Classifying European cigarette consumption trajectories from 1970 to 2015

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ABSTRACT

Objectives To systematically code and classify longitudinal cigarette consumption trajectories in European countries since 1970.

Design Blinded duplicate qualitative coding of periods of year-over-year relative increase, plateau, and decrease of national per capita cigarette consumption and categorisation of historical cigarette consumption trajectories based on longitudinal patterns emerging from the data.

Setting 41 countries or former countries in the European region for which data are available between 1970 and 2015.

Results Regional trends in longitudinal consumption patterns identify stable or decreasing consumption throughout Northern, Western and Southern European countries, while Eastern and Southeastern European countries experienced much greater instability. The 11 emergent classes of historical cigarette consumption trajectories were also regionally clustered, including a distinctive inverted U or sine wave pattern repeatedly emerging from former Soviet and Southeastern European countries.

Conclusions The open-access data produced by this study can be used to conduct comparative international evaluations of tobacco control policies by separating impacts likely attributable to gradual long-term trends from those more likely attributable to acute short-term events. The complex, regionally clustered historical trajectories of cigarette consumption in Europe suggest that the enduring normative frame of a gently sloping downward curve in cigarette consumption can offer a false sense of security among policymakers and can distract from plausible causal mechanisms among researchers. These multilevel and multisectoral causal mechanisms point to the need for a greater understanding of the political economy of regional and global determinants of cigarette consumption.

BACKGROUND

Continually updated country-level tobacco consumption data are critical to guiding conventional public health efforts. However, policy-relevant research questions such as whether and how tobacco control policies successfully decrease tobacco consumption often demand internationally comparable longitudinal or time-series data that are not readily accessible to most researchers or policymakers.[1] Beyond year-over-year trends in tobacco consumption, the historical trajectory of a country's tobacco epidemic could point to important causal mechanisms for the successful control of tobacco use.[2 3]

Lopez, Collishaw and Piha's (LCP) highly influential model of cigarette epidemics in developed country contexts put forth a typology in which smoking prevalence and consumption begins at a low level, rises rapidly (primarily among men) for two to three decades, begins a decline following the implementation of comprehensive tobacco control policies and finally transitions to a slowly decreasing plateau.[4] This sequence of events was hypothesised to occur asynchronously depending on each country's level of development and could be averted altogether if interventions were implemented in the early stages of the tobacco epidemic.[4]

Although the LCP model's generalisable concave 'inverted U' model of longitudinal cigarette use prevalence has been shown to accurately describe many countries' experiences,[5] the actual progression of cigarette epidemics can vary widely by country. As one example, the former Soviet Union's per capita consumption of cigarettes and *papyrosi* followed the trajectory outlined by the LCP model from 1960 to 1992, but following the dissolution of the USSR, a second rapid increase in cigarette consumption and resultant mortality lasting at least a decade was experienced by Russia and other former Soviet countries.[6–9] Less dramatic but nonetheless important deviations from the generalisable model can include whether tobacco consumption declines gradually over time due to continual minor improvements in tobacco control, or in the form of a punctuated equilibrium as a result of a single sweeping change in tobacco control policy.[10]

Even these seemingly minor deviations from the typical trajectory of national tobacco epidemics can have profound consequences for drawing causal inferences of the impacts of government policies or other population-level determinants of tobacco consumption. A brief pronounced period of change in consumption can be plausibly attributed to events like a substantial increase in the minimum pricing of cigarette packs or an acute economic recession,[11–15] while an extended period of gradual change can be more plausibly attributed to events like linking cigarette tax increases to inflation or improved population-wide education on the harms of tobacco use.[16–18] Despite the potential utility of these distinctions in historical trends for international comparative research, country-level tobacco epidemics have not yet been systematically categorised.

The historical trajectory of the European region offers several useful characteristics to explore the utility of this approach. Every European country has been exposed to widespread cigarette consumption for at least the last 50 years, with only Norway having recorded consumption below 1400 cigarettes

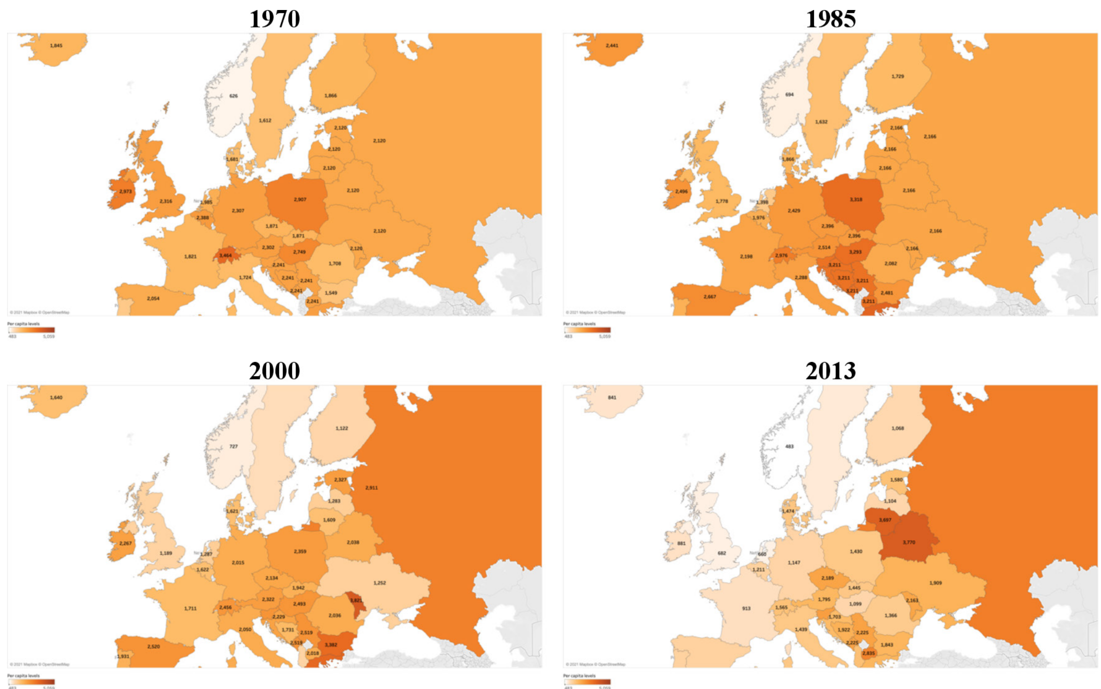

Figure 1 Map of per capita cigarette consumption. White and light orange indicates lower levels of consumption, with orange and dark orange shading representing higher levels of cigarette consumption (2013 is shown instead of 2015 because it is the last year with complete data for every country).

per adult per year and the average country consuming over 2000 cigarettes per adult per year in 1970 (figure 1).[19 20] This suggests that the LCP model would predict that all European countries should have transitioned to a stage of gradually decreasing tobacco consumption since this time.[4] The European region also offers the most reliable and fully collected longitudinal tobacco consumption data of any region in the world.[19 20] Finally, the 41 countries or former countries for which data are available have experienced very different social, political and economic determinants of tobacco consumption over the last half century.[10 21]

In this study, we leverage a previous systematic collection and quality appraisal of national cigarette consumption data from 1970 to 2015[19 20] to produce two analytical products for the empirical study of international tobacco control. First, we identify periods of relative increase, plateau and decrease of national per capita cigarette consumption in Europe using a blinded duplicate qualitative coding approach. Second, we classify national cigarette consumption trajectories based on longitudinal patterns emerging from the data. The utility of these open-access data products for conducting comparative tobacco control policy evaluations is then explained along with a review of the limitations of the data and avenues for future research.

METHODS

Cigarette consumption data

This study draws on a previous systematic collection and quality appraisal of national cigarette consumption data from 1970 to 2015.[19] Although survey-based data offer advantages of capturing cigarette use prevalence and smoking intensity, variations in survey questions and sporadic nationally representative data coverage do not allow for the systematic comparison of cigarette consumption across countries and over time.[22] By contrast, country-level cigarette consumption obscures the division between cigarette use prevalence and smoking intensity but is reported annually in comparable units by nearly all European countries.[23 24]

In brief, the source data were compiled using an adaptive search strategy to collect data from all national statistical agencies on production, trade and sales of cigarettes with supplemental data from international sources, academic and grey literature, and subject matter experts.[19] Data were appraised by two researchers to evaluate intersource consistency and data confidence, resulting in an open-access dataset of cigarette consumption estimates for 71 countries representing over 95% of the world's cigarette consumption and 85% of the world's population.[20] A single year was chosen as a break point at which to divide countries of the former USSR (1995), Yugoslavia (1990) and Czechoslovakia (1992), and at which to unite East Germany and West Germany (1990).

Despite the high level of coverage of global cigarette consumption represented by the original 71 countries, data for several European countries were not collected due to low country population or low per capita cigarette consumption. To maximise the data available for this study, we searched for and appraised cigarette consumption data using the same methods as previously used. This resulted in the addition of new country series for Albania, East Germany, Estonia, Finland, Latvia, Lithuania, Moldova, North Macedonia, Norway, and Slovenia, West Germany, which are now available in the International Cigarette Consumption Database.[20]

Coding and classification of data

Although it is possible to quantitatively code whether a country's year-over-year consumption is increasing or decreasing, in practice, country-specific variability in data reporting and relative magnitudes of change relative to historical trends can more easily be accounted for using qualitative coding.[24–26] In order to minimise bias in qualitative classification, we used a blinded, multiple coder approach.

First, all data series were de-identified by substituting country names with numerical country codes, after which raw data and line charts of per capita cigarette consumption were provided to two qualitative coders (MJP and GL). Coders independently evaluated de-identified country data on two dimensions: whether the year-specific consumption trend was increasing, plateauing or decreasing, and classifying emergent country-specific cigarette consumption trajectories since 1970. Details of notable events in the country time-series were also noted, in addition to the event years (online supplemental table 1). Rather than rely on predetermined categories, we used an inductive approach of allowing the data to dictate emergent categories using iterative classification.[27]

Once coders had independently coded each country, a third coder (LKW) mediated reconciliation of coding and served as an impartial arbiter in case of disagreement. Reconciliation was labelled as happening in either stage (1) same classification assigned by both coders, stage (2) coders agree after initial discussion or stage (3) independent mediator resolved differences in coding. Kappa statistic measures of inter-rater agreement prior to reconciliation for both year-over-year trends and country classifications were then calculated using Stata *kappa* command.[28] Finally, two additional coders independently classified the 41 countries using the emergent categories to assess validity of the consensus coding. All graphs and maps of the results were created using Tableau Release V.2020.2.[29]

RESULTS

Consensus qualitative coding of each country's year-over-year increases, plateaus and decreases in cigarette consumption is shown in online supplemental figure 1 and can be accessed in online supplemental file 1. Country-level cigarette consumption trajectory classification resulted in 17 countries being coded identically at first attempt (stage 1 agreement), consensus achieved after initial discussion for 20 countries (stage 2 agreement) and consensus reached in consultation with independent mediator for four countries (stage 3 agreement). The level of agreement achieved would normally imply fair inter-rater reliability for the year-over-year qualitative coding (κ=0.34, SE 0.02), substantial agreement for general classification (κ=0.65, SE=0.12) and fair agreement for specific classification (κ=0.30, SE 0.04); but since emergent typology categories were independently defined by each coder, this kappa value indicates stronger inter-rater reliability than would be found using predefined categories. This was confirmed by substantial agreement in general categories (κ_1=0.80, SE 0.12; κ_2=0.76, SE 0.12) and moderate agreement within specific categories (κ_1=0.52, SE 0.06; κ_2=0.53, SE 0.06) achieved by two additional independent coders in a validation exercise.

Regional trends in longitudinal cigarette consumption patterns can be clearly observed in figure 2. After a brief period of increase in the early 1970s, Northern, Western, and Southern European countries nearly universally experienced stable or decreasing cigarette consumption trends. In contrast, Eastern Europe transitioned from a period of relative stability until the 1980s, followed by widespread increasing cigarette consumption into the 2000s and a more recent pattern of decrease in the 2010s. Finally, Southeastern European countries display the most variability of any region, continually alternating between stability, increase and decrease throughout the study period.

The 15 emergent categories were narrowed down to 11 after reconciliation and validation, which are described in detail in table 1. Broadly, these can be separated into countries with generally decreasing consumption (continual decline, continual decline with interruption, decline to stable, stable to continual decline, stable with single decline), countries with unstable, stable, or reversing consumption trends (inverted U shape, sine wave or continual instability, stable), and countries with generally increasing consumption trends (increase to stable, stable with single increase, stable to continual increase). Figure 3 displays the line graphs of country-year per capita cigarette consumption and qualitative year-over-year trends grouped by country typologies, which can be more clearly observed in online supplemental figure 1.

Despite blinding coders to country names, clear regional trends in cigarette consumption typologies can be observed in figure 4. Eastern European countries of Russia, Ukraine and Latvia are the only countries to have experienced an 'inverted U' epidemic, while the oscillating 'sine wave or continual instability' typology is found in the Czech Republic, the former USSR, Baltic countries (Estonia and Lithuania) and throughout Southeastern Europe (Albania, Bosnia and Herzegovina, Bulgaria, Greece, Moldova, North Macedonia, Romania, and Serbia and Montenegro). In contrast, the most common typology of 'stable with single decline' can be found in Northern Europe (Denmark, Finland and Sweden), Western Europe (France, Germany, Netherlands, Portugal, Spain and West Germany) and Slovenia.

Other typologies are more varied in their regional distribution. Countries experiencing continual decline include Ireland and Central European countries (Belgium and Switzerland), while Austria, Croatia and the UK experienced continual decline with at least one interruption. The category of 'stable to continual decline' found in Hungary, Iceland and Poland, and 'stable' in Norway and Italy are notably varied in their distribution. Finally, less commonly found categories include 'decline to stable' (Slovakia), 'increase to stable' (East Germany and Yugoslavia), 'stable to continual increase' (Belarus) and 'stable with single increase' (Czechoslovakia).

DISCUSSION

Policy and research implications

This systematic qualitative coding of national cigarette consumption trajectories in Europe since 1970 provides comparative tobacco control researchers with two new data products and points to several new empirical findings. First, the identification of a characteristic 'inverted U' or 'sine wave' trajectory present throughout Eastern European countries has not yet been systematically described in the literature. These common trends point to the need to evaluate the political economy of regional and global determinants as drivers of cigarette use in these countries rather than limiting analysis to country-specific factors.[30–32]

Second, our findings provide researchers with descriptive models of short-term to medium-term cigarette consumption trajectories that complement the LCP model of tobacco epidemics in developed countries. The LCP model was intended to be 'a very general categorisation of the transition and does not exactly describe the experience of any one country', but has nevertheless maintained lasting relevance by effectively communicating the future health effects of current smoking.[4 5] In contrast, our classification of European cigarette epidemics at a lower level of abstraction identifies 11 real-world cigarette consumption trajectories that differ from

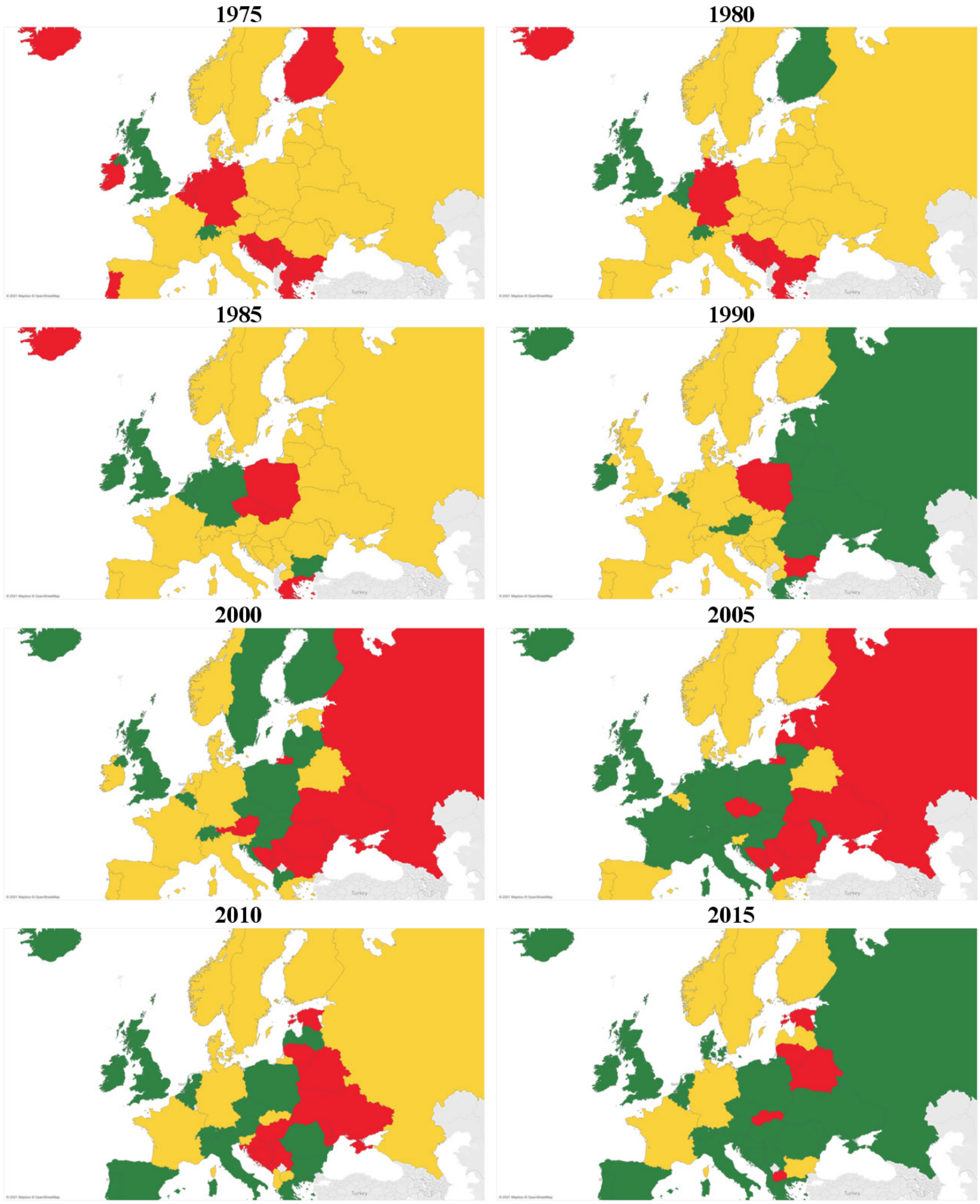

Figure 2 Map of 5-year average per capita cigarette consumption trends between 1970 and 2015: increasing (red), steady (yellow) or decreasing (green).

the generalisable model due to tobacco control policy implementation, changes in cigarette prices and broader systemic factors.

Among policymakers, an enduring normative frame of a generalised decline in tobacco consumption that inevitably follows the general public's increasing understanding and acceptance of the harms of tobacco use conflicts with the historical record and can lead to a false sense of security. Progress in combating national tobacco epidemics does not inevitably follow improved education related to smoking risks in high-income countries, as evidenced by the non-declining consumption trends in figure 3. What can appear to be a historical turning point in national tobacco consumption can easily become one of several peaks and valleys driven by national policy priorities as well as the regional and global political economy.

Among researchers, targeted tobacco control interventions cannot be assumed to achieve independent cumulative impacts, nor can they be separated from political and economic forces acting on a country.[31] While the cumulative layering effects of tobacco control interventions over time can lead to continual and gradual declines in cigarette consumption, sharp one-time reductions (or increases) present in countries like France or Estonia should be attributed to more plausible causal mechanisms. In many cases, these mechanisms can be reasonably attributed to geopolitical factors such as the dissolution of former countries, rapid privatisation of economies or events in the development of

Table 1 Descriptions for the 3 broad categories and 11 specific classifications of European cigarette consumption trajectories

Classification	Description
Generally decreasing consumption trends	
Continual decline	Characterised by consistent decline over the time period; lacks a well-defined period of plateau or single accelerated period of decrease
Continual decline with interruption	Characterised by a steady decrease over the time period interrupted by at least one well-defined period of plateau or increase
Decline to stable	Characterised by a period of decline followed by a protracted plateau period
Stable to continual decline	Characterised by a protracted plateau period followed by a well-defined period of continual decrease
Stable with single decline	Characterised by a protracted plateau period interrupted by an acute period of decrease
Unstable, stable or reversing consumption trends	
Inverted U shape	Characterised by a well-defined period of increase, followed either by (a) a well-defined period of decrease, or (b) a short plateau period, and then a well-defined period of decrease
Sine wave or continual instability	Characterised by alternating but clearly defined periods of increase and decrease, and/or extended periods of rapid increases and decreases
Stable	Characterised by a protracted plateau period; lacks a well-defined period of increase or decrease
Generally increasing consumption trends	
Increase to stable	Characterised by a period of increase followed by a protracted plateau period
Stable with single increase	Characterised by a protracted plateau period interrupted by an acute period of increase
Stable to continual increase	Characterised by a protracted plateau period followed by a well-defined period of continual increase

the European Union (EU).[6 32 33] This would suggest that the use of country-specific composite indices of the number of adopted MPOWER policies is likely too limited in scope to capture the distal factors likely driving tobacco consumption trends in many European countries and could misdirect normative frames of causal inference towards an ontological model of cumulative layering rather than punctuated equilibrium.

Lastly, the open-access data products produced by this study can be used across a range of research designs. The year-over-year qualitative coding providing a comprehensive picture of the changing nature of European cigarette consumption since 1970 can be used to conduct time-series analyses, longitudinal modelling or cross-sectional analyses. Classifications of national cigarette consumption trajectories (table 1) can be used in qualitative research designs such as comparative policy analyses but may also inform the identification of plausible causal mechanisms to evaluate using quantitative quasi-experimental methods. More generally, these data products form part of a broader project to more rigorously evaluate national and global legal instruments' impacts on health.

Strengths and limitations

Our findings are limited by the reliability of underlying data and the influence of changing prevalence and smoking intensity over time. Due to these underlying data, it is not possible to make direct comparisons between our cigarette consumption trajectories and the LCP model of cigarette use prevalence without also considering the impact of longitudinal changes in cigarettes consumed per smoker.[4] Rather, our classifications were primarily

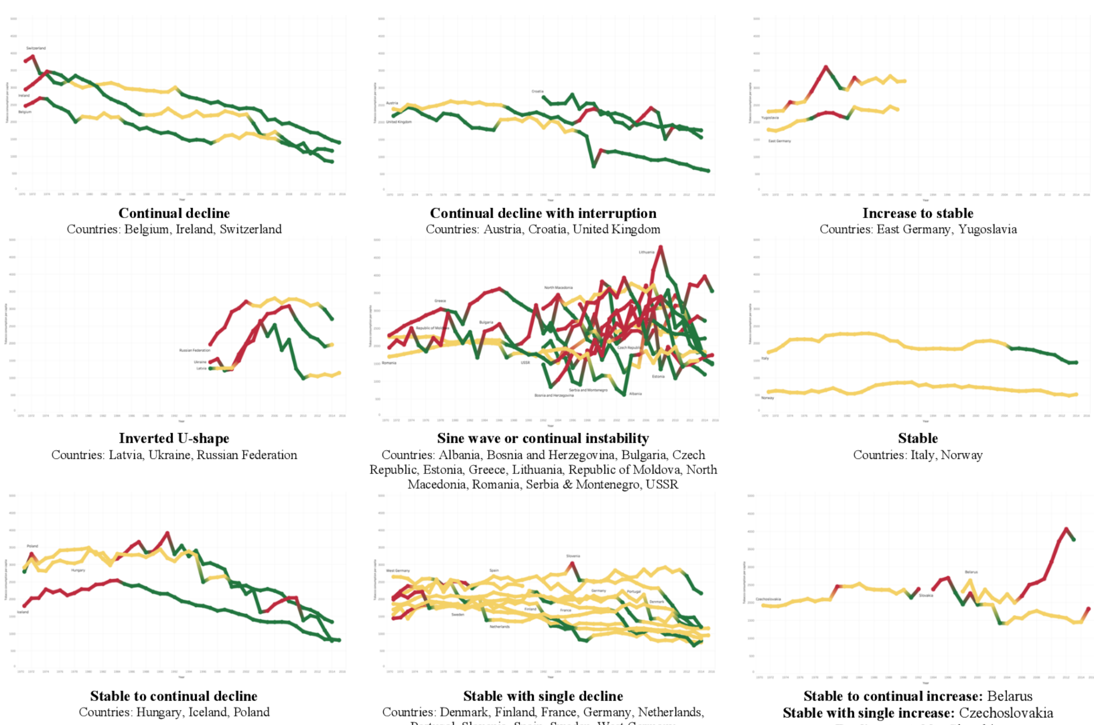

Figure 3 Line graphs of qualitatively coded increasing (red), plateauing (yellow) and decreasing (green) per capita cigarette consumption trend by country classification.

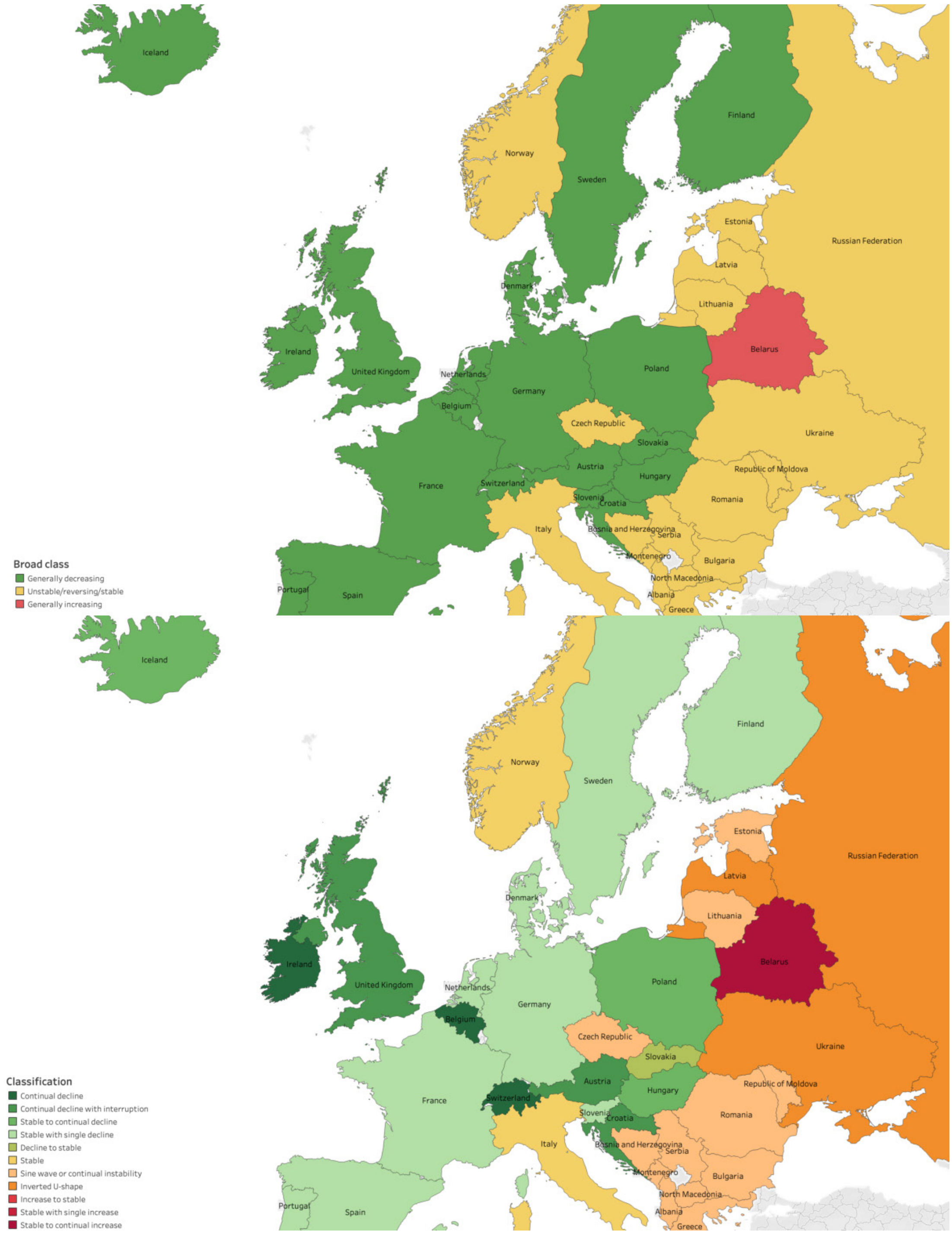

Figure 4 Maps of tobacco epidemic general (top) and specific (bottom) classifications identified for the time period of 1970–2015. Classifications for the former USSR, Yugoslavia, Czechoslovakia, East Germany and West Germany can be referenced in online supplemental table 1.

developed to support policy analysis, which led to decisions such as linking countries that have experienced a single interruption to a continual decline, whether that interruption consisted of an increase or decrease. This decision prioritises the need to identify a short-term shock to an otherwise gradual decrease over the need to distinguish the positive or negative nature of that short-term shock.

In fact, when taking these details into account, regional trends appear more distinct. The interruption to the continual decline in the UK was a short-term acceleration in declining consumption, while the interruptions in Austria and Croatia were temporary reversals of the continual decline. Similarly, of the two countries classified as 'stable', Norway's consumption has remained stable around 700 cigarettes per person per year throughout the study period, while Italy's consumption has remained stable at around 1800 cigarettes per person per year. These differences reveal even more dramatic divides between encouraging trends observed throughout Western and Northern Europe, and mixed or negative trends observed throughout Eastern and South-eastern Europe.

Our national cigarette consumption data do not include electronic cigarettes, water tobacco, chewing tobacco or roll-your-own tobacco, which can form a significant proportion of national tobacco consumption in some countries. Analysts should account for changes in the substitution of factory-manufactured cigarettes with other forms of combustible tobacco (eg, roll-your-own) or alternative tobacco products (eg, snus, electronic cigarettes) to prevent misestimation of longitudinal policy impacts.[34 35] Finally, data reliability can be affected by stockpiling, illicit international trade and consumption by non-citizens, which may underlie much of the variation found in the continual instability category.[19 33 36] We encourage researchers to draw on multiple data sources and closely examine the source data to ensure its appropriateness for their analyses.

CONCLUSIONS

This qualitative classification of European cigarette consumption trajectories from 1970 to 2015 provides researchers with two datasets that can be used to further our understanding of tobacco control policy. One specific research question that will be addressed using these data emerged from a previous study of the global impact of the Framework Convention on Tobacco Control (FCTC).[37] Although Europe was identified as the only region in the world that achieved significantly faster progress in reducing cigarette consumption than would have been expected in the absence of the FCTC, the confounding effect of concurrent accession of countries to the EU and strengthening of tobacco control laws through EU mechanisms could not be accounted for without the data needed to conduct detailed process tracing. More fundamentally, this systematic comparison and classification of historical cigarette consumption trajectories in Europe point to the need to thoroughly investigate complex, multilevel and multisectoral causal mechanisms rather than rely on simplified normative frames as a means to better understand the impact of tobacco control policies.

What this paper adds

- ⇒ Significant research attention has been dedicated to understanding population-level trends in tobacco consumption within European countries, but few studies have comparatively examined longitudinal European tobacco consumption trends' implications for tobacco control.
- ⇒ Generalisable models of cigarette epidemics effectively communicate the future health effects of current smoking, but policy analysis requires disaggregated classification of real-world cigarette consumption data.
- ⇒ This study systematically evaluates cigarette consumption data since 1970 to produce open-access datasets of year-over-year changes in consumption and 11 characteristic classifications of cigarette consumption trajectories in Europe.
- ⇒ The diversity of cigarette consumption trajectories in Europe points to the need to adopt complex, multilevel and multisectoral causal mechanisms rather than rely on simplified normative frames.

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Contributors MJP conceptualised the study, supervised data collection and analysis, participated in coding exercises, and led the drafting and revision of the paper. He is the guarantor. GL participated in coding exercises, collected and analysed the data, generated visualisations, and contributed to the drafting and revision of the paper. LKW participated in coding exercises and contributed to the drafting and revision of the paper. SJH led funding acquisition, and contributed to study conceptualisation, data collection and analysis, and drafting and revision of the paper.

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Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This study does not involve human participants.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available in a public, open access repository. All data relevant to the study are included in the article or uploaded as supplemental information. The full dataset used in this study can be accessed at: https://dataverse.scholarsportal.info/dataverse/ICCD. Additional data and methodological details can be found in the appendix. Please contact the corresponding author for any inquiries about the dataset and analyses.

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Appendix: Classifying European Cigarette Consumption Trajectories from 1970-2015

Appendix Table 1: Country epidemic classification notes for 41 countries categorized into typology groups during the study period 1970-2015 with indication of the stage to reach consensus.

- Stage 1 is early consensus, with both coders assigning the same or similar classification.
- Stage 2 requires both coders to agree after initial discussion.
- Stage 3 involves an independent mediator to resolve differences in coding.

Four major country dissolutions occurred during the study period. Czechoslovakia, Yugoslavia, and the former USSR were split into new countries post-dissolution. The former East Germany (German Democratic Republic) and West Germany (Federal Republic of Germany) were united in 1990. The country-years of each data series is indicated in brackets under the country name.

- Yugoslavia* split into Croatia, Macedonia, Serbia and Montenegro, and Slovenia (1990).
- The USSR** split into Belarus, Estonia, Latvia, Lithuania, Moldova, and Ukraine (1995).
- Czechoslovakia*** split into Czech Republic and Slovakia (1992).
- East and West Germany merged into Germany**** (1990).

Country	Coder 1 (MP)	Coder 2 (GL)	Stage of consensus	Notes	Event 1	Event 2
Class: Continual decline						
Belgium (1970-2015)	Continual decline	Continual decline	1	Continual decline beginning at 1973; final decrease starts in 2006 at steeper decline (not 2003 - part of plateau)	Decline begins at 1973	
Ireland (1970-2015)	Continual decline	Continual decline	1	Continual decline with small increase from 1970-1974 and plateau 1987-2002	Plateau 1987-2002	
Switzerland (1970-2015)	Continual decline	Continual decline	1	Continual decline after initial small increase		
Class: Continual decline with interruption						
Austria (1970-2015)	Continual decline	Stable	2	Continual decline with quick interruption from 1996-1999	Interruption increase 1996-1999	
Croatia (1991-2015)*	Continual decline with interruption	Continual decline with interruption	1	Continual decline with single interruption at 2004-2010. Event interruption 2004-2007, event interruption 2007-2009, event interruption 2009-2010	Event 2004-2010	
United Kingdom (1970-2015)	Continual decline	Rapid decrease	3	Continual decline with sharp interruption between 1998-1999	Rapid decline 1998-1999	
Class: Decline to stable						

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Slovakia (1993-2015)***	Rapid decrease	Gradual decline	2	Decline to stable	Decline 1996-1998	Decline 2002-2003
Class: Increase to stable						
East Germany (1970-1989)****	Increase to stable	Increase to stable	1	Persistent increase throughout 1970-1989	Mild drop 1981-1982	
Yugoslavia (1970-1990)*	Inverted U	Inverted U	2	Increase to stability; U increase 1973-1979; U decrease 1979-1981	Inverted U-shape 1973-1981	
Class: Inverted U-shape						
Latvia (1996-2015)**	Inverted U	Inverted W- shape	2	U Increase 2000-2004; U decrease 2004-2010	Inverted U-shape 2000-2010	
Russian Federation (1996-2015)**	Inverted U	Stable with recent decline	2	Prominent U increase; small decline from 2012-2014	Increase 1996-2002	
Ukraine (1996-2015)**	Inverted U	Inverted U	1	U increase 1999-2008; U decrease 2008-2013	Inverted U-shape 1999-2013	
Class: Sine wave or continual instability						
Albania (1990-2015)	U-shape	W-shape	3	Sine wave containing U-shape 1998-2004, otherwise relatively stable with two plateaus		
Bosnia and Herzegovina (1991-2015)*	Inverted U	Continual instability	2	Sine wave with initial decline from 1991-1993, increase 1993-2008, decline from 2008-2014	Initial decline 1991-1993	
Bulgaria (1970-2015)	Continual instability	Continual instability	1	Instability with inverted U-shape 1995-2010. U increase 1995-2003; U decrease 2003-2010	Inverted U-shape 1995-2010	
Czech Republic (1993-2015)***	Sine wave	Sine wave	1	Sine wave with initial increase	Initial increase 1993-1996	
Estonia (1996-2015)**	Rapid decrease	Inverted V-shape	2	Sine wave with initial increase and rapid decline from 2007-2008	Initial increase 1996-1997	
Greece (1970-2015)	Continual instability	Continual instability	1	Continual instability with two inverted U-shapes and decline	Decline 2007-2014	Inverted U shape 1981-1993
Lithuania (1996-2015)**	Rapid increase	Continual instability	2	Sine wave with initial decline and rapid increase	Initial decline 1997-2003	
North Macedonia (1991-2015)*	Continual instability	Continual instability	1	Continual instability		
Serbia and Montenegro (1991-2015)*	Sine with initial decline	Inverted U	2	Sine wave with initial decline from 1991-1997 and significant inverted U-shape	Initial decline 1991-1997	
Republic of Moldova (1996-2015)**	Continual instability	W-shape	2	Continual instability with two inverted U-shapes. First U increase 1998-2000; First U decrease 2000-2003; second U increase 2008-2010; second U decrease 2011-2015	Inverted U-shape 1998-2003	Inverted U-shape 2008-2015
Romania (1970-2015)	Continual instability	Stable with recent decline	2	Continual instability with possible inverted U-shape		
USSR (1970-1995)**	Sine wave	Sine wave	1	Sine wave with consistent increasing and decreasing segments throughout 1970-1986, with a prominent decline onwards of 1986	Decline 1986-1993	
Class: Stable						
Italy (1970-2015)	Stable	Stable	1	Stable with slight decline 2004-2013. Decline is very gradual	Decline 2004-2013	
Norway (1970-2015)	Stable	Stable	1	Stable with slight increase 1983-1991		

Class: Stable to continual decline						
Hungary (1970-2015)	Continual decline	Stable with recent decline	2	Stable to continual decline. Slight increase within continual decline from 2004-2009	Plateau 1970-1995	Continual decline 1995-2014
Iceland (1970-2015)	Continual decline	Rapid decrease	2	Stable to continual decline	Increase 1970-1984	Continual decline 1984-2015
Poland (1970-2015)	Continual decline	Gradual decline	2	Stable to continual decline from 1991-2014	Decline from 1991-2014	
Class: Stable to continual increase						
Belarus (1996-2015)**	Inverted U	Rapid increase	3	Protracted plateau from 1997-2005, followed by a rapid increase from 2005-2012	Rapid increase 2005-2012	
Class: Stable with single decline						
Denmark (1970-2015)	Stable with single decline	Stable with single decline	1	Stable with single decline from 2010-2014	Decline 2010-2014	
Finland (1970-2015)	Rapid decrease	Gradual decline	3	Stable with single decline from 1991-1996. The decline is rapid but small	Decline 1991-1996	
France (1970-2015)	Rapid decrease	Gradual decline	2	Stable with single decline from 2001-2004	Decline 2001-2004	
Germany**** (1990-2015)	Stable with single decline	Stable with single decline	1	Stable with a prolonged decline with varying intensity from 2003-2010	Decline 2003-2010	
Netherlands (1970-2015)	Rapid decrease	Stable	2	Stable with single rapid decline	Rapid decline 1983-1984	
Portugal (1970-2015)	Stable with single decline	Stable with single decline	1	Stable with single decline 2006-2007	Rapid decline 2006-2007	
Slovenia (1991-2015)*	Stable	Stable with recent decline	2	Stable with single recent decline from 2001-2014. Recent small decline from 2011-2014	Decline 2011-2014	
Spain (1970-2015)	Rapid decrease	Stable with recent decline	2	Stable with single recent decline from 2008-2014	Decline 2008-2014	
Sweden (1970-2015)	Rapid decrease	Stable with recent decline	2	Stable with single decline from 1992-1998	Decline 1992-1998	
West Germany**** (1970-1989)	Stable with single decline	Stable with single decline	1	Stable from 1970-1982 with single decline in 1982-1983	Decline 1982-1983	
Class: Stable with single increase						
Czechoslovakia (1970-1992)***	Stable with single increase	Stable with single increase	1	Stable with single rapid increase from 1980-1981. Single increase 1980-1981	Increase 1980-1981	

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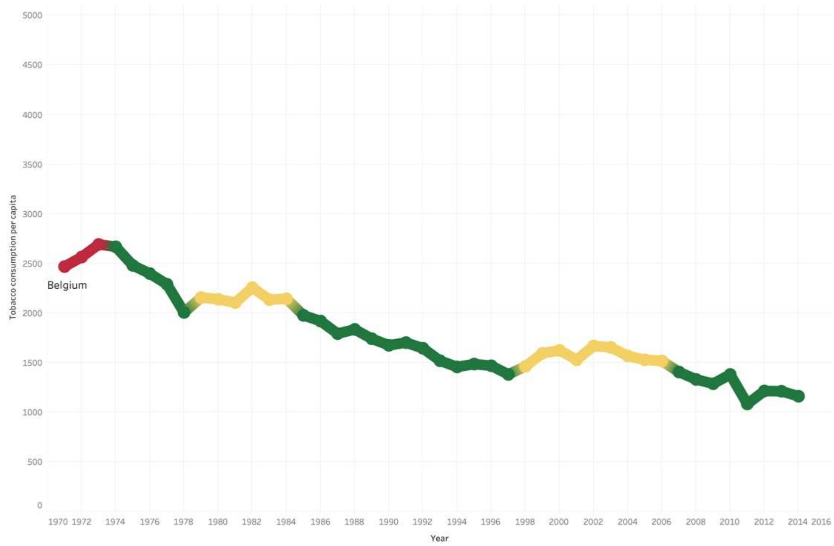
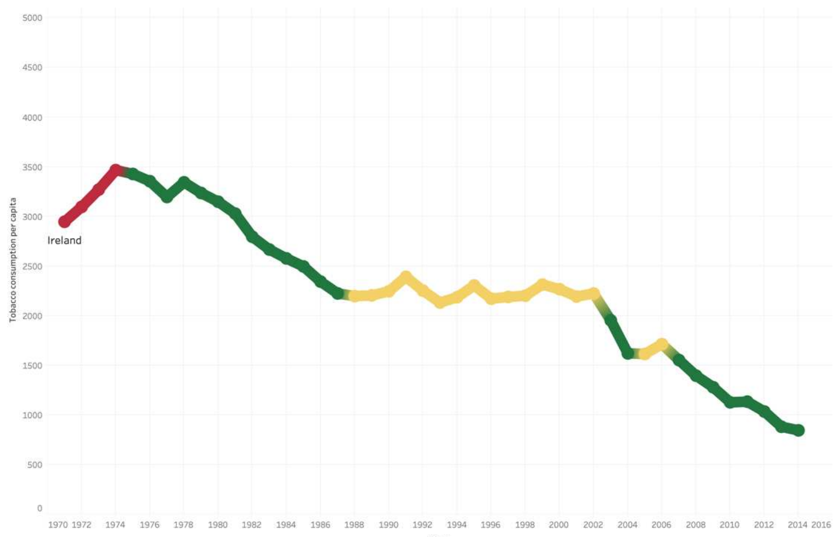
Appendix Figure 1: Country-year line graphs of per capita cigarette consumption and year-over-year increasing (red), plateauing (yellow), or decreasing (green) trend. The page of plots per classification is in brackets beside the class name.

Class: Continual decline (1/2)

Countries: Belgium, Ireland, Switzerland



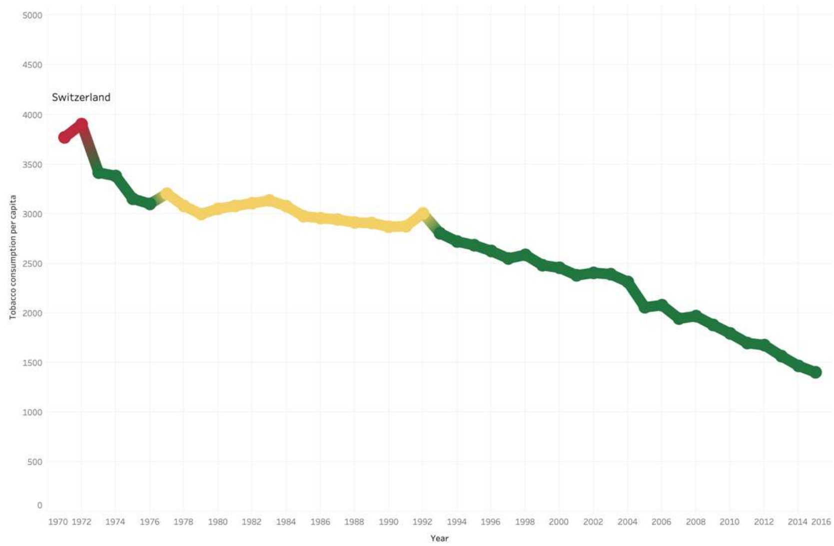
Belgium



Ireland

Class: Continual decline (2/2)

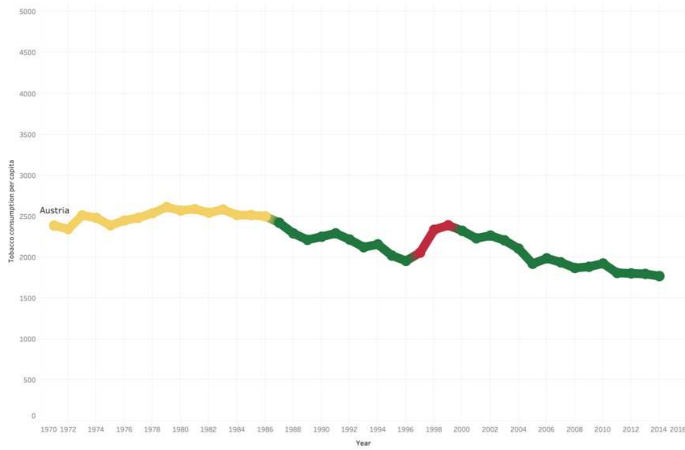
Countries: Switzerland



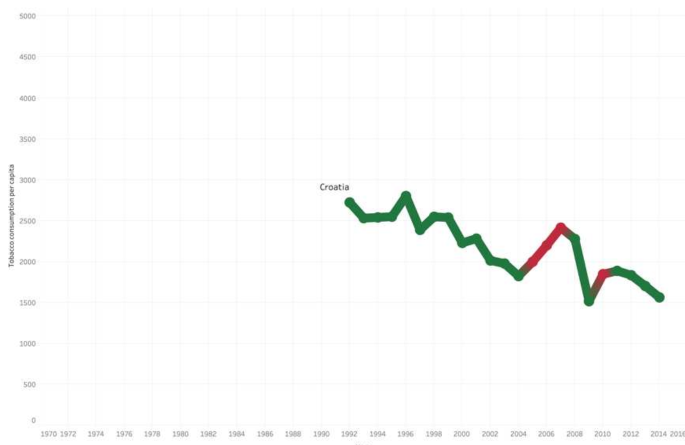
Switzerland

Class: Continual decline with interruption (1/1)

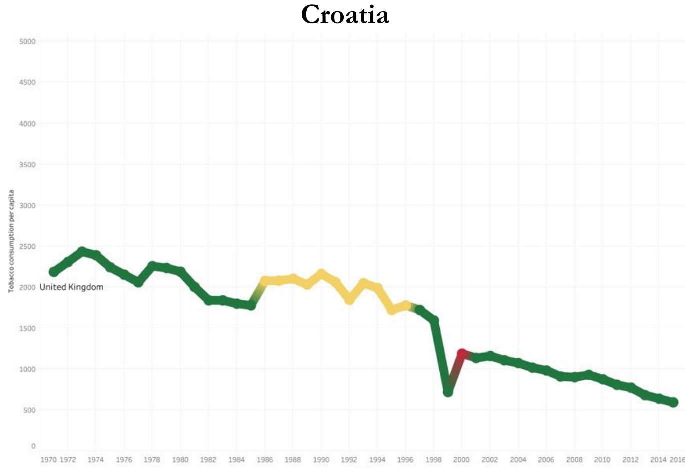
Countries: Austria, Croatia, United Kingdom



Austria



Croatia



United Kingdom

Class: Increase to stable (1/1)

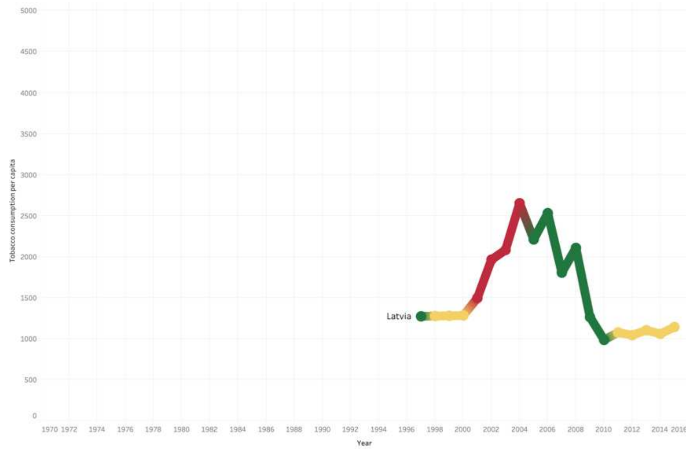
Countries: East Germany, Yugoslavia

East Germany

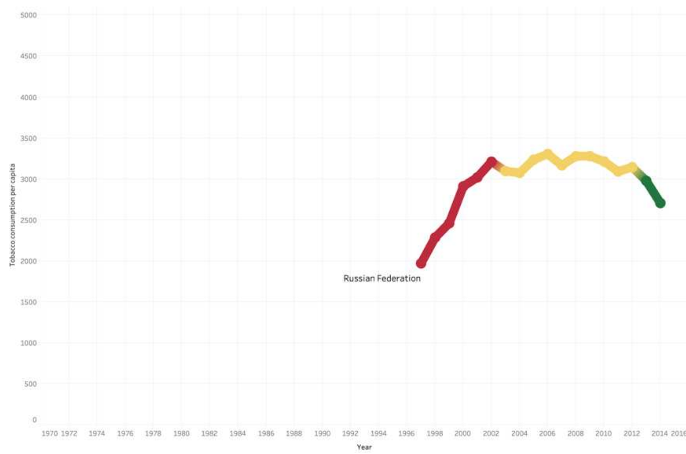
Yugoslavia

Class: Inverted U-shape (1/1)

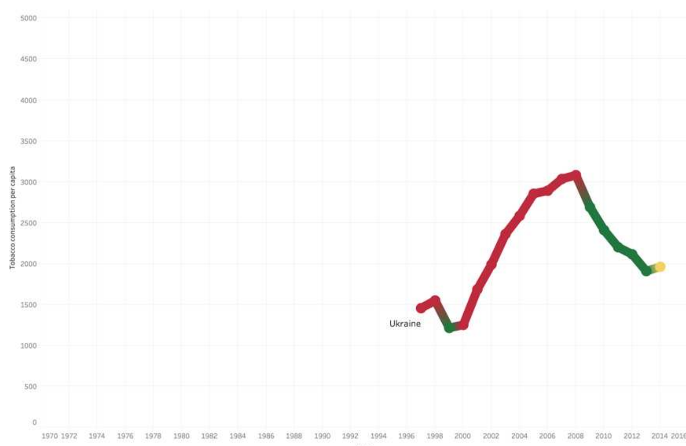
Countries: Latvia, Russian Federation, Ukraine



Latvia



Russian Federation

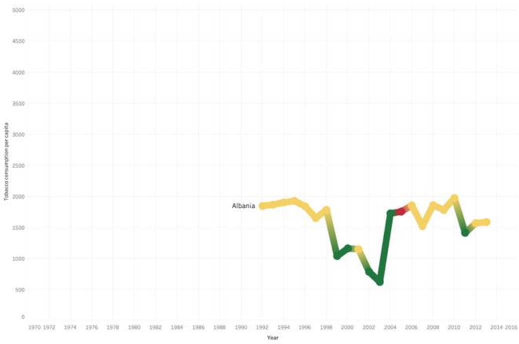


Ukraine

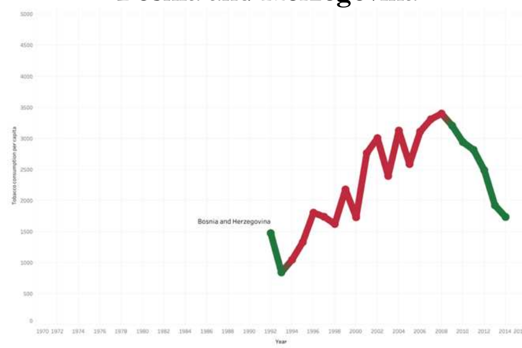
Class: Sine wave or continual instability (1/2)

Countries: Albania, Bosnia and Herzegovina, Bulgaria, Czech Republic, Estonia, Greece, Lithuania, Republic of Moldova, North Macedonia, Romania, Serbia & Montenegro, USSR

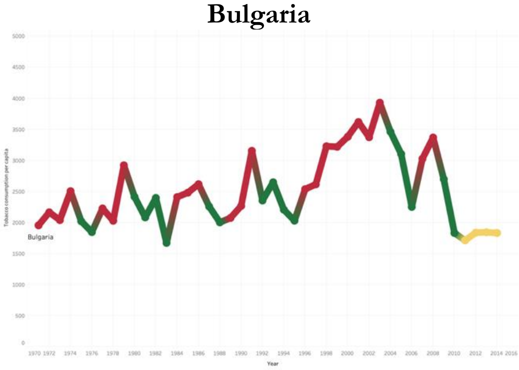
Albania



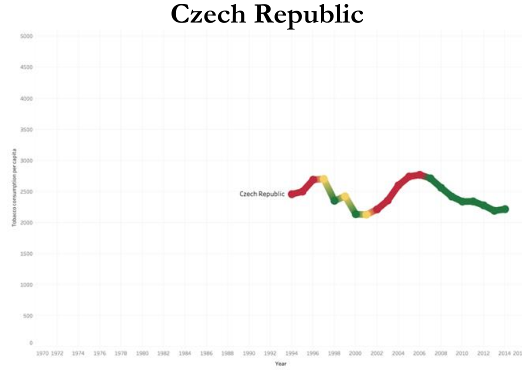
Bosnia and Herzegovina



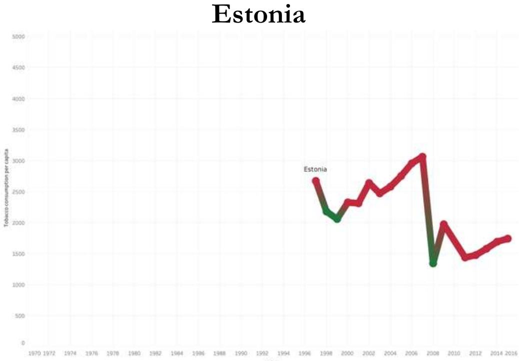
Bulgaria



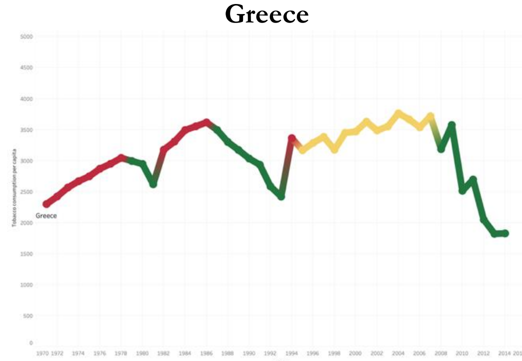
Czech Republic



Estonia



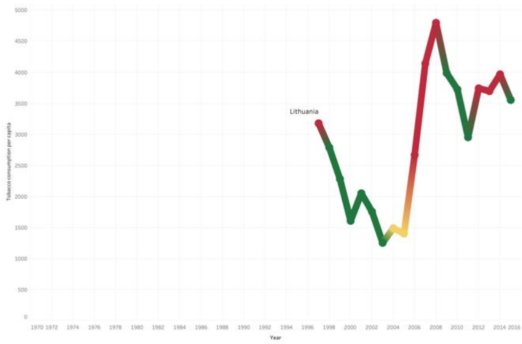
Greece



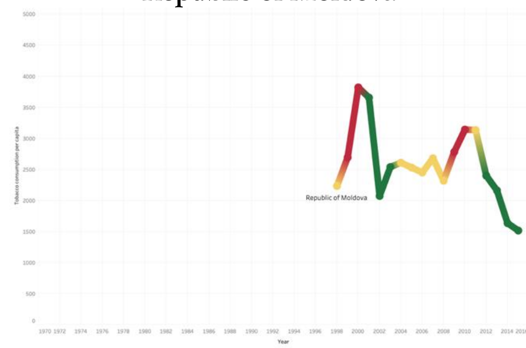
<u>Class: Sine wave or continual instability (2/2)</u>

Countries: Albania, Bosnia and Herzegovina, Bulgaria, Czech Republic, Estonia, Greece, Lithuania, Republic of Moldova, North Macedonia, Romania, Serbia & Montenegro, USSR

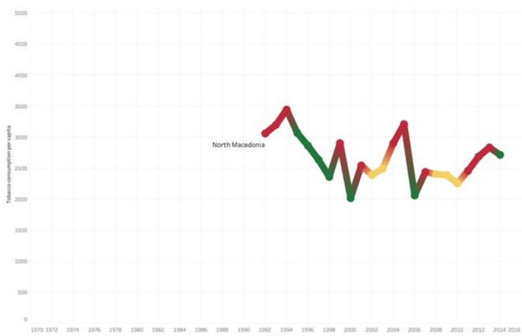
Lithuania



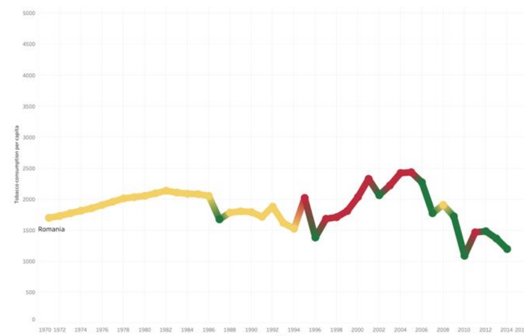
Republic of Moldova



North Macedonia

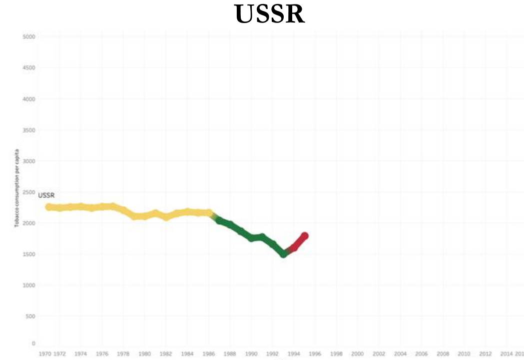


Romania



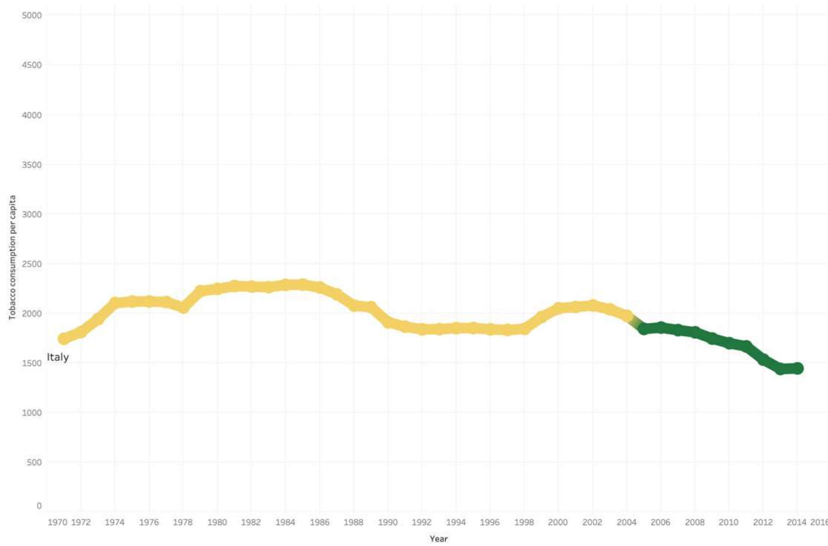
Serbia & Montenegro

USSR

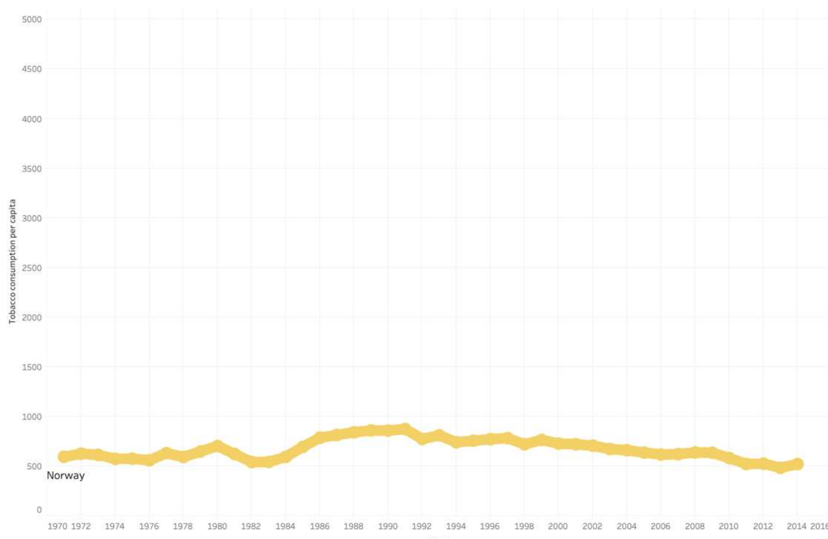


Class: Stable (1/1)

Countries: Italy, Norway



Italy

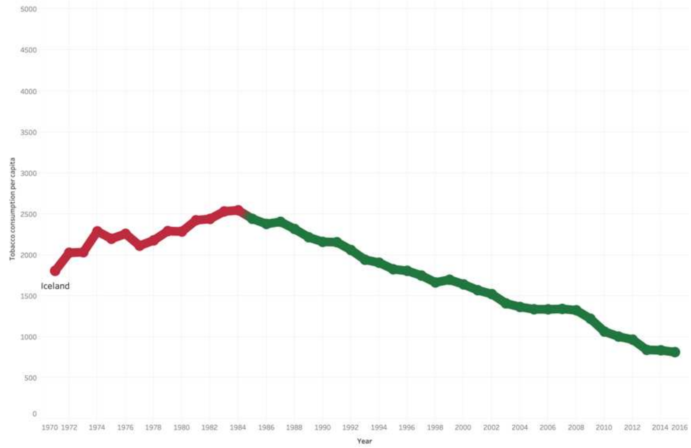


Norway

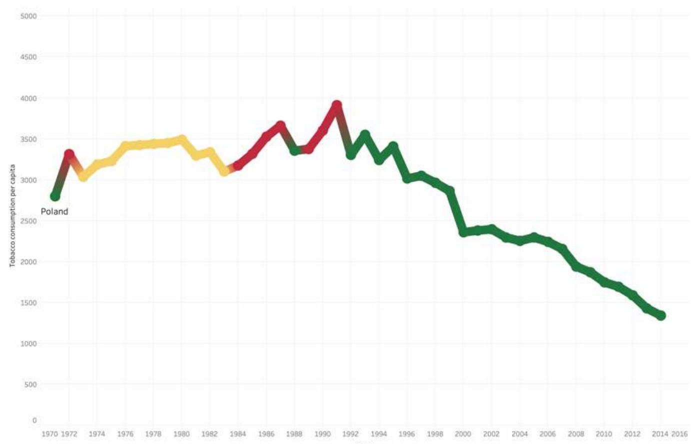
Class: Stable to continual decline (1/1)

Countries: Hungary, Iceland, Poland

Hungary



Iceland



Poland

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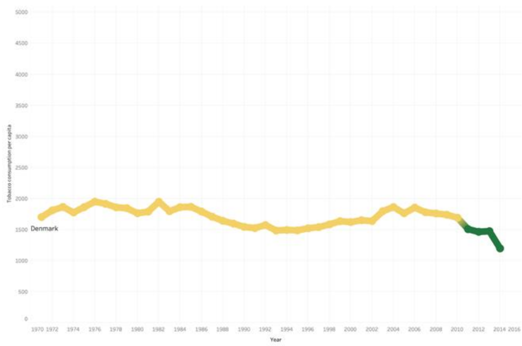
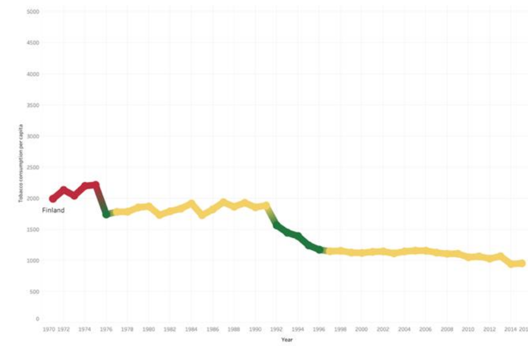
Class: Stable with single decline (1/2)

Countries: Denmark, Finland, France, Germany, Netherlands, Portugal, Slovenia, Spain, Sweden, West Germany

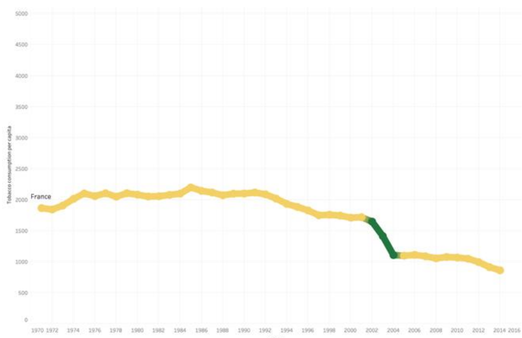
Denmark



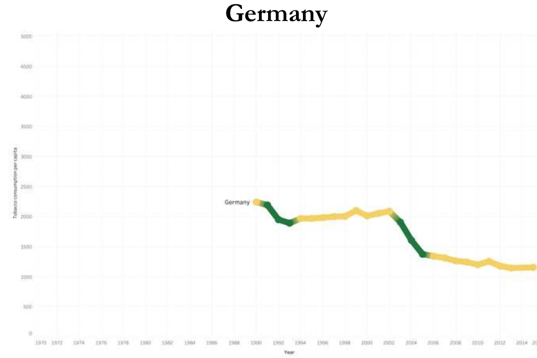
Finland



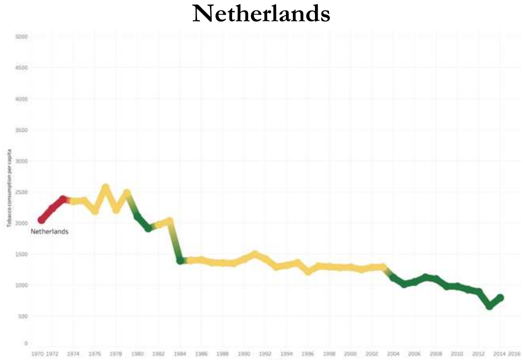
France



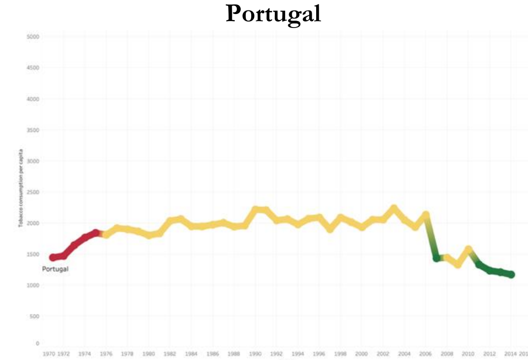
Germany



Netherlands



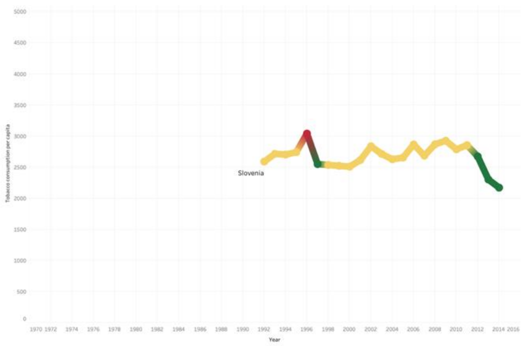
Portugal



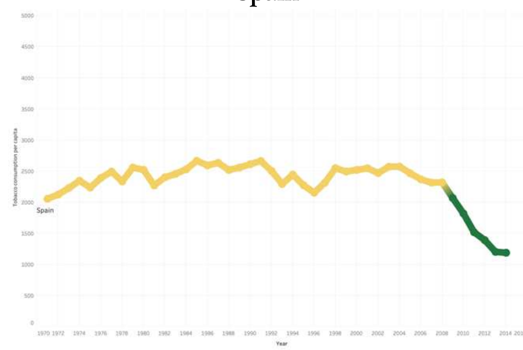
Class: Stable with single decline (2/2)

Countries: Denmark, Finland, France, Germany, Netherlands, Portugal, Slovenia, Spain, Sweden, West Germany

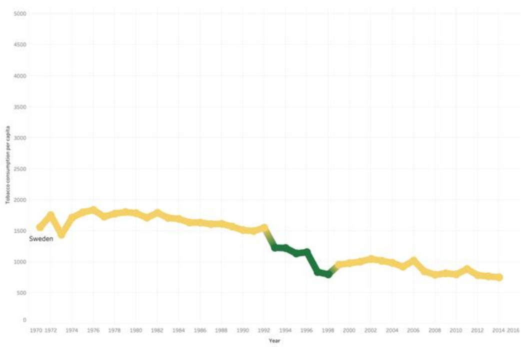
Slovenia



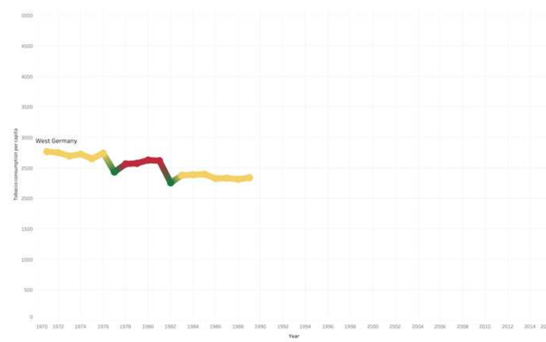
Spain



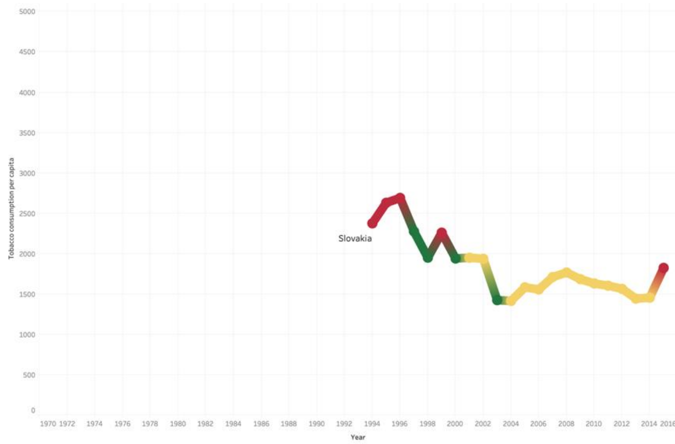
Sweden



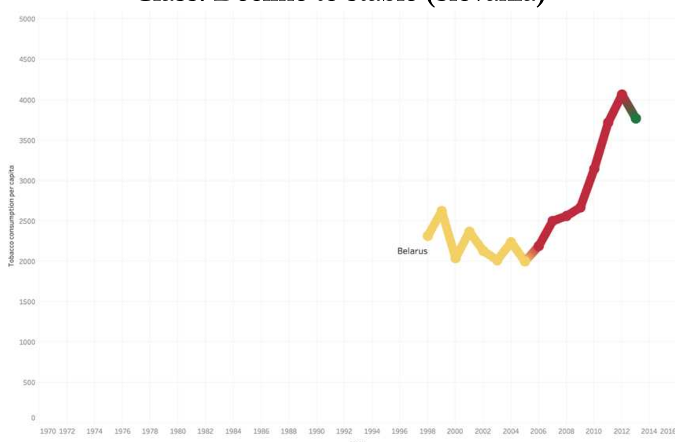
West Germany



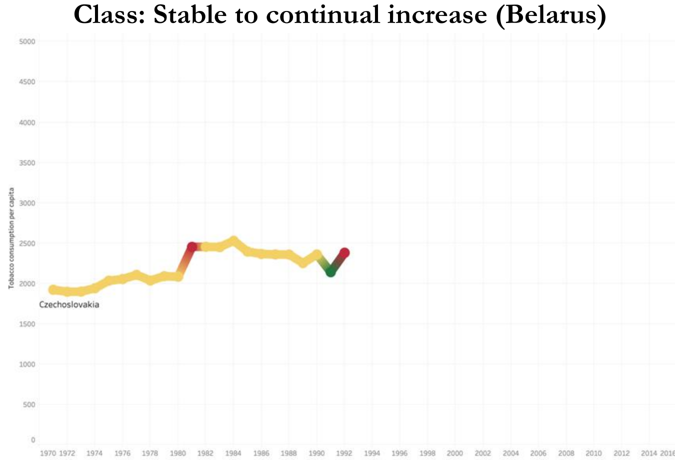
Emergent classes with one country only



Class: Decline to stable (Slovakia)



Class: Stable to continual increase (Belarus)



Class: Stable with single increase (Czechoslovakia)