Online Supporting Information:

Increasing potency and price of cannabis in Europe, 2006-2016

Supplementary tables S1-S2

Table S1: Country-specific information on coverage and sampling of cannabis potency data

Country	Coverage	Sampling
Austria	National	Routine analysis of seizures and test purchases at street level
Belgium	National	Seizures and collected samples following prosecutors' decision, amnesty bins
Bulgaria	District of Sofia	All seizures
Croatia	National	All seizures
Czech Republic	National	All seizures
Estonia	National	All seizures
Finland	National	All seizures for which test is requested and weight >150g
France	National	All seizures
Hungary	National	All seizures submitted for analysis of herbal cannabis >8g/resin >25g
Italy	National	Seizures under threshold/all seizures in Latium region
Malta	National	Random sample of police and customs seizures
Netherlands	National	Random sample of test purchases in coffee shops
Norway	National	All seizures
Poland	National	Seizures and material from cultivation
Portugal	National	Random sample of seizures <1g
Romania	National	Sampling when requested by authorities (< 1kg)
Slovakia	National	All seizures
Slovenia	National	Random sample of all seizures
Sweden	National	Police seizures
Turkey	National	Seizures analysed for judicial or law enforcement needs
UK	England and Wales	Sampled from street level users issued a warning

Table S2: Country-specific information on coverage and sampling of cannabis price data

Country	Coverage	Sampling
Belgium (a)	National	Annual police survey informed by drug users and dealers
Belgium (b)	Local (4 cities)	Annual survey of drug users recruited from the community
Bulgaria (a)	National	Annual police survey
Bulgaria (b)	Local (16 cities)	Two annual surveys from police and field workers
Croatia	National	Survey from police informants
Czech Republic	National	Two annual surveys from police
Denmark	National	Two annual surveys from police informed by drug users and dealers
Estonia	National	Annual police survey informed by informants and arrestees
Germany	National	Police survey based on interrogation and routine work
Greece	National	Police survey informed by drug users and police purchase
Hungary	National	Annual survey from drug users at outpatient treatment centres
Italy	National	Police survey
Lithuania	National	Police survey
Luxembourg	National	Annual survey from drug users in harm reduction services
Malta	National	Quarterly survey from police drug squad informed by arrestees
Netherlands	National	Random sample of test purchases in coffee shops
Norway	Oslo	Self-reported data from drug users
Poland (a)	National	Police survey
Poland (b)	National	Drug users surveyed about most recent purchase
Spain	National	Police survey informed by arrestees and operational intelligence twice a year
Slovakia	National	Survey of users, arrestees and test purchases
Slovenia	National	Annual survey of police and operational intelligence
Sweden	National	Two annual surveys from police
UK	National	Annual police survey informed by interviews, intelligence, test purchases and records

Supplementary figures S1-S6

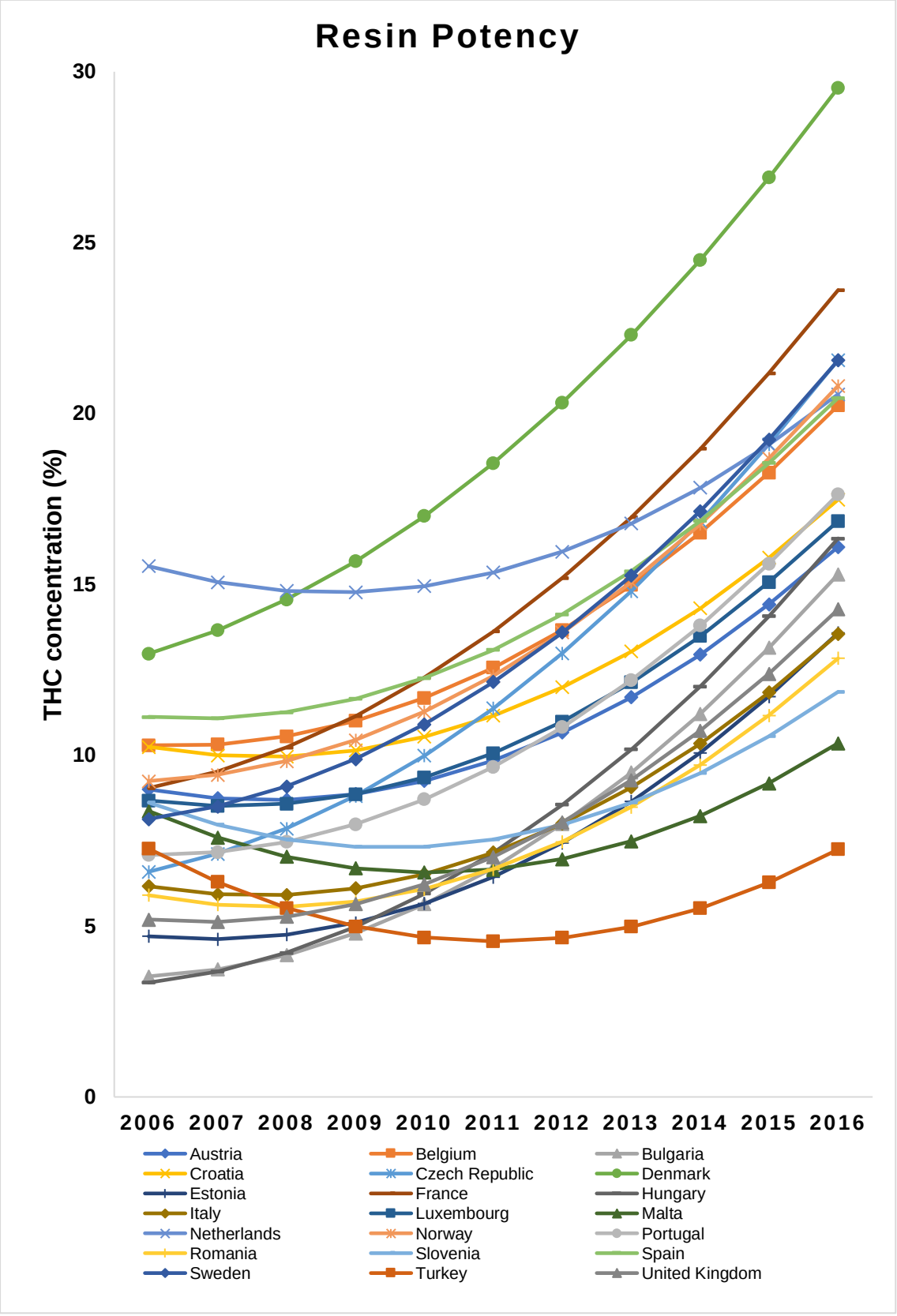

Figure S1. Changes in resin potency in Europe by year, 2006-2016. Data show parameter estimates for the random intercept and slope of Country. THC concentrations in resin (%) showed a quadratic trend over time. This model accounts for variation across countries at baseline (random intercept) and the magnitude of change from 2006-2016 (random slope)

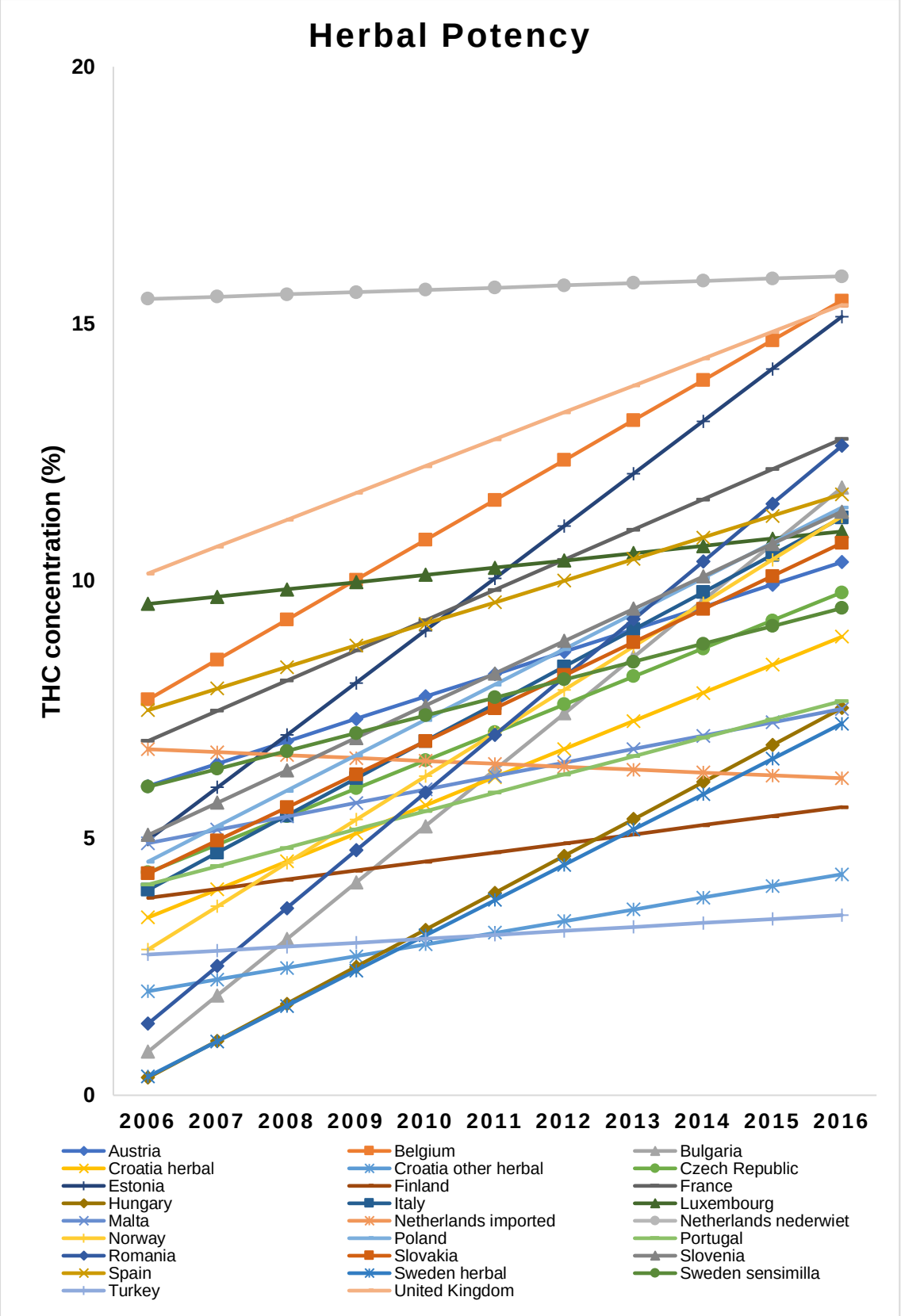

Figure S2. Changes in herbal potency in Europe by year, 2006-2016. Data show parameter estimates for the random intercept and slope of Country. THC concentrations in herbal cannabis (%) showed a linear trend over time. This model accounts for variation across countries at baseline (random intercept) and the magnitude of change from 2006-2016 (random slope)

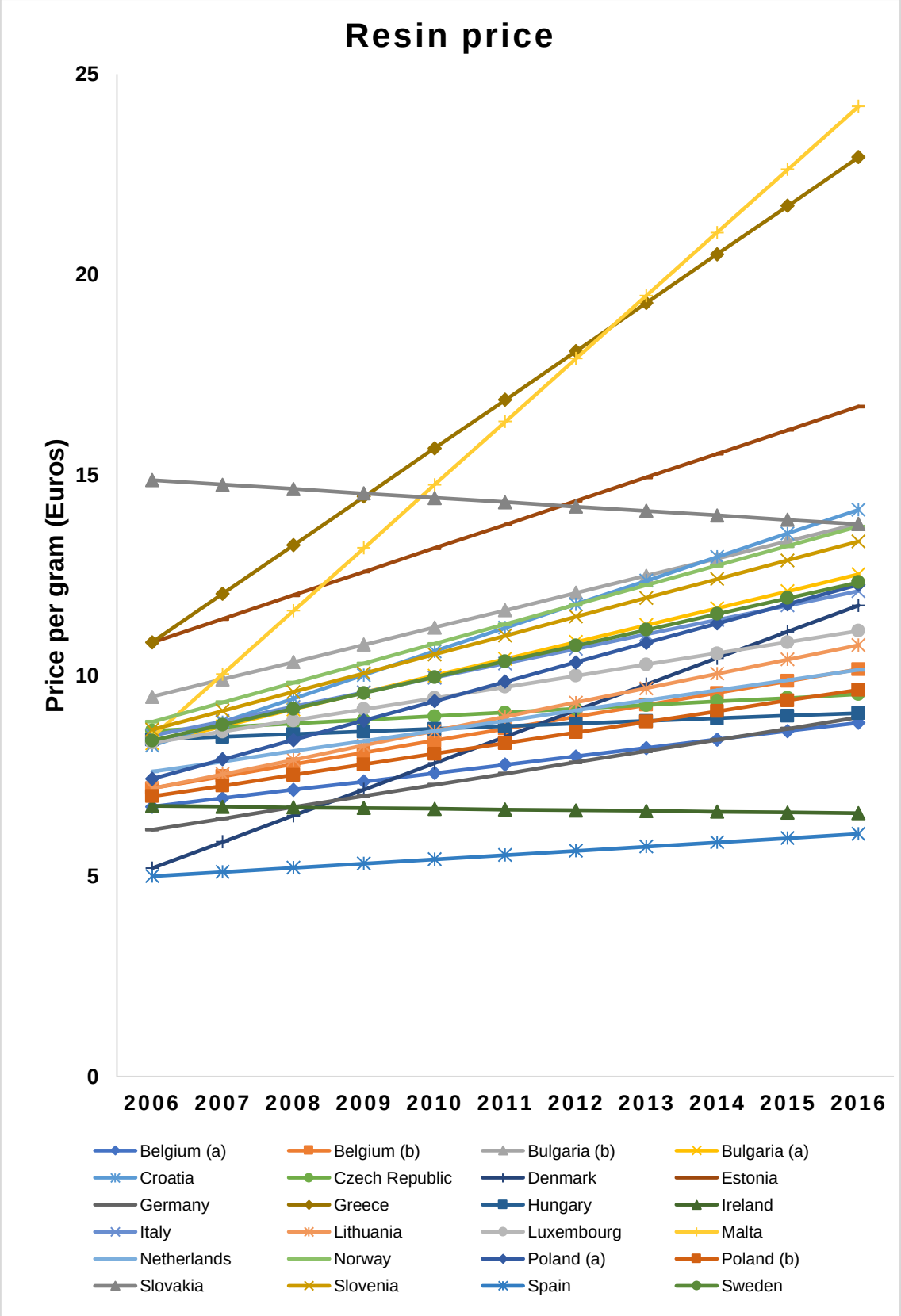

Figure S3. Changes in resin price in Europe by year, 2006-2016. Data show parameter estimates for the random intercept and slope of Country. The data shown are not adjusted for inflation. The price of cannabis resin (Euros) showed a linear trend over time. This model accounts for variation across countries at baseline (random intercept) and the magnitude of change from 2006-2016 (random slope)

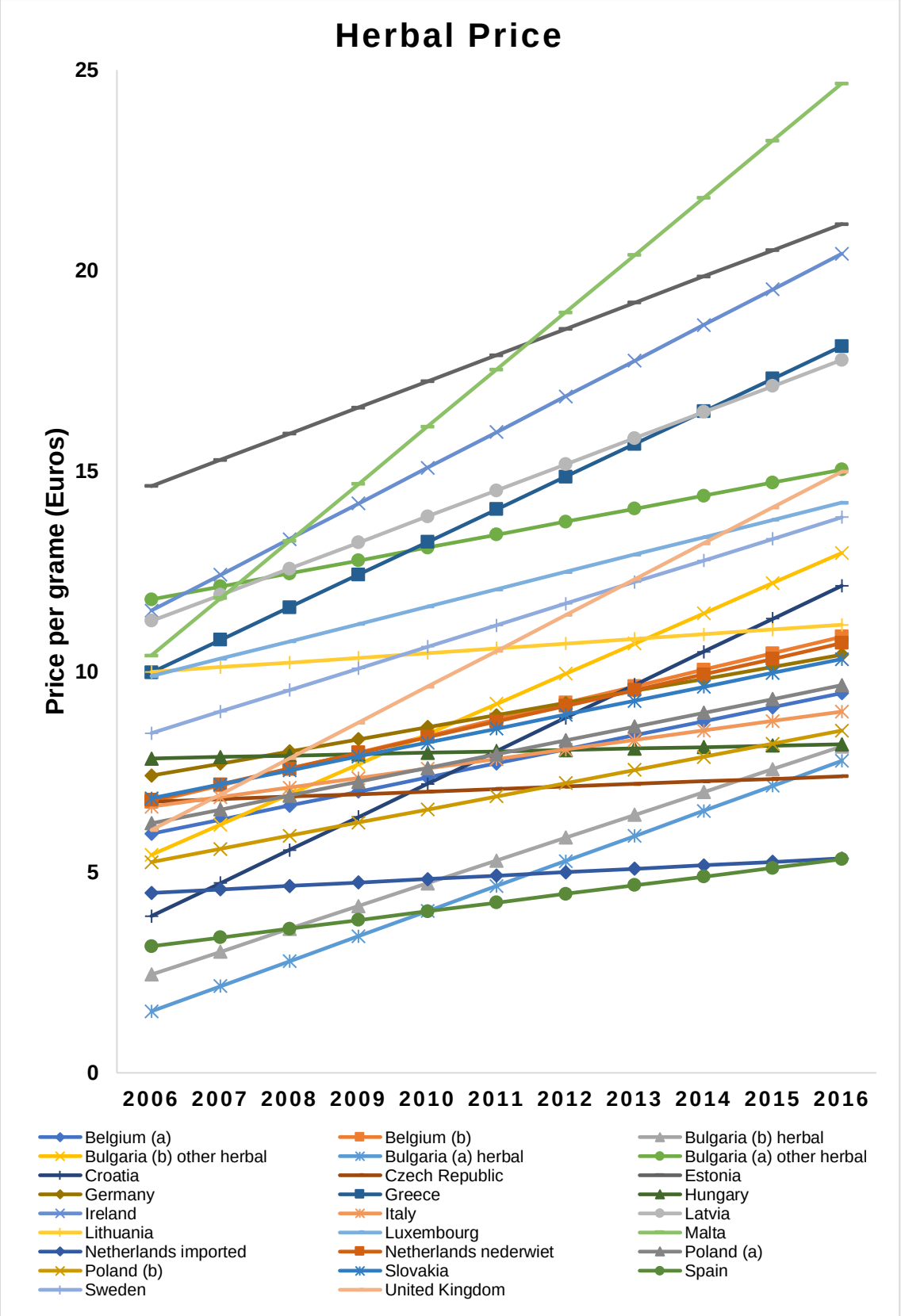

Figure S4. Changes in herbal price in Europe by year, 2006-2016. Data show parameter estimates for the random intercept and slope of Country. The data shown are not adjusted for inflation. The price of herbal cannabis (Euros) showed a linear trend over time. This model accounts for variation across countries at baseline (random intercept) and the magnitude of change from 2006-2016 (random slope)

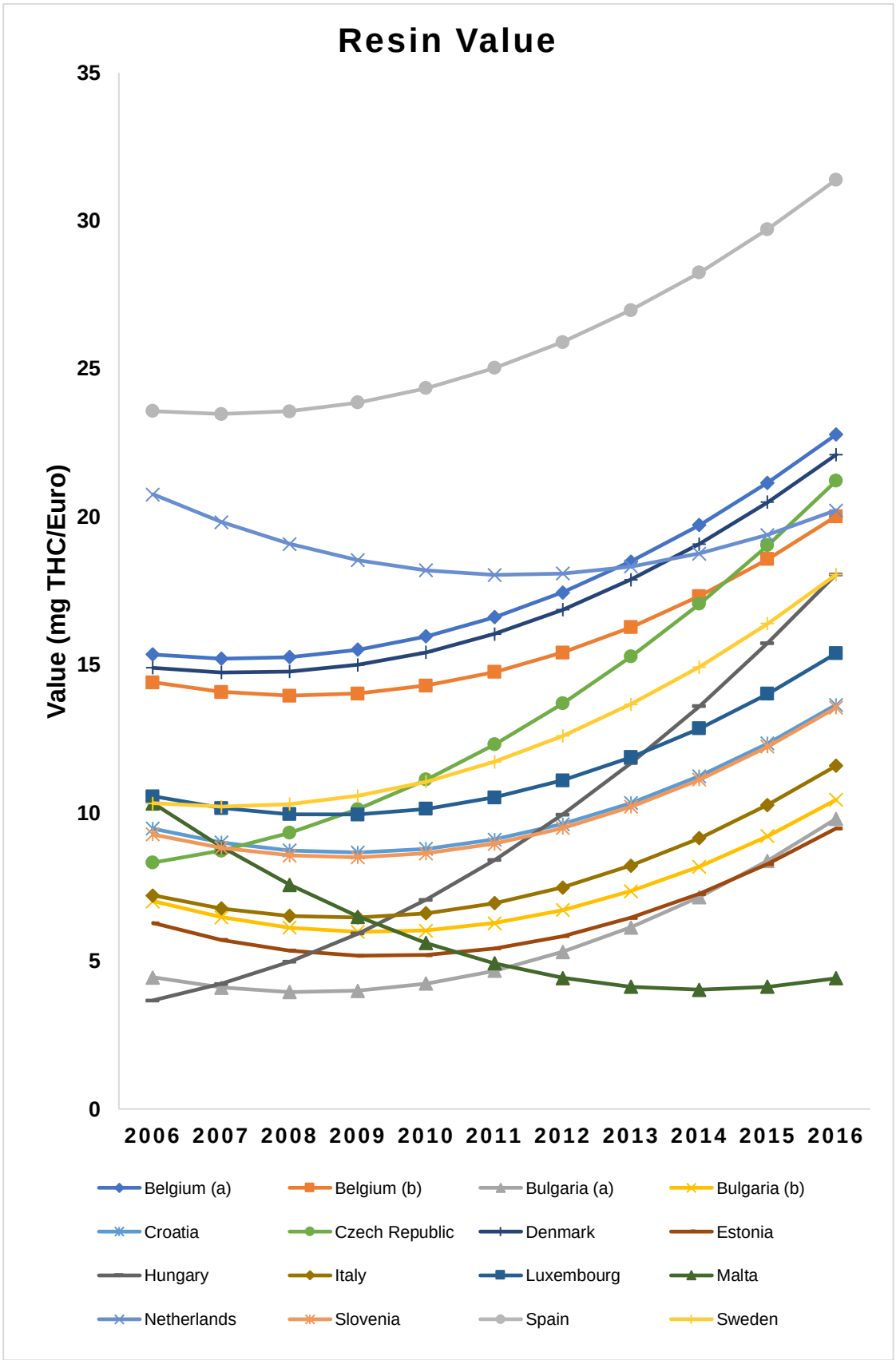

Figure S5. Changes in value of cannabis resin in Europe by year, 2006-2016. Data show parameter estimates for the random intercept and slope of Country. The data shown are not adjusted for inflation. The price of cannabis resin (Euros) showed a quadratic trend over time. This model accounts for variation across countries at baseline (random intercept) and the magnitude of change from 2006-2016 (random slope)

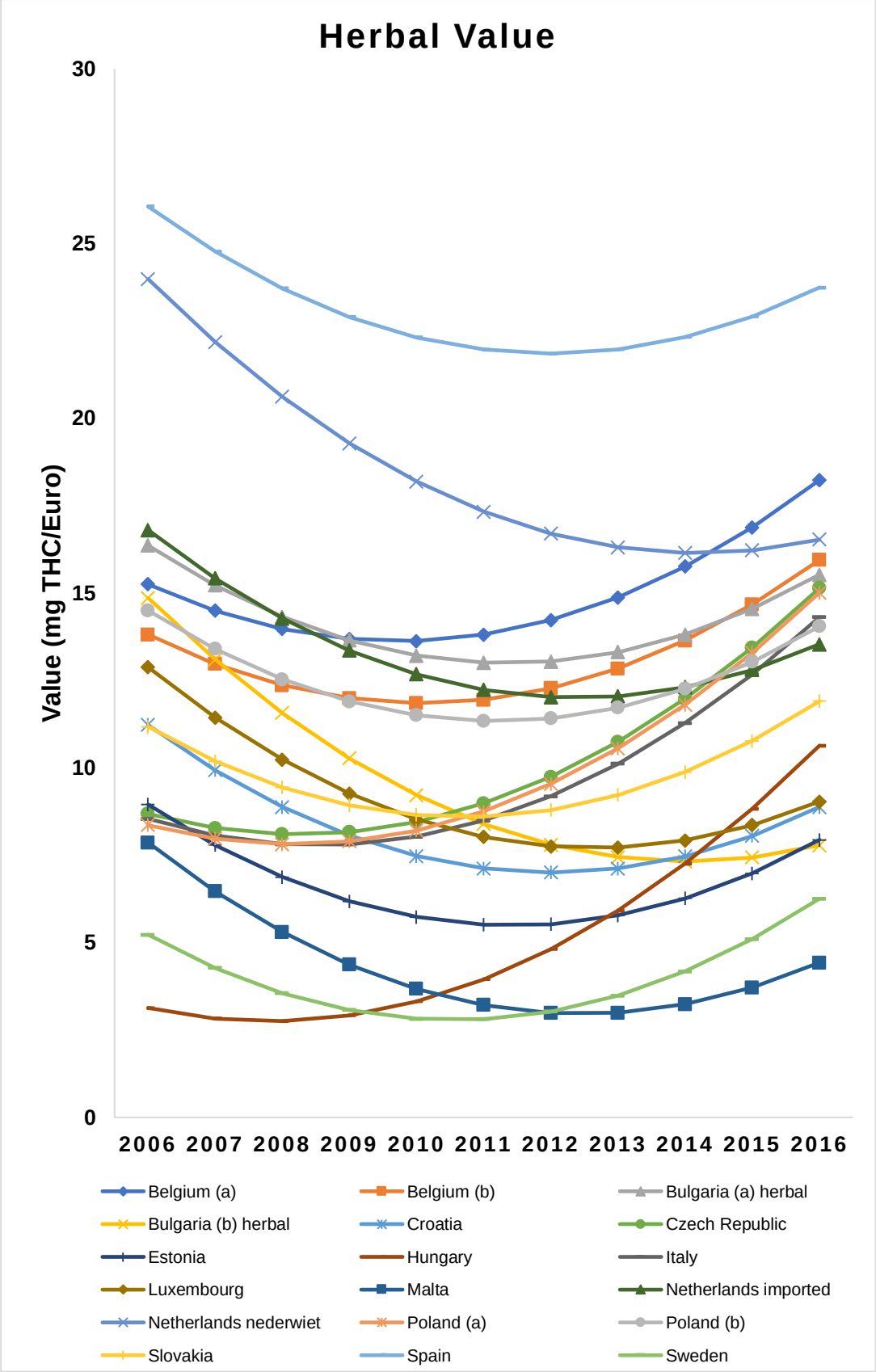

Figure S6. Changes in value of herbal cannabis price in Europe by year, 2006-2016. Data show parameter estimates for the random intercept and slope of Country. The data shown are not adjusted for inflation. The price of herbal cannabis (Euros) showed a linear and quadratic trend over time. This model accounts for variation across countries at baseline (random intercept) and the magnitude of change from 2006-2016 (random slope)

Supporting information on model fit statistics

(i) Changes in potency

Resin potency data from 2006-2016 are shown in Figure 1(A) and Table 2. Firstly, Year was fitted as a fixed effect to model a linear trend of annual changes in resin potency. In this model there was evidence for a linear increase in potency over time (z=8.98, $p<0.001$). Next, a quadratic trend of Year was added as a fixed effect. This improved model fit, as evidenced by a decrease in BIC (ΔBIC=9.34) and a significant likelihood ratio test ($\chi^2_{(1)}=14.56$, $p<0.001$). In this model there was evidence for a quadratic trend (z=3.89, $p<0.001$) but not a linear trend (z= -1.20, $p=0.231$). Next, a random intercept and slope of Country was added to account for variation in potency and its association with time across countries (Figure S1). This improved model fit, as evidenced by a decrease in BIC (ΔBIC=103.54) and a significant likelihood ratio test ($\chi^2_{(2)}=113.99$, $p<0.001$). In this final model, there was evidence for a quadratic trend of Year (β=0.11, 95% CI: 0.06, 0.16, z=4.01, $p<0.001$) but not a linear trend of Year (β= -0.17, 95% CI: -0.69, 0.34, z= -0.66, $p=0.510$).

Herbal cannabis potency data from 2006-2016 are shown in Figure 1(B) and Table 2. Firstly, a linear trend of Year was fitted as a fixed effect. In this model there was evidence for an increase in potency over time (z=6.13, $p<0.001$). Next, a quadratic trend of Year was added as a fixed effect. However, this did not improve model fit, as evidenced by an increase in BIC (ΔBIC=4.45) and a non-significant likelihood ratio test ($\chi^2_{(1)}=1.00$, $p=0.316$). Therefore, the quadratic trend was removed from the model. Next, a random intercept and slope of Country was added (Figure S2), which improved model fit (ΔBIC=209.30, likelihood ratio $\chi^2_{(2)}=220.22$, $p<0.001$). In this final model (including Year and Country), there was evidence for a linear trend of year (β=0.52, 95% CI: 0.43, 0.61, z=11.51, $p<0.001$).

(ii) Changes in price

Resin price data from 2006-2016 are shown in Figure 1(C) and Table 3. Firstly, a linear trend of Year was fitted as a fixed effect. In this model there was evidence for an increase in price over time (z=5.22, p<0.001). Next, a quadratic trend of Year was added as a fixed effect. However, this did not improve model fit, as evidenced by an increase in BIC (ΔBIC=4.58) and a non-significant likelihood ratio test ($\chi^2_{(1)}$=0.60, p=0.440). Therefore, the quadratic trend was removed from the model. Next, a random intercept and slope of Country was added (Figure S3), which improved model fit (ΔBIC=98.37, likelihood ratio $\chi^2_{(2)}$=108.74, p<0.001). In this final model (including Year and Country), there was evidence for a linear trend of Year (β=0.41, 95% CI: 0.23, 0.58, z=4.55, p<0.001).

Changes in resin price after adjusting for inflation: Firstly a linear trend of Year was fitted as a fixed effect predicting inflation-adjusted resin price. In this model there was evidence for an increase in price over time (z=3.17, p<0.001). Next, a quadratic trend of Year was added as a fixed effect. However, this did not improve model fit, as evidenced by an increase in BIC (ΔBIC=5.02) and a non-significant likelihood ratio test ($\chi^2_{(1)}$=0.16, p=0.689). Therefore, the quadratic trend was removed from the model. Next, a random intercept and slope of Country was added which improved model fit (ΔBIC=98.89, likelihood ratio $\chi^2_{(2)}$=109.25, p<0.001). In this final model (including Year and Country), there was evidence for a linear trend of Year (β=0.23, 95% CI: 0.06, 0.40, z=2.59, p=0.010).

Herbal cannabis price data from 2006-2016 are shown in Figure 1(D) and Table 3. Firstly, a linear trend of Year was fitted as a fixed effect. In this model there was evidence for an

increase in price over time (z=6.16, p<0.001). Next, a quadratic trend of Year was added as a fixed effect. However, this did not improve model fit, as evidenced by an increase in BIC (ΔBIC=2.99) and a non-significant likelihood ratio test ($\chi^2_{(1)}$=2.42, p=0.120). Therefore, the quadratic trend was removed from the model. Next, a random intercept and slope of Country was added (Figure S4), which improved model fit (ΔBIC=208.50, likelihood ratio $\chi^2_{(2)}$=219.24, p<0.001). In this final model (including Year and Country), there was evidence for a linear trend of Year (β=0.49, 95% CI: 0.35, 0.62, z=6.99, p<0.001).

Changes in herbal cannabis price after adjusting for inflation: Firstly, a linear trend of Year was fitted as a fixed effect predicting inflation-adjusted resin price. In this model there was evidence for an increase in price over time (z=4.40, p<0.001). Next, a quadratic trend of Year was added as a fixed effect. However, this did not improve model fit, as evidenced by an increase in BIC (ΔBIC=3.89) and a non-significant likelihood ratio test ($\chi^2_{(1)}$=1.54, p=0.214). Therefore, the quadratic trend was removed from the model. Next, a random intercept and slope of Country was added. This improved model fit (ΔBIC=212.58, likelihood ratio $\chi^2_{(2)}$=223.32, p<0.001). In this final model (including Year and Country), there was evidence for a linear trend of Year (β=0.32, 95% CI: 0.18, 0.46, z=4.60 p<0.001).

(iii) Changes in value

Changes in value for cannabis resin (quantity of THC per price unit; mg THC/Euro) are shown in Figure 1(E) and Table 4. Firstly, a linear trend of Year was fitted as a fixed effect. In this model there was evidence for an increase in value over time (z=2.17, p=0.030). Next, a quadratic trend of Year was added as a fixed effect. This produced provided weak evidence for an improvement in model fit, as evidenced by a decrease in BIC of <2 (ΔBIC=1.06). However, the likelihood ratio test was significant ($\chi^2_{(1)}$=5.85, p=0.016) and therefore the

quadratic trend was retained in the model. In this model, there was evidence for a quadratic trend of Year (z=2.45, p=0.014) but not a linear trend of Year (z= -1.75, p=0.080). Next, a random intercept and slope of Country was added (Figure S5), which improved model fit (ΔBIC=99.03, likelihood ratio $\chi^2_{(2)}$=108.61, p<0.001). In this final model, there was evidence for a quadratic trend of Year (β=0.10, 95% CI: 0.03, 0.17, z=2.68, p=0.007) but not a linear trend of Year (β= -0.44, 95% CI: -1.23, 0.34, z= -1.10, p=0.270).

For changes in value of cannabis resin after adjusting for inflation, a linear trend of Year was fitted as a fixed effect. In this model there was evidence for an increase in value over time (z=3.11, p=0.002). Next, a quadratic trend of Year was added as a fixed effect. This provided weak evidence for an improvement in model fit, as evidenced by a decrease in BIC of <2 (ΔBIC=0.06). However, the likelihood ratio test was significant ($\chi^2_{(1)}$=4.85, p=0.028) and therefore the quadratic trend was retained in the model. In this model, there was evidence for a quadratic trend of Year (z=2.22, p=0.026) but not a linear trend of Year (z= -1.27, p=0.203). Next, a random intercept and slope of Country was added, which improved model fit as evidenced by a reduction in BIC (ΔBIC=98.58) and a significant likelihood ratio test ($\chi^2_{(2)}$=108.15, p<0.001). In this final model, there was evidence for a quadratic trend of Year (β=0.08, 95% CI: 0.01, 0.15, z=2.25, p=0.025) but not a linear trend of Year (β= -0.09, 95% CI: -0.88, 0.70, z= -0.22, p=0.829).

Changes in value of herbal cannabis (quantity of THC per price unit; mg THC/Euro) are shown in Figure 1(F) and Table 4. Firstly, a linear trend of Year was fitted as a fixed effect. In this model there was no evidence for a linear trend (z= -0.85, p=0.393). Next, a quadratic trend of Year was added as a fixed effect. This produced provided weak evidence for an improvement in model fit, as evidenced by a decrease in BIC of <2 (ΔBIC=0.36). However,

the likelihood ratio test was significant ($\chi^2_{(1)}$=5.39, p=0.020) and therefore the quadratic trend was retained in the model. In this model, there was evidence for a linear trend of Year (z= -2.49, p=0.013) and a quadratic trend of Year (z=2.34, p=0.019). Next, a random intercept and slope of Country was added (Figure S6), which improved model fit (ΔBIC=128.08, likelihood ratio $\chi^2_{(2)}$=138.14, p<0.001). In this final model, there was evidence for a linear trend of year (β= -1.17, 95% CI: -1.97, -0.36, z= -2.83, p=0.005) and a quadratic trend of Year (β=0.12, 95% CI: 0.05, 0.19, z=3.18, p<0.001).

For changes in value of herbal cannabis after adjusting for inflation, a linear trend of Year was fitted as a fixed effect. In this model there was no evidence for a linear trend (z= 0.53, p=0.595). Next, a quadratic trend of Year was added as a fixed effect. This produced provided weak evidence for a decrease in model fit, as evidenced by an increase in BIC of <2 (ΔBIC=1.01). However, the likelihood ratio test was significant ($\chi^2_{(1)}$=4.02, p=0.045) and therefore the quadratic trend was retained in the model. In this model, there was evidence for a quadratic trend of Year (z=2.02, p=0.044) but not a linear trend of Year (z= -1.80, p=0.072). Next, a random intercept and slope of Country was added, which improved model fit (ΔBIC=127.76, likelihood ratio $\chi^2_{(2)}$=137.82, p<0.001). In this final model, there was evidence for a quadratic trend of Year (β=0.10, 95% CI: 0.03, 0.17, z=2.66, p=0.008) but not a linear trend of Year (β= -0.75, 95% CI: -1.57, 0.06, z= -1.81, p=0.070).