Gender, education and Russia's tobacco epidemic: a life-course approach

Abstract:

While a number of studies, based on cross-sectional data for Russia, have documented strong increases in female smoking during the past two decades, the analysis of longer-term trends in smoking prevalence is hampered by the lack of representative data for the Soviet era. In this paper we create life-course smoking histories based on retrospective data from the Russia Longitudinal Monitoring Survey of HSE (RLMS-HSE) and the Global Adult Tobacco Survey (GATS) which allow us to examine the dynamics of smoking patterns over the past 7 decades. We make three main claims: (i) starting in the 1970s, female smoking rates increased across successive cohorts in Russia; (ii) the evolution of the smoking-education gradient is consistent with the predictions of the tobacco epidemic model and models of innovation diffusion; and (iii) the discrepancies between the smoking prevalence rates in the RLMS-HSE and the GATS data can be explained through a closer examination of the wording and format of the respective questionnaires.

Key words: life-course smoking, economic transition, retrospective data, tobacco epidemic model, Russia, gender.

1 Introduction

Russia's long-term health and demographic problems have been well-documented. There are half a million premature male deaths per annum (Peto, Lopez, Boreham, & Thun, 2012) and circulatory disease, the biggest cause of death, kills at about 4 times the rate that it does in the UK, for both men and women (Shkolnikov, Andreev, McKee, & Leon, 2013). While the contribution of alcohol to the excess mortality rates is well-rehearsed, tobacco consumption, which accounts for 150,000 of the excess male deaths annually, receives less attention. However, while male smoking prevalence, which stood at 61 percent in 1995, has declined recently, female smoking has increased from around 9 percent, in 1995, to around 14 percent in 2014. The role of tobacco is therefore a critical one.

In the face of Russia's catastrophic health profile and the very high levels of engagement in unhealthy behaviours, the Russian government has recently increased its efforts to address these unhealthy behaviours, starting with alcohol policy in the mid-2000s, and subsequently adopting an ambitious anti-smoking law signed by President Putin in 2013. This law ushered in a total ban on advertising, sponsorship, and promotion; a ban on smoking in public buildings, restaurants, workplaces and on public transport; a ban on the sale of tobacco in the ubiquitous Russian street-corner kiosks; and ambitious minimum price and tax increases.

While it is still too early to assess the effectiveness of this legislation, it has certainly transformed the context in which current and future cohorts of potential smokers will live and has pushed Russia dramatically along the tobacco consumption trajectory envisaged in the widely used four-stage model of the "tobacco epidemic" (Lopez, Collishaw, & Piha, 1994). According to this stylised description, based on historic data for a number of developed countries, the prevalence of smoking in a population evolves in a manner similar to an epidemic, spreading from narrow population groups, in to the mainstream, before then declining. A key feature of the model is the 3-4 decade lag with which smoking-related mortality mirrors the pattern of smoking prevalence. Following the initial increase in

smoking, the negative health consequences become more visible to the population, the political climate becomes more favourable for tobacco control policies and consequently prevalence rates begin to decline. The original model proposes that smoking rates among women start rising with a lag of 2-3 decades compared to men, due to the stronger prevailing social norms against female smoking. A recent revision however, concludes that, given the complexity of gender-based socio-cultural changes, male and female smoking are best analysed separately (Thun, Peto, Boreham, & Lopez, 2012).

The public health literature has extended this model through the 'diffusion of innovations' framework. (Rogers, 2003). In this spirit, Pampel et al. (2015), find that in the initial stages of the epidemic, smoking is first adopted by individuals in higher SES groups, which are generally more receptive to innovations, and then spreads to individuals in lower SES groups, leading the smoking gradient to reverse from positive to negative. The same mechanism also posits that the "innovation" of healthy lifestyles is first adopted by individuals of higher SES, in consequence, giving rise to a steepening of the negative smoking-SES gradient.

In this paper, we examine cohort smoking patterns based on data from the Russia Longitudinal Monitoring Survey of HSE (RLMS-HSE) and the Global Adult Tobacco Survey (GATS) and interpret these within the broad descriptive context of the tobacco epidemic model. This is an important task in the Russian case for a number of reasons: (i) the high mortality rates and the associated contribution of smoking-related illness; (ii) the exceptionally high male smoking prevalence and the rising female consumption patterns; (iii) the experience of the Soviet regime and the transition to a market-oriented environment; and (iv) the more recent change in the political climate to one more willing to accommodate tobacco industry regulation.

We argue that the evolution of smoking in Russia is more similar to patterns described in the tobacco epidemic model than has previously been suggested. In doing so, we make three substantive

contributions. First, we support the recent finding of Lillard & Dorofeeva (2015) arguing that the earlier literature may have over-stated the role of economic transition in promoting tobacco consumption in Russia. We provide alternative and complementary explanations for that finding. Second, we examine the development of educational gradients in smoking across successive cohorts of smokers. Third, we offer an explanation for potentially important discrepancies in the prevalence and distribution of smoking in Russia that emerge between the RLMS-HSE and the GATS data.

The remainder of the paper proceeds as follows. In section 2 we survey the most relevant empirical evidence on the historical evolution of smoking, including through describing the data we use in this paper. In section 3 we outline our main analytical apparatus, in the form of life-course smoking histories. Section 4 then presents and explains our results, which are discussed further in the concluding section.

2 Empirical evidence on smoking prevalence in Soviet and post-Soviet Russia

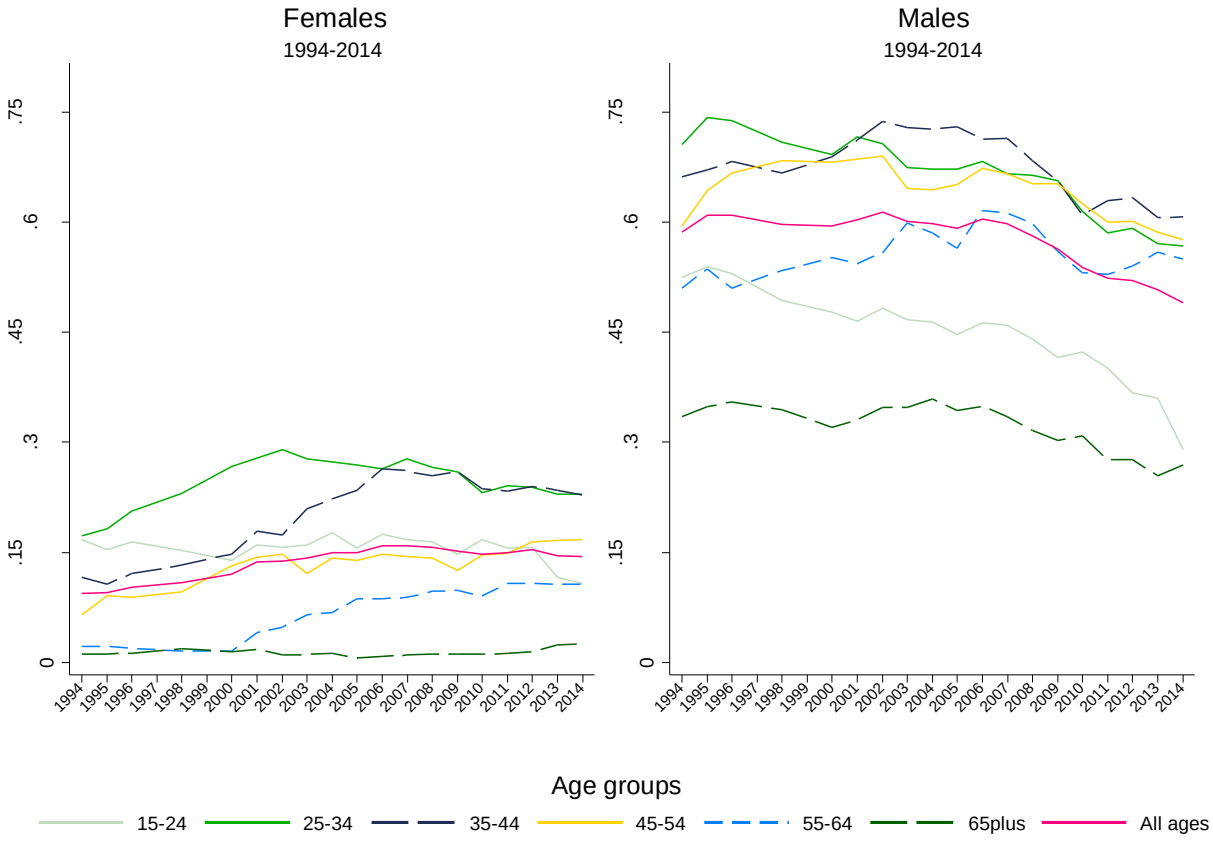
While many of the high-income countries of the US and northern European regions have routinely collected survey data on smoking prevalence and consumption intensity since the middle of the 20th century, there is a paucity of representative survey data available for low and middle-income countries, including the countries of the former Soviet Union. Since population surveys were quasi non-existent in the Soviet Union, there are very few sources of information on smoking patterns prior to 1990. In two publications that piece together disparate surveys from this period, prevalence rates range from 40 to 70 percent for men and 5 to 20 percent for women (Forey, Hamling, & Lee, 2002; Gilmore, 2005). Consistent with this, Deber (1981) reports that 9.3 per cent of women smoked in 1975 and that, according to officials at the USSR Ministry of Public Health, smoking was becoming increasingly popular with women and from an earlier age. Similarly, Cooper (1982), finds smoking among women

in the younger age groups approaching the one third mark, which leads him to the conclusion that "the emerging pattern of cigarette use is remarkably similar to the experience of Western industrialised countries".

For the post-Soviet period the richest source of data derives from the RLMS-HSE, a large-scale, nationally representative series of household surveys designed to monitor the health and economic welfare of individuals and households in Russia. Each autumn, the survey collects rich information on a range of socioeconomic, demographic, health status as well as behavioural and attitudinal indicators for approximately 10,000 individuals, as well as detailed data on expenditures, income, and service utilisation at the household-level. The RLMS-HSE is designed as a repeated cross-section survey, with follow-up visits each round to a fixed national probability sample of dwelling units. Detailed information on the survey, in English, can be found at http://www.cpc.unc.edu/projects/rlms-hse. By now, there are 20 years of data available from the second, more reliable, phase of the survey, covering the period 1994-2014.

Figure 1 below plots the prevalence of smoking by age and gender between 1994 and 2014, drawing on the representative cross-sectional samples for each year.

Figure 1 Prevalence of current smoking in the RLMS-HSE (1994-2014)



Source: Representative cross-sectional samples, using the survey weights provided by the RLMS-HSE, overall prevalence standardised for age

While for most of the past 20 years, male smoking prevalence stayed at around 60 percent, from 2007, smoking rates started to decline and had fallen to below 50 percent by 2014. The strongest decreases are observed in the two youngest age groups (15-24 and 25-34). In 1995, a staggering three quarters of men in the latter of these age groups reported to be current smokers, while by 2014, this number had fallen to 57 percent. It seems clear that the prevalence of smoking among men from the cohorts who grew up in the post-Soviet period is markedly lower and is decreasing. A study comparing two larger cross-sectional surveys from 2000 and 2010 confirms this downward trend in smoking among men (Roberts et al., 2012).

For females, the opposite holds true: until 2010, smoking rates among women increased in all but the oldest age groups. Since 2010, there has been some levelling off of these increases and indeed a slight decline for the youngest age group. So, in contrast to men, smoking appears to have increased among women who were growing up in the Perestroika and transition periods. For example, in 1994, only 6.5 percent of women aged 45-54 (i.e. those born between 1940 and 1950) reported to be current smokers, but by 2014 the share of smokers in this age group (now consisting of women born between 1960 and 1970) had risen to 16.7 percent. These data are in line with an earlier cross-sectional study drawing on 8 waves of RLMS-HSE data from 1994 to 2003 (Perlman, Bobak, Gilmore, & Mckee, 2007).

In interpreting the survey data of the post-Soviet period, the recent epidemiological literature argues that female smoking only started increasing in the 1990s. Much of this literature links this development with the entry in to Russia of the major Transnational Tobacco Companies (TTCs), which were known to have specifically targeted women with aggressive advertising campaigns during this period (Gilmore et al., 2004; Perlman et al., 2007; Roberts et al., 2012). However, while there is substance in this interpretation, it does not do justice to the full story that the data tell, since repeated cross-sectional samples of the population can only provide limited insights into the longer-term evolution of smoking. For example, the increases in the smoking rate of women aged 25-34 between 2000 and 2001 could be due to a higher take-up among never smokers, women who had previously quit now resuming their habit, or the movement into that category of a higher incidence sub-group. That is, when looking at smoking rates by age group and year, as in Figure 1, it is difficult to separate age, period and cohort effects. While not providing an empirical test of these three components, an important and complementary alternative is to use retrospective data to reconstruct smoking status for each year that an individual has been alive. This enables the plotting of the evolution of smoking rates for each birth cohort across the life-course (i.e. by age). This approach can provide indicative evidence of the relative contribution of age, period and cohort effects.

In a recent book that compares life-course smoking patterns in ten countries (Lillard & Christopoulou, 2015), Lillard and Dorofeeva (2015) analyse smoking across several generations in Russia and Ukraine and provide the first life-course contribution to the Russian smoking literature. While confirming the emerging evidence of the cross-sectional studies referred to above, they also present evidence, based on the RLMS-HSE, that female smoking rates had started to increase in the 1970s, before the arrival of TTCs in Russia. They attribute these earlier increases to innovations in tobacco product range, such as lighter tar and filter based cigarettes.

Finally, while providing the richest source of data, it is important to note that the smoking rates reported in the RLMS-HSE are lower than in the majority of surveys that have been carried out in this time period, particularly for the youngest and oldest age groups (Bobak, Gilmore, McKee, Rose, & Marmot, 2006; Gilmore et al., 2004; Giovino et al., 2012; McKee et al., 1998; Roberts et al., 2012). Table A-1 in the appendix summarises the available evidence on current smoking prevalence by gender and age from the RLMS-HSE and other representative survey data for the period 1994-2014. The biggest differential is with the 2009 WHO Global Adult Tobacco Survey (GATS) which reports 5-6 percent higher prevalence rates than the RLMS-HSE (60.4 versus 55.5 percent for males, and 21.7 versus 15.2 percent for females). This difference can be traced, in part, to the different wording of the questions on current smoking status in the two surveys: while the GATS question distinguishes between daily and less-than-daily smokers, the RLMS-HSE only asks "Do you smoke now?", and therefore excludes some of the smokers captured by GATS as 'infrequent smokers'. Indeed, when we only look at current daily smoking, the difference in prevalence rates produced between the two surveys largely disappears.

3 The life-course approach

To examine the longer-term dynamics of smoking, an approach widely used for data from elsewhere, but only employed once using Russian data, involves creating life-course smoking histories based on retrospectively reported smoking data. In addition to current smoking status and consumption intensity, many surveys routinely collect retrospective information on age at smoking initiation as well as former smoking status and age at (or time elapsed since) smoking cessation. We follow the substantial literature which uses such retrospective smoking data to reconstruct smoking prevalence rates and analyse smoking patterns (i) across the life-course and over successive cohorts (Kemm, 2001; Kenkel, Lillard, & Liu, 2009; Kenkel, Lillard, & Mathios, 2003b; Laaksonen et al., 1999; Lillard & Christopoulou, 2015), and (ii) with respect to educational gradients (Christopoulou, Lillard, & de la Miyar, 2013; Federico, Costa, & Kunst, 2007; Pampel, 2005; Pampel et al., 2015).

In this paper we draw on a pooled sample, for the years 2001-2010, from the RLMS-HSE, and the cross-sectional 2009 survey from the GATS data, in order to create life-course smoking histories for Russia. By combining an individual's age at the time of the survey with reported initiation and cessation ages we can create an indicator of life-course smoking that captures whether or not an individual smoked in each calendar year in which she was alive. This indicator of life-course smoking status then allows us to reconstruct prevalence rates in each year, dating back as far as the beginning of the 20th century for the oldest respondents.

To examine the diffusion of smoking we plot the prevalence of smoking over time and across the life-course for each birth cohort, separately by gender. In the second step, we disaggregate prevalence rates in each cohort by education and plot these over time. Since a comparison of educational attainment in the two surveys is hampered by different classification schemes, we focus our attention on the RLMS-HSE, which provides for greater disaggregation, taking into account the specificities of the Soviet educational system. Specifically, while the RLMS-HSE distinguishes between different combinations

of years of formal schooling and vocational education, the GATS data group all types of vocational education into one category. For ease of presentation we combine the original 6 levels of education into three categories: university education; completed secondary education (consisting of individuals with 11 years of formal schooling, with or without vocational education); and incomplete secondary education (consisting of 8 years of formal schooling, with or without vocational education).

The viability of the reconstructed smoking rates in the life-course smoking histories rests crucially on the reliability of the self-reported retrospective information. There are two main sources of measurement error in retrospective data on smoking: (1) under-reporting, meaning that former smokers may not identify as such, particularly if their smoking dates back a long time or they only occasionally smoked, so-called 'lighter smoker bias', (Kenkel, Lillard, & Mathios, 2004); and (2) recall error giving rise to incorrect reporting of age at smoking initiation or of time elapsed since cessation. The longitudinal nature of the RLMS-HSE, with multiple observations per individual between 2001 and 2010, allows us to examine the extent of both types of measurement error.

The first type of measurement error will lead to an under-estimation of life-course smoking prevalence if individuals who reported to be current or former smokers in earlier years report never having smoked when we last observe them. In our dataset, 13 percent of individuals who are surveyed in multiple rounds report their smoking status inconsistently in one or more years, with 3 percent of the inconsistencies falling on the last observation year. The inconsistencies observed (Appendix A-2) provide evidence of lighter smoker bias as relatively more inconsistencies occur in the younger cohorts and among females. In order to mitigate this type of measurement error, we re-classify these individuals as former smokers in the last survey year. The second type of measurement error stems from recall error in start and quit ages. While Kenkel, Lillard, & Mathios (2003a) did not find any systematic pattern in reported starting ages over time, Bright & Soulakova (2014) found that the time elapsed since smoking initiation tends to increase the reported start age, meaning that the start ages in

the older cohorts are potentially more affected by recall bias. Similarly, our data exhibit this pattern of reported start ages increasing with respondent age (Appendix A-3) as well as increasing divergence in quit ages.

In order to mitigate the effect of recall error in start and quit ages, we calculate life-course smoking status based on the minimum reported start age and maximum reported quit age for each individual. This strategy ignores temporary quits between 2001 and 2010 but is consistent since we cannot observe these patterns in data preceding the survey period. Appendix A-4 presents the smoking prevalence rates with adjustments for the two forms of measurement error described above and indicates that measurement error only marginally impacts on the estimate of life-course smoking patterns, in the range of 0.3 to 2.3 per cent. This magnitude is in line with the study by Kenkel, Lillard, & Mathios (2003a) who found retrospective information to provide reasonably valid measures of life-time smoking status, with the highest level of agreement occurring between repeated measures of ever-smoking status, and an acceptable concurrence between annual smoking rates constructed based on the reported timing of smoking initiation and cessation. We are therefore content that measurement error does not qualitatively effect our key findings.

In addition to measurement error, smoking patterns in the older cohorts may be biased due to the differential mortality of smokers, as has been shown to be the case for Russian men over the age of 70 (Christopoulou, Han, Jaber, & Lillard, 2011). Therefore, as a robustness check, we follow the approach adopted in Christopoulou, Han, Jaber, & Lillard (2011) to examine whether and how the prevalence rates change after adjusting for differential mortality of smokers and non-smokers, drawing on cause-specific death rates for Russia from the Human Causes of Death (HCD) database (1965-2010), complemented with overall mortality rates for 1959-64 from the Human Mortality Database. Finally, the problem of non-random attrition in the RLMS-HSE data has been explored by Gerry and

Papadopoulos (2015). They confirm that elderly males are more likely to leave the longitudinal sample but that the overall impact of health-related attrition is likely to be weak.

Aside from measurement error, differential mortality and longitudinal representativeness, missing observations for start and quit ages pose a potential problem. In the cross-sectional samples of the RLMS-HSE the share of missing start ages in each survey round ranges between 1 and 8 percent for males and 1 and 6 percent for females. In the GATS survey 6.5 and 4.6 percent of start ages are missing for males and females respectively, with the majority being for current less-than-daily smokers and among the youngest cohort. In the RLMS-HSE, the share of missing quit ages ranges between 2 and 10 percent, whereas in the WHO GATS data the quit ages are complete. Through exploiting the longitudinal nature of the RLMS-HSE we are able to minimise the effect of missing data as only for 1.3 (2.6) percent of respondents start or quit ages are missing in all survey years. We find no evidence that the missing age reports systematically bias the results, either in the RLMS-HSE or the GATS data.

As mentioned above, the differences in the phrasing of the smoking questions between the RLMS-HSE and GATS surveys also has an impact on the life-course smoking data. Analogous to the question on current smoking status, the GATS survey also distinguishes between daily and less than daily former smokers, yielding a much more fine-grained classification of 'smoking states' than the RLMS-HSE. The five possible states identifiable in the GATS data are:

(i) current daily smoker

(ii) current less than daily smoker, who was
   a. a former daily smoker
   b. or a former less than daily smoker

(iii) current non-smoker, who was
   a. a former daily smoker
   b. or a former less-than daily smoker

By comparison, the RLMS-HSE distinguishes simply between those that smoke now, do not smoke now and used to smoke. Table A-4 in the appendix compares the rates of current and former smoking

by gender in the two datasets that we are using to create the life-course smoking histories. While, as we saw in the previous section, current smoking rates between the two surveys differ by 5-7 percentage points, the discrepancy in ever-smoking rates is less pronounced, particularly once we correct for inconsistent reporting of former smoking status. When we include all types of daily and less than daily smokers, the share of ever-smokers in the GATS survey slightly exceeds the share of ever-smokers in the RLMS-HSE. However, for the calculation of life-course smoking histories we can only draw on current and former daily smokers, since the GATS survey does not ask occasional smokers about their age at initiation. When we apply this definition, the share of ever-smoking turns out to be 3-4 percent lower for both genders in the GATS data compared to that of the RLMS-HSE. Thus, we expect that the life-course analysis will yield lower peak prevalence rates for the GATS data.

4 Results

Our results based on the reconstructed smoking rates are presented in Figures 2-4 and Table 4.1. Among males, smoking prevalence has remained at very high levels across cohorts, and with nearly identical life-course trajectories, peaking at around 75 percent for those entering their 20s (i.e. around the age of compulsory military service). Our data suggest that peak prevalence rates have been falling slightly over time, starting in the 1970 cohort. In contrast, for females, smoking prevalence has increased in each successive cohort, with the steepest increases occurring among women born in the 1970s. These women were in the vulnerable age for smoking initiation in the Perestroika and early transition period. However, in line with the findings from Lillard and Dorofeeva (2015), both the RLMS-HSE and the GATS data indicate that smoking rates already started increasing more notably from the beginning of the 1960s, prior to the entry of TTCs in Russia. Appendix A-5 presents the adjustment for differential mortality between smokers and non-smokers. Consistent with Christopoulou, Han, Jaber, & Lillard (2011) we find evidence that for older cohorts of males differential mortality is a significant factor and that therefore the curves representing male smokers born in the 1940s in Figures 2 and 3 below represent an underestimate of the true smoking prevalence among that cohort.

Figure 2 Smoking prevalence over time by gender and birth cohort in the RLMS-HSE and GATS

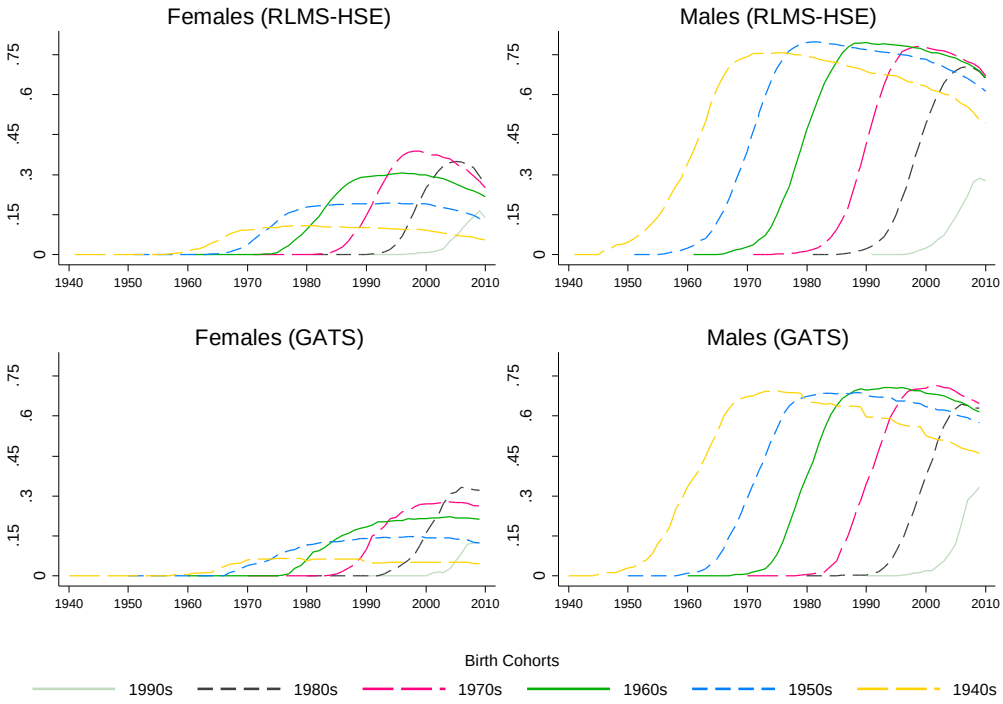
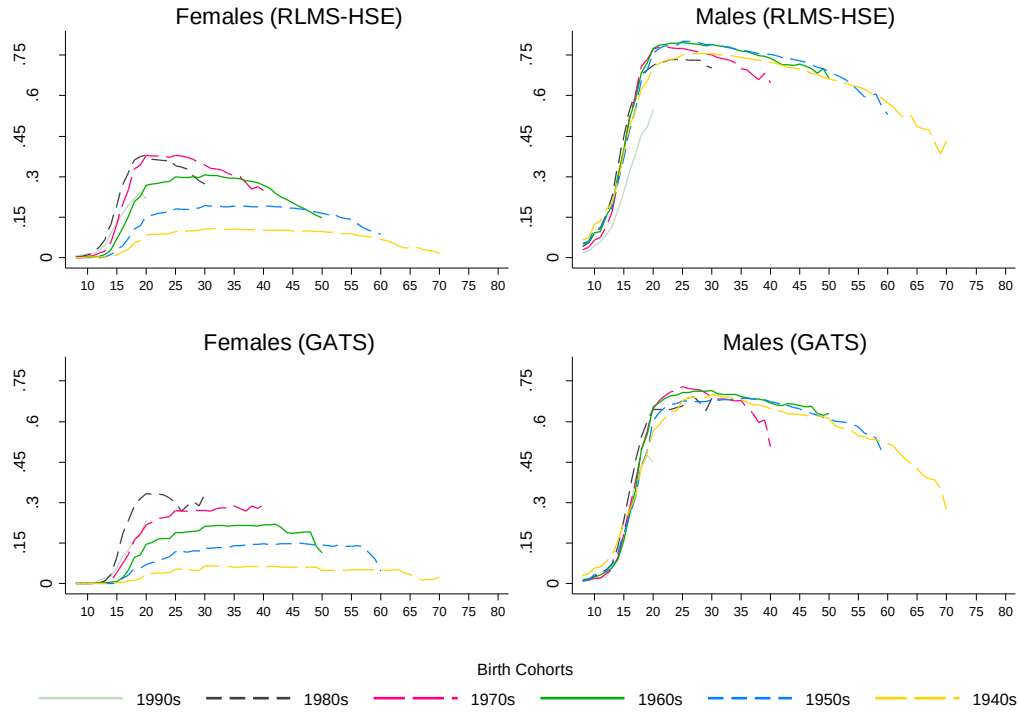
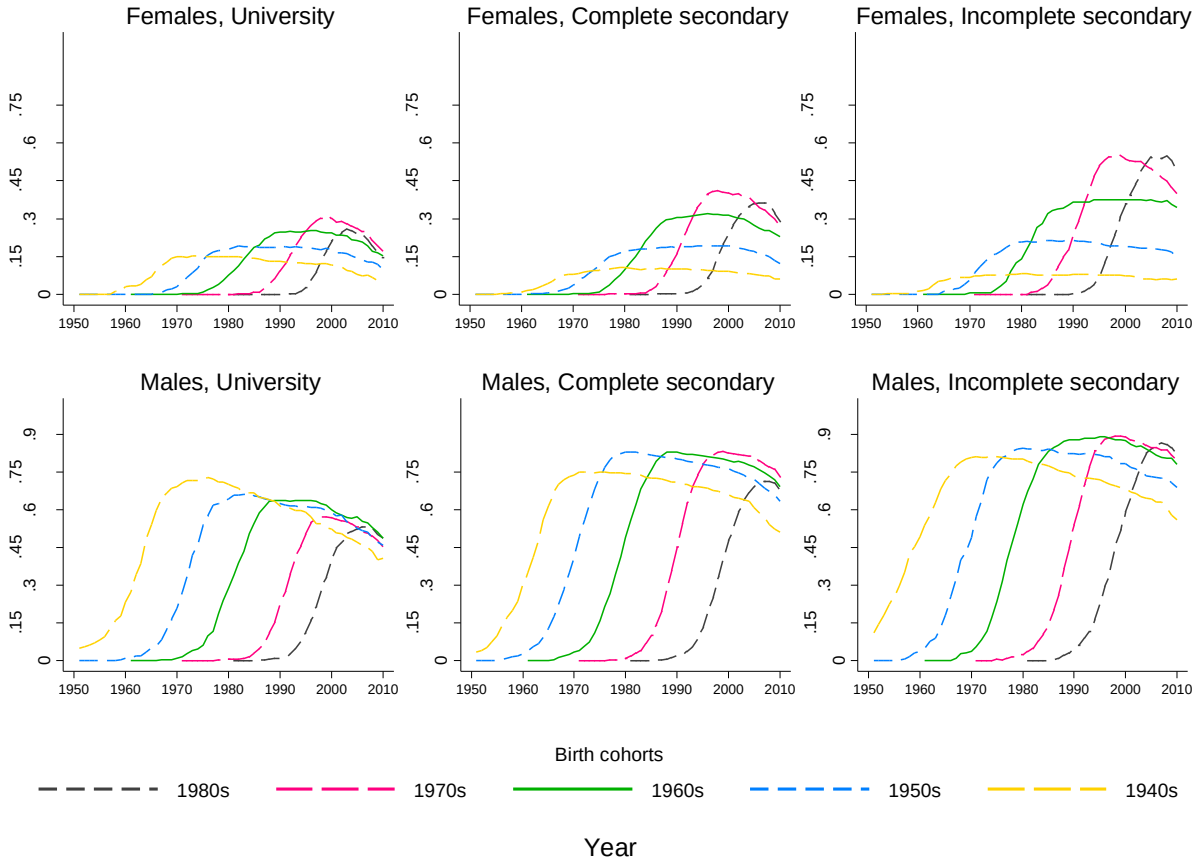


Figure 3 Smoking prevalence across the life-course by gender and birth cohort in the RLMS-HSE and GATS



More interesting are our results (Figure 4 and Table 4.1) concerning the smoking-education gradient. For females, the development of smoking rates by education across successive birth cohorts fits neatly within the parameters of the diffusion model according to which the habit is first adopted by individuals in higher socioeconomic groups and then spreads to other groups. Whereas in the two oldest cohorts (born in the 1940s and 1950s) those with university education have higher or similar levels of prevalence compared to individuals with lower education, this pattern clearly reverses across successive cohorts, with smoking rates being nearly 2 (3) times higher in the lowest educational group compared to those with university education for males (females). For women, smoking rates do increase among those with university education from one cohort to the next, but they do so more rapidly for those with lower education levels, particularly in the 1970 cohort. For males, the pattern of diffusion is similar, but the timing is different. That is, as with females, smoking rates initially increased among the more educated, but as prevalence among this group declined (much earlier than it appears to have done for females) it correspondingly increased among the less educated. These

Figure 4 Smoking over time by gender, birth cohort and education in the RLMS-HSE



results are also broadly consistent with the more fine-grained educational classification, presented in Appendix A-6 to A-8 and are examined further in our discussion. Bearing in mind that we cannot adjust for differential mortality in creating Figure 4, we consider how our education gradient results could be shaped by the aggregate differential mortality explained above. If the differential is evenly spread across the education categories then our findings are unaffected. If the underestimate is relatively higher at the upper levels of education, then our estimate of the education reversal is a lower bound and the actual reversal is greater, since the decline in smoking among the most educated is steeper than presented here. Finally, if the underestimate is relatively higher among the less educated groups then we may have overestimated the reversal. However, in each case, there is still strong evidence of a decline in male smoking among the most educated.

Before moving to our discussion, we explore one further possibility, that, if mortality rates are declining (increasing) over time while the ratio of mortality for smokers relative to non-smokers is staying constant, our estimates of cohort-specific smoking prevalence would be overestimated (underestimated). For the majority of the period under consideration mortality rates in Russia have in fact been increasing and only in 2013 did male life expectancy recover to its 1960 level (Shkolnikov et al., 2013). Somewhat surprisingly, smoking-attributed mortality in Russia has been falling for both men and women since 1990, although smoking prevalence rates continued to increase beyond that time. One reason for this apparently paradoxical development in Russia is related to an important cohort effect relating to those who were in their teenage years during the Second World War and the decade after. Due to the short supply of cigarettes in this period, the cohort born between 1926 and 1938 had fewer smokers, and their reaching of the age of 65 (from 1991), where age specific death rates are highest for lung cancer, produces observed decreases in smoking-attributable mortality (Shkolnikov, McKee, Leon, & Chenet, 1999). A possible alternative or complementary explanation may lie in the change of consumption patterns, from the high-tar Soviet papyrosi (20mg and above) to manufactured cigarettes which, with their lower tar-content, might have been less "deadly" and therefore have resulted in fewer smoking-related deaths.

Table 4.1 Peak prevalence rates by gender, cohort and education in the RLMS-HSE

Cohort	University						Complete secondary						Incomplete secondary					
	N	Year peak	Age peak	Peak prev.	Confidence interval		N	Year peak	Age peak	Peak prev.	Confidence interval		N	Year peak	Age peak	Peak prev.	Confidence interval	
Males																		
1980s	496	2007	24	0.54	0.488	0.582	1,742	2007	22	0.71	0.688	0.737	671	2007	22	0.87	0.831	0.897
1970s	592	1998	23	0.57	0.530	0.611	1,459	1999	24	0.83	0.811	0.850	500	1998	23	0.89	0.861	0.918
1960s	416	1990	26	0.64	0.589	0.683	1,279	1990	26	0.83	0.808	0.850	287	1995	31	0.89	0.846	0.922
1950s	363	1983	28	0.66	0.610	0.710	1,152	1980	25	0.83	0.807	0.851	368	1980	25	0.85	0.804	0.881
1940s	231	1976	30	0.73	0.665	0.784	449	1971	25	0.75	0.708	0.790	318	1974	29	0.81	0.767	0.856
Females																		
1980s	814	2003	20	0.26	0.228	0.289	1,913	2006	22	0.36	0.338	0.387	453	2008	23	0.55	0.487	0.610
1970s	921	1999	24	0.31	0.281	0.342	1,483	1998	23	0.41	0.387	0.438	309	1999	24	0.55	0.496	0.610
1960s	594	1996	31	0.25	0.220	0.291	1,342	1996	31	0.32	0.294	0.345	178	2003	38	0.38	0.305	0.452
1950s	567	1982	27	0.19	0.159	0.225	1,586	1998	43	0.19	0.174	0.213	308	1985	31	0.21	0.170	0.264
1940s	353	1973	27	0.15	0.117	0.195	811	1980	34	0.11	0.086	0.129	352	1980	34	0.08	0.056	0.116

5 Discussion

In the previous sections we document three main findings: (i) starting in the 1970s, female smoking rates increased across successive cohorts in Russia; (ii) the evolution of the smoking-education gradient is consistent with the predictions of the tobacco epidemic model and models of innovation diffusion; and (iii) the apparent discrepancies between the smoking prevalence rates in the RLMS-HSE and the GATS data can be explained through a closer examination of the wording and format of the respective questionnaires.

With regard to female smoking, we are not the first to observe that the increase pre-dated the period of economic transition. Our findings add important layers of interpretation and explanation to the recent empirical findings of Lillard and Dorofeeva (2015), who question the prevailing claims that the process of smoking diffusion among women in Russia was prompted by the entry of TTCs during the early transition period (Gilmore et al., 2004; Perlman et al., 2007; Roberts et al., 2012). There is little doubt that the aggressive marketing targeted at women, combined with the intensive price competition in this period, contributed to the rising prevalence of female smoking. However, we view these forces as 'accelerators' that acted to unlock the dynamic of existing behavioural patterns within cohorts of women that were at vulnerable ages for taking up the habit. Firstly, smoking was reconfigured in the public mind as a socially acceptable and desirable behaviour for modern women, and secondly, the availability, diversity and affordability of tobacco was dramatically transformed.

Even prior to this period, smoking was seen as a sign of a Western lifestyle that attracted young men and women (Gilmore, 2009), so that the marketing efforts by TTCs fell on fertile ground. In the context of falling real prices in the struggle for market share, this created favourable conditions for increasing demand. In addition, branding strategies and product innovations introduced by TTCs might have had a greater impact on women as their consumption behaviour tends to be more sensitive to the aesthetic

qualities of tobacco products, e.g. smell and taste (Waldron, 1991). Lillard and Dorofeeva (2015) link the increases in female smoking in the 1970s with innovations in the tobacco market, such as the arrival of lower tar and filter cigarettes, as replacement for the traditional Russian papyrosi. At the same time, the USSR also started importing Bulgarian cigarettes, which were based on American tobacco blends and, while more addictive and carcinogen-laden, were milder in taste compared to traditional Russian brands (Neuburger, 2009). So, while the traditional papyrosi without filter might have been too rough in taste, the aesthetic turn to filtered cigarettes, and particularly the milder Bulgarian cigarettes, contributed to the 'arrival' of cigarettes as a product for women.

More recently, a similar pattern of product innovation, geared especially towards potential female smokers has emerged, with cigarettes that are marketed as 'healthier' or 'less harmful', such as 'super-slim' or 'micro-slim' cigarette formats as well as flavoured cigarettes (Euromonitor, 2015). It appears that these strategies do have an impact, as illustrated by the fact that a significant share, higher among the more educated, of respondents to the GATS survey believed that there are 'less harmful' cigarettes (WHO, 2009).

To shed further light on the gender asymmetries observed in the education gradients, we look to other countries for which the smoking trajectories of men and women have evolved in strikingly different ways during the last century. In the case of the US, Ho and Fenelon (2015) argued that the later uptake of smoking by women reflected shifts in the cultural meaning and social acceptability of female smoking, changing occupational affiliations during World War II, and the strategic targeting of certain sub-groups of women by tobacco manufacturers in the 1960s aiming deliberately at both gender-based and education-linked characteristics. During this period, smoking was promoted as fashionable, feminine and associated with weight control, but at the same time, information concerning the harmful effects of smoking for men dominated the public health narrative. These factors not only act to shape the evolution of gender smoking behaviour but also of asymmetries in education-related smoking

behaviour, including initiation, the number and types of cigarettes smoked, success in quitting and the overall longevity of smoking.

In Russia too, the earlier uptake of smoking by males, as well as their somewhat flatter educational gradients, reflects greater military participation and traditionally gendered occupational structures dominating the military-industrial complex. Correspondingly, the link of female smoking with an absence of respectability and sophistication was not reversed until the 1970s and 1980s when smoking among women was recast as fashionable, stylish and a marker of the newly emerging urbanism. It is no coincidence that this followed rapidly behind the 'secondary increase' in female smoking in the US (Ho & Fenelon, 2015) where smoking was also being rebranded as a fashion accessory for stylish females. Equally, what public health narrative there was, documented health risks to males even as the new 'healthier' form of cigarettes were becoming increasingly attractive to women, who perceived of them as natural accompaniments to their changing social and workplace contexts. Accordingly, even as educated male smoking prevalence was in decline, educated female smoking was still on the rise.

It is also important to understand the changing educational dynamics in Russia during this period. Contrary to what one might expect, in all cohorts a larger proportion of females are both university-educated and have completed technical/medical education compared to men, and this differential increases over time. On the one hand this reflects the scope of the military draft which provided for a consistent upper-bound on male participation in higher education, but on the other it also captures the strong political drive for vocational training initiated in the late 1950s through Krushchev's education reform and which males were increasingly enrolled in (Ruble, 1990). For females, the proportion of individuals with university education increases by 5-6 percent in the post-war years. This raises the possibility that the female education-smoking gradient we observe is partly driven by compositional changes. However, in view of the scale of the prevalence difference between those with university and incomplete secondary education (e.g. 34 versus 55 percent in the 1970s cohort) we are confident that the gradients are not entirely driven by shifts in the education distribution.

While it is clear that product innovation and marketing have played an important role in the greater uptake of smoking among women, both in the late Soviet and post-Soviet period, we argue that this

can only be understood within the broader context of the dynamic cultural and social changes shaping social norms, expectations and participation in education. As recognised in the revised version of the tobacco epidemic model, female smoking is subject to stronger gender norms and social constraints on behaviour, which inhibit the diffusion of the habit among women and interact differently with female human capital.

There are several distinctive factors that contributed to the changing cultural and social norms towards female smoking in the late Soviet period, including: (i) the increasing emphasis on consumer culture that emerged in the Brezhnev era (Kelly & Shepherd, 1998); (ii) increasing urbanisation, in the 1960s and 1970s (Becker, Mendelson, & Benderskaya, 2012), giving rise to reduced social control over female behaviour; and (iii) the development of youth cultural groups in the post-Stalin period, most prominently the 'tusovka' – cultural, well-educated, groupings located in large cities and based principally on music, dance and fashions (Pilkington, 2013). So, while not underestimating the immense success of the tobacco industry in 'recruiting' female smokers across the globe, our argument is that their marketing campaigns have responded to existing cultural trends, rather than going against prevailing norms (Brandt, 1996). Accordingly, both the change in industry strategy and the change in female smoking behaviour began in the 1970s and accelerated through the 1980s and 1990s and did not happen in isolation.

Last but not least, having confidence in the secondary smoking data is important. We have identified discrepancies in the Russian data that may seem alarming. However, through closer examination of these data, and the questionnaires on which they are based, we have been able to trace the sources of the discrepancies to important differences in the wording of questions on smoking status. The longitudinal information available in the RLMS-HSE enabled us to investigate inconsistent reporting of former smoking status over time and to mitigate the effects of lighter smoker bias in creating the life-course data. The inclusion of these interim/lighter smokers results in higher peak prevalence rates

for females and a sharper decline in the 1990s and 2000s. Yet, despite these discrepancies, the general patterns in both datasets are consistent enough to assure us about the overall validity of both the RLMS-HSE and the GATS data.

To conclude, male smoking prevalence in Russia has remained at very high levels since the mid-20th century and only in the most recent period has fallen below 50 percent. Female smoking, by contrast, only started increasing towards the end of the 1960s, and accelerated incrementally through in to the 1990s. Despite the enormous differences in the economic, social, health and political contexts between countries, we find that the convergence in gender smoking rates, as well as the asymmetrically evolving educational gradient over time are similar to patterns observed in Western high-income countries, are as described by the model of the tobacco epidemic and in part reflect the creeping globalisation that was emerging, even before the cold war had ended.

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Appendix

A-1 Share of current smokers by gender and age according to various representative cross-sectional surveys (1994-2014)

		Age group						
Year	**Source**	**15-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65plus**	**All ages**
Males								
1994	RLMS-HSE	52.5	70.6	66.2	59.5	51.0	33.5	58.6
1995	RLMS-HSE	53.9	74.3	67.1	64.3	53.6	34.9	61.0
1996	RLMS-HSE	53.0	73.8	68.3	66.7	51.0	35.5	61.0
	New Russia Barometer	*65.0*	*73.0*	*71.0*	*64.0*	*49.0*	*41.0*	*63*
1998	RLMS-HSE	49.3	70.9	66.7	68.4	53.4	34.5	59.7
2000	RLMS-HSE	47.8	69.2	68.9	68.2	55.2	32.0	59.5
2001	RLMS-HSE	46.5	71.6	71.2	68.6	54.4	33.1	60.3
	LLH survey	*66.4*	*.5*	*68.2*	*59.9*	*42.2*		*60.3*
2002	RLMS-HSE	48.3	70.7	73.7	69.0	55.8	34.8	61.4
2003	RLMS-HSE	46.7	67.4	72.9	64.6	59.9	34.8	60.1
2004	RLMS-HSE	46.4	67.2	72.7	64.4	58.5	35.9	59.8
	New Russia Barometer	*63*	*74*	*69*	*66*	*55*	*46*	*64*
2005	RLMS-HSE	44.7	67.2	73.0	65.1	56.5	34.3	59.2
2006	RLMS-HSE	46.3	68.3	71.3	67.3	61.6	34.9	60.4
2007	RLMS-HSE	46.0	66.6	71.4	66.6	61.2	33.5	59.8
2008	RLMS-HSE	44.1	66.4	68.4	65.2	59.8	31.6	58.1
2009	RLMS-HSE	41.6	65.7	65.6	65.2	56.0	30.3	56.3
	GATS	*52.5*	*69.2*	*67.2*	*65.1*	*58.2*	*40.7*	*60.2*
2010	RLMS-HSE	42.3	61.5	61.0	62.5	53.1	30.9	53.8
	HITT survey	*57.3*	*68.7*	*61.7*	*52.2*	*30.6*		*53.27*
2011	RLMS-HSE	40.1	58.5	62.9	60.0	52.9	27.6	52.4
	Levada	*54.8*	*59.4*	*59.7*	*56.8*	*47.9*	*28.2*	*53.4*
2012	RLMS-HSE	36.8	59.2	63.4	60.1	54.0	27.6	52.1
2013	RLMS-HSE	36.0	57.1	60.6	58.6	55.9	25.4	50.8
2014	RLMS-HSE	29.0	56.8	60.7	57.6	55.0	26.9	49.0

		Age group						
Year	**Source**	**15-24**	**25-34**	**35-44**	**45-54**	**55-64**	**65plus**	**All ages**
Females								
1994	RLMS-HSE	16.7	17.3	11.6	6.5	2.2	1.1	9.4
1995	RLMS-HSE	15.4	18.2	10.7	9.1	2.2	1.2	9.5
1996	RLMS-HSE	16.4	20.6	12.1	8.9	1.9	1.3	10.3
	New Russia Barometer	*27*	*28*	*14*	*12*	*5*	*5*	*14*
1998	RLMS-HSE	15.3	23.0	13.3	9.6	1.6	1.9	10.9
2000	RLMS-HSE	13.9	26.7	14.8	13.2	1.6	1.5	12.0
2001	RLMS-HSE	16.0	27.9	17.9	14.3	4.1	1.8	13.7
	LLH survey	*30.5*	*23.5*	*13*	*13*	*2.5*		*15.38*
2002	RLMS-HSE	15.7	29.0	17.4	14.8	4.8	1.0	13.8
2003	RLMS-HSE	16.0	27.7	20.9	12.1	6.5	1.1	14.2
2004	RLMS-HSE	17.7	27.3	22.3	14.2	6.8	1.3	15.0
	New Russia Barometer	*28*	*31*	*17*	*12*	*8*	*1*	*15*
2005	RLMS-HSE	15.6	26.9	23.5	13.9	8.7	0.6	15.0
2006	RLMS-HSE	17.5	26.4	26.4	14.8	8.7	0.8	15.9
2007	RLMS-HSE	16.7	27.8	26.1	14.4	8.9	1.0	15.9
2008	RLMS-HSE	16.4	26.6	25.4	14.2	9.7	1.2	15.7
2009	RLMS-HSE	14.8	26.0	26.0	12.6	9.8	1.2	15.2
	GATS	*32.6*	*32.1*	*30.6*	*22.1*	*12.6*	*2.9*	*21.7*
2010	RLMS-HSE	16.7	23.1	23.7	14.7	9.1	1.1	14.8
	HITT survey	*26*	*24.5*	*18.2*	*11.8*	*2.2*		*16.13*
2011	RLMS-HSE	15.6	24.1	23.3	14.9	10.8	1.3	15.0
	Levada	*25.0*	*27.2*	*19.5*	*11.3*	*10.9*	*2.3*	*15.8*
2012	RLMS-HSE	15.7	23.9	24.0	16.4	10.8	1.5	15.4
2013	RLMS-HSE	11.6	22.9	23.5	16.6	10.7	2.4	14.6
2014	RLMS-HSE	10.8	22.9	22.8	16.7	10.7	2.6	14.4

LLH= Living Standards, Lifestyles and Health survey (as reported in Roberts et al. (2012)). HITT= Health in Times of Transition survey (as reported in Roberts et al. (2012)). The study drawing on the LLH and HITT surveys uses a different age grouping and only includes individuals aged 18 and older, therefore the age-specific smoking rates are not directly comparable. The age groups are: 18-29, 30-39, 40-49, 50-59, 60 and above. Levada= Representative survey commissioned by the authors in 2011 and conducted by the Levada institute (N=1,500). The youngest group in the Levada survey includes individuals aged 18-24.

A-2 Inconsistent reporting of former smoking status in the RLMS-HSE

	(1) Current smoker in t-1, never-smoker in t				(2) Former smoker in t-1, never-smoker in t			
	All years		In last year		All years		In last year	
Cohort	Males	Females	Males	Females	Males	Females	Males	Females
1990	12	6	5	3	27	17	8	9
1980	113	96	27	31	164	251	34	56
1970	101	93	27	15	114	220	25	47
1960	74	49	16	13	90	125	24	29
1950	63	48	12	8	96	88	21	28
1940	29	13	8	5	59	42	20	14
All	392	305	95	75	550	743	132	183

A-3 Measurement error in reported start and quit ages

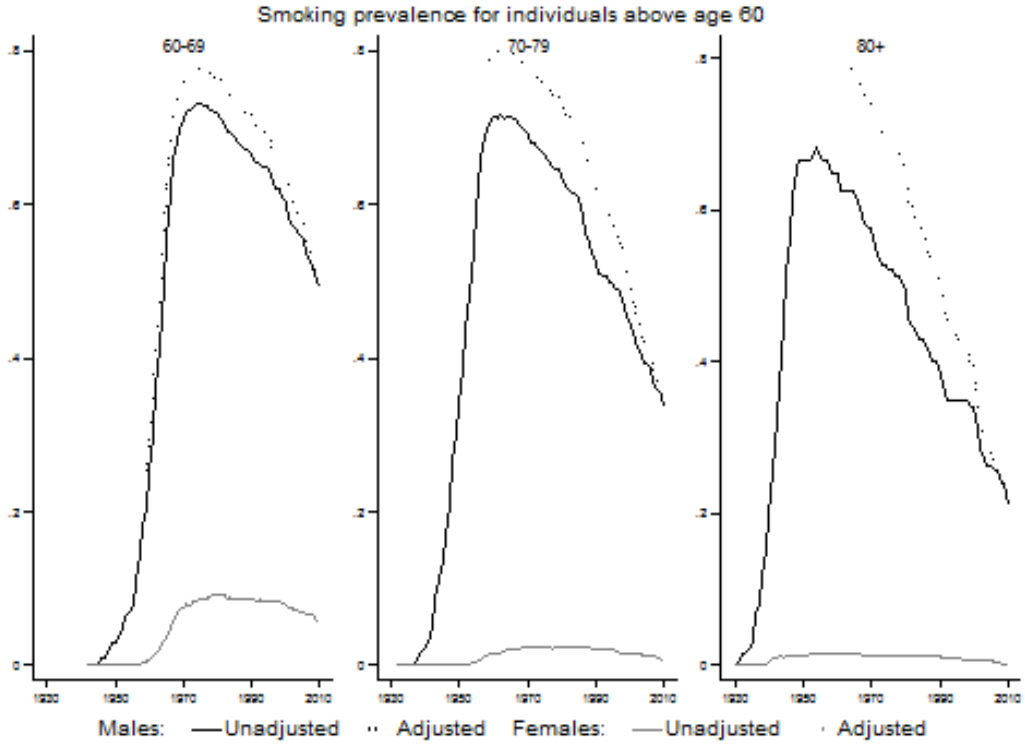
	Males			Females		
Cohort	Mean start age	Mean divergence in start ages	Mean minimum start age	Mean start age	Mean divergence in start ages	Mean minimum start age
1990	14.30	1.74	13.36	14.52	1.14	14.05
1980	15.27	2.69	13.75	16.16	2.23	15.02
1970	16.47	2.92	14.86	18.19	2.87	16.71
1960	16.86	3.99	14.79	20.52	3.96	18.56
1950	17.08	4.39	14.95	23.04	5.90	20.13
1940	17.48	4.46	15.14	24.68	6.24	21.51
	Mean quit age	Mean divergence in quit ages	Mean maximum quit age	Mean quit age	Mean divergence in quit ages	Mean maximum quit age
1990	14.84	1.37	15.14	15.77	1.24	16.35
1980	19.26	1.96	20.19	19.93	2.14	21.45
1970	26.89	2.35	29.38	25.81	2.96	28.48
1960	33.73	3.52	37.43	32.28	3.97	36.02
1950	38.60	4.88	44.54	38.24	5.53	43.49
1940	43.70	8.43	50.82	41.70	7.47	49.90

A-4 Share of ever-smokers in the RLMS-HSE and GATS

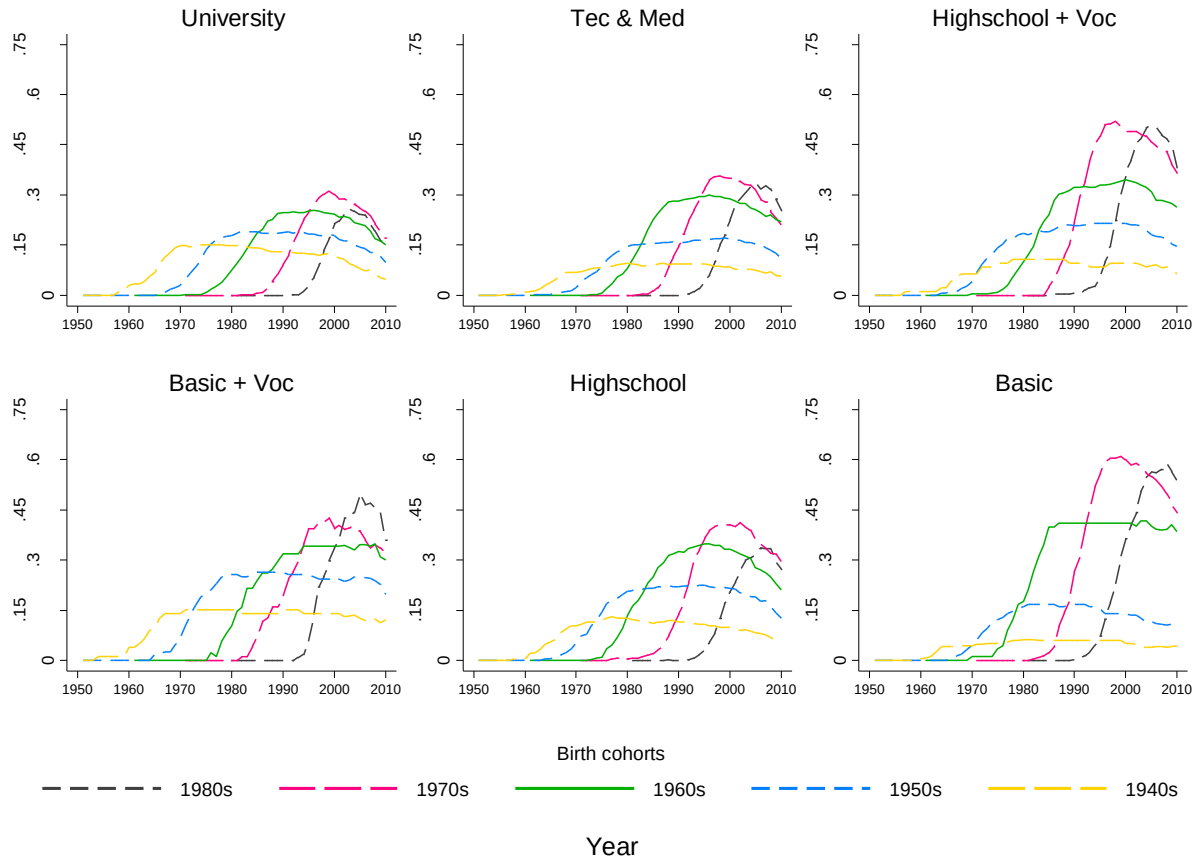
	Males				Females			
	RLMS-HSE	RLMS-HSE adjusted	GATS daily	GATS < daily	RLMS-HSE	RLMS-HSE adjusted	GATS daily	GATS < daily
Share of current smokers								
15-24	47.2	47.2	45.0	7.5	19.7	19.7	23.1	9.5
25-34	67.2	67.2	63.4	5.8	26.9	26.9	23.7	8.4
35-44	65.8	65.8	60.8	6.5	25.9	25.9	24.5	6.0
45-54	65.0	65.0	61.3	3.8	17.4	17.4	15.7	6.4
55-64	56.2	56.2	54.9	3.4	10.5	10.5	10.3	2.3
65plus	33.1	33.1	37.7	3.0	1.7	1.7	2.7	0.2
All ages	57.1	57.1	55.0	5.3	16.7	16.7	16.3	5.4
Share of former smokers								
15-24	8.0	8.8	3.9	5.6	10.6	11.5	3.6	7.0
25-34	11.4	12.6	7.7	4.4	13.0	14.2	5.3	9.9
35-44	13.6	14.6	12.3	4.9	10.4	11.5	3.4	8.1
45-54	15.5	16.5	13.6	4.4	6.8	7.5	2.6	7.8
55-64	21.0	22.5	18.6	3.7	4.5	4.8	6.0	6.3
65plus	35.6	37.9	33.4	5.3	1.7	2.0	3.0	2.0
All ages	15.7	16.9	13.1	4.7	7.8	8.5	3.8	6.7
Share of ever-smokers								
15-24	55.2	56.0	51.1*	62.0	30.3	31.2	28.3*	43.2
25-34	78.7	79.8	73.5*	81.2	39.9	41.1	32.2*	47.3
35-44	79.4	80.4	76.2*	84.4	36.3	37.4	30.7*	42.0
45-54	80.5	81.5	77.1*	83.1	24.2	24.9	19.8*	32.5
55-64	77.2	78.7	75.3*	80.6	15.0	15.4	16.9*	24.9
65plus	68.7	71.0	72.7*	79.5	3.4	3.7	5.8*	7.9
All ages	72.8	74.0	70.3*	78.0	24.4	25.2	21.7*	32.2
Sample size	12,597	12,597	6,217		15,818	15,818	5,189	

RLMS-HSE data: pooled sample for 2001-2009, keeping the last observation year for individuals who are surveyed in multiple years. * Share of current and former daily smokers only (since start ages are only asked from current or former daily smokers but not occasional smokers, the smoking histories can only consider prevalence of daily smoking).

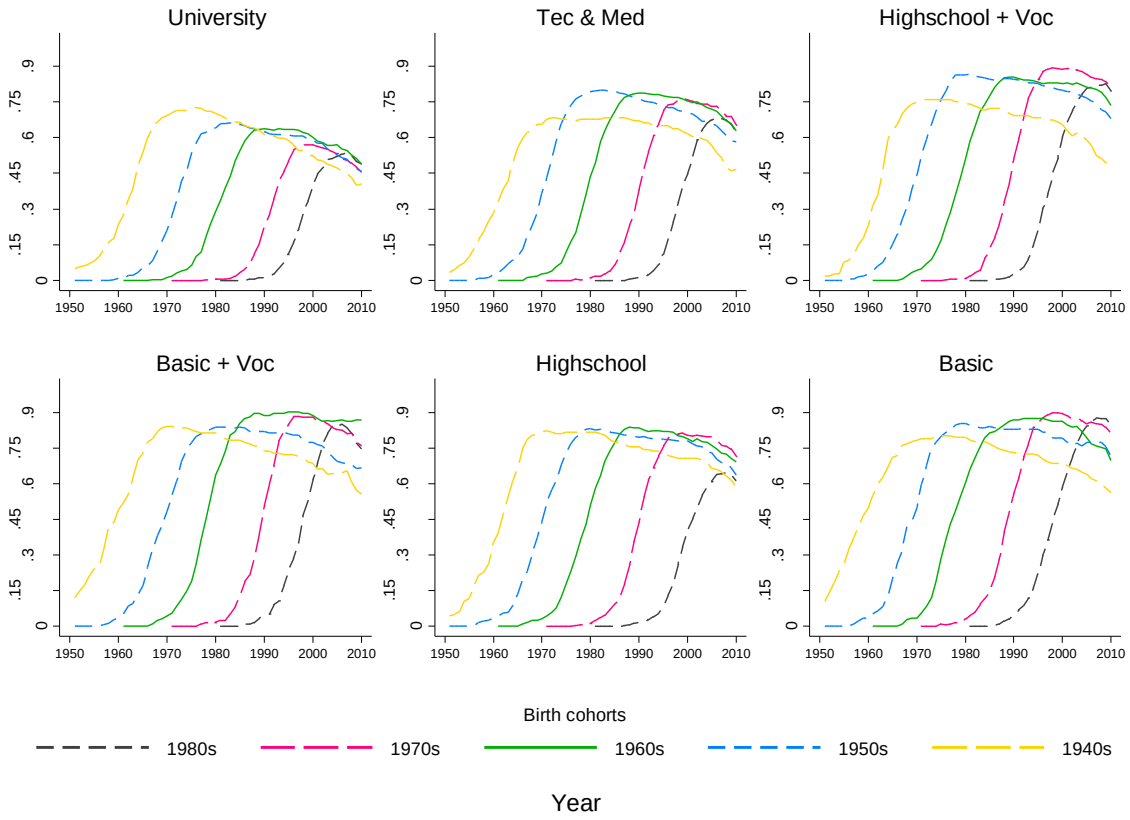
A-5 Smoking prevalence by gender adjusted for differential mortality



A-6 Female smoking prevalence by birth cohort and education with more detailed educational classification (RLMS-HSE)



A-7 Male smoking prevalence by birth cohort and education with more detailed educational classification (RLMS-HSE)



A-8 Sample sizes and peak prevalence by birth cohort and education in the RLMS-HSE data (6 education categories)

Cohort	University						Tec & Med						Secondary+ vocational					
	N	Year peak	Age peak	Peak prev.	Confidence interval		N	Year peak	Age peak	Peak prev.	Confidence interval		N	Year peak	Age peak	Peak prev.	Confidence interval	
Males																		
1980s	496	2007	23.9	0.54	0.478	0.575	443	2006	22.1	0.68	0.637	0.730	535	2009	24.5	0.83	0.784	0.863
1970s	592	1998	23.0	0.57	0.530	0.611	381	1999	24.4	0.77	0.721	0.808	559	1998	23.3	0.90	0.868	0.920
1960s	416	1990	25.7	0.64	0.589	0.683	338	1990	25.6	0.79	0.739	0.829	475	1989	24.5	0.85	0.820	0.885
1950s	363	1983	28.0	0.66	0.610	0.710	368	1982	27.3	0.80	0.754	0.839	357	1981	25.8	0.87	0.829	0.902
1940s	231	1976	30.5	0.73	0.665	0.784	177	1972	26.5	0.68	0.610	0.751	108	1971	24.8	0.76	0.667	0.836
Females																		
1980s	814	2003	20.3	0.26	0.228	0.289	640	2005	21.2	0.34	0.297	0.375	349	2005	20.9	0.50	0.448	0.561
1970s	921	1999	23.9	0.31	0.281	0.342	695	1998	23.4	0.36	0.321	0.394	392	1998	23.3	0.52	0.470	0.571
1960s	594	1996	31.7	0.25	0.220	0.291	670	1996	31.6	0.30	0.266	0.336	347	2000	35.5	0.35	0.296	0.398
1950s	567	1982	27.0	0.19	0.159	0.225	820	1999	44.2	0.17	0.146	0.198	299	1993	37.8	0.21	0.169	0.265
1940s	353	1973	27.5	0.15	0.117	0.195	464	1980	34.4	0.09	0.070	0.125	94	1978	31.9	0.11	0.052	0.187

Cohort	Primary + vocational						Complete secondary						Primary					
	N	Year peak	Age peak	Peak prev.	Confidence interval		N	Year peak	Age peak	Peak prev.	Confidence interval		N	Year peak	Age peak	Peak prev.	Confidence interval	
Males																		
1980s	150	2006	21.7	0.85	0.772	0.908	764	2008	22.9	0.65	0.601	0.689	521	2007	31.9	0.88	0.836	0.911
1970s	174	1996	21.3	0.89	0.828	0.928	519	1999	24.3	0.81	0.777	0.846	326	1998	22.8	0.90	0.861	0.929
1960s	143	1995	30.9	0.90	0.841	0.945	466	1988	23.9	0.84	0.802	0.871	144	1992	27.7	0.88	0.810	0.924
1950s	199	1980	25.4	0.84	0.781	0.887	427	1980	25.2	0.83	0.792	0.866	169	1979	24.6	0.85	0.789	0.902
1940s	150	2006	21.7	0.85	0.772	0.908	764	2008	22.9	0.65	0.601	0.689	521	2007	31.9	0.88	0.836	0.911
Females																		
1980s	103	2005	20.8	0.50	0.395	0.605	924	2006	21.1	0.34	0.301	0.375	350	2008	32.9	0.59	0.515	0.661
1970s	94	1999	24.2	0.43	0.324	0.532	396	2002	27.3	0.41	0.362	0.465	215	1999	23.8	0.61	0.541	0.675
1960s	88	2008	44.0	0.35	0.237	0.472	325	1995	30.8	0.35	0.296	0.402	90	2003	38.7	0.42	0.310	0.529
1950s	152	1985	30.3	0.26	0.195	0.341	467	1994	39.1	0.22	0.188	0.265	156	1981	26.6	0.17	0.112	0.235
1940s	79	1971	25.8	0.15	0.081	0.250	253	1977	31.2	0.13	0.092	0.178	273	1980	35.9	0.06	0.037	0.098