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The Passive Use Value of the Mediterranean Forest

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SUMMARY In this study we estimate the passive use value of forest in different ecological zones in the Mediterranean region. We estimate these values for forests using meta-analysis. These estimates are used to reveal the annual monetary values per hectare for each country. The total annual amount of passive use value of the Mediterranean forest is about one billion international dollars. The estimated passive use value of the forest from this study can be used to account for the social welfare loss caused by fire, insects, diseases, biotic agents, and abiotic factors.

Keywords: forest, Mediterranean region, passive use, welfare loss

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1 Introduction

The Mediterranean region partially covers the land of three continents: Africa, Asia, and Europe. The countries in this region are diversified in terms of economic development, culture, and marine and terrestrial ecosystems. This region constitutes 13.5% to the world Gross Domestic Product and 7.7% of the world population and is also known for its rich and unique ecosystems. The Mediterranean basin ecosystems include around 25,000 plant species, 768 marine and fresh water species, 351 reptiles, 601 birds, and 296 terrestrial mammals (Myers et al., 2000).

Due to extensive human activity, environmental conditions, and climate this hotspot region is one of the most endangered and threatened in the world. Historically, the Mediterranean natural ecosystems have been used intensively for agricultural purposes. Today, in the north, forests has recovered due to less intensive agricultural use, while southern territories are still over-exploited, leading to deforestation and erosion in this region (see Figure 1 in Appendix). As a result of human activities, many native tree species from terrestrial ecosystems in this region are vulnerable, threatened, or even endangered (see Figure 2).

It is well known that forest is crucial for human well-being. It provides many goods such as timber, fodder, food, fuel, etc., and services such as recreational activities (hiking, biking, etc.), watershed services, carbon sequestration, and preservation of many plant, animal, and bird species. The total economic value of forest consists of use and non-use values. The use value can be assigned to any resource that can be sold on the market. This value includes the direct and indirect use values, and option value.[1] The direct use value arises from the actual use of forest such as timber, fodder, etc., while the indirect use value is attributed to indirect benefits of forest such as watershed protection, carbon sequestration, etc. Also, people place an option value on having the opportunity to use forest products and its benefits in the future.

Beside the use value, people also attribute the non-use value. This value is assigned

[1] For a detailed discussion see Bateman et al. (2002).

by people who do not use these goods and who do not intend to use them. However, they do value the forest ecosystem simply in knowing of its existence. This value is also known as a passive use value, and includes altruistic, bequest, and existence values. While computating the forest use value is straightforward, computating the passive use is a challenge.

The first attempts to calculate the passive use value for the Mediterranean region countries were undertaken by Merlo and Croitoru (2005) and Croitoru (2007). Croitoru (2007) points out that the passive use value estimates for this region are either missing due to the scarcity of research or not reliable meaning that "*.... no strong conclusion can be drawn*".

Another study by Chaibai et al. (2009), suggests a methodology to compute the passive use value of forest and provide monetary estimates at the regional level. The estimates are based on the findings from earlier studies related to stated preference techniques in different world regions, and then, adjusted to the region of interest based on its demographic situation and economic development.

Our study contributes to the literature by computing the passive use value of forest in different ecological zones in the Mediterranean region countries. Using the selected case studies that applied stated preference techniques, we implement a meta-analysis approach. Meta-analysis is an important statistical tool for combining the main findings from different studies (Glass, 1976). Meta-analyses have been used to study woodland recreation values and forest valuation (see Bateman et al., 1999; Bateman and Jones, 2003) and for the forest benefits (see Lindhje, 2007), among others. In addition, meta-analysis can be helpful in summarizing results of a single study that provides multiple estimates.

The range of monetary estimates presenting the passive use value of the forest vary considerably, from 0.06 in Slovenia to 188.17 international US dollars (int.$) in Spain. The differences in values are not surprising since countries differ widely with respect to demographic and economic situations, as well as the total forest area and its conservation area. The total amount of passive use value of the Mediterranean forest is 1,112,730,000 int.$ per year. The estimated passive use value of the forest from this study can be used to account for the damage caused by fire, insects, diseases, biotic agents, and abiotic factors. These monetary values are based on the preferences of individuals, and therefore should not be ignored by policy makers.

The rest of the paper is organized as follows. In the next section the data are presented. Section 3 presents methodology. Sections 4 and 5 discuss the results and conclude.

2 Data

Little research has been conducted in the less developed countries compared to the developed ones, and may indicate that less developed countries cannot afford to invest in research. According to Christie et al. (2012) for ecosystem services, 11.6% of studies have been conducted in less developed countries, with 88.6% in more developed ones. Most countries of Africa and Asia of the Mediterranean region, except Cyprus and Israel are classified as low- or upper-middle income countries, according to the World Bankwhile while most European countries in this region are classified as high income countries.

We searched for case studies related to countries of interest (the Mediterranean) and if none were found, we searched for studies in the neighboring countries. This strategy is especially useful for the African countries, where little research is reported. In order to guarantee that we capture non-use values, we select only the case studies that apply the stated preference techniques such as contingent valuation, choice modeling, and choice experiment.

Table 1 shows the selected studies. Due to a paucity of case studies, the African countries are represented by the studies for Burkina Faso, Ethiopia, Kenya, and Uganda. The Asian part of the Mediterranean region is represented by Cyprus, Israel, Lebanon, and Turkey. The European countries are represented by Denmark, Greece, France, North Ireland, and Spain. Even though Denmark and North Ireland do not belong to the Mediterranean region, the decision to include these countries is based on a high quality of studies conducted for the forest from the temperate zone. According to FAO/FRA (2000), all countries from this region are allocated in either subtropical or temperate ecological zones (see Figure 3). The countries' values of wood and non-wood forest products removals, forest, and other woodland (OWL) areas and their territories are presented in Table 2.

Overall we explore the marginal values from 22 studies. The number of marginal values varies much from study to study. As seen in Figure 2, the maximum number of values available in one study is 12 while the minimum is one.

The values for forest ecosystem services in the selected case studies are reported in different currencies and time periods. Also, mean and/or median WTPs per household, per trip, per year, and/or per hectare are presented. We standardize the marginal values into the common metric of 2005 international \$ per hectare per year (int.\$/ha/year). In order to transfer these values to the local currency unit (LCU), the official exchange rate (LCU per US\$, period average) is used. In addition, GDP deflators with varying base year by country and PPP conversion factor, GDP (LCU per international \$), are applied. The data regarding the exchange rate, GDP deflators, and conversion factor are taken from the World Bank site.[2] Then, WTPs per person or per visit are converted to the marginal values per hectare per year given information on a number of trips and respondents or population size in a particular study.

Unfortunately, some selected studies do not provide any information regarding the study site area. In this case the area is approximated from information in the Food and Agricultural Organization of the United Nations, Food and Agricultural Data Network, or Country Report on Global Forest Resources Assessment.[3]

[2] See www.worldbank.org.

[3] For Food and Agricultural Organization of the United Nations and Country Report on Global

3 Methodology

In this section we describe the proposed methodology to estimate the non-use value of the Mediterranean region countries. For that purpose we apply meta-analysis. This analysis is a useful tool since it allows us to combine results across studies and to transfer values from studied sites to the sites of particular interest (Glass, 1976). This is an important feature since in less developed countries no studies of interest are available. However, this analysis has several caveats since it involves different studies.

First, some studies provide several estimates for the same forest and its services at stake but with just some difference in attributes, for instance, levels of preservation area or considering different species of animals and plants. Thus, even though these studies address the same subject, the information provided varies considerably. Also, from the statistical point of view several aspects such as heteroskedacticity, outliers, leverage, and non-independence of residuals, in the meta regression have to be taken into account. Ignoring these aspects may lead to spurious findings as well as wrong statistical inference.

Regarding heteroskedasticity, the estimated coefficients are not affected, but the standard errors are invalid. Next, having an outlier in a sample is an indication of measurement error or a heavy-tailed distribution. Therefore, retaining outliers may result in misleading findings.

Another potential concern is a leverage effect. It occurs when one of the independent variable deviates substantially from its mean. In this case, the estimated coefficients in the meta-analysis are affected. Finally, non-independence of residuals arises when several estimates are provided in the same study. It is possible that the estimates provided in a study may not be independent, and as a result, residuals are not independent as well. If this non-independency is not taken into account, we may end up with wrong statistical inference. To cope these potential caveats, we use

Forest Resources Assessment, see www.fao.org/forestry/ while for Food and Agricultural Data Network see www.countrystat.org.

the iteratively reweighted least squares regression. This approach is implemented in STATA (see rreg command).

After careful selection of 22 case studies for our analysis, the first step of the meta-analysis is an OLS regression. It is worth mentioning that the OLS analysis provides equal weights to residuals while in the robust approach large residuals are given small weights. The regression of potential interest is as follows:

$$\begin{aligned} ln(WTP) &= \beta_0 + \beta_1 Year + \beta_2 Median + \beta_3 Attr + \beta_4 NonUse + \\ &\quad + \beta_5 Authors + \beta_6 Subtrop + \beta_7 Temp + \beta_8 Asia + \\ &\quad + \beta_9 Europe + \beta_{10} ln(Resp) + \beta_{11} ln(Area) + u \end{aligned} \qquad \text{(Eq.1)}$$

where $ln(WTP)$ stands for the natural logarithm of the estimated willingness to pay (WTP). WTP is standardized in 2005 international US dollars per hectare per year (int.\$/ha/year). The variable $Year$ represents a year of collected data. If the date of the collected data is missing in the study, the year of publication is taken instead. $Median$ is a dummy variable and equals one for the median WTP and zero for the mean. $Attr$ is a dummy variable that equals to one if different forestry attributes such as forest inhabitants, animals, birds, and/or plants are also explored in the study and zero if only the forest is studied. $NonUse$ equals one if the study provides the non-use/passive value (estimate) and zero otherwise. The variable $Authors$ stands for the number of authors in a study. $Subtrop$ and $Temp$ equal one if the forest from subtropical or temperate ecological zones, respectively, and zero if for the tropical one. $Asia$ and $Europe$ equal one if the study is conducted in a country from Europe or Asia and zero if from Africa. $ln(Resp)$ and $ln(Area)$ stand for the natural logarithms of the number of respondents and area in hectares involved in a particular study. u is a stochastic disturbance.

After estimating *Eq.1*, we use the iteratively reweighted least squares in order to improve our model and to cope with the potential caveats stated above. Then, for each observation we estimate leverage and weight based on the size of its residual. A small weight of an observation indicates that this observation distorts the outcome and accuracy of the model. As a result, we drop the observations with large leverage and small weights. Then, *Eq.1* is reestimated using the Huber-White sandwich estimators (see Huber, 1967; White, 1980). The standard errors from this approach are robust and clustered at the case study. Finally, we obtain the predicted value of $ln(WTP)$ for the forest from each ecological zone and continent.

Next, we apply the second step following Chiabi et al. (2009):

$$WTP_{j,b} = WTP_{i,b}(\frac{N_j}{N_i})(\frac{S_{i,b}}{S_{j,b}})^{\widehat{\beta}}(\frac{GDP_j}{GDP_i})^{\widehat{\gamma}} \tag{Eq.2}$$

where the subscript j stands for a country and subscript i stands for continent (Africa, Asia, or Europe) while subscript b stands the forest in a particular ecological zone. $\hat{\beta}$ and $\hat{\gamma}$ are the estimated parameters and are taken from Chiabi et al. (2009). $WTP_{i,b}$ stands for the average willingness to pay from continent i and forest from ecological zone b derived from the first step. N_j and N_i stand for population in country j and the average population in the studied countries from continent i, respectively. $S_{i,b}$ and $S_{j,b}$ are the forest areas designated to conservation in country i and continent j, respectively. GDP_j and GDP_i are the $Gross\ Domestic\ Product$ per capita based on purchasing power parity (PPP). This methodology can be easily extended for the future trajectory of the marginal values of forest.

4 Estimation Results

In this section we present and discuss the results for the marginal values (WTP) of the forest in the Mediterranean region countries. Table 3 shows the results of the meta-regression analysis. As observed from this table, $Year$, $Median$, $Asia$, $Subtrop$, and $Temp$ are important explanatory variables for predicting $ln(WTP)$. However, in

Figure 5, where residuals and the fitted values are plotted, we observe the presence of heteroskedasticity in our analysis. For instance, the circled points (observations) in the right top corner of this figure point out that for these observations we have large residuals. As such, the statistical inference presented may be misleading.

In order to provide robust results, we apply the iteratively reweighted least squares procedure described in the methodological section. The results of the procedure are in Figure 6, where the x-axis in this figure is a normalized residual squared and the y-axis stands for leverage. As shown in this figure there are two observations with numbers 86 and 87 that have large variances. Also, the estimated weights for these observations are equal to zero. We therefore drop these observations from our analysis.

Further analysis of this figure shows that observations 29 and 30 may create a leverage effect, meaning that the estimated coefficients might be substantially affected. As a result, these observations must be excluded. Also, observation number 5 can be the product of leverage and outlierness. This is influential as it substantially changes the estimates of regression. Thus, it has to be removed from the analysis. Given this information, *Eq.1* is reestimated taking into account heteroskedasticity and non-independency of residuals. The results are in Table 4.

As seen in this table R^2 is substantially increased from 0.49 to 0.57 compared to the estimation from Table 2. Moreover, the sign and significance of some variables have changed. This procedure shows that the statistical inference and estimated coefficients are results of potential caveats described in the methodological section. Out of 22 studies we left with 19 (see number of clusters) since some observations are previously removed.

The estimated coefficient on $Median$ is significant, suggesting that the median WTPs in studies are on average lower than means. Also, if the case study involves additional attributes of forest, woodland, or trees, such as different types of animal species, birds, plants, etc. then WTP is lower (see the coefficient on $Attr$). This may indicate a substitution effect between included attributes. Regarding the coefficient on the $NonUse$ variable, it is not significant, meaning that people attribute equal weight to use and non-use forest services.

The estimate on the number of authors, $Authors$, has a negative sign. It may be the case that some authors are more familiar with the studied region, and thus, the survey designed may take into account particular country specifics. It is worth mentioning that the explanatory variable *Subtrop* is not statistically significant, suggesting that the value of forest in the subtropical zone is not different from the value of the forest in the tropical zone. $Temp$ is positive and significant, meaning that the value of forest from the temperate zone has higher WTP. In addition, the value of forest is higher in Asia and Europe compared to Africa. This can be explained by the captured income effect since on average European, and Asian countries of the Mediterranean region are richer in terms of GDP per capita than the African countries. We also reject the possibility that coefficients on *Europe* and *Asia* are equal ($H_0 : \beta_{Europe} = \beta_{Asia}$; $p - value = 0.00$) supporting the previous explanation.

The negative sign of the study site area, $ln(Area)$, indicates diminishing returns to scale for forest values. However, the estimated coefficient is not statistically significant. Overall, the results are consistent with the literature underlining the robustness of the suggested methodology in revealing the marginal value (WTP) for the forest.

The marginal values calculated in the first step are shown in Table 5, where we see that for each of the continents and forest from different ecological zones, the marginal values per hectare per year and studied areas are reported, and that Avg. GDP and Avg. Population stand for the average GDP per capita and average population in the case studies. These values are used to calculate the marginal value for each country in the next step.

Next, the second step (see Eq.2) for approximating the marginal values per hectare for each of the country is applied. In Table 6, these monetary values (WTPs) for each country are given. The columns in this table stand for countries, Marg. Value for subtropical forest, Marg. Value for temperate forest, subtropical conservation area forest, temperate conservation area forest, and total amount in international US dollars. The columns for WTPs for subtropical and temperate forests provide information regarding the marginal value for each type of the forest in a particular country derived from the second step. The columns for subtropical and temperate conservation areas stand for the designated area for conservation in hectares. These areas are approximated based on the information from FAO/FRA (2000; 2005; 2010).

As seen in Table 6, the marginal values per hectare per year vary a great deal, from 0.06 in Slovenia to 188.17 int.$ in Spain. The differences in values are not surprising since the countries differ considerably with respect to demographic and economic situations as well as the total forest area and its designation for conservation. On average, the non-use value of forest designated for the conservation or protected area in the European countries of the Mediterranean region is 93.85 int.$/ha/year while the value of the forest without any designated status is only 19.48 int.$/ha/year. Overall, the total non-use value of the Mediterranean forest in the African countries is 2,650,000 int.$, in the Asian countries is 15,140,000 int.$, and in the European countries is 1,093,630,000 int.$.

5 Conclusion

The findings of this study can be used to calculate the welfare loss based on the passive value of the forest which is burned or damaged by insects, diseases, abiotic factors and biotic agents. These monetary values for the non-use values of the forest are based on the preferences of individuals and, therefore, should not be ignored by policy makers. The values presented in this study can be considered as lower bounds because some countries do not correctly classify the use of forest. In particular, according FAO/FRA (2010), some countries classify their forest as a multiple purpose area even though this forest is indeed a conservation area.

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Appendix

Table 1: *Selected studies*

Countries of the Case Study	References	Forest by Ecological Zones
Africa Burkina Faso, Ethiopia, Kenya, Uganda	Bush et al. (2010), Mekonnen (2000), Murrithi and Kennon (2002), Naidoo et al. (2005), Yelkouni (2005)	tropical
Asia Cyprus, Israel, Lebanon, Turkey	Biro (1998), Gurluk (2006), Sattout et al. (2006), Shechter et al. (1998)	subtropical/temperate
Europe Denmark, Greece, France, North Ireland, Italy, Spain	Bellù and Cistulli (1997), Bonnieux et al. (2006), Bujosa et al. (2010), Brey et al. (2007), Despres (1998), Kontogianni et al. (2001), Montagné et al. (2005), Noublanche and Chassany (1998), Olsen (2009), Reira and Mogas (2004), Scarpa et al. (2000), Soliño (2010), Soliño et al. (2010)	subtropical/temperate

Table 2: *Values from removals, land area, forest area, and other wooded land*

Country	Value of Wood and Non-wood forest products removals in 2005 (million $)	Land area (1000 ha)	Forest area (1000 ha)	OWL (1000 ha)	Designated Area for Conservation (in %)
Albania	111	2,740	794	261	9
Algeria	18	238,174	2,277	1,595	4
Bosnia-Herzegovina	n.a.	5,120	2185	549	1*
Croatia	263.7	5,592	2,135	346	3*
Cyprus	0.45	924	174	214	2*
Egypt	11	99,545	67	20	2*
France	33	55,010	15,554	1,708	3*
Greece	n.a.	12,890	3,752	2,780	4.2
Israel	n.a.	2,171	171	81	18*
Italy	n.a.	29,411	9,979	1,047	30
Lebanon	1.75	1,023	136	106	2.6
Libya	n.a.	175,954	217	330	100
Malta	n.a.	32	0	0	-
Monaco	n.a.	2	0	0	-
Morocco	25.5	44,630	4,364	408	12*
Portugal	n.a.	9,150	3,783	84	16.3
Slovenia	145.5	2,012	1,264	44	46*
Spain	874.3	49,944	17,915	10,299	37
Syria	n.a.	18,378	461	35	100
Tunisia	127.8	15,536	1,056	170	3.7
Turkey	748.6	76,963	10,175	10,689	7.6

Sources: FAO/FRA (2005;2010)
Notes: n.a. is not available. * stands for information from FAO/FRA (2010) otherwise from FAO/FRA (2005)

Table 3: *Meta-analysis, OLS approach*

Dependent Variable: ln(WTP) Explanatory Variables	Coefficients		Standard Errors	t-statictic
Constant	717.77	***	159.11	4.51
Year	-0.359	***	0.079	-4.51
Median	-1.294	*	0.774	-1.67
Attr	-0.391		0.787	-0.50
NonUse	-0.785		1.063	-0.74
Authors	-0.189		0.314	-0.60
Subtrop	-2.514	**	1.189	-2.11
Temp	2.971	***	1.058	2.81
Asia	6.393	***	1.254	5.10
Europe	1.801		1.084	1.66
ln(Resp)	0.073		0.191	0.38
ln(Area)	0.057		0.140	0.41
Number of Observations			98	
R^2			0.49	

Note: ***, **, *stand for 1, 5, and 10% significance levels, respectively.

Table 4: *Robust estimation regression after iteratively reweighted approach*

Dependent Variable: ln(WTP) Explanatory Variables:	Coefficients		Robust Standard Errors	t-statictic
Constant	146.02		139.11	-1.01
Year	-0.706		0.069	-2.37
Median	-1.337	**	0.564	-2.49
Attr	-3.696	**	1.487	1.11
NonUse	1.643		1.483	-2.18
Authors	-0.642	**	0.295	0.58
Subtrop	0.683		1.185	2.64
Temp	4.445	**	1.685	2.06
Asia	2.983	**	1.217	2.42
Europe	3.414	*	0.691	-0.90
ln(Resp)	-0.182		0.691	-1.20
ln(Area)	-0.182		0.152	1.50
Number of Observations			93	
Number of Clusters			19	
R^2			0.57	

Note: ***, **, *stand for 1, 5, and 10% significance levels, respectively.

Table 5: *Marginal values (WTPs) from the first step*

Continents	Marg. Value for Sub. Forest	Marg. Value for Temp. Forest	Sub. Forest Area	Temp. Forest Area	Avg. GDP per Capita	Avg. Population
Africa	1.07	0	61,989.88	0	976.7575	103,154,937
Europe	2.7	116.05	19,247.5	741,640.1	29,468.82	36,664,419
Asia	17.4	655.27	694	814,000	16,446.62	26,220,006

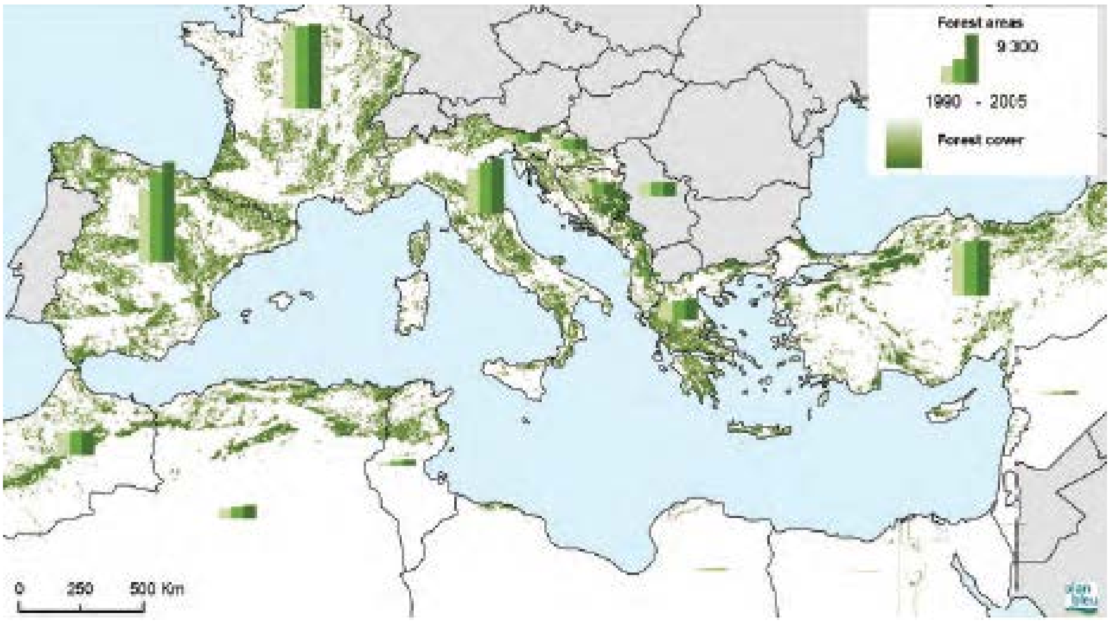
Notes: Marg. Value is the marginal value. The marginal values for this step are calculated at *Median* equals zero.

Table 6: *Marginal values (WTPs) for the Mediterranean forest*

Country	Marg. Value for Sub. Forest (int.$/ha/year)	Marg. Value for Temp. Forest (int.$/ha/year)	Sub. Con. Area Forest (ha)	Temp. Con. Area Forest (ha)	Marg. Value of all Forest (int.$ /ha/year)	Total Amount (Int.$)
Africa						
Algeria	2.61	0	91,080	0	0.10	237,718.80
Egypt	0.38	0	2,100	0	0.01	798.00
Libya	1.32	0	217	0	1.32	286.44
Morocco	3.89	0	615,720	0	0.55	2,395,150.80
Tunisia	0.46	0	39,072	0	0.02	17,973.12
Total in Million Int.$						2.65
Int.$/ha/year for Con. Area						3.54
Int.$/ha/year for all Forest Area						0.33
Asia						
Cyprus	2.67	0	3,460	0	0.05	9,238.20
Israel	61.79	0	7,011	0	2.53	433,209.69
Lebanon	4.55	0	3,536	0	0.12	16,088.80
Syria[ɣ]	2.28	0	461,000	0	2.28	1,051,080
Turkey[!]	19	20.72	634,106	139,194	1.47	14,932,113.68
Total in Million Int.$						16.44
Int.$/ha/year for Con. Area						13.17
Int.$/ha/year for all Forest Area						1.48
Europe						
Albania	0.32	0.21	59,311.8	12,148.2	0.03	21,530.90
Bosnia-Herzegovina	0.08	0.33	4,151.5	17,698.5	0.01	6,172.63
Croatia	0.49	1.47	17,934	46,116	0.04	76,578.18
France	0	77.93	0	155,540	0.78	12,121,232.20
Greece	6.59	1.38	152,856.48	4,727.52	0.27	1,013,848.18
Italy	78.56	184.12	2,514,708	778,362	34.16	340,867,471.9
Portugal	4.16	7.98	505,077.93	118,475.07	0.81	3,046,555.25
Slovenia	0.06	4.11	69,165.6	501,450.6	1.63	2,065,111.90
Spain	89.1	188.17	5,302,840	1,391,995.5	40.99	734,414,837.24
Total in Million Int.$						1,093.63
Int.$/ha/year for Con. Area						93.85
Int.$/ha/year for all Forest Area						19.48
Africa+Asia+Europe						
Total in Million Int.$						1,112.73
Int.$/ha/year for Con. Area						81.52
Int.$/ha/year for all Forest Area						14.79

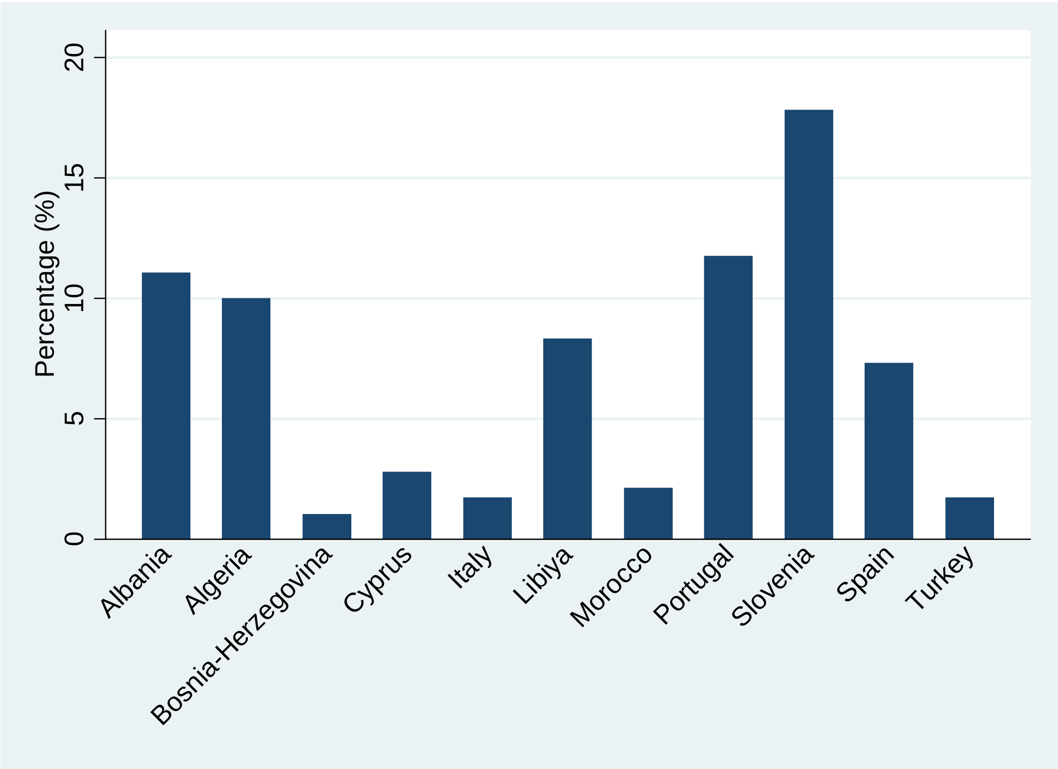
Notes: [!] The calculation of the marginal values for this country is based on the European marginal value. [ɣ] The calculation of the marginal values for this country is based on the Asian marginal value. Int.$ stands for international US dollar. Con. Area is the conservation area. Marg. Value is the marginal value (WTP).

Figure 1: *Trends in the forest area 1990-2005 (in 1000 ha)*



Source: State of the Environment and Development in the Mediterranean (2009).

Figure 2: *Percentage of the endangered, threatened, and vulnerable native tree species*



Source: FAO, Global Forest Resources Assessment (2005) and the International Union for Conservation of Nature.

Figure 3: *Forest by ecological zones in the Mediterranean region countries*

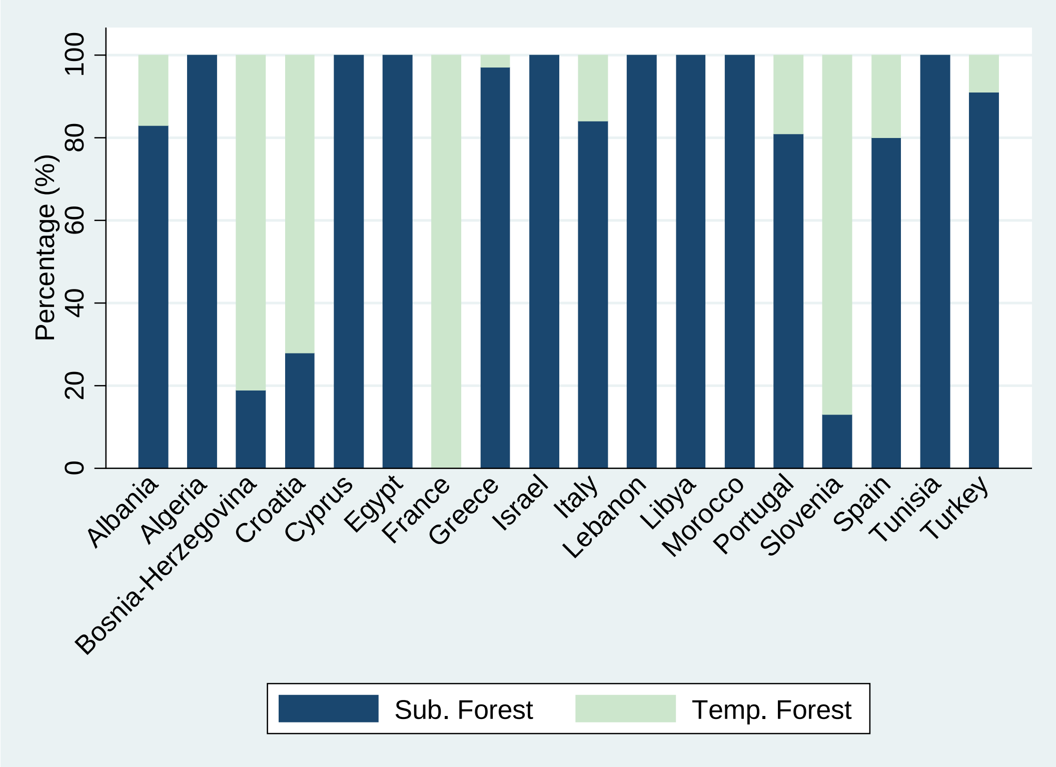


Figure 4: *Number of marginal values in the selected studies*

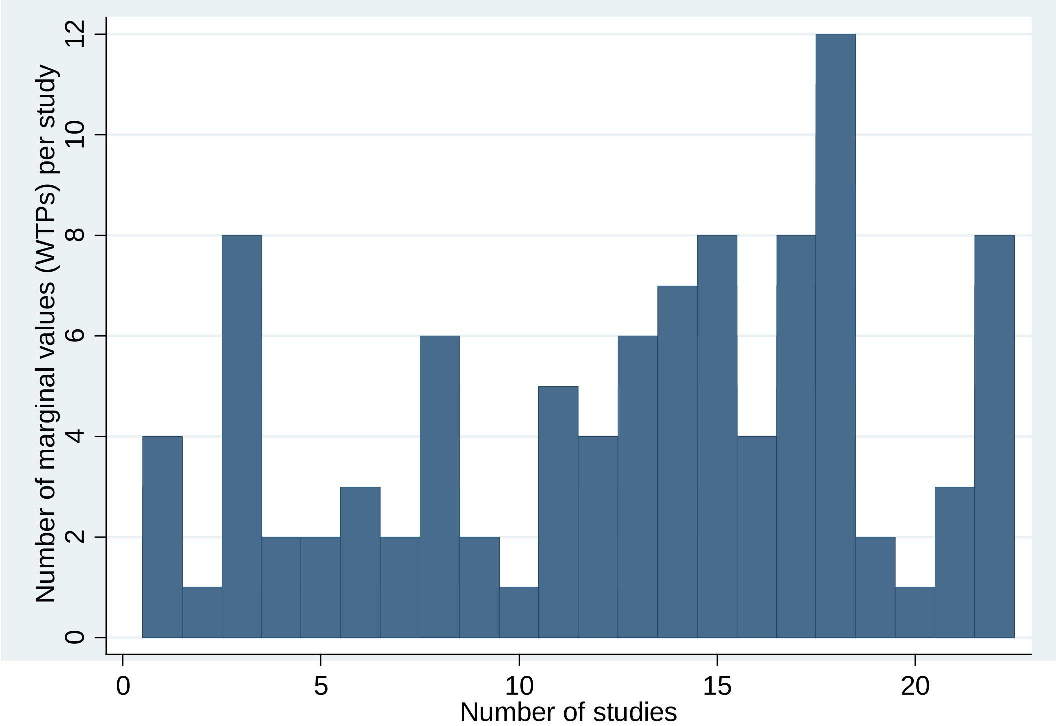
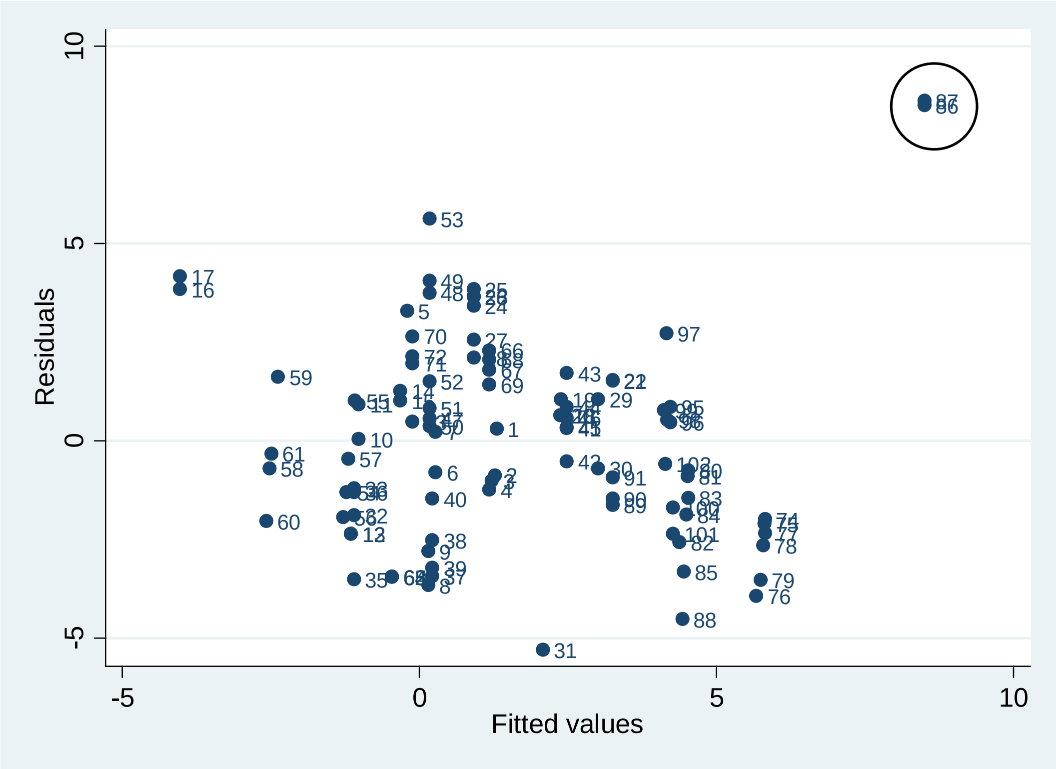
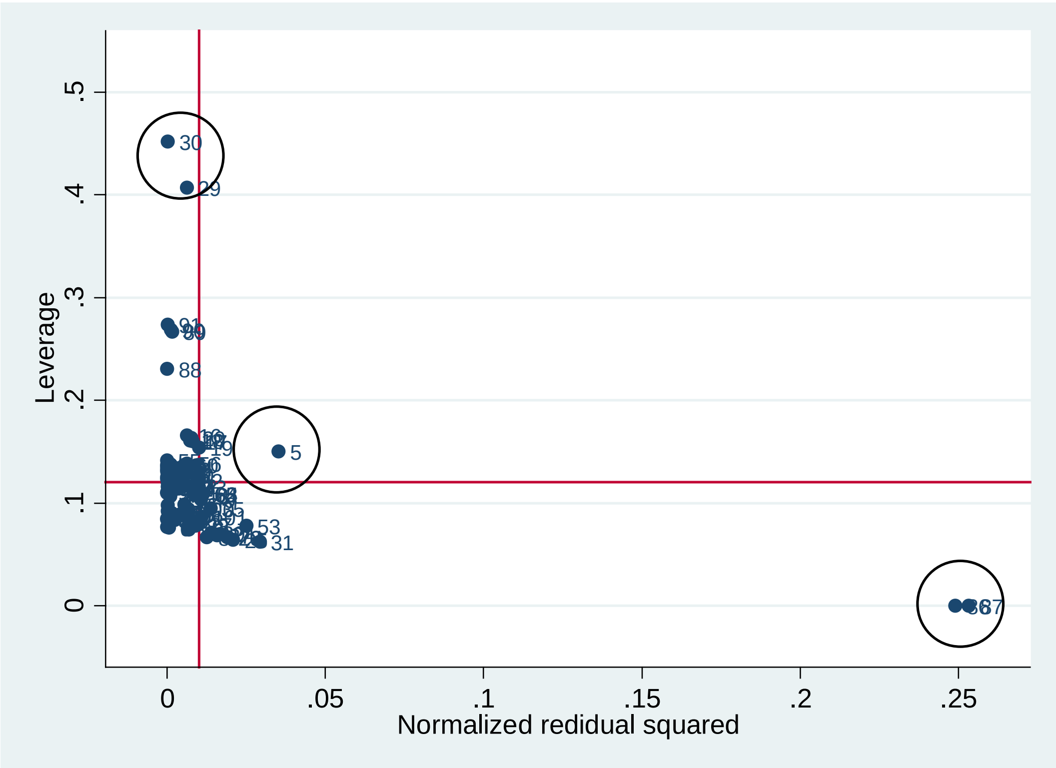


Figure 5: *Residuals and fitted values from the OLS regression*



Notes: The residuals and fitted values are from eq. 1. The circled observations point out the presence of heteroskedasticity.

Figure 6: *Iteratively reweighted least squares approach*



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