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ABSTRACT: The growth in the number of tourist arrivals in Spain in recent years has had significant economic repercussions; yet, little has been reported about its negative impact. This study goes some way to rectifying this by estimating the impact of tourist activity on crime rates in the Spanish provinces during the period 2000-2008. We use both 2-SLS and GMM techniques in a panel data framework to overcome the various challenges posed by estimating this relationship, namely, controlling for the unobserved characteristics of the provinces, and accounting for both the possible endogeneity of the tourist variable and the inertia of criminal activities. The results show that tourist arrivals have a positive and significant impact on crimes against both property and the person.

JEL Codes: C23, H50, I2, J24, K24

Keywords: Crime, tourism, seasonality.

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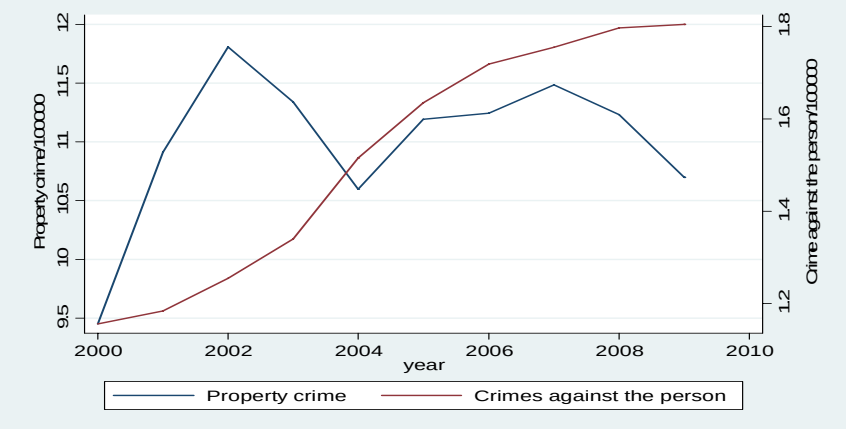
1. Introduction

Crime is a major concern in many countries affecting directly (and indirectly) the decisions of economic and social agents and, hence, the efficiency and development of the overall economy. In Spain, in 2008, the Center of Sociological Research (CIS) reported that citizen insecurity was one of the three main concerns for almost one in every five Spaniards.[3] To tackle these concerns, the Spanish government allocates an average of 2.1% of public expenditure to law enforcement.[4] Yet, the recent evolution in criminal activity (including both crimes against property and against the person) in Spain presents an upward trend. However, while this trend is steeper for crimes against the person, the total number of property crimes is ten times higher.

Figure 1: Property crime and crime against the person



Source: Based on INE data. Note: The provinces of Barcelona, Tarragona, Girona, Lleida, Alava, Guipuzcoa, Navarra, Vizcaya and Ceuta and Melilla are excluded.

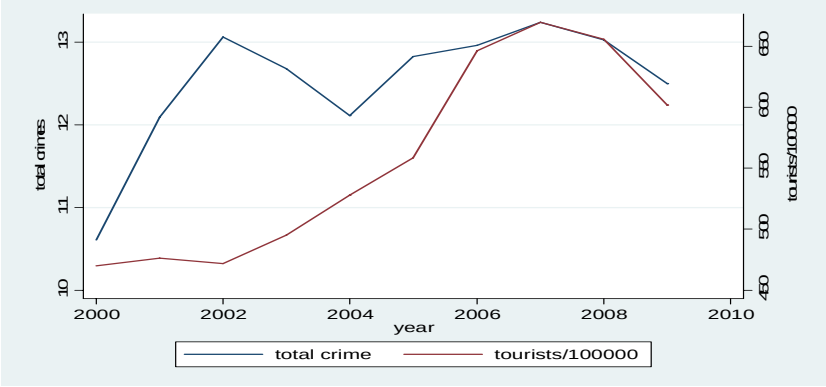
Spain's tourist activity (albeit characterized by a markedly heterogeneous distribution across regions) is of great importance to the Spanish economy. In 2008, 11.5% of its total gross domestic product (GDP) and 10% of its total employment were provided by the tourist sector.[5] The importance of tourism both

[3] Note citizen insecurity does not include concerns about terrorism.
[4] The main law enforcement agencies in Spain are the *Guardia Civil* with 82,812 police officers and the *Cuerpo Nacional de Policía* with 66,038 officers in the year 2009. This does not include local police agencies, the regional police agencies of Catalonia, the Basque Country and Navarra, and the *Servicios de Vigilancia Aduanera*, which are therefore excluded from this analysis.
[5] These estimates reflect the (direct) share of the tourist sector in GDP and employment and, as such, the indirect benefits of tourism are not taken into account.

in terms of production and employment is based on the arrival of 59 million tourists in 2008, making Spain one of the main European destinations, second only to France.

Given the growing importance of tourism, especially over the last ten years, it has become essential to account not only for the benefits of these visitors but also for their costs. One of the potentially negative impacts that has not to date been examined empirically for the Spanish case is the effect that tourists might have on criminal activity. Indeed, an initial examination of the evolution of the two variables (i.e., tourism and crime rates) shows that both have experienced an upward trend in the last ten years (see Figure 2). Given the relevance of both variables for the Spanish case, the aim of this study is to disentangle the potentially causal relationship between tourism and crime rates and, more specifically, to determine whether or not tourist arrivals are responsible for negative externalities in terms of increased criminal activity. Thus, we empirically estimate the effect of tourist arrivals on crime rates (distinguishing between minor and serious crimes against both property and the person) for Spanish provinces in the period 2000-2008 taking into account potential endogeneity problems. Indeed, there is a large body of empirical evidence pointing to the fact that criminal activity acts as a deterrent to tourism, which gives rise to a reverse causality problem when estimating the effect tourism has on crime. In order to obtain unbiased and consistent estimates, we correct this potential endogeneity problem by applying a recently developed instrument in the literature of the economics of crime. Additionally, we construct a seasonality index of tourist arrivals, as a proxy for tourism quality, so as to capture its effect on crime rates.

Figure 2: Total number of crimes and tourists arrivals evolution



Source: Based on INE data. Note: The provinces of Barcelona, Tarragona, Girona, Lleida, Alava, Guipuzcoa, Navarra, Vizcaya and Ceuta and Melilla are excluded.

The rest of the paper is structured as follows: section 2 presents an empirical literature review of the relationship between tourism and crime. Section 3 presents the empirical strategy as well as the data and variables used, while section 4 presents the main results obtained. Finally, section 5 presents a concluding section and discusses the policy implications derived from our results.

2. Literature review: tourism and crime, a dual relation

Since Becker's (1968) seminal model, which established that the committing of a crime is a rational decision based on a maximization problem given a certain level of benefits from legal and illegal activities, and given a certain probability of being apprehended, various attempts have been made to examine the determinants of criminal activities in a variety of countries, over a range of time spans and adopting different techniques. These include, for example, the studies of Ehrlisch (1973) and Grogger (1998) for the United States; Entorf and Spengler (2000) for Germany; Buonanno (2006) for Italy and Buonanno and Montolio (2008) for Spain. The literature on the economics of crime is broad (and expanding) and concerns itself with many aspects, including the relationship between personality and drug consumption (Fajnzylber *et al.* 2002), age profile and crime (Usher, 1997), as well as the impacts of urbanization levels (Glaeser *et al.* 1999) and unemployment rates (Freeman, 1991) on crime.

The relationship between crime and tourism has also been studied over the last forty years, the body of literature taking three main approaches:

2.1. The impact of tourism on criminal activity

This approach analyses tourist destinations to determine whether, in aggregate terms, a relationship exists between tourism and crime. The principal argument is that tourism may stimulate economic activity in the recipient region, which, as Gould (2002) points out, could result in more job opportunities for residents (and, hence, lower crime rates) or higher salaries and higher returns on illegal activities (and, hence, higher crime rates). The overall effect remains, therefore, an empirical question. Representative studies of this approach include McPheters ***et al.*** (1974) for the case of Miami, Jud (1975) for that of Mexico and Albanese (1985) for Atlanta. These studies find a positive and significant effect of tourist arrivals on property crimes; however, they report a low level of significance of the effect of tourism on crimes against the person.[6]

This line of the literature typically assumes causality operating in the direction from tourism to crime; in other words, the exogeneity of the tourist variable with respect to crime rates is commonly assumed. However, crime also acts as a deterrent to tourism. As Gunn (1973) points out, crime rates are important when tourists make decisions about their destinations and a number of studies report a significant deterrent (see Levantis ***et al***. (2000) and Alleyne and Boxill (2003)) to the effect that high crime rates lead tourists to choose alternative destinations. Thus, there is evidence of the existence of a reverse causality, which if not tackled properly can result in inconsistent estimates.

Only a number of very recent studies have properly addressed this issue of causality, (Grinols ***et al***., 2011; Biagi and Detotto, 2012; and Biagi ***et al.,*** 2012), and it is one we seek to examine more fully here.

[6] The reasons forwarded for this outcome include the change in the economic structure from that of an agricultural- to a tourism-based economy (see Fujii and Mak, 1979 or Fukunaga, 1975), and the possible specialization in a type of tourism associated with prostitution and drugs (see Urbanowicz, 1977 and O'Donnell ***et al.,*** 1980) or with gambling (see Ochrym, 1990; Giacopassi, 2000; Moufakkiv, 2005; Grinols ***et al.,*** 2006 and Walker, 2008).

Grinols *et al.* (2011) using a simultaneous equation model to control for the reverse causality between crime and tourism, different specifications of tourist activity and a large panel data set on national park visitors in the United States, show that tourism has no effect on crime. However, their results are not in line with previous studies and are likely to be conditioned by the kind of tourism they analyze. Biagi and Detotto (2012) analyze the effect of tourism on crime in 2005 for the Italian provinces taking into account spatial correlations using a spatial lag model and a spatial error model. Their results show a positive and significant effect of tourism on crime. Biagi *et al.* (2012), applying a generalized method of moments (GMM) estimation, find on average a positive effect: a one-percent increase in the number of tourists in an Italian province leads to a 0.018% rise in the crime rate per 100,000 inhabitants.

2.2. Tourists as victims

The second approach adopted in analyses of the relationship between tourism and crime sees tourists as the victims of crime. Thus, the studies reviewed up to this point do not explicitly account for who the victims or the offenders are; rather, they concern themselves with whether living in a tourist area is synonymous with a higher risk of being victimized. Here, therefore, we review those contributions that aim to identify the victims of crime and, as such, examine the propensity of tourists to suffer criminal acts.

Ryan (1993) analyzes why tourists may make more obvious targets for criminals. Among the main explanations offered is the fact that tourists are less likely to report a crime, which reduces the probability of the offender being apprehended. In addition, the fact that tourists tend to spend more time outdoors (Maxfield, 1987) and are more likely to carry valuable items (including cash) mean offenders can expect higher benefits from committing crimes against tourists. Brunt *et al.* (2000) report that English tourists suffer more robberies when on holiday than they do at home. However, while this conclusion is based on a descriptive analysis lacking any econometric analysis, this line of literature also identifies a positive impact of tourism on crime rates.

2.3. Tourists as criminals

Alternatively, tourists may be cast as criminals rather than as victims, especially in sociological terms, but not, to the best of our knowledge, in economic terms.[7] Sharpley (1994) reports that some tourists are quite likely to behave differently when on holiday since the change in their routine may lead to a degree of irresponsible behavior. Higher crime rates are typically associated with the consumption of alcohol and drugs; hence, the presence of these "leisure" activities in certain tourist destinations may determine, at least in part, that some tourists engage in criminal activity.

In short, the preceding review of the literature examining the relation between tourism and crime reveals, in our view, certain weaknesses in the empirical strategies adopted. First, some studies base their results on (simple) comparisons of descriptive statistics between tourist and non tourist destinations (see, for instance, Jud, 1975; Ochrym, 1990; and Giacopassi, 2000); however, they take no steps to avoid the problem of omitted variables or to address causation issues adequately.

Second, other studies, including Fujii and Mak (1979), Jud (1975) and Pizam (1982) use cross-sectional or time series data. Despite certain advantages, the use of such data sets means that the intrinsic characteristics of each observation cannot always be captured and so estimations might be biased as they overlook important unobserved characteristics. Moreover, assuming exogeneity of the tourist variable with respect to crime rates, as the vast majority of studies do, is a major assumption.

In order to avoid these shortcomings, below we estimate a crime equation, as widely adopted in the economics of crime literature, using panel data techniques to overcome the omitted variable problem. At the same time, so as to overcome the endogeneity problem of the tourism variable, we estimate the equation using two-stage least squares (2-SLS) with the predicted number of tourists in each

[7] Ryan (1993) claims that problems of data availability may account for this absence of economic studies.

province and year as an instrument. Moreover, we use a GMM approach as a robustness check and to capture the possible existence of inertia of the criminal activity.

3. Data and empirical approach

3.1 Data and variables

In this study we use crime data[8] supplied by the Spanish Home Office (*Ministerio del Interior*, MIR) in its annual report, *Balance MIR* (2009). This supplies a summary of all crimes reported by the main Spanish police agencies[9], by province between 2000 and 2008, classified by type and severity.[10]

Given the availability of panel data at the province level, we are able to carry out estimations that take into account unobservable characteristics of each province (for instance, the number of police officers or the extent to which a criminal act is "socially accepted").[11] The following equation presents the simplest empirical approach:

$$Crime^{k}_{it} = \alpha_i + \alpha_t + \sum_z \beta_z (tourists_{it})_z + \sum_m \phi_m (socio\_econ_{it})_m + \sum_l \gamma_l (deterrence_{it})_l + \varepsilon_{it} \qquad (1)$$

where *i* denotes the province, *t* the year and *k* the type of crime: α_i is the fixed effect for each province that captures all their unobserved characteristics, while α_t represents the fixed time effect that captures all changes common to all provinces but which change over time. ε_{it} is the idiosyncratic error term.

[8] Table 1 presents the descriptive statistics of all the variables used.

[9] According to the *Centro de Investigaciones Sociológicas* (CIS), the crimes reported by the "*Cuerpo Nacional de Policia*" and "*Guardia Civil*" account for 77% of the total.

[10] The Spanish police agencies are organized by province. However, because of decentralization, over the last thirty years the Basque Country, Navarra and Catalonia have set up their own police agencies (*Ertzaina* in the case of the first two regions and *Mossos d'Esquadra* in the third) which operate separate crime registers. Therefore, we exclude from our analysis the Basque provinces of Álava, Guipúzcoa, Vizcaya; the Catalan provinces of Barcelona, Girona, Tarragona and Lleida; and Navarra.

[11] Sah (1991) claims that individuals who grow up in environments with high crime rates are more likely to commit crimes since the social punishment (or peer pressure) imposed by the (local) community is lower.

Dependent variable

$Crime^{k}_{it}$ represents the logarithm of the reported crime rate (expressed as the ratio between the reported crime and 1,000 inhabitants) of type *k* in province *i* in year *t*. The Spanish Home Office provides data on the type of crime (against the person or against property) and on the severity of the crime (faults and serious crimes). Faults are defined as crimes that receive non-custodial sentences whereas serious crimes are usually punished with prison terms. Clearly the motives for each crime type differ, and as Cherry *et al.* (2002) point out: "(…) it is inappropriate to pool crime types into a single decision model (…) much of the existing empirical evidence suffers from aggregation bias". Given that we can distinguish between property crimes and crimes against the person, we can eliminate such bias from our estimations.

Tourist variables

Our main variables of interest are included in the vector "$tourists_{it}$" in Eq. (1). We first include the logarithm of the total number of tourists (labeled "**tourists**"). As explained in section 2, the arrival of tourists is expected to boost crime rates although certain characteristics of tourist demand, such as seasonality, need to be taken into account. Thus, we include the variable "**season**" to capture a certain type of tourist presenting a marked seasonal pattern (sun and sand tourists, mass tourists, etc.) which could be indicative of agglomeration and low quality. In fact, as Capó *et al.* (2006) point out, hotel quality has a positive influence on the length of the season and, as such, it affects negatively the level of seasonality. In order to measure the seasonality of tourist demand for each province and year, we use an entropy index (see Theil, 1967).[12]

$$Entropy_{it} = \frac{1}{\beta(\beta-1)} \sum_{k=1}^{12} \left[\left(\frac{y_k}{\eta_i} \right)^{\beta} - 1 \right] \qquad (2)$$

[12] As a robustness check, a Gini index has also been computed and used providing similar outcomes to those presented in the results section.

where η_i represents the tourist arrivals in province *i* and y_k represents the tourist arrivals in each province in each month. Thus, we obtain an index of seasonality for each province and year. β represents the parameter that defines that part of the distribution to which we want to give most weight in terms of tourist arrivals. The larger β is, the more weight we give to changes in the upper part of the distribution (that is, months with high numbers of tourist arrivals). In our analysis we use $\beta = -1$ giving more weight to changes in the lower part of the distribution[13] (months with low numbers of tourist arrivals). The seasonality indices present values that range from 0.002 in 2001 in the province of Las Palmas de Gran Canaria (Canary Islands), indicating low seasonality, to 0.82 for the case of the Balearic Islands in 2009, indicating high seasonality. In principle, we associate high seasonality with "low quality" and, hence, with higher crime rates; however, given the markedly provincial distribution of this index we do not expect a specific sign for this variable given that higher seasonality might also be associated with more job opportunities and, hence, more legitimate (job) opportunities in those provinces.[14] Whatever the case, the need is clear when conducting the estimations of the impact of tourism on crime to control for the seasonality of tourism.

Socio-economic variables

In Eq. (1) all the potential socio-economic determinants of crime are included in the vector $socio\_econ_{it}$. These variables are drawn from a variety of sources including the Spanish National Institute of Statistics (INE), the Valencian Institute of Economic Research (IVIE) and the Annual Report of *La Caixa* (see Table 1 for the descriptive statistics of the variables used).

The unemployment rate may, as discussed by Freeman (1991), affect crime rates both positively or negatively. In line with the Becker-Ehrlich model, unemployment means a lower opportunity cost of committing crime since the income derived from legitimate activities is lower as unemployment benefits always

[13] Using other values of β does not change the results significantly.
[14] Note that the two provinces that lie at the extremes of the seasonality index, Las Palmas de Gran Canaria and Balearic Island, are two of Spain's leading tourist resorts with similar patterns of tourism demand and supply.

forms a part of the salary. However, Freeman (1991) finds that the majority of offenders are employed when they commit a crime while, additionally, Witt *et al*. (1999) find that men are more prone to commit crimes. Consequently, we include the variable "**male_unemploy**" defined as the male unemployment rate in order to account for the effect of unemployment on crime.

We also include the youth rate ("**youth**") to reflect the effect of individuals aged between 15 and 30 on crime rates. As Freeman (1991,), Grogger (, 1995, 1998) and Levitt and Lochner (2001) point out, youths are more prone o commit crimes since their opportunity cost is much lower.

Glaeser and Sacerdote (1999) show that crime rates may be higher in urban areas since the probability of being arrested is lower and the benefits of committing a crime are greater with cities bringing individuals of low and high incomes into much closer contact. Moreover, there exist economies of scale in criminal acts since stolen goods are more easily sold on the black market and in large urban areas there is a lower probability of being recognized by victims. In order to capture this effect we add the variable "**urbanization**" to account for the percentage of inhabitants living in urban areas with more than 20,000 people.

The gross domestic product (GDP) is an approximation of the benefits that criminals may expect to obtain in both the legal and the black markets. If GDP captures the potential benefits of committing a crime, we would expect a positive sign in the crime regression. However, Fleisher (1966) states that GDP may also be an indicator of people's purchasing power. Consequently, a negative sign would also be expected. In this study we use an inequality measure ("**relative_gdp**") which captures the degree of inequality in the distribution of income across provinces. Values of the variable higher than 1 indicate that the province is richer than the provincial mean.

Closely related to income dynamics is the variable "**gdp_growth**" which accounts for the growth in GDP in each province. A higher GDP growth rate implies a more dynamic labor market as well as more potential benefits from legitimate opportunities. Therefore, it should, a priori, have a negative impact on crime rates.

Usher (1997) claims that education has a "civilizing effect". Consequently, we expect a negative sign for the variable "**education**" both for crimes against property and against the person. The variable is defined as the ratio between the number of people with 15 or more years of education and the total population in each province and year.

The labor market opportunities normally encountered by the immigrant population, many of whom do not hold the necessary work permits, might also be a determinant of their propensity to commit crime. Thus, illegal immigrants may be more prone to commit crimes as they have fewer opportunities of obtaining rents from legal sources. Given that illegal immigration data are not available for the Spanish provinces, this effect cannot be directly included in our estimates. However, the variable "**immigrants**", defined as the ratio between the number of immigrants in each province and the total population, seeks to capture the effect.

Deterrence variables

We include the rate of detentions defined as the total number of detentions divided by the total number of offences and distinguishing by type of crime ("**detention_person**" and "**detention_proper**"). We also include the clearance rate defined as the ratio of cleared crimes with respect to total crimes for both crimes against persons ("**clearance_person**") and property crimes ("**clearance_proper**").

Table 1: Descriptive statistics

Variable	Definition	Obs.	Mean	Std. Dev.	Min.	Max.
minor crimes person	(Minor crimes person/pop)*1,000	378	2.006	0.588	0.867	4.388
minor property crimes	(Minor property crimes/pop)*1,000	378	9.580	5.415	1.317	26.949
serious crimes person	(Serious crimes person/pop)*1,000	378	1.897	0.853	0.536	4.935
serious property crimes	(Serious property crimes/pop)*1,000	378	13.892	8.353	1.575	49.388
tourists	# tourist arrivals	378	1,315,207	1,613,479	160,071	9,307,724
season	Theil entropy index	378	0.058	0.099	0.002	0.752
male_unemploy	(unemployed/pop)*100	378	7.695	3.701	1.525	21.153
youth	(young/pop)*100	378	10.659	1.162	8.040	13.579
urbanization	people>20,000/pop	378	52.714	18.543	22.223	92.012
relative_gdp	GDP province/ Spanish mean GDP	378	0.880	0.153	0.630	1.360
immigrants	(# foreigners/pop)*100	378	5.283	4.648	0.316	23.599
gdp_growth	% GDP per capita growth	378	5.918	2.659	-2.000	15.000
detention_person	detention person/crimes person	378	0.315	0.136	0.094	0.921
detention_property	detention property/property crimes	378	0.192	0.072	0.068	0.467
clearance_proper	clearance property/property crimes	378	0.898	0.042	0.489	0.975
clearance_person	clearance person/crimes person	378	0.183	0.048	0.050	0.338

3.2 Empirical strategy

Two-Stage Least Squares

Estimating Eq. (1) by ordinary least squares (OLS) could lead to biased estimations if our main variable of interest, "**tourists**", is endogenously determined by crime rates. This reverse causality may bias the estimations in our model given that $Corr(Crime_{it}, \varepsilon_{it}) \neq 0$ In order to overcome this endogeneity problem, we estimate Eq. (1) using two-stage least squares (2-SLS), and using as our instrument the predicted number of tourists obtained from the following index:[15]

$$Z_{it} = \sum_{c} \frac{tourists_{ic1998}}{tourists_{c1998}} tourists_{ct} \qquad (3)$$

where $\frac{tourists_{ic1998}}{tourists_{c1998}}$ is the proportion of tourists of nationality ***c*** in province *i* in the base year 1998. Thus, this ratio captures the importance of certain tourists (by nationality) in a province in the base year. The variable $tourists_{ct}$ in Eq. (3)

[15] This is a version of the well-known Card index employed in the literature on immigration (Card, 2001).

represents the total number of tourists in Spain from country *c* in year *t*. This instrument indicates that an increase in, for instance, German tourists in Spain leads to an increase in the number of these tourists in each province proportional to the number of tourists existing in the base year in that same province. This phenomenon is attributable to “word of mouth marketing" between residents from the same foreign country which is translated into a "call effect". The intuition behind this instrument is that the distribution of tourists across provinces in 1998 does not explain crime rates in 2000 and, therefore, the correlation between these two variables is low.[16] However, the number of tourist arrivals in 1998 does explain the number of tourist arrivals in 2000 and, consequently, it proves to be a suitable instrument. Having obtained the values of Z_{it}, we can carry out the following first-stage regression:

$$tourists_{it} = \lambda_i + \lambda_t + \beta Z_{it} + \sum_l (socio\_econ_{it})_l + \varepsilon_{it} \quad (4)$$

where λ_i and λ_t represent the fixed effects of each province and year, respectively, and $socio\_econ_{it}$ represents the vector of socio-economic variables presented above. From Eq. (4) we obtain the predicted values of the arrival of tourists, "$\overline{Tourists_{it}}$”, which are used as the instrument in the second-stage.

$$\begin{aligned} Crime^k{}_{it} = {} & \alpha_i + \alpha_t + \beta\left(\overline{tourists}\right)_{it} + \psi\left(season\right)_{it} + \\ & + \sum_m \phi_m (socio\_econ_{it})_m + \sum_l \gamma_l (\text{deterrence}_{it})_l + \varepsilon_{it} \end{aligned} \quad (5)$$

β measures the impact of a one-percent increase in the number of tourists whereas *ψ* measures the impact of the seasonality of tourist demand.

GMM approach

In the literature of the economics of crime the inertia patterns presented by criminal activity, that is, the persistence of criminal activity over time, are well documented. This phenomenon can be attributed to several causes (Fajnzylber *et al.*, 2002, and Buonanno and Montolio, 2008). Thus, for instance, criminals seem to acquire new techniques as they commit more crimes and while committing these crimes they appear to learn from their previous mistakes. This implies that the

[16] The correlation is lower than 0.4.

costs of any criminal act are reduced over time (Case and Katz, 1991). Moreover, criminals who have served custodial sentences tend to have fewer opportunities of finding employment in the legal market (Grogger, 1995). As such, they are obliged once more to obtain rents from the illegal market. In empirical terms, including the lag dependent variable captures this criminal recidivism.

$$Crime^{k}_{it} = \lambda Crime^{k}_{it-1} + \alpha_i + \alpha_t + \beta\left(\overline{tourists}\right)_{it} + \psi\left(season\right)_{it} + \\ + \sum_m \phi_m (socio\_econ_{it})_m + \sum_l \gamma_l (deterrence_{it})_l + \varepsilon_{it} \quad (6)$$

Estimating Eq. (6), which contains the lag dependent variable as an explanatory variable, by means of ordinary methods would give inconsistent estimations as $Crime^{k}_{it-1}$ and α_i are correlated even if the idiosyncratic error term is not serially correlated. Removing the province fixed effect by taking first differences does not deal with the problem either since the lagged endogenous variable is correlated with the differences in the error term. That is, $Crime^{k}_{it-1}$ is correlated with ε_{it-1}. An alternative would be to obtain the "within" transformations; however, these transformations are only consistent under the strong assumption of exogeneity of the regressors. Given that in our model, at least the "**tourists**" variable might not be exogenous, the "within" transformation is not a solution. To solve this problem, we use the generalized method of moments (GMM) estimator (see Arellano and Bond, 1991; Arellano and Bover, 1995). This estimator requires, first, taking first-differences in order to remove the fixed effects.

$$Crime_{it} - Crime_{it-1} = \lambda(Crime_{it-1} - Crime_{it-2}) + \beta(X_{it} - X_{it-1}) + \varepsilon_{it} - \varepsilon_{it-1} \quad (7)$$

Eq. (7) presents the need for instrumentation as there is a clear correlation between the variables in the vector *X* (all the regressions previously presented) and the error term, as well as between the difference of the variable *Crime* and the error term. Similarly, applying the GMM requires the assumption of, at least, weak exogeneity of the variables. This implies that the variables in *X* are influenced by their past values but not by their future values. Moreover, we assume that the following moments hold:

$$E\left[Crime_{i,t-s} \times (\varepsilon_{i,t} - \varepsilon_{i,t-1})\right] = 0\Big] \text{ for } \quad s \geq 3 \quad (8)$$

$$E\left[X_{i,t-s} \times (\varepsilon_{i,t} - \varepsilon_{i,t-1})\right] = 0\Big] \quad \text{for} \quad s \geq 2 \quad (9)$$

The use of the lagged variables as instrument is typically referred to as the difference GMM estimator. Although the estimations are consistent, they are not efficient. For panel data with few observations, as is our case here, Blundell and Bond (1998) propose the GMM system estimator. This procedure constructs a system with both the equations in levels and the equations in differences. Given that in the level equation the fixed effects are still present, additional instruments have to be used to avoid the correlation with the other regressors. In this case, the instruments used are the lagged differences of the corresponding variables. Note that even if the levels of the right-hand-side variable and the province-specific effect can be correlated, the differences of these variables and the province specific effect are uncorrelated. This assumption results from the following stationarity property:

$$E[Crime_{it,t+p} \times \eta_i] = E[Crime_{i,t+q} \times \eta_i]$$
$$E[Crime_{it,t+q} \times \eta_i] = E[Crime_{i,t+p} \times \eta_i] \quad (10)$$

We also need to consider the additional moment conditions for the regression in levels that are given by:

$$E\left[(Crime_{i,t-s} - Crime_{i,t-s-1}) \times (\varepsilon_{i,t} + \eta_i)] = 0\right] \quad \text{for} \quad s=2 \quad (11)$$

$$E\left[(X_{i,t-s} - X_{i,t-s-1}) \times (\varepsilon_{i,t} + \eta_i)] = 0\right] \quad \text{for} \quad s=1 \quad (12)$$

To verify the validity of the instruments we use the Hansen test of overidentifying restrictions. We also need to check for the absence of serially correlated error terms, which is a required condition for the consistency of the GMM estimator. We perform tests for first (AR(1)) and second order (AR(2)) serial correlations under the null hypothesis of the presence of serial correlation. If there is no serial correlation in the error term, the first-differenced residuals should reject the null hypothesis in the AR(1) test but not that in the AR(2) test (see Arellano and Bond, 1991).

4. Results

This section presents the results of the first-stage and second-stage estimations for all crime types. First-stage results are presented in Table 2. Column 1 presents the estimation of the instrument obtained with the index (see Eq. 3) for

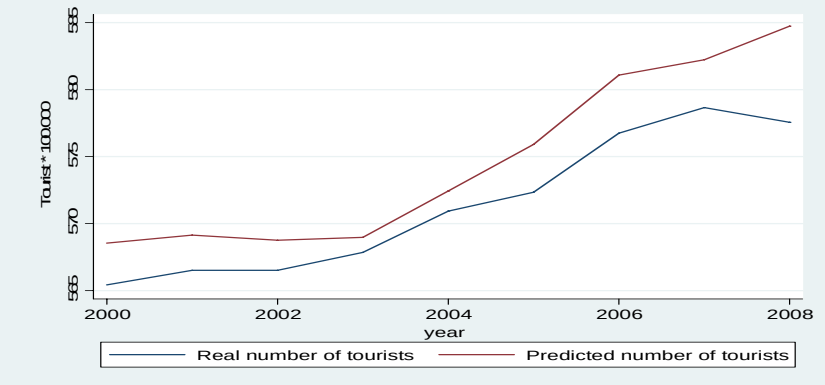
the total number of tourist arrivals without taking into account any fixed effects. Column 2 accounts for the socio-economic variables while columns 3 and 4 add province and year fixed effects, respectively. We chose the fourth column as our estimation with which to construct our instrument,[17] the validity of which can also be evaluated in Figure 3. This instrument is optimal since it is highly correlated with the dependent variable, given that the number of tourists in each province in 1998 accounts for the number of tourists in the following years, and the correlation between our instrument and the crime rates for all crime types is always lower than 40%, indicating that the number of tourists in 1998 does not account for the crime rates in the following years.

Table 2: First-stage results

	tourists			
VARIABLES	(1)	(2)	(3)	(4)
Z_{it}	1.02273***	0.97913***	1.01519***	0.99387***
	(0.009)	(0.012)	(0.059)	(0.061)
Observations	420	378	378	378
R-squared	0.966	0.977	0.747	0.757
Province FE	NO	NO	YES	YES
year FE	NO	NO	NO	YES
Control Variables	NO	YES	YES	YES

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Figure 3: Real number of tourists and predicted number of tourists



[17] The choice of the instrument also depends on the second stage of the estimation. As we use province and year fixed effects, we have to use the same control variables in the first-stage.

Second-stage results are presented in Table 3 for crimes against the person and in Table 4 for property crimes. In both tables, columns 1 to 3 report the estimations for serious crimes while columns 4 to 5 present the estimations for minor crimes. For each estimation, we report the results when using fixed effects, 2-SLS and GMM system estimations. In the GMM system estimations the tourist variable is instrumented with the predicted number of tourist arrivals obtained in the first-stage, whereas the lagged value of the crime rate as well as the detention rate, clearance rate, male unemployment and GDP growth are instrumented with the usual instruments of the GMM system.[18]

Crimes against the person

The results for our variable of interest, tourism, show little or no effect when using fixed effects (columns 1 and 4 of Table 3) and no effect when using 2-SLS (columns 2 and 5 of Table 3). Nevertheless, as explained above, the fixed effect estimations are likely to be inconsistent as the number of tourist arrivals is affected simultaneously by criminal activity while the 2-SLS does not take into account the inertia of crime or the potential endogeneity of other variables. Therefore, we focus our attention on those results that we believe to be consistent and efficiently estimated. The GMM estimates (columns 3 and 6 of Table 3) show that the lag dependent variable, which captures the inertia of criminal activities at the provincial level, is positive and highly significant, indicating that provinces with high crime rates in the past are likely to experience high crime rates today, as a consequence perhaps of the tendency for criminals to reoffend (see Fajnzylber *et al*., 2000). The impact of the number of tourist arrivals on crime rates is positive and statistically significant in the case of serious crimes and positive but not significant for minor crimes. A one-percent increase in the number of tourists increases the rate of serious crimes against the person by 0.10%.

[18] Up to four lags were used in the estimations for both the level and the difference equations. A larger number of lags gives similar results but weakens the Hansen test.

Table 3: Serious and minor crimes against the person.

	Serious crimes			Minor crimes		
	FE	2-SLS	GMM-system	FE	2-SLS	GMM-system
Variables	(1)	(2)	(3)	(4)	(5)	(6)
tourists	0.12424*	0.11481	0.10818**	0.01517	0.03012	0.00704
	(0.075)	(0.077)	(0.041)	(0.069)	(0.055)	(0.034)
season	0.80114***	1.11519	-0.41980***	0.36886	0.45980	-0.28428**
	(0.301)	(0.776)	(0.136)	(0.610)	(0.908)	(0.111)
urbanization	0.00337	0.00903	-0.00158	0.00118	0.00444	0.00091
	(0.004)	(0.007)	(0.001)	(0.005)	(0.005)	(0.001)
relative_gdp	0.37682	1.08903**	0.69189***	0.11031	0.76190***	0.46398***
	(0.322)	(0.522)	(0.171)	(0.353)	(0.284)	(0.132)
immigrants	0.00893	0.03023***	0.00791**	-0.01110**	0.01337***	0.00606*
	(0.006)	(0.008)	(0.004)	(0.005)	(0.004)	(0.003)
gdp_growth	-0.00006	-0.00153	-0.00124	-0.00066	-0.00327**	0.00843
	(0.003)	(0.003)	(0.007)	(0.002)	(0.002)	(0.006)
male_unemploy	-0.00819*	-0.01027***	0.00036	-0.00965**	-0.01920***	0.01328***
	(0.004)	(0.004)	(0.003)	(0.004)	(0.002)	(0.003)
youth	0.08975***	0.00033	0.08873***	0.14163***	0.07127***	-0.00038
	(0.024)	(0.052)	(0.017)	(0.032)	(0.027)	(0.025)
clearance_person	0.08514	0.12002	0.64113	-0.07337	-0.31670	-0.28517
	(0.212)	(0.315)	(0.383)	(0.208)	(0.218)	(0.241)
detention_person	0.88963***	1.53340***	-0.50328	-0.30190	0.10310	-0.36192
	(0.152)	(0.147)	(0.340)	(0.197)	(0.103)	(0.241)
education	0.00309	0.00357	-0.01551*	-0.00804*	0.00394	-0.01676**
	(0.006)	(0.010)	(0.008)	(0.005)	(0.006)	(0.007)
$crime_{it-1}$			0.73399***			0.85629***
			(0.097)			(0.080)
Observations	378	378	336	378	378	336
R-squared	0.859	0.834		0.520	0.338	
Number of provinces	42	42	42	42	42	42
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
hansenp	.	.	0.922	.	.	0.784
ar1p	.	.	1.40e-05	.	.	2.70e-05
ar2p	.	.	0.656	.	.	0.304

Note: Robust standard errors in parentheses for the fixed effect estimation. Bootstrapped errors in parentheses for the 2-SLS and GMM estimations. ***p<0.01, **p<0.05, *p<0.1.

A possible explanation for the absence of any effect of tourist arrivals on minor crimes is that of underreporting. If it is the tourists themselves that are the

victims, typically their time is more limited when on holiday and so they do not report such crimes to the police, unless that is they involve loss of documentation or injuries that require medical treatment. In the case of the seasonality index, this is found to have a negative effect on crimes against the person, indicating that the concentration in time of tourist arrivals reduces the number of crimes against the person.

In general, the socio-economic variables present the expected sign. However, some specific results are worth noting given that crimes against the person are usually not (very well) explained by economic factors. In this sense, "**gdp_growth**" and the level of "**urbanization**" of a province are not statistically significant. By contrast, "**relative_gdp**" has a positive impact and "**male_unemploy**" presents a positive sign when taking its possible endogeneity into account (GMM estimates). Another result in line with findings in the literature (Freeman, 1991; Grogger, 1998 and Levitt, 2001) is the positive impact of "**youth**" on (serious) crimes against the person. The share of "**immigrants**" also has a positive impact on crimes against the person.[19] The variable "**education**" presents a negative effect on crime indicating that the higher the level of education, the lower the probability of committing crimes. Following Lochner (2007), this result can be explained in terms of higher youth socialization and/or higher returns from legitimate work. As expected for crimes against the person, the deterrence variables do not seem to have a statistically significant impact on such crimes. The positive impact obtained for the "**detention_person**" in the 2-SLS may be capturing the fact that more crimes are now being detected due to an increase in the resources devoted to the prevention, detection and investigation of such crimes in Spain in the years under study.

Property crimes

As documented in the literature of the economics of crime, we would expect property crimes to be better explained by socio-economic variables than is the

[19] This result would seem to be in line with certain police reports that indicate that immigrants are involved in 3 out 5 cases of domestic violence.

case of crimes against the person (see Table 4). With respect to our main variable of interest, the number of tourist arrivals has a positive and significant impact on property crime rates when inertia and endogeneity of the socio-economic variables are taken into account (columns 3 and 6).

Table 4: Serious and minor property crimes

	Serious crimes			Minor crimes		
	FE	2-SLS	GMM-system	FE	2-SLS	GMM-system
Variables	(1)	(2)	(3)	(4)	(5)	(6)
tourists	-0.04373	0.04228	0.35482***	0.03355	-0.15009	0.10170*
	(0.105)	(0.115)	(0.088)	(0.157)	(0.226)	(0.051)
season	-1.07535***	-1.05804**	-0.30073	-0.55141	-0.62950	-0.73823
	(0.369)	(0.443)	(0.474)	(0.367)	(0.881)	(0.502)
urbanization	-0.01815**	-0.01901**	-0.00010	-0.00347	-0.00448	0.00183
	(0.008)	(0.009)	(0.004)	(0.010)	(0.008)	(0.004)
relative_gdp	-0.04375	-0.10196	0.94082**	3.10840	2.96481**	0.10427
	(0.545)	(0.676)	(0.456)	(1.973)	(1.268)	(0.326)
immigrants	0.00145	-0.00157	0.01096	0.03018	0.03582	-0.01745***
	(0.009)	(0.011)	(0.007)	(0.038)	(0.038)	(0.005)
gdp_growth	-0.00453	-0.00417	-0.01970**	-0.02077*	-0.02185**	-0.01164*
	(0.003)	(0.004)	(0.008)	(0.012)	(0.009)	(0.006)
male_unemploy	-0.00164	-0.00196	0.00869	-0.00767	-0.00759	0.00802
	(0.007)	(0.005)	(0.011)	(0.009)	(0.006)	(0.009)
youth	0.14744**	0.16678***	0.14735*	0.01619	-0.00319	0.03165
	(0.057)	(0.055)	(0.086)	(0.123)	(0.152)	(0.037)
clearance_proper	-3.56666**	-3.63911***	-3.59763***	-1.08852	-0.90515	-1.96978***
	(1.419)	(1.179)	(1.055)	(0.660)	(1.082)	(0.511)
detention_proper	-1.19079**	-1.08664***	-0.53128	-1.35957	-1.65885	-1.09641**
	(0.508)	(0.386)	(0.561)	(0.919)	(1.052)	(0.434)
education	0.00614	0.00822	-0.00797	-0.02662		0.02000
	(0.010)	(0.008)	(0.018)	(0.021)		(0.014)
$crime_{it-1}$			0.00383			0.59849***
			(0.086)			(0.121)
Observations	378	378	336	378	378	336
R-squared	0.551	0.437		0.350	0.346	
Number of provinces	42	42	42	42	42	42
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
hansenp	.	.	1	.	.	1
ar1p	.	.	0.0565	.	.	0.113
ar2p	.	.	0.221	.	.	0.0853

Note: Robust standard errors in parentheses for the fixed effect estimation. Bootstrapped errors in parentheses for the 2-SLS and GMM estimations. ***p<0.01, **p<0.05, *p<0.1.

The impact is much greater for serious property crimes than it is for minor property crimes. Specifically, a one-percent increase in the number of tourists increases serious property crimes by 0.35% and minor property crimes by 0.10%. Moreover, seasonality does not seem to have a marked impact on property crime and if it does, the effect is negative, meaning that the higher the concentration of tourist arrivals in time, the smaller the number of property crimes.[20]

The inertia of criminal activity seems to be present only in the case of minor crimes, with serious crimes tending not to show the same degree of inertia. This means for instance that provinces with a high degree of pickpocketing (the most frequently reported minor crime) tend to have higher crime rates in the following years. This is particularly true of provinces with large tourist cities whose crowded and commercial streets are favored by pickpockets.

The proportion of people living in cities with over 20,000 inhabitants ("**urbanization"**) has a negative impact on serious property crimes when inertia is not taken into account. This result is somewhat controversial as the literature consistently points to the positive effect of urbanization on crime rates, especially property crimes (Gaeser and Sacerdote, 1999). The variable "**relative_gdp**" seems to present a positive impact, at least for serious crimes, suggesting that the richer the province compared to other provinces, the higher its property crime rate. The variable "**immigrants**" shows no impact on serious crimes and a negative and significant impact for minor crimes, indicating that the higher the number of immigrants, the higher the property crime rate. Economic activity measured by "**gdp_growth**" presents a negative sign, indicating that the higher the opportunities to obtain legal rents, the lower the rate of property crimes (Fleisher, 1966). However, "**male_unemploy**" and "**education**" are not statistically significant in the estimations performed. The share of young people does not affect the number of minor property crimes but it positively affects the serious property crime rate, suggesting that vandalism and large benefits attract young criminals. It is perhaps

[20] The negative impact might be due to the fact that criminals focus their attention on provinces with lower seasonality (higher quality) because of the higher expected returns from illegal activities.

worth stressing once more that minor crimes (in general) suffer from a problem of underreporting. For instance, someone who has his motorbike scratched may not report it to the police since they may consider it a waste of time as the chances of the offender being caught are low. This could explain why only a few coefficients are statistically significant in the estimations presented.

Finally, for the property crimes, the deterrence variables in general show the expected negative and significant sign. Both the clearance and detention rates show negative and highly significant signs.

5. Conclusions

To date, the models and techniques adopted in the literature of economics of crime have reported a somewhat ambiguous relationship between tourism and crime. The contribution of the present study has been to estimate, by means of panel data techniques for the Spanish provinces between 2000 and 2008, the impact of tourist arrivals on crime rates distinguishing by the severity of the crime (serious and minor crimes) and typology (crimes against the person and property crimes). Additionally, the endogeneity problem (by and large ignored in previous studies) arising from the existence of reverse causality between crime and tourism makes the use of empirical approaches other than OLS essential. Here, we employ 2-SLS estimates where the instrument selected is the predicted number of tourist arrivals obtained from an index with a base year of 1998. The power of this instrument enables us to control for the endogeneity of our main variable but not for the potential endogeneity of the other variables. Therefore, in order to obtain consistent estimations we take into account the inertia of criminal activity and use a GMM system approach instrumenting the lagged dependent variable as well as the detention rate, clearance rate, male unemployment and GDP growth with the usual GMM instruments.

Our results highlight an important negative externality of tourist arrivals. In the case of property crimes, a one-percent increase in the number of tourist arrivals in a given province leads to a 0.10% increase in minor crimes and a 0.35% increase in serious crimes. In the case of crimes against the person, tourist arrivals

also constitute a negative externality, but only on serious crimes. The impact of a one-percent increase in the number of tourist arrivals leads to a 0.10% increase in the number of serious crimes against the person.

This paper has also examined the impact of tourist concentration in time (seasonality) on crime rates. Here, when the estimated coefficient is statistically significant it presents a negative sign indicative of the fact that criminal activity tends to concentrate in provinces with lower seasonality and, hence, with higher quality, that is, where the returns to illegal activities associated with tourism are highest.

Given the impact of tourism on property crime rates and on crimes against the person, it is clear that policy makers need to take these results into account and allocate greater amounts of resources to law enforcement in regions recording high numbers of tourist arrivals.

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