

Links, Calumet; Green, Erik; Fourie, Johan

Working Paper

Was Slavery a Flexible Form of Labour? Division of Labour and Location Specific Skills on the Eastern Cape Frontier

African Economic History Working Paper Series, No. 42/2018

Provided in Cooperation with:

African Economic History Network (AEHN)

Suggested Citation: Links, Calumet; Green, Erik; Fourie, Johan (2018) : Was Slavery a Flexible Form of Labour? Division of Labour and Location Specific Skills on the Eastern Cape Frontier, African Economic History Working Paper Series, No. 42/2018, African Economic History Network (AEHN), s.l.

This Version is available at:

<https://hdl.handle.net/10419/242671>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.



WAS SLAVERY A FLEXIBLE FORM OF LABOUR?
DIVISION OF LABOUR AND LOCATION SPECIFIC
SKILLS ON THE EASTERN CAPE FRONTIER

African economic history working paper series

No. 42/2018

Calumet Links

LEAP, Stellenbosch University

Calumet.Links@gmail.com

Johan Fourie

LEAP, Stellenbosch University

Erik Green

LEAP, Lund University

ISBN 978-91-981477-9-7

AEHN working papers are circulated for discussion and comment purposes. The papers have not been peer reviewed, but published at the discretion of the AEHN committee.

The African Economic History Network is funded by Riksbankens Jubileumsfond, Sweden

For submissions, contact:
Erik Green
Department of Economic History
Lund University
P. O. Box 7083

Was Slavery a Flexible Form of Labour? Division of Labour and Location Specific Skills on the Eastern Cape Frontier.

Calumet Links , Johan Fourie & Erik Green

The flexibility of slave labour as an economic institution has often been assumed as a given. In general, some capital investment is necessary to retrain novice slaves but essentially they could be substituted for any other form of labour. This paper refutes the claim of the flexibility of slave labour through employing a longitudinal study for the Graaff-Reinet region of the Cape colony. We calculate Hicksian elasticity of complementarity coefficients for each year of a 21-year combination of cross-sectional tax datasets (1805-28) in order to test whether slave labour was substitutable with other forms of labour. We find that Khoe, family and slave labour are not substitutable over the period of the study. This lends credence to the finding that slave and settler family labour were two different inputs in the agricultural production process. Indigenous Khoe and slave labour also remain complements throughout the period of study even when Khoe labour becomes scarce after the frontier conflicts, confirming the notion that slave labour at Graaff-Reinet was not a flexible labour source. We argue that the lack of substitutability of slave labour was due to the need of the settlers to acquire labour with location-specific skills such as the indigenous Khoe.

Keywords. slavery, location-specific skills, frontier, indigenous labour

Introduction

The enslavement of one man to another is arguably one of the darkest blemishes on mankind's history. However; slavery's persistence as an economic institution for millennia serves as a testament to its success in adapting to different settings across time and space (Acemoglu, et al., 2002; Acemoglu, et al., 2005; Nunn, 2008; Engerman, 1992). Coerced labour formed the basis of the 18th and 19th century economies of the Caribbean, Latin America, the southern United States and colonial Africa (Worden, 1985; Klein & Vinson III, 2007; Rönnbäck, 2016; Lovejoy, 2011). One of the important advantages of slave labour was its relative flexibility when compared to other forms of unfree as well as free labour (Engerman, 1992; Anderson & Gallman, 1977). In principle it is relatively inexpensive to retrain and repurpose slaves since above subsistence level the slave-owner could extract earnings over the entire lifetime of the slave and their offspring. Meanwhile, slave labour could also quickly be mobilised for a wide range of different activities, which made this form of labour especially suitable for agricultural enterprises where 'time is of the essence' (Berry, 1993). Achieving this level of output, flexibility and labour supply security from other types of labour was very challenging. Acemoglu & Wolitzsky (2011) and Fogel & Engeman (1974) also note the complimentary relationship between coercion and effort, largely dispelling the notion of the superior productivity of free labour.

This relative flexibility of slave labour as an economic institution has often been assumed as a given. Naturally, some capital investment is necessary to retrain novice slaves but essentially they could be substituted for any other form of labour after this initial '*training*' period is completed. Nevertheless, this substitutability assumption has been challenged to a certain degree by many cross-sectional studies

performed especially on American slave data which have found that slave and free labour are essentially two very different production inputs and cannot be assumed to be substitutes. The fact that these cross-sectional studies by nature largely ignores time and the evolution of labour characteristics leaves the debate on the adaptability of slavery open (Field, 1988; Schmitz & Schaefer, 1978). Longitudinal studies which account for both the characteristics of labour and how they change over time is essential to gain insights into the degree of flexibility of slave labour.

The district of Graaff-Reinet in the Cape Colony at the close of the 18th century presents an opportunity to test the flexibility of slave labour theory. The district was located on the open eastern frontier of the Cape Colony. Following the sociological definition of open frontier societies this means that a clear hierarchical order had not yet been established. The fluidity of the social organisation in early 19th century Graaff-Reinet has been noted in the abundant literature on the recurrent frontier wars in which white settlers and indigenous populations entered into violent conflicts. For the settler farmers - who were mainly engaged in pastoral farming and relied significantly on the employment of the indigenous Khoer population – the frontier wars meant increasing difficulties in obtaining sufficient access to workers. Theoretically since this society was pastoral in nature, slavery as a source of labour should not have existed (Domar, 1970). A small but wealthy group of slave-owning farmers were, however present in Graaff-Reinet and could theoretically respond to this exogenous shock by substituting the loss in the indigenous labour force with slave labour. In this paper, we analyse to what extent the indigenous labour was actually substituted by slave labour, i.e. to what extent did slave labour constitute a flexible form of labour that could be used to cope with the exogenous shocks caused by the recurrent frontier wars?

The availability of transcribed Cape colonial datasets such as the Dutch East India Company (VOC) Opgaafrollen or tax census data and the MOOC8-series probate inventories, give the added ability to empirically assess the relationship between

different types of labour in this open frontier society. Since free family, Khoe and slave labour are included in the tax census data, this study is uniquely able to account for all forms of labour in the agricultural production process. Hicksian elasticity of complementarity coefficients are calculated for each year of the 21-year combination of cross-sectional tax datasets (1805-28) to assess the relationship between slave, settler and Khoe labour over time. The elasticities of complementarity are calculated by estimating Transcendental Logarithmic (Translog) production functions for each year of the study (Berndt & Christensen, 1973). We find that Khoe, family and slave labour remain strong complements over the period of the study. Insofar as the family and slave labour relationship goes, the results confirm that the master-servant dynamic was in place. This fact by itself lends some credence to the finding that at least slave and settler family labour may be two completely different inputs in the agricultural production process.

The results pertaining to the relationship between slave and Khoe labour is somewhat surprising since it would be natural to assume that at least these two forms of labour would be easily substitutable. Yet Khoe and slave labour remain complements throughout the frontier period, largely dispelling the notion that slave labour at Graaff-Reinet was a reasonably flexible labour source over time. We argue that the lack of substitutability was due to the need of the settlers to acquire labour with location specific skills and the inability of slave-owners to arm their slaves - due to colonial legislation. Herding in Graaff-Reinet required knowledge about the environment and climate. These were skills that Khoe labourers already possessed due to their long tradition of engaging in pastoral farming practices. They knew the environment very well and how herds needed to be moved throughout the season in order to access high quality grazing lands. The Khoe were also considered to be free men and could be armed in order to protect livestock from predators and attacks from other indigenous people. Slaves on the other hand needed to be trained in order to reach the same level of proficiency and were not allowed to carry guns. Training in these location specific skills were costly and time-consuming and slaves, who

could already speak the language of their masters, were mainly employed for domestic work and semi-skilled tasks such as carpentry and cooking. In times of shortages of Khoer labour, employing slaves as herders were not an option as long as they lacked the location-specific skills and were not able to protect vital assets.

This paper is organised as follows. In section two we discuss what explains the resilience of slavery as an economic institution. Section three examines the state of the eastern Cape frontier at the advent of the 19th century. Section four discusses the sources of labour employed at Graaff-Reinet for the period. Section five gives an overview of the data sources along with the method employed in this paper. Section six presents the results obtained from the Translog analysis and Hicksian elasticity of complementarity coefficients. Section seven discusses the context specific preference for labour at Graaff Reinet and the division of labour in the livestock rearing process. Finally, section eight concludes.

Explaining the Resilience of Slavery as an Economic Institution.

A popular argument - famously known as the Nieboer-Domar hypothesis - is that slavery as an economic institution is likely to arise in an open frontier environment with abundant land and scarce labour (Domar, 1970; Engerman, 1992; Nieboer, 1900). In this setting, coercion, in the presence of elite pressure, is needed to force otherwise free labour to produce agricultural staple outputs. In essence, the sheer absence of willing and able labourers in the face of vast tracts of land for agricultural undertakings creates the necessity to enslave. This theory seems to apply broadly to the early Cape colony where initially the settlers and indigenous people were completely economically disentangled, but as the settler economy expanded more coercive measures were used to bring foreign slaves but also the indigenous population into the labour market (Feinstein & others, 2005).

In a closed frontier setting where land is scarce and labour numerous, unfree labour arrangements would dissipate as a landless wage-earning labour class would be readily available to perform the work formerly performed by slaves. In the light of this argument the American Civil War or anti-coercive labour movements in Africa appears to have been a futile undertaking since slavery would have disappeared naturally as land became more scarce (Fenske, 2013). Engerman (1992) specifically notes that the Nieboer-Domar theory on the origins of slave labour provides no time facet as to when this slavery-free or scarce land point would be reached and very seldom if ever has any system of enslavement spontaneously disintegrated. Unfree labour arrangements, if anything, continues to persist and yields significantly more economic benefits to its benefactors than merely being a temporary placeholder for supposedly more efficient free labour (Engerman, 1992; Russel, 1941; Stone, 1997).

Eltis, Lewis and Richardson (2005) finds that prior to its abolition the slave owning regions of Cuba and the Caribbean far outperformed the non-slave owning North American colonies of the 18th century in terms of economic expansion. During the 1700s Cuba and the Caribbean, barring the fact that they were agrarian societies, economically expanded at rates similar to industrialising Britain and the USA (Eltis, et al., 2005). The slave-oriented 18th century Cape colony also rivalled the Netherlands and Europe with respect to wealth (Fourie & Von Fintel, 2010; Worden, 1985). A study by Barzel (1977) found that coerced labourers simply had to work much harder to stay alive than free men, making them more productive. Slaves in the antebellum South were often fed and treated better than many free men since they would have had to maintain this higher level of productivity (Barzel, 1977). This hypothesis seems to be supported by a study conducted by Foust & Swan (1970) which found that the southern US cotton producing slaves, during the 1850s and 1860s, were extremely productive and was still seeing productivity growth shortly before the American Civil War (Foust & Swan, 1970). Another study by Ronnback (2016) confirms that slave labour at the Cape Coast castle in Ghana was

quite productive and compensation for slaves above subsistence was more frequent than originally thought. In fact, slaves on the gold coast of Ghana were paid similar wages to free labourers of southern Europe and East Asia. These studies ultimately support the notion that slave labour was quite productive.

In contrast to free labour, the enforcement costs related to slave labour are much lower (Gray, 1930; Klein, 1998). Often the immense distance between the slave's place of origin and their eventual destination of work made large-scale desertion improbable. Additionally, unlike free labour, slaves were less prone to organise strikes or lockouts due to pay disputes since there was no need to compensate a slave above subsistence levels. In a foreign, far-away land, slaves had no choice but to stay with their masters; therefore, being available for tasks any time at their master's leisure (Klein, 1998). Gray (1930) also found that slaves were particularly profitable for the production of staple crops such as sugar, cotton and tobacco but not for general farming. This was largely due to the economies of scale which can be gained from large scale staple crop cultivation by a large labour force as opposed to small scale general farming operations.

Perhaps the most important direct benefit to slaveholding came through its relative inexpensiveness when compared to other forms of unfree labour. On the one hand Austin (2005) notes that the cost of a slave in 19th century Asante Africa was so low that oxen, salt or guns often cost more (Austin, 2005). On the other hand, since slave prices reflect, among many things, the lifetime labour benefit of the slave and their offspring, purchasing indentured labour for a similar amount, in principle, would be relatively more costly (Nash & Flesher, 2005; Gray, 1930). This is primarily due to the fact that indentured labour by its very nature may be contractually bound for a pre-specified time. Investing in the training of a slave therefore becomes less costly since the appropriable period of service stretches across most of the slave's lifetime and that of their offspring, whereas indentured service does not have this benefit – at some point the contractual labour benefit ends. Ultimately, slave labour is much

less expensive than indentured workers to retrain as farming needs change. This relative inexpensiveness when compared to other forms of labour exhibited by slavery makes it extremely flexible.

The relative flexibility of slave labour in open frontier communities implies that with some investment in training slave labour could effectively perform any type of work at great benefit to the slave-owner (Gressley, 1958). Engerman (1992) notes that it is precisely due to the economic success and the great flexibility of slavery in the Antebellum Southern United States that there were no signs of the economic demise of slavery, despite heavy political opposition during the 1830s. The slave trade in West Africa also existed for centuries prior to the arrival of Europeans since slave labour was utilised in a myriad of activities such as in agriculture, military conquests or as concubines (Klein, 1998). Slave labour was essentially substitutable with any type of other labour should the slave-owner have need of it.

A significant amount of literature on the economics of slavery assumes the near perfect substitutability between free and slave labour (Klein, 1998; North & Thomas, 1971; Domar, 1970; Fenoaltea, 1984; Engerman, 1992). Hopkins (1973) also confirms this fact by assuming that the African employers of the Asante had a deliberate preference for slave labour rather than wage labour. However, the degree of flexibility between these two types of labour is questioned by Austin (2005) for the 19th century Asante since slave and wage labour did not overlap during this period. This assumed flexibility is also questioned by Field (1988) for plantation slavery in the southern US. She finds that slave and free labour in the Antebellum South are compliments or considered to be entirely different inputs in the agricultural production process. Slaves performed the hard gang-labour on these cotton plantations and free labour played a managerial role. On the larger plantation farms, African American slaves would work under the supervision of overseers and on smaller farms under the direct eye of the slave master themselves (Zeichner, 1939). A later study conducted by Schmidt & Schaefer (1978), utilising a CES-

production function analysis also concluded that free and slave labour are quantitatively different inputs in the agricultural production process. These conclusions suggest that slave labour may not be as easily substitutable as is commonly assumed (Schmitz & Schaefer, 1978). However, these studies employ cross-sectional datasets taken in one specific year effectively giving a static picture of the substitutability between various types of labour. It is therefore important to study the characteristics of slave labour over time since only when a temporal dimension is incorporated can the premise that slave labour is truly flexible be tested.

Ultimately, the Cape Colony offers the ability to study a slave society outside of the Americas, which may be useful in testing the robustness of some of the general conclusions made on slave labour. Graaff-Reinet in particular offers the unique ability to test the slave labour flexibility assumption in a pastoral setting. The rich Cape colonial longitudinal data we have available, also enables us to evaluate the evolution of slave labour characteristics over an extended period of time. This district is also unique since despite the fact that most economic theories on the origin of slavery, claim that slavery or serfdom would not arise in a pastoral setting, Graaff-Reinet settler farmers made use of both slaves and indentured indigenous labour.

The State of the Cape Eastern Frontier at the Advent of the 19th century.

The Cape Colony was governed by the Dutch East India Company (VOC) from 1652-1795 before coming under British control. The VOC's strategic interest in the Cape primarily stemmed from the need for a refreshment station for its passing ships en route to the east. As the allure of the Cape outpost grew over time and settler family fertility expanded, the number of European inhabitants increased steadily and by the early 18th century the Cape had established itself as a settler colony (Fourie & Von Fintel, 2010; Shell, 2005). Most European farmers settled in the

southwestern part of the Cape, where they engaged in wine and wheat farming but as immigration continued more and more European settlers moved further into the eastern and northern frontier regions.

The Graaff-Reinet district, on the eastern frontier of the Cape Colony, was established in 1786 to accommodate the growing need for land by newly arrived Europeans at the Cape (Newton-King, 1988). By the advent of the 19th century the levels of wealth inequality in this district were even for Cape Colony standards strikingly high, and while a small group were doing very well a majority of farmers were hardly making ends meet (Newton-King, 1988; Cilliers & Green, 2017). In contrast to the southwestern Cape, pastoral farming was by far the dominant economic activity in Graaff-Reinet. Stock-farming was not new to the area. On the contrary, the area had been an area utilised for stock farming for more than 2,000 years (Keay-Bright & Boardman, 2006). Although not being isolated from the rest of the Cape economy, trade with the commercial southwestern Cape was limited primarily to the livestock trade because of long-distances, poor infrastructure and rough weather conditions (Beinart, 2008).

Although we lack precise estimates, scattered evidence shows that land was in abundance while labour was scarce in Graaff-Reinet by the early 19th century. Following the Nieboer-Domar hypothesis it seems plausible to assume that various forms of coercion was needed for the Europeans to access adequate supplies of labour (Nieboer, 1900; Domar, 1970). While various forms of coercion were applied, it was less common to use it in its most extreme form – slavery – compared to the southwestern Cape. This may be explained by the combination of the average farmer being relatively poor and the dominance of pastoral agricultural activities. The Nieboer-Domar framework notes that slavery or serfdom will not take root in a pastoral agricultural society since it is a labour saving agrarian practice. Theoretically, an open livestock rearing frontier setting, will therefore not lead to coerced labour arrangements (Conning & others, 2004). Despite this, most at

Graaff-Reinet were dependent upon on a combination of both free and unfree labour. Wealthier farmers utilised slaves side by side with 'free' Khoe wage labourers and indentured labour, while poorer households combined family labour with wage and indentured labour. Given that Graaff-Reinet was an open frontier marked by a fluid social organisation with a changing balance of power one could argue that the advantages of relying on different forms of labour depended to which degree they were substitutes or not. Since it is critical to the assumptions of this paper it is important to discuss to what extent it is valid to conceptualise Graaff-Reinet over the 1805-28 period as an open frontier.

The frontier literature primarily identifies two different approaches to conceptualise an open and closed frontier. In the economic literature an open frontier is characterised by low population densities, low levels of urbanisation and limited market access (see McInnis 1977 for an overview). For the purpose of this paper we are, however, more interested in the sociological definition of an open frontier. In that regard, Giliomee (1971) provides a useful framework within which to evaluate the frontier closure process. The entire frontier closure process is denoted by closure of the political, economic and social landscape. Economic closure is characterised by the increased scarcity of land, a shift from subsistence to commercial agricultural practises and growing control over the factors of production by a dominant group. A closing political frontier is signified by the rise of a single source of authority and finally, social subjugation entails the stratification of society based on criteria such as race or wealth. When these three processes are complete the society cannot be considered an open frontier any longer (Penn, 1986; Giliomee, 1971). Closure on these fronts is often accompanied by periods of intense violence as one group attempts to achieve supremacy above another.

Cilliers & Green (2017) show that Graaff-Reinet over the 1800-28 period was a *closing* but not a *closed* frontier in the economic sense of the term due to increased population pressure causing the continuous establishment of new district boarders. The frontier closure in the political sense was also far from complete since no supreme colonial authority had been established yet. Ultimately, Graaff-Reinet frontier closure would be considered complete only when the colonial powers had succeeded by then to establish themselves as the singular hegemonic authority (Giliomee, 1971).

Newton-King (1980) argues that the frontier was already closed in the political sense by late 18th century as the colonists had already gained the upper hand in the struggle for the eastern frontier at Graaff-Reinet. Newton-King (1980) neglects to account for, as Figure 1 suggests, the tremendous fluctuation in Graaff-Reinet population numbers. This was a clear indication that no political dominance had yet been established by the colonial authority. The settler population numbers at Graaff-Reinet varied substantially over the 1805-28 period, indicating a society still very much in flux and far from hegemonic. The major declines in the number of settler households at Graaff-Reinet coincided with major frontier events.

Figure 1 shows the size of the settler, slave and Khoe population at Graaff-Reinet over the 1805-28 period. It clearly shows that settler, slave and Khoe numbers were contracting and recovering throughout the period. To some extent this pattern can be explained by administrative changes. For example, one of the first significant settler population declines in Graaff-Reinet occurred around 1806. Not only was this the first year of the second British occupation at the Cape but it was also the year after the formation of the Tulbagh district. The Tulbagh district initially formed part of Graaff-Reinet, but as settler numbers swelled on the frontier the necessity for a greater degree of governance grew as well. These two significant changes meant that colonial boundaries were considerably altered, with some settlers previously categorised in the greater Graaff-Reinet *landdrost*, now finding

themselves in the newly established Tulbagh sub-district (Legassick, 1972; Freund, 1972). Moreover, the incentive for accurate or at least credible record-keeping was also much lower during the time of handover from the Batavians to the English due to political uncertainty.

Having said that, the major subsequent declines in the settler and Khoe population was not caused by administrative changes but social and political conflicts. During what is now known as the Third Frontier War of 1799 to 1803, Xhosa chiefs and heavily armed Khoe virtually destroyed the eastern frontier settler economy, forcing many settler families to flee from the company loan-farms that they occupied (Freund, 1972). Not only was this a tumultuous time for the Graaff-Reinet region, but for the entire Cape. At the time, control of the colony briefly shifted to the British during the Napoleonic Wars prior to the conclusion of the Treaty of Amiens in 1802, where after control of the Cape reverted back to the Batavian Republic. This weakness in colonial authority was effectively capitalised on by the amaXhosa and Khoe clans as the Batavians were forced to agree to leave the Xhosa in the Zuurveld and the eastern colonial border unchanged. The decline in 1814 occurred immediately after the conclusion of the Fourth Frontier War (1811 to 1813) (Legassick, 1972). In addition to the loss of life related to the conflict, the colonial authorities actively campaigned for settlers residing in Graaff-Reinet and Uitenhage to relocate to the Zuurveld after the Xhosas had been expelled. This move was encouraged so that the likelihood of the Xhosas returning to the Zuurveld area would be reduced substantially. As a natural consequence population numbers fell steeply since the disillusioned settlers moved further east in search of greener pastures. It is also not imprudent to assume that the settler farmers relocated with their slaves and cattle. The Fifth Frontier War which occurred from 1818 to 1819 also led to decline in settler numbers at Graaff-Reinet, albeit to a smaller extent, since the then governor of the Cape, Lord Charles Somerset, encouraged resettlement to the area between the Fish and Keiskamma rivers (Legassick, 1972). The advancement further east clearly indicates that economic closure was also by no means complete.

Had social stratification set in to the degree that the eastern Cape frontier could be considered closed in the social sense over the 1805-28 period? Social stratification had already set in by the early 19th century given the treatment of the indigenous Khoe and Xhosa, by European settlers. Legislative coercion measures such as the *Inboekstelsel* – a pass system which severely inhibited the movement of Khoe who did not carry the right papers – in 1775, was one of the first official measures utilised to impose settler hegemony upon the indigenous people (Penn, 2005). In the early 19th century, the English made further attempts to formalise indigenous subjugation through indenturing Khoe labour to European settler farmers by implementing the Caledon Code of 1809. The traditionally nomadic Khoe now had to show proof of a fixed place of abode which had to be approved by a local colonial government official. Additionally, this legislation deliberately lacked explicit recognition of Khoe property rights, denigrating the indigenous population to a landless labour class (Eldredge, 1994; Penn, 2005). However; the presence of often successful indigenous revolts in the form of at least two frontier wars over the period of the study paints the picture that settler hegemony and social stratification, although growing in extent, was also vehemently challenged (Cornwell, 2003; Mason, 1994). Although social stratification, despite being challenged by the indigenous population, had already taken hold, the eastern frontier was open on political and economic grounds presenting a considerable challenge for European farmers in maintaining a stable indigenous labour force.

Since Khoe labour still had the opportunity to opt out of working for settlers in the Graaff-Reinet district, it is natural to assume that settler farmers would prefer household and slave labour as an alternative workforce. In theory, slave and household labour would be much easier to mobilise and the enforcement costs of inducing the necessary work would be much lower than would be the case with the Khoe, especially in the turbulent open frontier setting. At times of frontier conflict, the costs involved in either hiring or capturing indigenous labour would outpace the

productivity gains from utilising the Khoe. If a sufficient number of slave and family labour is available, it would always be preferable to utilise less of the rebellious Khoe.

Labour on the Eastern Frontier.

It is widely known that slavery at the Cape was initiated at the behest of the VOC. As such, Cape slavery originated as an urban phenomenon, motivated through the demand of the VOC for labour to complete amongst many other tasks its various infrastructural endeavours (Shell, 2005; Fourie & Von Fintel, 2011; Green, 2014). As wheat and wine production expanded over the course of the 18th century – largely due to the arrival of the French Huguenots in 1689 – so the utilisation of slave labour grew amongst the free settler farmers. In theory, however slavery or serfdom would not arise in the pastoralist eastern frontier environment, particularly due to the fact that cattle and sheep rearing activities are labour saving. Slave labour, nevertheless, became an integral part of Cape society, even on the fringes of the colonial borders. Wealthier frontier farmers at Graaff-Reinet made extensive use of slaves in their pastoral farming practices and homestead, albeit to a noticeably smaller extent than wheat and wine farmers at the fertile southwestern (Fourie & Von Fintel, 2011). This is also evident from Figure 1, since slaves were present in settler households throughout the period of this study.

The main sources of labour that were available to the Graaff-Reinet pastoralist economy during the 1805-28 period were family labour, Khoe and slaves. The services of knechts (i.e. European wage workers) were also utilised on farms; however, their contribution to the pastoral eastern colonial economy remained negligible. Table A shows that the average settler household at Graaff-Reinet had a sheep flock size of around 496 and had 44 heads of cattle. Graaff-Reinet frontier

households also had 3 family labourers, 4 Khoe and 1 slave available on average. However; these figures obscure wealth inequality at the frontier and may not be a true reflection of the labour distribution at Graaff-Reinet over the period of the study.

Since the eastern frontier had represented the possibility of economic prosperity for poorer settlers, many flocked to the Graaff-Reinet hinterland in search of greater fortune (Mitchell, 2009). Dooling (2005) notes that the poorer eastern frontiersmen were primarily dependent upon family labour in order to tend to what little planting and livestock was available to them. Frontier settlers were also the offspring of German, Baltic and Dutch artisans that were forced into the service of the VOC by poverty. In addition to being pastoralists many of the frontiersman also possessed artisanal skills passed down to them from their parents newtonking1988. The artisanal trades included masonry, shoemaking, carpentry, tailoring and saddle-making. The poorer frontiersmen would therefore employ a mix of economic activities (plying their trade and rearing some livestock) in order to survive.

As settler flocks grew over the decades so they would employ the services of indigenous labour to tend to livestock. Despite these fortuitous prospects for settlers, Penn (2005) argues that the open frontier presented a significant challenge for the migrant settlers. Vast tracts of land were available for grazing and raising large flocks, yet labour was scarce. Historians concur that labour shortages were acutely felt by settler households on the eastern frontier by the turn of the 18th century (Penn, 1986; Penn, 2005; Marks & Atmore, 1980; Mason, 1994). Indigenous labour was not only in short supply, but remained highly unreliable. Figure 1 above clearly indicates the extreme volatility in Khoe numbers, especially during and after the Fourth Frontier War (1811-14 period).

In order to deal with the scarce and volatile labour supply experienced by settler farmers at Graaff-Reinet and since the Cape was already a slave based economy, the flexibility of slave labour should have made it easy for settlers to merely purchase

slaves and have them retrained to do the necessary work. The Graaff-Reinet district was peculiar in this respect as Khoe labour (indentured or free) was always preferred to slave labour.

The critical question remains as to why eastern frontier settler households did not merely rely on slave labour to a greater degree when indigenous labour was such a volatile labour source? If the risk of the Khoe simply deserting farms or stealing cattle was great and it was relatively more expensive to utilise indigenous labour it would seem that the least risk and cost would be incurred by purchasing imported slave labour which would easily be able to adapt to the pastoral farming environment. However, the journey to the Graaff-Reinet frontier exceeded 600 km in distance and would often take weeks to complete, since no navigable rivers were present. Purchasing at least one slave in Cape Town and transporting that slave to the interior would be a vast expense for the relatively poor frontiersmen. It was therefore significantly less costly to capture and maintain Khoe indentured labour than to purchase slaves (Freund, 1972). Figure 2 clearly illustrates that the use of slave labour was highly concentrated in wealthier households. Over the entire 1805 to 1828 period the poorest 20% of households only had access to an average 0.2 slaves (virtually no slaves at all). In contrast the wealthiest 20% of households at Graaff-Reinet had access to an average of 3.2 slaves over the period of the study. Slave use was highly concentrated in wealthier households.

Similarly, Figure 3 shows how the poorest 20% (in terms of livestock wealth) of settler households had access to around an average of 0.4 Khoe labourers over the entire period of the study. The wealthiest households naturally had access to an even greater pool of Khoe labour. The top 20% of wealthy households at Graaff-Reinet had access to an average 10.2 Khoe labourers over the period of the study, once again confirming that Khoe labour was more widely utilised. Poorer households could rely on family labour but were much more likely to make use of Khoe labour than slave labour (this fact is somewhat obscured by the average figures).

Mason (1994) also confirms the fact that the settler population at Graaff-Reinet had always favoured the use of cheaper (indentured and free) Khoer labour to slaves since roughly 40% of the population at Graaff-Reinet consisted of "free" indigenous servants. More important, the Khoer possessed location specific skills for stock farming in the eastern frontier district that was critical for any successful farming endeavour (Adhikari, 2010). The indigenous Khoer had the exact knowledge of the most appropriate watering holes, the types of predators and their general locations, the most prevalent diseases, the distribution of edible vegetation and the rainfall patterns of the area. This vast toolkit of knowledge regarding sheep and cattle farming had been accumulated across the centuries as the Khoer had been pastoralists themselves (Beinart, 2008).

Data Sources and Method

Data

The main data component employed in this analysis comes from the transcribed Graaff-Reinet VOC Opgaafrollen for the 1805 – 1828 period. This data combines a series of cross sectional information sets for settler farming families in different sub-districts¹, recording their holdings for a given year so that their tax liability could be determined by company officials. Figure 4 exhibits a map outline of the various sub-districts (Feld Cornetsies) of Graaff-Reinet. What makes this dataset particularly unique is its ability to observe household level characteristics at the farm-level. This level of detail for agricultural pre-industrial societies, much less frontier communities, is extremely rare and effectively gives an in depth look at the economic activities taking place on each settler farm of the Graaff-Reinet district.

¹ These areas included Graaff-Reinet town, Agter op Sneeuwberg, the Agter op Rhinocerberg, the Zuurberg, Buffelshoek, the Camdeboo, Zwartruggens, Ghoup, Nieuweveldt, the Lower and Upper Zeekoei rivier, the Hantam, Zwartberg, the Winterveldt, Uitvlug and Swaggershoek, collectively termed the Graaff-Reinet district for the purposes of this study.

A further benefit of the Opgaafrollen dataset is the fact that farming units can be observed over an extended period of time allowing for the analysis of the dynamics of this primarily pastoral frontier society. One of the paramount advantages of this dataset is that details of Khoe employed on settler farms is recorded. This information is particularly important, especially since excluding the Khoe from studies of the economy of the early Cape colony would yield an inaccurate overall picture of the colonial agricultural production process (Fourie & Green, 2015). The richness of this quite unique dataset enables us to achieve insights into frontier life that is unparalleled in any other prior studies.

The settler holdings recorded in the dataset included, amongst other things, the number of Khoe labour, slave labour, the amount of livestock kept, the number of wagons, the number of vines, the amount of wine produced as well as the amount of crops sown and reaped. One of the shortcomings of the dataset is that it does not include information for the years 1804, 1808 and 1827. The data employed also limits the scope of this study to the eastern frontier population recorded in the VOC Opgaafrollen. This essentially means that our analysis falls prey to the “population under European influence” problem (Fourie & Von Fintel, 2011). This problem is not unique since most colonial data collection institutions focused primarily on the white settler population and not on indigenous inhabitants of the colonised territories. In the case of the Graaff-Reinet district the Khoe members of society were only included if they were in service of settler households.

The dataset includes information on Khoe labourers on settler farms. However; no distinction is made between indentured and free Khoe labour. What is important to note is that the percentage of indentured Khoe does increase steadily over the first half of the 19th century as settler influence over the frontier grows (Elphick & Giliomee, 1979). Figure 1 shows that on average, Khoe labourers at Graaff-Reinet outnumbered slaves by four to one, which effectively proves that Khoe labour was always more important on the eastern frontier than slaves if similar levels of

productivity is assumed for both groups. Settler household and Khoe labour have roughly similar reported numbers in the Graaff-Reinet tax censuses.

Since sheep and cattle rearing formed the backbone of Graaff-Reinet agriculture it would be normal to expect that the size of sheep and cattle holdings vary with the frontier migration patterns since sheep and cattle move with their owners. Figure 5 plots the log value ² of combined sheep and cattle numbers spanning the period 1805 to 1828. This plot clearly shows the extreme volatility present in frontier livestock holdings over the period of study. What is also clear is the apparent devastating effect that frontier conflicts such as both the Fourth (1811 to 1813) and Fifth Frontier Wars (1818 to 1819) had on livestock holdings. It also appears as if the livestock holdings of frontier settlers at Graaff-Reinet does not recover completely after the Fourth Frontier War in part due to migration of Graaff-Reinet and Uitenhage settlers further into the Zuurveld. The severe dip in livestock holdings in 1828 and missing 1827 values is as a result of poor record-keeping to the end of the utilisation of the *Opgaafrollen* by the British colonial authorities. By the mid 1820s the British colonial government was replacing the older VOC administrative processes with its own administrative processes, especially since it wanted to discourage the old loan-farm system in favour of free-hold farming. The incentive to maintain accurate *Opgaafrollen* data declined sharply as a result.

Method

The ultimate aim of this paper is to determine whether or not slaves at Graaff-Reinet was a flexible source of labour. Since Graaff-Reinet at the time of this study was a

² The price data obtained to calculate the values for cattle and sheep holdings is taken from the MOOC8-series probate inventories as indicated later in this paper. This approach is taken from fourie2010dynamics which made use of MOOC-10 probate price information.

typical frontier society it would be natural to expect that slave labour would at the very least be substitutable with Khoe labour, especially during times of Khoe desertions. What makes this study particularly unique is the fact that the indigenous Khoe labour can also be incorporated into this analysis. In order to observe whether this substitutable labour relationship was present in this open frontier society this study makes use of Transcendental Logarithmic (Translog) production functions to calculate elasticity coefficients for each year of the Opgaaffrollen considered (Field, 1988; Behar, 2010). We will essentially be estimating the price elasticity of complementarity between the three types of labour (slave labour, Khoe labour and settler labour) on the eastern frontier for each year from 1805 to 1828. The elasticities derived for each year (and production factor) of the study will effectively show whether these types of labour during the period of study remain substitutes or not. Graaff Reinet frontier household units will be treated similarly to firm units analysed by (Behar, 2010).

Methodologically, utilising a Translog production function relaxes the assumption of strong separability between the production inputs assumed by other functional forms such as Constant Elasticity of Substitution (CES) and Cobb-Douglas production functions (Berndt & Christensen, 1973). This a priori assumption may lead to incorrect inferences if the degree of elasticity between the factor inputs is different for different settler households. This problem is largely solved by utilising more flexible functional forms such as the Generalised Leontief production Functions or Translog Production functions (Berndt & Christensen, 1973).

Ultimately the following translog production function is specified:

$$\log(Q_{it}) = \beta_0 + \beta_{t2} \log(S_{it}) + \beta_{t3} \log K_{it} + \beta_{t4} \log F_{it} + \beta_{t5} \log(S_{it})^2 + \beta_{t6} \log(S_{it})^2 + \beta_{t7} \log(S_{it})^2 + \beta_{t8} \log(K_{it}) \log(S_{it}) + \beta_{t9} \log(S_{it}) \log(F_{it}) + \beta_{t10} \log(F_{it}) \log(K_{it}) + \alpha_{it} + u_{it} \quad (1)$$

In equation (Fel! Hittar inte referenskölla.), $\log(Q_{it})$ represents the log of output for each settler household at time t . S_t , K_t , F_t are the utilisation of slave, Khoe and household labour in the Graaff-Reinet agricultural production process at time t . Furthermore, we assume that the major industry for the Graaff-Reinet district was livestock rearing penn2005forgotten. More specifically, the output variable in the production function, Q_{it} , is assumed to be a combined sheep and cattle indicator. In making this assumption the fact that other non-agricultural or even crop based agricultural outputs are not considered may also have a distorting effect on the elasticity of substitution coefficients calculated. This is especially true when considering the fact that the *Opgaafrollen* entirely neglects to incorporate data on manufactured goods such as soap (although brandy and wine production is also included), which appears to have generated large profits for frontier households (Mason, 1994).

The final output variable was obtained through multiplying settler household cattle and sheep holdings per year by price data obtained from the eastern Cape colonial probate inventories recorded in the MOOC8-series³. The entire probate inventories information transcribed span 162-years and record the value of assets accumulated in an individual's estate at death. We only utilised prices which appeared in the records during the 20-year period of the study. Ultimately, the value of total cattle production and sheep production were then added together to form a global output variable for Graaff-Reinet. Since the output variable in the translog production function has to be transformed from a stock concept to a flow, each year's stock output was multiplied by a rate of return on capital of 6% (Worden, 1985).

The rate of return of 6% selected stems from the fact that the general average rate of return on assets or loans for the Cape colony at the time was approximately at this level. This decision was also taken since merely calculating the change in cattle

³ MOOC is an abbreviation for The Master of the Orphan Chamber

and sheep holdings from year to year and multiplying that figure by price would not yield any meaningful results. Particularly due to the fact that if stocks of cattle decline from one year to the next, it might be either due to a farmer's sale of the livestock or due to losses as a result of disease. The inability to ascertain whether the livestock is lost or sold between any two given years of the dataset prompted the decision to apply the aforementioned simplifying assumption.

In equation((1)), HEC_{ijt} is the calculated elasticity of complementarity between factor i and j at time t . (β_{ijt}) represents the estimated parameter for the interaction term between $\ln i$ and $\ln j$ at time t . M is the logarithmic marginal product $\frac{\partial \log Q_{it}}{\partial \log X_{it}}$ at time t . M_{it} and HEC_{ijt} are functions of the inputs K , S and F . This analysis will derive Elasticity of Complementarity values for each settler household during each year of the study.

$$HEC_{ijt} = \frac{(\beta_{ijt} + M_{it}M_{jt})}{M_{it}M_{jt}} \quad (1)$$

In estimating the translog production function for each year of the *Opgaafrollen* a five year moving average for each year is calculated. This smoothing approach increases the observations utilised in each regression adding to the robustness of the eventual results. If the elasticity of complementarity coefficient is calculated to be strongly positive ($HEC_{ij} > 0$) the inputs in the production process are complements (different inputs all together), however; if the elasticity of complementarity coefficient is calculated to be negative ($HEC_{ij} < 0$) the inputs considered are substitutes.

This physical production process will be estimated by means of Ordinary Least Squares (OLS). It is assumed that all inputs are exogenous, factor prices are endogenous and that input and output value selection does not occur simultaneously. The estimated parameters will then be utilised to calculate the cross-price Hicksian

Elasticity of Complementarity (HEC) for the different labour inputs. The HEC coefficient for each year will be estimated by the following equation:

Results

Let us begin by calculating the elasticities between settler family labour and slave labour. In Figure 6 the mean calculated elasticity of complementarity coefficient from 1805-28 shows that slave and settler family labour are complements throughout the period of analysis, since the Hicksian mean elasticities of complementarity are all positive over the entire period of study. Complementarity implies that the two labour inputs are distinctly different. This result is to be expected since the master-servant relationship already existed between slave and settler household labour at the Cape Colony (Field, 1988). It is clear that slave and settler family labour remain distinctly different types of labour throughout the period. Eastern frontier settlers remain the supervisory masters and slaves perform the domestic labour around the farm homestead. This complementarity appears to be reasonably strong for most settler households at Graaff-Reinet over the entire period of study, which primarily dispels the notion of a fluid relationship between slave and settler household labour (Domar, 1970).

The mean elasticity of complementarity estimates for household and Khoe labour for the period in question shown in Figure 7 also remains positive throughout. Khoe and family labour are also distinctly different labour inputs into the livestock rearing production process at Graaff-Reinet. In addition, the elasticity estimates from 1814 to around 1818 show a widening trend in its spread across frontier farms with a number of farms reporting negative elasticities of complementarity (substitutes). This phenomenon can largely be explained by the recovering population numbers after the Fourth Frontier War. As a coping mechanism to labour losses after the

Frontier War some farms had to substitute family labour with Khoe labour. This may suggest household and Khoe labour were somewhat fluid and to some degree could be substituted. This may also indicate that the Khoe still enjoyed a reasonable degree of freedom.

In times of scarce Khoe labour the most logical response would be to replace them with slave labour as a coping mechanism, if the option was available. Yet when viewing Figure 8 the mean elasticity of complementarity figures calculated for slaves and Khoe over the 1805 to 1828 period remains complements throughout. This result indicates that slaves and Khoe at the Graaff Reinet frontier were performing very different tasks in the farming production process. This is an especially important conclusion since it refutes the idea that slave labour is relatively flexible and with some degree of investment in retraining can be repurposed to do almost anything.

Restriction to individuals present in 1815 and who have been in the panel for
longer than two years.

So far our estimates have not taking into consideration that the period was marked by major changes in the composition of the frontier labour force caused by conflict and wars. The periods during and directly after the Fourth Frontier War shows a marked decline in the population numbers of all the different labour groups to varying degrees. The largest simultaneous decline in the Graaff Reinet settler, slave and Khoe numbers over the period of this study occurs in 1814 after the Fourth Frontier War. The total population of settlers, Khoe and slaves recorded in the Opgaafrollen declines by 33.5%, 37.7% and 31.1% respectively. This structural break in the data may bias the results obtained in favour of this complementary labour relationship in the aforementioned analysis so we restrict the sample utilised in the calculation of elasticities of complementarity to settler households that were present before and after the population shock in 1814. If this restriction is applied

the total observations across all the years falls substantially to around 8,000 from roughly 42,180.

Figure 9 shows the recalculated elasticity of complementarity estimates for settler household labour and slaves after the aforementioned restriction is imposed. In the case of household labour and slaves the complementary relationship continues to persist. Save for 1805 and 1806 (where substitutability is present) all the years show reasonably strong complementarity (positive mean elasticities of complementarity). When viewing Khoe and slaves, it is also clear that these two types of labour inputs remain complements throughout the period of analysis even after the restriction is imposed as shown in Figure 10. What does appear to happen from 1822 onwards is that Khoe and slave labour become substitutes on a small number of farms (possibly wealthier farms). This phenomenon can be explained by the fact that Khoe numbers started declining rapidly in the later years of the Opgaaffrollen, effectively forcing more settler farming endeavours, who could afford to acquire slaves, to substitute away from Khoe labour. However; since this was not possible for all farms Khoe and slave labour remained complements on most farms.

Figure 11 confirms that even when only individuals that were present in the Opgaafrollen prior to the 1814 structural break are followed it is clear to see that the mean elasticity of complementarity estimates between Khoe and family labour remains positive over the period of this study. However, from 1816 to 1828 it appears as if the complementary relationship between household and Khoe labour becomes significantly weaker. This conclusion seems to support the notion that as Khoe labour supplies were declining over time and the frontier settlers had to rely less on Khoe labour for rearing their cattle and sheep. Overall, since it is impossible to increase settler household sizes over short time horizons the strong reliance on Khoe labour did persist to some extent.

Restricting analysis to slave-owners only from 1805 to 1828

As shown in the descriptive statistics slave ownership was primarily concentrated to a smaller group of wealthier households. That we find no substitution effect may simply be because for the vast majority using slaves as a coping strategy was not an option. Let us therefore focus solely on the minority group of slaveholders to analyse to what extent they used slaves to substitute for Khoe labour. This restriction will also test the robustness of the complementarity result for slave, Khoe and settler family labour over the period of this study. Unfortunately, after instituting this restriction (keeping only households with one or more slaves in the sample) the number observations in the dataset is reduced from 42,180 to 11,456. This also clearly illustrates that slave ownership was not widespread as 73% of the observations are dropped from the sample if settler households in possession of one or more slaves are viewed.

Figure 12: shows that the mean elasticity of complementarity estimates for slaves and household labour when imposing the aforementioned restriction from 1805 to 1828 remains positive (Save for 1805). This finding broadly supports the conclusion that settler (family labour) and slave labour was complementary as was found with the entire sample. However; the degree of complementarity when restricting the sample to slave owners at Graaff-Reinet is much weaker. Slave labour therefore is not easily substitutable with family labour and seriously brings into question whether slave labour itself can be considered flexible.

When considering the complementarity estimates between slaves and Khoe for the period 1805 to 1822 in Figure 13 for slave owning households the result shows a strong complementary outcome (1828 also shows a complementary outcome). However; after 1822 when Khoe numbers fall drastically Khoe and slave labour become substitutes. It therefore appears as if slave and Khoe labour perform distinctly different labour roles in the livestock rearing production process from 1805 to 1822; yet as Khoe numbers decline the wealthier slave-owning frontiersmen

are able to substitute away from Khoe labour and procure slaves as a coping mechanism. This result indicates that many slaves may have acquired the location specific skills which made Khoe labour desirable over time. It may thus have been easier for frontier farmers to replace lost Khoe labour with slaves as time passed. Indeed, it is clear that if slaves were available to employ in the Graaff-Reinet pastoral production process that settler farmers would opt to use them. However; this only occurred when Khoe labour was relatively scarce.

Division of Labour and Location Specific Skills

In the frontier production process, the settlers would serve as the supervisors to the Khoe labour, performing an oversight role in the pastoral process. However; Khoe labourers were also rebellious and were often far from a reliable source of labour. This has been made evident from the continuous conflicts in the eastern frontier zone over the period of the study.

In response to the unstable Khoe labour supply, it would be convenient to expect that if households at the frontier had the means they would rely on slave labour to a greater degree. Yet the results from the analysis shows that Khoe and slave labour also remained complements throughout the period, even in wealthier slave owing households (for the majority of the period). Context specific factors therefore play a significant role in determining the degree of flexibility of slave labour. In this study we theorise that this inflexibility of slave labour with respect to Khoe labour stems from two primary reasons. The first, is the fact that the capital investment necessary to purchase, transport and train a slave for pastoral farming practices was far too high for the primarily poor frontiersmen. It was much easier to partake in Khoe raids or obtain indigenous wage labour who had been practising pastoral agriculture in the region prior to the arrival of the settlers. The second reason was due to colonial legislation which prohibited slaves from bearing arms - an essential component in the cattle rearing process (Dooling, 1992). These two reasons made

slave and Khoe labour completely different inputs in the pastoral Graaff-Reinet production process.

Slaves at Graaff-Reinet were mostly kept either as domestic labour around the home, as a status symbol for more affluent settler families, or tended to the small number of wine, wheat, barley and rye endeavours that were present at Graaff-Reinet (Worden, 1985; Dooling, 1992). The presence of wheat reaped, vines, barley reaped, rye reaped for a rather small number of eastern frontier farmers confirms that at least a small amount of crop cultivation took place. Since many slaves that were purchased by the wealthier interior farmers at Graaff-Reinet acquired slaves from the wine and wheat producing Cape centre, slave labour in general was more suitably trained for crop cultivation. The location specific context therefore made slave labour relatively inflexible with respect to Khoe labour. Fourie & von Fintel (2011) also argues that slaves were primarily used as employees in the "proto-factories", which farmers began in order to produce manufactured articles such as brandy for local markets.

In order to further illustrate the fact that slaves and Khoe labourers at Graaff-Reinet were initially performing very different tasks we estimate the models presented in Table 2. In the first two models of Table 2, the probability of being a pastoral or wine farmer is regressed on the log of Khoe, family and slave labour as well the log of wagons. The probit model for Pastoral farming clearly shows that the availability of Khoe and settler family labour have a positive influence on the probability of establishing a pastoral farm at Graaff-Reinet over (1805 to 1828). Slave labour has an insignificant impact on the choice of establishing a pastoral farm. When looking at the probit model for viticulture the availability of Khoe labour also has a significant impact on the probability of planting vines. Slave labour and wagons have a positive and significant impact on planting grapes, but the greater availability of settler family labour seems to reduce the likelihood of planting vines. The result for family labour is surprising suggesting that grape farming at Graaff-Reinet relied

almost solely on slave labour and Khoe labour. In terms of the third model of Table 2, slave labour was significant for the probability of manufacturing brandy and greater quantities of available settler household labour resulted in a lower probability of manufacturing brandy. The probit results clearly demonstrate that slaves and Khoe were working in distinctly different labour markets.

It does appear that when the entire sample is restricted to slave owning households that over time slave labour does become substitutable with Khoe labour. This may be due to the fact that sufficient time had passed for slaves to acquire the knowledge and skill for pastoral farming, previously explaining the preference for Khoe labour. Since the wealthier frontier families had access to slaves initially they were able to invest time and resources in retraining their slaves to cope with declines in Khoe labour. Nevertheless, this back-up measure was only available to the wealthy and the poor effectively had no means to substitute away from Khoe labour, especially since the period it took for slaves and Khoe to eventually become substitutable took 18 years. This time investment was vast since it would span a significant portion of the useful life of a slave. This was simply not a viable option for households who were just making end meet.

Separation of Sheep and Cattle Rearing

If the output variable for the production function is split into its respective cattle and sheep components the greater level of substitutability achieved over time between slaves and Khoe becomes significantly more pronounced. Figure 9 clearly shows that by 1822 slave and Khoe labour become more substitutable on a significant number of farms (the mean elasticity of complementarity becomes negative). In the case of sheep rearing this effects is significantly more pronounced. As is clear from Figure 10, slave and Khoe labourers become substitutes in sheep rearing between 1821 and 1826. This effect gives further credence to the theory that over time slaves, if they were available for use, were adapting more easily to sheep and cattle rearing at Graaff-Reinet.

After roughly 15 years slaves are forced to perform more pastoral tasks owing to the fact that Khoe labour is unreliable. The Amelioration policies of the colonial government instituted in 1823 also had a negative impact on the preference for Khoe labour as a result of the fact that farmers could now be legally challenged by Khoe workers if they were unjustly treated (Dooling 1992). Since slaves remained the property of farmers labour disputes were unlikely and now made slave labour more desirable.

Conclusion

In general slaves are considered to be the most flexible type of labour when compared to free and indentured labour. In fact, economic theories on the origins of slavery, such as the Nieboer-Domar hypothesis, relies heavily on the assumption that slave labour in an open frontier setting, with some retraining, could effectively be substituted with any form of labour. This conclusion has not gone uncontested. Many cross-sectional studies have shown that at least slave and free labour could be considered to be completely different inputs in the agricultural production process. However; these static cross-sectional studies, apart from focusing almost completely of slavery in the Americas, do not account for the fact that labour characteristics may evolve over time.

The eastern frontier district of the Cape colony at Graaff-Reinet over the 1805 to 1828 period presents a fertile testing ground for the degree of flexibility of slave labour in an open frontier setting. Despite the fact that economic theory on the origins of slavery posit that unfree labour arrangements would not arise in labour saving pastoral societies, slave and indentured indigenous labour was present in the primarily sheep and cattle rearing Graaff-Reinet district. Settler households in this open frontier district made extensive use of family, (free and indentured) Khoe and slave labour in the livestock production process. However; the fluidity of this frontier society meant that the Khoe were not a very reliable source of labour (Ross,

1983). Frequent revolts by the indigenous people of Graaff-Reinet meant that often the Khoe would simply desert settler farming endeavours.

The results obtained from the elasticity of complementarity estimates between settler family labour and Khoe show that the master-servant relationship between these two groups had already been established by the advent of the 19th century. The Khoe were tending to the livestock, largely due to their in-depth knowledge of the environment as well as their extensive experience with pastoralism over millennia. In turn, the settler family members were performing a more supervisory role.

As a natural coping mechanism one would assume that frontier farmers would automatically rely more on slave labour especially due to the fact that slaves were a reasonably flexible source of workers. However; as the elasticity of complementarity results show context specific factors matter very much for the degree to which slaves can be substituted for other forms of labour. Slave and Khoe labour remain complements in pastoral production for almost the entirety of the study period. Slave labour was available to only a few wealthy frontiersmen and would have to be acquired at a vast capital expense. The context specific knowledge of pastoral agriculture also took a very long time to transfer to slaves. Ultimately, the cost and effort involved to make use of slaves was not available to frontier households who were barely making ends meet.

References:

Acemoglu, D., Johnson, S. & Robinson, J. A., 2002. Reversal of fortune: Geography and institutions in the making of the modern world income distribution. *The Quarterly journal of economics*, Volume 117, pp. 1231-1294.

- Acemoglu, D., Johnson, S. & Robinson, J. A., 2005. The colonial origins of comparative development: an empirical investigation. *Revista de Economía Institucional*, Volume 7, pp. 17-67.
- Acemoglu, D. & Wolitzky, A., 2011. The economics of labor coercion. *Econometrica*, Volume 79, pp. 555-600.
- Adhikari, M., 2010. A total extinction confidently hoped for: the destruction of Cape San society under Dutch colonial rule, 1700--1795. *Journal of genocide research*, Volume 12, pp. 19-44.
- Anderson, R. V. & Gallman, R. E., 1977. Slaves as Fixed Capital: Slave Labor and Southern Economic Development. *The Journal of American History*, Volume 64, pp. 24-46.
- Austin, G., 2005. *Labour, land, and capital in Ghana: from slavery to free labour in Asante, 1807-1956*. s.l.:Boydell & Brewer.
- Barzel, Y., 1977. An economic analysis of slavery. *The Journal of Law and Economics*, Volume 20, pp. 87-110.
- Behar, A., 2010. Would cheaper capital replace labour?. *South African Journal of Economics*, Volume 78, pp. 131-151.
- Beinart, W., 2008. *The Rise of Conservation in South Africa: settlers, livestock, and the environment 1770-1950*. s.l.:Oxford University Press.
- Berndt, E. R. & Christensen, L. R., 1973. The translog function and the substitution of equipment, structures, and labor in US manufacturing 1929-68. *Journal of econometrics*, Volume 1, pp. 81-113.
- Berry, R., 1993. Civil Liberties Constraints on Tribal Sovereignty After the Indian Civil Rights Act of 1968. *JL & Pol'y*, Volume 1, p. 1.
- Cilliers, J. & Green, E., 2017. The Land-Labour Hypothesis Revised: Wealth, Labour And Household Composition At The South African Frontier. *African Economic History Network Working Paper Series*, Volume 2017.
- Conning, J. & others, 2004. On the Causes of Slavery or Serfdom and the Roads to Agrarian Capitalism: Domar's Hypothesis Revisited. *Hunter College: Department of Economics*.
- Cornwell, G., 2003. Disgraceland: history and the humanities in Frontier country. *English in Africa*, Volume 30, pp. 43-68.
- Domar, E. D., 1970. The causes of slavery or serfdom: a hypothesis. *The Journal of Economic History*, Volume 30, pp. 18-32.

- Dooling, W., 1992. Slavery and Amelioration in the Graaff-Reinet District, 1823--1830. *South African Historical Journal*, Volume 27, pp. 75-94.
- Eldredge, E., 1994. Delagoa Bay and the Hinterland in the Early Nineteenth Century: Politics: Trade, Slaves, and Slave Raiding. *Slavery in South Africa: captive labor on the Dutch frontier*, pp. 1800-1830.
- Elphick, R. & Giliomee, H., 1979. *The Shaping of South African Society, 1652--1840.* s.l.:Wesleyan University Press.
- Eltis, D., Lewis, F. D. & Richardson, D., 2005. Slave prices, the African slave trade, and productivity in the Caribbean, 1674--1807. *The Economic History Review*, Volume 58, pp. 673-700.
- Engerman, S. L., 1976. Some economic and demographic comparisons of slavery in the United States and the British West Indies'. *The Economic History Review*, Volume 29, pp. 258-275.
- Engerman, S. L., 1992. Coerced and free labor: property rights and the development of the labor force. *Explorations in economic history*, Volume 29, pp. 1-29.
- Feinstein, C. H. & others, 2005. *An Economic History of South Africa: conquest, discrimination, and development.* s.l.:Cambridge University Press.
- Fenoaltea, S., 1984. Slavery and supervision in comparative perspective: a model. *The Journal of Economic History*, Volume 44, pp. 635-668.
- Fenske, J., 2013. Does land abundance explain African institutions?. *The Economic Journal*, Volume 123, pp. 1363-1390.
- Field, E. B., 1988. Free and Slave Labor in the Antebellum South: Perfect Substitutes or Different Inputs?. *The Review of Economics and Statistics*, pp. 654-659.
- Fogel, R. W. & Engerman, S. L., 1974. *Time on the Cross: Evidence and Methods, a Supplement.* s.l.:Little, Brown.
- Fourie, J. & Green, E., 2015. The missing people: accounting for the productivity of indigenous populations in Cape Colonial History. *The Journal of African History*, Volume 56, pp. 195-215.
- Fourie, J. & Green, E., 2015. The missing people: accounting for the productivity of indigenous populations in Cape Colonial History. *The Journal of African History*, Volume 56, pp. 195-215.
- Fourie, J. & others, 2011. Slaves as capital investment in the Dutch Cape Colony, 1652-1795. *Agricultural Transformation in a Global History Perspective.*

- Fourie, J. & Von Fintel, D., 2010. The dynamics of inequality in a newly settled, pre-industrial society: the case of the Cape Colony. *Cliometrica*, Volume 4, pp. 229-267.
- Fourie, J. & Von Fintel, D., 2011. A history with evidence: Income inequality in the Dutch Cape colony. *Economic History of Developing Regions*, Volume 26, pp. 16-48.
- Foust, J. D. & Swan, D. E., 1970. Productivity and Profitability of Antebellum Slave Labor: A Micro-Approach. *Agricultural History*, Volume 44, pp. 39-62.
- Freund, W. M., 1972. The Eastern Frontier of the Cape Colony during the Batavian Period (1803--1806) 1. *The Journal of African History*, Volume 13, pp. 631-645.
- Giliomee, H., 1971. *Processes in Development of the Southern African Frontier..* s.l.:Yale University Press.
- Gray, L. C., 1930. Economic Efficiency and Competitive Advantages of Slavery under the Plantation System. *Agricultural History*, Volume 4, pp. 31-47.
- Green, E., 2014. The economics of slavery in the eighteenth-century Cape Colony: Revising the Nieboer-Domar Hypothesis. *International Review of Social History*, Volume 59, pp. 39-70.
- Gressley, G. M., 1958. The Turner thesis: A problem in historiography. *Agricultural History*, Volume 32, pp. 227-249.
- Habakkuk, H. J., 1958. The economic history of modern Britain. *The Journal of Economic History*, Volume 18, pp. 486-501.
- Hopkins, T., 1973. *An economic history of West Africa.* s.l.:London.
- Key-Bright, J. & Boardman, J., 2006. Changes in the distribution of degraded land over time in the central Karoo, South Africa. *Catena*, Volume 67, pp. 1-14.
- Klein, H. S. & Vinson III, B., 2007. *African slavery in Latin America and the Caribbean.* s.l.:Oxford University Press.
- Klein, M. A., 1998. *Slavery and colonial rule in French West Africa.* s.l.:Cambridge University Press.
- Ladurie, E. L. R., 1976. *The peasants of Languedoc.* s.l.:University of Illinois Press.
- Legassick, M., 1972. *The frontier tradition in South African historiography.* s.l., s.n., pp. 1-33.
- Lovejoy, P. E., 2011. *Transformations in slavery: a history of slavery in Africa.* s.l.:Cambridge University Press.

Marks, S. & Atmore, A., 1980. Economy and Society in pre-industrial South Africa.. In: s.l.:Hong Kong: Longman Group Limited, pp. 1-28.

Mason, J., 1994. *Fortunate Slaves and Artful Masters: Labour Relations in the Rural Cape Colony during the Era of Emancipation, ca. 1825-1838.* s.l.:University of Natal Press.

Mitchell, L. J., 2009. *Belongings: property, family, and identity in colonial South Africa (an exploration of frontiers, 1725-c. 1830).* s.l.:Columbia Univ Pr.

Nash, C. Y. & Flesher, D. L., 2005. Employee leasing. The antebellum 1800s and the twenty-first century: A historical perspective of the contingent labour force. *Accounting, Business & Financial History*, Volume 15, pp. 63-76.

Newton-King, S., 1988. *Commerce and material culture on the eastern Cape frontier 1784-1812.* s.l., s.n.

Nieboer, H. J., 1900. Slavery as an Industrial System (1900). *JK Ingram*.

North, D. C. & Thomas, R. P., 1971. The rise and fall of the manorial system: A theoretical model. *The Journal of Economic History*, Volume 31, pp. 777-803.

Nunn, N., 2008. Slavery, inequality, and economic development in the americas. *Institutions and economic performance*, pp. 148-80.

Penn, N., 2005. *The forgotten frontier: colonist and Khoisan on the Cape's northern frontier in the 18th century.* s.l.:Juta and Company Ltd.

Penn, N. G., 1986. Pastoralists and pastoralism in the northern Cape frontier zone during the eighteenth century. *Goodwin Series*, pp. 62-68.

Rönnbäck, K., 2016. Waged Slavery--Incentivizing Unfree Labour at Cape Coast Castle in the Eighteenth Century. *Slavery & Abolition*, Volume 37, pp. 73-93.

Ross, R., 1983. The Rise of the Cape gentry. *Journal of Southern African Studies*, Volume 9, pp. 193-217.

Russel, R. R., 1941. The Effects of Slavery upon Nonslaveholders in the Ante Bellum South. *Agricultural History*, Volume 15, pp. 112-126.

Schmitz, M. D. & Schaefer, D. F., 1978. Slavery, freedom, and the elasticity of substitution. *Explorations in Economic History*, Volume 15, pp. 327-337.

Shell, R. C.-H., 2005. Immigration: The Forgotten Factor in Cape Colonial Frontier Expansion, 1658 to 1817. *Safundi: The Journal of South African and American Comparative Studies*, Volume 6, pp. 1-38.

Stone, D., 1997. The productivity of hired and customary labour: evidence from Wisbech Barton in the fourteenth century. *The Economic History Review*, Volume 50, pp. 640-656.

Worden, N., 1985. *Slavery in Dutch South Africa*. s.l.:Cambridge University Press.

Worden, N., 1985. *Slavery in Dutch South Africa*. s.l.:Cambridge University Press.

Zeichner, O., 1939. The Transition from Slave to Free Agricultural Labor in the Southern States. *Agricultural History*, Volume 13, pp. 22-32.

Appendix:

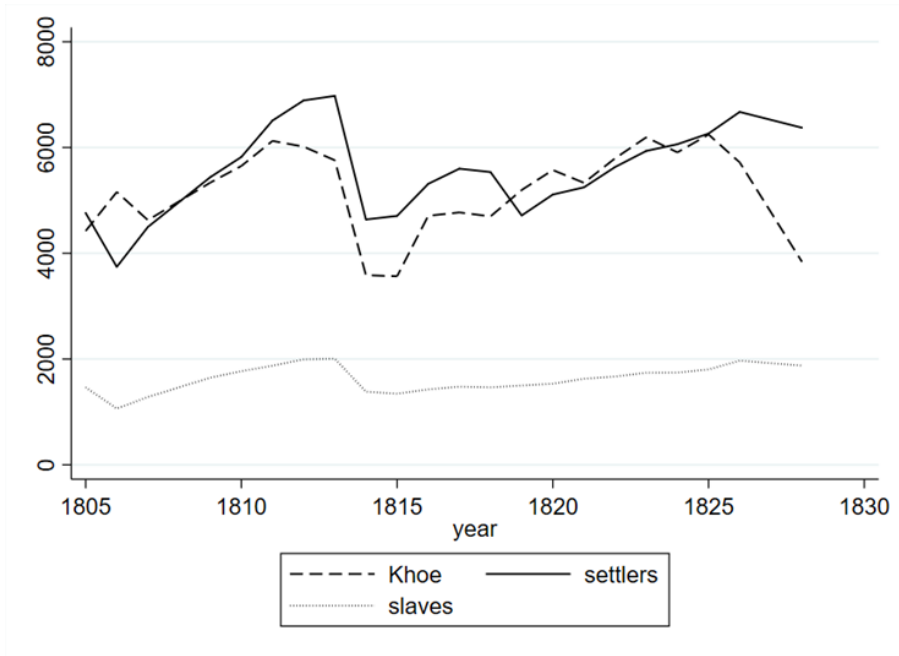


Figure 1: Population numbers at Graaff-Reinet

Source: VOC Opgaafrollen

	Mean	Std.Dev	Min	Max
Sheep	496.82	759.92	0.00	14,121.00
Cattle	44.73	72.84	0.00	2,831.00
Family Labour	3.93	2.84	0.00	16.00
Khoe	4.10	6.78	0.00	78.00
Slaves	1.15	2.95	0.00	61.00

Table 1: Frontier Pastoralist Farms

Source: VOC Opgaafrollen

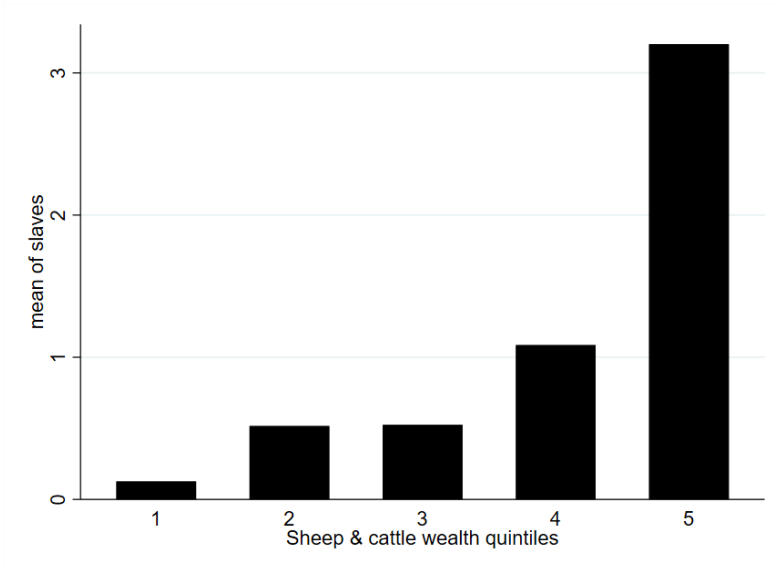


Figure 2: Average number of slaves per household

Source: VOC Opgaafrollen and MOOC-8 series

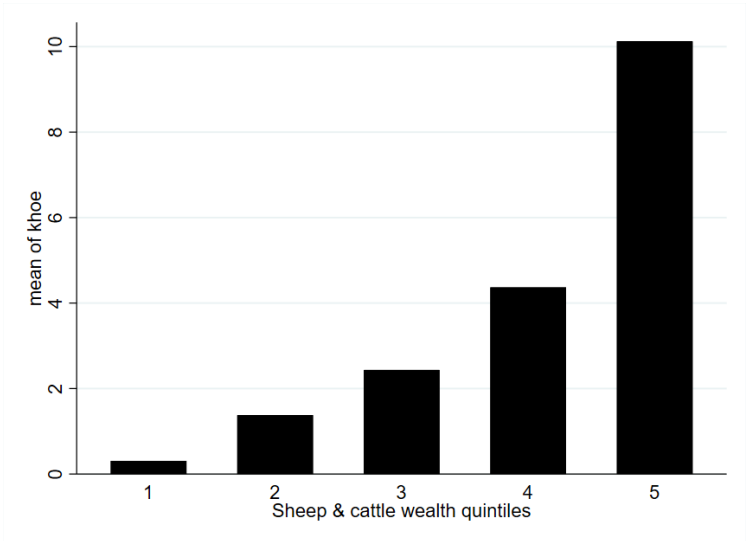


Figure 3: Average number of Khoe per household

Source: VOC Opgaafrollen and MOOC-8 series

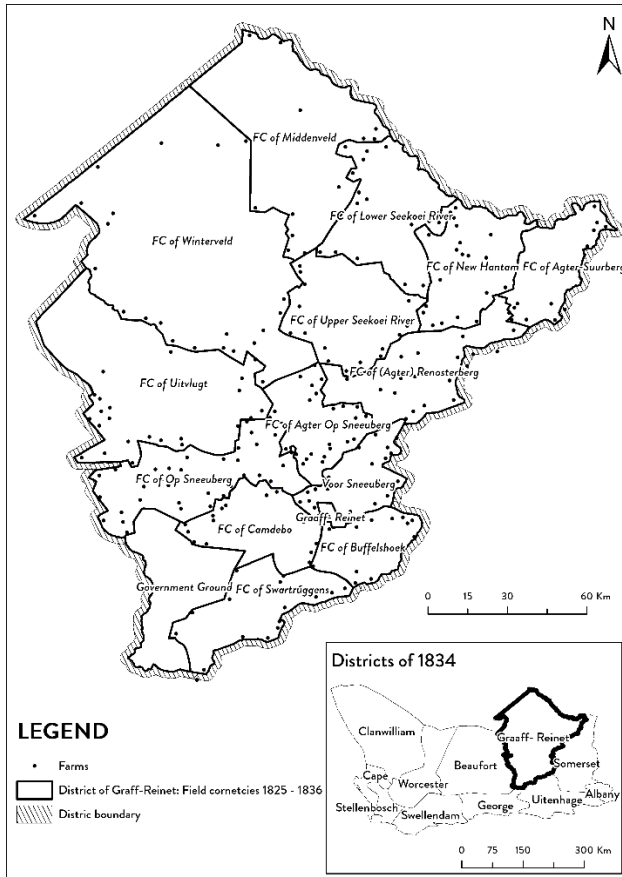


Figure 4: Map of Graaff-Reinet

Source: VOC Opgaafrollen



Figure 5: Log output Graaff-Reinet

Source: VOC Opgaafrollen and MOOC-8 series

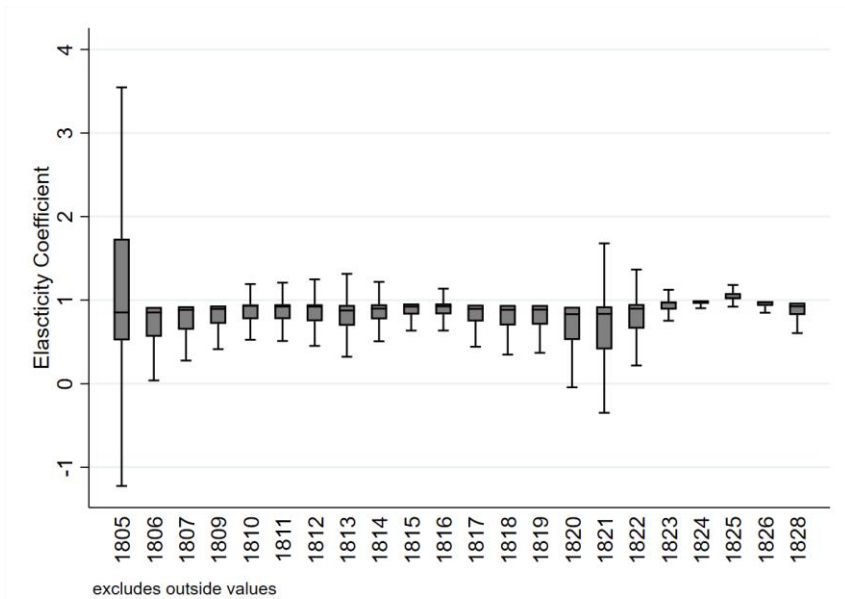


Figure 6: Elasticity of Complementarity Household Labour and Slaves

Source: VOC Opgaafrollen and MOOC-8 series

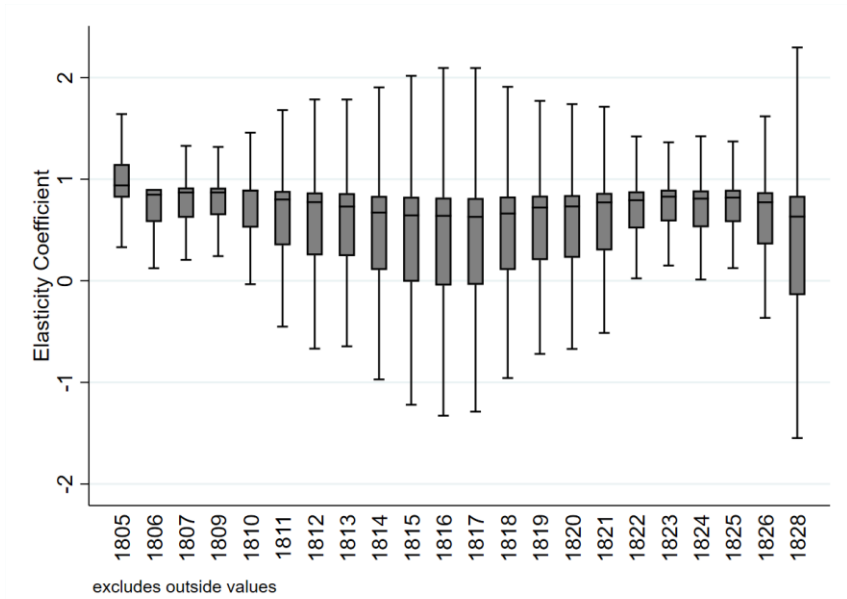


Figure 7: Elasticity of Complementarity Household Labour and Khoe

Source: VOC Opgaafrollen and MOOC-8 series

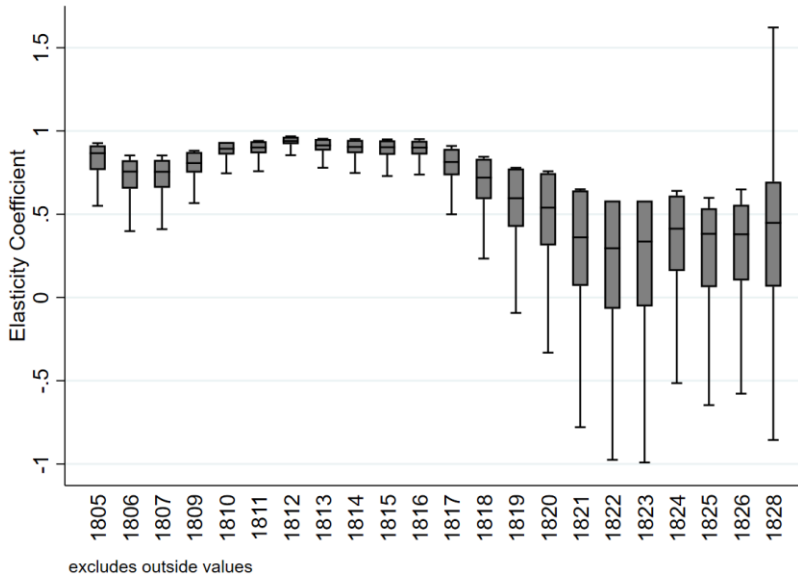


Figure 8: Elasticity of Complementarity Slaves and Khoe

Source: VOC Opgaafrollen and MOOC-8 series

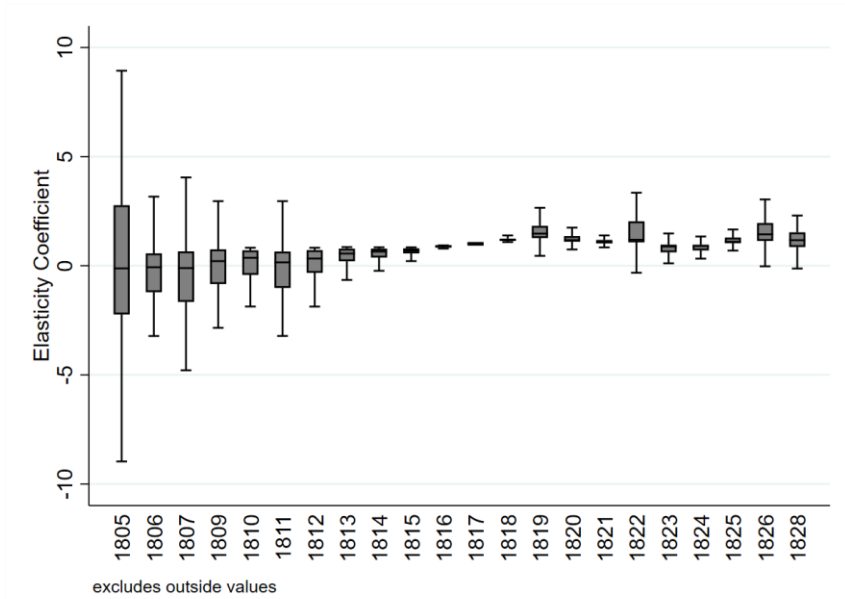


Figure 9: Elasticity of Complementarity Household Labour and Slaves

Source: VOC Opgaafrollen and MOOC-8 series

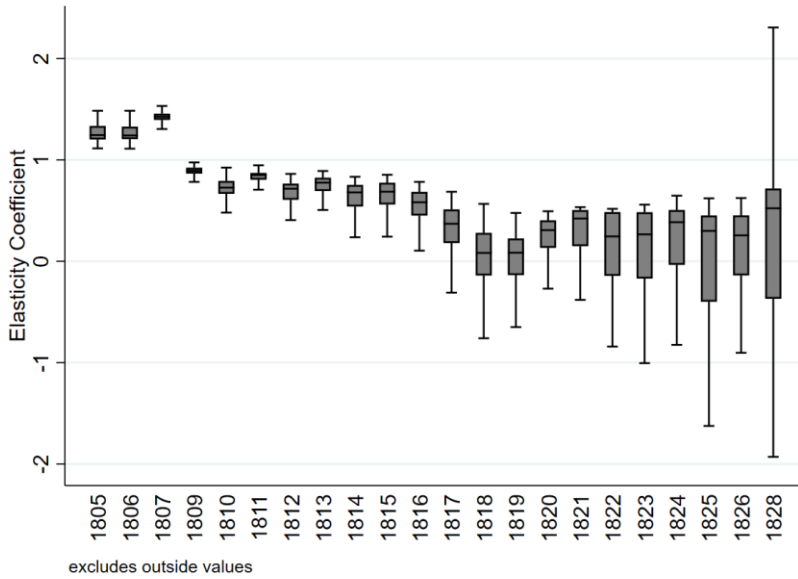


Figure 10: Elasticity of Complementarity Slaves and Khoe

Source: VOC Opgaafrollen and MOOC-8 series

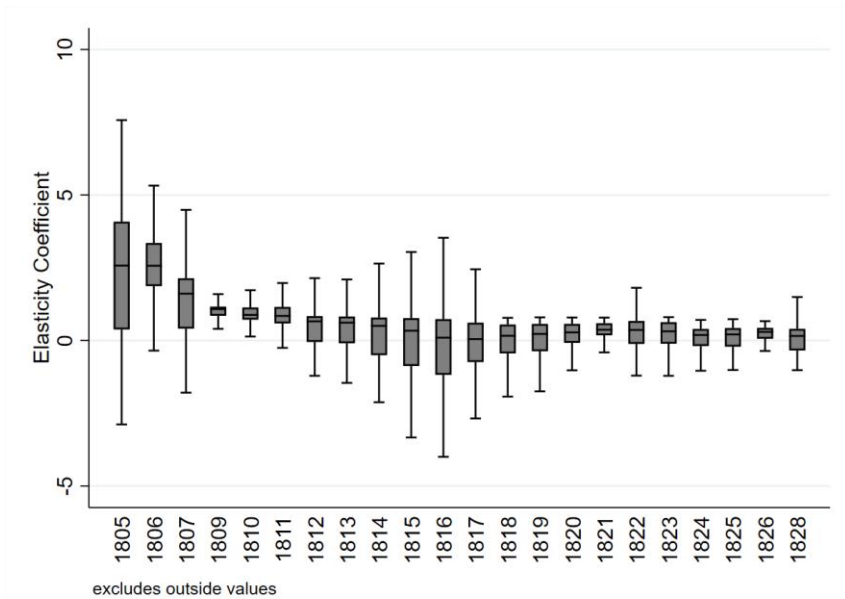


Figure 11: Elasticity of Complementarity Household Labour and Khoe

Source: VOC Opgaafrollen and MOOC-8 series

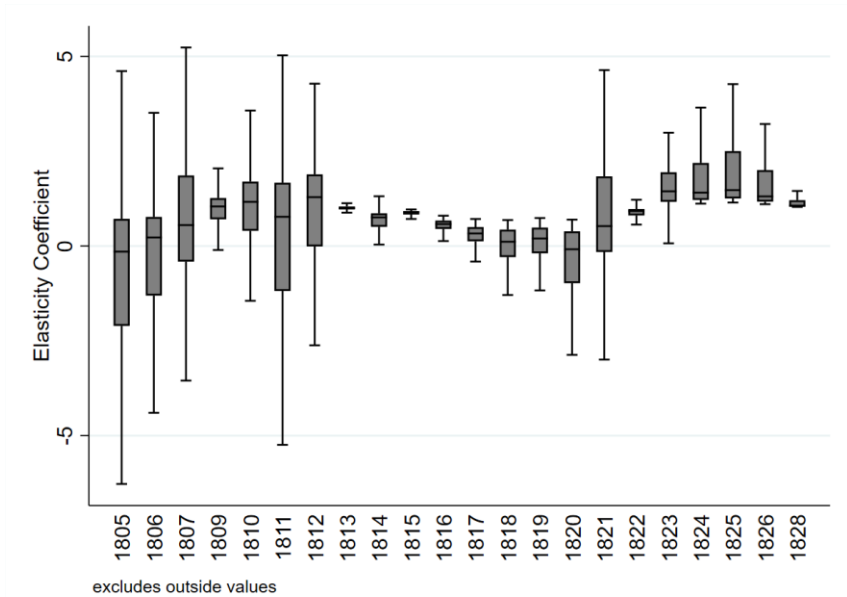


Figure 12: Elasticity of Complementarity Household Labour and Slaves

Source: VOC Opgaafrollen and MOOC-8 series

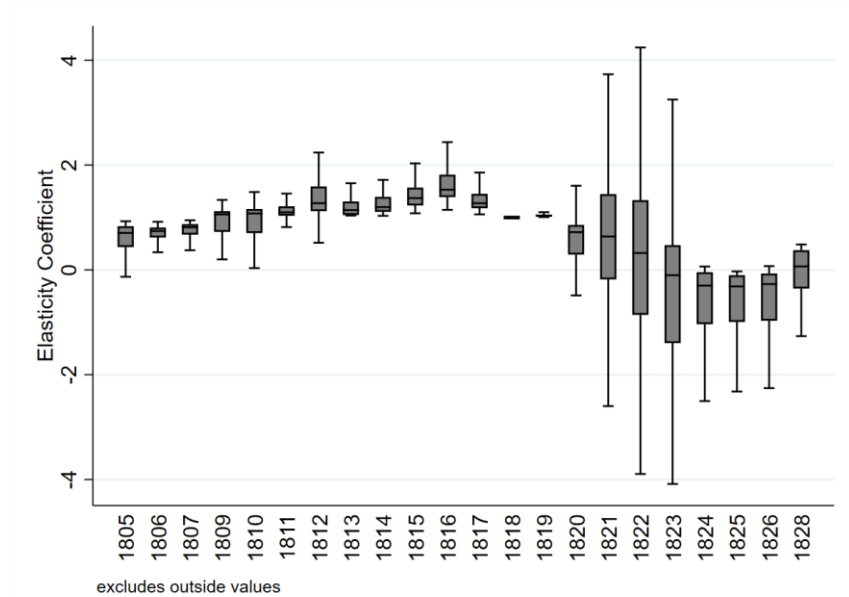


Figure 13: Elasticity of Complementarity Slaves and Khoe

Source: VOC Opgaafrollen and MOOC-8 series

	Pastoralism	Viticulture	Brandy
Log slaves	-0.00978	0.600 ***	0.439 ***
Log khoe	0.236 ***	0.0629 ***	0.0371
Log family labour	0.552 ***	-0.687 **	-0.106 **
Log wagons	-0.674	0.237 ***	0.271 ***
_cons	1.396 ***	-1.984 ***	-2.326 ***
<i>N</i>	19,120	19,120	19,120
t statistics in parentheses			
^* * $p < 0.05$, ^*** $p < 0.01$, ^**** $p < 0.001$			

Table 2: Probit Models for Graaff-Reinet, 1805-1828

Source: VOC Opgaafrollen and MOOC-8 series

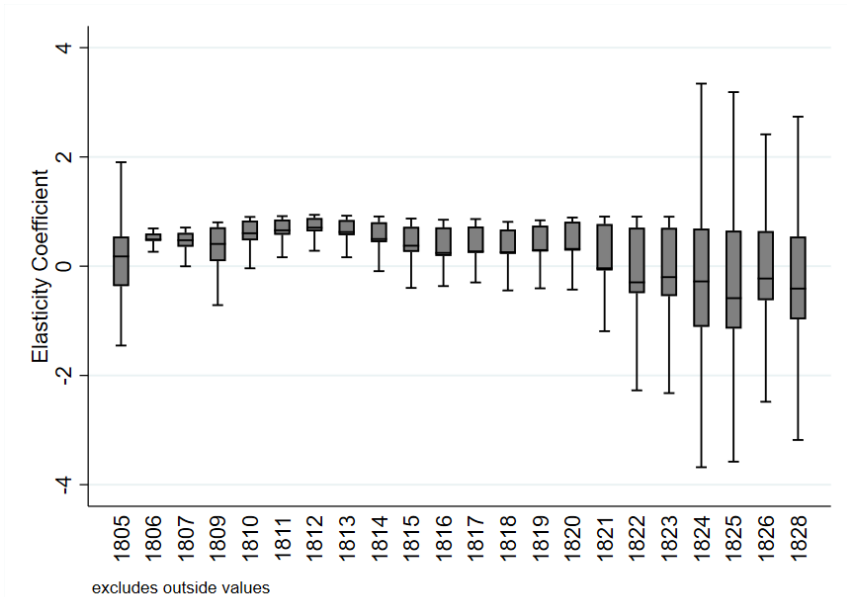


Figure 14: Elasticity of Complementarity Slaves and Khoe (Cattle)

Source: VOC Opgaafrollen and MOOC-8 series

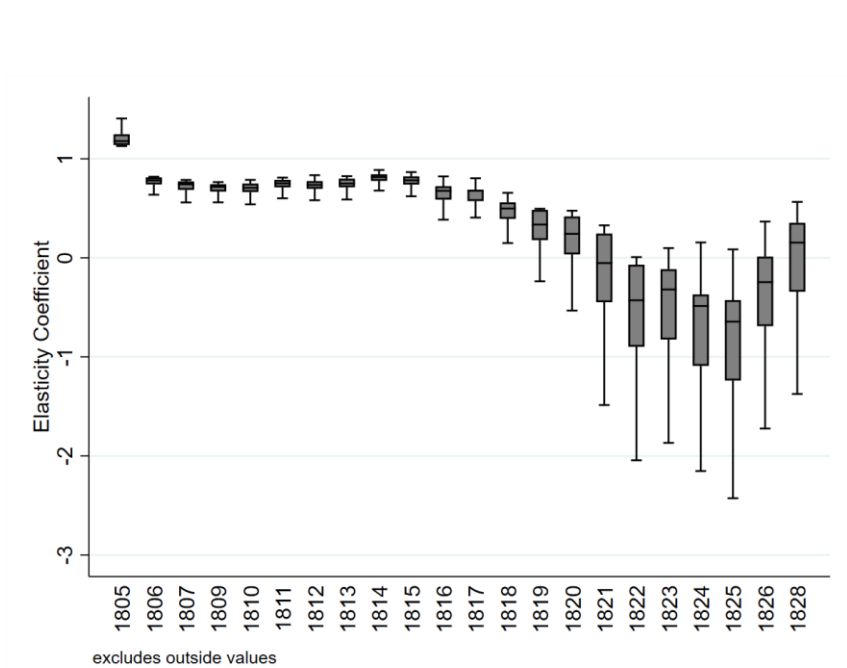


Figure 15: Elasticity of Complementarity Slaves and Khoe (Sheep)

Source: VOC Opgaafrollen and MOOC-8 series

