Weather Shocks, Poverty and Crime in 18th-Century Savoy

CÉDRIC CHAMBRU*

May 25, 2020

Abstract

Did weather shocks increase interpersonal conflict in early modern Europe? I address this question by exploiting year-to-year seasonal variations in temperature and detailed crime data assembled from Savoyard criminal procedures over the period 1749–92. I find that temperature shocks had a positive and significant effect on the level of property crimes, but a negative and significant effect on violent crimes. I further document how seasonal migration helped to increase the coping capacity of local communities. Indeed, migrant labour both brought in remittances that supplemented communities' resources, as well as temporarily relieved impoverished households of burden of feeding these workers. I show that while temperature shocks were strongly associated with an increase in property crime rates, the effect was much lower in provinces with high levels of seasonal migration. I provide historical evidence demonstrating that the inflow of remittances may have driven this relationship.

Keywords: Weather shocks; Migration; Crime; Grain Prices; Savoy; 18th century.

JEL: J61, N33, N53, Q10.

*Cédric Chambru, Department of Economics, University of Zurich, Zürichbergstrasse 14, CH-8032 Zürich. Email: cedric.chambru@econ.uzh.ch.

1 Introduction

In April 1780, Pantaléone Terrier was prosecuted for food theft after she stole two *bichets* of buckwheat flour, worth approximately three *livres*, from a miller in Moûtiers.[1] Terrier declared that she had decided to steal the flour because she was "in great a misery, my husband being sick and unable to work ever since All Saints' Day, and having two children suffering from hunger". Considering that the plaintiff had refused to sold her flour on credit and that "a man driven by misery and hunger to commit petty theft of food is less guilty than if he was driven by cupidity", the judge decided to dismiss the charges against Terrier and released her from custody.[2] Fifty years earlier, Pierre Lavin, a day labourer from the province of Chablais, was less fortunate. In 1734, "due to all the harvest having failed over the last year in his homeland, he had no choice but to leave to beg for food here and there". He migrated to France but was later arrested in Beaujeu, near Lyon, and condemned for begging by the French constabulary.[3] Lavin's experience suggests that seasonal migration could represent an efficient coping mechanism against income shocks, but only if one had the ability to secure a job and stable earnings.

This article sheds light on the effect of economic conditions on the occurrence of property crimes and violent crimes by exploiting within-province variations in weather-induced negative income shocks in Savoy from 1749 to 1792.[4] Specifically, I use the spatial heterogeneity in the migration pattern between lowland and upland communities to show how seasonal migration constituted an efficient buffer against weather-induced income shocks.[5] Indeed, migrant labour brought in remittances, which not only supplemented communities' resources but also temporarily relieved impoverished households of the burden of feeding these workers.

I assemble a new data set on the occurrence of property crimes and violent crimes between spring 1749 and summer 1792 at the provincial level. I combine these data with reconstructed seasonal temperature data and population census data, as well as information on average migration rate, annual wheat prices, grape harvest dates and annual wine prices. I document how weather shocks translated into transitory negative income shocks for local communities. I show that warmer temperatures were associated with earlier grape harvest date (GHD) and lower wine prices. This fact is consistent with previous findings in the literature (Daux et al. 2012; Meier et al. 2007), and can be explained by the fact that temperatures and growing

[1] One *bichet* of flour was roughly equivalent to eight kilograms, while the average income of a farming household amounted to 200 *livres* a year during the 18th century. The fundamental accounting currency in the Duchy of Savoy during the second half of the 18th century was the *Livre de Savoie* (hereafter £), which was pegged on the *Lira piemontesi*. See Appendix A.2 for more details.

[2] Archives Départementales (hereafter Arch. Dép.) Savoie, 2B 10702, Pantaléone Terrier.

[3] Arch. Dép. Rhône, 7 B 21, Pierre Lavin.

[4] During the 17th century and the first half of the 18th century, Savoy was occupied on many occasions by foreign troops. In 1749, a seven-year rule of the Holy Roman Empire ended, and for the next 40 years, Savoy was not involved in any military conflict. Political and judicial institutions were thus very stable over this period.

[5] Hereafter, I use *Savoy* to refer to the duchy of Savoy, whereas I use *Savoie* for the province constituting part of the duchy. Chambéry was the capital city of both the duchy of Savoy and the province of Savoie. See Section 2.1.

season length are a critical aspect for the cultivation of winegrapes. They have a major impact on grape ripening and fruit quality: warmer temperatures quicken vegetative growth and increase ripening potential. Warmer temperatures were also associated with higher wheat prices.[6] Since bread made up the bulk of the Savoyard consumption basket where vegetables, fruits and livestock products only marginally supplemented diets (Nicolas 1979), variations in grain prices had a larger impact on household real income than did those in wine prices.

In the face of an economic downturn, a rise in food prices, joblessness and/or the inability to secure financial resources, individuals may turn to illegal income-generating activities. In other words, these individuals who lack economic resources may have greater incentives to commit crime (Becker 1968). Specifically, Becker (1968) suggests that individuals weigh the benefits and costs of committing a crime, such that any change in the relative gains and the level of crime deterrence can have an impact on the incidence of misconduct.

I use panel estimates with province and year fixed effects to compare crime rates in provinces with high and low seasonal migration rates. I find that transitory negative income shocks associated with weather shocks significantly increased the occurrence of property crimes, but significantly decreased that of violent crimes. Specifically, a one standard deviation increase in temperature raised the property crime rate by 6.8 per cent, but decreased the violent crime rate by 8.7 per cent. Further, I provide evidence that the rise in property crimes was partially driven by the need to survive: an increase in temperature affected property crimes involving the theft of edible products. A fall in the opportunity cost of illegal activities due to shrinking agricultural income could have increased the pay-off of committing thefts and, in turn, increased the probability of committing property crimes. On the contrary, the drop in real income caused by temperature shocks may explain the negative relationship between warmer temperature and violent crime rates. Despite lower wine prices, alcohol consumption, a major criminogenic trigger, is likely to have declined as households' income decreased.

Freedman et al. (2018) show that, among immigrants in the United States, the likelihood of committing income-generating crimes is higher when they are prevented from participating in the local labour market. The case of Pierre Lavin, arrested and condemned for begging, is certainly not representative of the fate of most Savoyard migrants. Many contemporaries and scholars have, in fact, highlighted that seasonal migration constituted a significant source of income for local communities– from £25 to as much as £100 per migrant (Grillet 1807; Guichonnet 1945; Verneilh-Puiraseau 1807). Seasonal migration offered a viable alternative to crime for generating income and, therefore, reduced the expected returns to property crimes. This may, in turn, have diminished the incidence of such crimes during transitory economic shocks. Drawing on data from Becchia et al. (2012), I exploit spatial variations in seasonal migration rates to show that, indeed, such labour movements reduced the need to stealing to survive, and was an efficient strategy to mitigate the negative effect of weather shocks. Historical evidence thus suggests that the cash inflow generated by seasonal migrants, as well as the temporary relief of Malthusian constraints, helped alleviate the impact of adverse

[6] This result is also in line with previous findings in the literature (Franck and Galord 2017; Jia 2014).

weather shocks.

Related literature. My work relates to the literature that studies the linkages between weather variability, agricultural risks, vulnerability and migration (Falco et al. 2018; Feng et al. 2010; Jha et al. 2018; Marchiori et al. 2012). Ratha (2005) emphasises the positive effects of remittances: they represent a net fiscal gain for countries of origin, provide currency for importing scarce inputs, and can serve as a buffer against negative income shocks in migrants' home countries. Yang and Choi (2007) show that, in Filipino households with overseas migrants, remittance inflows from overseas replace up to 60 per cent of exogenous declines in income. Focusing on internal migration in Tanzania, Kubik and Maurel (2016) find that weather shocks are an important migration driver through their effect on agricultural income.

Additionally, my findings build on and advance the historical literature on seasonal migration (Fontaine 1998, 2003; Siddle 2000; Viazzo 1989). For instance, Siddle (1997) suggest that the deployment of successful migration networks in the Alps contributed to sustain the flows of migration remittances and savings, and helped mountain communities to prosper. Lorenzetti (2003) emphasises that the conjunction of a strong demand for labour in urban areas and the necessity of buying not locally available food best explains migratory movements in the Insubric valley.[7]

The findings in this paper also contribute to a prior literature that examines the determinants of interpersonal conflicts. More specifically, this article relates to lines of research that analyse the direct effect of temperature (heat) on violence; or the effects of weather on economic activity which, in turn, can influence the propensity for property and violent crimes.[8] For instance, Mares (2013) analyses the level of violent crime rates in Saint-Louis between 1990 and 2009, and finds that a one degree increase toward a warmer temperature is associated with a one percent increase in violent crimes. Using Finnish data spanning 1996–2013, Tiihonen et al. (2017) find similar results, whereas Harp and Karnauskas (2018) and Schinasi and Hamra (2017) show that, in line with the routine activities theory, the relationship between mean heat daily heat index and violent crimes is particularly significant during cold months.[9]

Axbard (2016) studies how climate-induced changes in income opportunities for Indonesian fishermen affect the number of piracy attacks. An improvement in fishing conditions significantly increases the income of fishermen while the level of sea piracy is significantly reduced. In particular, Axbard shows that the effect of negative income shocks is smaller in areas with many alternative legal income opportunities consistent with the fact that opportunity costs drive, at least partially, the relationship between transitory negative income shocks and crimes. Blakeslee and Fishman (2018) and Dix-Carneiro et al. (2018) respectively analyse the effect of adverse weather conditions and trade shocks on crime rates, and show that the reduction of

[7] A more traditional view holds that mountain communities used emigration mostly to ease pressure on subsistence and escape Malthusian positive checks, but does not generally consider pull factors (e.g. Dupâquier 1988: 99–143; Poussou 1970).

[8] More broadly, this paper also relates to the decades-long literature on business cycles and crime (e.g. Arvantes and Defina 2006; Bell et al. 2018; Mocan and Bali 2010; Draca et al. 2013).

[9] See Miles-Novelo and Anderson (2019: 37–40) for a recent literature review on heat stress and violent crimes.

agricultural income and labour market earnings results in significantly higher crimes rates in India and Brazil.

In 19th-century Bavaria, negative transitory income shocks associated with adverse weather conditions resulted in a significant increase in property crimes and significantly fewer violent crimes (Mehlum et al. 2006). In particular, Mehlum et al. posit that the decline in violent crime rates was driven by a reduction in alcohol consumption. Many historians of crime have, in fact, related alcohol consumption and drunkenness to violent behaviour. Because alcohol lowers inhibitions, impairs a person's judgement and may exaggerate the offence taken, an increase in alcohol consumption could lead to a surge in violent crimes (Brennan 1988; Greenshields 1994; Lecoutre 2010). Further empirical evidence from 19th-century Prussia (Traxler and Burhop 2010) and 19th-century France (Bignon et al. 2017) support this underlying mechanism. Traxler and Burhop assemble data on beer production, rye prices, seasonal rainfall and crime in 19th century Prussia, and demonstrate that beer consumption had a strong and highly significant impact on violent crimes. In particular, they show that rainfall shocks, a proxy for negative transitory income shocks, had no impact on violent crime once they account for beer consumption. Bignon et al. (2017) use geographical variations in the timing of the phylloxera crisis to identify the effect of negative income shocks on property and violent crime rates. In wine growing areas, contagion by phylloxera resulted in a significant decrease in wine production, and represented a strong exogenous income shock. On average, property crime rates subsequently increased by 18 per cent, while violent crime rates decreased by 12 per cent.

The remainder of the article is organised as follows. Section 2 provides historical background and discusses how seasonal migration helped to mitigate the effects of weather shocks. Section 3 reports data sources and the dataset construction, and provides descriptive statistics. Section 4 presents the estimation strategy, quantifies the effect of weather shocks on the incidence of crimes, and considers a number of robustness checks. Section 5 concludes.

2 Historical Background

2.1 Savoy during the 18th century

In 1720, the Treaty of The Hague ended the War of the Quadruple Alliance, and attributed Sardinia to the duke of Savoy, to whom it brought the royal title. The newly-formed Kingdom of Sardinia then encompassed Aosta Valley, Nice, Oneglia, Piedmont, Sardinia and Savoy. Savoy, itself composed of six provinces and two bailiwicks, was then an administrative division of the new political entity (online Appendix Figure D.4). In 1749, a seven-year rule of the Holy Roman Empire ended, and Savoy was not occupied until the invasion of French revolutionary troops in September 1792.[10]

Institutionalised in the mid-16th century, the Senate of Chambéry, a court of appeal, was then the main ruling institution in the duchy until the creation of intendants in the turn of the

[10] French troops entered in Chambéry on September 23. The decree of *Réunion de la Savoye à la France* was ratified by the Convention on 27 November 1792.

18th century. Within each province, there was a court of first instance called *judicature-mage*. The head judge, the *juge-mage*, had pre-eminence on other local judges and was responsible for judging criminal cases for £2000 or less.[11] Judges had to solve the cases within 3 months after issue and should prioritise criminal over civil court cases (*Loix*, Articles 1 and 4, Title XVI).[12]

The duchy of Savoy was a land of contrast. In the north and the west, areas with high population densities and a rain-fed agrarian economy centred on the production of grains. In the east, the mountainous mass precluded the intensive cultivation of grains and pasture-based livestock production had a more central position in the agricultural mix. During the first half of the 18th century, many institutional and tax reforms contributed to the standardisation of financial practices, reduction the to the unification bureaucracy, the purge of some seigniorial institutions, and the creation of local intendants in each province (Storrs 2009; Symcox 1983).[13]

In the mean time, agriculture experienced little innovations (Nicolas 1978). The total agricultural output stagnated and could barely sustain population increases. Yields remained static during this period and close to the subsistence level, leaving the local communities vulnerable to adverse weather conditions.[14] Harsh climate conditions and the lack of activity during winter, in particular in hilly areas, pushed many inhabitants to seasonally migrate and find work outside the duchy. Migration offered the opportunity to earn an additional income and temporarily reduced population pressure. Overall, several estimates suggest that migrants made up to 30,000 individuals, about 10 per cent of the total population, by the end of the 18th century.

2.2 Climate, weather variability and agricultural production

Located in the Western Alpine region, the duchy of Savoy is under the influence of a continental climate with harsh winters (snow and prolonged frost), and warm and dry summers. By the mid-18th century, Savoy was a rural rain-fed agrarian economy with a

[11] For an overview on the functioning of local justice, see Dullin (1915: 7–44). For a detailed account of the evolution of the senate and its criminal policies from the 16th century onward, see Laly (2010; 2012: Chap. 2). For a general description of Savoy prior to the 18th century, see Laly (2012: Chap. 1).

[12] In 1770, the *Loix et constitutions de Sa Majesté le roi de Sardaigne*, also called Royal Constitution, (hereafter *Loix*) stipulated in the Article 5, Title II, Livre IV, that "all information and acts necessary to the proceeding of criminal trials will be written by a clerk or their substitute who should be notaries [...] or anyone else as long as he is a notary [...] and swear oath of secrecy and exactitude". Other edicts required judges to send quarterly summary of their activities to the intendant general in Chambéry to ensure they work effectively (Laly 2013: 95–101).

[13] Intendant were responsible for, among other things, the collection of taxes and the maintenance of public infrastructure, such as roads and dikes. They also sent monthly reports depicting the social and economic situation in their province to the intendant general in Chambéry, who could then take measures to better cope with sources of distress (Esmonin 1960; Verdo 2012).

[14] To reduce the competition from French products, agricultural and industrial tariffs were raised in the aftermath of the Spanish occupation. Bigot de Sainte Croix (1877: 64–6), then French ambassador in Turin, retells that the tariffs on basic goods were too high and impeded trade. Tochon (1871: 66) claims that they were detrimental to the population because it left staple prices and wine prices more vulnerable to weather whims. In his account of his travel to Italy in the 1760s, Richard (1766: 87) also pointed out that the depreciation of foreign currencies and high tariffs severely impeded the foreign trade in the Sardinian Kingdom. More generally on the volume and composition of trade in Savoy, see Nicolas (1978: 93–104).

relatively low agricultural productivity by European standards.[15] Seed-yield ratio averaged 4.6:1 for wheat and 3:1 for rye (Crook et al. 2004).[16] Yields in viticulture were also low, 15 to 25 hectolitres per hectare, and often insufficient to meet local demand, and sometimes to provide a living for local producers.

Pastures typically occupied fifty per cent of the agricultural area, arable land thirty per cent– of which one third was planted to wheat–, and grape growing about five per cent (Gex 1943; Guichonnet 1955, 1969; Nicolas 1978; Vion 1956). Table 1 provides an overview of the socio-economic structure of a typical mountainous parish, with the predominance of rye and hay to feed livestocks. The province of Genevois, Maurienne and Faucigny produced enough grains to export a small surplus in the neighbouring regions. On the contrary, the province of Savoie had to annually import between 8,000 and 12,000 hl of grains from the neighbouring city of Belley or the province of Dauphiné in France (Nicolas 1978: 95–6).[17] Much of the annual variations in crop yields depended on year-to-year fluctuations of the weather.

In general, wet summers were detrimental to the quality of harvests, because the high moisture content of the grains made its storage harder (Brunt 2004). Wet and cold summers also meant that grapes did not mature as they should, leaving yields to be down compared to normal years. By contrast, a warm and early spring fostered the development of grains and meant an earlier harvest– the usual harvest time for wheat and rye ranged from early July to early August (Collomb 1977: 37; Daquin 1787: 32; Verneilh-Puiraseau 1807: 170–1, 422). Early harvests had the advantages of reducing the risk of catastrophic damage to the crop from hailstorms, and preventing the mature crops from drying and rewetting due to rainy spells (Le Roy Ladurie 2006; Pfister and Brázdil 2006). However, warmer temperatures also resulted in lower number of grains formed and lower grains weight, which in turn reduced wheat grain yield.[18]

Several episodes of adverse weather conditions occurred between 1749 and 1789. Becchia et al. (2012) review the historiography on climatic conditions in Savoy, and note that a series of dry summers occurred in 1754, 1762, 1766–7, and repeated droughts hampered agricultural output in the 1770s and the 1780s increasing the environmental pressure over a growing

[15] Nicolas (1978: 686–91) report that the average yield of wheat was about 4.5 to 6 hectolitres per hectare during the 18th century. For a lengthy description of the agricultural situation and practices, see Costa de Beauregard (1774), Tochon (1871), and Verneilh-Puiraseau (1807: 421–72).

[16] Arch. Dép. Haute-Savoie, 1 C 4 178, pièce 18, État des récoltes tel qu'il a été envoyé à Saint-Julien. In the early 19th century, Verneilh-Puiraseau (1807: 424, 470–1) indicates that the seed-yield ratio averaged 4-5:1 for wheat, 5-6:1 for rye and 15-20:1 for potatoes.

[17] Introduced in the 1730s, potatoes and maize were already consumed in the 1740s. Their cultivation really expanded after the repeated episodes of food distress in the early 1770s (Ferrand 1979; Nicolas 1978: 692–4). In 1787, the doctor Daquin (1787: 33–8) reported that harvests of potatoes were plentiful, and "so precious for peoples in the countryside, that there is no peasant who does not cultivate them, and that lower people in cities". In the province of Faucigny potatoes represented almost one-fourth of total agricultural production in 1789, and, in the province of Chablais, the intendant noted that potatoes constituted "most of the food of a large number of peasants, in particular in mountainous areas". Arch. Dép. Haute-Savoie, 1 C 99, pièce 99, lettre du 26 janvier 1789.

[18] Recent studies show that the net effect warming is associated with net yield reductions: one degree increase in temperature reduces yield by five to ten per cent (Tack et al. 2015; Uprety and Reddy 2016: 45–54).

Table 1 – Demographic structure and agricultural production of Sainte-Foy-Tarentaise, 1756

Demographic structure		**Agricultural production**		
Population	1,204	Rye	6,624	*bichets*
Number of families	276	Wheat	400	*bichets*
Number of men	493	Beans	500	*bichets*
Number of women	711	Barley	800	*bichets*
Number of migrants	≈100	Hay	7,500	quintals
		Nuts	150	*bichets*

Sources: Arch. mun. Sainte-Foy-Tarentaise, Réponse à l'intendant Agiono, État de la communauté de Sainte-Foy, 1756.
Notes: The *bichet* of Sainte-Foy-Tarentaise is a unit of capacity for grains equal to 15.5 litres for wheat and 10.3 litres for oats. The city council further reported that: (i) "About hundred men, either peddlers or chimney sweeps, migrate every to France between late September and the beginning of the summer"; (ii) "The inhabitant do not cultivate other crops excepted a lots of potatoes (or *truffes*) and straws, which I did not bother to mention". In 1761, the inhabitants owned 1,171 cows and assimilated as well as 713 ewes. The population then included 142 children younger than five and 1075 individuals older than five.

population.[19] For instance, the intendant of Genevois revealed that, in 1770, the harvest fell short of an average one-fifth or less for one-fourth of the parishes. In another two-thirds of the 170 parishes, the level of harvest ranged from one-third to two-thirds of a normal year.[20]

2.3 Institutional relief, migration and crime

Weather-induced agricultural failures had a strong effect on household real incomes and living standards. Because food crops were more widely consumed than wine in Savoyard household, the net income effect of warmer temperature on household budget tended to be negative.[21] Ruff (1984: 124–8) shows that deprivation was a major cause of thefts in early modern France. In particular, wheat price movements deeply affected the poorest, and correlates with the rate of theft. Elevated food prices made it more difficult for many households to meet their minimum subsistence needs, leaving thievery as the only solution for survival. Using various population censuses, Nicolas (1978) finds that between 8 and 13 per cent of the households were recorded as poor during normal years, but numbers significantly inflated in times of food shortage.

Local population and authorities used various strategies to mitigate the negative effect induced by weather shocks. In June 1759, the province of Chablais experienced an episode of drought followed by continuous rains in July and August. In September, the intendant noted that peasants reaped only half of a normal grain harvest. Apple and pear trees gave no fruit, and there were only few cherries and plums.[22] Later in that year, the king granted a

[19] Similarly, wet summers in 1749, 1751, 1756–9, and 1770 led to repeated bad harvest. A series of long and cold winters also occurred between 1766 and 1774, 1778 and 1780, and 1788 and 1789, and led to repeated marked fluctuations in grains prices.
[20] Arch. Dép. Haute-Savoie, 1 C 4 178, pièce 6, État général de la qualité de la récolte de l'année 1770.
[21] Online Appendix B contains a more detailed discussion of living standards during the 18th century.
[22] Arch. Dép. Haute-Savoie, 1 C 2 72, pièce 13, État de la récolte en Chablais en 1759.

£90,000 tax exemption to reduce "the extreme misery of the peoples", and an additional £40,000 to support poor relief (Nicolas 1978). Overall, the system of relief provided by municipal and state authorities altogether worked well but was insufficient to cover all the needs of the population.[23]

Beside tax exemption and poor relief, local communities resorted to other strategies, including occasional smuggling, thefts, and seasonal migration to build resilience to weather shocks and maintain their living standards. During the second half of the 18th century, seasonal migration involved between 20,000 and 30,000 individuals– about ten per cent of the total population or one-third of the able-bodied young men (Blanchard 1937; Pérouse 1930; Verneilh-Puiraseau 1807: 394–6).[24] Paris, Lyon, Northern Italy and South Germany were the preferred destinations. Maistre et al. (1992: 26) estimate that, during the 18th century, merchants amounted to at least 15 per cent of the migrants. The bulk of individuals migrating seasonally was composed of workers in the building industry, metal workers, agricultural workers, servants and other unskilled occupations. Migrants, sometimes attracted by the opportunities of expanding towns, stayed away for good.[25]

In Saint-Maxime-de-Beaufort, seasonal migration involved 7.8 per cent of the population in 1757 and 11.7 per cent in 1787. In Nancy-sur-Cluses, there was 45 absentees out of 376 inhabitants in 1780 (Maistre and Maistre 1986: 16). In Saint-Jean-de-Maurienne and Saint-Sorlin d'Arves, seasonal migrants respectively totalled 11.4 per cent and 11.25 per cent of the population in 1773 and 1789 (Pérouse 1930: 40). Other medium-sized towns like Boëge, Flumet, Sallanches, and Samoëns had similar levels of seasonal migration. By contrast, seasonal migration in lowland cities was much lower. About five per cent of the population of Aix-les-Bains migrated every year, three per cent in Annecy, and one per cent in Thonon-les-Bains (Bouverat 2013; Viallet 1993).[26] Workers from upland valleys continuously streamed below to the plains to find seasonal employment, whereas urban dwellers more rarely migrated, so that these structural differences in migration rates remained relatively stable over the pre-industrial period.[27]

The seasonal migration of young men might have contributed, *de facto*, to a direct reduction of violent and/or deviant behaviour in provinces of emigration. Indeed, public houses were a common location for alcohol consumption, and contributed to the structuring of individual

[23] Online Appendix C contains a detailed discussion of the set of actions undertaken by public authorities and assistance institutions to attenuate transitory poverty shocks.

[24] Lorenzetti (2003: 370) reports that 25 to 30 percent of the adult males participated to seasonal migration in the Italian Alps.

[25] In Bordeaux, a large number of *frotteurs* (furbishers) were from the parish of Sainte-Foy-Tarentaise in Savoy. In 1770, forty of them wrote the City Council to blame one of their fellow, named Maurice Blanc, after he repeatedly committed theft. The plaintiffs openly reported Maurice Blanc and asked for his expulsion from Bordeaux to preserve the reputation of the migrant community as honest workers. Arch. Dép. Gironde, 12 B 339 (as cited in Poussou 1978: Annexes III, 692–5).

[26] In 1789, there were 2,175 seasonal migrants out 64,372 inhabitants in the province of Genevois. Arch. Dép. Haute-Savoie, 1 C 4 178, pièce 8, État comparatif des productions année commune tant en bled que menu bled, 1789.

[27] For an overview on the pattern of migration across the Alps, see Mathieu (2009: 123–7). For a general overview of push and pull factors and their impacts on migration patterns in early modern Europe, see Lucassen (1987).

social relations. Ill treatment of women (wife-beating) by drunken men and/or the murder of a rival or an acquaintance in a fight were not unusual events. Lecoutre (2010) describes the usual drunkards as a peasant or craftsman aged between 20 and 34, and drinking in public houses every evening and on Sunday. However, seasonal migration may also have an indirect positive income effect on violence leaving the overall net effect unclear.

Another plausible mechanism through which migration may influence crime propensity is the inflow of remittances and the transitory reduction of the Malthusian constraint. If poverty and need drove some of the migration flow, seasonal and commercial emigration also responded to other dynamics. Many migrants belonged to wealthier social groups, were well integrated in their local communities, and provided remittances to pay family taxes, local debts, and purchases of grains (Fontaine 2003; Maistre et al. 1992; Siddle 1997; Viazzo 1989). For instance, in Magland in the province of Faucigny, the three hundred seasonal migrants usually came back home with about £200 of profits per capita. That allowed the community, which grew only on third of the grains it consumed, to pay for the £37,000 of grains required to sustain a living. Similarly, in Sainte-Foy-Tarentaise, seasonal migrants earned £8,000 a year, which represented 60 per cent of the total cash inflow of the parish– one quarter of it was devoted to the purchase of grains (Table 2). Migrants from Nancy-sur-Cluses earned, on average, a net income of £100 in 1758 (Maistre and Maistre 1986: 16). In Ugine, a town of 2,000 inhabitants, annual remittances amounted to approximately £4,000 (Devos and Grosperrin 1985).[28]

A back-of-the-envelope calculation suggests that 25,000 seasonal migrants could have brought back to their parish as much as £2.5 million per year, which would have been enough to be buy 200,000 *coupes* of wheat or 300,000 *coupes* of rye. In 1789, the intendant of Genevois pointed out that four *coupes* of wheat were sufficient to feed an individual for a year, meaning that seasonal migration could have help to feed as many as 50,000 inhabitants– the total population of the duchy of Savoy was approximately 350,000 inhabitants in 1776 (Rousseau 1960: 46).[29] Migrants cash flow was used to cover other expenditures, such as state taxes, so that the overall effect on poverty reduction was likely smaller

3 Data

By 1749, there were six provinces in the duchy of Savoy, each corresponding to an independent judicial division, named the *judicature-mage*. My sample consists of offenders who committed at least one property crime and/or violent crime between spring 1749 and summer 1792 in one of these six provinces. I use year-on-year seasonal temperature variations at the level of provinces to identify the effect of adverse weather conditions on the likelihood of committing crimes. I digitised and geo-referenced the map drawn by Cary (1808: 17) to create a digital

[28] Verneilh-Puiraseau (1807: 394–6) reports a lower estimate of £25 to 30 per migrant.

[29] The *coupe* of Annecy is a unit of capacity for grains equal to 88.86 litres for wheat. See online Appendix B for a discussion on living standards during the 18th century. Arch. Dép. Haute-Savoie, 1 C 4 178, pièce 8, État comparatif des productions année commune tant en bled que menu bled, 1789.

Table 2 – Cash inflow and outflow in Sainte-Foy-Tarentaise, 1756

Sources of income		**Sources of expenditure**	
Migrants income	£8,000	State taxes	£6,865
Livestock sales	£3,500	Salt tax	£3,000
Cheese and butter sales	£800	Rye purchases	£2,120
Cloth sales	£130	Wine and other crops purchases	£1,000
Lace sales	£150		
Other textiles	£400		

Sources: Arch. mun. Sainte-Foy-Tarentaise, Réponse à l'intendant Agiono, État sur l'argent qui entre et sort annuellement, 1756.
Notes: State taxes include the *taille*, which was levied on people and their real estate; extraordinary taxes; and taxes on bridges and highways (*Ponts et chausées*).

vector data set that reproduces the administrative borders of Savoy during the 18th century. I use this data set to compute the average seasonal temperature anomalies in each province before matching them with crime data and data on seasonal migration rate. Table 3 reports descriptive statistics at the province level for the dependent and independent variables used in my empirical analysis. The respective data sources are discussed in the following sections.

Table 3 – Summary statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Pctl(75)	Max
Crime data							
Crime rate per 100,000	1,044	7.08	8.81	0	1.7	9.9	100
Violent crime rate per 100,000	1,044	3.77	6.17	0	0	5.5	73
Property crime rate per 100,000	1,044	3.31	5.07	-1	0	4.9	67
Weather data							
Temperarature anomalies	1,044	0.12	0.97	-3.49	-0.50	0.76	3.11
Precipitation anomalies	1,044	-0.47	2.15	-9.61	-1.68	0.64	9.87
Temperarature (°C)	1,044	5.88	5.96	-5.70	1.34	10.34	17.30
Precipitation (mm)	1,044	314	110	32	241	395	614
Grape harvest date	174	43	8	19	37.2	49	59
Socio-economic data							
Seasonal migration rate	6	0.090	0.046	0.036	0.059	0.121	0.155
Prices data							
Annecy wheat prices (ag/l)	76	0.68	0.17	0.42	0.55	0.81	1.16
Chambéry wheat prices (ag/l)	73	0.74	0.19	0.42	0.57	0.83	1.20
Annecy red wine prices (ag/l)	49	0.84	0.27	0.36	0.72	0.90	1.63
Population data							
Population in 1719	6	49,724	29,190	26,123	32,831	55,958	104,022
Population in 1758	6	49,070	24,449	28,124	32,182	59,109	91,443
Population in 1776	6	58,708	31,197	33,682	36,632	68,227	114,917
Population in 1793	6	66,770	39,207	37,863	39,757	80,556	136,650

Notes: Grape harvest date is expressed as the number of days after the 31 August.

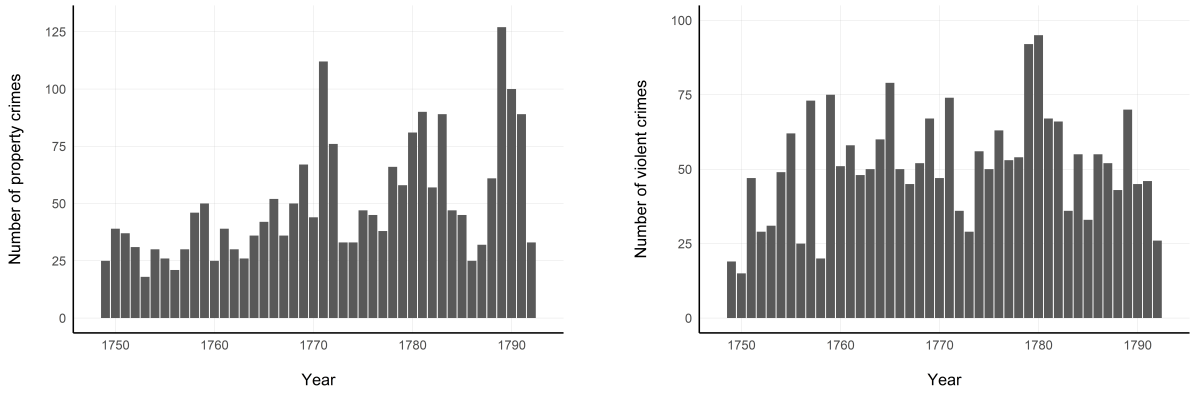
3.1 Crime data

The Savoyard judicial archives are constituted of approximately 36,000 criminal procedures spanning over the 16th, 17th and 18th centuries. Each criminal procedure includes the criminal

charge, the trial record and the judgement. A sample of 11,617 criminal procedures covering the three centuries has been created by local archivists.[30]

I use criminal procedures from this sample to assemble a data set gathering information on the location, the date of the event, the course of action, and the actors involved in any property crime and violent crime occurring between spring 1749 and summer 1792.[31] Property crimes include events such as burglary, larceny, highway robbery, and theft. Violent crimes include events like homicide, assault, insults, and threats.

Overall, I collect data from 2,169 procedures that involved 3,975 offenders. Violent crimes constitute 52 per cent of all reported crimes, which is consistent with previous estimate in historiography.[32] Additionally, I collect population data at the level of provinces for various years from archival sources and secondary literature and linearly interpolate for missing values.[33]



(a) Property crimes

(b) Violent crimes

Figure 1 – Number of crimes in Savoy, 1749–92

Sources: See Section 3.1.

[30] Arch. Dép. Savoie, B0, Procédures civiles et criminelles, directes ou en appel, 1559 à 1792. Arch. Dép., 2B, Procédures civiles et criminelles, appels et directes, (1424–1792). Before before being classified and referenced, criminal procedures were kept in undefined bags. The criminal procedures in the sample have been selected from a random sample of bags by the archivists, but there is no way to guarantee their representativeness. For a more detailed discussion of the representativeness of the sample, see Laly (2010: 910–2). For a detailed description of the judicial archives, see Claus (2013).

[31] Social status, city of birth and place of residence of the criminal are also sometimes included in the criminal records.

[32] Ruff (1984: xix) reports that, throughout the 18th century, violent crimes constituted 58 per cent of the total reported crime in the *Sénéchaussée* of Bazas and 52 per cent in the *Sénéchaussée* of Libourne. In Périgueux, 416 of the 976 affairs (42.6 per cent) brought before the local court between 1720 and 1790 were related to theft (Cameron 1981: 179). Guicheteau (2008: 340) analyses 381 criminal procedures from the *présidial* courts in Nantes between 1760 and 1790. 51.7 per cent of the prosecutions related to violent crimes. In Languedoc, property crimes represented between 51 and 58 per cent of the total reported crime during the second half of the 18th century (Castan 1977: 198). In Normandy, 53 per cent of the criminal procedures analysed by Gégot (1966: 105) dealt with property crimes.

[33] Population data for 1793 are from the Cassini website: http://cassini.ehess.fr/cassini/fr/html/index.htm. Population data for 1783 are from Rousseau (1960). Population data for 1719 are from Nicolas (1978: 12). Population data for 1776 and 1756–8 are from archival sources. Arch. Dép. Savoie, C 433, Récapitulation des Consignes du Sel des Provinces du Duché de Savoye pour L'année 1776. Arch. Dép. Savoie, C 434, Paralelle du denombrement des personnes, Bestiaux, et de la Taxe en Sel relative au denombrement.

For each province, I construct a measure of *Total crime* as the ratio of offenders in all criminal procedures per 100,000 inhabitants. Then, I disaggregate criminal procedures by type of criminal offences and create two additional variables: *Violent crime* and *Property crime*. Figures 1a and 1b present the distribution of property crimes and violent crimes over time. In both figures, annual variations are important and can be related to weather conditions discussed in Section 2.2. In general, the forms of theft varied in style and purpose, as did the scope of objects stolen. It included, among other things, money, food, animals, clothes, tissues and furniture. I make use of the information contained in the judicial records to create a sub-category of crime: *Theft of edible products*. It involves any event in which food was stolen. Judicial records, however, do not always state the exact object of theft and hence potential variations in the level of reporting means that this variable may not be exempt of bias. As a consequence, I only use this variable to supplement the baseline estimates, and suggest that increase in property crimes induced by weather shocks were partially driven by the need to survive.

One caveat of using criminal procedures to capture interpersonal conflict lies in their plausibly biased representativeness. For instance, one concern rises from the fact that changes in state capacity and the ability to enforce the law due to external events, such as wars and weather-induced income shocks, may have shifted the government's ability to carry judicial activity. From 1749 to 1792, the political situation was relatively stable, no foreign troops were stationed in the Savoyard territory, and Savoy was not involved in any war, which reduces the risk of bias due to political turmoil and violence against foreign soldiers. Besides, because criminal cases had predominance of civil cases, it is unlikely that capacity constraint influenced the number of judged cases (see Section 2.1. In addition, judicial spendings were only a tiny fraction of the state budget and studies on the functioning of the judicial system report no sign of exceeding the system's capacity during the 18th century (Briegel and Milbach 2013; Laly 2012). Figure D.5 in online Appendix D shows that the total number of crimes varied greatly from one year two another with spikes in 1771 and 1789, two years with notoriously extreme weather, reducing the concern that adverse events might have influenced the number of treated cases. Another concern is that, in early modern Europe, a proportion of crimes did not come before the courts, but were dealt on an infrajudicial level, either by arrangements or retribution (Garnot 2000; Ruff 1984). There is no reason, however, to believe that homicide, for instance, were reported less frequently in years with bad weather. A final concern is that changes in the nature of the judicial law and the functioning of judicial courts over time might have influenced the level of reporting. The short time span of my sample and the stabilisation of judicial practices during the first half of the 18th century nevertheless reduce this concern (Laly 2010).

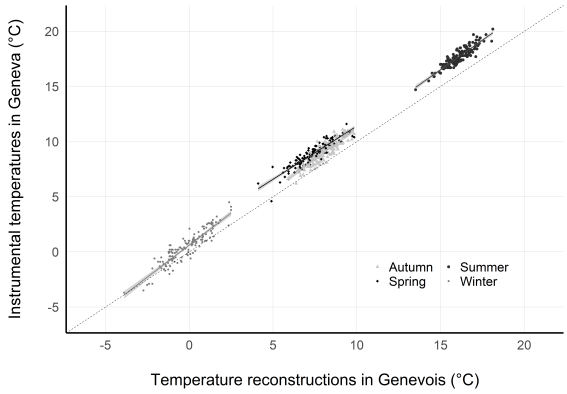
3.2 Weather data

The historical weather data are taken from the European Temperature and Seasonal Temperature and Precipitation (ESTPR) data set (Luterbacher et al. 2004; Pauling et al. 2006). These data provide European-wide seasonal temperatures and precipitation data at 0.5 $\times$

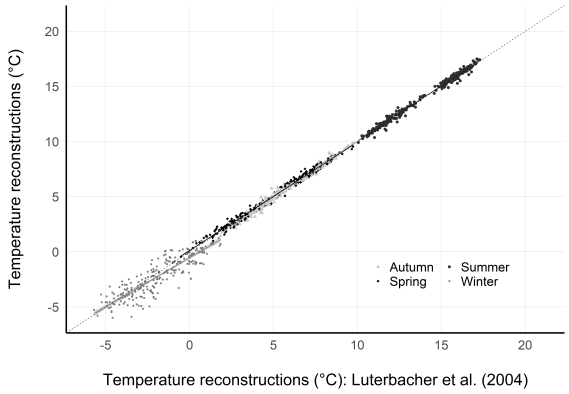
0.5 degree resolution.[34] Values are interpolated for each grid node from a number of homogenised instrumental data series, reconstructed sea-ice and temperature indices derived from documentary records, and some seasonal temperature reconstructions from ice cores and tree rings.[35] I use the map I digitised to aggregate these weather data to the province-season-year level. To do so, I weight each grid value that intersects a polygon (province) by its relative share in the total area of the given polygon. I then calculate the weighted mean seasonal temperature and precipitation for each set of province i, season s, and year t. Finally, I calculate the seasonal standardised temperature deviation from the long-term mean (1500–1600) for each of the six provinces:

$$Temperature_{ist} = \frac{T_{ist} - \overline{T}_{is}}{SD(\overline{T}_{is})}$$

where T_{ist} is the value of the seasonal temperature in province i during season s of year t. $\overline{T}_{is}$ is the long-term mean (1500–1600) of the seasonal temperature in province i, and $SD(\overline{T}_{is})$ is the standard deviation of the long-term mean of the seasonal temperature in province i.[36]



(a) Seasonal temperatures in the province of Genevois, 1760–1900



(b) Seasonal temperatures in Savoyard provinces, 1749–92

Sources: Temperature data in Geneva (Auer et al. 2007). Temperature reconstructions in the European Alps (Casty et al. 2005).

In comparison to instrumental weather data, interpolated data might be subject to measurement error and other biases. To assess the reliability of temperature reconstructions, I compare the ESTPR data set to three other set of temperature data. Figure 2a shows that there is a strong correlation between instrumental temperature data in Geneva and temperature

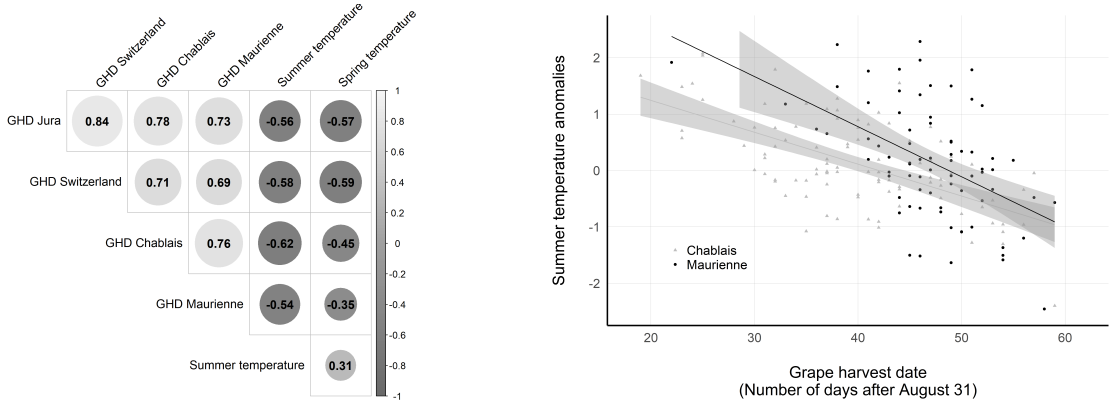
[34] Approximately 2,000 square kilometres at the latitude of Chambéry. The total land area of the duchy of Savoy was about 10,500 square kilometres in 1789.

[35] The ESTPR data set is the only paleoclimatological offering similar spatial and temporal coverage, and is widely used in the literature (Ashraf and Michalopoulos 2015; Grosfeld et al. 2020; Jedwab et al. 2019; Pei et al. 2013: e.g.). For instance, Chimani et al. (2013) provide newer estimates of temperature grid data for the Greater Alpine Region but cover 1780–2008.

[36] Online Appendix Figure D.9 and Figure D.10 respectively display the distribution of seasonal standardised temperature deviation and the distribution of seasonal standardised precipitation deviation between 1749 and 1789.

reconstructions in the neighbouring province of Genevois.[37] Second, I compare seasonal temperature data from the ESTPR data set with independent temperature reconstructions in the European Alps (Casty et al. 2005) and find a strong correlation rate between the two series (Figure 2b), which is consistent with broader comparison in the literature.[38]

I further compare temperature reconstructions to documentary records of grape harvest dates (GHD) in the provinces of Chablais and Maurienne (Nicolas 1978: 584–5; Tissot 1887: 320–2).[39] GHD are tightly related to spring and summer temperatures, and therefore provide a reliable proxy for reconstructing weather conditions in the past: on average, the variation of GHD is about 10 days for 1°C variation of the growing season temperature (Chuine et al. 2004; Etien et al. 2009; Le Roy Ladurie and Rousseau 2011; Meier et al. 2007). First, I compare Savoyard GHD with series from French Jura (Daux et al. 2012) and neighbouring Switzerland (Meier et al. 2007) to asses their reliability. These two regions are close to Savoy and subjected to similar weather patterns, so that GHD are expected to move together on an annual basis. Figure 3a reports the correlation matrix of these series and indicates that GHD series for Savoy are strongly correlated with series from Switzerland and French Jura. Savoyard GHD are thus reliable indicators of the summer temperature conditions during the 18th century. In Figure 3b, I show the scatter plot of my temperature variable derived from the ESTPR data set against the GHD: the higher the temperature anomalies, the warmer the temperature during the summer, and the earlier the harvest of grapes. Overall, these results suggest that temperature variables derived from paleoclimatological data are a reliable estimate of past weather conditions.



(a) Correlation matrix of GHD series, 1688–11794 (b) Temperatures and GHD in Savoy, 1688–1794

Sources: GHD in Jura (Daux et al. 2012), GHD in Switzerland (Meier et al. 2007), GHD in Chablais (Tissot 1887: 320–2), GHD in Maurienne (Nicolas 1978: 584–5).

I also construct two additional measures of weather shocks to capture only extreme events.

[37] I derive seasonal temperature data in Geneva between 1760 and 1900 from the HISTALP project (Auer et al. 2007): http://www.zamg.ac.at/histalp. The city of Geneva was not part of the Duchy of Savoy, but it was located 40 km north of Annecy, the head city of the province of Genevois. These data were not used in the reconstruction by Luterbacher et al. (2004).

[38] For instance, Casty et al. (2007: 795) use independently reconstructed gridded temperature data and find an overall 0.95 correlation rate with temperature data from Luterbacher et al. (2004).

[39] Nicolas uses vintage bans in Montmélian and its surroundings to build a series spanning 1713–90. Montmélian is a town located 15 kilometres south of Chambéry. Tissot reports GHD from 1688 to 1794 in Thonon-les-Bains in the province of Chablais.

I create a dummy variable, *Droughts*, equal one if the seasonal temperature deviation is at least one standard deviation larger than the long-term mean, and zero otherwise. Similarly, to capture extremely wet seasons during which floods were more likely, I create a dummy variable, *Floods*, equal one if the seasonal precipitation deviation is at least one standard deviation larger than the long-term mean, and zero otherwise.

3.3 Socio-economic data

Migration data. I collect data on the average rate of seasonal migration at the province level from Becchia et al. (2012). During the 18th century, the administration also carried out, for military purposes, enquiries regarding the number of males aged over 13 in every parish. A few of these documents (*consigne des mâles*) survived for the years 1726, 1758 and 1776. For each individual, they recorded information on the name, the age, the occupation, and the place of living (including if the individual was living abroad). Migration estimates are derived from these documents. These estimates are consistent with estimations from other sources including enquiries carried out by the administration to evaluate the magnitude of migration across several towns in Savoy (Depoisier 1858; Guichonnet 1945; Letonnelier 1920). A potential concern is that the level of seasonal migration varied from one year to another across provinces depending, among other things, on the local economic conditions. Historical evidence, however, show that seasonal migration patterns were quite stable over time.[40]

Prices data. I collect data on wheat prices in early October, right after the harvests, on the markets of Annecy and Chambéry to approximate annual changes in living standards (online Appendix Figure D.11).[41] In Table 4, I show the correlation between wheat prices and the standardised temperature deviation during summer in the province of Genevois and Savoie. Warmer temperature are positively correlated with higher wheat prices, supporting the idea that temperature shocks often resulted in negative transitory economic shocks that could, in turn, influence the incidence of crime.

Mehlum et al. (2006) argue that higher rye prices were concomitant with higher beer prices, leading to less alcohol consumption, and reducing the incidence of violent conflicts. Every year, in early December, the city council of Annecy would set the price of a jug of locally produced wine, based on information it gathered about the outcome of the grape harvest.[42] I collect these prices from the registers of deliberations of the city council of Annecy to investigate the effect of temperature shocks on the price of wine. Online Appendix Table E.11 reports the correlation between summer temperature shocks in the province of Genevois and the price of red wine in Annecy, and shows that warmer temperatures had a negative effect on the level of wine prices. This result is consistent with the fact that warmer temperatures foster

[40] I discuss this issue in more details in Section 4.2.

[41] Annecy: monthly average of wheat prices on the four markets of October. Arch. mun. Annecy, HH2, Mercuriales 1629–1789. Chambéry: wheat prices on 29 September (Saint-Michel). Arch. mun. Chambéry, 189E-Dépôt 1265 – 1294, Registre de la Grenette.

[42] Arch. mun. Annecy, BB 45 à 55, Registre des délibérations de la ville d'Annecy.

Table 4 – Temperature shocks and wheat prices in Savoy (1717–89)

	Log of wheat prices (ag/l)			
	(1)	(2)	(3)	(4)
Temperature	0.030	0.036	0.031	0.032
	(0.013)	(0.014)	(0.014)	(0.014)
	[0.020]	[0.009]	[0.023]	[0.020]
Temperature *t-1*			0.053	0.053
			(0.014)	(0.013)
			[0.0001]	[0.0001]
Province FE	No	No	No	Yes
Observations	149	149	149	149
R^2	0.043	0.060	0.172	0.198

Notes: OLS estimations. Robust standard errors and p-values are reported in parentheses and brackets, respectively.
The dependent variable is the log of wheat prices in grams of silver per litre in province *i* during after harvest time (Autumn) in year *t*. The data set covers the provinces of Genevois (1717–92) and Savoie (1717–89). The independent variable Temperature is the summer temperature deviation from the long-term seasonal mean (1500–1600) in province *i*, divided by its standard deviation. The other independant variables are defined accordingly. In columns 2 to 4, summer precipitation anomalies are included as control variables. Province FE is a set of province fixed effects.

the development of grape and positively affect wine grape harvests, as reflected by earlier GHD. However, the share of wine in the consumption basket was relatively small compared to crops, so that the overall effect of temperature shocks on living standards was likely negative.

4 Empirical strategy and results

4.1 Property crime and violent crime

I begin by examining whether changes in year-on-year seasonal temperature influence property crime rates and violent crime rates in Savoy from spring 1749 to spring 1792. I estimate a reduced-form model of the form:

$$Crime_{ist} = \beta_1 \, Temperature_{its} + \beta_2 \, Temperature_{ist} \times Migration_i + \delta_i + \delta_t + \epsilon_{ist} \tag{1}$$

where $Crime_{its}$ is the log of the *Total crime* rate in province i in season s in year t. Accordingly, *Property crime*, *Violent crime*, and *Theft of edible products* denote the log of the crime rate for each category of criminal offence.[43] $Temperature_{its}$ is the seasonal standardised temperature deviation from the long-term mean (1500–1600) in province i during season s in year t.[44] $Migration_i$ is (i) a dummy variable equal to one if the seasonal migration rate in province

[43] Crime rate is calculated as the ratio of offenders per 100,000 inhabitants (see Section 3.1).
[44] See Section 3.2.

i is higher than the mean migration rate in the duchy of Savoy, and zero otherwise; (ii) a continuous variables equal to the seasonal migration rate in province i. δ_i are province fixed effects that account for time-invariant province characteristics, such as altitude, land characteristics, and distance to markets. δ_t are year fixed effects, and account for time-variant characteristics that may affect all provinces at the same time. Standard errors are clustered at the provincial level. Because my data set includes only six provinces, I estimate the p-value of the coefficients of interest from the wild cluster bootstrap-t procedure (Cameron et al. 2008). The β_1-coefficient captures the effect of temperature shocks on the incidence of crimes. The β_2-coefficient indicates the differential effect between provinces with high migration rates, and provinces with low rates.

Table 5 – Temperature shocks and crime rates in Savoy (1749–92)

	Total crimes	Violent crimes	Property crimes
	(1)	(2)	(3)
Temperature	−0.020	−0.087	0.068
	(0.052)	(0.039)	(0.039)
	[0.708]	[0.028]	[0.078]
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In column 1, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In columns 2 to 3, the dependent variables are defined accordingly for violent crimes and property crimes. The independent variable Temperature is the seasonal temperature deviation from the long-term seasonal mean (1500–1600) in province i, divided by its standard deviation. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

To identify the effect of temperature shocks on crime rates, I begin by estimating Equation 1 without the interaction term. Table 5 reports the main results. In column 1, I report the estimate from pooling together all crime categories in a single category, *Total crime*. The estimated coefficient is statistically non-significant, which is not surprising given that theory suggests that temperature shocks may have opposite effect on the violent crimes rates and property crimes rates. Column 2 reports the coefficient of the effect of *Temperature* on violent crimes rates. The coefficient is negative and statistically significant, indicating that there were significantly less violent crimes during economic downturns. Previous empirical studies suggest that transitory poverty shocks temporarily reduced the level of alcohol consumption, which in turn reduces the frequency of violent crimes (Bignon et al. 2017: 37; Traxler and

Burhop 2010: 11–3). In Section 3.3, I showed that warmer temperature was correlated with lower wine prices and resulted into a positive income effect. However, warmer temperature was also correlated with higher wheat prices leading individuals to spend a higher share of their total income on staple crops rather than alcohol consumption (substitution effect). Besides, the increases in crop prices affected all members of the household, whereas the decline in wine prices affected at most two members of the household. That means that the welfare gain (income effect) was likely to be smaller than the welfare loss (substitution effect) induced by increases in crop prices. Overall, the reduced-form effect of temperature shocks on violent crimes was negative in 18th-century Savoy.[45] Results presented in column 3 suggest that warmer temperature had a positive and statistically significant effect on property crimes rates. A one standard deviation increase in temperature increased the incidence of property crimes by 6.9%.[46] Adverse weather conditions reduced prospects of the next harvest and increased pressure on current prices. This in turn created situation of economic stress for more vulnerable individuals.[47] This is consistent with the fact that weather-induced economic shocks were a source of economic deprivation that led some individuals to commit crimes to survive (Bignon et al. 2017; Mehlum et al. 2006).

Robustness checks. In this subsection, I present a variety of robustness exercises that support the interpretation of my findings. For instance, it is possible that moderate levels of weather fluctuations have had the strongest effects on crime rates because they did not trigger public assistance scheme from the local and state authorities (see online Appendix C). In online Appendix Table E.12, I test for non-linear effects of temperatures on crimes by adding a quadratic term, but I don't find any evidence of an inverted U-shaped relationship. Results are also robust to the inclusion of precipitation (columns 2, 4, and 6) and to different definitions of temperature shocks (online Appendix Table E.13). Additionally, I restrict my attention to most extreme events– *Droughts* and *Floods*. Online Appendix Table E.16 reports the estimated effects of seasonal *Droughts* and seasonal *Floods* on violent crime and property crime rates. The signs of the coefficient estimates are in line with my baseline estimates. However, magnitudes are larger suggesting that more extreme weather shocks had stronger negative impact on local economic conditions leaving more households in situation of economic stress.

In online Appendix Table E.14, I further refine the *Temperature* variable by attributing more weight to cells that have higher agricultural suitability. Shocks that affect areas with better agriculture potential may be more detrimental to the local population than shocks occurring in areas less suitable for agriculture.[48] Results remain stable across all specifications. Online

[45] It should be noted, however, that the worst shocks, i.e. those associated with famine, could result in an increase in violent crime (e.g. Alfani 2011: 30–1). This result is not in line with temperature-aggression hypothesis. However, the low temporal granularity of the temperature data prevents to infer any conclusion regarding the validity of this hypothesis.

[46] Blakeslee and Fishman (2018: 765–7) find an effect of similar magnitude in contemporary India.

[47] For more details about this mechanism, see Labrousse (1933), Goubert (1960), and Nicolas (1978).

[48] To do so, I use the Crop suitability index (value) estimated for intermediate input level rain-fed wheat from the Global Agro-Ecological Zoning (GAEZ).

Appendix Table E.15 reports the estimates from Equation 1 when seasonal lags are added as independent variables. Past climatic conditions have no significant impact on violent crime rates and property crime rates.[49] Finally, I re-estimate Equation 1 using gridded seasonal temperature data from Casty et al. (2005). Results are qualitatively similar to those obtained in the baseline specification, even though the estimated effect of temperature on crime rates is stronger.

4.2 The role of seasonal migration

Was seasonal migration an efficient buffer against weather shocks? In Section 2.3, I provide historical evidence to argue that seasonal migration could contribute to the mitigation of weather shocks through two channels: remittances and reduction of the Malthusian constraints. To investigate this question, I analyse whether temperature shocks affect crime rates differentially in provinces in which average seasonal migration rate was high (Equation 1).

Table 6 reports the coefficient estimates when $Migration_i$ is defined as a dummy variable. In Section 2.3, I provide narrative evidence to show that remittances derived from migrant labour made the former provinces relatively better-off. In column 3, the coefficient associated with the interaction term between temperature and the dummy variable that indicates whether seasonal migration is structurally high in the province is negative and statistically significant. The magnitude of the effect of seasonal migration is substantial, since it completely offset the negative effect of temperature shocks on property crime rates. According to the estimates presented in column 3 of Table 6, seasonal migration was an efficient coping strategies to reduce the size of weather-induced income shocks.[50] The back-of-the-envelope calculation in Section 2.3 suggests that migrants cash inflow could help to sustain a significant share of the population, in particular because this inflow ended up in provinces with high migration rates.

It is, however, impossible to identify the exact underlying mechanism. The effect may be driven by the fact that provinces with higher seasonal migration rate benefited from cash inflow, faced temporarily lower population pressure or were temporarily discharged from some of its most criminogenic population, young able-bodied men who constituted the bulk of criminals in the 18th-century Europe (Lecoutre 2010; Ruff 1984). If the reduction in property crime rates in province with high seasonal migration rate was driven by the departure of migrants, the share of young men among offenders during the winter time should have been lower than during the rest of the year. Online Appendix Figure D.7 presents the age distribution of offenders involved in property all year around and during winter– when

[49] In column 6, the coefficient for *Temperature* is positive but non-significant at the conventional level. Interestingly, the coefficient of *Temperature s-2* is negative, though not statistically significant, suggesting that temperature shocks that occurred half a year earlier had a negative impact on the current level of property crimes. One plausible explanation is that if province successively experienced adverse weather conditions, local and state authorities were able to intervene and provide sufficient relief to mitigate the negative effect of temperature shocks, reducing the expected benefit derived from perpetrating crime against property and thus making it unnecessary (see online Appendix C).

[50] In Online Appendix Table E.18, I document that this finding holds when using the seasonal migration rate in province *i* instead of a dummy.

Table 6 – The effect of seasonal migration: Intensive margins

	Total crimes	Violent crimes	Property crimes
	(1)	(2)	(3)
Temperature	0.045	−0.044	0.115
	(0.029)	(0.026)	(0.024)
	[0.118]	[0.086]	[0.00001]
Temperature × Migration	−0.198	−0.129	−0.143
	(0.034)	(0.057)	(0.045)
	[0.000]	[0.024]	[0.002]
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In column 1, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In columns 2 to 3, the dependent variables are defined accordingly for violent crimes and property crimes. The independent variable Temperature is the seasonal temperature deviation from the long-term seasonal mean (1500–1600) in province i, divided by its standard deviation. Migration is a dummy variable equal to one if the average seasonal migration rate in province i is above the Savoyard mean, and zero otherwise. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

seasonal migrants are absent. In both cases, age group 21-35 represented 61 per cent of the offenders, excluding the possibility that the mitigation effect of seasonal migration is driven by a composition effect.

Table 7 – Mitigation of physical violence against persons

	Physical violence against persons		
	(1)	(2)	(3)
Temperature	−0.067	−0.034	0.011
	(0.040)	(0.021)	(0.047)
	[0.099]	[0.106]	[0.823]
Temperature		−0.099	
× Migration dummy		(0.064)	
		[0.125]	
Temperature			−0.009
× Migration rate			(0.007)
			[0.205]
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
The dependent variable is the log of total number of physical violence against persons (exlcuding homicide) per 100,000 inhabitants in province i during season s in year t. The independent variable Temperature is the seasonal temperature deviation from the long-term seasonal mean (1500–1600) in province i, divided by its standard deviation. Migration intensive is a dummy variable equal to one if the average seasonal migration rate in province i is above the Savoyard mean, and zero otherwise. Migration extensive is a continuous variable equal to the rate of seasonal migration in province i. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

If as suggested in previous empirical studies, the decline in violent crimes is driven by a relative decline in purchasing power, then one should expect the coefficient *Temperature* × *Migration* to be positive in column 2 of Table 6. That it is negative indicates that the effect of welfare gains linked to seasonal migration was smaller than the effect of a temporary reduction in the criminogenic population. Online Appendix Table 7 reports the effect of temperature shocks and migration on a subset of violent crimes: physical violences committed against individuals but excluding homicide. The results are in line with the previous findings and suggest that seasonal migration had no positive effect on the level of violence.

In Table 8, I present estimates of the effect of temperature shocks on the rate of property crimes that involved the theft of edible products. This specific type of property crime can be more directly related to hunger, and may, in turn, provide additional evidence on the underlying mechanism at stake in the relationship described above. Columns 1 reports the result from estimating Equation 1 without the interaction term. Columns 2 and 3 report estimated coefficients when seasonal migration is respectively defined as a dummy variable

Table 8 – The effect of seasonal migration: thefts of edible products

	Thefts of edible products		
	(1)	(2)	(3)
Temperature	0.034	0.056	0.098
	(0.019)	(0.019)	(0.027)
	[0.067]	[0.004]	[0.0004]
Temperature		−0.066	
× Migration dummy		(0.019)	
		[0.001]	
Temperature			−0.007
× Migration rate			(0.002)
			[0.0001]
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
The dependent variable is the log of total number of thefts of edible products per 100,000 inhabitants in province i during season s in year t. The independent variable Temperature is the seasonal temperature deviation from the long-term seasonal mean (1500–1600) in province i, divided by its standard deviation. Migration intensive is a dummy variable equal to one if the average seasonal migration rate in province i is above the Savoyard mean, and zero otherwise. Migration extensive is a continuous variable equal to the rate of seasonal migration in province i. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

and a continuous. In all columns, the coefficient on *Temperature* is positive and statistically significant, suggesting that temperature shocks had strong impact on the level of property crimes rates that involved the theft of edible products. This result confirms the idea that economic deprivation was one of the main factors behind the increase of property crime rates, when provinces were subjected to adverse weather conditions. Coefficient associated with the interaction term in columns 2 and 3 yields results that are qualitatively similar to my baseline findings (Table 6). In provinces with higher shares of migrant labour, seasonal migration allowed for an inflow of remittances as well as a temporary escape from the Malthusian pressure, significantly improving the life of individuals who did not migrate, and providing them with better capabilities to cope with transitory economic shocks. This may, in turn, decreased the necessity of stealing to survive. Given the limitations behind the construction of the variable on the theft of edible products (see Section 3.3), this evidence is merely suggestive, but in line with previous empirical evidence in the literature (Axbard 2016; Bignon et al. 2017).

The level of seasonal migration varied from one year to another across provinces depending, among other things, on the local economic conditions. One concern is that using the average rate of migration at the provincial level may fail to capture changes in the intensity of migration and/or changes in the geographical pattern of migrations. If the migration rate was higher than the average during economic downturns, then its potential mitigating effect on crime rates may be over-estimated. Conversely, its effect could be under-estimated during non-crisis year, leaving the overall direction of the bias undetermined. Another concern is that the relative importance of migration across provinces changes over time due to variations in the timing of exposure to strong weather shocks. Two factors assuage the concern described above. First, the most important weather shocks were of regional, if not continental, dimension during the second half of the 18th century. That means, in turn, that all provinces were badly affected at the same time by the worst weather shocks in the early 1770s and in the 1780s. Second, historians have shown that the pattern of seasonal migration is highly persistent over time because it required structured (village) networks and some sorts of specialised knowledge (Bruchet 1897; Guichonnet 1945; Letonnelier 1920; Siddle 1997). Migrants from one village often migrated to the same area every year and specialised in one of the following occupations: mason, charcoal burner, pedlar, or agricultural worker. Therefore, it is unlikely that a negative transitory shock completely shook up the structural differences across provinces in seasonal migration movements.

5 Conclusion

Research questions raised in this article were motivated by a recent trend in the literature that has consistently demonstrated the existence of a significant relationship between weather variations, economic shocks, and interpersonal conflicts. I link temperature data with economic variables and crime data to examine the effect of temperature shocks in the context of early modern Savoy. I investigate the role of seasonal migration, and try to ascertain whether it was effective in alleviating the effect of negative economic shocks. Overall, I show

that temperature shocks had a positive and significant effect on property crimes rates and a negative impact on violent crimes rates. Previous findings in the literature also suggest that there is a positive relationship between alcohol consumption and violence. I show that temperature shocks were associated with lower wine prices in the province of Genevois, but the net welfare effect of temperature shocks was negative given the relative share of crops in the household consumption basket. Additionally, I provide qualitative and quantitative evidence suggesting that seasonal migration weakened the link between temperature shocks and property crimes. Together with poor relief and state interventions, seasonal migration helped local communities to build higher resilience against weather shocks and sustain population growth during the 18th century.

Disclosure statement

The author declares that he has no relevant or material financial interests that relate to the research described in the article.

Acknowledgements

I thank my advisors Mathieu Couttenier and Michael Huberman for their continued guidance and support. I am grateful to Guido Alfani, Maleke Fourati, Roberto Galbiati, James Fenske, Luigi Lorenzetti, Jérémy Luchetti, Kostadis Papaioannou, Mathias Thoenig, and Ulrich Woitek as well as participants of the AGRICLIOMETRICS III, EHES 2017 meetings, and seminar audiences at the University of Geneva, University of Montreal, and University of Oxford for helpful comments and suggestions.

Funding sources

This work was supported by the University of Geneva, the University of Zurich, and the Swiss National Science Foundation (grant number: P1GEP1_161588).

References

Alfani, Guido. 2011. "The Famine of the 1590s in Northern Italy. An Analysis of the Greatest "System Shock" of Sixteenth Century". *Histoire & Mesure* 36 (1): 17–50. doi:10 . 4000 / histoiremesure.4119.

Arvantes, Thomas M., and Robert H. Defina. 2006. "Business Cycles and Street Crime". *Criminology* 44 (1): 139–164. doi:10.1111/j.1745-9125.2006.00045.x.

Ashraf, Quamrul, and Stelios Michalopoulos. 2015. "Climatic Fluctuations and the Diffusion of Agriculture". *The Review of Economics and Statistics* 97 (3): 589–609. doi:10.1162/REST_a_00461.

Auer, Ingeborg, Reinhard Böhm, Anita Jurkovic, Wolfgang Lipa, and Alexander Orlik. 2007. "HISTALP–historical instrumental climatological surface time series of the greater Alpine region 1760—2003". *International Journal of Climatology* 27 (1): 17–46. doi:10.1002/joc.1377.

Axbard, Sebastian. 2016. "Income Opportunities and Sea Piracy in Indonesia: Evidence from Satellite Data". *American Economic Journal: Applied Economics* 8 (2): 154–94. doi:10.1257/app.20140404.

Becchia, Alain, Fabrice Delrieux, Émilie-Anne Pépy, Hervé Laly, Frédéric Meyer, and Bruno Gachet. 2012. *Atlas historique et statistique de la Savoie au XVIII^{e} siècle*. 222. Chambéry: Université de Savoie.

Becker, Gary S. 1968. "Crime and Punishment: An Economic Approach". *Journal of Political Economy* 76 (2): 169–217. doi:10.1086/259394.

Bell, Brian, Anna Bindler, and Stephen Machin. 2018. "Crime Scars: Recessions and the Making of Career Criminals". *The Review of Economics and Statistics* 100 (3): 392–404. doi:10.1162/rest_a_00698.

Bignon, Vincent, Eve Caroli, and Roberto Galbiati. 2017. "Stealing to Survive? Crime and Income Shocks in Nineteenth Century France". *The Economic Journal* 127 (599): 19–49. doi:10.1111/ecoj.12270.

Bigot de Sainte Croix, Louis-Claude. 1877. "Mémoires historiques sur la maison royale de Savoie et les États du roi de Sardaigne". In *Miscellanea di storia italiana. Tome XVI*, 1–106. Torino: Fratelli Bocca Librari Di S. M.

Blakeslee, David S., and Ram Fishman. 2018. "Weather Shocks, Agriculture, and Crime Evidence from India". *Journal of Human Resources* 53 (3): 750–782. doi:10.3368/jhr.53.3.0715-7234R1.

Blanchard, Marcel. 1937. "Textes relatifs à l'économie savoyarde (XVII^{e}–XVIII^{e} siècles)". *Revue de géographie alpine* 25 (1): 211–223. doi:10.3406/rga.1937.3968.

Bouverat, Dominique. 2013. "Villes et bourgs en Savoie de la Réforme à la Révolution". PhD Thesis, Université Lyon 2.

Brennan, Thomas Edward. 1988. *Public Drinking and Popular Culture in Eighteenth-Century Paris*. 334. Princeton: Princeton University Press.

Briegel, Françoise, and Sylvain Milbach, eds. 2013. *Le Sénat de Savoie : archives, historiographies, perspectives (XVI^{e}–XIX^{e} siècles)*. 252. Chambéry: Université de Savoie.

Bruchet, Max. 1897. "L'émigration des Savoyards originaires du Faucigny au XVIII^{e} siècle". *Bulletin historique et philologique du Comité des Travaux Historiques et Scientifiques* Année 1896:815–832.

Brunt, Liam. 2004. "Nature or Nurture? Explaining English Wheat Yields in the Industrial Revolution, c. 1770". *The Journal of Economic History* 64 (1): 193–225. doi:10 . 1017 / S0022050704002657.

Cameron, A. Colin, Jonah B. Gelbach, and Douglas L. Miller. 2008. "Bootstrap-Based Improvements for Inference with Clustered Errors". *The Review of Economics and Statistics* 90 (3): 414–427. doi:10.1162/rest.90.3.414.

Cameron, Iain A. 1981. *Crime and Repression in the Auvergne and the Guyenne, 1720–1790*. 283. Cambridge: Cambridge University Press. doi:10.1017/CBO9780511896163.

Cary, John. 1808. *Cary's New Universal Atlas, Containing Distinct Maps of all the Principal States and Kingdoms Throughout the World, from the Latest and Best Authorities Extant*. London: Printed for J. Cary.

Castan, Nicole. 1977. "Délinquance traditionnelle et répression critique à la fin de l'Ancien Régime dans les pays de Languedoc". *Annales historiques de la Révolution française* 16 (2): 182–203.

Casty, Carlo, Christoph C. Raible, Thomas F. Stocker, Heinz Wanner, and Jürg Luterbacher. 2007. "A European Pattern Climatology 1766—2000". *Climate Dynamics volume* 29:791–805. doi:s00382-007-0257-6.

Casty, Carlo, Heinz Wanner, Jürg Luterbacher, Jan Esper, and Böhm Reinhard. 2005. "Temperature and Precipitation Variability in the European Alps since 1500". *International Journal of Climatology* 30:1855–1880. doi:10.1002/joc.1216.

Chimani, Barbara, Christoph Matulla, Reinhard Böhm, and Michael Hofstätter. 2013. "A New High Resolution Absolute Temperature Grid for the Greater Alpine Region Back to 1780". *International Journal of Climatology* 33 (9): 2129–2141. doi:10.1002/joc.3574.

Chuine, Isabelle, Pascal Yiou, Nicolas Viovy, Bernard Seguin, Valérie Daux, and Emmanuel Le Roy Ladurie. 2004. "Historical Phenology: Grape Ripening as a Past Climate Indicator". *Nature* 432 (7015): 289–290. doi:10.1038/432289a.

Claus, Sylvie. 2013. "Le Sénat : une histoire d'archives". In Briegel and Milbach 2013, 11–48.

Collomb, Gérard. 1977. "Techniques agricoles en zone de montagne. L'exemple du Beaufortin (Savoie)". *Ethnologie française* 7 (4): 319–344.

Costa de Beauregard, Alexis. 1774. *Essai sur l'amélioration de l'agriculture dans les pays montueux et en particulier dans la Savoye*. 288. Chambéry: Imprimerie M. F. Gorrin.

Crook, D. S., D. J. Siddle, J. A. Dearing, and R. Thompson. 2004. "Human Impact on the Environment in the Annecy Petit Lac Catchment, Haute-Savoie: a Documentary Approach". *Environment and History* 10:247–284. doi:10.3197/0967340041794312.

Daquin, Joseph. 1787. *Topographie médicale de la ville de Chambéry et de ses environs*. 152. Chambéry: Imprimerie M. F. Gorrin.

Daux, Valérie, Iñaki Garcia de Cortazar-Atauri, Pascal Yiou, I. Chuine, E. Garnier, E. Le Roy Ladurie, O. Mestre, and J. Tardaguila. 2012. "An Open-access Database of Grape Harvest Dates for Climate Research: Data Description and Quality Assessment". *Climate of the Past* 8 (5): 1403–1418. doi:10.5194/cp-8-1403-2012.

Depoisier, Joseph. 1858. "Étude statistique sur les émigrations de la Savoie depuis 1783 jusqu'en 1847". *L'Investigateur : Journal de l'Institut historique* 3:33–64.

Devos, Roger, and Bernard Grosperrin. 1985. *La Savoie de la Réforme à la Révolution française*. 568. Rennes: Ouest France.

Dix-Carneiro, Rafael, Rodrigo R. Soares, and Gabriel Ulyssea. 2018. "Economic Shocks and Crime: Evidence from the Brazilian Trade Liberalization". *American Economic Journal: Applied Economics* 10 (4): 158–1950. doi:10.1257/app.20170080.

Draca, Mirko, Theodore Koutmeridis, and Stephen Machin. 2013. "The Changing Returns to Crime: Do Criminals Respond to Prices?" *The Review of Economic Studies* 86 (3): 1228–1257. doi:10.1093/restud/rdy004.

Dullin, Ferdinand. 1915. "Étude historique sur la judicature mage et le Tribunal de Saint-Julien (Haute-Savoie)". *Mémoires de l'Académie des sciences, belles-lettres et arts de Savoie* 5 (3): 1–98.

Dupâquier, Jacques. 1988. *Histoire de la population française. De la Renaissance à 1789*. 601. Paris: Presses Universitaires de France.

Esmonin, Edmond. 1960. "Les intendants de Savoie au XVIII^{e} siècle". In *Actes du 85^{e} Congrès national des sociétés savantes, Chambéry-Annecy, 1960*, 7–34. Paris: Comité des Travaux Historiques et Scientifiques, Imprimerie Nationale.

Etien, N., V. Daux, V. Masson-Delmotte, O. Mestre, M. Stievenard, M. T. Guillemin, T. Boettger, N. Breda, M. Haupt, and P. P. Perraud. 2009. "Summer Maximum Temperature in Northern France over the past Century: Instrumental Data versus Multiple Proxies (Tree-ring Isotopes, Grape Harvest Dates and Forest Fires)". *Climatic Change* 94 (3-4): 429–456. doi:10.1007/s10584-008-9516-.

Falco, Chiara, Franco Donzelli, and Alessandro Olper. 2018. "Climate Change, Agriculture and Migration: A Survey". *Sustainability* 10 (5): 1405. doi:10.3390/su10051405.

Feng, Shuaizhang, Alan B. Krueger, and Michael Oppenheimer. 2010. "Linkages among Climate Change, Crop Yields and Mexico–US Cross-Border Migration". *Proceedings of the National Academy of Sciences* 107 (32): 14257–14262. doi:10.1073/pnas.1002632107.

Ferrand, Félix. 1979. "Les débuts de la pomme de terre en Savoie-Propre et sur ses confins dauphinois". In *Vie quotidienne en Savoie : Actes du XXVI^{e} Congrès des sociétés savantes de Savoie, Conflans, 1976*, 33–45. Annecy: Académie Salésienne.

Fontaine, Laurence. 1998. "Migration and Work in the Alps (17th-18th Centuries): Family Strategies, Kinship, and Clientelism". *The history of the Family* 3 (3): 351–369. doi:10.1016/S1081-602X(99)80251-6.

— . 2003. *Pouvoir, identités et migrations dans les hautes vallées des Alpes Occidentales (XVII^{e}–XVIII^{e} siècle)*. 248. Grenoble: Presses Universitaires de Grenoble.

Franck, Raphël, and Oded Galord. 2017. *Technology-Skill Complementarity in Early Phases of Industrialization*. Working Paper No 23197. National Bureau of Economic Research. doi:10.3386/w23197.

Freedman, Matthew, Emily Owens, and Sarah Bohn. 2018. "Immigration, Employment Opportunities, and Criminal Behavior". *American Economic Journal: Economic Policy* 10 (2): 117–51. doi:10.1257/pol.20150165.

Garnot, Benoît. 2000. "Justice, infrajustice, parajustice et extrajustice dans la France d'Ancien Régime". *Crime, Histoire & Sociétés / Crime, History & Societies* 4 (1): 103–120. doi:10.4000/chs.855.

Gégot, Jean-Claude. 1966. "Étude par sondage de la criminalité dans le bailliage de Falaise (XVII^{e}–XVIII^{e} siècle)[Criminalité diffuse ou société criminelle ?]" *Annales de Normandie* 16 (2): 103–164. doi:10.3406/annor.1962.4517.

Gex, François. 1943. "La vigne dans la Combe de Savoie". *Revue de géographie alpine* 31 (4): 443–512. doi:10.3406/rga.1943.4392.

Goubert, Pierre. 1960. *Beauvais et le Beauvaisis de 1600 à 1730 : Contribution à l'histoire sociale de la France du XVII^{e} siècle*. 778. Paris: S.E.V.P.E.N.

Greenshields, Malcolm R. 1994. *An Economy of Violence in Early Modern France: Crime and Justice in the Haute Auvergne, 1587–1664*. 262. University Park, Pennsylvania: Pennsylvania State University Press.

Grillet, Jean-Louis. 1807. *Dictionnaire historique, littéraire et statistique des départements du Mont-Blanc et du Léman*. 466. Chambéry: J. F. Puthod.

Grosfeld, Irena, Seyhun Orcan Sakalli, and Ekaterina Zhuravskaya. 2020. "Middleman Minorities and Ethnic Violence: Anti-Jewish Pogroms in the Russian Empire". *The Review of Economic Studies* 87 (1): 289–342. doi:10.1093/restud/rdz001.

Guicheteau, Samuel. 2008. *La Révolution des ouvriers nantais : mutation économique, identité sociale et dynamique révolutionnaire (1740–1815)*. 376. Rennes: Presses Universitaires de Rennes.

Guichonnet, Paul. 1945. "L'émigration saisonnière en Faucigny pendant la première moitié du XIX^{e} siècle (1783–1860)". *Revue de géographie alpine* 33 (3): 465–534. doi:10.3406/rga.1945.5192.

— . 1955. "Le cadastre savoyard de 1738 et son utilisation pour les recherches d'histoire et de géographie sociales". *Revue de géographie alpine* 43 (2): 255–298. doi:10.3406/rga.1955.1175.

— . 1969. "Biens communaux et partages révolutionnaires dans l'ancien département du Léman". *Études rurales* 36:7–36. doi:10.3406/rural.1969.1476.

Harp, Ryan D., and kristohpher B. Karnauskas. 2018. "The Influence of Interannual Climate Variability on Regional Violent Crime Rates in the United States". *GeoHealth* 11 (2): 356–369. doi:10.1029/2018GH000152.

Jedwab, Remi, Mark Koyama, and Noel D. Johnson. 2019. *Pandemics, Places, and Populations: Evidence from the Black Death*. Discussion Paper DP13523. Centre for Economic Policy Research.

Jha, Chandan Kumar, Vijaya Gupta, Utpal Chattopadhyay, and Binilkumar Amarayil Sreeraman. 2018. "Migration as Adaptation Strategy to Cope with Climate Change: A Study of Farmers' Migration in Rural India". *International Journal of Climate Change Strategies and Management* 10 (1): 121–141. doi:10.1108/IJCCSM-03-2017-0059.

Jia, Ruixue. 2014. "Weather Shocks, Sweet Potatoes and Peasant Revolts in Historical China". *The Economic Journal* 124 (575): 92–118. doi:10.1111/ecoj.12037.

Kubik, Zaneta, and Mathilde Maurel. 2016. "Weather Shocks, Agricultural Production and Migration: Evidence from Tanzania". *The Journal of Development Studies* 52 (5): 665–680. doi:10.1080/00220388.2015.1107049.

Labrousse, Ernest. 1933. *Esquisse du mouvement des prix et des revenus en France au XVIII^{e} siècle*. 306. Paris: Dalloz.

Laly, Hervé. 2010. "De la conciliation à la répression : la politique criminelle du Sénat de Savoie aux XVI^{e} et XVII^{e} siècles". *Revue historique* 312 (4): 909–932. doi:10.3917/rhis.104.0909.

— . 2012. *Crime et justice en Savoie (1559–1750). L'élaboration du pacte social*. 350. Rennes: Presses Universitaires de Rennes.

— . 2013. In Briegel and Milbach 2013, chap. Le Sénat de Savoie au XVIII^{e} siècle : une histoire politique.

Le Roy Ladurie, Emmanuel. 2006. *Histoire humaine et comparée du climat. Disettes et révolutions (1740–1860)*. 611. Paris: Fayard.

Le Roy Ladurie, Emmanuel, and Daniel Rousseau. 2011. "Histoire vendémiologique et climatologie historique". *Revue historique* 1 (657): 53–60. doi:10.3917/rhis.111.0053.

Lecoutre, Matthieu. 2010. "Ivresse et ivrognerie dans la France moderne (XVI^{ème}–XVIII^{ème} siècles)". PhD Thesis, Université de Bourgogne.

Letonnelier, Gaston. 1920. "L'émigration des Savoyards". *Revue de géographie alpine* 8 (4): 541–584. doi:10.3406/rga.1920.2809.

Lorenzetti, Luigi. 2003. "Economic Opening and Society Endogamy: Migratory and Reproduction Logic in the Insubric Mountains (18th and 19th centuries)". *The History of the Family* 8 (2): 297–316. doi:10.1016/S1081-602X(03)00030-7.

Lucassen, Jan. 1987. *Migrant Labour in Europe, 1600–1900: The Drift to the North Sea*. 340. Lunen: Routledge.

Luterbacher, Jürg, Daniel Dietrich, Elena Xoplaki, Martin Grosjean, and Heinz Wanner. 2004. "European Seasonal and Annual Temperature Variability, Trends, and Extremes since 1500". *Science* 303 (5663): 1499–1503. doi:10.1126/science.1093877.

Maistre, Chantal, and Gilbert Maistre. 1986. *L'émigration marchande savoyarde aux XVIIe et XVIIIe siècles : l'exemple de Nancy-sur-Cluses*. 311. Annecy: Académie Salésienne.

Maistre, Chantal, Gilbert Maistre, and Georges Heitz. 1992. *Colporteurs et marchands savoyards dans l'Europe des XVII^{e} et XVIII^{e} siècle*. 264. Annecy: Académie Salésienne.

Marchiori, Luca, Jean-François Maystadt, and Ingmar Schumacher. 2012. "The Impact of Weather Anomalies on Migration in Sub-Saharan Africa". *Journal of Environmental Economics and Management* 63 (3): 355–374. doi:10.1016/j.jeem.2012.02.001.

Mares, Dennis. 2013. "Climate Change and Levels of Violence in Socially Disadvantaged Neighborhood Groups". *Journal of Urban Health* 90:768–783. doi:10.1007/s11524-013-9791-1.

Mathieu, Jon. 2009. *History of the Alps, 1500–1900: Environment, Development, and Society*. 260. Morgantown: West Virginia University Press.

Mehlum, Halvor, Edward Miguel, and Ragnar Torvik. 2006. "Poverty and Crime in 19th Ccentury Germany". *Journal of Urban Economics* 59 (3): 370–388. doi:10.1016/j.jue.2005.09.007.

Meier, Nicole, Christian Pfister, Heinz Wanner, and Jürg Luterbacher. 2007. "Grape Harvest Dates as a Proxy for Swiss April to August Temperature Reconstructions Back to AD 1480". *Geophysical Research Letters* 34 (20). doi:10.1029/2007GL031381.

Miles-Novelo, Andreas, and Craig A. Anderson. 2019. "Climate Change and Psychology: Effects of Rapid Global Warming on Violence and Aggression". *Current Climate Change Reports* 5:36–46. doi:10.1007/s40641-019-00121-2.

Mocan, H. Naci, and Turan G. Bali. 2010. "Asymmetric Crime Cycles". *The Review of Economics and Statistics* 92 (4): 889–911. doi:10.1162/REST_a_00048.

Nicolas, Jean. 1978. *La Savoie au XVIII^e siècle, Noblesse et bourgeoisie*. 1244. 2 vols. Paris: Maloine.

— . 1979. "L'innovation alimentaire en Savoie au XVIII^e siècle". In *Vie quotidienne en Savoie : Actes du XXVI^e Congrès des sociétés savantes de Savoie, Conflans, 1976*, 69–80. Annecy: Académie Salésienne.

Pauling, Andreas, Jürg Luterbacher, Carlo Casty, and Heinz Wanner. 2006. "Five Hundred Years of Gridded High-Resolution Precipitation Reconstructions over Europe and the Connection to Large-Scale Circulation". *Climate Dynamics* 26 (4): 387–405. doi:10.1007/s00382-005-0090-8.

Pei, Qing, David D. Zhang, Guodong Li, and Harry F. Lee. 2013. "Short and Long Term Impacts of Climate Variations on the Agrarian Economy in Pre-Industrial Europe". *Climate Research* 56 (2): 169–180. doi:10.3354/cr01145.

Pérouse, Gabriel. 1930. "Histoire d'une population aux XVII^e et XVIII^e siècles. Étude statistique et démographique sur Saint-Sorlin d'Arves, commune des hautes vallées alpines". *Mémoires et Documents de la Société Savoisienne d'Histoire et d'Archéologie* 67:15–65.

Pfister, Christian, and Rudolf Brázdil. 2006. "Social Vulnerability to Climate in the "Little Ice Age": An Example from Central Europe in the Early 1770s". *Climate of the Past* 2 (2): 115–129. doi:10.5194/cp-2-115-2006.

Poussou, Jean-Pierre. 1970. "Les mouvements migratoires en France et à partir de la France de la fin du XV^e siècle au début du XIX^e siècle : approche pour une synthèse". *Annales de démographie historique* 27 (4): 11–78. doi:10.3406/adh.1971.1072.

— . 1978. "L'immigration bordelaise, 1737–1791 : essai sur la mobilité géographique et l'attraction urbaine dans le Sud-Ouest de la France au XVIII^e siècle". PhD Thesis, Université de Paris IV.

Ratha, Dilip. 2005. "Workers' Remittances: An Important and Stable Source of External Development Finance". In *Remittances: Development Impact and Future Prospects*, ed. by Samuel Munzele Maimbo and Dilip Ratha, 19–51. Washington, DC: The World Bank Group.

Richard, Jérôme. 1766. *Description historique et critique de l'Italie, ou Nouveaux mémoires sur l'état actuel de son gouvernement, des sciences, des arts, du commerce, de la population et de l'histoire naturelle*. 1:519. Dijon: chez François Desventes.

Rousseau, Raymond. 1960. *La population de la Savoie jusqu'en 1861*. 263. Paris: S.E.V.P.E.N.

Ruff, Julius R. 1984. *Crime, Justice and Public Order in Old Regime France: The Sénéchaussées of Libourne and Bazas, 1696–1789*. 242. London: Routledge. doi:10.4324/9781315672366.

Schinasi, Leah H., and Ghassan B. Hamra. 2017. "A Time Series Analysis of Associations between Daily Temperature and Crime Events in Philadelphia, Pennsylvania". *Journal of Urban Health* 94:892–900. doi:10.1007/s11524-017-0181-y.

Siddle, David J. 1997. "Migration as a Strategy of Accumulation: Social and Economic Change in Eighteenth-Century Savoy". *The Economic History Review* 50 (1): 1–20. doi:10.1111/1468-0289.00042.

— , ed. 2000. *Migration, Mobility and Modernization*. 225. Liverpool: Liverpool University Press. doi:10.5949/UPO9781846313578.

Storrs, Christopher. 2009. "The Savoyard Fiscal-Military State in the Long Eighteenth Century". In *The Fiscal-Military State in Eighteenth-Century Europe: Essays in Honour of P.G.M. Dickson*, ed. by Christopher Storrs, 201–235. Farnham: Ashgate.

Symcox, Geoffrey. 1983. *Victor Amadeus II: Absolutism in the Savoyard State, 1675–1730*. 272. Berkeley: University of California Press.

Tack, Jesse, Andrew Barkley, and Lawton Lanier Nalley. 2015. "Effect of Warming Temperatures on US Wheat Yields". *Proceedings of the National Academy of Sciences* 112 (22): 6931–6936. doi:10.1073/pnas.1415181112.

Tiihonen, Jari, Pirjo Halonen, Laura Tiihonen, Hannu Kautiainen, Markus Storvik, and James Callaway. 2017. "The Association of Ambient Temperature and Violent Crime". *Scientific Report* 7:6543. doi:10.1038/s41598-017-06720-z.

Tissot, E. 1887. "Résumé des observations météorologiques d'Annecy et de la Haute-Savoie faites en 1885 et pendant la période décennale antérieure". *Revue savoisienne* 28:3–10.

Tochon, Pierre. 1871. *Histoire de l'agriculture en Savoie*. 262. Chambéry: Imprimerie de F. Puthod.

Traxler, Christian, and Carsten Burhop. 2010. "Poverty and Crime in 19th Century Germany: A Reassessment". *MPI Collective Goods Preprint* 2010/35.

Uprety, Dinesh Chandra, and V. R. Reddy. 2016. *Crop Responses to Global Warming*. 125. Singapore: Springer. doi:10.1007/978-981-10-2004-9.

Verdo, Rémy. 2012. "Les attributions des intendants sardes en Savoie au XVIII^{e} siècle". *Revue historique de droit français et étranger* 90 (4): 517–548. doi:10.2307/43859235.

Verneilh-Puiraseau, Joseph. 1807. *Statistique générale de la France : département de Mont-Blanc*. 560. Paris: Imprimerie Testu.

Viallet, Hélène. 1993. *Les alpages et la vie d'une communauté montagnarde : Beaufort du Moyen-Âge au XVIII^{e} siècle*. 275. Annecy: Académie Salésienne.

Viazzo, Pier Paolo. 1989. *Upland Communities. Environment, Population and Social Structure in the Alps since the Sixteenth Century*. 344. Cambridge: Cambridge University Press.

Vion, Robert. 1956. "Un vignoble savoyard. La Chautagne". *Revue de géographie alpine* 44 (4): 717–739. doi:10.3406/rga.1956.1787.

Yang, Dean, and HwaJung Choi. 2007. "Are Remittances Insurance? Evidence from Rainfall Shocks in the Philippines". *The World Bank Economic Review* 21 (2): 219–248. doi:10.1093/wber/lhm003.

Online Appendix

A Weights, measures and currency

Before 1792, different units of weights and measures were in use throughout the Duchy of Savoy. The lack of a uniform system of weights and measures often hindered regional and international trade and made difficult the payment of rents. Several monetary reforms during the eighteenth century further complicated these payments. This section provides metric equivalent of the units of weights and measures of the main towns as well as a brief summary of the monetary reforms that occurred during the 18th century.

A.1 Weights and measures

I derive capacity measures for dry products (mostly grains) and wet products (wine, beer, oil, and the like) from Verneilh-Puiraseau (1807: 528, 534–6) and *Tables de rapport des anciens poids et mesures* (1849: 145–85), unless stated otherwise.

- Weights
  - *Livre* of Annecy: 627.92 grams
  - *Livre* of Chambéry: 418.61 grams
  - *Livre* of Geneva: 550.694 grams
  - *Livre* of Haute-Maurienne: 341 grams[51]
  - *Livre* of Lyon: 418.64 grams[52]
  - *Livre* of Montmélian: 416.5 grams
  - *Livre* of Paris: 489.5058 grams
  - *Livre* of Turin: 368.845 grams[53]
- Grains
  - *Bichet* of Aime: 15.50 litres
  - *Bichet* of Moûtiers: 15.50 litres
  - *Bichet* of Pont-de-Beauvoisin: 25.90 litres
  - *Bichet* of Sallanches: 30.0 litres
  - *Boisseau* of Genoa: 29.133 litres
  - *Coupe* of Annecy: 88.86 litres
  - *Coupe* of Bogève: 75.2 litres

[51] Charbonnier (2005: 323).
[52] Charbonnier (2005: 241).
[53] *Tables de rapport des anciens poids et mesures* (1849: 30).

  - *Coupe* of Bonneville: 84.40 litres
  - *Coupe* of Évian-les-Bains: 46.96 litres
  - *Coupe* of Faverges: 94.1 litres
  - *Coupe* of La Roche: 84.40 litres
  - *Coupe* of Rumilly: 88.80 litres
  - *Coupe* of Saint-Jeoire: 72.0 litres
  - *Coupe* of Taninge: 74.80 litres
  - *Coupe* of Thônes: 73.56 litres
  - *Coupe* of Thonon-les-Bains: 54.00 litres
  - *Emine* of Aoste: 22.4 litres[54]
  - *Emine* of Piedmont: 23.00556 litres[55]
  - *Quarte* of Aiguebelle: 13.54 litres
  - *Quarte* of Albertville: 23.00 litres
  - *Quarte* of Faverges: 23.525 litres
  - *Quarte* of Lanslebourg: 13.11 litres
  - *Quarte* of Saint-Jean-de-Maurienne: 13.34 litres
  - *Sac* of Aoste: 134.40 litres[56]
  - *Sac* of Piedmont: 115.275 litres[57]
  - *Sétier* of Nice: 40.4375 litres[58]
  - *Veissel* of Chambéry (wheat): 81.26 litres
  - *Veissel* of Chambéry (rye): 76.48 litres
  - *Veissel* of Chambéry (oat): 143.4 litres
  - *Veissel* of Châtelard: 80.04 litres
  - *Veissel* of Montmélian: 82.14 litres
  - *Veissel* of Yenne: 89.16 litres
- Liquids
  - *Asnée* of Lyon: 93.13 litres[59]
  - *Pinte* of Nice: 0.78625 litres[60]
  - *Pinte* of Paris: 0.9313 litres
  - *Pinte* of Piedmont: 1.369 litres[61]
  - *Pot* of Aoste: 1.850 litres[62]

[54] *Tables de rapport des anciens poids et mesures* (1849: 143).
[55] *Tables de rapport des anciens poids et mesures* (1849: 30).
[56] *Tables de rapport des anciens poids et mesures* (1849: 143).
[57] *Tables de rapport des anciens poids et mesures* (1849: 30).
[58] *Tables de rapport des anciens poids et mesures* (1849: 134).
[59] Charbonnier (2005: 237).
[60] *Tables de rapport des anciens poids et mesures* (1849: 136).
[61] *Tables de rapport des anciens poids et mesures* (1849: 30).
[62] *Tables de rapport des anciens poids et mesures* (1849: 144).

  - *Pot* of Aiguebelle: 1.5579 litres
  - *Pot* of Aime: 1.875 litres
  - *Pot* of Albertville: 1.845 litres
  - *Pot* of Annecy (wine): 1.426 litres
  - *Pot* of Annecy (oil): 1.640 litres
  - *Pot* of Beaufort: 1.544 litres
  - *Pot de quinte* of Bonneville: 2.250 litres
  - *Pot de débit* of Bonneville: 2.12 litres
  - *Pot* of Bourg-Saint-Maurice: 2.0 litres
  - *Pot* of Chambéry (wine): 1.858 litre
  - *Pot* of Chambéry (oil): 2.228 litres
  - *Pot* of Douvaine: 1.1278 litres
  - *Pot* of Évian-les-Bains: 1.212 litres
  - *Pot* of Faverges: 1.714 litres
  - *Pot* of La Roche: 1.50 litres
  - *Pot* of Lanslebourg: 1.468 litres
  - *Pot* of Lyon: 1.058 litres[63]
  - *Pot* of Montmélian: 2.228 litres
  - *Pot* of Moûtiers: 1.452 litres
  - *Pot* of Pont-de-Beauvoisin: 1.582 litres
  - *Pot* of Rumilly (wine): 1.904 litres
  - *Pot* of Rumilly (oil): 2.144 litres
  - *Pot* of Saint-Jean-de-Maurienne: 1.483 litres
  - *Pot de quinte* of Sallanches: 1.942 litres
  - *Pot de débit* of Sallanches: 1.74 litres
  - *Pot de quinte* of Taninge: 2.233 litres
  - *Pot* of Thônes: 1.684 litres
  - *Pot* of Thonon-les-Bains: 1.3065 litres
- Firewood
  - *Corde* of Savoy: 3.834 *stères*[64]
- Distance
  - *Pied de chambre*: 0.33937 m
  - *Lieue* of Savoie: 7.706489 km
  - *Mille* of Piedmont: 2.46607 km

[63] Charbonnier (2005: 237).

[64] Verneilh-Puiraseau (1807: 536). Logs were usually 4 *pieds de chambre* long (1.357 m). *Tables de rapport des anciens poids et mesures* (1849: 145–85) gives 4.3776 *stères*. See also Arch. mun. Annecy, 4F 5/12, Relevé du prix des grains et autres denrées.

A.2 Currencies

The *Florin de Savoie* was the fundamental currency of accounting in the Duchy of Savoy from the 1610s to the early 18th century. It was subdivided in 12 *sols* or 144 *deniers*, and pegged on the French *Livre tournois* at fixed rate of £2.[65] On 17 February 1717, Victor Amadeus II enforced a new edict enacting the replacement of the *Florin de Savoie* by the *Livre de Savoie* as a unit of account. It was subdivided in 20 *sols* or 240 *deniers*, and pegged on the *Lira piemontesi* at par. Its value was equivalent to 1.5 *Florin de Savoie* (Fellonie 1968: 20). It remained the unit of account until the end of the Ancien Régime, even though additional reforms took place in 1733, 1741, 1755 and 1784 (Nicolas 1978: 1127).

The *marco* was used to weight coins. It was slightly heavier than in France and weighted 245.896 grams: it was equivalent to 1 French *marc* of silver plus 22.25 *grains*.[66]

- 1 marco = 8 once = 245.896 grams of silver
- 1 oncia = 24 denari = 30.737 grams of silver
- 1 denaro = 24 grani = 1.280708 grams of silver
- 1 grano = 24 granotti = 0.05336285 gram of silver
- 1 granotto = 0.002223452 gram of silver

In the 1717, the value of the *Livre de Savoie* was set at 4 *denari* 19 *grani* and 5 *granotti* (4.800347 *denari*), and had a fineness of 0.91667. Its silver contains was thus 5.635 grams. Later, the Edict of 25 June 1733 set the value of the *Livre de Savoie* at 4 *denari* 15 *grani* and 17 *granotti* (4.654514 *denari*), which corresponds to 5.464 grams of silver.[67] The Edict of 13 February 1741 introduced a new *Lira*, worth 4 *denari* 11 *grani* and 4 *granotti*, which set the value of a coin at 5.242 grams of silver. The currency was further devaluated in 1744 to worth 5.152 grams of silver. On 15 February 1755, Charles Emmanuel III issued another edict to create the *Scudo piemontese* which was subdivided in six *Lire piemontesi*. It was worth 35.1634 grams of silver and had a fineness of 0.90625. Thus, it set the value of the *Livre de Savoie* at 5.311 grams of silver (Fellonie 1968: 23, 31).[68] Following the Edict of December 1785, the gold coins created after the Edict of 1755 ceased to be current as money within the Kingdom of Piedmont-Sardinia and were replaced by new silver coins. The weight and the value of the silver coins remained unchanged by this reform.

[65] BnF, V-17708. *Essai sur le rapport des poids étrangers avec le marc de France*, 53. BnF, NUMM-6578254. *Réduction des florins en livres de Savoïe*, 329.

[66] In France, the *marc* of silver weighted 244.7529 grams. BnF, V-17708. *Essai sur le rapport des poids étrangers avec le marc de France*, 60–1. See also BnF, NUMM-5833482. *Encyclopédie méthodique. Commerce. Tome 3*, 411.

[67] BnF, NUMM-6578254. *Réduction des florins en livres de Savoïe*, 7.

[68] BnF, 4-L16-12 (3). *Dictionnaire universel géographique, statistique, historique et politique de la France*, 474.

B Living standards in 18th-century Savoy

In his *Travels in France*, Young (1892: 278) describes the average Savoyard villages as "apparently poor" with "houses ill built, and the people with few comforts about them". He further adds that the inhabitants are "in general mortally ugly and dwarfish", though anthropometric evidence from the early 19th century suggest that Savoyard conscripts were not smaller than their French counterparts.[69]

The average household ate a diet based primarily on rye bread meat, vegetables and fruits (Nicolas 1978: 345–55; 1979). In 1789, the intendant of Genevois reported that "there is only one-fifth of the population of the province that consumed wheat, the others eat only a mixture of grains [menu bled]". He further pointed out that four *coupes* of wheat– roughly 350 litres– were sufficient to feed an individual for one year if the diet was completed with dairy products, fruits and roots.[70] Various estimates from the second half of the 18th century set the average daily consumption of bread at 1,200 to 1,600 grams, which could have represented up to 80 per cent of the total caloric intake.[71] Despite the importance of livestock in the local economy, meat was not widely consumed. Becchia et al. (2012) suggest that, on average, meat consumption amounted to 20 kg a year in Savoy.[72] Milk was mostly processed into butter and cheese, a high-protein food source easily storable. Cheese was consumed in large quantities at every meal, at least in the more mountainous areas (Viallet 1993: 118, 154, 193). Vegetables, fruits, and potatoes from the 1760s onward, were supplementary articles in the diet of the average household. Table B.9 provide a tentative summary of the Savoyard consumption basket in the late 18th century.

According to the Doctor Daquin (1787: 97), wine was the "the usual drink among city dwellers" in Chambéry. Malanima (2013: 50) estimates that per capita annual wine consumption averaged 150 litres in Northern Italy during the 18th century. [73] In Table B.10, I combine daily consumption estimates from Table B.9 and prices information provided by Verneilh-Puiraseau (1807: 400), official prices reports and various account books. A rural daily worker spent about 14.3 *sols* per day to cover his food expenses. Adding five per cent to account for the housing costs leaves exactly 15 *sols*.

Palluel (1805: 160) reports that the average hospitals' daily expenditure per inmate was 12 *sols* in the late 18th century. Only a fraction of that amount was dedicated directly to the poor though. In Chaméry, about two-thirds of the budget of the *Charité* was used to purchase food for its inmates. The minimum amount necessary to cover a person's food for a day was thus around 8 *sols*. In the early 19th century, Verneilh-Puiraseau (1807: 400) reported that the wage

[69] See Verneilh-Puiraseau (1807: 279–81) for Savoy and Djedid (2009: 52), Heyberger (2007: 237–40), Schubert and Koch (2011: 280–1), and Weir (1997: 174–6) for various French provinces.

[70] Arch. Dép. Haute-Savoie, 1 C 4 178, pièce 8, État comparatif des productions année commune tant en bled que menu bled, 1789.

[71] Arch. Dép. Haute-Savoie, 5 C 15 et 16. Arch. Dép. Haute-Savoie, 4 C 80.

[72] See also Tempête (2000: 47–8). In the neighbouring city of Geneva, the annual consumption of meat averaged to 80 kg.

[73] In Lyon, the per capita daily wine consumption averaged 0.5 litre, or roughly 180 litres per year (Durand 1979: 47–9).

Table B.9 – Consumption basket for a working adult man in Savoy (c. 1780)

	Quantity per year	Unit	Kcal/unit	Grams of protein/ unit	Nutriments per day	
					Kcal/day	Grams of protein
Wheat bread	438	kg	2,450	100	2,940	120
Rye bread	438	kg	2,380	100	2,856	120
Bean	20	kg	1,125	71	62	4
Meat	20	kg	2,500	200	137	11
Eggs	52	each	79	6.25	11	1
Butter	10	kg	7,268	7	199	0
Cheese	10	kg	3,750	214	103	6
Salt	2.95	kg	0	0	0	0
Wine	150	l	850	0	349	0
				Total	3,801	142
Candles	2.6	kg				
Firewood	365	kg				
Rent	5%					

Notes: The caloric and protein content are based on Allen et al. (2011: 38) who derived it from USDA, National Nutrient Database. The composition of the basket respects the fact that (i) the daily average consumption of bread was about 1,200 grams per inhabitant; (ii) bread made up about 80 per cent of the total caloric intake; (iii) the annual consumption of meat was no more than 20 kg per inhabitant; (iv) households had to buy a minimum of eight *livres of Turin* of salt per person older than five (Becchia et al. 2012; Lansard 1988; Malanima 2013; Nicolas 1979; Vermale 1911). The relative share of bean, butter and cheese are derived from standard consumption baskets in early modern Europe and adapted to the Savoyard context based on descriptive evidence.

gap between fed and unfed daily labourers in 1792 ranged from 7 *sols* in the countryside to 10 *sols* in urban areas. These estimates are lower than the amount presented in Table B.10, which represents an upper-bound consumption basket.[74] For instance, a subsistence basket with no wine consumption and a bread consumption reduced by one third would yield 2,472 kcal and cost about 9 *sols*. Switching from bread made of a mix of wheat and rye to bread bread made of a mix of barley and oats would further reduced the cost of the consumption basket (Nicolas and Nicolas 1979: 197–9).[75] Finally, it is interesting to note that Verneilh-Puiraseau (1807: 400) reported that servants and daily labourers needed about 15 *sols* to cover their daily food and housing expenses, which is in line with the estimate proposed in Table B.10.

During the 18th century, the average standard deviation of the annual prices of wheat and red wine in Annecy were respectively 0.19 and 0.27, which is equivalent to a 25 per cent and 32 per cent deviation from the mean (Table 3). A one standard deviation increase in the price of wheat would increase the price of the daily portion of bread by 2.5 *sols*, whereas a standard deviation decrease in the price of red wine would decrease the price of the daily portion of wine by 0.66 *sols*. In Tables 4 and E.11, I show that an increase in summer temperature had a positive and significant effect on the prices of wheat and negative and significant effect on the prices of red wine. Therefore, the potential net income effect of warmer summer temperature

[74] In Thonon-les-Bains, the monks from the *Chartreuse de la Ripaille* spent £30 per capita per month on foods in 1787. Their eighteen domestics received £15 per capita per month to cover their food expenses in addition to their annual wages of £50. Arch. Dép. Haute-Savoie, C 99, folio 41.

[75] In addition, because the *Charité* received parts of its rents in kinds and had access to wholesale prices, it is likely that the daily expenditures per capita were actually higher than the estimates derived from the expenses book.

on household budget is negative. It could be even larger than suggested given that children usually consumed bread but did not drink alcohol.

Table B.10 – Consumption basket: Prices of goods in Savoy (1792)

	Prices in *sols*	Unit	Daily expenditures Consumption	*sols*	% income [1]
Wheat bread[2]	8.27	kg	1.2	9.93	61.3
Meat	13.65	kg	0.05	0.74	4.6
Wine	5.0	litre	0.41	2.05	12.7
Salt	11.58	kg	0.008	0.09	0.6
Firewood	124.9	m^3	0.003	0.34	2.1
Other products[3]				1.14	7.0
			Total	14.29	88.2

Sources: Verneilh-Puiraseau (1807: 400). Arch. Dép. Savoie, 4B 1256, Livre de comptes des hommes d'affaires du marquis de Mont-Saint-Jean (1780–1790). Arch. Dép. Savoie, 4B 293, Bénédictins, Prieuré de Bellevaux-en-Bauges : livre de comptes. Arch. Dép. Savoie, C 589, Mercuriales du prix des grains aux marchés de Chambéry.

[1] Verneilh-Puiraseau reports that the wage of a daily labourer in rural and urban areas were respectively 16.2 *sols* and 24.3 *sols*. Rural wages are used as a reference category.

[2] Wheat bread (*pain de froment*) was the least expensive types of bread sold in Chambéry, before the *pain clair* and the white bread (*pain blanc*).

[3] *Other products* includes butter (14.3 *sols*/kg), cheese (20.3 *sols*/kg), eggs (0.42 *sol* each) and candles (19.11 *sols*/kg).

C Poverty shocks and public assistance

Throughout the 18th century, no comprehensive system of relieving those in need, like the poor law in England, existed in the duchy Savoy. The Savoyard system relied on state and municipal interventions as well as permanent institutions run thanks to patronage and religious orders. Figure D.11 displays price variations of wheat on the markets of Annecy and Chambéry. Because of the importance of staple crops in the average diet, any increase in prices resulted in a quasi-immediate decline in living standards, and increase pressure on relief institutions.

The provision of poor relief was, however, really strict. Every city council had to establish comprehensive lists of all poor in its parishes by distinguishing those in absolute misery and those having some very limited resources.[76] In 1769, the king granted 26 *sols* per head to households fallen victim to summer hailstorm, and recognised as poor on such lists.[77]

At the individual level, motivations for charity ranged from spiritual movements to conflict over family wealth and search for prestige among elite groups, whereas states authorities' concerns were twofold: the reduction of insecurity, and the education of its people (Cavallo 1995; Fouquet 1986).[78] Municipal authorities ran most of the hospitals and other charity institutions with the help of various religious orders.[79] In 1717, an edict required every city and town to create either a hospital or an almshouse, and some flourished after receiving several donations. To make it easier for hospitals and charity institutions to raise funds, state authorities granted them tax exemptions and made it compulsory for notaries to suggest to testators to make a donation to such institutions (Fouquet 1986).[80]

Only the wealthiest could afford such donations, though, and about one-fifth of testators actually donated to charity. In Chambéry, the hospitals of *Saint-François et Maché* and *Charité* had an annual income of nearly ten thousand *florins* and fifty thousand *florins* respectively in the early 18th century. They drew the bulk of their income from private donations, property income, and profits derived from their workhouses. Only a fraction of that income was dedicated to the poor though. The *Charité* spent directly about 9,000 *florins* per year to alleviate poverty, about sixty per cent of which was used to buy food. From the mid-1730s onward, the *Hôpital Général* provided outdoor relief to the poor through weekly distributions of bread

[76] Arch. Dép. Haute-Savoie, C 4 178.

[77] On average, each household received about £4, which was sufficient to afford enough grains for about ten days. For instance in Évian-les-Bains, a total of £669 were distributed to 162 households totalling 515 individuals. Wheat cost about £15 per *coupe*. An adult needed approximately 0.68 litres of wheat per day (250 litres annually). Arch. Dép. Haute-Savoie, 1 C 2 72, pièce 21, État des pauvres de la paroisse d'Évian, province de Chablais.

[78] Particularly important at that time was the distinction between the 'good' poor who deserved help, and the unworthy poor, such as able-bodied beggars, lazy and immoral adults, and sometimes foreigners (Jones 1989).

[79] For a detailed description of public assistance in Savoy, see Bouverat (2013: 266–310). For a comparison with the system of public assistance in Turin, see Cavallo (1995).

[80] The ambition of such scheme was to discourage face-to-face charity, and to direct citizen's charitable acts towards the municipal system of poor relief. Individuals sometimes bequeathed substantial sums of money to charity in their wills. Through the late 1680s, the widow of Mr. Zamondy, a rich merchant from Chambéry, bequeathed the equivalent of 12,300 *florins* to the hospital of *Saint-François et Maché* and *Charité*. In 1775, François Vespre bequeathed £22,000 to the different hospitals in Chambéry (Palluel-Guillard 1963).

taking place every Sunday morning after the Mass (Fouquet 1986).[81] Beside hospitals, which were mostly dedicated to the assistance of the poor and needy, two other types of institutions were providing public assistance. Hostel of God (*Hôtel-Dieu*) and leprosarium focused on the recovery of the ill, while various religious and mendicant orders provided alms to the indigent in times of dire need (Palluel-Guillard 1963). In 1748, the village of Rumilly experienced a harvest failure. After visiting the village, the Visitandines noticed that "because of the exorbitant price of food, numerous poor are suffering". In the following weeks, the Sisters provided "potage made of vegetables, dry plums, and flour and distributed it once or twice a week to a large number of poor looking pitiable, be they were starving".[82] Similarly, in Moûtiers in 1768, the archbishop set an annual donation to the hospital amounting to 344 hectolitres of grains, to be distributed to poor and individuals affected by frost and fires.

In case of emergency caused by famine and epidemics, municipal and state authorities supplemented the actions of these institutions in the provision of aid to the poor with additional specific actions. The expansion of bureaucratisation in the first mid of the 18th century made it easier for them to monitor socio-economic conditions, and adopt a more interventionist attitude by using anti-dearth measures.

In 1734, misery was so widespread in the province of Savoie after three years of shortage, that several thousands of poor needed to be provided for. Between the 25th of April and the 20th June 1734, the city council of Chambéry spent £6,885 to organise daily distribution of bread and soup at the *Hôpital Général*.[83] A decade later, the king allowed the city council to sell 4,000 bags of wheat from the military stockpile at reduced prices to mitigate the effect of harvest failure. In 1771, the city council of Chambéry decided to borrow £22,000 to be able to import 4,000 bags of wheat from Piedmont. Overall, the sales of wheat to needy inhabitants amounted to £34,605 that year. In 1778, imports from Geneva provided enough grains to feed 3,000 individuals in Chambéry and twenty six surrounding parishes for several weeks (Palluel-Guillard 1963). In June 1783, the Laki Craters eruption began and led to the hottest summer in a century, and caused severe thunderstorms and acid rains damaging crops all over Europe, leaving the local population under stress. That year, Sébastien Ribbaz bought on the behalf of the province of Carouges the equivalent of £30,000 of wheat to provide subsistence for the poor.[84]

In the province of Chablais, the community secretary of Évian, the notary Cottet, had to buy 266 bags of wheat from Sardinia to relieve 20 communities. Abundant snow had delayed the harvest by a month, before a hailstorm caused serious damage to the crops, and left several of

[81] Poor often had to comply with requirements such as attendance at the Mass, participation at funerals, saying prayers at fixed time, and remaining silent during meals, as parts of the educational effort to redeem themselves.

[82] Cited in Bouverat (2013).

[83] Arch. mun. Chambéry, IR 106, carton 1022.

[84] Cities and towns were generally very active in the provision of assistance. On 7 March 1783, the city council of Chambéry decided to create a commission to identify families in need in the different neighbourhoods and to distribute them the relief they needed. Since the beginning of the 18th century, the city council was also offering annually free apprenticeship to six orphans originating from the city, and provided six poor young women with dowries. In Saint-Jean-de-Maurienne, the city council decided in 1758 to offer four hundred *livres* a year to attract a new physician in town. In following years, several cities, including Carouge, Moûtiers, and Termignon, used similar design to attract new physicians.

these communities in absolute misery. On March 30, Cottet further requested the king to loan him £5,000 to 6,000 to buy more grain.[85] One month and half later, the minister De Mouroux wrote to the intendant general in Chambéry to gather information on how Cottet was using the £4,000 loan he received from the king. In addition, De Mouroux reminded the intendant the necessity to send grain to Onnion and the surrounding parishes, which needed it to crop their fields.[86] In late August 1771, the city council of Le Biot informed the local intendant that, thanks to the crops provided in May, they were able to harvest thirty-eight hectolitres of barley and about ten hectolitres of oat, thus eliminating the risk of famine.[87]

Municipal and state authorities worked together to cope with the challenges raised by transitory poverty shocks, and improve the provision of poor relief in time of distress. Between 1750 and 1789, about fifty episodes of riots occurred in Savoy, but only five of which were related to the question of subsistence riots (Nicolas 1973, 1974), suggesting that the system of relief was successful in absorbing most of the negative effect of weather-induced poverty shocks. That, in turn, means that either local communities were very resilient at the aggregate level and did not need to resort to riots in times of dire need or Savoyard authorities were able to provide sufficient relief to prevent the occurrence of popular disorders.

[85] Arch. Dép. Haute-Savoie, 1 C 2 73, pièce 11, lettre du 30 mars 1771.
[86] Arch. Dép. Haute-Savoie, 1 C 2 73, pièce 29, lettre du 18 mai 1771.
[87] 48 *coupes* and 2 *quarts* of Thonon, and 12 *coupes* of Thonon, respectively. Arch. Dép. Haute-Savoie, 1 C 2 73, pièce 229, Extrait de la délibération du conseil du Biot.

D Additional figures

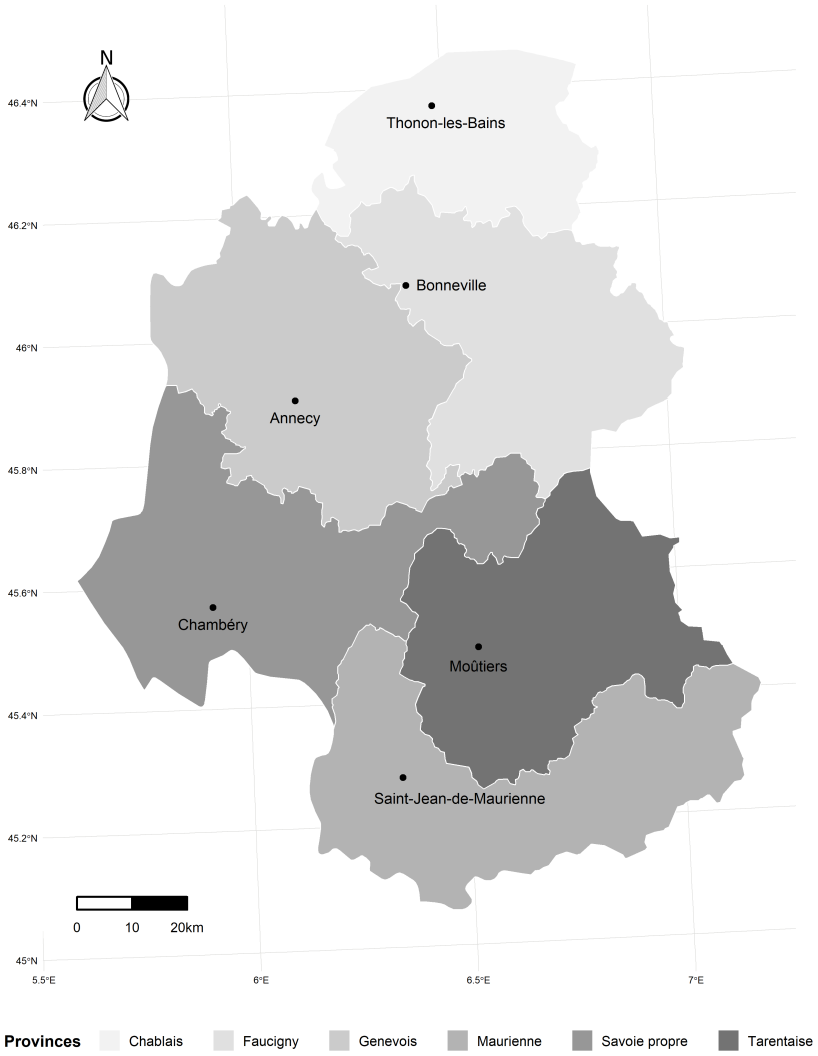


Figure D.4 – The Duchy of Savoy (c. 1750)

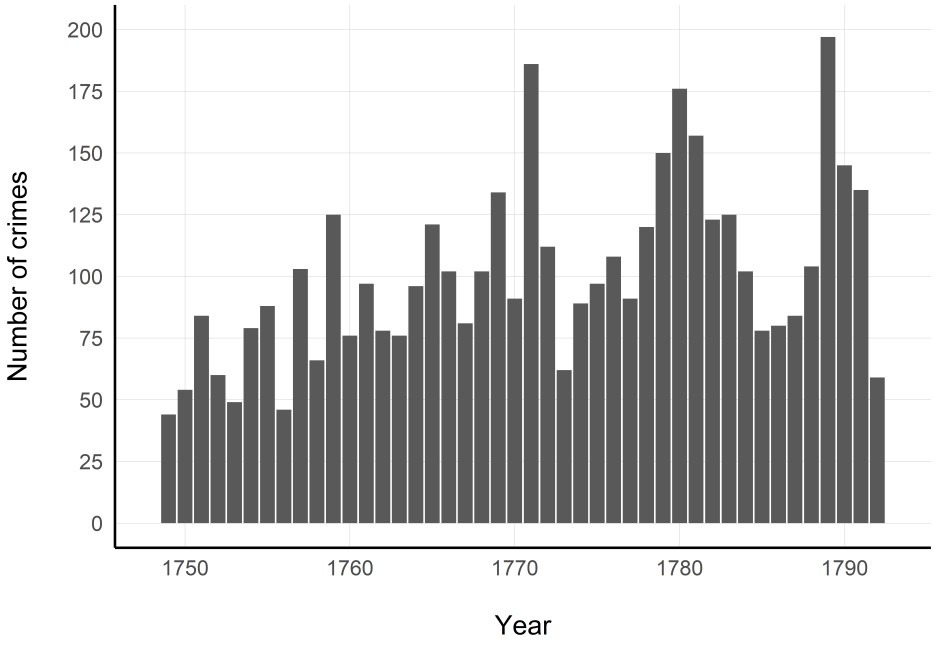


Figure D.5 – Total number of crimes in Savoy, 1749–92

Sources: See Section 3.1.

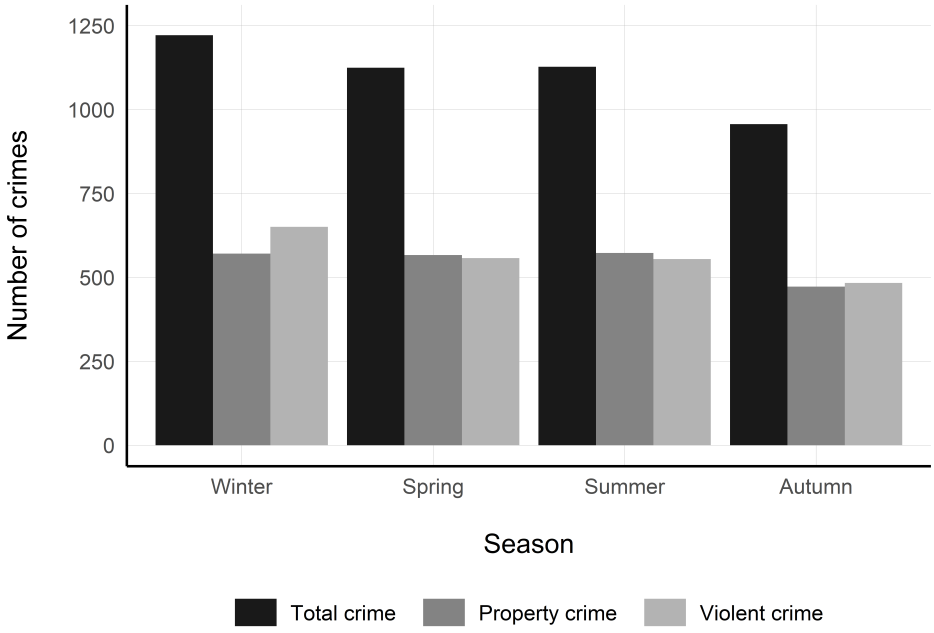
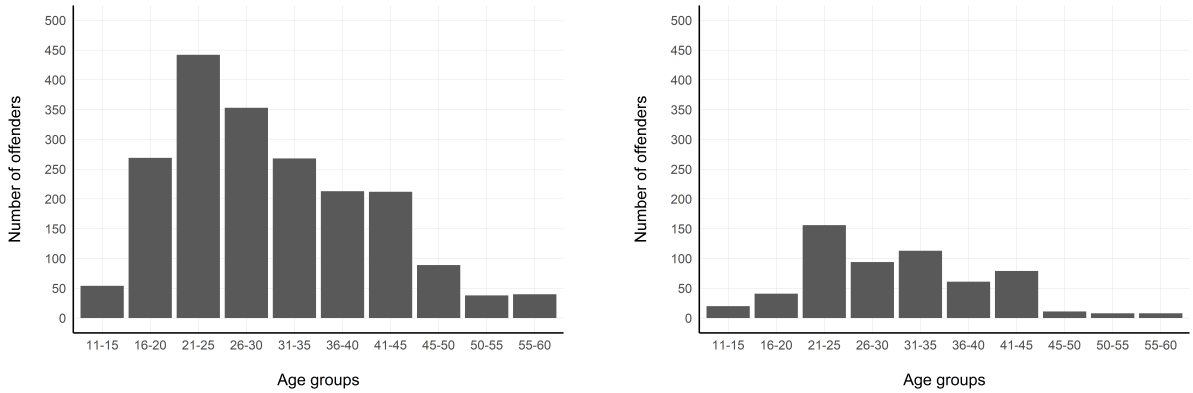


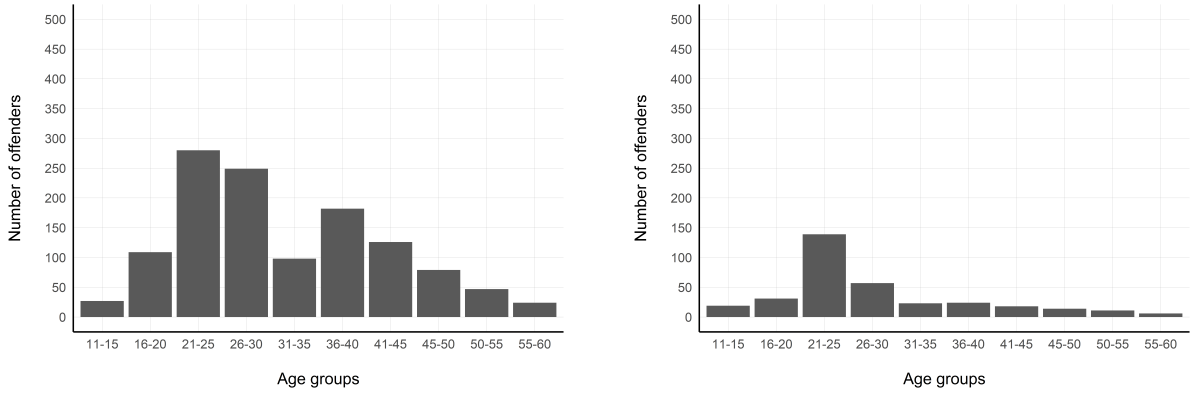
Figure D.6 – Seasonal distribution of crimes in Savoy (1749–92)



(a) All seasons (b) Winter

Figure D.7 – Age distribution of offenders involved in property crimes, 1749–92

Sources: See Section 3.1.



(a) All seasons (b) Winter

Figure D.8 – Age distribution of offenders involved in violent crimes, 1749–92

Sources: See Section 3.1.

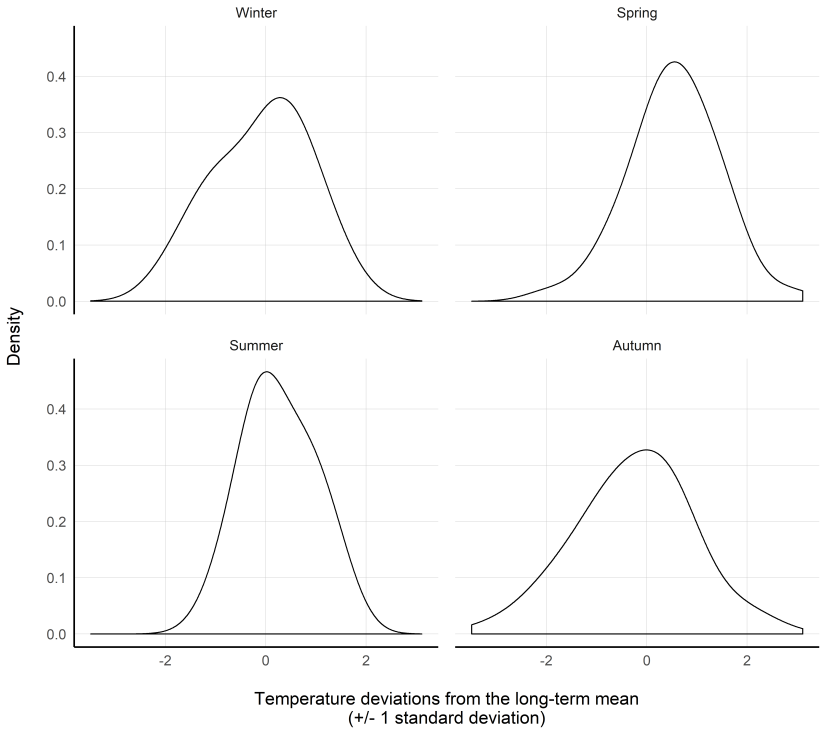


Figure D.9 – Distribution of seasonal temperature, 1749–92

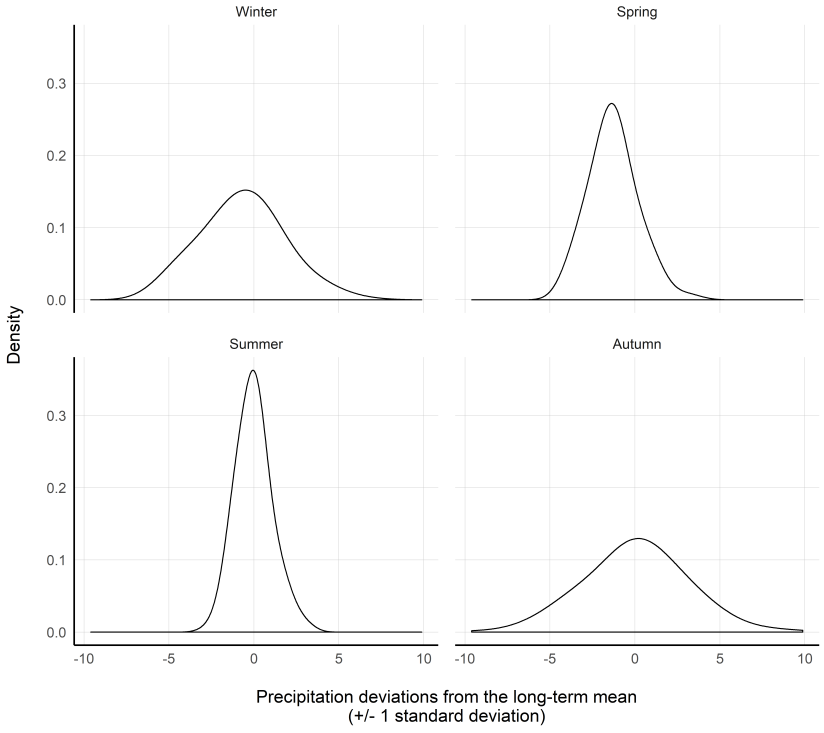


Figure D.10 – Distribution of seasonal precipitation, 1749–92

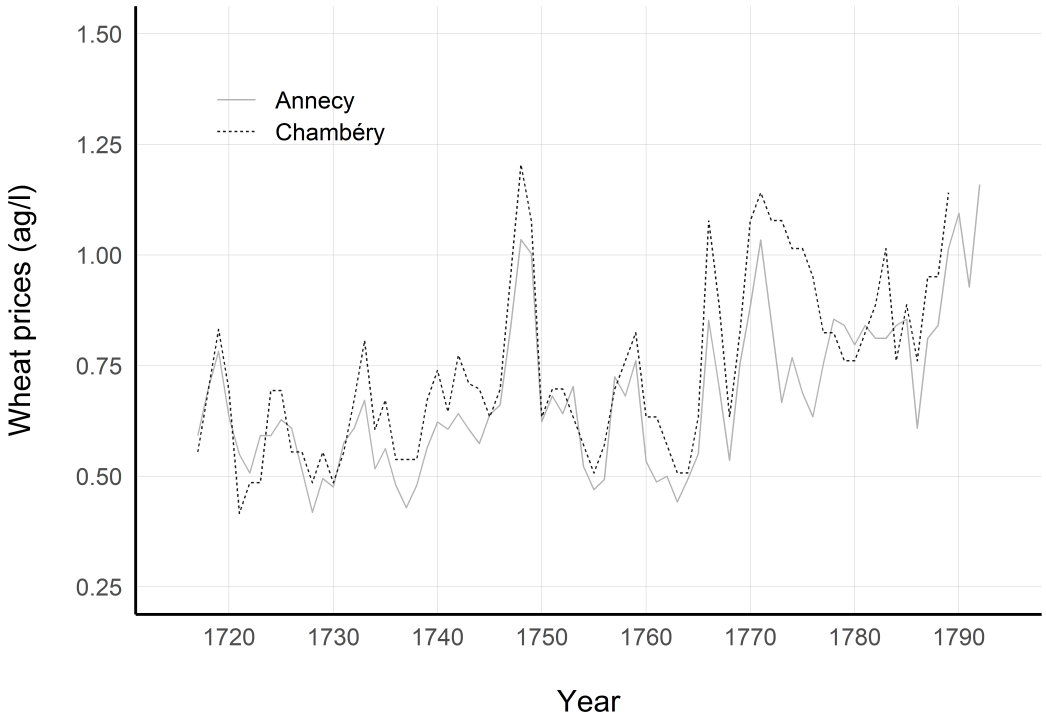


Figure D.11 – Wheat prices in the provinces of Genevois and Savoie (1717–92)

Sources: Annecy: monthly average of wheat prices on the four markets of October. Arch. mun. Annecy, HH2, Mercuriales 1629–1789. Chambéry: wheat prices on 29 September (Saint-Michel). Arch. mun. Chambéry, 189E-Dépôt 1265–1294, Registre de la Grenette.

E Additional results

Table E.11 – Temperature shocks and wine prices in Savoy (1741–89)

	Log of wine prices (ag/l)		
	(1)	(2)	(3)
Temperature	−0.053	−0.061	−0.077
	(0.031)	(0.033)	(0.033)
	[0.086]	[0.062]	[0.019]
Temperature *t-1*			−0.075
			(0.033)
			[0.023]
Observations	49	49	49
R^2	0.059	0.071	0.171

Notes: OLS estimations. Robust standard errors and p-values are reported in parentheses and brackets, respectively.
The dependent variable is the log of red wine prices in grams of silver per litre in the city of Annecy in year *t*. The price is fixed by the city counsil in early December after the end of the grape harvest. The independent variable Temperature is the summer temperature deviation from the long-term seasonal mean (1500–1600) in the province of Genevois, divided by its standard deviation. The other independant variables are defined accordingly. To account for the early growing season, columns 2 and 3 include the spring temperature deviation from the long-term seasonal mean (1500–1600) in the province of Genevois, divided by its standard deviation.

Table E.12 – Controlling for linearity and seasonal precipitation

	Total crime		Violent crime		Property crime	
	(1)	(2)	(3)	(4)	(5)	(6)
Temperature	−0.016	−0.016	−0.089	−0.086	0.069	0.074
	(0.052)	(0.051)	(0.036)	(0.037)	(0.042)	(0.041)
	[0.757]	[0.756]	[0.016]	[0.021]	[0.100]	[0.072]
Temperature^2	0.016		−0.008		0.005	
	(0.015)		(0.015)		(0.019)	
	[0.278]		[0.607]		[0.804]	
Precipitation		0.016		0.003		0.024
		(0.024)		(0.024)		(0.013)
		[0.506]		[0.891]		[0.076]
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,044	1,044	1,044	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In columns 1 and 2, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In Columns 3 to 6, the dependent variables are defined accordingly for violent crimes, and property crimes. The independent variable Temperature is the seasonal temperature deviation from the long-term seasonal mean (1500–1600) in province i, divided by its standard deviation. The other independant variables are defined accordingly. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

Table E.13 – Alternative measures of temperature and crime rates in Savoy (1749–92)

	Total crime		Violent crime		Property crime	
	(1)	(2)	(3)	(4)	(5)	(6)
Temperature 50 MA	−0.029		−0.097		0.068	
	(0.050)		(0.039)		(0.038)	
	[0.557]		[0.014]		[0.076]	
Temperature level		−0.005		−0.009		0.004
		(0.005)		(0.004)		(0.006)
		[0.316]		[0.016]		[0.477]
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,044	1,044	1,044	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In columns 1 and 2, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In Columns 3 to 6, the dependent variables are defined accordingly for violent crimes, and property crimes. The independent variable Temperature 50 MA is the seasonal temperature deviation from the 50 years moving average in province i, divided by its standard deviation. Temperature level is the average temperature in province i during season s in year t. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

Table E.14 – Weighted temperature shocks and crime rates in Savoy (1749–92)

	Total	Violent	Property
	(1)	(2)	(3)
Temperature	−0.016	−0.085	0.073
	(0.053)	(0.040)	(0.038)
	[0.760]	[0.036]	[0.056]
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In column 1, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In columns 2 to 3, the dependent variables are defined accordingly for violent crimes and property crimes. The independent variable Temperature is the weighted seasonal temperature deviation from the long-term seasonal mean (1500–1600) in province i, divided by its standard deviation. For each province, the share of each cell in the mean seasonal temperature is weighted by the share of the cell's soil suitability to grow wheat in the total soil suitability of the province. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

Table E.15 – Controlling for lagged temperature

	Total crime		Violent crime		Property crime	
	(1)	(2)	(3)	(4)	(5)	(6)
Temperature	−0.021	−0.040	−0.091	−0.104	0.070	0.057
	(0.057)	(0.064)	(0.045)	(0.049)	(0.038)	(0.043)
	[0.713]	[0.529]	[0.044]	[0.033]	[0.069]	[0.185]
Temperature *s-1*	−0.005	−0.025	−0.017	−0.030	0.007	−0.006
	(0.028)	(0.034)	(0.037)	(0.041)	(0.019)	(0.019)
	[0.851]	[0.471]	[0.646]	[0.473]	[0.722]	[0.737]
Temperature *s-2*		−0.055		−0.036		−0.037
		(0.034)		(0.022)		(0.040)
		[0.103]		[0.114]		[0.348]
Province FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,044	1,044	1,044	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In columns 1 and 2, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In Columns 3 to 6, the dependent variables are defined accordingly for violent crimes, and property crimes. The independent variable Temperature is the seasonal temperature deviation from the long-term seasonal mean (1500–1600) in province i, divided by its standard deviation. The other independant variables are defined accordingly. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

Table E.16 – Droughts, floods and crime rates in Savoy (1749–92)

	Total crimes	Violent crimes	Property crimes
	(1)	(2)	(3)
Droughts	0.122	−0.063	0.230
	(0.061)	(0.034)	(0.076)
	[0.047]	[0.068]	[0.003]
Floods	0.057	0.035	0.116
	(0.099)	(0.112)	(0.049)
	[0.566]	[0.755]	[0.019]
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In column 1, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In columns 2 to 3, the dependent variables are defined accordingly for violent crimes and property crimes. The independent variable Droughts is a dummy variable equal to one if seasonal temperature in province i is one standard deviation or more above the long-term seasonal mean (1500–1600), and zero otherwise. The independent variable Floods is a dummy variable equal to one if seasonal precipitation in province i is one standard deviation or more above the long-term seasonal mean (1500–1600), and zero otherwise. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

Table E.17 – Temperature shocks and crime rates in Savoy (1749–92)

	Total crimes	Violent crimes	Property crimes
	(1)	(2)	(3)
Temperature	−0.004	−0.111	0.137
	(0.035)	(0.054)	(0.068)
	[0.900]	[0.040]	[0.042]
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,488	1,488	1,488

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In column 1, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In columns 2 to 3, the dependent variables are defined accordingly for violent crimes and property crimes. The independent variable Temperature is the seasonal temperature deviation from the long-term seasonal mean (1700–1800) in province i, divided by its standard deviation (Casty et al. 2005). Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

Table E.18 – The effect of seasonal migration: Extensive margins

	Total crime	Violent crime	Property crime
	(1)	(2)	(3)
Temperature	0.144	0.008	0.190
	(0.030)	(0.048)	(0.031)
	[0.00001]	[0.864]	[0.000]
Temperature × Migration	−0.018	−0.011	−0.014
	(0.004)	(0.006)	(0.005)
	[0.00001]	[0.070]	[0.004]
Province FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	1,044	1,044	1,044

Notes: The sample is a balance panel of provinces covering 1749–92. Panel linear estimations with province fixed effects and year fixed effects. Cluster bootstrapped standard errors (Cameron et al. 2008) and p-values are reported in parentheses and brackets, respectively.
In column 1, the dependent variable is the log of total number of crimes per 100,000 inhabitants in province i during season s in year t. In columns 2 to 3, the dependent variables are defined accordingly for violent crimes and property crimes. The independent variable Temperature is the seasonal temperature deviation from the long-term seasonal mean (1500–1600) in province i, divided by its standard deviation. Migration is a continuous variable equal to the rate of seasonal migration in province i. Province FE is a full set of province fixed effects. Year FE is a full set of year fixed effects.

References

Allen, Robert C., Jean-Pascal Bassino, Debin Ma, Christine Moll-Murata, and Jan Luiten Van Zanden. 2011. "Wages, Prices, and Living Standards in China, 1738–1925: in Comparison with Europe, Japan, and India". *The Economic History Review* 64 (s1): 8–38. doi:10.1111/j.1468-0289.2010.00515.x.

Becchia, Alain, Fabrice Delrieux, Émilie-Anne Pépy, Hervé Laly, Frédéric Meyer, and Bruno Gachet. 2012. *Atlas historique et statistique de la Savoie au XVIII^e siècle*. 222. Chambéry: Université de Savoie.

Bouverat, Dominique. 2013. "Villes et bourgs en Savoie de la Réforme à la Révolution". PhD Thesis, Université Lyon 2.

Casty, Carlo, Heinz Wanner, Jürg Luterbacher, Jan Esper, and Böhm Reinhard. 2005. "Temperature and Precipitation Variability in the European Alps since 1500". *International Journal of Climatology* 30:1855–1880. doi:10.1002/joc.1216.

Cavallo, Sandra. 1995. *Charity and Power in Early Modern Italy: Benefactors and Their Motives in Turin, 1541–1789*. 280. Cambridge: Cambridge University Press.

Charbonnier, Pierre. 2005. *Les anciennes mesures locales du Centre-Est, d'après les tables de conversion*. 408. Clermont-Ferrand: Presses universitaires Blaise Pascal.

Daquin, Joseph. 1787. *Topographie médicale de la ville de Chambéry et de ses environs*. 152. Chambéry: Imprimerie M. F. Gorrin.

Djedid, Karim et Michel Hau. 2009. "Stature et malnutrition dans l'Alsace de la première moitié du XIX^e siècle". *Histoire, Économie et Société* 28 (1): 35–56. doi:10.3917/hes.091.0035.

Durand, Georges. 1979. *Vin, vigne et vignerons en Lyonnais et Beaujolais (XVI^e–XVIII^e siècles)*. 540. Lyon: Presses Universitaires de Lyon.

Fellonie, Guiseppe. 1968. *Il mercato monetario in Piemonte nel secolo XVIII*. 365. Milano: Banca Commerciale Italiana.

Fouquet, Yannick. 1986. "Pauvreté et assistance au XVII^e siècle : le cas exemplaire de Chambéry". *Mémoires et Documents de la Société Savoisienne d'Histoire et d'Archéologie* 89:1–152.

Heyberger, Laurent. 2007. "Toward an Anthropometric History of Provincial France, 1780–1920". *Economics & Human Biology* 5 (2): 229–254. doi:10.1016/j.ehb.2007.04.003.

Jones, Colin. 1989. *The Charitable Imperative: Hospitals and Nursing in Ancien Regime and Revolutionary France*. 317. London: Routledge.

Lansard, Monique. 1988. "L'alimentation dans les communautés religieuses en Savoie au XVIII^e siècle". In *Vie religieuse en Savoie : mentalités, associations. Actes du XXXI^e Congrès des sociétés savantes de Savoie, Annecy, 1986*, 277–287. Annecy: Académie Salésienne.

Malanima, Paolo. 2013. "When did England Overtake Italy? Medieval and Early Modern Divergence in Prices and Wages". *European Review of Economic History* 17 (1): 45–70. doi:10.1093/ereh/hes022.

Nicolas, Jean. 1973. "Éphémérides du refus : Pour une enquête sur les émotions populaires au XVIII^e siècle. Le cas de la Savoie". *Annales historiques de la Révolution française* 214 (4): 593–607.

— . 1974. "Éphémérides du refus : Pour une enquête sur les émotions populaires au XVIII^e siècle. Le cas de la Savoie". *Annales historiques de la Révolution française* 215 (1): 111–153.

— . 1978. *La Savoie au XVIII^e siècle, Noblesse et bourgeoisie*. 1244. 2 vols. Paris: Maloine.

— . 1979. "L'innovation alimentaire en Savoie au XVIII^e siècle". In *Vie quotidienne en Savoie : Actes du XXVI^e Congrès des sociétés savantes de Savoie, Conflans, 1976*, 69–80. Annecy: Académie Salésienne.

Nicolas, Jean, and Renée Nicolas. 1979. *La vie quotidienne en Savoie aux XVII^e et XVIII^e siècles*. 284. Paris: Hachette.

Palluel, Joseph. 1805. *Annuaire statistique du département du Mont-Blanc, pour l'an XIII*. Chambéry: Imprimerie Cléaz et Gorrin.

Palluel-Guillard, André. 1963. "L'administration communale de Chambéry au XVIII^e siècle". *Mémoires et Documents de la Société Savoisienne d'Histoire et d'Archéologie* 73:9–142.

Schubert, Hermann, and Daniel Koch. 2011. "Anthropometric History of the French Revolution in the Province of Orleans". *Economics & Human Biology* 9 (3): 277–283. doi:10.1016/j.ehb.2011.04.003.

Tables de rapport des anciens poids et mesures des États de Terre ferme du Royaume avec les poids et mesures du système métrique décimal. 1849. 192. Turin: Imprimerie Royale.

Tempête, Emmanuelle. 2000. "Le commerce de la viande à Chambéry au XVIII^e siècle". Master Thesis, Université de Savoie.

Vermale, François. 1911. *Les classes rurales en Savoie au XVIII^e siècle*. 337. Paris: Ernest Leroux.

Verneilh-Puiraseau, Joseph. 1807. *Statistique générale de la France : département de Mont-Blanc*. 560. Paris: Imprimerie Testu.

Viallet, Hélène. 1993. *Les alpages et la vie d'une communauté montagnarde : Beaufort du Moyen-Âge au XVIII^e siècle*. 275. Annecy: Académie Salésienne.

Weir, David R. 1997. "Economic Welfare and Physical Well-being in France, 1750–1990". In *Health and Welfare during Industrialization*, ed. by Richard H. Steckel and Roderick Floud, 161–200. Chicago: University of Chicago Press.

Young, Arthur. 1892. *Travels in France During the Years 1787, 1788, 1789*. 366. London: George Bell / Sons.