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Local labor markets and crimes by non-residents

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Abstract

Research that investigate the extent of labor market prospects on crime rates focus on conditions in a region and crime rate in that region. However, this approach neglects criminal mobility. It is also possible that an improvement in the labor market in a region may attract non-residents, either professional criminals who travel only to commit crime or individuals who migrate hoping to find a job and failing to do so may inclined to commit crime. Indeed, using regional data from Turkey shows that almost 40% of crimes are committed by non-residents. This number is over 10% on average even one only considers violent crimes, and can reach as high as 18%. In this paper, using conviction rates from Turkey I estimate the effect of unemployment rate and average wages on crime in a region committed by non-residents, as well as implement a gravity model using both labor market characteristics in region where crime is committed and region of the criminal's residence. The results show that while local labor market conditions fail to explain crime rate in a region, they are strong predictors of crimes committed by non-residents.

1   Introduction

In the last four decades there is a growing body of research on the socio-economic determinants of crime. The economists recent interest in the subject emerged after Becker's (1968) seminal paper in which he applied the theory of rational behavior under uncertainty to crime and postulated that propensity of crime depends on the potential benefits and expected costs of engaging in criminal activity. Later Ehrlich (1973) extended Becker's model by allowing time allocation consideration of individuals and introduced an empirical specification that includes some indicators of legal and illegal opportunities in the population.

Following these early work a number of empirical studies investigated the effects of labor market opportunities on the criminal activity. Basic economic model predicts that worsening conditions in labor market alter incentives to commit crime. While a decline in wages implies lower opportunity cost of engaging in criminal activity, an increase in unemployment rate in the region raises the probability of being unemployed and increases the likelihood of committing crime. Based on these premises and that most criminal activities are committed by unskilled individuals, Gould, Weinberg and Mustard (2002) for the U.S. and Machin and Meghir (2004) for the U.K., for example, investigated the impact of changing wages of unskilled workers on the crime rate across different regions. Their analysis has shown that indeed there is a strong negative relationship between wages and criminal activity. On the other hand, research examining the relationship between unemployment and crime reached ambiguous results (Freeman, 1999). Depending on the econometric specification (Butcher and Piehl, 1998), age groups (Öster and Agell, 2007; Fougère et al., 2009), country (Entorf and Spengler, 2000) and type of crime (Levitt, 1997), the relationship between unemployment and crime could be positive, non-existent or even negative.

In this paper, differing from the previous literature, I focus on the relationship between labor market variables and crimes committed by residents in different regions as well as crimes committed by non-resident in the same region, which I call "exported" and "imported" crime, for short[1] The motiva-

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[1]It is true that some earlier papers controlled for the fraction of immigrants (foreign

tion comes from the observation by Cohen and Felson (1979) that the supply of crime requires three conditions: (i) motivated offenders, (ii) suitable targets, and (iii) the absence of guardians. So far, all studies investigate the relationship between unemployment in a region and crime rate in that particular region. However, when people are allowed freely to move across regions, as is the usual case within a country, a decrease in the unemployment rate in a region may reduce probability of committing crime by the *residents* of the same region (a decline in the motivation), yet attracts *non-residents* to that region as wealth in that region increases (an increase in the suitable targets), thus causing a counterbalancing effect on crime. Similarly a change in the wage rate in a region may provide different incentives for residents and non-residents. Hence, the estimated effects of labor market opportunities on crime in the existing literature is a mixture of these forces and depending on the attractiveness of the wages and unemployment opportunities may yield varying results.

My conjecture assumes that the benefits of crime committed in a far away region is large enough to compensate the cost of traveling. Indeed, there are some anecdotal evidence from the newspapers that some people drive a long distance just to commit crimes, particularly theft. On the other hand, the original intention does not necessarily have to be to commit crime. People may move to a different region to find a job, yet failing to do so in a reasonable period of time may force them to engage in criminal activity. Indeed, conviction numbers of adult males in NUTS-2 level regions in Turkey between 2004 and 2008 show that more than a quarter of all crimes are committed by non-residents, and imported crimes can account as high as 40% of all crimes committed in a region. While the ratio varies across types of crimes, even for violent crimes (murder, physical assault and robbery) it is above 10% at national level and can reach as high as 18% at regional level[2]. Thus, the data allows me to test the effects of wages and unemployment in a particular

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nationals) in the region (e.g., Entorf and Spengler, 2000 and Buonanno and Montolio, 2008, among others.) In this paper I am more concerned about the relationship between labor market opportunities and crimes that are committed by nationals that are not residing in that region.

[2]Detailed statistics on these numbers will be provided later.

region on the crime propensity of residents and non-residents separately. Furthermore, the data set also provides information on the residents of convicts, enabling to assess the what extent pairwise differences in labor market conditions in two regions, one in which crime is committed and the other in which the convict resides, can explain crime.

The findings show that local labor market conditions can not explain crime rates in a particular region in Turkey. However, unemployment rate in a particular region deters non-residents to commit crime whereas higher per capita income has a significant effect attracting non-resident criminals. Thus there is evidence that labor market conditions and crime relationship is beyond locale.

2 Data

The data used in this paper are obtained from Annual Prison Statistics (APS) published by the Turkish Institute of Statistics. They are about convictions rather than reported crimes which has been used in previous studies of crime in advanced countries, and as such, they underestimate actual crime rates[3]. Since this paper's main idea is about imported crimes, it is essential to identify the residence of the criminals and that is only possible if the criminal is caught and tried. As long as there are no discrimination between residents and non-residents in pursuing criminals and judicial treatment, and there is no ground to believe that there is, this should not create any bias in the following analysis. Hence, I will refer to "crimes" rather than "convictions" in the rest of the paper, nonetheless the interpretation should be made carefully.

Originally the data contains information on the type and place of the crime and residence of the convict at provincial (NUTS3) level. Unfortunately, since labor market data is only available at 26 regional (NUTS2) level and only for years after 2004, they had to be aggregated further and limited to five years, 2004-2008. The dataset also reports gender and age bracket (15-24, 25-34 and 35+) of the convicts. Since children and females face different labor market conditions and may have different motives and opportunities to commit crime,

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[3]It is also a fact that even reported crimes are underestimating actual crimes as many crimes, particularly domestic crimes and crimes against children are commonly not reported.

they are left out of the sample[4]. The data is therefore restricted to males over the age of 15.

Figure 1: Crime rates, 1990-2008 (per 100,000)
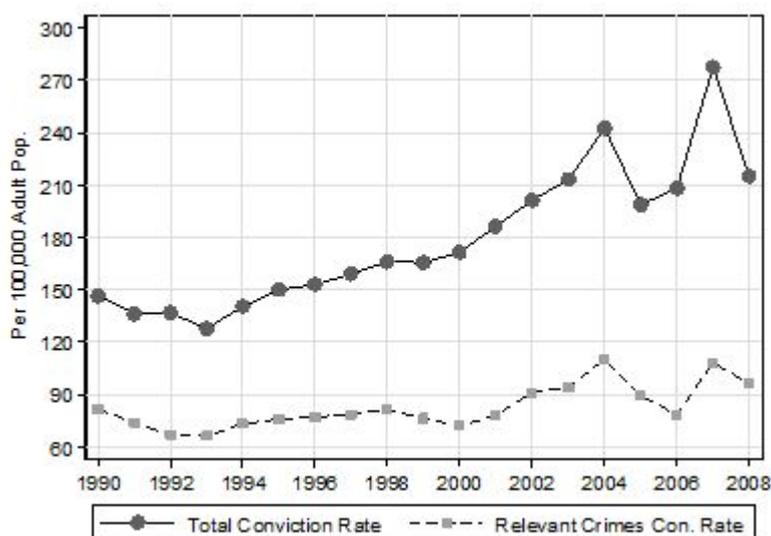
Data provided in APS classify several types of crimes. Clearly, some crimes may be independent of the labor market conditions in the region in which they are committed, for example, traffic violations or avoiding military draft. Financial crimes (swindling, forgery, embezzlement, bribery and smuggling) are also excluded from the data set as they may not be fully related to labor market conditions in the region. The focus is, therefore, on specific types, namely theft, violent crimes (including robbery, homicide, assault and kidnapping), sex crimes and narcotics[5]. These "relevant" crimes constitute on average 42% of all crimes. Note that some of these crimes, for example, murder or rape, may have nonpecuniary motivations. However, the records report most severe crime in a multiple crime incidence and thus it is probable that some of these crimes have indeed been motivated by material gains. But most importantly,

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[4]Moreover, the number of juveniles and females are very small in the dataset to obtain meaningful results.

[5]Around 95% of narcotic crimes are about producing and selling narcotics, the rest is use of narcotics.

as argued by Gould et al. (2002), an increase in legal opportunities, holding everything else constant, should make one less likely to commit any crime as time spent in jail means larger loss in legal revenues. Nonetheless, results that includes all types of crimes are in the same direction as the ones reported here, yet have different magnitudes.

Figure 2: Specific crime rates, 1990-2008 (per 100,000)
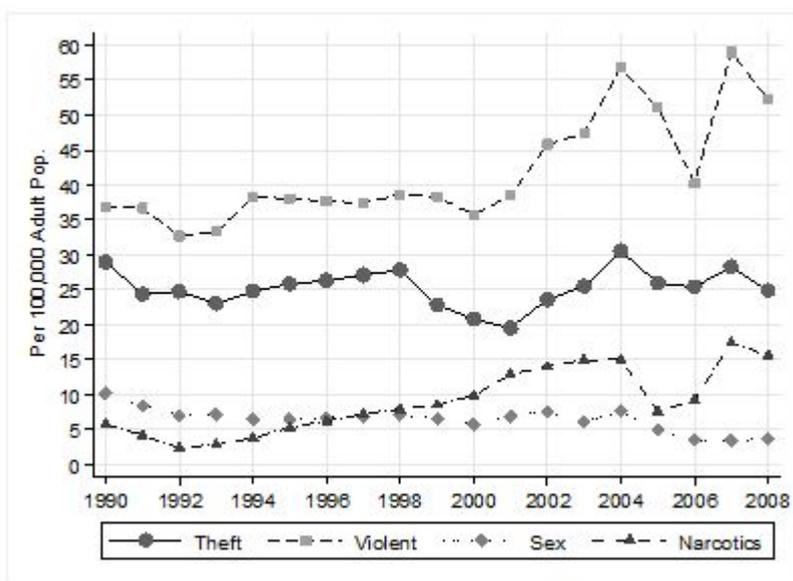
The crime rate in Turkey, or at least the recorded one, is relatively low compared to other countries. Yet the perception within the country is just the opposite[6]. The data used here shows that there is a hike in the crime rates after 2001, the year in which the country had a deep financial crisis and consequently real wages declined around 15% and unemployment rose to unprecedented levels in the history. Even though total crime rates followed an upward trend in the last 15 years, indicating a rise in total crime rates from a minimum of 127 per hundred thousand adults in 1993 to 171 in year 2000, there is a steeper increase since then reaching 277 crimes per hundred thousand adults in 2007 (Figure 1). Relevant crimes, that is, crimes considered in this paper follow a similar pattern, there were 66 crimes per hundred thousand adults in

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[6]A survey conducted by Ipsos in 2009 shows that the second most important concern of Istanbul inhabitants is crime after traffic congestion.

1993, 72 in 2000 and 108 in 2007. Specific crimes, however, exhibit different trends (Figure 2). Thefts, for example, have not increased as expected as that they would after 2001 crisis. Although there is an increase in theft crime rate since 2000, the level reached at the end of the sample period was not much different than earlier years. Sex crimes have even a downward trend. On the other hand, violent crimes increased very rapidly, implying (and perhaps also explaining the worry of the population) that most crimes now involves some violence. Similarly there is a secular increase in narcotic crimes.

During the period, when the relationship between crime rates and labor market conditions examined in this paper, crime rates already reached a relatively high level and do not show a significant trend. Yet there is wide variation across regions (Table 1). There are three times higher crime rates between the most crime-ridden region and low crime region. The difference is even higher when different types of crimes are considered.

Table 1: Crime rates, 2004-2008 (per 100,000)

	All Relevant Crimes	Theft	Violence	Sex	Narc.
Crime Rate in the Region					
Region Avg.	20.8	21.9	47.8	4.4	8.9
Region Std.	5.0	7.0	12.9	1.5	5.3
Region Min.	9.2	9.9	17.4	1.4	2.3
Region Max.	29.7	36.3	69.6	6.5	20.6

Despite labor market regulations are uniform in Turkey, there are also significant variations in unemployment rates and real wages across regions. Table 2 reports statistics on these variables that are derived from Household Labor Force Surveys. Recent work on crime (e.g. Gould et al., 2002; Machin and Meghir, 2004) has shown that wages of less skilled workers are better proxy for those who are at the margin to commit crime. Hence, two set of unemployment rate and wage variables used in this paper, first one includes all wage-earners, the second one focuses only on employees who have less than highschool education. While there seems to be not much of a difference in the average unemployment rates of unskilled and skilled adult males, the average wage of unskilled workers is significantly lower. Regardless whether unemployment and wage measures are based on total population or on unskilled population,

the statistics indicate non-negligible differences in the labor market conditions across regions.

Table 2: Labor market conditions

	Unemp. Rate	UR of Unskilled	Avg. Wage (TL)	Avg. Wage of Unskilled (TL)
Region Avg.	10.1	10.0	0.95	0.63
Region Std.	3.3	3.7	0.12	0.14
Region Min.	5.6	5.2	0.62	0.31
Region Max.	16.8	17.9	1.21	1.00

The main argument of this paper is that labor market conditions in a particular region applies not only crimes committed by residents in that region but also crimes committed by non-residents. Table 3 provides information about "import rates", the ratio of crimes committed by non-residents in a region relative to all crimes committed in that region and "export rates," that is, the ratio of crimes committed by residents of a region in a region other than their own residence to all crimes committed by residents.

Table 3: Crime rates, 2004-2008 (per 100,000)

	Rel. Crimes	Theft	Violence	Sex	Narc.
Import Rates					
Region Avg.	12.7	17.1	9.5	12.1	20.4
Region Std.	4.1	6.0	3.3	4.6	12.8
Region Min.	7.1	8.4	5.0	4.9	3.0
Region Max.	24.5	37.1	18.6	22.9	57.8
Export Rates					
Region Avg.	16.7	21.3	12.3	13.9	30.2
Region Std.	8.0	9.6	6.1	5.7	11.8
Region Min.	9.1	10.5	6.2	7.0	8.3
Region Max.	39.0	47.5	27.9	27.8	54.3

The table shows that on average almost 13% of crimes committed in a region are "imported" and it even reaches 25% for some regions. The figures are much higher for theft and narcotic crimes, though the latter may be due to specific conditions of this particular type of crime. The most interesting finding here is that high shares of non-residents even for violent and sex crimes. "Exported" crime rates are higher than imports, possibly due to size differences

across regions: more populated regions can be more attractive for criminal behavior. These statistics imply that crimes are not restricted to the locale in which the individual lives.

3 Empirical model specifications and results

3.1 Empirical specifications

In this section I analyze the influence of labor market conditions on crime. The starting point is the standard model developed by Ehrlich (1973) where crime rate in a region is related to unemployment rate. The specification also includes real wage as it measures labor market prospects of potential criminals and as previous literature suggests that wages rather than unemployment rate may be more important for criminal decisions.

A third variable included in the specification is income per equivalent adult in the region. A region may be attractive for criminal behavior for two reasons: First, individuals may move to a different region to find a job. In this case labor market conditions would be very important for migration decision. However, failing to find a job in a given period of time may force them to engage in criminal activity. Second, a wealthier region may attract criminals who visit temporarily to commit a crime, particularly property crimes, and there are some evidence in the newspapers of this kind of activity. Per equivalent adult income variable is included to control for the latter motive.[7]

$$C_{it} = \beta_0 + \beta_1 U_{it} + \beta_2 W_{it} + \beta_3 I_{it} + \phi_1 X_{it} + \varepsilon_{it}^1 \qquad (1)$$

where C_{it} is the crime rate in region i at time t, U_{it} and W_{it} are unemployment rate and average wages, respectively, and I_{it} is income per equivalent adult. Following Gould et al. (2002) both labor market variables are constructed for less-skilled group though the results do not vary significantly when average

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[7]On the other hand, individuals with higher income are known to invest more in self-protection (Gould et al., 2002). Indeed, in richer districts in Turkey a lot of housing complexes have private security. Hence how wealth is related to crime is an empirical question. As noted earlier by Öster and Agell (2007), there is yet one other reason to have an income variable in the specification. Average income is correlated with unemployment rate and omission of such a variable can cause biases in the estimates.

wage and unemployment rate within entire population are used and available upon request.

The vector X_{it} includes additional demographic and economic controls as well as a set of time dummies. The time fixed effects eliminate all national trends and thus the impact of labor market variables are identified through within region variation. Ideally one would like to control for unobserved region specific factors by using region fixed effects. However, since the time span is relatively short and there is limited time-variation in the regional variables, the model is estimated with simple OLS. Yet, I hope that additional controls included in the model can partially account for these factors. Nonetheless, fixed effects at a higher aggregate level is included in the model.

The vector X also includes the shares of agriculture and manufacturing in total employment in the region. The dissolution of agriculture, the sector in which skill level is low, may increase unemployment rates in regions that have been primarily relying on agricultural production. The size of manufacturing, on the other hand, may provide an opportunity to be employed. A related variable that is employed in the model is the share of employed people without social security in the region. Labor market regulations in Turkey impose a minimum wage that is higher than the equilibrium wage and consequently we observe a large share of "informal" employment. The extent of this (unlawful) flexibility in a region may attract individuals from neighboring areas to search for employment, yet it may also indicate the lax of deterrence.

Finally, there are also a set of demographic variables in the model. The share of young population is included as unemployment rate is higher for this group and because it has been argued that they may be more likely to commit crimes (at least, some types of crimes). Some studies indicate that the level of education in a region is an important determinant of crime and average level of education is added to the specification along with the size of population and urbanization rate which may have additional effects on propensity to commit crime.

The model is estimated for all crimes as well as for specific types of crimes. The standard model ignores whether individuals commit crime reside in that region or not. Two more specifications based on the presumption that local labor market conditions may have varying effects on residents and non-

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residents are also estimated. These specifications consider exported and imported crimes, that is crimes committed by residents in other regions or crimes committed in a region by non-residents:

$$IC_{it} = \delta_0 + \delta_1 U_{it} + \delta_2 W_{it} + \delta_3 I_{it} + \phi_4 X_{it} + \varepsilon_{it}^4 \tag{2}$$

$$EC_{it} = \gamma_0 + \gamma_1 U_{it} + \gamma_2 W_{it} + \gamma_3 I_{it} + \phi_3 X_{it} + \varepsilon_{it}^3 \tag{3}$$

where IC_{it} and EC_{it} are the ratio of crimes committed in a region i by non-residents to total adult population of the region where crime is committed and the ratio of crimes committed by individuals in a different region other than their own residence i to total adult population of region i, respectively. δ coefficients indicate how attractive conditions in a region are for criminals residing in a different region whereas γ coefficients measure the extent to which local conditions led individuals to commit crime elsewhere.

Finally, I also consider a gravity model. Using more detailed data on region of residence and region where crime is committed, I estimate the effect of distance and labor market conditions in both regions on the imported crimes. In its most elementary form, the gravity model can be written as (omitting time subscript):

$$C_{ij} = \kappa \frac{Z_i^{\beta_1} Z_j^{\beta_2}}{d_{ij}^{\beta_{01}}} \tag{4}$$

where C_{ijt} is the number of crimes committed by residents of region j in region i, κ is a proportionality constant, for $k = i, j$, $Z_k = [U_k \ W_k \ I_k \ X_k]$, $\beta_k = [\beta_{1k} \ \beta_{2k} \ \beta_{3k} \ \phi_k]$ and d is distance which has been measured as the road distance between the centers of regions i and j. Taking logarithms gives:

$$ln(C_{ijt}) = \beta_0 + \beta_0 1 ln(dist) + \beta_{11} U_{it} + \beta_{12} U_{jt} + \beta_{21} W_{it} + \beta_{22} W_{jt} +$$
$$\beta_{31} I_{it} + \beta_{32} I_{jt} + \phi_{11} X_{it} + \phi_{12} X_{jt} + \varepsilon_{ijt} \tag{5}$$

The model has controls for local conditions in both regions where the convict resides and where the crime is committed, as well as a variable to control the distance between two regions centers.

3.2 Results

Table 4 presents the OLS estimates of the coefficients in standard specification (Eq. 1) for all relevant crimes and four different crime types[8]. The specification includes time and higher level region fixed effects as well as control variables discussed above. It appears that neither labor market variable is significant to explain crime[9]. The unemployment variable has the wrong sign (except for violent crimes), an increase in unemployment rate seems to decrease crime, yet it is insignificant in all types of crime but narcotics. This is not uncommon in the previous literature. For example, Fougère et al. (2009) report similar results using panel data. On the other hand, average wages of relatively unskilled workers have a negative but insignificant effect on crime rates. This is in contrast to findings of Gould et al. (2002) and Machin and Meghir (2003). The only variable that has some significance in all crimes regression is income per equivalent adult. There are higher crimes in richer regions, thus one tend to conclude that the attractiveness of wealth overcomes self-protection ability.

The results are very discouraging to explain crime with regional labor market conditions. One possible explanation could be endogeneity of labor market variables. There is evidence that high-income individuals tend to leave cities with high crime rates (Cullen and Levitt, 1996). Roback's (1982) model for labor market also imply that firms in high crime areas may pay higher wages to compensate high crime rates. However, the unit of analysis in this paper are regions. High wage earners may migrate to suburban areas of high crime cities or at most to neighboring cities, but decision to move to a different region is most likely to be exogenous to increases in local crime rates. Nonetheless, following Gould et al. (2002) and using their strategy an instrumental variable approach has been also adopted.

The construction of instruments are based on regional differences in initial sectoral composition, changes in national trends in employment in each region and changes that may benefit specific groups. There is significant divide between western and eastern regions of Turkey, east being more heavily depen-

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[8]The table only reports coefficients of three most important variables. Full results are given in the Appendix.

[9]However, when region specific fixed effects are not included in the regression, the regression R^2 was quite high, around 60%, and average wages have negative and significant coefficients.

Table 4: Effects of labor market conditions on crime in a region

	All Crimes	Theft	Violence	Sex	Narc
Unemp. rate	-0.434	-0.822	0.562	-1.578	-2.696**
	(0.855)	(1.312)	(0.880)	(1.630)	(1.253)
Unskill. wage	-0.370	-0.256	-0.564	-0.787	-0.909*
	(0.351)	(0.344)	(0.413)	(0.527)	(0.477)
ln(Inc. per e.a.)	0.365**	0.355*	0.369*	0.182	0.533**
	(0.169)	(0.179)	(0.188)	(0.226)	(0.207)
ln(Pop)	0.164	0.254	0.101	0.214	0.329
	(0.183)	(0.203)	(0.193)	(0.217)	(0.288)
Urb. rate	-0.157	0.158	-0.415	-1.934***	0.870
	(0.494)	(0.666)	(0.461)	(0.576)	(0.785)
Educ	0.152	0.170	0.251*	0.367***	-0.110
	(0.119)	(0.176)	(0.124)	(0.126)	(0.121)
Sh. of young	-0.096	0.364	-0.764	0.422	3.092
	(1.231)	(1.521)	(1.445)	(1.654)	(1.875)
Sh. of agr.	0.802	0.748	1.832**	0.288	-3.745***
	(0.651)	(0.751)	(0.774)	(0.971)	(0.911)
Sh. of man.	1.506	1.843	1.755*	2.736**	-1.794
	(1.095)	(1.141)	(0.978)	(1.080)	(1.752)
Unreg. Empl.	0.173	0.174	-0.183	-0.110	1.027
	(0.774)	(1.063)	(0.823)	(1.042)	(0.815)
Constant	-2.676	-5.782	-3.018	-4.913	-6.421
	(4.106)	(4.139)	(4.269)	(4.452)	(5.588)
Observations	130	130	130	130	130
R-squared	0.715	0.765	0.731	0.823	0.846

Regressions include a set of aggregate region specific fixed effects.

Standard errors in parentheses. They are robust to heteroskedasticity and consistent with respect to correlation within regions.

*** p<0.01, ** p<0.05, * p<0.1

dent on agriculture and have larger share of young population, although both the importance of agriculture and fertility rates are declining in the last couple of decades. Furthermore, there is a secular trend in educational attainment particularly within young population. Based on these observations, components of predicted change for six age-education groups' (ages 15-24, ages 25-34 and ages35 or more, education less than highschool and highschool or more) shares of employment are used as instruments for three variables, unemployment rate of unskilled population, unskilled wage and income per capita.

After controlling for demographic variables, the partial R^2 between sets of instruments and labor market variables are 0.11 for unskilled employment, 0.32 for wage rate and 0.11 for per capita income. While not reported here, the coefficients are still insignificant. The standard errors are now much larger compared to OLS estimates as the instruments are only partially correlated with independent variables. The coefficients for unemployment rate have same sign but larger in magnitudes while the instrumental variable coefficients for wage rate are closer to zero. The results indicate that endogeneity is not what is driving the results. If there is a bias, it is downwards for both variables. Thus in the rest I will only report OLS estimates.

Now I turn to estimates from regressions for imported and exported crimes. The upper panel of Table 5 presents the results for 'import regressions'. For all relevant crimes, the coefficient of unemployment rate is negative and significant. Since the model is estimated in logarithmic form, the coefficient implies that a one percent increase in unemployment in a particular region reduces the crimes committed by non-residents 2.7%. Interestingly, the effect of unemployment rate is more significant on violent and sex crimes, and insignificant for property crimes. A plausible explanation for this finding would be that an increase in the unemployment rate of unskilled labor does not discourage criminals to travel for property crimes. Indeed, the coefficient of wealth measure is much higher for theft than violent and sex crimes. The wage variable has negative coefficient as well and is statistically significant for aggregated crime measure and for theft and violent crimes. A 10% increase in real wages of unskilled workers decreases imported crimes over 6% and reduces thefts by non-residents by almost 10%. Thus, worsening of labor market prospects in a region reduces its attractiveness. On the other hand, per capita income in a

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region is positively related to all types imported crime except sex crimes, and it is the only significant variable in narcotic crimes regression.

Table 5: Import and Export Regressions

	Imports Regressions				
	All Crimes	Theft	Violence	Sex	Narc
Unemp. rate	-2.765**	-1.119	-3.093**	-6.198**	-1.747
	(1.299)	(2.106)	(1.409)	(2.407)	(2.381)
Unskill. wage	-0.636**	-0.975***	-0.567**	-0.345	-0.456
	(0.287)	(0.223)	(0.234)	(0.484)	(0.934)
ln(Inc. per e.a.)	0.810***	0.812***	0.677***	0.193	1.125***
	(0.187)	(0.192)	(0.221)	(0.326)	(0.365)
Observations	130	130	130	122	125
R-squared	0.788	0.803	0.718	0.442	0.694
	Exports Regressions				
Unemp. rate	1.924	3.057**	2.677**	3.982*	-0.094
	(1.231)	(1.390)	(1.055)	(2.021)	(2.320)
Unskill. wage	-0.552**	-0.475	-0.679***	-0.454	-0.928
	(0.235)	(0.378)	(0.243)	(0.555)	(0.590)
ln(Inc. per e.a.)	-0.018	-0.124	0.212	-0.333	-0.163
	(0.128)	(0.187)	(0.138)	(0.366)	(0.287)
Observations	130	130	130	125	129
R-squared	0.806	0.707	0.745	0.459	0.787

The regressions include all other variables as in Table 4.
Standard errors in parentheses. They are robust to heteroskedasticity and consistent with respect to correlation within regions.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The lower panel of Table 5 provides estimation results for 'exports' of crime. The coefficients of labor market variables have expected signs, yet not all of them are significant. While unemployment rate variable is insignificant in all crimes regression, it is significant for theft and violent crimes at conventional levels. In other words, increasing unemployment of unskilled workers in a region induces some of its residents to seek for gains in other regions and at times in the form of illegal activity.The coefficient of unskilled wage is also negative but significant only for violent crimes. Narcotic crimes, once again, seems to be independent of the local labor market conditions. Overall, these results are in line with the existing literature, for example Gould et al. (2002) or Öster and Agell (2007), except in this paper the coefficients are for crimes

committed by non-residents.

The failure of finding any significant relationship between labor market variables and crimes committed in a region could be due to aggregation. Yet, estimates for 'imports' and 'exports' regressions, even at the same aggregation level, indicates that market prospects have differential effect on residents and non-residents in the region where crime is committed. Furthermore, the differences in significance and magnitude of labor market variables on attracting non-resident criminals to a region or on providing incentives to travel abroad and commit crime suggest a different approach where both conditions in the region where the crime is committed and residence of the criminal are taken into account. The gravity model is formed to deal with this problem as well as controlling for distance which is most likely a significant factor to deter criminal mobility. Table 6 reports the OLS estimates of gravity equation.

Table 6: OLS Estimation of Gravity Model

	All Crimes	Theft	Violence	Sex	Narc
Distance	-0.656***	-0.501***	-0.495***	-0.080***	-0.372***
	(0.034)	(0.032)	(0.033)	(0.023)	(0.052)
UR in Crime Region	-4.048***	-1.953*	-3.445***	-2.311**	-1.072
	(0.999)	(1.082)	(0.993)	(0.935)	(1.424)
UR in Residence	0.049	0.037	0.725	0.189	0.596
	(0.913)	(0.992)	(0.902)	(0.934)	(1.574)
Wage in Crime Region	-0.003	-0.255	-0.245	-0.424	0.616*
	(0.213)	(0.218)	(0.224)	(0.276)	(0.359)
Wage in Residence	-0.043	0.180	-0.189	0.067	0.071
	(0.224)	(0.226)	(0.210)	(0.203)	(0.357)
Inc in Crime Region	0.379***	0.309***	0.202**	-0.065	0.408***
	(0.093)	(0.105)	(0.097)	(0.107)	(0.144)
Inc in Residence	-0.082	-0.097	-0.138	-0.076	-0.140
	(0.096)	(0.111)	(0.097)	(0.112)	(0.152)
Observations	2,361	1,618	1,857	526	942
R-squared	0.643	0.561	0.512	0.233	0.517

The regressions include all other variables as in Table 4.
Standard errors in parentheses. They are robust to heteroskedasticity and consistent with respect to correlation within regions.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The gravity model allow distance as an explanatory variable in the model.

Higher distance between two regions make it less beneficial for criminals to travel just to commit crime. On the other hand, it may also imply that people seeking employment may not travel too far away. The latter argument is relatively weak in the case of Turkey, as evidence shows that most people migrate to big metropolises, such as Istanbul, Ankara or Izmir, regardless of their residence (more than 40% of migrants between 2010 and 2011 moved to big cities, and in 2011 half of the Istanbul population consists of migrants who moved to the city at one point in time). As such, distance between two regions could be interpreted as an important deterrent of crime mobility. The coefficient of this variable is statistically significant for all types of crimes and implies a six percent decline in all crimes when distance increases ten percent.

More importantly estimation results show that it is conditions in regions where crime is committed matters most. The unemployment rate at the crime region has a negative and significant effect on crime mobility and this is true for all crimes but narcotic crimes whereas unemployment rate in the residence region of criminals have positive but insignificant effect. Unemployment rate has smallest and relatively less significant effect on theft crimes among all other types. Regression results also indicate that wages whether in the region of crime or the residence region of criminals are not significant, except narcotic crimes for which there is some weak evidence that higher wage regions attract more criminals. Income per capita in the crime region is another significant variable. It turns out to be income is an indicator of illegal rather than legal opportunities, as similarly reported by Enthorf and Spengler (2000) for Germany. The coefficient is highest for narcotic crimes, possibly higher income means more potential users of narcotic drugs. Per capita income in the residence of criminals has expected negative sign yet it is insignificant for all crime types.

In the estimation above we had originally 650 region pairs per year, totalling 3,250 observations. There were non-negligible zero incidences, which were omitted from the total set of observations due to the use of logarithmic transformation. Suspecting that such censoring could lead to biased estimates, all equations above estimated using hurdle regressions which combines a binary model to predict zero outcomes and a zero-truncated negative binomial model to predict non-zero counts (Mullahy, 1986; Cameron and Trivedi, 1998). The

Table 7: Hurdle Model or Gravity Equation

	Probability of Zero Incidence	Crime
Distance	1.264***	-0.847***
	(0.115)	(0.026)
UR in Crime Region	10.501***	-4.464***
	(2.574)	(1.073)
UR in Residence	3.739	-0.254
	(2.557)	(0.956)
Wage in Crime Region	1.025*	-0.010
	(0.602)	(0.304)
Wage in Residence	-0.082	-0.116
	(0.631)	(0.238)
Inc. in Crime Region	-0.865***	0.741***
	(0.311)	(0.123)
Inc. in Residence	0.279	-0.231**
	(0.309)	(0.112)
Observations	3,250	2,361

The regressions include all other variables as in Table 4.
Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

model assumes that two processes generating the zero and the positive values are not constrained to be the same. A binomial probability determines the binary outcome, and when the "hurdle" is crossed the conditional distribution is a truncated-at-zero count model.

Table 7 present results of hurdle regression model for all relevant crimes. The first column reports coefficients of variables that affect the probability of observing zero crime mobility. The coefficient of distance is positive and zero, that is, the farther away a region the more likely to observe zero incidence. An increase in the unemployment rate and a decrease in per capita income in the crime region also yield the same result, whereas an increase in the unskilled wage in the crime region reduces the probability of crime mobility.

Coefficient estimates conditional on crossing zero hurdle are reported in the second column of the table. The coefficients have similar signs as OLS model implying that censoring does not cause any serious bias in the original model. The only difference is that per capita income in the residing region is

Table 8: Hurdle Model or Gravity Equation for Specific Crimes

	Probability of Zero Incidence	Crime	Probability of Zero Incidence	Crime
	Theft		Violence	
Distance	1.175***	-0.811***	1.140***	-0.803***
	(0.091)	(0.037)	(0.091)	(0.035)
UR in Crime Region	9.862***	-1.599	7.685***	-5.252***
	(2.501)	(1.731)	(2.397)	(1.576)
UR in Residence	1.893	0.879	3.588	1.404
	(2.368)	(1.387)	(2.325)	(1.335)
Wage in Crime Region	1.291**	-0.470	-0.229	-0.690
	(0.636)	(0.525)	(0.595)	(0.456)
Wage in Residence	0.372	0.213	0.464	-0.719**
	(0.582)	(0.361)	(0.571)	(0.334)
Inc. in Crime Region	-1.035***	0.801***	-1.003***	0.462***
	(0.301)	(0.182)	(0.288)	(0.177)
Inc. in Residence	0.614**	-0.271*	-0.308	-0.233
	(0.287)	(0.161)	(0.281)	(0.153)
Observations	3,250	1,618	3,250	1,857
	Probability of Zero Incidence	Crime	Probability of Zero Incidence	Crime
	Sex Crimes		Narc Crimes	
Distance	0.853***	-0.385***	1.067***	-0.765***
	(0.091)	(0.106)	(0.088)	(0.064)
UR in Crime Region	7.766**	-10.690*	10.042***	-3.135
	(3.256)	(5.982)	(2.824)	(3.270)
UR in Residence	-1.343	3.444	1.240	5.899***
	(2.997)	(3.879)	(2.772)	(1.959)
Wage in Crime Region	-0.334	-2.240	1.124	0.784
	(0.944)	(1.841)	(0.768)	(0.918)
Wage in Residence	0.652	-0.035	-0.872	1.327***
	(0.794)	(1.061)	(0.715)	(0.441)
Inc. in Crime Region	-0.806**	-0.197	-1.201***	1.318***
	(0.389)	(0.689)	(0.338)	(0.348)
Inc. in Residence	0.681*	-0.473	0.158	-0.152
	(0.362)	(0.515)	(0.337)	(0.266)
Observations	3,250	526	3,250	942

The regressions include all other variables as in Table 4.

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

significantly reduces number of crimes committed elsewhere.

The hurdle regression estimates for individual crimes are reported in Table 8. The signs of coefficients are similar to aggregate crime, yet for different crimes different variables are significant. For theft, the variables that matter are distance and per capita income in the region where crime is committed, both larger in magnitude compared to violent crimes. For violent and sex crimes unemployment rate in the region of crime is a major deterrent. Once again, narcotic crimes have completely different motives. While income in the crime region increases narcotic crimes by non-residents providing possibly a large market for their products, higher unemployment in the residence region increases the number of crimes committed by these non-residents, possibly providing more incentives to engage in criminal activity.

4   Conclusion

Existing literature relating crime to labor market prospects in a region assumed zero crime mobility. However, even regional level aggregate data from Turkey shows that significant amount of crimes committed in a region are by non-residents. These non-resident criminals could be either those who travel just to commit crime or migrants seeking employment opportunities failing to do so may choose to commit crimes. While it is not possible with the existing data to differentiate between the two groups, this paper investigates how local labor market conditions affect criminal behavior of both resident and non-resident population.

Using regional panel data from 26 regions in Turkey from 2004 to 2008, the paper finds that local labor market conditions are not capable of explaining crime rate in a region. However, differences in unemployment rates and wages of unskilled group has significant effects to explain crimes committed by non-residents. Both higher unemployment rates and higher wages in a region reduces 'imported crimes' in general, yet the importance of these variables differ for specific crimes. While wages are more important for property crimes by non-residents, violent crimes are affected by unemployment.

Using information on both the region where the crime is committed and region of the residence of the criminals a gravity model is estimated. The

results imply that only unemployment rate and per capita income in the crime region determine 'crime trade'. Wages which has been argued to be more relevant do not have any significant effect on crimes in Turkey.

From a policy perspective, local measures to eliminate unemployment may reduce crimes committed by residence, however in the presence of perfect mobility of individuals this may lead only to more crime in that region. Thus, labor market policies has to be coordinated at a national level.

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