more pronounced in the informal sector than in the formal sector. Real hourly wages in the informal sector went up 28.5% in the period compared to the rise of 25% in the formal sector. The increase of female share in the informal sector is striking. From 2005 to 2019, female share of the informal sector has gone up from 19.8% to 37.8%. There has been a considerable rise in the share of university graduates in the formal sector; from 24.9% to 37.6%. The share of WCLS jobs in the informal sector almost doubled in the 2005-2019 period, from 25.5% to 48.9%.

Table 2. Over Time Changes in Summary Statistics for the Mean

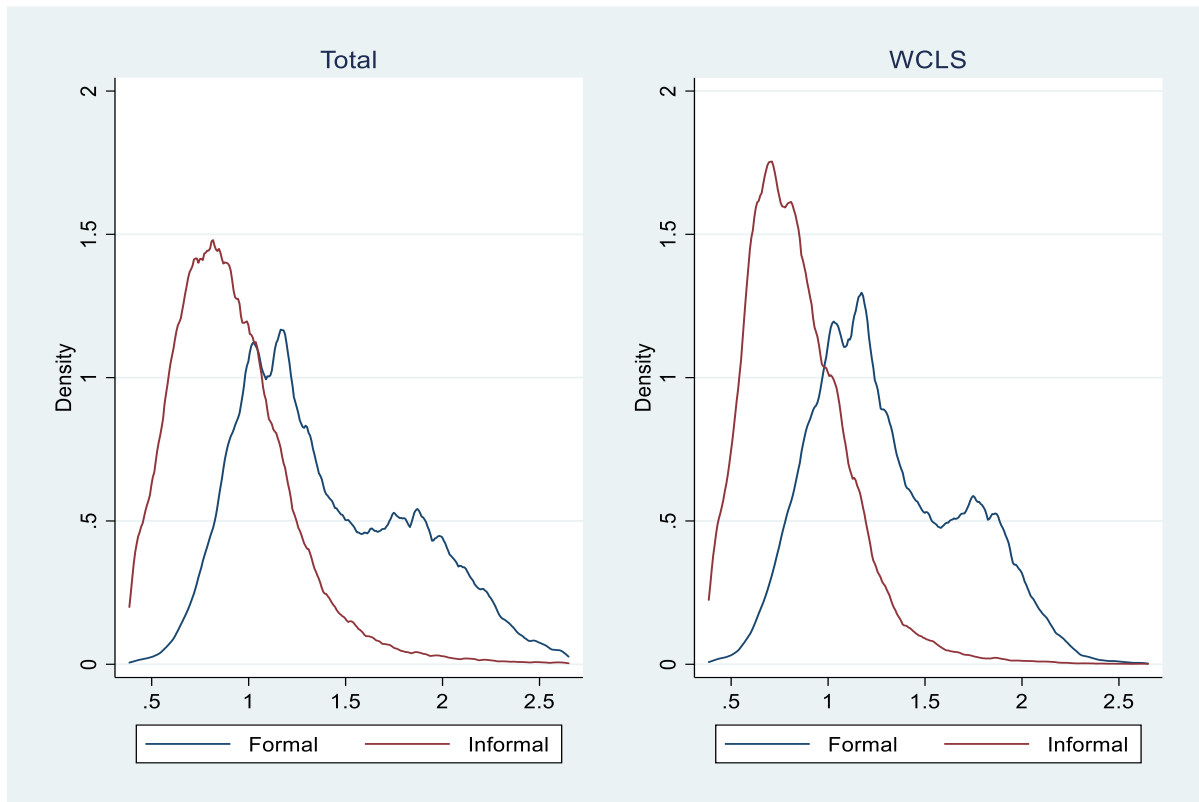
	Formal 2005	Informal 2005	Formal 2019	Informal 2019
Male	79.1	80.2	69.9	62.2
Female	20.9	19.8	30.1	37.8
Less than primary	1.3	9.2	1.7	13.1
Primary	29	50.4	18.8	36
Secondary	13.1	19.6	16.3	28.4
High	31.7	17.5	25.6	16.4
University or higher	24.9	3.3	37.6	6.2
Less than 10 emp.	18.9	71.4	24.1	79.7
10-50 emp.	31.3	20.6	28.4	13.3
More than 50 emp.	49.7	8	47.5	7
WCLS	24.5	25.5	31.7	48.9
BCLS	27.8	35.5	24.4	26.7
WCHS	31.7	7.8	31.4	6.1
BCHS	16	31.3	12.5	18.3
(Mean) Age	34.7	32.1	37	38.5
(Mean) experience	8.5	4.7	7.1	3.2
(Mean) Weekly working hours	50	56.7	46.3	50
(Mean) Real Wage	583	314.3	737.4	361.2
(Mean) Real Hourly Wage	3	1.4	4	1.8

Through Tables A2-A3 we look at the changes for the bottom and top deciles across sectors. The feminization of the low-end jobs in the informal sector is quite visible. Share of females has increased from 21.2% to 48.2%. The mean experience in the informal sector goes down by 1 year, but the drop in the formal sector is greater at 1.4 years. The share of BCHS workers in the informal sector declines from 30.4% to 15.3%. Instead, the share of WCLS workers rises from 34.5% to 61.2%. Thus, by 2019 most of the jobs in the bottom decile of the informal sector are associated with white-collar low-skilled qualifications. When we turn to top decile, most of the worker and job characteristics have been stable during the 2005-2019 period. The share of university graduates in the informal sector has increased from 36.4% to 46.6% whereas the share of workers who were primary school graduates has dropped from 29% to 17.9%. Although weekly working hours decrease for both in the formal and in the informal sector, the decline in the informal sector is much more; from 35.1 to 27.9 hours.

In Figure 3, we examine distributions of hourly real wages in informal and formal sectors for the whole sample and for the White-Collar-Low-Skilled (WCLS) workers. In both figures, formal sector wages are right skewed and have peaks at higher wage levels compared to the informal sector wages. Moreover, wage distribution of employees in WCLS jobs are highly

similar to the whole sample, where informal sector participants are concentrated at the bottom end. Figure A1 in the Appendix presents raw real hourly wage gaps for the entire sample and for WCLS workers throughout the period. From these figures, it is visible that over time changes in the earnings differences between formal and informal employees are mostly influenced by the WCLS becoming the dominant group in the informal sector.

Figure 3. Density of Hourly Real Wages



4.2 Empirical Strategy

Our first regression equation is based on the Mincerian earnings function, which assumes that individual wages are determined by education, work experience and its square (Mincer, 1974). To detect the impact of informality on wages we include a dummy variable, and the coefficient captures the conditional wage penalty/premium for the informal sector. Also, in parallel to other studies, we include several other variables to offer a fuller model of individual wages. We first estimate the model on a sample of pooled cross-sectional observations of individual-year pairs. The equation to be regressed is as follows:

$$\ln w_{it} = \delta I_{it} + \beta X_{it} + \varepsilon_{it} \quad (1)$$

where $\ln w_{it}$ is real wage for individual i at time t . X_{it} is the vector for explanatory variables including demographic, human capital, firm, industrial, occupational and regional features. I_{it} is a dummy variable taking a value one if the wage earner is informal at time t and ε_{it} is the error term.

Given that informal employment has differential effects along the wage distribution and the higher share of such work at the lower end, UQR is a fitting method to examine the relationship between informality and earnings. Unconditional QR allows us to see how unconditional expectation of the dependent variable changes when unconditional distribution of the explanatory variable changes. Influence function (IF) and re-centered influence function (RIF) are estimated to reach unconditional QR (Firpo et al., 2009; Fortin et al., 2011). The main advantage of this method over conditional regression is that the estimated effects do not depend on the set of explanatory variables in the model. Since we are interested in how informality affects hourly wages, it is more useful to assume no conditionality on the distribution. We compute the unconditional quantile partial effects based on RIF. RIF of the π^{th} quantile (q_π) of the logged hourly wages is:

$$\text{RIF}(\ln(w_{it}), q_\pi) = q_\pi + \text{IF}(\ln(w_{it}), q_\pi) = q_\pi + \frac{\pi - I(\ln w_{it} \leq q_\pi)}{f \ln(w)^{q_\pi}} \quad (2)$$

By replacing the unknown components with their sample estimators in equation (2) gives us the estimated RIF:

$$\underline{\text{RIF}}(\ln(w_{it}), \underline{q_\pi}) = \underline{q_\pi} + \underline{\text{IF}}(\ln(w_{it}), \underline{q_\pi}) = \underline{q_\pi} + \frac{\pi - I(\ln w_{it} \leq \underline{q_\pi})}{\underline{f \ln(w)^{\underline{q_\pi}}}} \quad (3)$$

$$E[\underline{\text{RIF}}(\ln \ln(w_{it}), \underline{q_\pi}) | X_{it}, IF_{it}] = \underline{\sigma}_\pi + \underline{\beta}'_\pi X_{it} + \sum \underline{\delta}_{j\pi} I(IF_{i=j}, t) \quad (4)$$

where X_{it} is the vector of covariates and IF_{it} is the informal employment dummy.

Quantile regressions presume linearity of the covariate effects, however, the distribution of covariates between formal and informal sectors may differ. This can be accounted for by using matching techniques. Matching techniques enable a comparison of wage outcomes for formal and informal workers only with comparable characteristics. This deals with the lack of common support in OLS where we may be comparing very dissimilar workers. They provide

consistent estimates even if the relationship between the dependent variable and the covariates are nonlinear (Fortin et al. 2011). The conditional independence assumption required to have unbiased estimates is likely to be satisfied since a large number of factors which determine both selection into informal sector and earnings are considered. The propensity scores of being in the formal and informal sectors are estimated via a probit model of sector selection given in Table A4 in the Appendix.

$$p(x) = P(T = 1|X = x) \tag{5}$$

A common problem with IPTW is the individuals with a propensity score very close to 0 (i.e. those extremely unlikely to be treated) will end up with an enormously large weight, potentially making the weighted estimator highly unstable (Hernan and Robins, 2020). Thus, we employed stabilized weights to overcome this issue and use marginal probability of treatment in the weight numerator calculations. For treated individuals and individuals in the control group, we weight their outcome by the calculating the scores below, respectively. To examine the over-time changes, we separately compute weights for each year and reweight each year's UQR with the corresponding IPTW.

$$w(x_T) = \frac{P(T=1)}{p(x)} = \frac{P(T=1)}{P(T=1|X=x)} \tag{6}$$

$$w(x_C) = \frac{P(T=1)}{1-p(x)} = \frac{1-P(T=1)}{1-P(T=1|X=x)} \tag{7}$$

5. Findings

5.1 Effect of Informality on Wages along Distribution

We first present our pooled cross-sectional results in Table 3 at the mean and along the distribution. The estimation output for pooled OLS and UQR before IPTW weighting is shown in Table A5 in the Appendix. At the mean, coefficient on informal employment without matching is -0.14, which suggests that when similar individuals are considered in estimations, the penalty is slightly higher. In contrast, the coefficient on informality decreases from -0.46 log points to -0.32 for the lower end of the distribution. This implies that difference in observable characteristics across formal and informal sectors explain part of the wage gap for the low paid employees. However, IPTW weighting does not alter the coefficient at the median

and slightly increase it at the top, hence, for these segments, self-selection is less of an issue. All covariates keep their signs and significance levels across specifications.

At the mean, informal sector employment in Turkey reduces wages by nearly 15% after IPTW weighting. All the covariates have the expected signs with the exception of part-time. Age, education above primary schooling, experience, firm size and part-timeⁱⁱ are positively related to earnings while being female and temporary contracts are negatively associated. When we move from OLS to UQR, it becomes obvious that informality does not reduce wages uniformly in the Turkish labor market. At the 10th quantile, employees face a penalty of -0.32 log points whereas this reduces to -0.15 log points at the median and -0.07 log points at the 90th quantiles. In percentage terms, these are equivalent to 27%, 14% and 7% decline in real hourly wages, which translates into substantial losses for a full-time worker in the informal sector at the bottom end of distribution. But as can be seen for the upper end workers, having a job in the informal sector is not very punitive. These findings are in line with the previous studies on Turkey, which found substantial penalty for the workers at the bottom and insignificant coefficients for the workers at the top after time invariant unobserved heterogeneity is regarded (Duman, 2020).

Table 3. Effect of Informal Employment on Wages

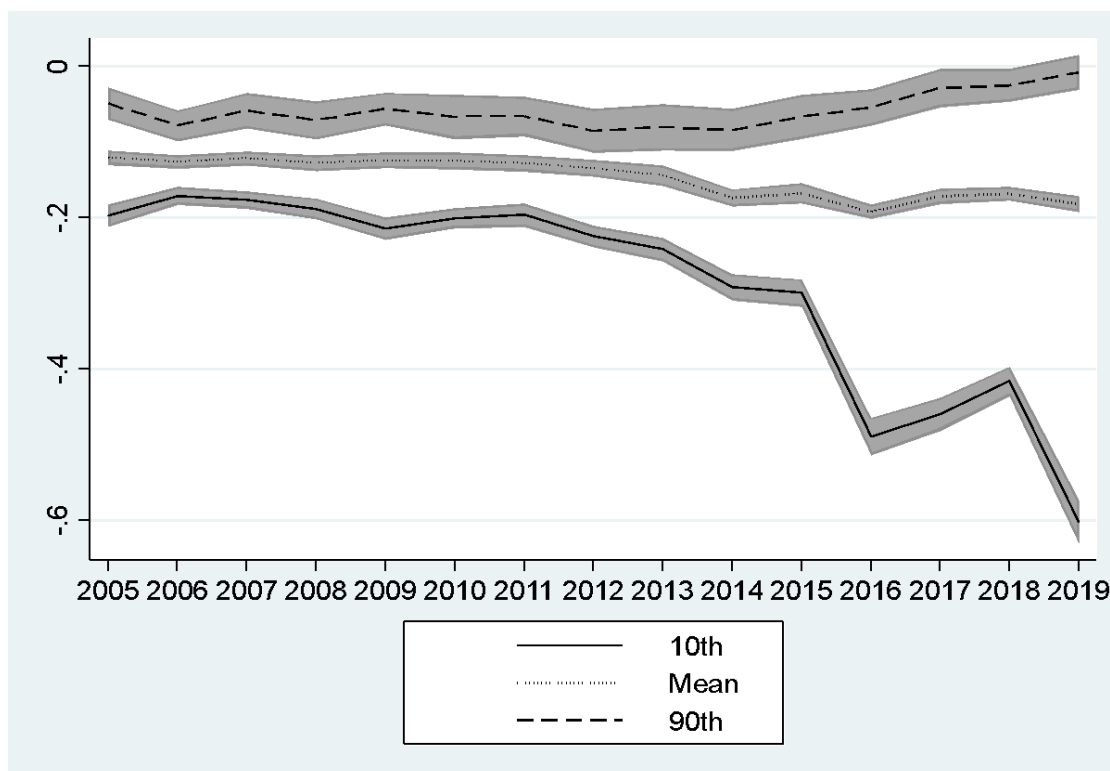
	OLS	10th	50th	90th
Informal	-0.16**	-0.32**	-0.15**	-0.07**
	(0.00)	(0.00)	(0.00)	(0.00)
Female	-0.07**	-0.03**	-0.05**	-0.05**
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.03**	0.04**	0.03**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
Age-Squared	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Primary	-0.01**	0.02**	0.01	-0.06**
	(0.00)	(0.01)	(0.00)	(0.00)
Secondary	0.04**	0.06**	0.09**	0.00
	(0.00)	(0.01)	(0.00)	(0.00)
High School	0.12**	0.13**	0.16**	0.00
	(0.00)	(0.01)	(0.00)	(0.00)
University	0.31**	0.19**	0.27**	0.45**
	(0.00)	(0.01)	(0.00)	(0.00)
Experience	0.01**	-0.00**	0.01**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
Experience-Squared	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Medium	0.09**	0.10**	0.07**	0.06**
	(0.00)	(0.00)	(0.00)	(0.00)
Large	0.17**	0.11**	0.13**	0.19**
	(0.00)	(0.00)	(0.00)	(0.00)
Part-time	0.22**	0.03**	0.13**	0.47**
	(0.00)	(0.00)	(0.00)	(0.01)
Temporary	-0.05**	-0.05**	0.03**	-0.10**
	(0.00)	(0.00)	(0.00)	(0.00)
Occupation	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
R-squared	0.63	0.19	0.36	0.37
N	1296139	1296139	1296139	1296139

Notes: The reference category is standard employment. All specifications include control variables (age, education, experience, firm size, occupation, industry and year). Pooled OLS models are estimated with cluster-robust standard errors; UQR models are estimated with bootstrapped standard errors. ** and * denote statistical significance at the .01 and .05 levels, respectively. Standard errors are in parenthesis.

In Figure 4, over time changes in informal wage penalty in Turkey are presented. It is visible that even controlling for a long list of individual, firm, industrial and occupational factors, being employed in the informal sector has a statistically significant and negative effect on the wages for the bottom quantile. Moreover, the impact has gone up from -0.2 log points

in 2005 to -0.6 log points in 2019. These correspond to roughly a decrease in hourly real wages by 18% in 2005, which rose to 45% in 2019. Unlike the lower end of the distribution, the wage penalty of informal sector employment at the mean is quite stable over the years. In 2005, the coefficient was around -0.12 and went up to -0.18 in 2019. While informality hurts the average worker in Turkey after controlling for observable characteristics and IPTW reweighting, still the magnitude of the effect is quite limited in comparison to the low paid workers. When we look at the upper end of wage distribution, 90th quantile, an entirely different picture emerges. Not only was the coefficient extremely small, around -0.05 log points in 2005, it diminished further and was estimated to be -0.01 at the end of the period. These indicate that for high paid/high productivity workers in Turkey, the informal sector does not generate disadvantages in terms of earnings.

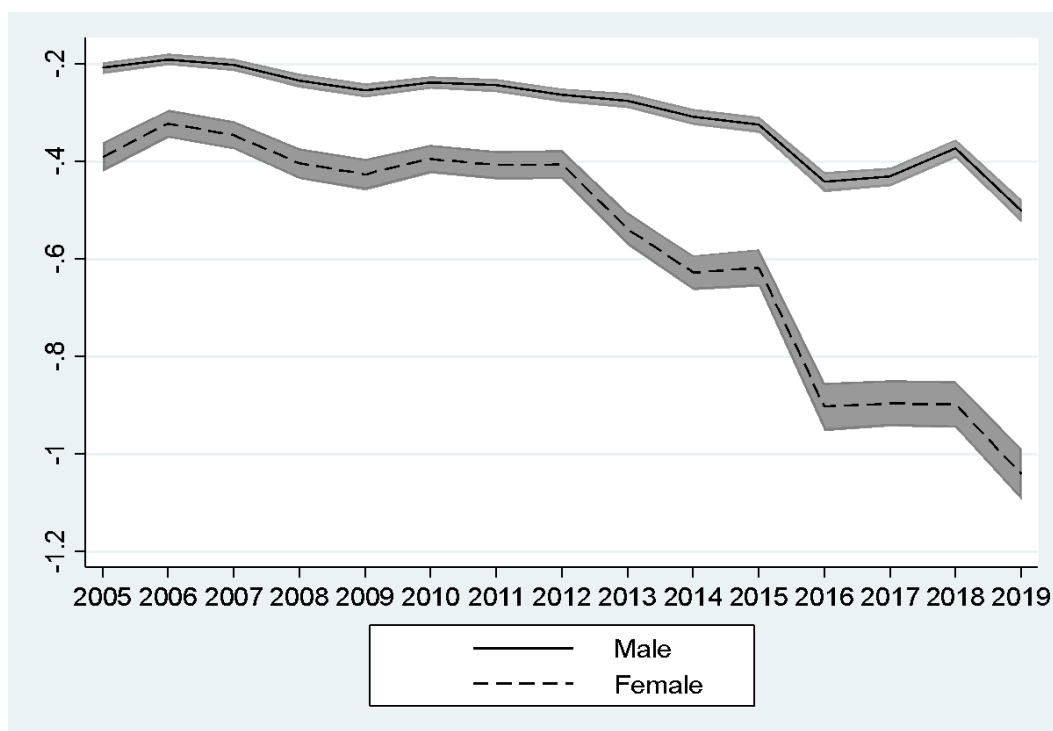
Figure 4. Coefficient of Informal Employment over Time



Notes: The reference category is standard employment. All specifications include control variables (age, education, experience, firm size, work type, contract type, occupation, industry and region). UQR models are estimated with bootstrapped standard errors. ** and * denote statistical significance at the .01 and .05 levels, respectively. Lines represent the coefficients and shaded areas represent confidence intervals.

Next, we examine whether the above declining trend for informal sector wage penalty at the 10th quantile by gender. Turkey suffers from extremely low levels of female labor force participationⁱⁱⁱ, and we want to test if this has an impact on the link between informal employment and wages. From Figure 5, we can see that informality decreases the earnings of both men and women in Turkey for the low paid employees. However, the coefficient is larger for females throughout the entire period. For example, in 2005, informal employment decreased real hourly wages by -0.21 log points for men and -0.39 log points for women, and these rose to -0.5 log points and -1.04 log points in 2019 for the respective groups. Even though, Turkish women at the bottom end of distribution are experiencing a higher reduction in their wages if they have an informal job, over time changes are quite comparable across gender. There is a steady increase in the size of wage penalty, and the penalty got much larger after 2013 both for male and female low paid workers. It should be also noted that once we include an interaction variable between WCHS and informality, penalty got much smaller for women but not for men^{iv}.

Figure 5. Coefficient of Informal Employment over Time by Gender at 10th Q



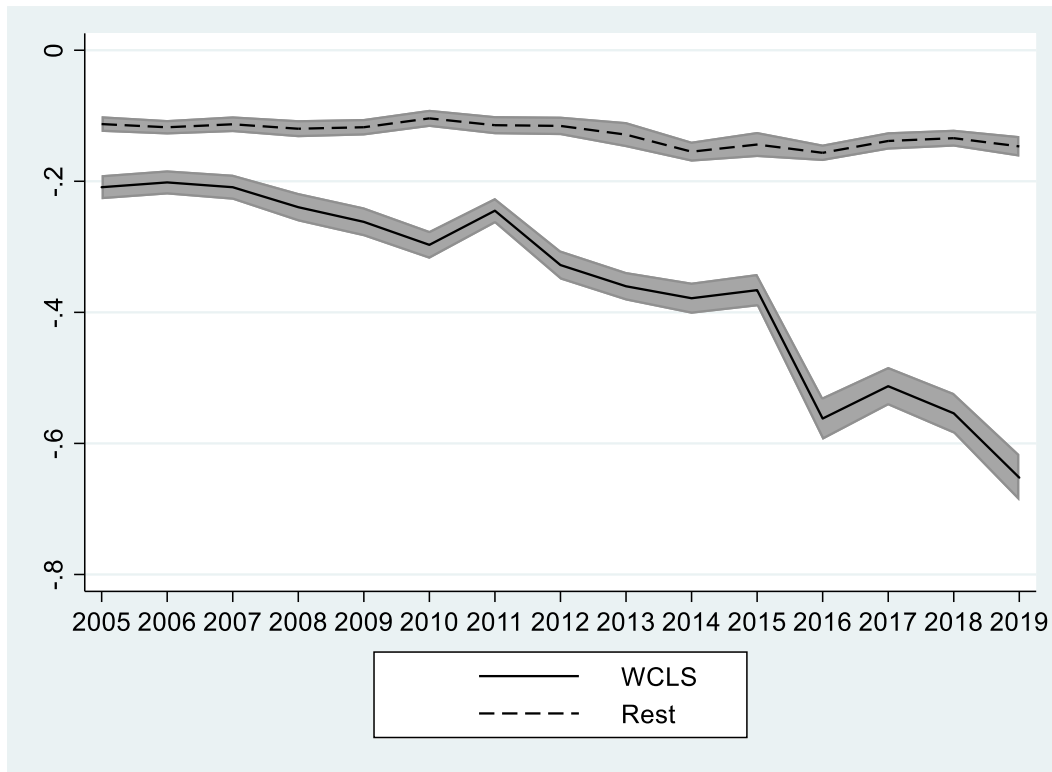
Notes: The reference category is standard employment. All specifications include control variables (age, education, experience, firm size, work type, contract type, occupation, industry and region). UQR models are estimated with bootstrapped standard errors. ** and * denote statistical significance at the .01 and .05 levels, respectively. Lines represent the coefficients and shaded areas represent confidence intervals.

Since employees who have adequate human capital resources are expected to move to the formal sector when there are enough jobs, the decreasing penalty at the top end can be due to compensation. Informal sector employers can only attract higher ability employees by more generous wage scales in Turkey where the share of informal sector employment is diminishing. The above findings hint at the fact that voluntary selection can be a relevant aspect of the Turkish labor market for high earning individuals. On the other hand, employees who have fewer resources and lower human capital are locked in the informal sector, and they might have difficulties to enjoy formalization of jobs. Additionally, as we have shown, the reductions in informal employment in Turkey are not even, and for the bottom earners, the share of informal jobs continues to be substantial. Our preliminary results imply that Turkey has a dual labor market structure and informal sector employment is more detrimental for already underprivileged workers.

5.2 Occupational Composition

As discussed in the previous sections, occupational composition of formal and informal sector in Turkey did not change in the same direction. Over time skilled jobs, both in services and manufacturing, decreased a little from 47% to 43% whereas low skilled service occupations grew from 24.5% to 31.8%. Within informal sector high skilled jobs had a share of nearly 39% at the beginning of the period to approximately 24% at the end. More strikingly, WCLS occupations increased their portion from 25.3% to almost 49% among the informal employees. Wage levels differ across occupations, thus, changes in the sectoral composition of employment can noticeably affect earnings gap between formal and informal workers. For example, a rise in the share of employment in sectors with low wage levels can dampen wage growth, and if low wage occupations are disproportionately concentrated in the informal sector, the downward pressure would be larger. To investigate the relationship between sectoral composition and earnings, we divide the sample into WCLS and rest of the economy.

Figure 6. Coefficient of Informal Employment over Time and Occupation, 10th Q



Notes: The reference category is standard employment. All specifications include control variables (age, education, experience, firm size, work type, contract type, industry and region). UQR models are estimated with bootstrapped standard errors. ** and * denote statistical significance at the .01 and .05 levels, respectively. Lines represent the coefficients and shaded areas represent confidence intervals.

Figure 6 exhibits the change in informal employment’s impact on wages within low skilled service jobs and remaining occupations. The coefficient is negative for all types of jobs, around -0.2 log points for WCLS and nearly -0.1 log points for the rest in 2005. In 2019, the magnitude rose to -0.64 log points for the former and -0.18 log points for the latter. These correspond to roughly 47% and 17% decreases in real hourly wages, and even though 17% cut in earnings can be still regarded as sizable, 47% is definitely a big loss that low paid-low service sector workers have to experience. These results are in line with our expectations, majority of the growth in informal employment penalty is driven by the occupational composition, and the bigger gap between formal and informal sectors in terms of job characteristics. In Turkey formalization occurred at a much slower pace at the bottom quantile, and at the same time share of WCLS jobs has increased at a higher rate than the average. Consequently, real hourly wages among this occupational group diminished and pulled down the wages for informal sector workers at the lower end of distribution.

5.3 Robustness Checks

We apply three strategies to investigate the validity of our key results on the relationship between informal employment and wages. These include comparing regions with low/high refugee density, running separate regressions for small enterprises, and splitting workers by their age. Evolution of coefficient on informality across regions is presented in Figure A2^v, and Figure A3-A4^{vi} show sub-samples of small firms and older workers.

A massive volume of refugees arrived at Turkey since 2012 and according to the latest figures, the number is almost 4 million. Only a minority of refugees have work permits, and big part of them are able to find jobs in the informal sector. Thus, we want to test if there is a difference in the relationship between wages and informality, especially in regions that are hosting large amounts. We distinguish high refugee density regions at the NUTS-2 level with more than 10% of local population. Low refugee density regions are the ones with less than 2% of local population. As can be seen from Figure A3, there is no distinction between high/low refugee regions neither at the top nor at the bottom. However, it should be also noted that in high refugee density regions, penalty began decreasing rapidly immediately after the influx of refugees, around 2012. On the other hand, the reduction in real hourly wages in low refugee density regions follow the same trend and diminished at a faster rate.

In the literature there is a lot of discussion on the close association between the size of enterprises and informality, hence, we first want to check if this variable is responsible for wage penalty and if over time changes can be attributed to firm size. For this, we divide the sample into small firms, which have less than 10 workers and the rest. Second, we focus on older workers (individuals above the age of 55 years) to test if older employees, who are already retired holding informal jobs as secondary sources of income, have an impact on the relationship between informality and hourly wages. In Turkey, a series of reforms in 1990s made it possible for many workers to retire at a relatively younger age, and these groups might have reentered the labor market through informal sector^{vii}.

Our results are maintained and neither firm size nor age appear to be capturing the changes over time. In fact, older workers face relatively smaller declines in their wages due to informality, and the coefficient was -0.07 log points in 2005 reaching to -0.5 log points in 2019. For prime age and younger employees, informal jobs affected real hourly wages by -0.2 log points in 2005 which rose to -0.65 log points in 2019. Similarly, the magnitude of coefficient across small, medium, and larger firms is not large. While informal sector employees in small enterprises faced a reduction in wages by -0.12 log points in 2005, this was -0.17 log points for

workers in larger companies. Firms with different sizes experienced an identical trend, and coefficient of informality went up to -0.36 and -0.28 log points in 2019. Hence, informal employment is negatively related to the real hourly wages for the workers at the bottom end of the distribution in Turkey regardless of their age and size of the firm they work for.

6. Conclusion

Informality is a pervasive aspect of Turkish labor market and even though its relative size over time declined, still a major part of employment is generated in this sector. Our paper examined the wage gap between formal and informal workers in Turkey both at the mean and along the distribution using matching techniques. According to our findings, informality decreases the earnings for the bottom quantile substantially and the negative effect has increased over time. In contrast, informal sector workers at the highest quantile do not experience almost any reduction in their earnings, and the effect of informality even got smaller for the period under consideration. The lack of informality penalty in the case of high ability-high earning individuals is due to compensation and scarce amount of informal sector jobs at the top. Employers can only attract higher ability employees by more generous wage scales in Turkey where the share of informal sector employment is diminishing.

For low paid employees, having an informal job is exceedingly chastising, and given the already meager earnings of this group, this is likely to cause socio-economic problems. Insufficient incomes and lack of social security render these workers vulnerable as they have no possibility to self-protect against risks. Besides, wage penalty for this group in Turkey has been increasing over time. We argued that this is partly due to uneven decline of informal employment, and persistently high rates of informality for this segment. Moreover, we showed that the composition of informal jobs has changed significantly in Turkey, and WCLS jobs increased its share within this sector. Even though polarization is not discernible in Turkish labor markets as the ratio of skilled and unskilled jobs remain stable, within the informal sector low skilled sectors gained a greater share. Low skilled service jobs are notorious for low pay, and this coupled with informality, in our view, augmented the wage gap for the employees at the bottom end.

The persistence of the informal sector in the Turkish economy is evident. Thus, the wage dynamics in the informal sector will be essential for millions of workers in the medium term covering the coming several years if not the decades. The policy makers should take into account the widening informal wage gap and design policies to alleviate this problem.

Incentives for formalization, although necessary, cannot be sufficient to deal with the increasing informal sector wage gaps especially for the bottom deciles as the firms these workers are employed are less likely to benefit from the incentives to formalize. One possible policy venue can be enhancement of the productivity of the informal firms by subsidizing the adoption of the digital technologies for the very small firms that employ the white-collar-low-skilled workers. Another policy is to offer training and education opportunities to individuals that have low paid service sector jobs.

This paper utilized several methodological extensions to provide unbiased estimates, however, few limitations remain. First, we are unable to control for time invariant heterogeneity since our data set is cross-sectional. Obviously, unobserved characteristics might have an impact on sectoral selection as well as wages. Nonetheless, panel data for Turkey is not available to trace the long-term developments of informal sector effect on wages. Second, we are unable to account for the macro-level changes that have occurred in Turkey between 2005 and 2019, which might disproportionately influence one of the sectors. For example, there were several years when statutory minimum wage was raised considerably. Since the informal sector is not covered by the legislation, it is unlikely that informal employees have benefited from these wage hikes.

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Appendix

Table A1. Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Gender
Male	1271948	.743	.437	0	1
Female	1271948	.257	.437	0	1
Age	1271948	35.472	10.608	15	96
Education	.	.	.	.	.
Less than primary	1271948	.034	.18	0	1
Primary	1271948	.269	.444	0	1
Secondary	1271948	.175	.38	0	1
High	1271948	.257	.437	0	1
University and higher	1271948	.265	.442	0	1
Experience	1271852	6.511	7.652	0	64
Firm size	.	.	.	.	.
Less than 10 emp	1271948	.327	.469	0	1
10-50 emp	1271948	.29	.454	0	1
More than 50 emp	1271948	.383	.486	0	1
Work Type	.	.	.	.	.
Fulltime	1271948	.967	.179	0	1
Part-time	1271948	.033	.179	0	1
Contract Type	.	.	.	.	.
Permanent	1271947	.915	.279	0	1
Temporary	1271947	.085	.279	0	1
Occupation	.	.	.	.	.
Managers	1271948	.043	.202	0	1
Professional	1271948	.13	.336	0	1
Technicians and associate professionals	1271948	.087	.282	0	1
Clerical support workers	1271948	.106	.307	0	1
Service and sales workers	1271948	.195	.396	0	1
Skilled agricultural, forestry and fishery workers	1271948	.003	.054	0	1
Craft and related trades workers	1271948	.162	.368	0	1
Plant and machine operators, and assemblers	1271948	.133	.339	0	1
Elementary occupations	1271948	.143	.35	0	1
Industry	.	.	.	.	.
Agriculture, Forestry and Fishing	1271948	.256	.436	0	1
Mining and Quarrying	1271948	.007	.084	0	1
Manufacturing	1271948	.004	.063	0	1
Electricity, Gas, Steam and Air Conditioning Supply	1271948	.076	.265	0	1
Water Supply; Sewerage, Waste Management and Remediation Activities	1271948	.133	.339	0	1
Construction	1271948	.048	.213	0	1
Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	1271948	.059	.236	0	1
Transportation and Storage	1271948	.01	.1	0	1
Accommodation and Food Service Activities	1271948	.015	.122	0	1
Information and	1271948	.007	.082	0	1

Communication					
Financial and Insurance Activities	1271948	.022	.147	0	1
Real Estate Activities	1271948	.051	.22	0	1
Professional, Scientific and Technical Activities	1271948	.115	.318	0	1
Administrative and Support Service Activities	1271948	.093	.29	0	1
Public Administration and Defence; Compulsory Social Security	1271948	.062	.241	0	1
Education	1271948	.006	.075	0	1
Human Health and Social Work Activities	1271948	.026	.159	0	1
Arts, Entertainment and Recreation	1271948	.012	.107	0	1
Region	.	.	.	.	.
İstanbul	1271948	.149	.356	0	1
West Marmara	1271948	.067	.249	0	1
Aegean	1271948	.136	.343	0	1
East Marmara	1271948	.11	.312	0	1
West Anatolia	1271948	.125	.331	0	1
Mediterranean	1271948	.106	.308	0	1
Central Anatolia	1271948	.054	.226	0	1
West Black Sea	1271948	.073	.259	0	1
East Black Sea	1271948	.037	.19	0	1
Northeastern Anatolia	1271948	.037	.188	0	1
Central Eastern Anatolia	1271948	.042	.201	0	1
Southeastern Anatolia	1271948	.065	.247	0	1

Table A2. Over Time Changes in Summary Statistics Bottom Deciles

	Formal 2005	Informal 2005	Formal 2019	Informal 2019
Male	83.1	78.8	72.3	51.8
Female	16.9	21.2	27.7	48.2
Less than primary	3.4	11.1	4.2	16.8
Primary	45.2	44.3	25.4	34.8
Secondary	21.3	23.7	39.9	30.9
High	26.4	18.8	21.9	14.2
University or higher	3.7	2.1	8.6	3.4
Less than 10 emp.	50.9	81.1	52.6	86.8
10-50 emp.	29.7	14.6	25.2	8.1
More than 50 emp.	19.4	4.3	22.2	5.1
WCLS	34.5	34.5	49.1	61.2
BCLS	34.6	29.5	27.1	20.6
WCHS	11.5	5.6	7.5	3
BCHS	19.4	30.4	16.4	15.3
(Mean) age	31.9	29.3	32.3	37.3
(Mean) experience	4.7	4.1	3.3	3.1
(Mean) Weekly working hours	71.7	63.2	58.6	55.2
(Mean) Real Wage	258.4	200	349.3	261.9
(Mean) Real Hourly Wage	0.8	0.7	1.4	1.1

Table A3. Over Time Changes in Summary Statistics Top Deciles

	Formal 2005	Informal 2005	Formal 2019	Informal 2019
Male	74.3	80.7	64.8	81
Female	25.9	19.3	35.2	19
Less than primary	0.3	4.5	0	1.2
Primary	8.7	29	0.9	17.9
Secondary	4.1	8	0.9	9.5
High	22	22	5.5	23.8
University or higher	65	36.4	92.7	46.6
Less than 10 emp.	5.6	40.9	6.3	45.2
10-50 emp.	31.5	34.7	33.7	26.2
More than 50 emp.	62.9	24.4	60	28.6
WCLS	10.8	11.4	9.8	9.5
BCLS	8.2	22.7	1.4	17.9
WCHS	72.6	58	87.7	63.1
BCHS	8.4	8	1.1	9.5
(Mean) age	38.9	42.3	40.2	43.7
(Mean) experience	13.5	6.5	14.1	5.9
(Mean) Weekly working hours	39.7	35.1	37	27.9
(Mean) Real Wage	1154.1	1082.8	1413.2	1101.6
(Mean) Real Hourly Wage	6.8	7.3	9	9.4

Table A4. Probit Model for Informal Sector Selection

	Informal
25-55 old	-0.61** (0.00)
>55 old	0.32** (0.00)
Gender	0.61** (0.00)
Primary	-0.54** (0.00)
Secondary	-0.86** (0.00)
High	-1.39** (0.00)
University and higher	-2.11** (0.01)
Number of Informal	0.69** (0.00)
West Marmara	0.36** (0.00)
Aegean	0.27** (0.00)
East Marmara	0.14** (0.00)
West Anatolia	0.31** (0.00)
Mediterranean	0.49** (0.00)
Central Anatolia	0.37** (0.01)
West Black Sea	0.53** (0.00)
East Black Sea	0.73** (0.01)
Northeastern Anatolia	0.83** (0.01)
Central Eastern Anatolia	0.83** (0.01)
Southeastern Anatolia	0.76** (0.00)
# of Obs.	2384021
Pseudo R-Sq	0.3052
Wald chi2(35)	596163.7
Prob > chi2	0

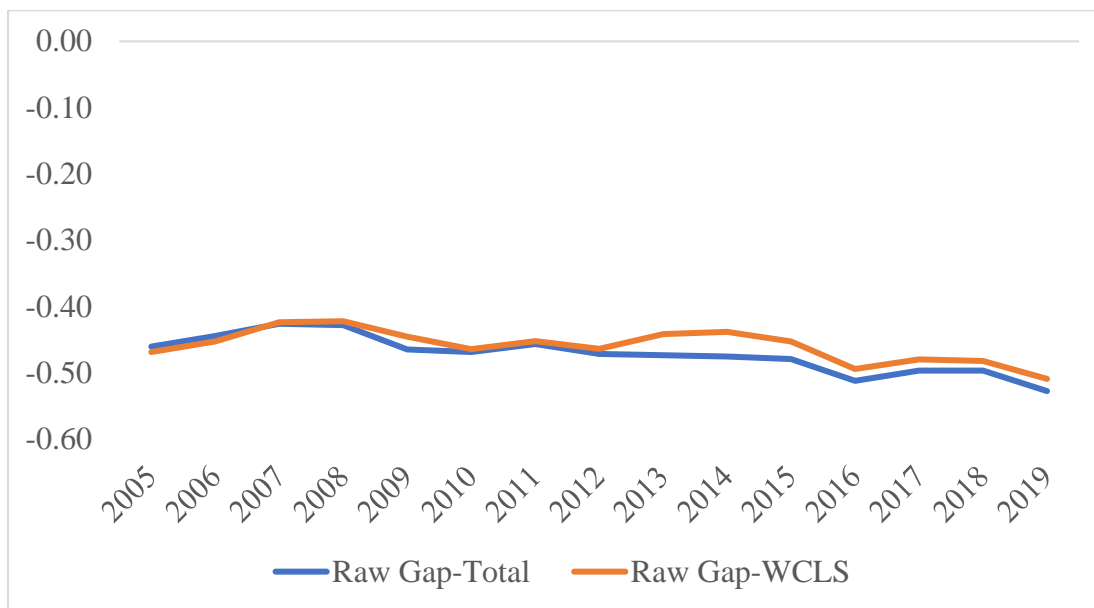
Notes: Dependent variable takes the value of one if informal sector and zero otherwise. ** and * denote statistical significance at the .01 and .05 levels, respectively. Standard errors are in parenthesis.

Table A5. Effect of Informal Employment on Wages-without IPTW

	OLS	10th	50th	90th
Informal	-0.14**	-0.46**	-0.15**	0.05**
	(0.00)	(0.00)	(0.00)	(0.00)
Female	-0.08**	-0.04**	-0.06**	-0.06**
	(0.00)	(0.00)	(0.00)	(0.00)
Age	0.03**	0.04**	0.03**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
Age-Squared	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Primary	0.00	0.05**	-0.01**	-0.05**
	(0.00)	(0.00)	(0.00)	(0.00)
Secondary	0.06**	0.07**	0.09**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
High School	0.13**	0.15**	0.17**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
University	0.33**	0.19**	0.31**	0.38**
	(0.00)	(0.00)	(0.00)	(0.00)
Experience	0.01**	-0.00**	0.01**	0.01**
	(0.00)	(0.00)	(0.00)	(0.00)
Experience-Squared	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Medium	0.09**	0.10**	0.07**	0.05**
	(0.00)	(0.00)	(0.00)	(0.00)
Large	0.17**	0.10**	0.15**	0.17**
	(0.00)	(0.00)	(0.00)	(0.00)
Part-time	0.23**	0.07**	0.15**	0.48**
	(0.00)	(0.00)	(0.00)	(0.00)
Temporary	-0.05**	-0.05**	0.02**	-0.10**
	(0.00)	(0.00)	(0.00)	(0.00)
Occupation	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes
Region	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
R-squared	0.67	0.26	0.43	0.35
N	1296139	1296139	1296139	1296139

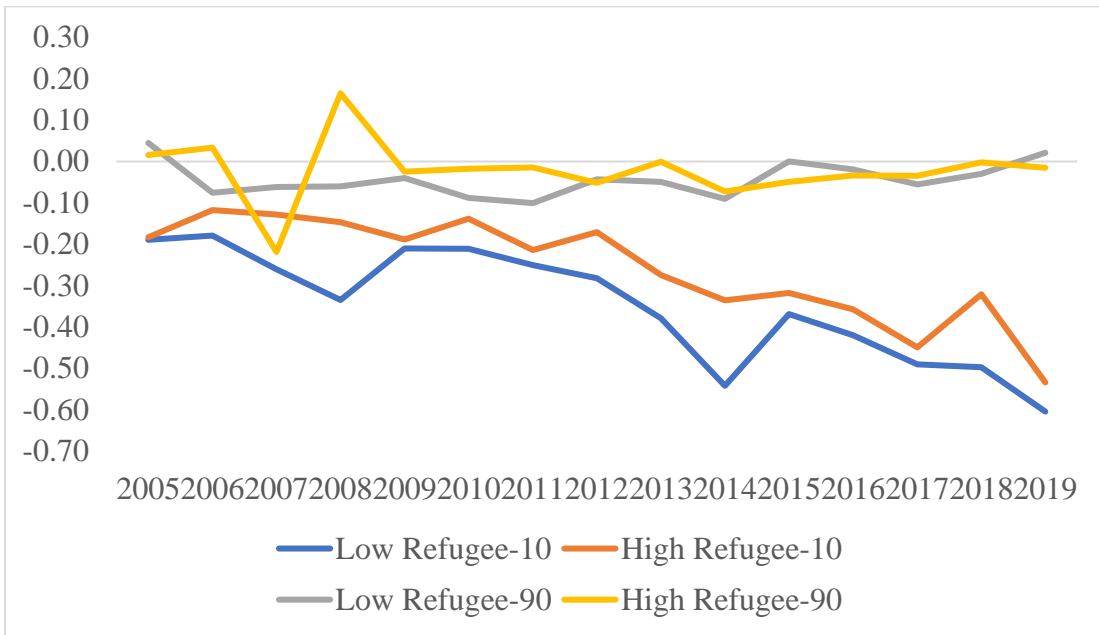
Notes: The reference category is standard employment. All specifications include control variables (age, education, marital status, experience, firm size, occupation, industry and year). Pooled OLS models are estimated with cluster-robust standard errors; UQR models are estimated with bootstrapped standard errors. ** and * denote statistical significance at the .01 and .05 levels, respectively. Standard errors are in parenthesis.

Figure A1. Raw Wage Differences



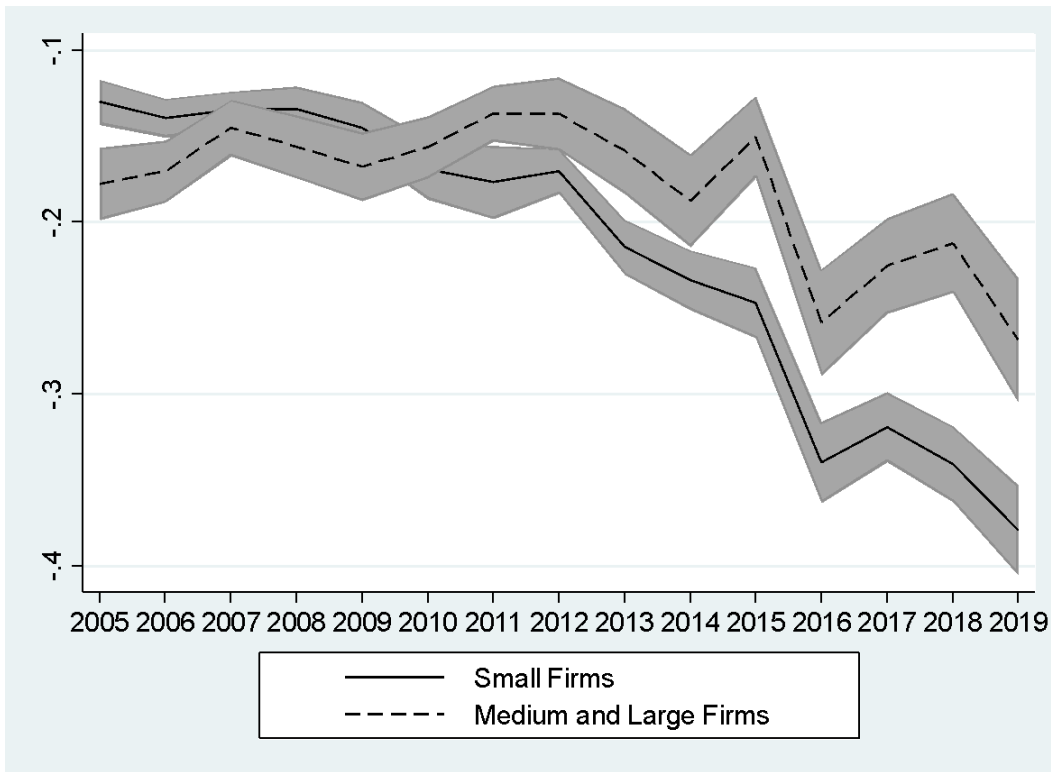
Notes: Based on authors' calculations from LFS data.

Figure A2. Effect of Informal Employment over Time across Regions



Notes: The reference category is standard employment. All specifications include control variables (age, education, experience, firm size, work type, contract type, occupation, industry and region). UQR models are estimated with bootstrapped standard errors.

Figure A3. Effect of Informal Employment over Time by Firm Size at the 10th Quantile



Notes: The reference category is standard employment. All specifications include control variables (age, education, experience, firm size, work type, contract type, occupation, industry and region). UQR models are estimated with bootstrapped standard errors. ** and * denote statistical significance at the .01 and .05 levels, respectively. Lines represent the coefficients and shaded areas represent confidence intervals.

Figure A4. Effect of Employment over Time by Age at the 10th Quantile



Notes: The reference category is standard employment. All specifications include control variables (age, education, experience, firm size, work type, contract type, occupation, industry and region). UQR models are estimated with bootstrapped standard errors. ** and * denote statistical significance at the .01 and .05 levels, respectively. Lines represent the coefficients and shaded areas represent confidence intervals.

ⁱ In addition to these control variables, we include dummy variables for industry according to NACE-Rev2 classification at the 2-digit level, dummy variables for occupation at the ISCO-08 2-digit level, dummy variables for regions at NUTS-2 level.

ⁱⁱ Part-time employment is merely 3.33% in our sample, among women, 6.76%, has part-time work arrangements as opposed to 2.1% for men.

ⁱⁱⁱ In 2005, LFP for women was merely 23% which went up to 34% in 2019. Even though there is a rise in female's paid work activity, still this ratio is significantly lower than countries with the same level of economic development.

^{iv} For the female sample, the interaction term cut down the coefficient on informality from 1.04 log points in 2019 to -0.54 log points whereas the reduction in the male sample was much smaller for the same year, from -0.5 log points to -0.43.

^v For an update report on refugees, see <https://reliefweb.int/report/turkey/unhcr-turkey-operational-update-october-2020>.

^{vi} To save space we only show the informality coefficient at the 10th quantile, full results can be asked from the authors.

^{vii} Before 1999, retirement age on average was quite low and only after this year it was set at 60 for men and 57 for women. For details of policy changes, see Gökbayrak, 2010, and for the relationship between early retirement and informality, see Brook and Whitehouse, 2010.