Raising Capital to Raise Crops:

Slave Emancipation and Agricultural Output in the Cape Colony

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Raising capital to raise crops: Slave emancipation and agricultural output in the Cape Colony*

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Abstract

Agricultural output fluctuated worldwide after the emancipation of slaves. The usual explanation is that former slaveholders now lacked labor. This is not the full story: slaves were not just laborers but capital investments to support production. Using databases covering more than 40 years from Stellenbosch in the British Cape Colony, this study measures changes in output before and after emancipation to determine the role of slaves as factors of production. Large shortfalls in compensation paid to slaveholders after the 1833 Abolition Act reveal that slaves were a source of capital that strongly influenced production levels, an important reason for the output variation.

Keywords. slave emancipation, slave trade, agricultural history, labor coercion, Cape Colony
JEL code. J47, N37, N47, N57

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1 Introduction

While the idea of slavery as a set of property rights embracing more than a labor arrangement is not particularly new (Engerman 1973; Garnsey 1996; Wright 2006; Dooling 2006; Martin 2010; Kilbourne 2015; González et al. 2017; Ribeiro and Penteado 2020), very little has been done to quantify the importance of slaves as providers of labor *and* capital to the production process. In this article, Cape Colony's slaveholding households are analyzed from a longitudinal perspective, such that the interdependencies of slave ownership, agricultural output, and related capital are considered simultaneously. I conclude that output variation in the years after emancipation was chiefly determined by the inability of slaveholders to effectively raise capital once slaves were freed. Labor withdrawal, despite taking place in some estates, did not pose a significant threat to the viability of former slaveholding farms after emancipation. These findings cast light not only upon the agricultural economy of the Cape but also to theoretical debates around slavery's persistence and demise.

The inevitable transition to wage labor had mixed economic effects. In Jamaica, the United States, and Haiti, for example, outputs either shrank or stagnated for long periods after the emancipation (Higman 1976; Higman 1986; Fogel 1994; Irwin 1994; Attack and Passell 1994; Wright 2006). Other regions seem to have made the change with their production relatively unscathed: Cuba continued to be a large producer of sugar and Brazil's coffee achieved production records in the years after emancipation (Galloway 1971; Lamounier 1993).

The case of the Cape Colony, however, is puzzling. Historians have been unable to determine exactly how the loss of labor affected output. From 1835 to 1839 slaves were still tied to their former masters as "apprentices" — emancipation only became fully effective in 1840. Dooling (2007, p. 116) says that when the apprenticeship period was over, "the freed slaves left their masters *en masse*". He says that in the days immediately after the emancipation there was a "large-scale withdrawal of labor from the wheat and wine estates of the Western Cape". Giliomee (2003, p. 116), on the other hand, notes that the colonial government did not make any land available for small-scale farming, so most of the slaves had little option other than to remain farm laborers. He quotes H. Calderwood, an eyewitness to the emancipation day, who commented that it was "ridiculous to talk of [the emancipated slaves] refusing to work when they know very well they must either work or starve".

Difficulties assessing the effects of the emancipation of the slaves in the Cape Colony stem from the nature of its economy. Unlike the Americas or the Caribbean, the Cape had a farming system made up mostly of small-scale landowners who had on average no more than four slaves (Worden 1985; Shell 1994). Slaveholders could hardly benefit from economies of scale, meaning that the employment of slaves as capital investments was particularly crucial for the viability of a slaveholding estate. Here, it is important to diverge from previous literature that treats slavery primarily as a coercive labor contract (Nieboer 1900; Engerman 1973; Genovese and Fox-Genovese 1983; Fenoaltea 1984; Engerman 1986;

Lovejoy 2000; Post 2003; Conning 2004; Acemoglu and Wolitzky 2011) and consider the understanding that slavery was a property system that gave slaveholders complete rights to a mobile asset. It provided slaveholders with a source of labor *and* capital. In this article I argue that it was not only labor loss but also capital loss – a factor that research has mostly neglected – that affected output after the emancipation.

In order to measure changes in farm output in the years before and after the emancipation, the article uses six newly digitized historical datasets covering the Stellenbosch and Drakenstein districts (henceforth "Stellenbosch", as this is how the two are often referred to). The Drakenstein district was a subdivision of the Stellenbosch district created in 1691. It continued to be administered by Stellenbosch. During most of the colonial history of the Cape and especially during the early nineteenth century, these were the most important agricultural districts.

The output variables of interest – grain and wine – are estimated as a function of the labor supply available to farmers, farm-specific characteristics such as farm size and topography, and other economically relevant covariates. The results are analyzed both at the aggregate and the individual level. Adding the compensation claims makes it possible to disaggregate the effects of emancipation into labor loss and capital loss. The estimation strategy consists of a household-level OLS estimator with random effects where output during the transition from slave labor to apprenticeship and later from apprenticeship to wage labor is captured in full.

The results suggest that after the emancipation small farmers with only a few slaves did not find it difficult to maintain their output level. The wealthiest farmers, however, with the largest estates and the most slaves, did indeed struggle. For this group, the loss of the ability to raise capital from their slaves was responsible for 70% of grain and 20% of wine output reduction. The literature usually limits the participation of slaves in the production process to the labor they offered, but this study finds evidence that slaves served as an important source of capital that kept the largest farming operations profitable.

This article makes two contributions. The finding that most farmers remained equally productive without slaves raises questions about the economic value of slavery. By showing that the economic role of slaves in the Colony was not restricted to farm work, the article draws attention to the need to revise theoretical frameworks in which the role of slaves is usually limited to labor. It also adds to the debate about the persistence of slavery by showing that slaves had additional value as capital. The second is to South African economic history studies more generally. The use of novel micro-level data to establish how the emancipation affected farmers of widely varying wealth levels and type of production adds depth and detail to a topic that has mostly been explored only descriptively and at aggregate level.

2 Historical background

The emancipation had a mixed effect on agricultural output in former slave economies. The southern United States, for example, experienced a sharp decline in output per person and stagnation in the years following the emancipation (Irwin 1994; Attack and Passell 1994). The American civil war was responsible for much of this, but Easterlin (1971, p. 46) points out that "there was also the problem of disorganization arising from the abolition of the slave system and the consequent need to work out new arrangements that would assure a stable and continuous labor supply". Before emancipation the plantation system enjoyed considerable per capita output and sustained economic growth; afterwards, former slaves left to become small-scale farmers (Fogel and Engerman 1977; Fogel 1994; Fogel and Engerman 1995).

Elsewhere, however, the picture was different. In Cuba the plantation economy remained strong, with sugar production peaking at around one million tons a year (Lamounier 1993), and in two Brazilian states, Pernambuco and Alagoas, the "change in the type of labor did not injure the sugar industry" (Galloway 1971, p. 602). In those cases, the authors argue, the long emancipation process allowed planters to readjust labor relations and find ways to cope after the inevitable freeing of the slaves. Cuba freed the slaves only in 1886 and Brazil in 1888. The Brazilian case is particularly interesting since not only did manumissions become more attainable for slaves during the period leading to the full emancipation, but from as early as 1880 European immigrant labor began to be attracted to replace them (Costa 1986; Bethell 1989; Sánchez-Alonso 2007). Italians were in the majority, but significant populations of Spanish, Portuguese, German, and Japanese migrants also eased the constraints on labor supply caused by the freeing of the enslaved workers (Fausto 1986).

The effects were also mixed throughout the British Empire. While Barbados, St. Kitts, and Barbuda managed the transition to wage labor without major disruptions in output, Jamaica experienced quite the reverse. Green (1991) suggests that as the abundance of arable land in Jamaica would have allowed former slaves to pursue subsistence farming, they would hardly have served as a reliable source of labor to former planters. Many plantations in Jamaica had been completely abandoned by the 1840s (Higman 1986; Higman 1987) and sugar output declined sharply as the planters "commonly agreed that the fundamental problem in maintaining plantation agriculture was an absolute shortage of labor" (Higman 2005, p. 235). Jamaica's coffee economy also shrank; however, Talbot (2015, p. 51) says the coffee plantations survived as a "smaller and restructured" sector well into the 1880s and were responsible for building the reputation of Jamaica as the producer of some of the world's best coffee.

Most of the literature investigating the effects of emancipation on output concentrates on the role of slaves as agricultural workers. The crux of the debate, therefore, is how well former slaveholders were able to secure a supply of labor. We have plenty of anecdotal evidence from the Cape. The Burgher Senate – a council responsible for the Colony's civic affairs and mostly composed of slaveholders – declared in

a memorandum in 1826 that they inhabited "a country of which the population is not and never has been equal to the extent of Territory nor adequate to the proper cultivation thereof" (Toit and Giliomee 1983, p. 62). Slaveholders at the Cape were concerned that the amelioration laws being implemented by British authorities were undermining their control over the slaves, something that would arguably be detrimental to the Colony's agricultural economy. By 1839, George Thomas Napier, the Colony's army commander , reported that "a large supply of labor was withdrawn from the country" (Dooling 2007, p. 117).

Compelling though the anecdotal evidence may be, scholars today continue to debate the effects of emancipation on agriculture in the Cape. The Cape differed in two important ways from other slave economies. Firstly, although established as a slave economy, it did not use a plantation system, where economies of scale would justify the investment in slaves. We have some evidence that slaves at the Cape were employed in activities not directly related to farming, meaning that slaveholders could profit from the slaves beyond their employment in agriculture (Worden 1985; Shell 1994; Fourie 2013; Green 2014; Swanepoel 2017). Secondly, the Cape had another source of labor: its indigenous population. The Khoisan, present in considerable numbers in the European settlement area, were employed as paid farm laborers right from the start of the Colony in 1658 (Elphick 1977; Elphick and Malherbe 1989; Fourie and Green 2015; La Croix 2018).

Thus, since slaves were widely employed in activities outside agriculture, Khoisan labor was readily available, and the Colony did not use a plantation system, the scenario of a stagnant and labor-constrained agricultural landscape at the Cape due to widespread loss of slave labor should be approached cautiously.

From the Colony's early years there were doubts about the viability of slave labor at the Cape. The original reason for colonizing the Cape was largely its geographic location and not its soil quality or suitability for agriculture. Perfectly placed to cater to ships passing to and from Asia, the Colony was set up as a refreshment station by the Dutch East India Company (the VOC, *Vereenigde Oostindische Compagnie*) in 1652. Its subsequent growth can be attributed to the increasing demand for spices and the growth of sea-trading routes.

Nevertheless, the Colony had slaves from its early years. As early as 1658, for example, more than 400 slaves disembarked at the Cape of Good Hope. Of these, 187 were re-shipped to Batavia, modern-day Jakarta, 89 were "sold on credit to the burghers [...] and the Company retained the remainder in its service" (Theal 1907, p. 78).

It is difficult to assess how many of the first settlers were employed directly by the VOC and how many were free farmers but, given the number of slaves that were retained by the VOC, it is unlikely that the ratio of slaves to free farmers exceeded one to one. Either paid or family labor must therefore have helped to keep farms productive and the Colony working as a refreshment station. The literature suggests that it was mostly the former, with farmers relying on Khoisan and *knechts* who were farm

overseers, usually white landless colonists (Worden 1985; Guelke and Shell 1983; Green 2014; Fourie and Green 2015).

One reason for relying on Khoisan to produce farming output in the early days of the Colony was the settlers' failure to employ slaves efficiently. Worden (1985, p. 6) says that in the early stages the agrarian labor was a "disaster" and many free farmers returned the slaves to the VOC, complaining that "it would be easier to do without them". The expansion of the Colony, however, dictated the need for more surplus produce, so despite the settlers' initial difficulties, slave imports continued.

The demand for slaves in the Colony intensified after the smallpox epidemic of 1713 devastated the Khoisan, with a death toll ranging from 30% to 90% of their original population in the Cape (Marks 1972; Ross 1977; Worden 1985; Armstrong and Worden 1989; Plessis et al. 2015; Fourie and Green 2015; La Croix 2018). By 1739, the slave population was roughly double that of the settlers, consolidating the Cape as a slave economy.

The increasing number of slaves did not, however, lead to economies of scale as on the plantation farms of the Americas and the Caribbean. During much of the eighteenth century, 85% of the Colony's farmers were slaveholders. Worden (1985, p. 31) says that slaveholding was "widespread, at least amongst the arable sector" but he points out that the holdings were quite small, "with units of over twenty adult male slaves still being rare by the end of the century". Slaves in the Cape Colony, therefore, were scattered across a large number of slaveholders. The farms were of two types: small ones run by family labor, Khoisan, and few slaves and specializing in one crop (either grain or vines), and large ones with a substantial number of slaves, running diversified operations and encumbered by debt that in some cases surpassed 160% of the farm's market value (Theal 1891; Hengherr 1953; Ross 1993; Dooling 2007).

After the Colony passed from Dutch to British rule in 1805, a period of particular relevance in the history of slavery began. The abolitionist movement was gaining traction both in Britain and in its overseas possessions aided by an increasing public disapproval of coerced labor. Emancipation eventually came in 1834 when the Slavery Abolition Act came into effect.

The Act abolished slavery within the British Empire and subjected the slaves to a period of apprenticeship, originally intended by the British authorities to be six years, but shortened at the Cape to four. During the apprenticeship, the slaves had to be "prepared" for life as a free citizen while still subjected to the slaveholders' authority. In theory, the apprenticeship offered an opportunity to the slaveholding class to establish "stable social patterns that would induce freedmen to remain settled in estate villages when the system ended" (Green 1991, p. 130).

After the period of apprenticeship, the British Parliament purchased the freedom of the slaves through cash compensations awarded to the former slaveholders. But slaveholders were concerned about the impending loss of labor. As early as 1797, W.S. van Ryneveld, a member of the Colony's Council of Policy, had told the governor of the Cape at the time, Sir George Macartney, that slaves were "absolutely necessary because there are no other hands to till this extensive country, and therefore it will be the work,

not of years, but as it were of centuries to remove by attentive and proper regulation this evil established with the first settling of the Colony" (quoted in Toit and Giliomee (1983, pp. 46–49)). His concerns were echoed by Krauss (1966, p. 42), a German traveler in the Cape at the time of the emancipation, who observed that former slaves left their former masters "as if by arrangement". Dooling (2007, p. 116) quotes a letter to *De Zuid Afrikaan*, a newspaper generally aligned with the slaveholding class, from a group of farmers saying "it is known to every person who is not blind, deaf or dumb, that the whole of the late apprentices, with but few exceptions, left their late employers immediately on their final emancipation".

Labor withdrawal certainly had an effect on output, but it is not the whole story. Two factors mitigated the effect. Firstly, as no compensation was offered to the slaves or land made available to them, it is likely that many remained in the districts where their former owners lived and provided them with seasonal paid labor. Secondly, as many slaves were not employed as agricultural workers, no large effect on farming output should be assumed, particularly as most of them were dispersed among many small farmers who were unlikely to benefit from using them to achieve economies of scale. Shell (1994) argues that the agricultural losses incurred by slaveholders were short-lived and that slaveholders quickly re-established their post-emancipation levels of output, and Worden (1992, p. 20) notes that "at the Cape, the majority [of freed slaves] remained on the farms as low-paid labourers". It is against this background that this article makes its argument, using the rich data presented in the next section.

3 Data

The data for this study comes from six sources: (1) the *Bewaarders Van Ons Erfenis* (BVOE, "custodians of our heritage"), a transcribed index of all farm owners in all the Cape Colony districts; (2) data on farms' topography, from the National Oceanic and Atmospheric Administration (NOAA), and soil types, from the International Soil Reference and Information (ISRIC) center; (3) tax censuses – known as *opgaafrollen* – collected annually by the British colonial authorities between 1823 and 1844; (4) the South African Families (SAF) database, which contains records of all settler families in the Cape Colony between 1652 and 1910; (5) the Cape Colony's consumer price index produced by Zwart (2013); and (6) records of slave valuation and cash compensation awarded by the British government to former slaveholders, from the Office of Commissioners of Compensation (OCC).

The BVOE was produced by the Drakenstein Historical Society. It is based on land ownership records collected by Cape colonial officials between 1849 and 1850 under the auspices of Sir Henry Wakelyn Smith, the governor of the Cape at the time and first published in the Cape Colonial Gazette. This dataset makes it possible to link the farmers appearing in the tax censuses with their respective farms. Because the tax censuses used in this article cover the period 1824 to 1844, I had to rely on the assumption that farmers I observe during this period remained on the same farm. The Drakenstein

Historical Society also linked the ownership information to maps available at the Cape Archives, which makes it possible to assess the size of the farms as well as their location. Figure 15 in Appendix C shows all the registered farms in the Cape Colony in 1850 and highlights those in Stellenbosch. Knowing their location made it possible to obtain farm-specific details of topography and soil type (see Figures 16 to 20 in Appendix C and the explanation of variables in Appendix D). The BVOE contains information on 517 farms associated with 509 farmers in Stellenbosch.

The tax censuses or *opgaafrollen* contain information on household size, agricultural output, and related capital. Agricultural output in Stellenbosch consisted mostly of grain – such as oats, rye, wheat, and barley – and wine. Livestock such as sheep and cattle are also recorded in the *opgaafrollen*. Family size and the gender of the family members are recorded. Household heads are often men, identified by their first name and surname. If married, the name and married surname of the wife also features separately on the records. Some records also provide genealogical information, such as the name of the father of the household head. This information is useful because it helps us to distinguish between individuals who had the same first name and the same surname. Lastly, slaves and Khoisan are also reported as household assets although Khoisan were wage laborers.

Since this study explores variations in output during the decades before and after the emancipation of the slaves (1834), only tax censuses between 1824 and 1844 were considered. To create a household-level panel, the residents of Stellenbosch were manually linked over the years of interest using the names from the BVOE as a baseline. The entire set of *opgaafrollen* from 1824 to 1844 contains more than 29,000 observations. The linking was done using the men's first names and surnames in combination with the names of their wives. To make the links more accurate, I used the South African Families database, which has the genealogical records of all settler families in the Cape Colony between 1652 and 1910. Each individual in the SAF has a unique ID that can be linked to the ID of his or her relatives, making it possible to double-check the links made directly through the *opgaafrollen*. The SAF also includes the individuals' marital status across time, making it possible to take into account the death of a spouse and subsequent remarriages. (See Appendix D for more detail on the methods used to identify links.) In the end I had a sample of 395 farmers that were in both the BVOE and the *opgaafrollen*, yielding 4,254 observations. Figure 1 shows the location of their farms in Stellenbosch.

The Cape Colony's consumer price index produced by Zwart (2013) was a valuable source of data, given the inflation during the emancipation period. The British cash compensation scheme caused the circulation of specie to double during 1837 (Meltzer 1989). This influx of cash was sufficient to cause a financial upheaval at the Cape, lowering interest rates and triggering inflation.

Incompleteness is a common problem in historical datasets. In the BVOE, some farmers have more than one farm and some farms have more than one owner, which explains the difference between the number of farms and the number of farmers. In some instances farms are named but I could not identify the owner, and in others I found a farm owner but could not identify his farm. Given these shortcomings,

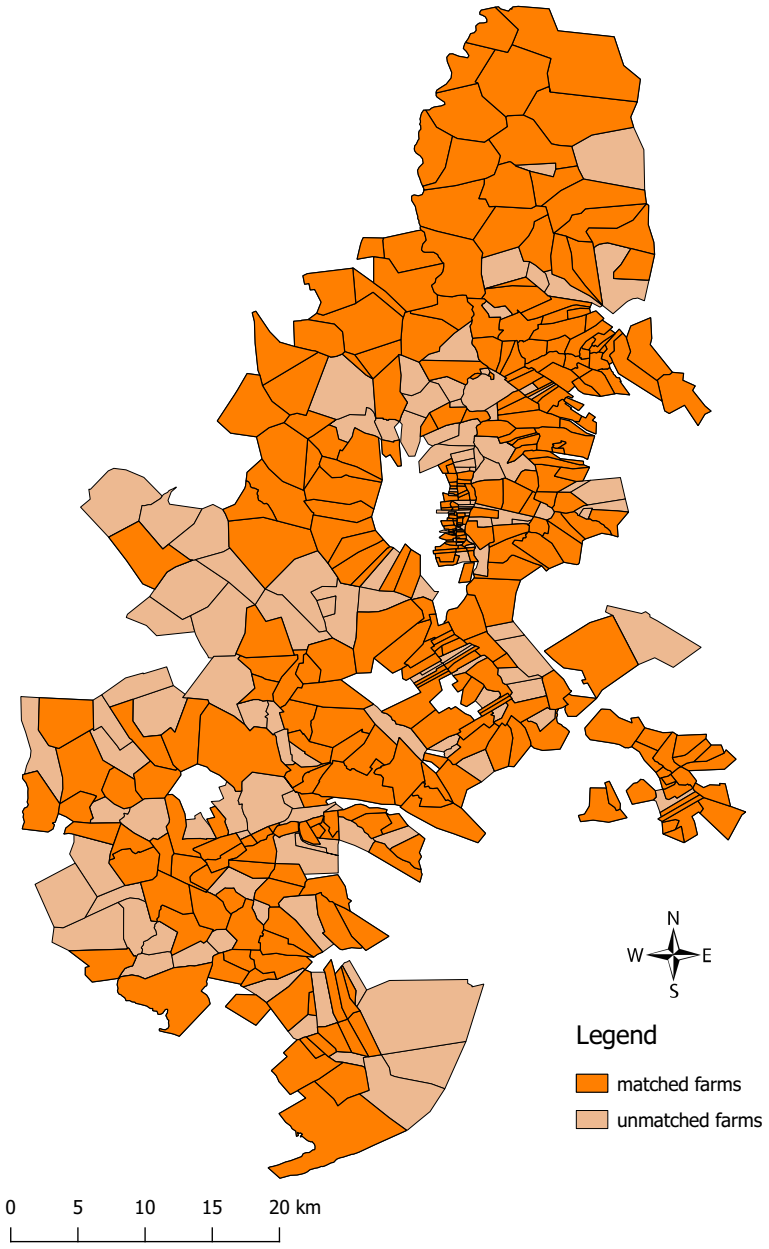

Figure 1: Matched and unmatched farms, Stellenbosch

the analytical sample – i.e. a sample in which all observations contain all the relevant information for this study – was reduced to 365 farmers and 3,584 observations from 1824 to 1844. The tax censuses did not collect information on agricultural output for the years 1830 and 1839, so those years are excluded from the analysis. Table 1 presents the descriptive statistics for the analytical sample.[1]

[1]Descriptive statistics of unmatched individuals – who could not be linked over the years of interest using the names from the BVOE as a baseline – are displayed on Table 7 in Appendix A. In short, unmatched individuals produce less wine, have smaller families, less livestock, fewer slaves and fewer Khoisan working on their farms. Grain output is similar to the analytical sample. Consequently, unmatched individuals are poorer than the ones matched. This is not surprising as record-keeping is traditionally better among wealthier individuals. See Rijpma et al. (2019) for detailed information on *opgaafrollen*'s record linkage.

Table 1: Descriptive statistics - analytical sample, individual-level

Variable	No. of farmers	Obs.	Mean	Std. dev.	Min	Max
Total grain	358	3,577	36.14	96.97	0	5,200
Total wine	358	3,577	20.69	26.35	0	2,401
Total settlers	357	3,559	5.01	3.05	0	27
Total labor	357	3,564	10.32	9.09	0	148
Slaves	357	3,564	4.22	6.02	0	81
Khoisan	365	3,584	3.35	3.42	0	74
Total livestock	358	3,577	41.46	94.47	0	1,480
Farm size	365	3,584	4.55	6.64	0.02	44.12
Carbon content	365	3,584	16.44	5.01	8.70	40.15
Cation exchange	365	3,584	12.97	2.84	7.54	28.32
Clay content	365	3,584	21.22	1.97	16.74	26.09
Elevation	365	3,584	220.38	140.57	31.00	816.19
Soil pH	365	3,584	63.00	1.74	56.84	66.66

[Notes] Grain is reported in *muids*, a South African dry measure of capacity equivalent to 109 liters. Wine is reported in *leggers*, equivalent to 576 liters. Farm size is reported in square kilometers. Clay content is presented as percentage, cation exchange of soil capacity is measured in cmolc/kg, soil carbon content (fine earth fraction) in g per kg and soil pH x 10 in H2O. Mean elevations are reported in meters.

Table 1 shows that the average number of slaves per household and the average size of the farms in Stellenbosch are quite small. Farming was mostly on a small scale and counted on the participation of family, slaves and indigenous labor. Complementary to Table 1, it is also important to analyze output trends over time. Figures 2 and 3, therefore, display the total output in Stellenbosch during the whole period of interest of this study.

The figures show that grain production fluctuated while wine production remained relatively stable. However, the decline in grain production dates from the early 1830s, which suggests that the emancipation did not make much difference to the trend. It is also relevant that in 1840 — when the slaves were effectively liberated – production recovered quickly and reached levels similar to those of the 1820s. The aggregate picture represented by Figures 2 and 3 does not show any clear effect of the emancipation on Stellenbosch's agricultural output.

Another possible conclusion we can draw from Table 1 is that grain, wine, and slave ownership were highly unequal within the district, judging by the large standard deviations of the three variables. Using all the datasets combined we can find specific examples of the disparities between farmers. Let us take one Petrus Johannes de Villiers as an example.

Between 1824 and 1844 there were at least two men by the name of Petrus Johannes de Villiers in Stellenbosch. Their marriage records make it possible to differentiate between them. Afrikaner families tended to name their children after their relatives. If the first-born was male, he was named after the paternal grandfather; if female, the paternal grandmother. The second-born was named after the maternal grandparents and the third-born after the parents, conditional, of course, on sex. This pattern was extended to the parents' siblings, depending on the size of the family. This tradition led to several individuals bearing the same first names and surnames, making the marital status – and consequently

Figure 2: Total grain output in *muids*

the wife's name – a valuable tool to match individuals successfully across different tax censuses.[2]

The genealogical records show that the Petrus Johannes de Villiers we have selected as an example was born in Paarl in February 1794, the tenth of the twelve children of Petrus and Magdalena de Villiers. Petrus Johannes had a tumultuous married life: he had four marriages, was widowed three times, and had 18 children from the four wives. He died at 69 years of age in 1863. He had a relatively small farm named Schoongezicht, devoted mostly to viticulture, producing an average of 20 *leggers* of wine per year.[3] During the period of observation, he reported no grain output and very little livestock. He owned slaves and reported eight of them in 1830, slightly above the district's average. He also used some indigenous labor, sporadically reporting one or two Khoisan working on his farm.

Petrus Johannes represents an average wine producer in the district. Other farmers invested in a wider range of agricultural goods. Hendrik Jacobus van der Spuy, for example, was the owner of more than 19 square kilometers of land, made up of two farms, Otterkuil and Paarl Diamant. A large livestock holder, between 1824 and 1844 Hendrik Jacobus averaged more than 200 head of livestock, half of which were cattle. There were few occasions when his grain output reached less than 800 *muids*.[4] He also successfully produced wine, averaging 40 *leggers* a year. By Stellenbosch standards – and also those of

[2]For more details about the Afrikaner naming tradition, see de Villiers and Pama (1981).
[3]About 11,520 liters, a legger being a barrelful, about 576 liters.
[4]About 70 tons, a muid being a sackful, about 109 dry liters.

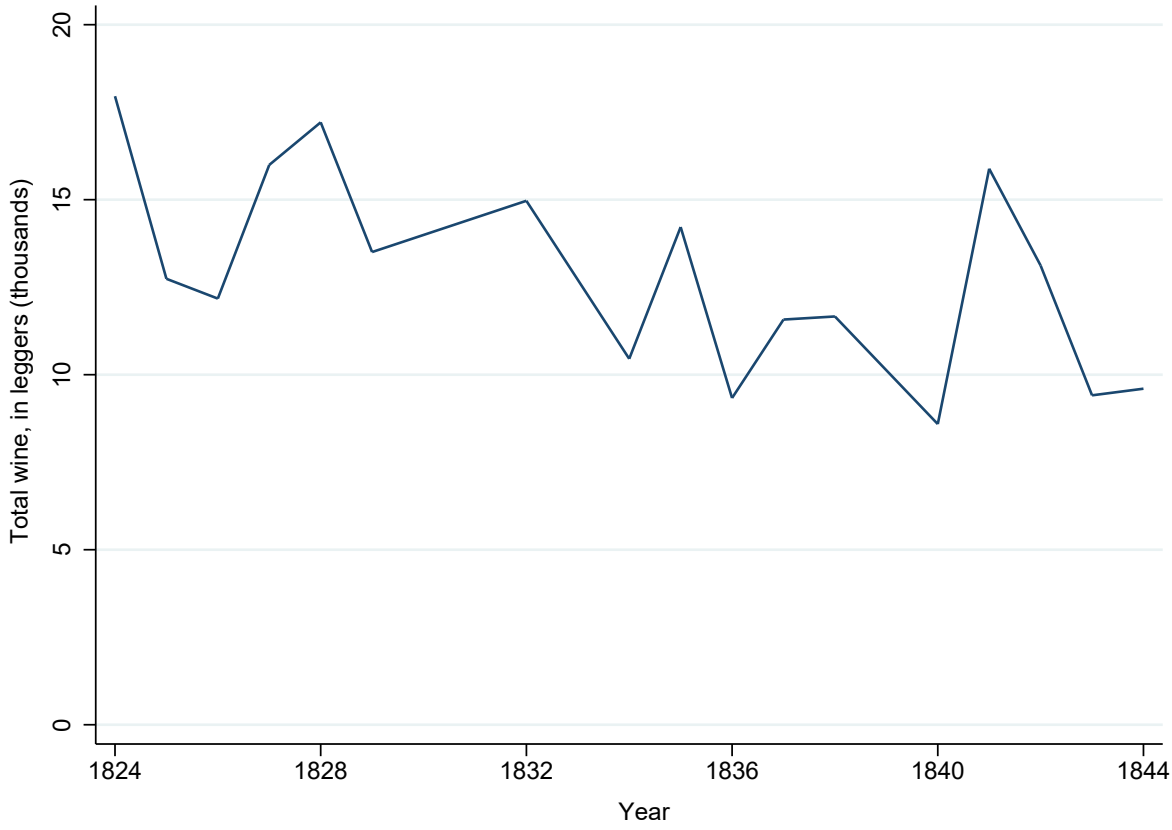

Figure 3: Total wine output in *leggers*

the Cape Colony – his output was above average. The same was true for slaves. In 1827, he reported 14 slaves on his estate. He also employed several Khoisan, from five to seven depending on the year of analysis. He was married to Anna Hillegonda Aspeling and died in 1864 at 79 years of age, leaving a thriving farming operation for his wife and their nine children. These and other examples show that the possession of slaves was widespread even among farmers reporting very different agricultural output. Table 2 shows that relationship and the number of farmers in each slaveholding category.

Table 2: Number of farmers, observations, farm size, grain and wine output by group of slaveholders

Slaves held	No. of farmers	Obs.	Farm size	Grain, mean	Wine, mean
0 slaves	81	529	3.34	13.81	7.95
1 to 4	107	1,136	4.80	21.42	10.09
5 to 7	39	499	3.29	25.45	20.21
8 to 12	54	634	4.51	45.72	35.82
13 to 20	32	417	4.32	77.30	41.56
More than 20	52	369	6.66	121.38	54.17

[Notes] Farm size is reported in square kilometers. Grain output is reported in *muids*, a South African dry measure of capacity equivalent to 109 liters. Wine output is reported in *leggers*, equivalent to 576 liters.

The figures in Table 2 are mostly in line with expectations, but it is important to note that the cohort who owned between one and four slaves had, on average, larger farms than all their peers other than those with more than 20 slaves. This cohort's grain and wine outputs per square kilometer are

relatively low.[5]

The current data inspection provides us with some lessons. Firstly, no immediate rupture on output trends can be observed during the apprenticeship or post-emancipation periods when looking at aggregate numbers. Secondly, farm size is just weakly correlated with the amount of grain and wine output. Moreover, slaveholding status increases with farm size although not on a linear relationship. These descriptive statistics add to the puzzle of the farming economy of the Cape. Slaveholding is widespread among estates differing in size and agricultural yield, imposing difficulties on the assessment of 1) the ways in which slaves were employed and 2) *a priori* expectations concerning the effects of emancipation. A model that seeks to explain the relationship between emancipation and production patterns is, therefore, necessary. I discuss it in the next section.

4 Methods

I start with the assumption that the agricultural output (y) of a farmer (i) in a given year (t) is given by the amount of capital (K) and labor employed (L) plus an error term μ, written as:

$$y_{it} = f_{it}(K_{it}, L_{it}) + \mu_{it} \tag{I}$$

I divide the emancipation of the slaves into three periods: 1824–1834, during which Stellenbosch operated as a slave economy, 1835–1839, reflecting the apprenticeship period, and 1840–1844, which captures the effective emancipation of the slaves. Mathematically, this process is represented by the dummy variable E_t. This dummy variable interacts with the slaveholding status of each farmer to capture the effects of emancipation on production across the groups of slaveholders T_i. In this case, let us consider a function g denoted by:

$$y_{it} = g_{it}(K_{it}, L_{it}, T_i, E_t) + \mu_{it} \tag{II}$$

And g can be written as:

$$g = K_{it} + L_{it} + T_i E_t + \mu_{it} \tag{III}$$

In equation III, labor can be divided between family labor (F), consisting of all household members, and non-family labor (NF) consisting of Khoisan and knechts before emancipation. After emancipation, this variable also includes freed slaves. Capital includes the farmer's livestock (V), farm size (A), and range (z) of characteristics associated with the land (G), meaning that (g) can be further developed to:

[5] Average agricultural output according to the number of slaves a farmer owned is shown in Figures 8 and 9 in Appendix B.

$$g = F_{it} + NF_{it} + A_{it} + V_{it} + \sum_{z} G_{zi} + E_t T_i + \mu_{it} \tag{IV}$$

Ultimately, the basic functional form can be written as:

$$y_{it} = \beta_1 F_{it} + \beta_2 NF_{it} + \beta_3 L_{it} + \beta_4 V_{it} + \sum_{z} \beta_5 G_{zi} + \beta_6 E_t + \beta_7 T_i + \beta_8 E_t T_i + \mu_{it} \tag{V}$$

The terms $E_t T_i$ represent the interaction between slaveholding status and the three periods of the emancipation. Since NF_{it} controls for labour at any given time during the period of interest, E_t captures the aggregate effect of the emancipation – from the perspectives of labor withdrawal and/or loss of collateral – on output, while T_i captures production differences that existed between the groups of slaveholders before emancipation. The range z of covariates associated with farm-specific conditions are clay and carbon content, cation exchange, mean elevation, and soil pH. Equation V is estimated through a simple OLS with random effects and its results are discussed in the next section.

5 Results

Tables 3 and 4 present a reduced form of the estimates to show the effects of emancipation on the output of grain and wine. The complete regression tables can be found on tables 8 and 9 in Appendix A.

Table 3 displays six different estimates. Starting with estimate 1, it represents the most basic functional form where grain output, measured in *muids*, is regressed on the number of settlers in the household, the labor available to farmers, the inflation index of the Cape Colony and the livestock in the farm. Estimates 2 to 6 incorporate farm-specific characteristics alongside an augmented number of covariates. Estimate 3 incorporates the number of slaves owned by each slaveholder (slaveholding status) and estimate 4 incorporates the three periods of the emancipation timeline, (1824–1834), (1835–1839), and (1840–1844). Estimate 5 represents the interaction effect between the emancipation timeline and the slaveholding status. Lastly, estimate 6 excludes the year 1839 from the base estimates because of data incompleteness (total labor available to farmers was not properly recorded).

Taking estimate 6 as the benchmark makes it possible to verify that inflation has a negative effect on output, despite being marginal when compared to the positive correlation that exists between grain output and total livestock. The importance of family labor, on the other hand, is not conclusively demonstrated across all estimates. As regards slaveholding status, it is clear that more slaves are associated with more output, especially for farmers who had more than 20 slaves, confirming that larger-scale slaveholders could use their slaves to achieve economies of scale.

By representing the effects of apprenticeship and emancipation on production, estimates 4, 5, and 6 provide important insights. The decline in output after the emancipation is statistically significant in estimate 4. However, because estimate 5 and 6 disaggregate the effects of the emancipation and

Table 3: Effects of the emancipation of slaves on grain output

y = Grain output	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Total settlers	0.76	1.40**	1.41**	1.59**	1.20*	1.26
Total labor	1.76***	1.24***	1.16***	1.20***	0.99***	0.95**
CPI	−0.08***	−0.08***	−0.08***	−0.06***	−0.07***	−0.08***
Total livestock	0.27***	0.30***	0.29***	0.30***	0.32***	0.30***
Number of slaves						
0 slaves			ref	ref	ref	ref
1 to 4			3.92	1.89	13.30	12.79
5 to 7			−10.79	−14.16	4.48	5.38
8 to 12			0.06	−3.16	21.13	24.58
13 to 20			14.74	10.27	34.34	39.44
More than 20			20.93	18.23	63.64***	77.35***
Emancipation timeline						
Before (1824-1834)				ref	ref	ref
Apprenticeship (1835-1839)				−5.99	18.30	15.00
After (1840-1844)				−9.97**	9.04	8.86
Interaction effects						
1 to 4 slaves						
x 1824-1834					ref	ref
x 1835-1839					−22.32	−22.03
x 1840-1844					3.28	3.51
5 to 7 slaves						
x 1824-1834					ref	ref
x 1835-1839					−18.50	−16.39
x 1840-1844					−19.82	−20.52
8 to 12 slaves						
x 1824-1834					ref	ref
x 1835-1839					−25.41	−26.35
x 1840-1844					−31.32*	−34.24*
13 to 20 slaves						
x 1824-1834					ref	ref
x 1835-1839					−28.66	−32.86
x 1840-1844					−26.39	−30.79
More 20 than slaves						
x 1824-1834					ref	ref
x 1835-1839					−45.51**	−55.48**
x 1840-1844					−60.41**	−72.34**
Constant	38.68***	560.22*	558.96*	558.92*	536.55*	527.40
R-squared	0.15	0.17	0.17	0.18	0.18	0.19
Observations	4234	3818	3818	3818	3818	3559
Groups	395	358	358	358	358	357

[Notes] Grain is reported in *muids*, a South African dry measure of capacity equivalent to 109 liters. Standard errors are clustered at the household level.

*p<0.10; **p<0.05; ***p<0.01

apprenticeship on output, we find that only the large-scale slaveholders struggled to maintain the same levels of output after emancipation, with one group in particular, those with more than 20 slaves, also facing difficulties during the apprenticeship period.

The magnitude of the coefficients is noteworthy. Holders of more than 20 slaves produced roughly 55 *muids* (4.7 tons) less grain per farm during the apprenticeship than before emancipation. After emancipation, their losses averaged more than 6 tons per farm. Slaveholders who had 8 to 12 slaves experienced more modest losses of roughly 34 *muids* (3 tons) per farm on average. To put this in

perspective, however, note that total grain production in Stellenbosch averaged more than 25,000 *muids* per year between 1840 and 1844 and no single slaveholding group accounted for much more than 20% of the total grain and wine output, as evidenced by Figures 11 and 13 in Appendix B. It thus appears that the smaller-scale slaveholders prevented the emancipation from having even worse effects on output, since they remained equally productive in the subsequent years. Figure 4 shows the estimates.

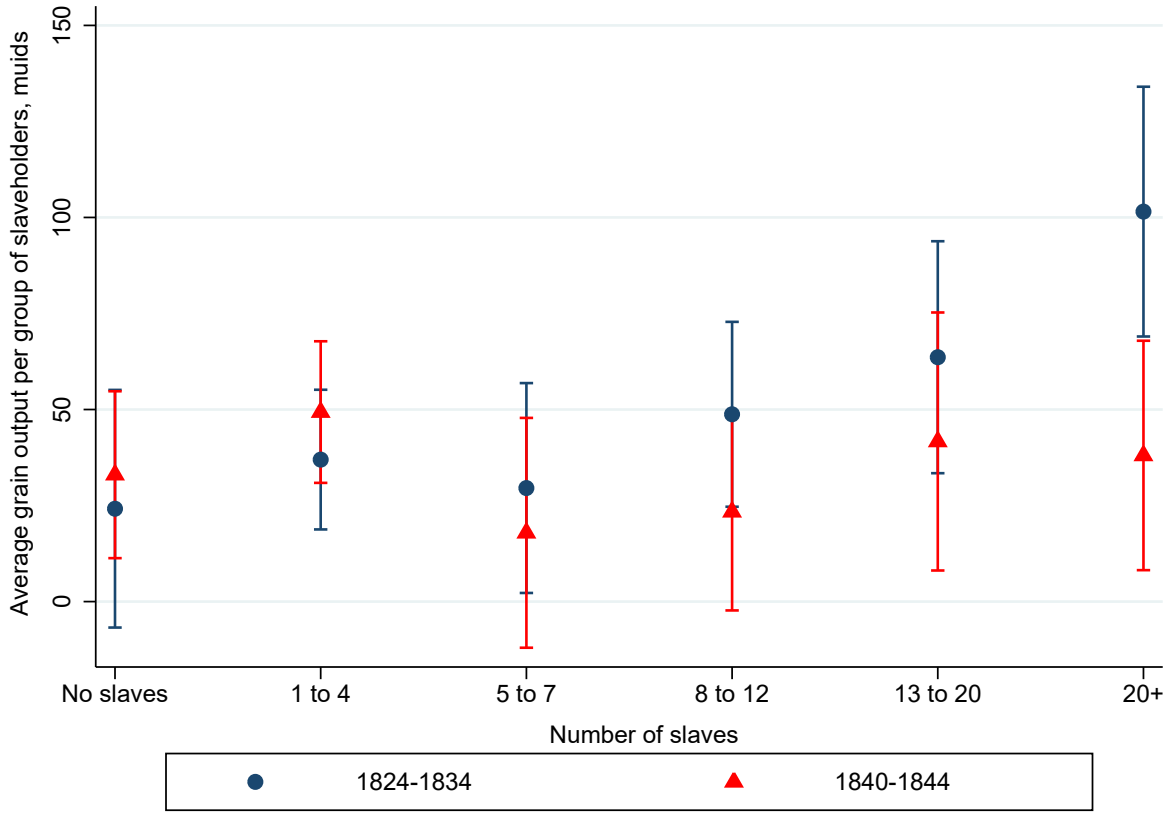

Figure 4: Estimated grain output in *muids* before and after emancipation per group of slaveholder

A similar deduction may be made from the wine output estimates in Table 4. Family and non-family labor contribute positively to wine output across all the estimates. The effects of inflation are not statistically significant. Larger farm sizes are not associated with a bigger wine output, suggesting that this was not a major determinant of the number of vines planted.[6] Like the estimates of grain output, the number of slaves contributes positively to wine production. Estimate 12 shows that farmers who had 13 to 20 slaves and those who had over 20 produced 19 (10,950 liters) and 26 (15,000 liters) more *leggers* of wine, respectively, than non-slaveholders.

The interaction effects between slaveholding status and the emancipation timeline do not provide as many significant results as the estimates of grain output. They are, nonetheless, valuable. After emancipation, farmers who had more than 20 slaves had a reduction in wine output amounting to 15

[6]When elements of soil quality are removed from the base estimates in 12, however, the farm size becomes statistically significant, leading us to conclude that soil quality – and not farm size – determined the quantity of wine produced.

Table 4: Effects of the emancipation of slaves on wine output

y = Wine output	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Total settlers	0.62***	0.64*	0.49**	0.56*	0.59*	0.67*
Total labor	1.10***	1.18***	0.97***	0.91***	0.79***	0.85***
CPI	0.01	0.00	0.00	−0.01	−0.01	−0.02*
Total livestock	0.05***	0.08***	0.07***	0.07***	0.07***	0.06***
Number of slaves						
0 slaves			ref	ref	ref	ref
1 to 4			2.75**	4.14***	1.06	0.27
5 to 7			7.13***	9.04***	4.65*	4.34
8 to 12			15.65***	17.49***	8.94	9.87
13 to 20			15.64***	17.94***	17.72***	19.52***
More than 20			16.19***	18.65***	23.18***	26.40***
Emancipation timeline						
Before (1824-1834)				ref	ref	ref
Apprenticeship (1835-1839)				8.77**	1.37	−0.77
After (1840-1844)				4.29***	3.10	2.09
Interaction effects						
1 to 4 slaves						
x 1824-1834					ref	ref
x 1835-1839					5.05***	5.97***
x 1840-1844					2.10	2.82
5 to 7 slaves						
x 1824-1834					ref	ref
x 1835-1839					8.08**	8.45**
x 1840-1844					5.37	5.60
8 to 12 slaves						
x 1824-1834					ref	ref
x 1835-1839					25.35***	24.47***
x 1840-1844					6.16	5.35
13 to 20 slaves						
x 1824-1834					ref	ref
x 1835-1839					1.25	−0.69
x 1840-1844					−2.68	−4.39
More than 20 slaves						
x 1824-1834					ref	ref
x 1835-1839					2.52	−7.39
x 1840-1844					−12.65*	−15.27**
Constant	4.68	71.91	76.05	69.63	67.48	63.28
R-squared	0.12	0.15	0.16	0.17	0.17	0.18
Observations	4234	3818	3818	3818	3818	3559
Groups	395	358	358	358	358	357

[Notes] Wine is reported in *leggers*, equivalent to 576 liters. Standard errors are clustered at the household level.

*p<0.10; **p<0.05; ***p<0.01

leggers (8500 liters) on average. The visual representation of these findings are displayed in Figure 5.

These estimates of grain and wine output reduction suggest that after the emancipation the major farmers found it difficult to keep producing Stellenbosch's two most important crops. This brings us back to this article's fundamental question: what caused the decline?

I argue that it was not just labor withdrawal: that answer is simplistic and ignores the complexity of the slave economy at the Cape. As Dooling (2007, p. 129) notes, "credit was essential to the operation of virtually every slaveholding estate". The economic success of many farmers rested on their ability to secure mortgages and short-term loans to keep farming operations afloat. The importance of slaves

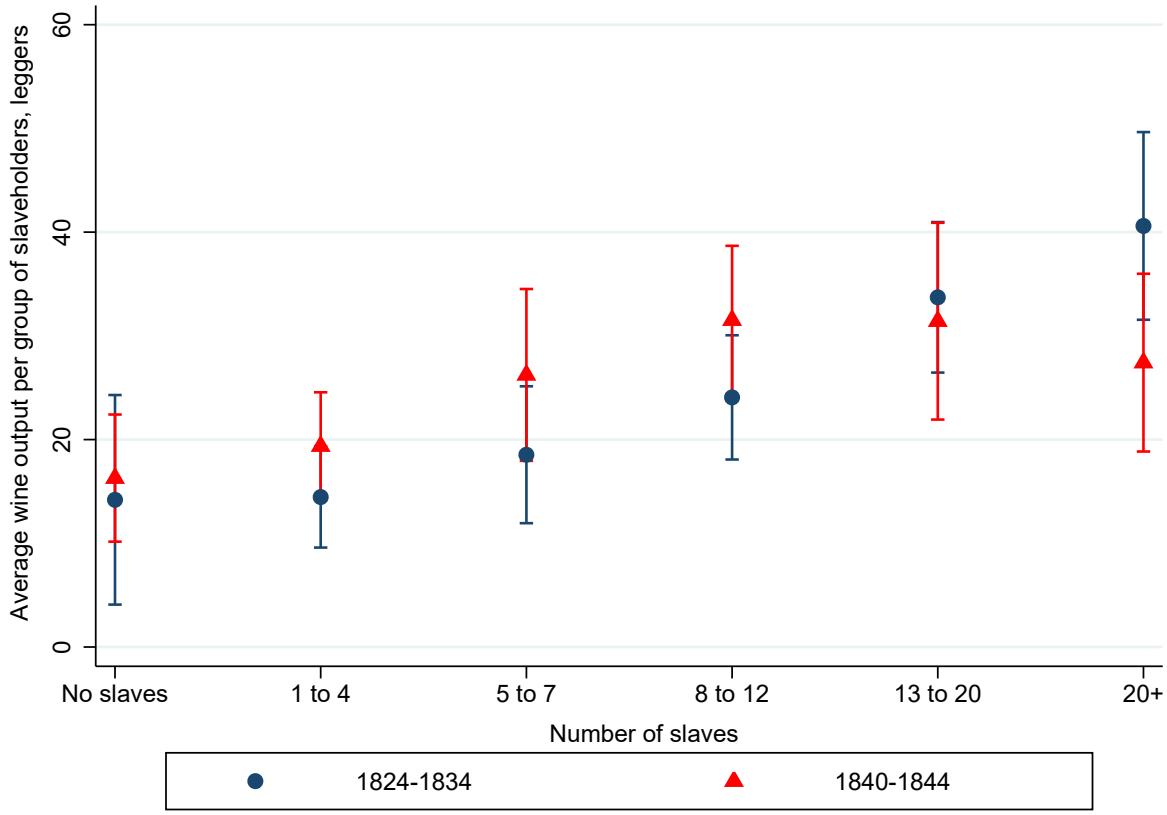

Figure 5: Estimated wine output in *leggers* before and after emancipation per group of slaveholder

as a source of collateral, together with reports suggesting that after emancipation former slaves mostly did not leave the district (Worden 2017), casts doubt on any explanation that limits the emancipation effects to loss of labor.

This is not to say, of course, that slave labor was not important. The labor market at the Cape Colony became under-supplied after 1840 and some farmers were not keen to adjust to the new wage-labor system (Shell 1994; Dooling 2007; Worden 2017). The international literature largely attributes the stagnation of once-thriving agricultural economies such as the southern United States, Jamaica and Haiti to loss of slave labor and difficulties in switching to a new mode of production. Strengthening the argument, the literature also attributes the success stories of Brazil and Cuba to the ability of farmers to secure a supply of labor. So we need to tread carefully if we want to provide a counter-argument for the Cape.

How can we separate out the possible causes of decline? One indication of the effect of capital losses on output in the Cape Colony is that cash compensation to former slaveholders did not match the value of the slaves. My data shows that the net loss of capital, or "shortfalls", was randomly distributed across slaveholders. This makes it possible to assess the effect of these shortfalls on output, especially as my model already incorporates the amount of labor available to farmers in the years after 1834. I elaborate in the next section.

6 More than just labor

6.1 The compensation scheme

To determine the effect that slaves as a capital investments, not labor, had on agricultural output, I analyzed the slave valuation and compensation records produced by the Office of Commissioners of Compensation (OCC). These records contain information on all the slaves who were emancipated in Stellenbosch.[7] They record the slaves' names, gender, age and place of birth, and their values. They also record the full names of the slaveholders, which makes it possible to link them to the *opgaafrollen* and the main dataset used in this article, the BVOE. Of my sample of 365 farmers, I identified 157 in the *opgaafrollen*. Further linking between the *opgaafrollen* and the BVOE generated 143 successful matches, yielding 1,859 observations.

The value of the slaves was derived from the prices paid for them at public and private sales between 1823 and 1830. To assess all the slaves in the Colony, the OCC sent appraisers to all slaveholding farms. Ultimately, the 38,000 individuals who made up the enslaved population at the Cape were valued at £2,800,000 (Hengherr 1953; Meltzer 1989; Shell 1994; Worden 2017).

The abolitionist movement accepted that emancipation would not be politically feasible unless compensation was paid. Fogel and Engerman (1974, p. 377) note that the main issue "was not whether holders of slaves should be compensated, but rather who should bear the costs of such compensation". The assessors conducting the slave valuation took into account market prices and, in theory, all the characteristics that slaveholders valued in their slaves. The compensators, however, considered only the sex and occupation of the slaves, and rated slaves in the same category as homogeneous and interchangeable (Draper 2008). Adding to slaveholders' frustrations was the fact that Britain did not apportion a sum that would cover the entire wealth worth of the slaves in its empire. The Cape, for example, was allotted £1,247,000, less than half the assessed value. Uncertainty about when and where the payments could be redeemed particularly alarmed slaveholders who had mortgaged slaves or incurred debts using slaves as collateral. In 1835, for example, 72 slaveholders from Cape Town sent an urgent letter to the chief secretary to the Colony's government, Sir John Bell, begging him to obtain clarity from the King and the British Parliament on how payment would be made.[8]

Slaveholders received wildly varying compensation that bore little relation to the value of their slaves. The appraisal and the compensation procedures had both been clearly defined, but there was a disjuncture between the two since they used different criteria: the assessors taking into account a wide range of characteristics while the compensators considered only sex and occupation and ignored distinctions within categories. The result was considerable discrepancies between value and compensation, as Figure

[7] For more information on the slave valuation and compensation records in Stellenbosch, see Heese (2019). The lists of compensation claims for slaves were transcribed from the sources. Digitized records can be found on the Legacies of British Slave-ownership (LBS) project's website https://www.ucl.ac.uk/lbs/.

[8] Cape Archives Memorials, vol. 6, CO 3977. Letter from 72 slaveholders to Sir John Bell. 17 July 1835.

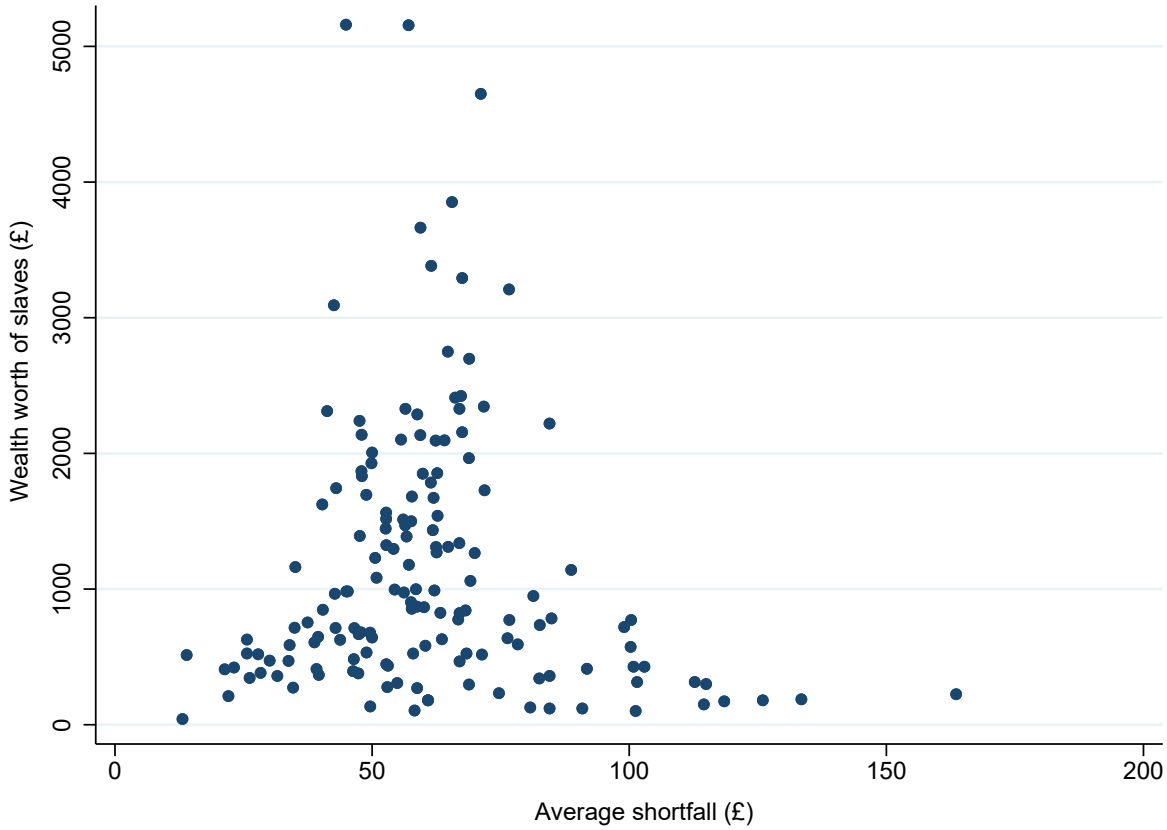

Figure 6: Cash compensation contrasted with slave valuation. Each data point represents a slaveholder

6 shows. It is clear that several slaveholders with slaves of a similar value received different amounts of compensation. This variation can be used to determine the loss of output resulting from capital loss while at the same time controlling for labor loss. This is explored in the next subsection.

6.2 Effects of capital on grain and wine output

Considering that the wealth (W) of a given slaveholder (i) in a given year (t) is given by his wealth worth of slaves (S) and other assets (A), then:

$$W_{it} = h_i(S, A) + \mu_i \tag{VI}$$

After emancipation in 1834, slaveholders lost S and received compensation, C. The function h, therefore, can be re-written as:

$$h = A + (C - pS) \tag{VII}$$

In equation VII, p represents the value assigned to each slave. C is a direct function of the number of slaves, therefore the more slaves owned, the bigger C will be. Since C and pS are proportional – the more slaves, the bigger the absolute compensation paid – this article considers a function h where wealth

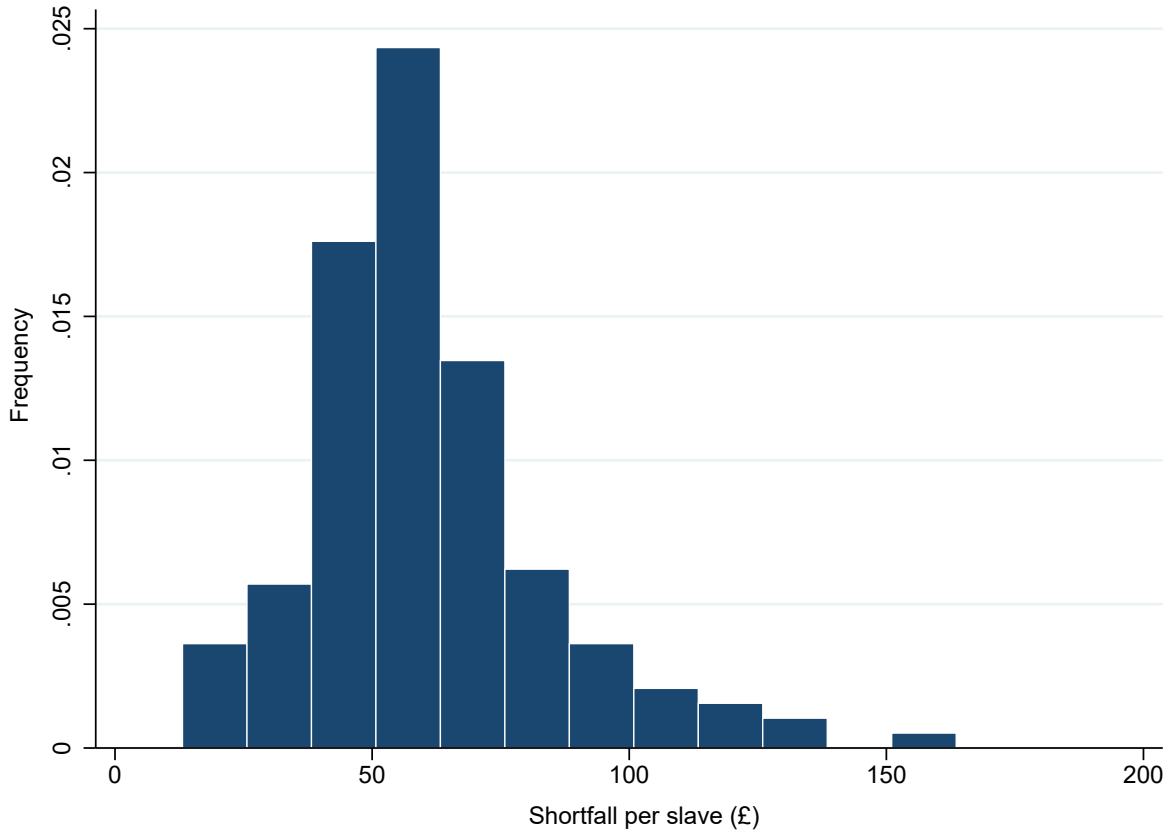

Figure 7: Distribution of mean shortfalls per slave

is a function of the mean compensation *per slave*. The distribution of the average shortfall is represented in Figure 7 and reveals that slaveholders experienced shortfalls of roughly £60 on average. Incorporating equation VII into equation V above makes it possible to estimate the effect of capital loss as distinct from labor loss for both grain output (Table 5) and wine output (Table 6).

Table 5 shows that the shortfalls had a statistically significant effect on grain output. The results are mostly as we would expect. The large-scale slaveholders, those who had more than 20 slaves, were the worst affected by the shortfalls, with every pound of uncompensated value resulting, on average, in a 0.85 muid (0.07 ton) reduction in output. Taking an average shortfall of £60, it is possible to conclude that on average 51 *muids* (4.2 tons) of wheat per large-scale slaveholder were not produced because of the loss of capital. If we now consider Table 3, which shows that large-scale slaveholders experienced a loss of 72 *muids* (6 tons) on average, we must conclude that loss of capital, e.g. inability to use slaves as collateral, was responsible for 70% of the grain output reduction and labor loss only 30%.

The results for wine, shown in Table 6, follow a similar pattern, though the effect of capital loss is smaller and its statistical significance is weaker. In fact, it might seem that the shortfalls had instead a positive and significant effect on wine output. This interpretation, however, is corrected when we look at the group-specific estimates. For the large-scale slaveholders, with 13 to 20 slaves, every pound of uncompensated value resulted, on average, in a 0.05 legger (29 liters) reduction in output. Again taking

Table 5: Effect of capital losses on grain output

y = Grain output	**(13)**	**(14)**	**(15)**	**(16)**
Total settlers	−0.78	−0.01	−0.01	−0.29
Total labor	2.65***	1.55***	1.43***	1.34***
CPI	−0.11***	−0.11***	−0.11***	−0.11***
Total livestock	0.21**	0.32***	0.31***	0.33***
Avg. shortfall	−0.28***	−0.23***	−0.23***	−0.026
Farm size		1.94**	1.51	1.50
Carbon content		0.45	1.54	1.42
Cation exchange		3.15	3.00	3.08
Clay content		−14.66***	−16.13***	−16.48***
Elevation		−0.08**	−0.10**	−0.10**
Soil pH		5.21	6.92	6.69
Number of slaves				
1 to 4			ref	ref
5 to 7			−12.49	−7.61
8 to 12			0.85	15.67
13 to 20			5.53	11.09
More than 20			57.17*	85.40*
Interaction effects				
Avg. shortfall				
x 1 to 4				ref
x 5 to 7				−0.12
x 8 to 12				−0.41**
x 13 to 20				−0.10
x More than 20				−0.85*
Constant	60.00***	0.46	−89.91	−74.20
R-squared	0.25	0.33	0.36	0.37
Observations	2051	1859	1859	1859
Groups	157	143	143	143

[Notes] Grain is reported in *muids*, a South African dry measure of capacity equivalent to 109 liters. Wine is reported in *leggers*, equivalent to 576 liters. Farm size is reported in square kilometers. Clay content is presented as percentage, cation exchange of soil capacity is measured in cmolc/kg, soil carbon content (fine earth fraction) in g per kg and soil pH x 10 in H2O. Mean elevations are reported in meters. Standard errors are clustered at the household level.

*p<0.10; **p<0.05; ***p<0.01

an average shortfall of £60, it is possible to conclude that on average 3 *leggers* (1,700 liters) of wine per large-scale slaveholder were not produced because of the loss of capital. If we now consider Table 4, which shows that large-scale slaveholders experienced a loss of 15 *leggers* (8,500 liters) on average, we must conclude that loss of capital was responsible for 20% of the wine output reduction and labor loss 80%.

Counterintuitively, two groups do seem to have benefited from the shortfalls: holders of 1 to 4 and 5 to 7 slaves. Although our data does not make it possible to explain fully why this might be the case, we can hypothesize that the benefit resulted from the gain in liquidity, since the compensation was paid in cash in a single installment. However, since compensation was usually less than the value of the slaves, the gains provided by liquidity would generally have been offset.

Table 6: Effect of capital losses on wine output

y = Wine output	**(17)**	**(18)**	**(19)**	**(20)**
Total settlers	0.88***	0.88***	0.84***	0.73***
Total labor	0.75***	0.75***	0.70***	0.67***
CPI	−0.01	−0.01*	−0.01*	−0.01*
Total livestock	0.03*	0.07***	0.06***	0.06***
Avg. shortfall	0.04**	0.04**	0.04**	0.05**
Farm size		−0.04	−0.04	−0.04
Carbon content		−0.29	−0.36	−0.35
Cation exchange		−0.85	−0.76	−0.75
Clay content		2.33**	2.51**	2.42**
Elevation		0.01	0.01	0.01
Soil pH		−3.63***	−3.27***	−3.28***
Number of slaves				
1 to 4			ref	ref
5 to 7			9.40**	6.52**
8 to 12			16.18***	16.25***
13 to 20			20.74***	24.43***
More than 20			16.61***	21.02***
Interaction effects				
Avg. shortfall				
x 1 to 4				ref
x 5 to 7				0.10
x 8 to 12				−0.01
x 13 to 20				−0.10*
x More than 20				−0.11
Constant	13.92***	206.38***	169.46**	172.69**
R-squared	0.25	0.37	0.41	0.41
Observations	2051	1859	1859	1859
Groups	157	143	143	143

[Notes] Grain is reported in *muids*, a South African dry measure of capacity equivalent to 109 liters. Wine is reported in *leggers*, equivalent to 576 liters. Farm size is reported in square kilometers. Clay content is presented as percentage, cation exchange of soil capacity is measured in cmolc/kg, soil carbon content (fine earth fraction) in g per kg and soil pH x 10 in H2O. Mean elevations are reported in meters. Standard errors are clustered at the household level.

*p<0.10; **p<0.05; ***p<0.01

We can conclude, therefore, that in Stellenbosch the effects of emancipation on output were limited to a specific group of slaveholders, those who held the most slaves before the emancipation. This group struggled to maintain their level of production for two reasons: labor withdrawal and capital losses. The former mostly affected viticulture; the latter mostly the grain output.

7 Conclusions

The findings of this study provide a more nuanced account than was previously available of what caused production to drop at the Cape after the slaves were freed. The implication is that understanding the effects of emancipation through the lens of labor is not wrong, just incomplete. To fully understand what

drove the productive process in the Cape's slave economy, it is necessary to incorporate the role of the slaves not only as laborers but also as capital.

This article contributes to the literature that explores the effects of the emancipation of slaves on agricultural output. It presents a quantitative household-level strategy that links grain and wine output to the labor and capital supply that the farmers of Stellenbosch had available on the eve of the emancipation and during its aftermath. To do this, it uses six data sources, consisting of tax censuses, records of farm ownership and their geographic location, soil type and topography, inflation indices, genealogical records, and compensation claims. It builds a longitudinal database in which variations of output, capital, and labor are recorded in their entirety before, during, and after the emancipation process.

The findings suggest that labor withdrawal did pose a threat to the productivity of Cape's large-scale farmers, especially in grain farming. Given that they had more slaves pre-emancipation, it is not surprising that this was also the group that found it hardest to cope with a new labor system. This, in part, corroborates evidence of farmers' struggles provided by Dooling (2007), though it must be emphasized that labor withdrawal did not seem to threaten the viability of the Cape's agricultural economy as a whole. This is in line with evidence suggesting that since no emancipation efforts were directed towards the enslaved people (they were not compensated, nor were they offered any active form of integration into the broader economy), most of them remained in the districts where they had been living and provided former slaveholders with seasonal paid labor (Ross 1993; Shell 1994; Worden 2017).

Capital losses, on the other hand, appear to have influenced grain production but, again, only significantly among large-scale slaveholders. We have evidence that mortgages and short-term loans were crucial for the farming operations at the Cape, but this factor has often been neglected in studies of the effects of emancipation on output (Dooling 2006; Worden 2017). Slaves were a vital means for farmers to obtain credit, enabling many farms to remain productive. The findings of this study are in line with the recent body of literature highlighting the importance of slaves as capital investments not only at the Cape (Fourie 2013; Green 2014; Plessis et al. 2015; Swanepoel 2017; Swanepoel and Fourie 2018), but also in the United States (Martin 2010; González et al. 2017) and Brazil (Ribeiro and Penteado 2018; Ribeiro and Penteado 2020).

In closing, and looking beyond the effects of emancipation, I suggest that a more thorough recognition of the role of slaves as capital investments might contribute much to studies of the economic foundations of slavery in the eighteenth and nineteenth centuries and, more broadly, to the economics of labor coercion.

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8 Appendixes

8.1 Appendix A: Tables

Table 7: Descriptive statistics - unmatched sample, individual-level

Variable	No. of farmers	Obs.	Mean	Std. dev.	Min	Max
Total grain	4032	12,673	38.46	195.97	0	10,020
Total wine	4032	12,671	5.05	16.51	0	502
Total settlers	4031	12,663	3.43	3.71	0	304
Total labor	4032	12,673	4.28	7.67	0	203
Slaves	4032	12,673	3.09	6.53	0	90
Khoisan	4032	12,673	1.19	3.34	0	203
Total livestock	4032	12,671	22.46	71.72	0	3,150

[Notes] Grain is reported in *muids*, a South African dry measure of capacity equivalent to 109 liters. Wine is reported in *leggers*, equivalent to 576 liters. Total settlers are the sum of all individuals in a given household. Its maximum value corresponds to an outlier most likely due to a transcription error.

Table 8: Effects of the emancipation of slaves on grain output, complete table

y = Grain output	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Total settlers	0.76	1.40**	1.41**	1.59**	1.20*	1.26
Total labor	1.76***	1.24***	1.16***	1.20***	0.99***	0.95**
CPI	−0.08***	−0.08***	−0.08***	−0.06***	−0.07***	−0.08***
Total livestock	0.27***	0.30***	0.29***	0.30***	0.32***	0.30***
Farm size		1.11	1.01	1.00	0.88	0.96
Carbon content		−0.16	0.07	0.05	−0.02	0.03
Cation exchange		5.27**	5.02**	5.07**	5.16**	5.40**
Clay content		−13.46***	−13.85***	−13.90***	−14.02***	−14.58***
Elevation		−0.12***	−0.13***	−0.13***	−0.13***	−0.13***
Soil pH		−4.49	−4.36	−4.35	−4.18	−3.84
Number of slaves						
0 slaves			ref	ref	ref	ref
1 to 4			3.92	1.89	13.30	12.79
5 to 7			−10.79	−14.16	4.48	5.38
8 to 12			0.06	−3.16	21.13	24.58
13 to 20			14.74	10.27	34.34	39.44
More than 20			20.93	18.23	63.64***	77.35***
Emancipation timeline						
Before (1824-1834)				ref	ref	ref
Apprenticeship (1835-1839)				−5.99	18.30	15.00
After (1840-1844)				−9.97*	9.04	8.86
Interaction effects						
1 to 4 slaves						
x 1824-1834					ref	ref
x 1835-1839					−22.32	−22.03
x 1840-1844					3.28	3.51
5 to 7 slaves						
x 1824-1834					ref	ref
x 1835-1839					−18.50	−16.39
x 1840-1844					−19.82	−20.52
8 to 12 slaves						
x 1824-1834					ref	ref
x 1835-1839					−25.41	−26.35
x 1840-1844					−31.32*	−34.24**
13 to 20 slaves						
x 1824-1834					ref	ref
x 1835-1839					−28.66	−32.86
x 1840-1844					−26.39	−30.79
More 20 than slaves						
x 1824-1834					ref	ref
x 1835-1839					−45.51	−55.48
x 1840-1844					−60.41**	−72.34**
Constant	38.68***	560.22**	558.96**	558.92**	536.55**	527.40**
R-squared	0.15	0.17	0.17	0.18	0.18	0.19
Observations	4234	3818	3818	3818	3818	3559
Groups	395	358	358	358	358	357

[Notes] Grain is reported in *muids*, a South African dry measure of capacity equivalent to 109 liters. Wine is reported in *leggers*, equivalent to 576 liters. Farm size is reported in square kilometers. Clay content is presented as percentage, cation exchange of soil capacity is measured in cmolc/kg, soil carbon content (fine earth fraction) in g per kg and soil pH x 10 in H2O. Mean elevations are reported in meters.

*p<0.10; **p<0.05; ***p<0.01

Table 9: Effects of the emancipation of slaves on wine output, complete table

y = Wine output	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Total settlers	0.62***	0.64**	0.49**	0.56*	0.59*	0.67*
Total labor	1.10***	1.18***	0.97***	0.91***	0.79***	0.85***
CPI	0.01	0.00	0.00	−0.01	−0.01	−0.02
Total livestock	0.05***	0.08***	0.07***	0.07***	0.07***	0.06***
Farm size		−0.17	−0.17	−0.18	−0.20	−0.21
Carbon content		−0.42	−0.47	−0.48	−0.44	−0.45
Cation exchange		−0.44	−0.52	−0.56	−0.53	−0.46
Clay content		2.61***	2.52***	2.52***	2.51***	2.65***
Elevation		0.00	0.01	0.01	0.01	0.01
Soil pH		−1.74*	−1.83**	−1.74*	−1.64*	−1.60
Number of slaves						
0 slaves			ref	ref	ref	ref
1 to 4			2.75**	4.14***	1.06	0.27
5 to 7			7.13**	9.04***	4.65*	4.34
8 to 12			15.65***	17.49***	8.94**	9.87
13 to 20			15.64***	17.94***	17.72***	19.52***
More than 20			16.19***	18.65***	23.18***	26.40***
Emancipation timeline						
Before (1824-1834)				ref	ref	ref
Apprenticeship (1835-1839)				8.77**	1.37	−0.77
After (1840-1844)				4.29***	3.10	2.09
Interaction effects						
1 to 4 slaves						
x 1824-1834					ref	ref
x 1835-1839					5.05***	5.97***
x 1840-1844					2.10	2.82
5 to 7 slaves						
x 1824-1834					ref	ref
x 1835-1839					8.08**	8.45**
x 1840-1844					5.37	5.60
8 to 12 slaves						
x 1824-1834					ref	ref
x 1835-1839					25.35***	24.47***
x 1840-1844					6.16	5.35
13 to 20 slaves						
x 1824-1834					ref	ref
x 1835-1839					1.25	−0.69
x 1840-1844					−2.68	−4.39
More than 20 slaves						
x 1824-1834					ref	ref
x 1835-1839					2.52	−7.39
x 1840-1844					−12.65*	−15.27**
Constant	4.68**	71.91	76.05	69.63	67.48	63.28
R-squared	0.12	0.15	0.16	0.17	0.17	0.18
Observations	4234	3818	3818	3818	3818	3559
Groups	395	358	358	358	358	357

[Notes] Grain is reported in *muids*, a South African dry measure of capacity equivalent to 109 liters. Wine is reported in *leggers*, equivalent to 576 liters. Farm size is reported in square kilometers. Clay content is presented as percentage, cation exchange of soil capacity is measured in cmolc/kg, soil carbon content (fine earth fraction) in g per kg and soil pH x 10 in H2O. Mean elevations are reported in meters.

*p<0.10; **p<0.05; ***p<0.01

8.2 Appendix B: Graphs

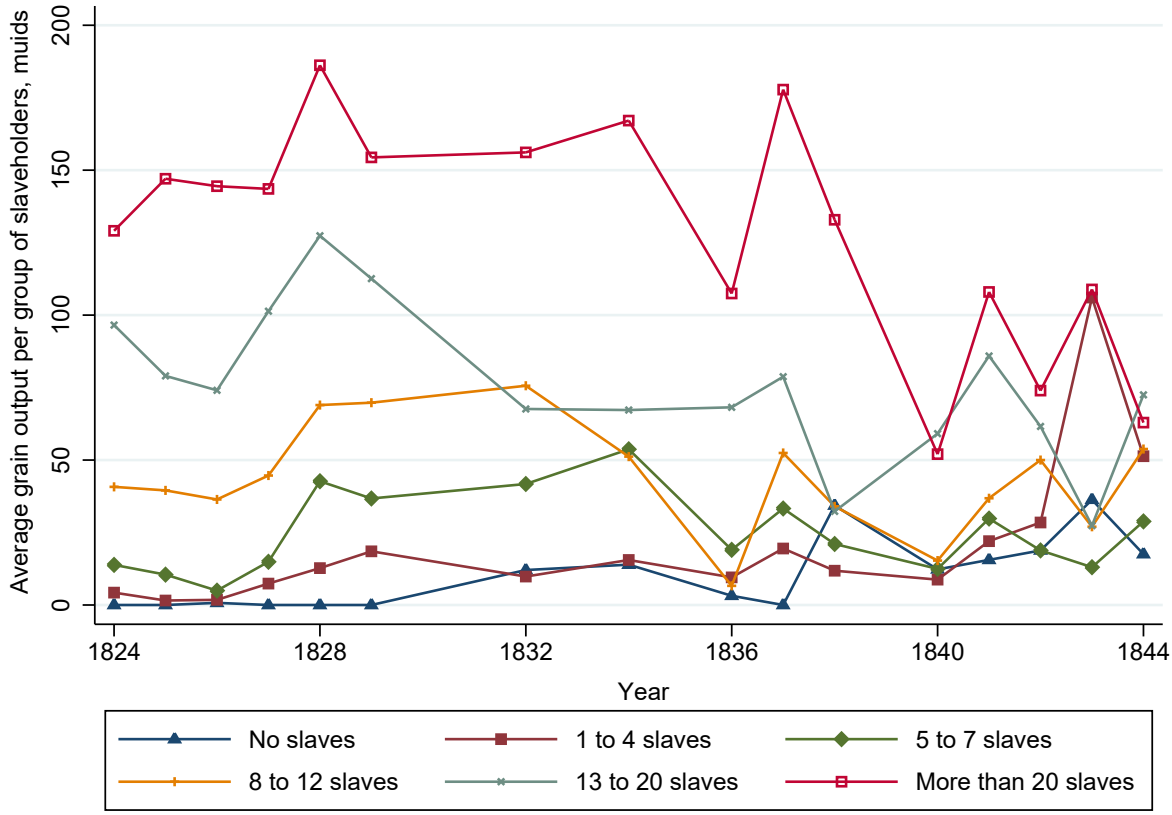

Figure 8: Average *muids* of grain by groups of slaveholders according to their number of slaves

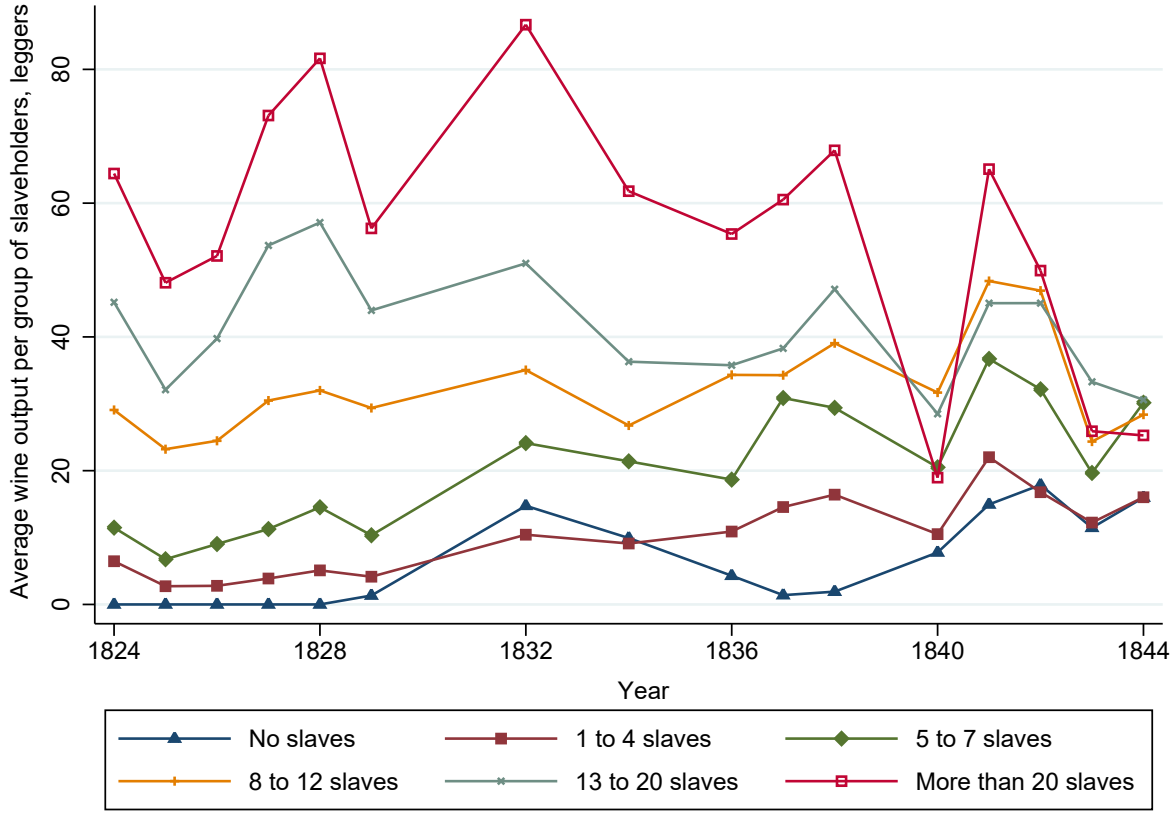

Figure 9: Average *leggers* of wine by groups of slaveholders according to their number of slaves

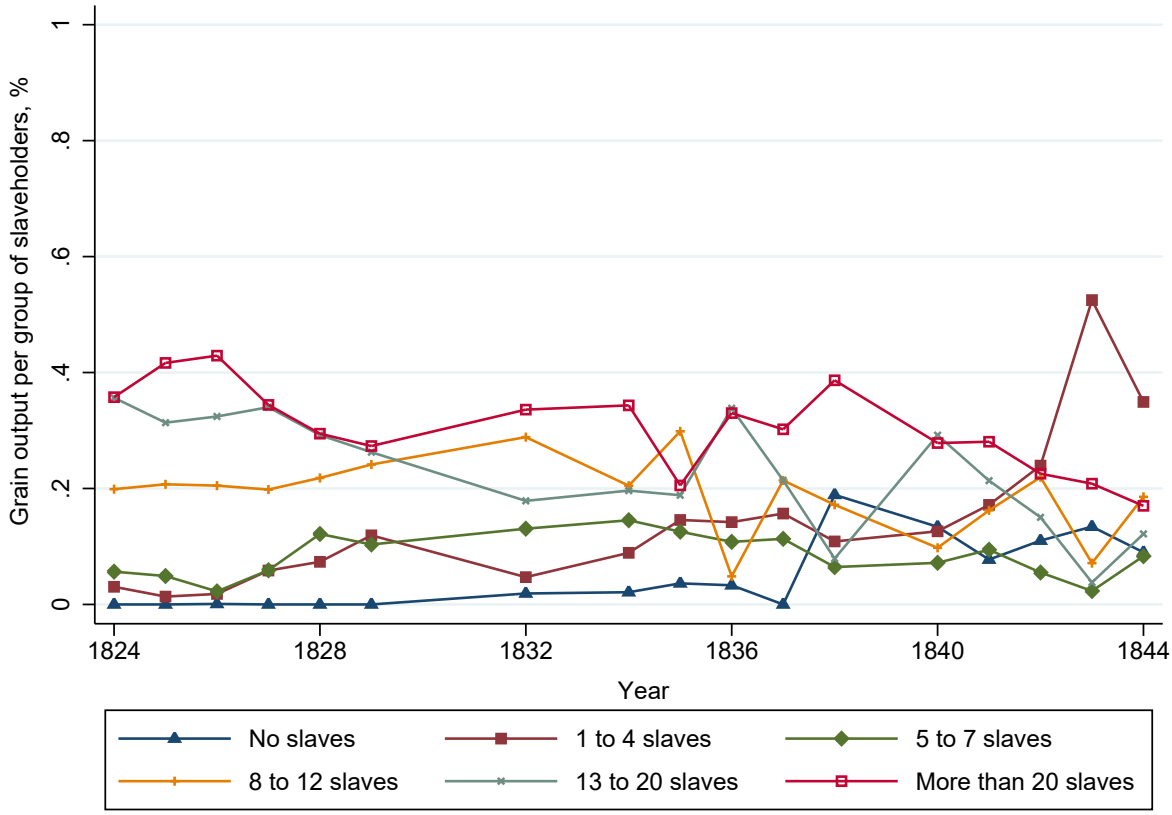

Figure 10: Proportion of grain output per group of slaveholders

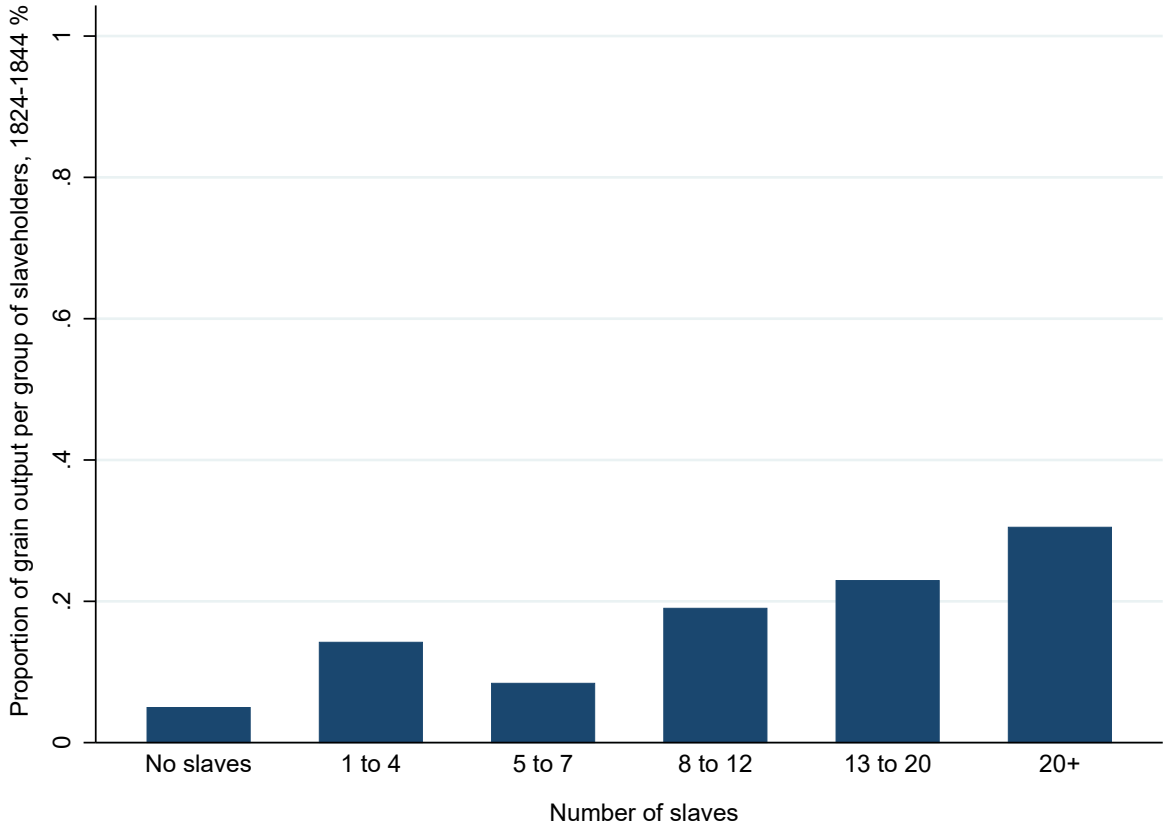

Figure 11: Mean proportion of total grain production in Stellenbosch by number of slaves per farm

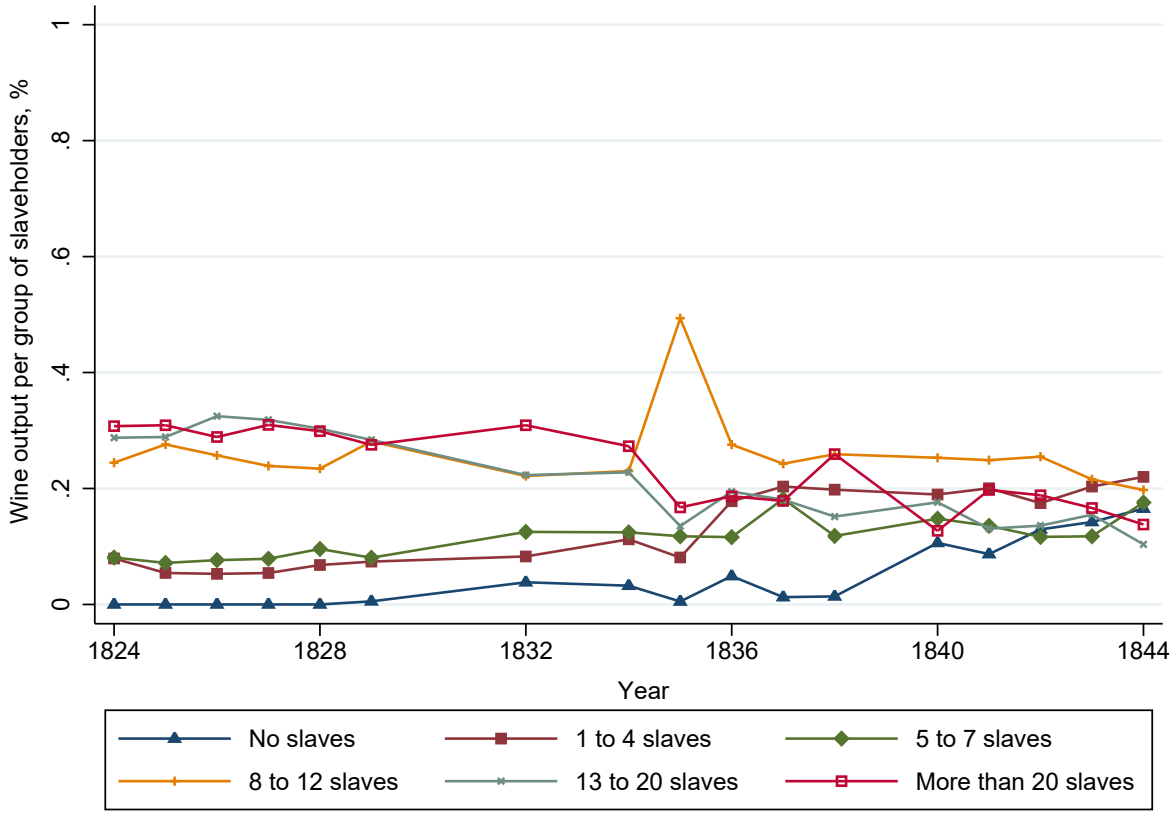

Figure 12: Proportion of wine output per group of slaveholders

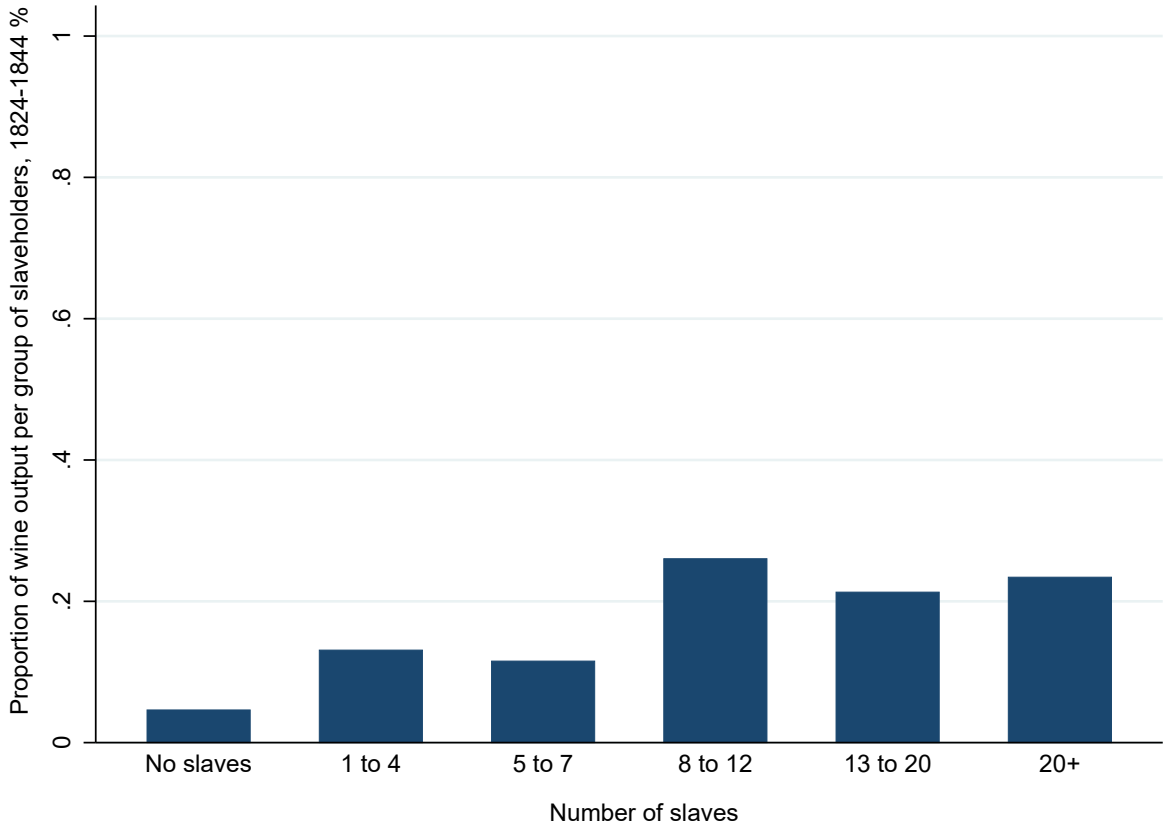

Figure 13: Mean proportion of total wine production in Stellenbosch by number of slaves per farm

8.3 Appendix C: Maps

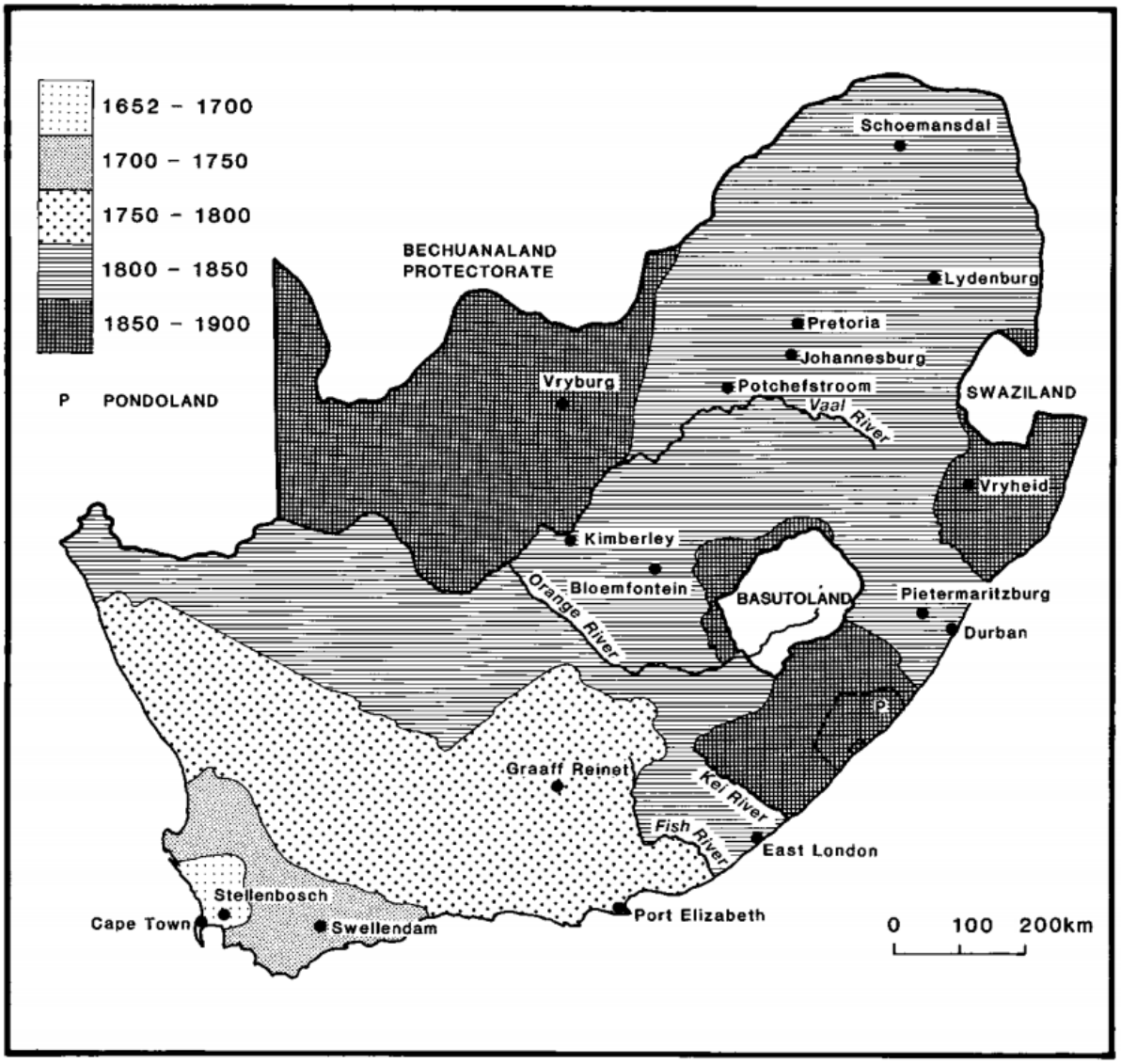

Figure 14: Expansion of European settlement in South Africa. Source: Christopher (2002, p. 15)

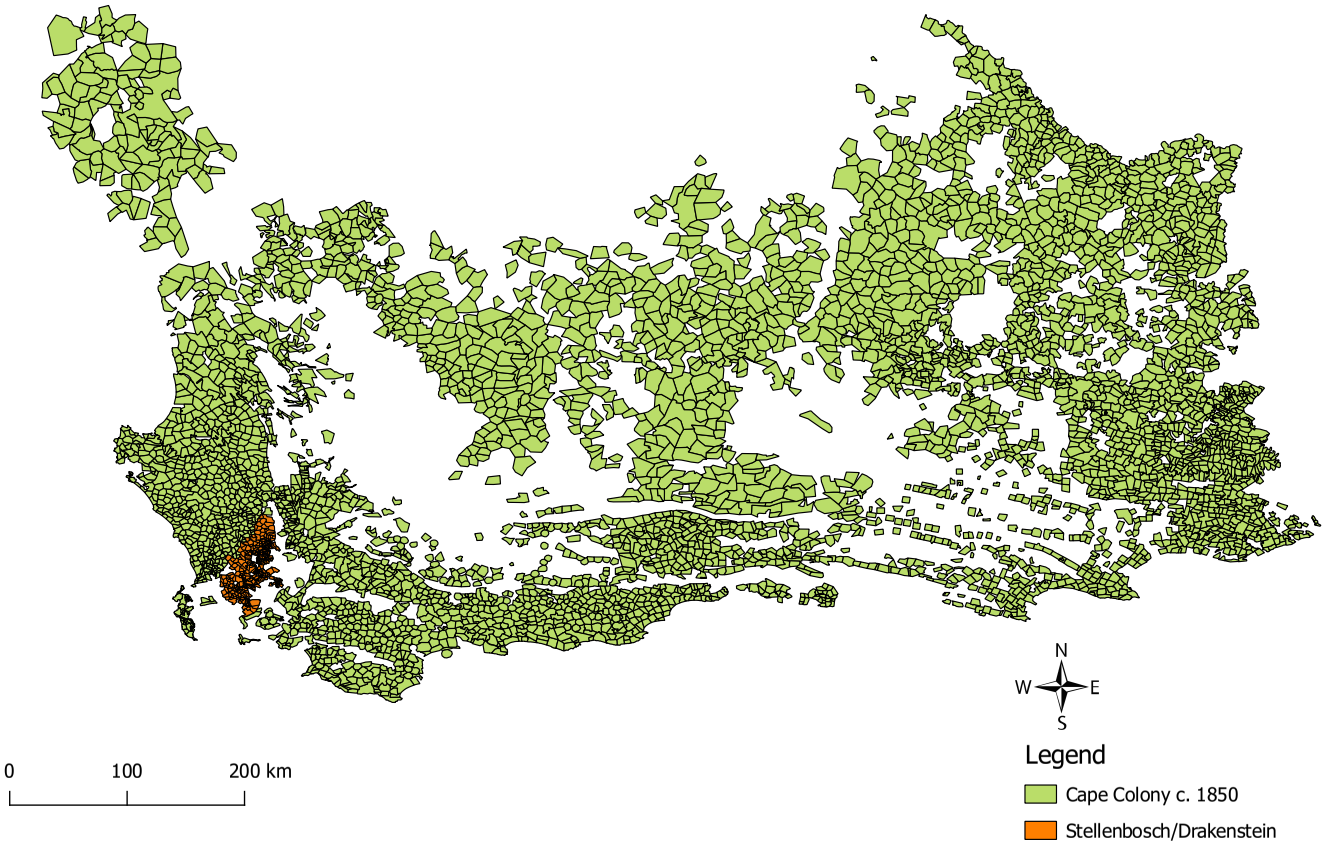

Figure 15: All farms in the Cape Colony in 1850. Stellenbosch highlighted

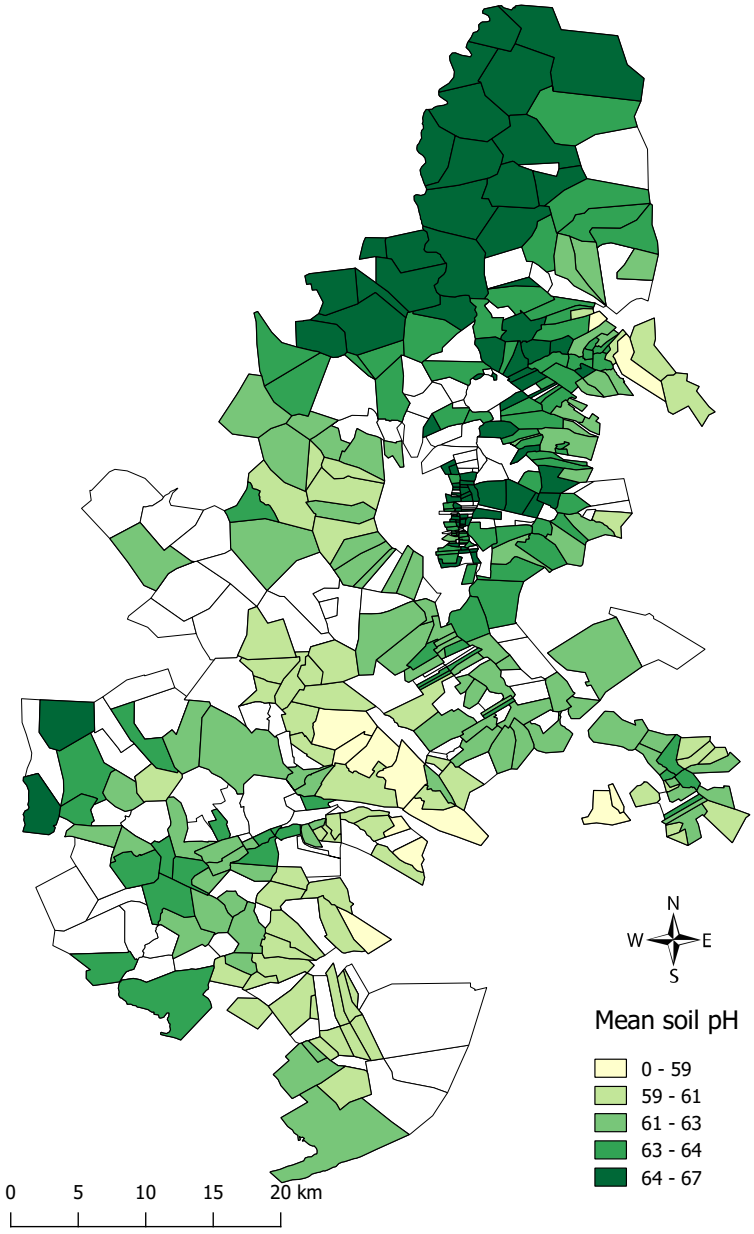

Figure 16: Mean soil pH of matched farms, Stellenbosch

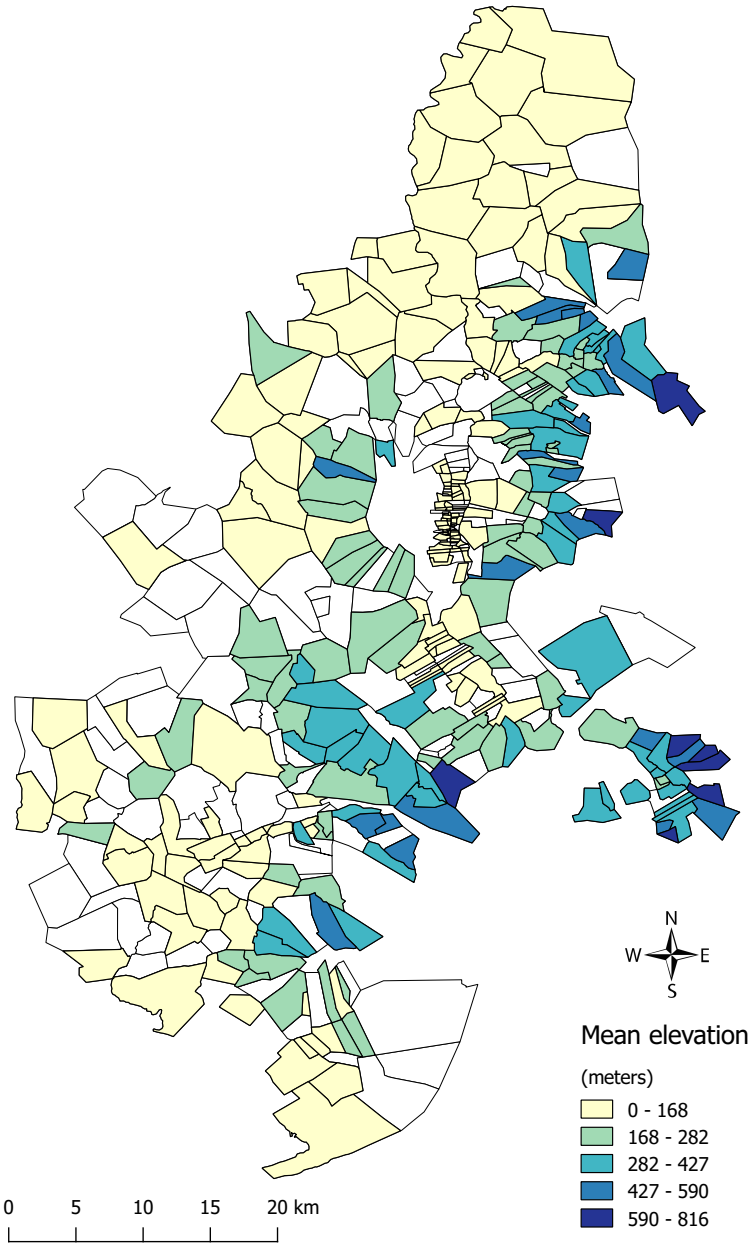

Figure 17: Mean elevation of matched farms, Stellenbosch

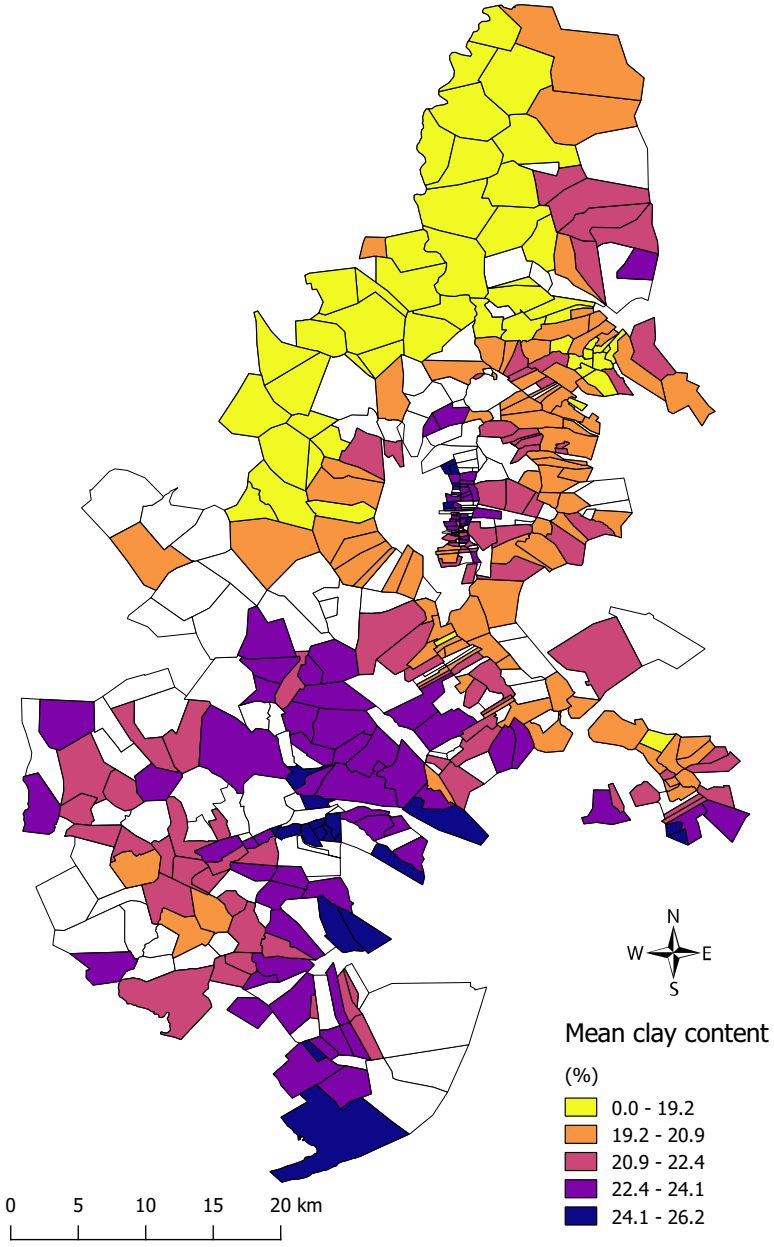

Figure 18: Mean soil clay content of matched farms, Stellenbosch

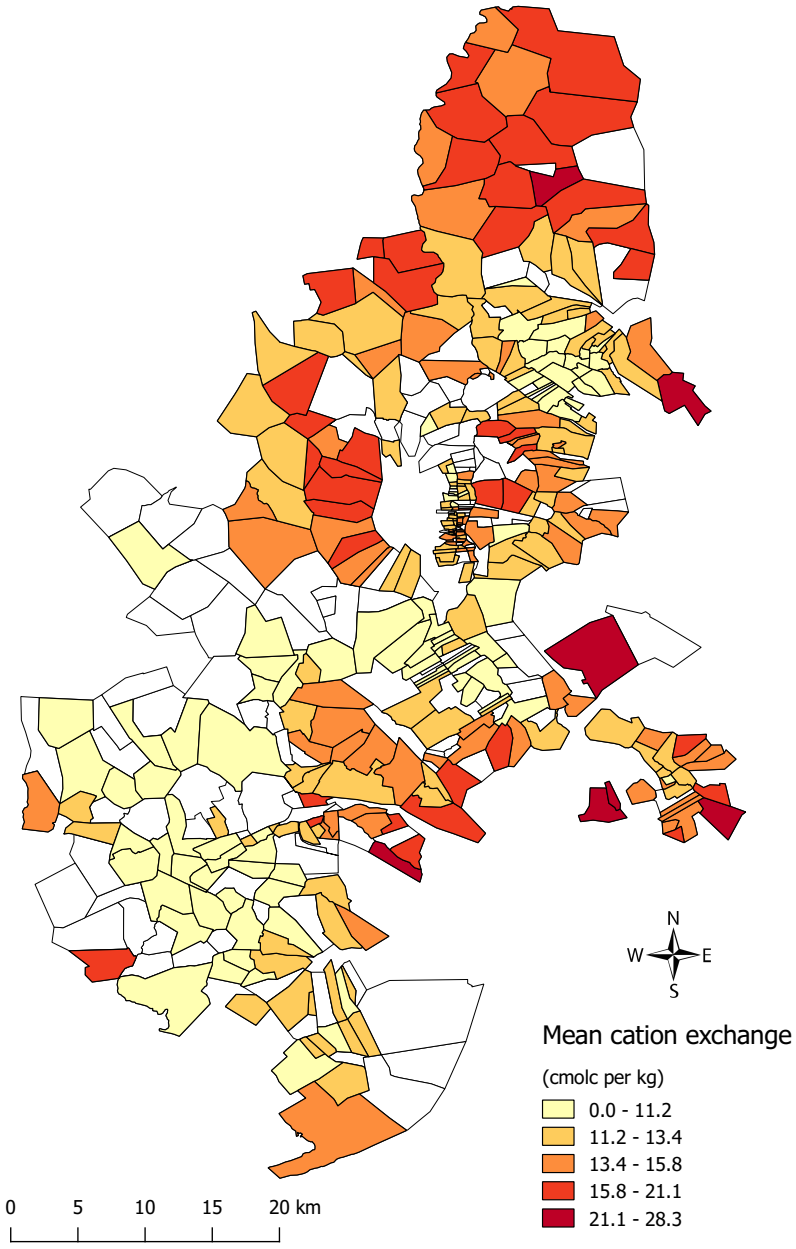

Figure 19: Mean cation exchange of soil capacity of matched farms, Stellenbosch

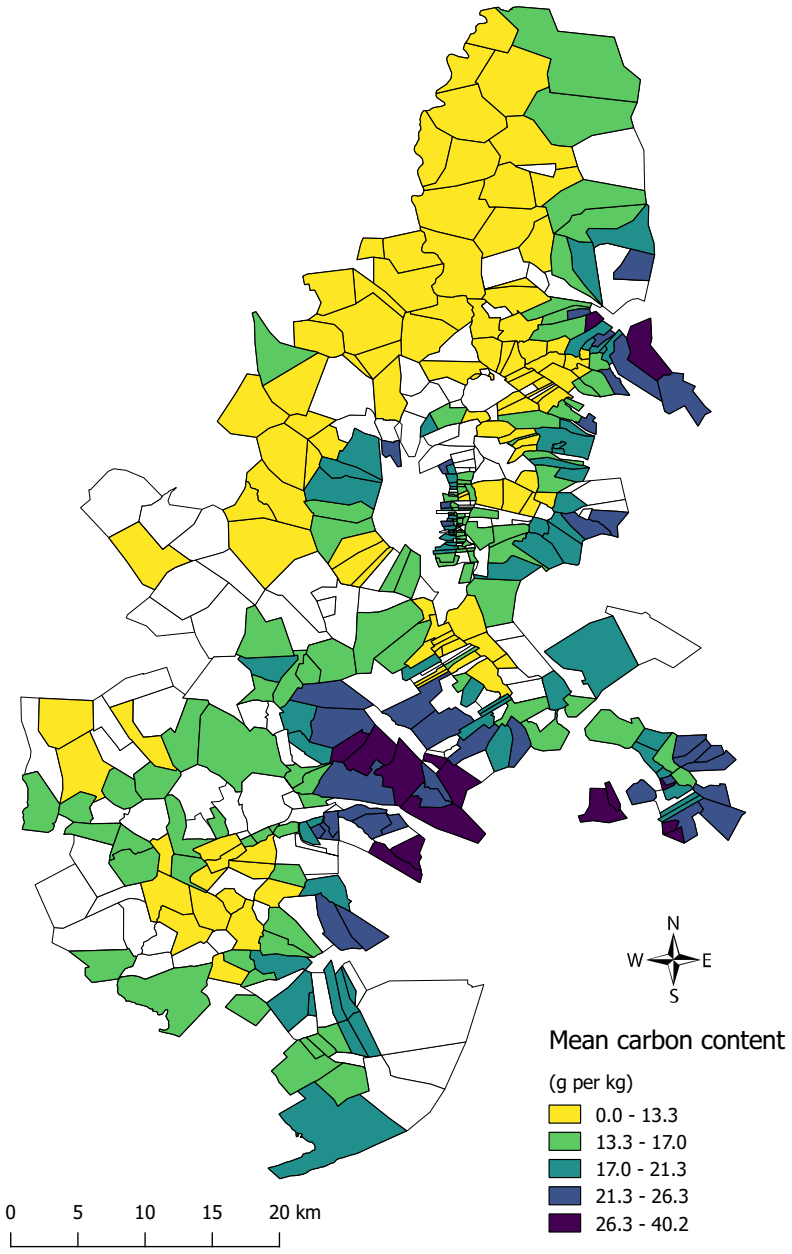

Figure 20: Mean soil carbon content of matched farms, Stellenbosch

8.4 Appendix D: Data

8.4.1 Tax censuses and their consistency over time

Inconsistencies, a common problem in historical data, are regularly encountered in the data for the Cape Colony for the first half of the nineteenth century, when slaves were emancipated, the slave trade was banned, and the control of the Colony passed to the British. Emancipation, from the point of view of a tax census taker, meant that slaves were no longer assets but potential taxpayers. The change of metropolis, on the other hand, meant that English replaced Dutch or Afrikaans as the language of administration and the replacement of several Dutch officials by British ones made language barriers increasingly common. Such events led to inconsistencies in the way the *opgaafrollen* were collected.

One item that was systematically collected by tax census takers was the number of settlers in each household. The years 1830, 1832, and 1835, however, do not account for the children in the household. To account for the size of the households during these years, I assumed that the number of children in each household remained constant between 1830 and 1835. For the regressions displayed in this article, I considered that family labor was performed by all settlers in the household, including children. There are no significant changes in the results by restricting this variable to settler adults. The year 1830 is a particular outlier. Data collection was done very differently that year. Besides leaving out the children, the tax census of 1830 did not record any agricultural produce, rendering it impossible to perform estimates with this particular year. This was therefore excluded from all analyses.

The tax census of 1830 also omitted the slaves, as did those of 1832 and 1834. Excluding 1830 from the analysis did not matter much, but 1832 and 1834 are years of particular significance since they represent the eve of emancipation. For those years, I assumed that the number of slaves in each household was the same as in 1829. Here, I benefited from the fact that slave imports had already been forbidden in the Colony since 1807, causing the prices of slaves to skyrocket and limiting the amount of trade between farmers (Dooling 2007). While this is not ideal, there is little reason to believe that the distribution of the slave population in Stellenbosch between 1829 and 1834 had undergone major changes. The same reasoning applies to the number of Khoisan per farm, which is also missing from those three years.

Problems in accounting for the labor supply available to farmers were multiplied for the period after the full emancipation, when the ex-slaves were no longer listed as part of household property. There is no consistency in the way household labor was recorded. Some census takers grouped all workers on a farm under one label and others divided them into "coloreds" and "whites". In this article, I grouped all farm laborers who were not part of the settler's family under one single variable called "non-family labor".

Livestock was also inconsistently recorded. Most of the tax censuses differentiated between cattle, sheep, and pigs, but after 1840 they were lumped into one category. The best I could do was to aggregate

all livestock under a single variable for the entire period of interest.

8.4.2 Farm-specific characteristics

Farm-specific characteristics were included to capture the ways in which the Stellenbosch farms differed.

Topographical information was obtained through a 1 arc-minute global relief model of Earth's surface available at the International Soil Reference and Information Centre (IIRSC) website (https://www.ngdc.noaa.gov/mgg/global/global.html).

The indicators of soil quality used were clay content in percentage, cation exchange capacity of soil in cmolc/kg, soil carbon content (fine earth fraction) in g per kg, soil pH x 10 in H2O. These variables are available at the National Oceanic and Atmospheric Administration (NOAA) website (https://www.isric.org/explore/isric-soil-data-hub).

8.4.3 Clay Content

Clay content measures the rock debris, silt, and clay particles in the soil. Clay soils tend to hold water for longer periods than sandy soils and are therefore better for agriculture. In this study, the clay content is measure as the percentage of the soil made of clay minerals.

8.4.4 Cation exchange

Cation exchange capacity measures the number of cations that can be retained on soil particle surfaces. It serves as a measurement of soil fertility as it indicates the ability of the soil to retain nutrients. In this study, cation exchange is measured in centimol positive charge per kg of soil (cmolc/kg).

8.4.5 Carbon content

Carbon content is the organic and inorganic carbon stored in the soil. The amount of carbon that is organic influences the chemical and biological properties of the soil and serves as an indicator of soil quality. It reduces soil erosion and increases water absorption which, in turn, increases plant nutrient retention and increases biological diversity. In this study, this variable was measured as grams of carbon per kilogram of soil.

8.4.6 Soil pH

Soil pH measures the alkalinity – or the acidity – of a soil. The soil pH usually ranges from 3 to 10, where values lower than 7 are considered acid and values above 7 are considered alkaline. This article considers the same scale times 10, therefore, from 30 to 100. In Stellenbosch, soil pH ranges from 59 (moderately acidic) to 67 (neutral).

8.4.7 Mean elevation

Stellenbosch is a hilly region with a fertile valley surrounded by the large Papegaaiberg hill and four mountains: Stellenbosch, Jonkershoek, Drakenstein and Simonsberg. Consequently, the average elevation of all farms in the sample was 220 meters above sea level. Some farms were located at considerable heights. Heremias Cornelis Wolfaart's farm Keerdweder, for instance, was 816 meters above sea level, on the Drakenstein mountain. Hendrik Johannes Morkel's Groot Verwachting, by contrast, was a mere 31 meters above sea level.