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GROWTH: EVIDENCE FROM  
A NATURAL EXPERIMENT**

Liam Brunt

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Liam Brunt, Université de Lausanne and CEPR

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Centre for Economic Policy Research  
90–98 Goswell Rd, London EC1V 7RR, UK  
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999  
Email: [cepr@cepr.org](mailto:cepr@cepr.org), Website: [www.cepr.org](http://www.cepr.org)

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## **ABSTRACT**

### **Property Rights and Economic Growth: Evidence from a Natural Experiment\***

In 1795 the British took control of the Cape colony (South Africa) from the Dutch; and in 1843 they exogenously changed the legal basis of landholding, giving more secure property rights to landholders. Since endowments and other factors were held constant, these changes offer clean tests of the effects on economic growth of colonial identity and secure property rights. The effects of both changes were immediate, positive and large. Other legal and institutional changes, such as the move to a common law system in 1827, had no such effects on economic growth.

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Liam Brunt  
Ecole des HEC  
Université de Lausanne  
CH-1025 Dorigny  
Internef Bureau 536  
SWITZERLAND  
Email: [Liam.Brunt@unil.ch](mailto:Liam.Brunt@unil.ch)

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“Commerce and manufactures can seldom flourish long in any state which does not enjoy a regular administration of justice, in which the people do not feel themselves secure in the possession of their property...”

Adam Smith, *The Wealth of Nations*, book 5, chapter 3, paragraph 7.

**0. Introduction.** Adam Smith was the first economist to emphasize the fundamental role that secure property rights play in stimulating economic activity. At the most basic level, Smith argued that secure property rights were both necessary and sufficient incentives for economic agents to produce more than they needed for bare subsistence (*Wealth of Nations*, book 4, chapter 5, paragraph 82):

“That security which the laws in Great Britain give to every man that he shall enjoy the fruits of his own labour is alone sufficient to make any country flourish.... The natural effort of every individual to better his own condition, when suffered to exert itself with freedom and security is so powerful a principle that it is alone, and without any assistance, not only capable of carrying on the society to wealth and prosperity, but of surmounting a hundred impertinent obstructions with which the folly of human laws too often incumbers its operations....”

Many of the most important insights of Smith’s analysis follow from this basic tenet. For example, secure property rights can be achieved only when individuals come together to form a society. But a society cannot function without government and thus we have rationale for the existence of governments, which we commonly observe in the world. If a government is to provide security then it must hold a monopoly on the provision internal and external force (i.e. it must have a police and a military). It can maintain this monopoly only by being given the power to levy taxes in order to pay for the police and military. Yet the government itself could be a threat to personal property rights, since it has a monopoly on force, so Smith thus provides us with a rationale for separating the executive and judicial branches of the government. Once such a separation has occurred, it is feasible for the government to bind itself in law and this in turn permits financial development such as the issuance of government bonds. And so the argument is developed further and further, with the whole edifice built up from the foundation of secure property rights.

Economists have long been persuaded of the fundamental importance of Smith’s insights. But we know that many other factors also affect the level of economic activity and it is appropriate to ask how quantitatively important are property rights in determining levels of income and economic growth. This has been the focus of a great deal of recent economic analysis and there is now a considerable body of research examining the role of property institutions – and the judicial systems that guarantee them – in promoting modern economic growth. Prominent contributions to this line of enquiry include the work on legal origins by Rafael LaPorta, Florencio Lopez-de-Silanes, Andrei Shleifer and Robert W. Vishny (hereafter LLSV) (1997, 1998, 1999); the work on finance and growth by Thorsten Beck, Asli Demirgüç-Kunt and Ross Levine (hereafter BDL) (2002a, 2002b, 2004); and the work on colonial origins by Daron Acemoglu, Simon Johnson and James Robinson (hereafter AJR) (2001, 2002, 2003). These papers are all in broad agreement: they offer strong empirical evidence showing that secure

property rights – typically measured as an index of freedom from expropriation – have a quantitatively important impact on the levels and growth rates of GDP and other variables such as the rate of investment. Unfortunately, these studies disagree on virtually everything else. For example, AJR undermine LLSV by specifically rejecting legal origin as an important cause of the variation in the security of property rights – according to AJR the variation is all down to colonial origins. By contrast, BDL support both LLSV and AJR by finding that both legal and colonial origins were important in generating increased investment and economic growth – but BDL then reject the argument proposed by both LLSV and AJR that secure property rights were the primary conduit through which this beneficial effect made itself felt, arguing instead that property rights were secondary to an efficient evolution of the legal system.

Virtually all the evidence presented by researchers in this area has been cross-sectional. This is somewhat problematic for several reasons. First, there is always the fear an omitted variable might be driving the results. Indeed, this is exactly the criticism that AJR would make of the work of LLSV, since they find that adding colonial origins to the LLSV regressions reduces the explanatory power of legal origins to almost zero. This raises the obvious question of whether some other variable (not yet discovered) could in turn reduce the explanatory power of colonial origins to zero. Second, there is the problem that the cross-section contains only a limited amount of identifying variance that we can use to test between the competing hypotheses. This is exacerbated by the fact that it is difficult to get data for many countries (the cross-sections generally contain only around 60 observations), there are only a small number of legal origins (English, French and German) and these are highly correlated with a small number of colonial origins (British, French, German, Spanish and Dutch) (BDL, 2001, 30-1 and table 2).

By contrast, this paper introduces a completely new body of time series evidence that gives us the identifying variance that we need to test empirically between the competing hypotheses. Our study is based on the European colony at the Cape of Good Hope, now known as South Africa. The Cape colony (as it was generally known) has the exceptional feature that it was a Dutch colony for 150 years and was then seized by the British in 1795 for geo-political reasons. Hence it offers a unique natural experiment, switching exogenously from Dutch to British colonial origins and from civil to common legal origins. It is also useful for our purposes that the change in legal origins occurred in two important stages. First, the common law and adversarial trials were introduced in 1827; and, second, the nature of property rights changed in 1843. All these changes give us the identifying variance that we need in order to test empirically between the competing hypotheses of LLSV, BDL and AJR. Our construction of an entirely new data set on annual output and productivity for the period 1701 to 1875 gives us the data that we need to do the job.

Before considering the new evidence we need to make a detailed comparison of the competing hypotheses in order to highlight their differences, since it is only by focusing on their differences that we can test between them empirically. It is to this task that we now turn.

The modern property rights literature goes back to Friedrich A. von Hayek (1960), who stressed the importance to investors of secure property rights – and, in particular, legal checks on the ability of the government to expropriate investors. This line of argument was taken forward by Douglass North and Barry Weingast (1989). They

argued that it was England's Glorious Revolution of 1689 which established the primacy of Parliament over the monarchy and ensured that investors would not be subject to the arbitrary exercise of power. This in turn boosted investment and economic growth and led to the British industrial revolution in the eighteenth century. But it was LLSV (1998) who really took the analysis forward by offering the first modern empirical investigation of the relationship between legal origins and financial structure.

The basic insight of LLSV is that the legal protection given to investors varies very considerably across countries. This stems from both the variation in nominal legal rights and the reliability with which those rights are enforced by the courts. For a sample of 49 countries LLSV collected data on a range of investor rights and the quality of legal enforcement and then took their empirical analysis in two directions.

First, they show that the variation in legal protection for investors results in important variations in financial structure. For example, countries with poor legal protection for shareholders tend to have much more concentrated share ownership. Second, they trace the variation in investor rights back to the origins of the legal system. In particular, they draw a distinction between countries where the legal system is based largely on the "common law" and countries where it is based on the "civil law". The common law system is built up organically from judicial rulings on individual cases and is essentially derived from English law, transplanted and later adapted in various British colonies.<sup>2</sup> By contrast, the civil law system is built upon a rational, idealized view of economic relations and the morality that governs them; this view is then codified by the executive and handed down to be implemented by the judges. The civil law system is ultimately derived from Roman law but its modern incarnation derives from France and Germany, whose systems have been widely influential in other continental European countries and the colonies that they created. There is an important difference between French and German civil law regarding its ability to evolve over time. Napoleon conceived his code to be timeless because it was based on fundamental principles, whereas German legal scholars were open to the idea that new types of dispute would arise which required evolution of the legal code. LLSV find that legal origin is a very important determinant of the level of investor rights in different countries, with common law systems offering substantially the strongest investor rights, German civil law much weaker investor rights and French civil law the weakest investor rights.

The distinction between French and German civil law systems is an important source of identifying variance that has been used by Levine, working with various co-authors on a number of fronts. One of Levine's goals has been to isolate the source of the benefits stemming from differences in legal origin. LLSV stress the importance of legal origin for the security of private property rights, whereas BDL stress its importance for the adaptability of the legal system. BDL (2002a) use four indicator variables to distinguish between the two hypotheses. The degree of power of the State over the judiciary is proxied by the length of tenure of Supreme Court judges and by the extent of Supreme Court power over the executive. The degree of legal adaptability is proxied by whether or not the law is built up from cases (judicial decisions) and by whether equity or statute are more commonly used as justification for new interpretations of the law. Using

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<sup>2</sup> Some of the literature refers to "British" legal origins. In fact, there is a substantial difference between English and Scottish law and it was English law that formed the basis of the legal systems of the British colonies. Hence we refer to "English" legal origins throughout this paper.

a cross-section of 115 (sometimes 54) countries, they regress financial development indicators on the four legal indicators, both separately and together, in order to run a horse race and see which indicators win out. All the indicators are instrumented using legal origin. The general results are that both adaptability and State power are important, but adaptability is more robustly associated with superior financial intermediation and has a larger effect. Hence BDL find that English legal origin is the most beneficial for economic growth, German legal origin is the next most beneficial and French legal origin is substantially worse. BDL (2004) have reinforced their argument by using micro-level data to supplement their cross-country regression analysis.

The literature was taken in a new direction by AJR (2001). AJR agree with LLSV that the key to modern economic development is secure property rights; hence the variable at the heart of their study is an index of protection against expropriation, which they use to explain cross-country variations in economic performance. But AJR strongly disagree with LLSV about the nature of successful institutions and what causes them to be created.

AJR argue that the temperate zones were amenable to European settlement, and therefore European migrants went there to settle. These migrants demanded – and received – similar social, political and institutional structures to those that existed in the home country. Essentially, this meant that the local institutions were fairly democratic and effective. By contrast, some parts of the world were inimical to European settlement, particularly due to the prevalence of malaria and yellow fever, against which Europeans had no natural immunity. Given very high death rates of European migrants, the colonizers relied on local populations to provide labor. But the colonizers felt no obligation towards the local population and therefore set up very extractive institutions, such as slavery and authoritarian regimes. Thus the physical endowment of a colony, in terms of its disease environment, determined the nature of colonization. These extractive institutions, which offer little protection for private property, have persisted to the modern period in modified form and continue to exert a negative influence on contemporary investment and economic growth.

The AJR argument implies that the mortality rates of European settlers in the nineteenth century should be able to explain (at least some of) the variation that we observe in the effectiveness of modern institutions, which is a very useful property. We would like to be able to regress GDP on the effectiveness of local institutions but the effectiveness of institutions could be endogenous (i.e. rich countries can afford, or have a taste for, more effective institutions). But modern levels of GDP cannot possibly have any effect on settler mortality rates from the nineteenth century, so settler mortality rates can be used as an instrument for the effectiveness of local institutions. AJR construct a data set of 64 former colonies and use settler mortality to instrument for the index of investor protection, which they find to be statistically significant and explain a reasonable amount of the observed variation. Hence AJR conclude that the physical endowment of a colony, working through settler mortality and the institutions to which it gives rise, determines modern levels of GDP.

The really interesting part of the AJR analysis is that they then introduce alternative explanations into their empirical estimation, in particular by using dummies for both legal origin and the identity of the colonial power. In sharp contrast to LLSV, they find that English legal origin has a *negative* overall effect on GDP (see panel A in

their table 5, where the French legal origin dummy is positive and significant and the excluded group is countries having English legal origins). They also find that having been a British colony – as opposed to having been a colony of any other non-French country – significantly *reduces* GDP (see panel A in their table 5, where the British colonial dummy is negative and significant; this should not be confused with panel B – the instrumenting equation – where the coefficient on the British colonial dummy is positive and significant). These are very surprising results. Various scholars, most recently Landes (1998), have highlighted the relatively benign nature of British colonization and the superior post-independence performance of British colonies. But AJR conclude that this is simply due to the fact that, on average, the British colonized areas that were amenable to European settlement.

The AJR argument has been supported in several respects by Lakshmi Iyer, working with various co-authors. Iyer (2004) finds that modern agricultural productivity is higher in Indian districts that were ruled by the British, rather than native princes, up to 1947. However, it turns out that this productivity gap arises from the superior fertility of districts that were annexed by the British and it disappears once she controls for this selection effect. This supports the AJR argument that the apparent superiority of British colonial performance was due merely to selection effects. The question then arises as to whether British colonial institutions had any permanent effects on India, as AJR would predict. Iyer finds that colonial institutions do indeed have permanent effects but the mechanism is different to the risk of expropriation index proposed by AJR. Iyer (2004), Iyer and Abhijit Banerjee (2005a, 2005b) and Iyer, Banerjee and Rohini Somanathan (2004) all find that there is a persistent colonization effect on the provision of public goods. Districts that were ruled by the British up to 1947 had a lower provision of public goods even in 1981 and 1991, and this was particularly marked in areas where the British had installed a class of landlords to collect government revenues.

Another important contribution of BDL (2002b) has been to test the power of legal origins as an explainer of economic growth against alternative possible explanations, particularly the colonial origin view of AJR and the ethnic and religious fractionalization views of Easterly and Levine (1997) and Landes (1998) respectively. Using the same cross-section of 64 countries as AJR, BDL set out to explain the variation in a number of financial variables. They do this using legal origin, settler mortality rates and ethnic and religious fractionalization. The basic conclusion is that there is very little evidence in favor of the politics view but a fair amount of support for both the endowments and legal origin views. Quantitatively, the settler mortality variable turns out to be able explain more of the observed variation than does the legal origin variable.

As a final twist, Naomi Lamoreaux and Jean-Laurent Rosenthal (2004) have added to the legal origins debate by examining long run time series evidence. Much of the debate between LLSV and BDL revolves around the ease with which different legal systems are able to evolve efficiently over time. It would seem natural to approach this issue directly by considering the degree and the nature of the evolution over time of the legal systems in countries with different legal origins. Lamoreaux and Rosenthal take the polar cases of the US and France (common law versus static civil law) and consider two issues. First, how free were businessmen to choose the legal form of their business (i.e. what menu of options were available)? Second, how did this menu evolve over time in response to new economic conditions?

Lamoreaux and Rosenthal find that the menu of organizational options in France encompassed that of the US (i.e. French entrepreneurs had available to them all the legal forms enjoyed by US entrepreneurs, and more). Also, the menu evolved equally quickly in France and the US. Hence Lamoreaux and Rosenthal manage to contradict *both* LLSV and BDL: the commercial law in common law countries offered no obvious channel by which it could beneficially affect economic relations, compared to its French civil law counterpart. Notice, however, that, whilst Lamoreaux and Rosenthal offer an interesting case study in comparative institutional history, they are unable to link their research directly to data on economic growth. For example, they do not show that changes in French and US law – or variations in the law across the US states – were associated with changes in output or productivity, or indeed in the rate of firm foundation.

By contrast, in this paper we use the historical record to link changes in legal origin directly to changes in output and productivity growth. We are thus able to address two important issues that are being debated. The structure of our test is summarized in table 1 below.

**Table 1. Empirical predictions of positive growth factors.**

	Secure property rights	Evolving legal system	Geographical endowment	Non-British colony
LLSV	Yes	Maybe	No	No
BDL	Maybe	Yes	Yes	No
AJR	Yes	No	Yes	Yes

First, BDL and LLSV disagree about the sources of the benefits of legal origin – was it the ability of the legal system to evolve or the security of property rights that mattered? We find that the rate of growth was unaffected by the introduction of common law and adversarial trials in 1827. By contrast, the improvement in the security of property rights in 1843 had an immediate and very large positive impact on the rate of growth. Hence LLSV are vindicated rather than BDL. Second, AJR and LLSV disagree as to whether the disease environment or legal origins were the primary determinant of the nature of institutions. Although the Cape colony changed the identity of its colonizing power and its legal origins, it did not change its geographical endowment and its disease environment. Therefore, in the context of the AJR model of colonization, the nature of institutions and the level of economic growth should have remained largely unaffected, with a slight negative effect as a result of Britain being the new colonial power. In fact, switching to British rule immediately resulted in a significant increase in the rate of growth. Changing the basis of property rights from the Dutch legal system to the English legal system in 1843 also greatly increased the rate of growth, so that by 1995 (when AJR observe the variation in GDP in their sample) the GDP at the Cape colony would have been five times higher as a result of the British takeover from the Dutch. Hence LLSV are vindicated rather than AJR. Therefore we find that LLSV emerge as the clear winners. First, it was legal origins (not colonial origins) that were the primary determinant of economic growth. Second, it was greater security of property rights that made the English legal origin important, not its ability to evolve over time. This is consistent with the recent work of Quy-Toan Do and Iyer (2004), which shows that the increased security of property rights in Vietnam following the introduction of the 1993

land law rapidly generated increases in cropped area. Our results are also very much in line with what Adam Smith would have predicted.

In the next section we briefly outline the historical development of the Cape colony, from its founding by the Dutch in the seventeenth century, through its seizure by the British in the early nineteenth century and up to the discovery of gold in 1867. We draw particular attention to the change in legal origins imposed by the British in 1827 and 1843, considering exactly what it meant for economic relations within the colony and how we would expect it to impact economic performance. In section 2 we briefly introduce the data set that we have compiled from tax and census returns (a full exposition is given in the appendices). In section 3 we analyze the data and reveal the marked breaks in output and productivity growth that occurred in 1795 and 1843. Section 4 concludes.

## **1. Historical development of the Cape colony.**

**1.1. Dutch rule, 1652-1795.** The Dutch East India Company (hereafter “the Company”) was founded in 1602 to exploit the mercantile potential of the Far East, in particular to bring spices back to Europe where they could be sold at an enormous profit. The strategy was very successful and throughout most the seventeenth century the Dutch had a virtual monopoly on the spice trade, becoming very wealthy as a result. But the journey from Holland to the Far East was very long and ships needed to touch land in order to take on drinking water. Hence in 1652 the Company founded a town at the Cape of Good Hope on the southern tip of Africa; this became known as Cape Town and lies in modern South Africa. The Cape offered an extremely good natural harbor in a temperate zone (most of the rest of the journey took place in the tropics, where disease was a major killer of Europeans), along with good watering facilities. Also the land around the town was very fertile and in 1657 the Company permitted the Dutch colonists to settle outside the walls of the city. The hope of the Company was that farmers would bring the land into production and furnish a sufficient agricultural surplus that they could supply passing ships with grain, since if each ship carried less grain on its voyage – because it could be re-supplied at the halfway point – then there would be more space in the hold for valuable spices.

The government of the growing Cape colony was very repressive (Campbell, 1795, pp. 137-40; Kersteins, 1795, pp. 168-71). The Company literally owned and controlled everything – the colony was a private enterprise and the colonists who lived and worked there were permitted to do so only by the good graces of the Company. The fiscal exactions of the administration were neither equitable nor predictable (Truter, 1813, especially pp. 375-8, 382-3, 389) they were merely designed to maximize profits for the company. As Adam Smith noted (*Wealth of Nations*, book IV, chapter 7, paragraph 85):

“When those establishments [colonies] were effectuated, and had become so considerable as to attract the attention of the mother country, the first regulations which she made with regard to them had always in view to secure herself the monopoly of their commerce; to confine their market, and to enlarge her own at their expence, and,

consequently, rather to damp and discourage than to quicken and forward the course of their prosperity.”

It may seem strange that the colony was wholly owned by a private enterprise but, in fact, this was normal at the time. The French East India Company owned various colonies (such as the islands of Réunion and Mauritius). The British East India Company owned virtually all of Britain’s Far Eastern possessions (including Sri Lanka and large swathes of India and Pakistan) and the British Government replaced the British East India Company in governing the Far Eastern colonies only in 1858 after the Indian Mutiny. The Spanish colonies were also privately owned. They were not the possession of the Spanish state, they were the possession of the Spanish Crown (as indicated by the fact that revenues from the colonies went directly to the monarch). The Spanish administrative structure was actually quite similar to those of the Dutch, French and British East India Companies. The monarch personally appointed an administrative board called the Council of the Indies, which in turn appointed Viceroys to implement its policies locally. The only difference between the Spanish case and the Dutch, French and British East India Companies was that in Spain the monarch held 100 per cent of the shares. This arose quite naturally because the King of Spain had personally financed the expeditions that led to the creation of the colonies, whereas the other nations had financed their ventures through joint-stock companies. A final example is that of King Leopold II of Belgium, who personally owned the Belgian Congo in the late nineteenth century, financing its exploitation out of his personal fortune and reaping all the financial returns himself. Since the purpose of these colonies was to make money for shareholders, it is scarcely surprising that they were administered in an autocratic way.

If colonies were owned privately by companies and individuals then we might ask how the legal origins of the possessor nations could be expected to influence the economic development of the colonies, either at the time or later. The simple answer is that the owners needed a legal system in order to facilitate economic relations and hence economic exploitation of their colony. It was only natural that they would take an off-the-peg legal system that they already knew very well – that of their home country – and transplant it to the colony. Of course, they generally did not adopt the legal system of their home country *in toto* – they adapted it to local conditions, sometimes to local customs and always to their ultimate goals. This is exemplified by the Company’s use of land law in the Cape colony: the land law was essentially Dutch but with a slightly more repressive twist. In the seventeenth century there were several forms of land tenure in common use in the Netherlands (as there were in other countries, such as England) and these different forms of tenure gave the landholders more or less secure property rights. When the Company made land available in the Cape colony it employed various forms of traditional Dutch tenure but mostly it offered only the least secure form of landholding, which effectively completely blocked private land ownership (Duly, 1968, pp. 13-20).

The most secure form of landholding in the Cape colony was *eigendom*, which was used mostly in Cape Town itself for houses and smallholdings. Eigendom was a form of outright ownership (i.e. freehold) but had stringent rules attached to it. In particular, the owner had to cultivate the land to its maximum capacity, pay one tenth of the produce to the government of the colony and allow (without compensation) any kind of road building that the government deemed necessary on the land. Violation of any of

these obligations made the land subject to forfeiture. These were unusual and rather draconian conditions to place on freehold landownership. The second most secure form of landholding was *quitrent*, which was introduced in 1732. The government leased out plots of land for periods of 15 years in return for a rent of 2 skillings per morgen per year. The leases could be renewed with the agreement of both parties; if the lease was not renewed then the government paid for any land improvements made by the landholder in the lifetime of the lease. It is interesting to note that his form of tenure was commonly used in English agriculture at this time and has been highlighted, both by contemporaries and modern scholars, as one of the major reasons for the success of English agriculture.<sup>3</sup> Adam Smith (*Wealth of Nations*, book 3, chapter 2, paragraph 15) argued that:

“When such farmers have a lease for a term of years, they may sometimes find it for their interest to lay out part of their capital in the further improvement of the farm; because they may sometimes expect to recover it, with a large profit, before the expiration of the lease.... There is, I believe, no-where in Europe, except in England, any instance of the tenant building upon the land of which he had no lease, and trusting that the honour of his landlord would take no advantage of so important an improvement. Those laws and customs so favourable to the yeomanry have perhaps contributed more to the present grandeur of England than all their boasted regulations of commerce taken together.”

Notice that much of the security enjoyed by the yeomanry (the class of small farmers) was based on *customs* (i.e. precedents that had become enshrined in the common law). The long length of the leases and the promise of compensation for unexhausted investments gave the farmer good incentives to make investments in the land (such as installing drainage, putting up buildings, using long-lived fertilizers and so on).

Several further points are worth emphasizing. First, the English system was considerably better in a number of ways than the Dutch system used in the Cape colony. In England the farmers were not holding land from the government but from local private landowners; this meant that the farmers had recourse to an independent judiciary in the case of any land dispute. This was not true in the Cape colony, where the landowner (i.e. the Company) was also the judiciary. As Smith further argues (*Wealth of Nations*, book 5, chapter 1, paragraph 68):

“When the judicial is united to the executive power, it is scarce possible that justice should not frequently be sacrificed to what is vulgarly called polities. The persons entrusted with the great interests of the state may, even without any corrupt views, sometimes imagine it necessary to sacrifice to those interests the rights of a private man. But upon the impartial administration of justice depends the liberty of every individual, the sense which he has of his own security.”

Second, the English system was superior also because the annual rents varied from place to place and time to time, whereas in the Cape colony they were completely fixed at 2 skillings per morgen. We would generally expect flexible prices to result in economic decisions that were more allocatively and productively efficient. For example,

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<sup>3</sup> British agriculture was extremely productive by international standards – see Wrigley (1987).

presumably there was land that would have been worth cultivating at an annual rent of 1 skilling but not 2 skillings, so a sub-optimal amount of land was in production in the Cape colony. Third, the English system was superior also because it was based on written contracts over surveyed areas of land, whereas the Dutch system was based on verbal contracts over unsurveyed areas of land. This was open to obvious abuse. Fourth, the quitrent system was virtually never used in Cape colony. In 1797 there were only 35 cases of quitrent tenure out of the tens of thousands of cases of land tenure. Thus the land tenure system that came closest to the English system (even though it remained considerably inferior in many dimensions) was almost never used on the ground.

By far the most common form of tenure offered in the Cape colony, accounting for 80 per cent of all the land held by the grace of the Company, was the *loan-place* system. This was a form of annual rent fixed at 12 rixdollars per year (24 rixdollars per year from 1732 onwards) plus an annual stamp duty of 6 rixdollars per year. The organization and administration of the loan-place system was virtually non-existent. There were no maps of land outside Cape Town and the land was almost totally unsurveyed. An applicant would ask the local administrator (the “landdrost”) to take out a loan-place on an unoccupied piece of land. This was very often centered on some kind of water source, since water was generally in short supply (Alexander, 1815, pp. 246-7). The plot was set out by walking for 30 minutes in each direction (north, south, east and west) and placing occasional markers. The resulting area was generally expected to contain around 9 square miles of land (3000 morgen). The local administrator was then supposed to transmit to Cape Town the farmer’s request to take out the loan-place, although frequently this was not done. Moreover, since there was no land survey and no written contract there was effectively no way that the Company bureaucrats in Cape Town could make any kind of meaningful registration. The loan-place farmers generally enjoyed *de facto* long term tenure, in that the government very rarely refused to renew a lease, but their *de jure* tenure was always limited to one year and this generated considerable uncertainty. One of the locals claimed that: “When the Company discovered that the farmers grew slack in the payment of their taxes, they without hesitation put their property to sale, seized upon their wagons, utensils of husbandry and cattle.” (Kerstein, 1795, p. 171). Whilst persistent non-payment of taxes would ultimately result in property seizure in England, it would be preceded by a lengthy judicial process. By contrast, the Dutch farmers at the Cape were extremely vulnerable to direct government action, such as immediate eviction, because they were on one-year leases and the government was their landlord.

An important point to note is that the loan-places were not contiguous. Instead they were scattered over large areas in response to topography and local water sources. One effect of this was that most loan-place farmers were able to cultivate or graze an area that was much larger than that to which they were entitled. Contemporary estimates suggest that loan-place farmers typically cultivated around 75 per cent more land than their legal entitlement (Duly, 1968, p. 16). There was no one *in situ* to monitor their activities – no government and no neighbors. Hence much of the land that was cultivated was held illegally.

In fact, illegal land occupation (squatting) was by far the most common form of landholding in the Cape colony. Reyburn (1934) shows that in Craddock District in 1812 only 38 per cent of families had any kind of legal recognition of their landholdings. On

the outer fringes on the colony near Kaffaria only 18 per cent of landholdings were legally recognized. This situation arose partly through migration. More and more farmers were fanning out from Cape Town in the west and traveling further eastwards in search of unoccupied land. After some years – when the new fringe area was sufficiently populated – the Company would bother to create an additional official district and appoint a local administrator. In the meantime, the land was being held illegally.

The irony of the situation was that the Company maintained draconian *de jure* rights over all land because it wanted to have total control over the colonists and their produce; the Company wanted to be able to extract the whole surplus from agricultural production. But, precisely because the Company was so extractive, the colonists continually moved further and further away from Cape Town; the absence of local administration in these far-flung areas then meant that the Company had absolutely no *de facto* control over the colonists and extracted very little. The unintended consequence of this train of events was that the vast majority of the farmers in the Cape colony had no legal right to hold the land that they were cultivating (D’Escury, p. 328). Adam Smith presciently summarized the results of such a policy (Wealth of Nations, book III, chapter 3, paragraph 12):

“Order and good government, and along with them the liberty and security of individuals, were, in this manner, established in cities at a time when the occupiers of land in the country were exposed to every sort of violence. But men in this defenceless state naturally content themselves with their necessary subsistence, because to acquire more might only tempt the injustice of their oppressors. On the contrary, when they are secure of enjoying the fruits of their industry, they naturally exert it to better their condition, and to acquire not only the necessaries, but the conveniences and elegancies of life.”

The prediction that insecure property rights would result in suboptimal levels of investment is supported by the qualitative evidence from the Cape colony. The early British observers noted that the Dutch worked the land using insufficient quantities of very outdated capital (Gourlay, 1819, pp. 153-60).

**1.2. British rule, 1795-1842.** The Company continued to rule the Cape colony uninterrupted until 1795, when Britain entered the scene. During the late eighteenth century Britain had come to dominate the Far East militarily and politically, gaining direct or indirect control over large areas of the Indian sub-continent and diverting much of the trade in exotic goods from Dutch to English ports. The British ships used Cape Town as a stopover and the British became increasingly worried that if the Netherlands supported France in a war against Britain – as they had in 1780-3 during the latter part of the American War of Independence – then Britain could effectively be cut off from her rich Far Eastern possessions. The obvious solution was for the British to seize control of the Cape colony in the event of war, and this is what happened in 1795 after the Dutch aligned themselves with the French.<sup>4</sup>

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<sup>4</sup> The Dutch decision to align themselves with the French was not entirely voluntary. The Netherlands was invaded by an army from Revolutionary France and the rulers were overthrown, to be replaced by a

The British were unsure what to do with the Cape colony once they had it. In the event that peace was made, it seemed likely that the British would have to return the Cape colony to the Dutch as a part of any overall agreement. The Cape colony was one of the Netherlands' most important overseas possessions and it seemed unlikely that France and the Netherlands would be willing to sign any peace deal that did not include its restitution to the Dutch. (France, too, had colonies in the Indian Ocean, such as Madagascar and the Seychelles, and so would clearly be much happier if the Cape colony were safely back in the hands of its Dutch ally). Hence in 1795 the British simply wanted to keep the colony as a stopover to the Far East and had no interest in its long term development. Moreover, Britain did not want to have to pour military resources into the colony whilst it was hard-pressed elsewhere and therefore it was trying to avoid antagonizing the Dutch colonists, who had already risen in revolt against the new government in 1795. Hence the explicit instructions from the Secretary of State for War and the Colonies, Henry Dundas, to the new governor in 1796 were to administer the Cape colony "in conformity to the laws and instructions that subsisted under the ancient government of the said settlement" (Duly, 1968, p. 23). In consequence, the British left the administration of the Cape colony virtually unaltered during their tenure, simply replacing the Dutch governor with a British governor who administered the colony through the existing cadre of Dutch staff.

It is worth noting that one of the British governors, Sir George Yonge, strongly disagreed with this policy. He felt that major reforms were needed in the colony to ensure its future prosperity and that they should be undertaken immediately. In particular, Yonge believed that the loan-lease system gave insufficient security of tenure and was too open to government interference and abuse. Yonge proposed instead that all land be let on 21-year inheritable leases (as was common in England) and he sent a detailed report to this effect to Dundas. In fact, Dundas himself was about to be replaced by Lord Hobart. When Hobart later read the report his view was that:

"Sir George Yonge's observations on the enormous extent of the loan lands and the evils necessarily resulting from the defects of the system according to which they are at present managed, appear to me to be very just, and however applicable that system might have been in the early periods of the settlement of the colony it must now become extremely detrimental to its increasing prosperity."

But Dundas had already blocked any kind of reforms along the lines that Yonge was proposing. One of Dundas' last acts as Secretary of State for War and the Colonies was to recall Yonge to London in disgrace and replace him with Dundas' own nephew, Major General Francis Dundas, who could be relied upon to implement his uncle's policy of no reform.

The British expectations about the shortness of their tenure of the Cape colony were proved to be correct when it was restored to the Dutch in 1802 by the peace treaty of Amiens. Interestingly, the Dutch changed the administration of the colony as soon as they retook possession in 1803 (Walker, 1957). By this time the Netherlands had become the Batavian Republic and the old (and somewhat inefficient) government bodies had

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republican government. The country was then renamed the Batavian Republic until 1806, when Napoleon made his brother Louis the new King of Holland.

been abolished. The Dutch East India Company went bankrupt in 1799 and it was replaced by a state body, the Council for the Asiatic Possessions. The Council appointed one of its members, Jacob Abraham de Mist, to be Commissary-General of the Cape colony. He spent 18 months there and, together with the Jan Willem Janssens, attempted to make the administration less repressive. One of his proposals was to change loan-place tenure into freehold tenure (i.e. outright ownership on the part of the farmer). De Mist believed that this would induce the farmers to undertake more investment, increase production and regenerate the colony's internal markets (Duly, 1968, p. 37). Unfortunately, this proposal had to be scrapped when some of the high-level local administrators – notably Van Ryneveld, the Chief Judge, President of the Council of Judicature and member of the Political Council – strenuously objected to giving up any of the government's rights over the land.

In any case, the Dutch reforms were largely moot. War broke out again in 1803 and the British reoccupied the Cape colony in January 1806. Again, it was unclear how long the British occupation would last and the British governor was again informed by London that "...the temporary administration of justice and police in the settlement shall as nearly as circumstances will permit be exercised by you in conformity to the laws and institutions that subsisted under the ancient government of the said settlement...". This state of uncertainty continued until 1815, when the Cape colony was ceded permanently to Britain as part of the peace treaty of Vienna. In the intervening nine years the administration of the land tenure system had become worse rather than better. The first governor, Lord Caledon, realized that the whole system was a mess, stemming both from the absence of a land survey (which made enforceable contracts virtually impossible) and the nature of the tenures that were granted. He therefore decided to stop awarding *any* kind of legal tenure and instead wrote to the government in London for advice – which they took two *years* to provide. In the meantime farmers simply squatted on the land that they wanted to register and started production in the hope that they would be given tenure at a later date (Duly, 1968, pp. 36-44).

The new governor who arrived in 1809, Sir John Cradock, was in the same mold as Sir George Yonge. His great desire was to replace the "inadequate and inferior" Dutch civil law system with one based on English legal principles (Duly, 1968, p. 50). As a part of this plan he favored granting land in freehold tenure. Prohibited by London from making any such radical changes, he instead he decided to make all new tenures under the traditional Dutch perpetual quitrent system (i.e. 15-year leases) but with the innovation that the annual rents would vary according to the location and fertility of the land. This made obvious economic sense and should have improved the efficiency of land use. As well as making all new land grants in the form of quitrents, Cradock also encouraged the conversion of loan-place tenures into quitrent tenures in order to increase the security of tenure. By 1821 82 per cent of loan-place farmers had applied to convert their loan-place tenures into quitrent tenures (Duly, 1968, p. 68).

Unfortunately, Cradock's scheme did not function very well. In 1814, as his scheme was finally coming into full operation, Cradock was replaced as Governor by Lord Charles Somerset. At the same time a new Inspector of Government Lands and Buildings was appointed, Charles D'Escury, who was very strong-minded and not afraid to hold his ground against (what he perceived to be) corruption and vested interest. Overall this greatly hindered the implementation of Cradock's scheme.

First, the rents to be set on new tenures were recommended by local assessors. But D'Escury believed that the assessors set the rents much too low and he therefore greatly delayed the granting of titles and sometimes simply refused to grant them. D'Escury spent 14 years as Inspector of Government Lands and Buildings and made a total of 2 061 grants of land (Duly, 1968, p. 73); but by 1824 there were already more than 5 000 requests outstanding! At D'Escury's rate of 150 grants per annum, it would have taken him 33 years to clear the backlog, assuming that no new applications arrived. Similarly, by 1823 there were 1 300 applications outstanding to convert loan-place tenures into quitrent tenures; at D'Escury's rate of 40 conversions per annum, this could also be expected to take 33 years. The interminable application delays once again drove the farmers back to a policy of squatting. At the same time, Lord Somerset and D'Escury found squatting unacceptable and the law was changed such that anyone who squatted on a piece of land automatically had their tenure application for it rejected (Alexander, 1814, p. 117-8). Obviously, this compounded the squatting problem.

Second, after the Napoleonic Wars ended in 1815 there was a period of generally falling prices which badly affected farmers in the Cape colony and elsewhere. Many of the farmers in the Cape colony went into rent arrears and petitioned the Governor to have their rents reduced, which would make economic sense if their rents had previously been set at market value. However, this process was mismanaged. The Governor and D'Escury disagreed over whether rent reductions were appropriate, with the Governor granting them against opposition from D'Escury. Notice that this problem was exacerbated by the absence of a private rental market for land (which had never developed owing to the government's refusal to sell off any land in freehold). The absence of a rental market meant that there were no rental price signals and therefore it was extremely difficult for the government in Cape Town to know whether local rent reductions were warranted or not. The Governor also made a tactical error. When he granted rent reductions he made it retroactive on rent arrears – so farmers had an obvious incentive to go into arrears until they could claim a rent reduction. Finally, the relevant government office was overwhelmed with requests for rent reductions and did not have the proper resources to consider them on their merits.

Lord Somerset and D'Escury both left office in 1828. Thereafter there was a considerable improvement in the efficiency of government in general and the granting of land tenure in particular. The new Surveyor General, Major Charles Michell, reorganized the land department and managed to increase the speed at which it worked, granting quitrent tenures for nearly 80 000 acres per annum in the period 1828-34 (Duly, 1968, p. 132). A further reorganization and some increased staffing raised this rate to nearly 3 million acres per annum in the period 1835-44. The interesting point to note, however, is that there was no correlation between the issuing of quitrent tenures and increases in the quantity of arable land in production. In fact, in the period 1835-44 the arable acreage was falling rather than rising. This suggests that, even when the quitrent system worked and it was possible for the farmer to get tenure, this type of tenure was not sufficient to encourage them to undertake arable production, which required investment in fixed capital. Instead they preferred to maintain their emphasis on pastoral production, which required investment only in circulating capital.

A Parliamentary inquiry, analyzing the data available up to 1844, summarized the situation very neatly: "The climate, soil, and pastures of the Cape of Good Hope extend

to this extensive colony nearly all the natural advantages; but it has neither increased in population, nor prospered in wealth or trade, in the same progressive rate as the distant colonies of Australia, or even that of Port Phillip [Melbourne].” (British Parliamentary Papers, 1849, p.363).

There is one further important point to note about British rule in this period. Although the land alienation system functioned poorly, this did not arise from any British animosity towards the Dutch farmers and agriculture in the Cape. On the contrary, the British had taken to heart Adam Smith’s exhortation (*Wealth of Nations*, book V, chapter 2, paragraph 47):

“The principal attention of the sovereign ought to be to encourage, by every means in his power, the attention both of the landlord and of the farmer, by allowing both to pursue their own interest in their own way and according to their own judgment; by giving to both the most perfect security that they shall enjoy the full recompense of their own industry; and by procuring to both the most extensive market for every part of their produce, in consequence of establishing the easiest and safest communications both by land and by water through every part of his own dominions as well as the most unbounded freedom of exportation to the dominions of other princes.”

The British implemented many reforms which could be expected to lead to increases in output. They awarded prizes to farmers who offered examples of agricultural best practice; they lowered tariffs on agricultural imports into Britain from the Cape (Irving, 1817, p. 291); they promoted the local Board of Agriculture (Alexander, 1812b, pp. 1-3); they improved the road system (Alexander, 1812a, pp. 251-2); they set up a new agricultural market (Cradock, Truter and Van Nuldt Onkruidt, 1812, pp. 387-90); and they sought to make the tax system more equitable and predictable (Truter, 1813, especially p. 399).

The British also reformed the law in several important respects. One of the most important pieces of legislation was the so-called “Hottentot Law” of 1809 which gave much greater rights to the indigenous population. Although there were many slaves in the colony, mostly imported from other parts of Africa, there was also a large and nominally free indigenous population. However, the white farmers held all the political and economic power and the rights of the indigenous population were greatly circumscribed almost to the point of slavery. They had no formal labor contracts setting out their rights, obligations and wages and they were also bound to remain in particular localities (which effectively meant that there was only very limited competition amongst potential employers). The Hottentot Law made labor contracts compulsory and permitted the indigenous population to sue their employers for breach of contract. It is noteworthy that the British also actively promoted the implementation of the new law by sending a British judge to tour rural areas in 1812 to hear such cases. It was also intended in 1809 to permit the free movement of labor but this clause was cut from the final draft of the law owing to strenuous opposition from the Dutch farmers. Free movement had to wait until 1828, when the government also granted complete emancipation of all Cape tribes. Slaves (i.e the non-indigenous black population) were emancipated in 1833, when a general Act was passed emancipating slaves everywhere in the British Empire.

Another important raft of reforms arrived in 1827. The British introduced the adversarial system of court proceedings, rather than relying on an investigating magistrate. They also introduced the common law notion that legal decisions should be based on precedent as well as statute. Initially, the precedents would be those based on local custom (i.e. the Dutch civil law system) but over time the law was free to evolve in response to new situations. These reforms were implemented by a judiciary trained in England.

**1.3. British rule after 1842.** In the 1820s a British politician, Edward Wakefield, analyzed the economic structure of several of the world's frontier regions, including Australia and the US. Wakefield was particularly impressed with the US land law of 1820 by which the government alienated land to private individuals (Wakefield, 1829, 1833). The land was divided into freehold tracts of not less than 80 acres and sold by public auction with a reserve price of \$1.25 per acre. Wakefield believed that this supply of freehold land encouraged settlers into the region and gave them the right incentives to invest and create self-sustaining communities. The parallel between the US frontier and the British imperial frontier in South Africa and Australia was self-evident: as Wakefield put it, "What is a new state formed in the western deserts of America, if it be not a new colony?" He therefore proposed the same system for the British empire. This approach was recommended by House of Commons in 1836 (British Parliamentary Papers, 1836) and adopted in 1839 by the new Colonial Secretary, Lord John Russell. Henceforth all land in the Cape was to be sold in freehold by public auction with a reserve price of two shillings and six pence per acre.

Implementing the auction scheme in the Cape proved to be a difficult and drawn-out process. Governor Napier and Surveyor General Michell were both strongly against the scheme. One reason for their opposition is that there were still thousands of outstanding claims made under the old scheme of quitrent tenures – some of which had been waiting 20 years for approval – and Napier and Michell felt that it was only reasonable that these claims should be dealt with before any new system was introduced. The colonial government did not have the administrative resources to implement both schemes at the same time. A second reason for their opposition was that South Africa was not a virgin territory like the western US. As a result, much of the land that had yet to be alienated was interspersed with tracts that were already occupied and which controlled the only local water sources. Hence these unoccupied tracts were really useful only to the farmers who occupied the adjacent lands and it was not clear that any kind of meaningful public auction could be implemented. Napier and Michell stalled the introduction of the new scheme for four years and continued alienating land under their previous quitrent scheme. Ultimately, this led to Napier's replacement as governor by Sir Peregrine Maitland in 1844. Thereafter the auction scheme was implemented for almost all new grants of land, as required by London, and also the old quitrent tenures were gradually converted into freehold tenures (the quitrent holders could do this by paying fifteen years' quitrent to the government in one lump sum). Finally, after 50 years of British rule, the colonial Dutch system of land holding was replaced by the British system and Cape farmers gained freehold property rights over their land.

The issue that we need to address is what effect these changes in colonizing power, legal procedure and property rights had on output and productivity in the Cape. We now turn to an empirical analysis of this question.

**2. Data on output and productivity in the Cape colony.** We would expect arable agriculture to be particularly adversely affected by institutional problems such as insecure property rights, arbitrary taxation and repressive government. This is because it requires a considerable amount of fixed investment in items such as buildings, fencing, drainage and irrigation. Efficient production also requires a considerable amount of investment in capital goods that are movable only with considerable difficulty, such as ploughs and reaping and threshing machines. This immobility means that the government can always find arable farmers and make them obey the law of the land. By contrast, pastoral production in the Cape required no fixed investment at all. The farmers would simply round up their cattle and drive them to the grazing areas that were in the best condition; the condition of the grazing areas was a function of recent rainfall patterns so the cattle herds were constantly on the move. This made it relatively easy to avoid government regulations and exactions. Given that we expect the nature of the law and institutions and the security of property rights to affect primarily the level of fixed investment, it clearly makes sense to look for the effect of legal and institutional changes in the output and efficiency of arable agriculture rather than pastoral agriculture. Therefore all of the analysis that follows relates to arable production.<sup>5</sup>

The data available for the Cape colony are not particularly good by modern standards but they are exceptionally good by the standards of the eighteenth and early nineteenth centuries. This stems from the fact that the colony was a private enterprise and the Dutch East India Company administered the territory more like a commercial venture than a country. The Company wanted to make as much profit as possible from its colony and this required decent bookkeeping. Since the Company was full of bookkeepers, skilled labor was not in short supply for this task.

The basic data source for the period of Dutch rule (1701-1795) are the annual Opgaaf returns, which reported data on most of the important economic variables. First, we have an annual population return (which is unheard-of for the eighteenth century) broken down into many different categories: European and non-Europeans, adults and children, men and women, freemen and slaves. Since the population was initially very small and migration was easy to monitor (ships calling at the Cape numbered tens per annum) it seems likely that the population data are accurate.

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<sup>5</sup> There is a second reason to avoid an empirical consideration of pastoral agriculture: the data are extremely poor. This is partly because the government did not collect data on the animal population. But it is also more fundamental than that. One of the variables that we are going to consider is the amount of land in production. With arable agriculture the “amount of land in production” is a concrete concept, whereas with quasi-nomadic cattle farmers it is almost meaningless. The Cape cattle farmers used not only their own quitrent land but also the unclaimed land around it (i.e. they squatted on large areas of land). Moreover, the land that they used changed from year to year in response to annual fluctuations in rainfall. If an area of land was grazed only in very dry years, say once every ten years, then does this land count as being in pastoral production? What about if the land is grazed only once, ever? Or should we count only land that was grazed in a particular year? This latter, restrictive definition would clearly drastically underestimate the amount of land used regularly in cattle farming. Moreover, there are absolutely no data available on the amount of land grazed each year. Hence it makes more sense to undertake an empirical analysis of arable agriculture only.

Second, we have annual data on the total input and output quantities of the major field crops – wheat, barley and rye – declared by farmers for the purposes of taxation. Output estimates made on the basis of tax returns are, of course, likely to be biased downwards and the Company was aware of this fact. On several occasions they made more intensive surveys in order to be able to gauge the level of underreporting; they did this either by sending inspectors directly out to the farms or by putting an inspection team on the road to Cape Town to record the number of wagonloads of grain going market (Cape Town provided the only market in the colony). We used both of these sources, together with estimates of consumption, to reflate the Opgaaf grain returns and thereby offset the underreporting by farmers. A full exposition of the procedure is given in the appendix. The main point to note is that our estimates of total output for the late eighteenth century are rather higher than previous estimates, which tends to push up our estimates of output growth under Dutch rule and reduce our estimates of growth under British rule.

Third, we know the quantity and value of imports and exports of all agricultural goods. As with the data on migrants, these data should be very accurate because shipping was easily and closely monitored – it was, after all, the *raison d'être* of the Cape colony. The trade data are useful for two reasons. First, once we know the trade balance we can estimate how much agricultural produce was available for domestic consumption; we can use this as a check on our production data. Second, the Opgaaf does not report the market prices of agricultural goods. We have therefore used export prices when valuing outputs.

The British were also keen to learn about their new colony in order to better exploit it. London was particularly adamant that the costs of the military occupation should be met by tax revenues raised in the colony. Unfortunately, the British were less effective than the Dutch at collecting both data and taxes. There were no data collected during the first occupation (1796-1803) and it is only from 1806 onwards that systematic data series are again available. For the period 1806-23 we again have annual data on population broken down into numerous categories. We also have data on the amount of grain sown and reaped. There are no data on prices so we have simply linearly interpolated between 1795 and 1836.

The British stepped up their data collection efforts from 1833 onwards and there are good data available annually for the years 1833, 1836-42 and 1852-4. These data include population (by district) and the acreages, yields, outputs and prices of all the major field crops (wheat, barley, oats, rye, hay, maize, peas, beans and potatoes). In this period Britain began collecting similar information for large areas of the empire in order that London could make more informed policy decisions about issues such as migration. It seems that the imperial administrators – many of whom were army officers – took these duties very seriously and it is likely that these data are fairly accurate.

Unfortunately, data collection seems to have lapsed in the Cape colony after 1854, which is surprising because it continued in other, comparable colonies such as Canada and Australia. But in the 1860s the imperial administration again stepped up a gear and began requiring a decadal census to be taken for the whole empire. In the Cape colony the census recorded not only population but also a wealth of data on agricultural production, including the acreages, yields, outputs and prices of all the major field crops. Hence we have two very reliable benchmarks for 1865 and 1875.

From the preceding discussion we can see that we have reasonable data on agricultural outputs. Unfortunately, we have much less data on agricultural inputs, particularly for the years 1701-1823, which makes productivity estimation extremely difficult. With regard to land, for the years 1701-1823 we do not have direct information on the acreage in production, only the output of each crop. The best that we can do is to back out estimates of the amount of land under each crop by dividing the total output of each crop by an estimate of the yield per acre of each crop. Fortunately, the observed crop yields between 1833 and 1875 show no trend, either upwards or downwards, so we have simply taken the average yield of each crop for 1833-42 and assumed that yields were the same in earlier years. With regard to labor, the story is similar. We have excellent population returns for the years 1701-1823 but we have little information regarding the division of labor inputs between sectors. Over time, the Cape colony was becoming relatively less dependent on agriculture and this can be seen in the downward trend of the proportion of adult males who were working in agriculture between 1833 and 1842. We extrapolated this trend back to 1806 and then estimated the adult male population in agriculture by multiplying the data series on adult male population by the data series on the proportion working in agriculture. We assumed that prior to 1806 the proportion was constant at its 1806 value (76 per cent). With regard to capital, there are essentially no data at all available and in consequence we have not attempted to make any calculations at all concerning total factor productivity. The data situation is summarized in table 2 below.

**Table 2. Data available on agricultural inputs and outputs at the Cape, 1701-1875.**

Years	Population	% Males in Agriculture	Output	Prices	Land in Production	Crop Yields
1701-95	Yes	Estimated	Yes	Yes	Estimated	Estimated
1806-23	Yes	Estimated	Yes	Estimated	Estimated	Estimated
1833-54	Yes	Yes	Yes	Yes	Yes	Yes
1865-75	Yes	Yes	Yes	Yes	Yes	Yes

Notes. For an exhaustive discussion of the estimation procedures employed, see the appendix.

The data constraints mean that overall we can offer reasonable estimates of output and acreage (both *in toto* and broken down by crop) and also of labor productivity. These are the series that we analyze in the next section.

**3. Legal and institutional changes and economic growth.** There are four years in which we might expect break points to occur in the output and productivity series of the Cape colony. The first candidate is 1795, when the British first seized control of the Cape and replaced the repressive Dutch administration with a somewhat less repressive (and almost certainly less effective) British administration. At this point we might expect the farmers to have increased production because they were probably able to hold onto a higher proportion of their output. The second candidate is 1814, when the Cape was definitively ceded to Britain. The administration clearly became less repressive at this point. The British began to replace loan-places with quitrent tenures and were keen to encourage the expansion of arable agriculture through improved institutions, such as the Cape Town market, the Board of Agricultural Improvement and the Hottentot Law. This

was generally a period when a benevolent regime was operating within the Dutch legal framework. The third candidate is 1827, when the British introduced adversarial court proceedings and the common law. We might expect output and productivity to rise as the legal system evolved to regulate economic transactions more efficiently. The fourth candidate is 1843, when the British implemented the new imperial land policy in the Cape and began selling off new land in freehold and converting quitrents into freehold. We would expect this to lead to increased fixed capital investment, such as fencing and irrigation, which would bring more land into production. And we might also expect to see increased investment in capital that was difficult to move, such as machinery, which would increase labor productivity.

We would like to test formally for structural breaks occurring in 1795, 1814, 1827 and 1843. Unfortunately, gaps in the data series preclude such a rigorous econometric approach. Fortunately, we will see that the observed changes in growth rates tell a convincing story on their own.

**3.1. Output growth.** In figure 1 below we graph the series on real arable output and the quantity of arable land in production. In some ways the quantity of arable land in production is a better guide to the state of agriculture than output. Annual fluctuations in the weather drive a wedge between what farmers are expecting to happen and what actually happens, so the amount of land in production sometimes offers a less noisy guide to the level of output that was planned or anticipated by farmers. The disadvantage of looking at the quantity of land in production is that it can be a misleading indicator of output trends if there is productivity growth. Therefore we choose to present both series.

It is very clear from the graph that there was a significant jump in output growth during the early part of the British occupation, 1795-1813. The annual growth rate of output in the period of Dutch rule, 1701-94, was 1.9 per cent ( $\pm 0.2$  per cent with 95 per cent probability).<sup>6</sup> But immediately after the British took over in 1795 the annual growth rate jumped to 4.5 per cent ( $\pm 2.0$  per cent). Since the British deliberately avoided introducing any significant institutional changes, this suggests that British imperial administration generated higher rates of growth than Dutch imperial administration, *ceteris paribus*. This piece of evidence therefore runs counter to the AJR argument that British colonies performed worse than those of other imperial powers, *ceteris paribus*.

There was then a long period of virtual stasis in the Cape colony in the period 1814-42. In the sub-period 1814-23 the annual growth rate of output was a mere 0.9 per cent ( $\pm 2.3$  per cent) and in the sub-period 1833-42 it was only 0.7 per cent ( $\pm 1.7$  per cent). This may be explained partly by the postwar depression, which lasted into the early 1820s, and partly by the problems that the government was having alienating land. However, we can also say that the changes in the legal system in 1827 – the move to adversarial trials and the common law – did not have any substantial positive impact on the rate of growth in its first 15 years of operation (i.e. up to 1842). This undermines the BDL argument that English legal origin was important because its basis in common law enabled it to evolve more rapidly to fit new economic circumstances.

The second marked break in the series occurred in 1843. The growth rate of output in the period 1843-75 was 3.5 per cent per annum ( $\pm 1.6$  per cent), nearly 3

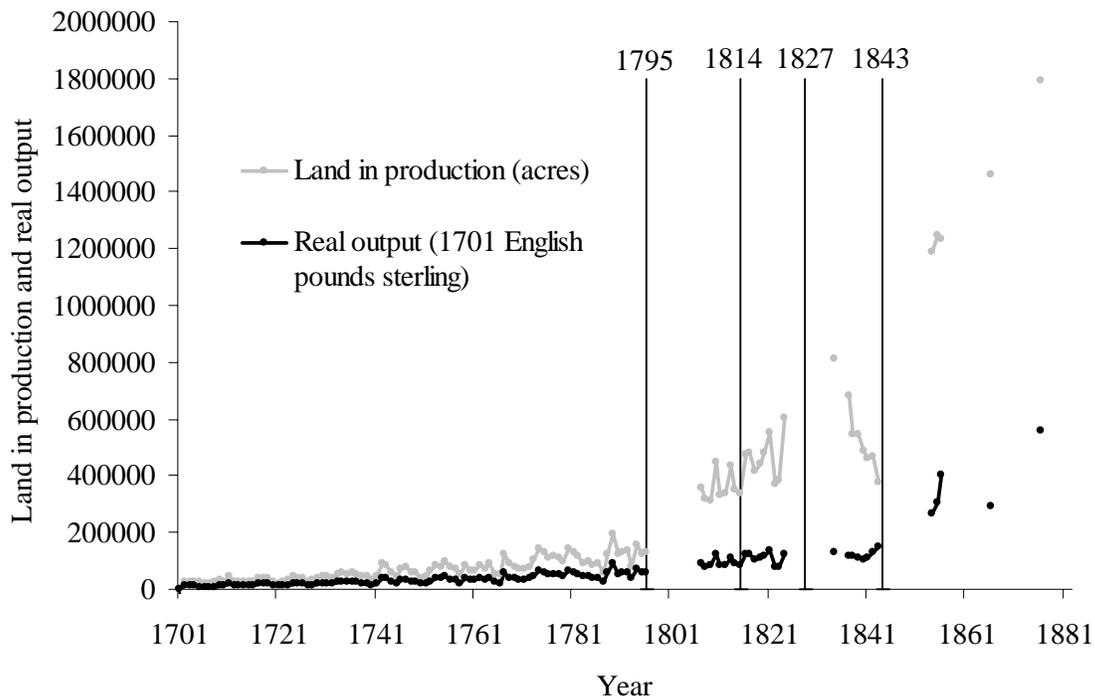
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<sup>6</sup> We estimate the growth rates by regressing the natural logarithm of output (or acreage) on a time trend.

percentage points above the rate of 1833-42. This is economically and statistically highly significant. It is strong evidence that the key to raising national income was secure property rights and that this was achieved by switching the legal basis of landholding from the Dutch system of quitrent or loan-place tenure to the English system of freehold tenure. This result offers strong support to the line of argument taken by LLSV: property rights were important and the British legal system protected them better than any other.

The massive increase in the growth rate from 1843 is obviously a striking result. When we made our initial analysis we had the data only for the years 1852-4 (i.e. we did not have the 1865 and 1875 benchmarks). Although there was an extremely high rate of growth in the years 1852-4, there was obviously a question as to whether this was just an aberration and we were therefore somewhat skeptical this result. But the data for 1865 and 1875 strongly reinforced the result; extrapolating the area of land in production forwards or backwards from 1852-4 puts us almost exactly on the observed data points for 1842, 1865 and 1875.

**Figure 1. Land in production and real output, 1701-1875.**



These data are supported by the qualitative evidence. It is important to note that the extension in acreage was not simply an expansion into more remote areas further away from Cape Town. In part, at least, it was an expansion into areas close to Cape Town that had previously not been cultivable. For example, Noble (1875, 274-5) notes: “Half a century ago it [the Wellington area] was spoken of as the ‘granary’ of the Colony. Then the whole of the wheat brought into Cape Town, from all parts, did not exceed 146 000 bushels. In 1865, this section of the country alone yielded nearly 400 000 bushels of wheat, in addition to 66 829 bushels of barley, 89 784 bushels of rye, 258 559 bushels of oats, and 137 548 hundred pounds of oat-hay, besides other produce.”

Given that the climate of the Cape was generally excessively dry for grain cultivation, the main way of rendering more land cultivable was to irrigate it (Alexander, 1815, pp. 246-7). Hence the Civil Commissioner for the district of Albert commented that in the dry year of 1862: "...no wheat could be sown except by the few farmers who possessed the means of irrigating their land." (*Cape of Good Hope Blue Book*, 1862, p. JJ25). And the Civil Commissioner for district of Mossel Bay commented that: "The soil of the division is very productive under irrigation; and it seems a national sin that it should, with others, be almost abandoned to the feeding of sheep and the growth of wild aloes." (*Cape of Good Hope Blue Book*, 1866, p. JJ15).

But by the 1860s many districts had already installed, or were installing, irrigation systems. In the district of Graaff-Reinet:

"The vast importance of dam making has forced itself on the minds of most of the sufferers by the drought; and, in several instances, dams are being constructed at a great cost of labor and money, with a determination which must eventually overcome many obstacles. One experiment, in particular, at Roodebloem, six miles from Graaff-Reinet, is being watched by many with great interest.

"The principal improvement, calculated to benefit those farmers on whose lands dam-making is impossible, is the introduction of several powerful forcing and lifting pumps, by means of which water can be forced from wells for irrigating purposes." (*Cape of Good Hope Blue Book*, 1860, p. JJ30-3).

In Colesberg, "Each year sees an addition to the number of dams in the division." (*Cape of Good Hope Blue Book*, 1860, p. JJ30-3). And in Swellendam in 1862, "One proprietor in this neighborhood, has, by means of such dams,... converted a dry extent of land, formerly fit for grazing during only a few months of the year, into a productive grain farm..." (*Cape of Good Hope Blue Book*, 1862, p. JJ13). Such examples could be multiplied many times.

One might ask whether this extension of irrigation after 1842 was simply due to the spread of superior technology, such as steam pumps, rather than any increase in farmers' willingness to invest. But, in fact, many of the irrigation systems used traditional technologies that had been around for centuries. For example, in the district of Robertson: "It has been attempted to raise water from the Breede River for irrigation. Two powerful pumps have been erected close to the town, the one for wind and the other for horse-power. A very extensive price of produce land can be thus brought into cultivation." (*Cape of Good Hope Blue Book*, 1860, p. JJ30-3).

It is also noteworthy that there were other forms of increased capital investment after 1842, such as improved threshing and plowing machinery. The improved ploughs, in particular, would have made it feasible to bring land into cultivation that had been too difficult to work with the older, Dutch technology. Hence in Caledon: "Several reaping machines have been introduced. These, when properly understood, will be much more appreciated, as tending to lessen the amount of manual labor. In some cases, threshing machines are being used with advantage.

"The English and American ploughs are also entirely superseding the heavy Dutch plough." (*Cape of Good Hope Blue Book*, 1860, p. JJ30-3). The *Blue Book* contains similar comments about the divisions of Alexandria, Calvinia, Colesberg, Fort Beaufort, Graaf-Reinet, Paarl and Picketberg.

Even if we accept that there was an increase in fixed investment and a drastic acceleration in output growth in the Cape colony from 1843, can we really attribute this to the switch from the Dutch system of land tenure to the British system? In many areas of the world output was certainly growing faster in the late nineteenth century than it had been in earlier periods. Frontier regions were growing particularly rapidly owing to the decline in international freight rates, which enabled their agricultural producers to benefit from the rising demand in European markets (Harley, 1995; O'Rourke and Williamson, 1999). One might wonder whether the rising rate of output growth in the Cape colony was just another example of this process in operation. In fact, a comparison with other frontier regions shows that the growth rate of the Cape colony was exceptionally slow up to 1843 and was relatively fast after 1843: the Cape changed from being the worst-performing colony in the group to being the best-performing. Table 3 below presents the growth rates of output in various frontier regions, as best as we can estimate them.

**Table 3. Output growth rates in frontier regions, 1701-1875 (per cent per annum).**

	1701-1794	1795-1813	1814-23	1833-1842	1842-1875
Cape colony	1.93 (±0.09)	4.54 (±1.01)	0.91 (±2.34)	0.73 (±1.69)	3.45 (±0.84)
Quebec <sup>a</sup>	4.18	2.25	2.25	2.25	2.97
Tasmania <sup>b</sup>				11.87 (3.29)	1.90 (0.23)
New South Wales <sup>b</sup>				10.83 (3.53)	3.64 (0.32)
USA <sup>c</sup>					2.88

Notes: estimation of standard errors is possible only for the Cape colony; standard errors reported in parentheses. The standard error for 1842-75 is particularly large because it is based a fairly small number of annual observations. *a* – data pertain to the years 1706-39, 1739-1844 (which cannot be broken down into sub-periods and so is assumed to be constant) and 1844-71. *b* – data pertain to the years 1833-42 and 1842-75. *c* – data pertain to total US output for the years 1839 and 1866-70. All of the data for the frontier regions outside the Cape colony are based on the author's calculations.

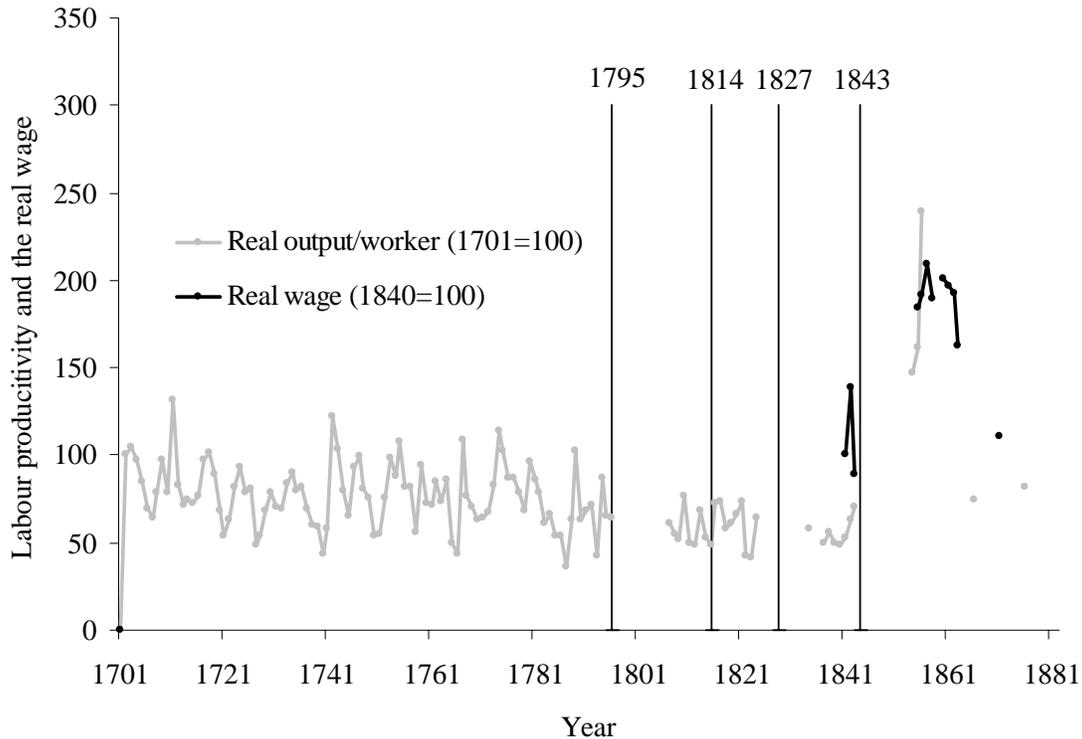
The comparison between the Cape colony and the French colony of Quebec is particularly interesting for several reasons. First, the Quebec colony was founded in the early 1600s, around the same time as the Cape colony. We would expect the rate of output growth to be higher in the early years of a colony's existence because the volume of output starts at a very low base and hence any small absolute increase constitutes a very high growth rate. Therefore it is more instructive to compare growth rates in colonies of a similar age, such as Quebec and the Cape. Second, there are some fairly early data available for Quebec and these show that the French colony consistently grew much faster than its Dutch counterpart up to 1842 (with the possible exception of the sub-period 1795-1813, which the data do not able us to distinguish in the case of Quebec). It would be interesting to compare this with output growth in the British North American colonies, but unfortunately there are no data available. Third, and most important, the British did not change the basis of Quebec's legal system after they gained permanent control of the colony in 1763. They were worried that doing so would generate unrest and possibly force the French colonists to ally with the turbulent British colonists in what is now the US. Thus the Quebec Act of 1774 retained the French civil law system for all

commercial transactions; only criminal law and constitutional law were rebased onto the British system. Therefore we would not expect to see a particular acceleration in output growth in Quebec after its annexation by the British – in contrast to the Cape colony – and this expectation is indeed borne out by the data.

The analysis of the output data has revealed that growth accelerated in the Cape colony immediately after the British seized control in 1795. This is consistent with the Landes view that British colonization was economically benign compared to that of other imperial powers, and it rebuts the contrary AJR view. There was then a period of stagnation during the postwar depression and this was not influenced by the move to adversarial trials and a common law system in 1827, thus casting doubt on the BDL view that the benefit of the British legal system was to be found in its evolutionary common law characteristic. Finally, there was a marked acceleration from 1843 that was not simply due to the worldwide acceleration of the late nineteenth century. Instead it was caused by the change in the basis of landholding from the Dutch to the British system, which increased the security of farmer's property rights and encouraged fixed investment. This vindicates the original argument of LLSV using new time series data.

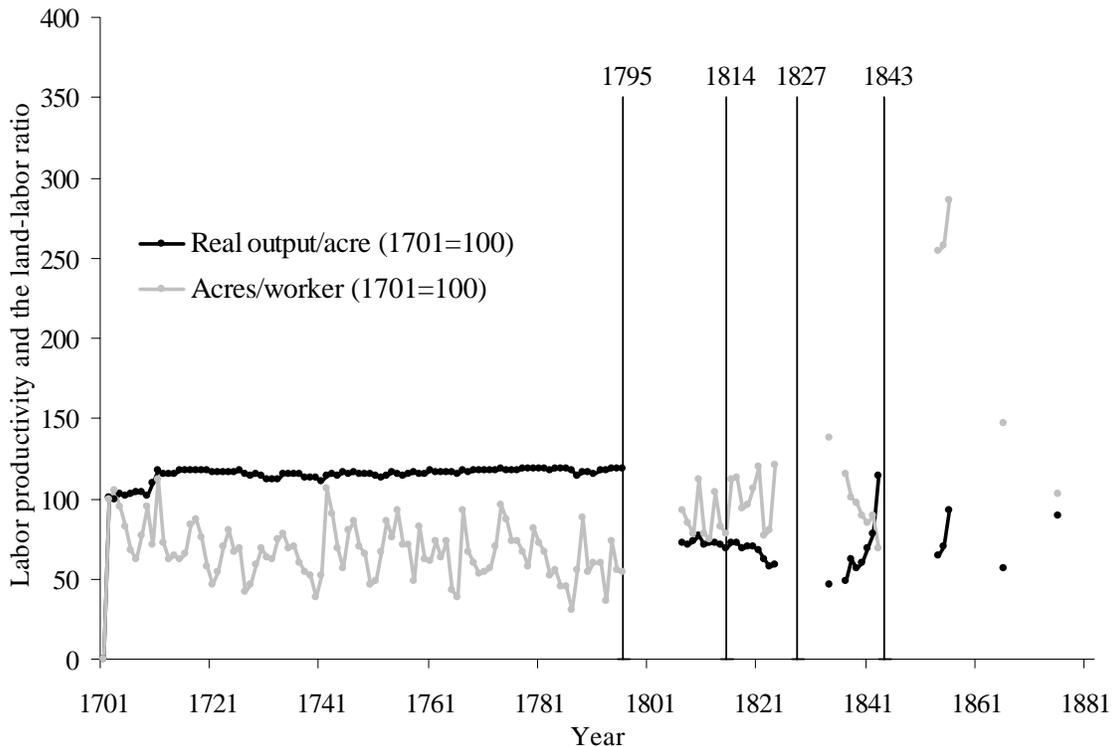
**3.2. Productivity growth.** The story on output growth in the Cape colony is clear but what about productivity growth? The scarcity of data means that we can consider only labor productivity with any degree of reliability but this turns out to be very interesting. Labor productivity boomed after 1842, with the value of real output per worker approximately tripling up to 1854. But labor productivity then collapsed and by 1865 had regained its old level of 1842, as demonstrated in figure 2 below. Given the apparently strange evolution of labor productivity, we need to ask two questions. First, did this boom really occur? Second, if the boom did really occur, then why? An obvious place to look for corroborating evidence of a labor productivity boom is in the real wage data, and here we are reassured. The pattern of real wages supports the existence of a short-lived boom in labor productivity, with a substantial spike in real wages at just the same time as the spike in labor productivity. This is again demonstrated in figure 2.

**Figure 2. Labor productivity and the real wage, 1701-1875.**



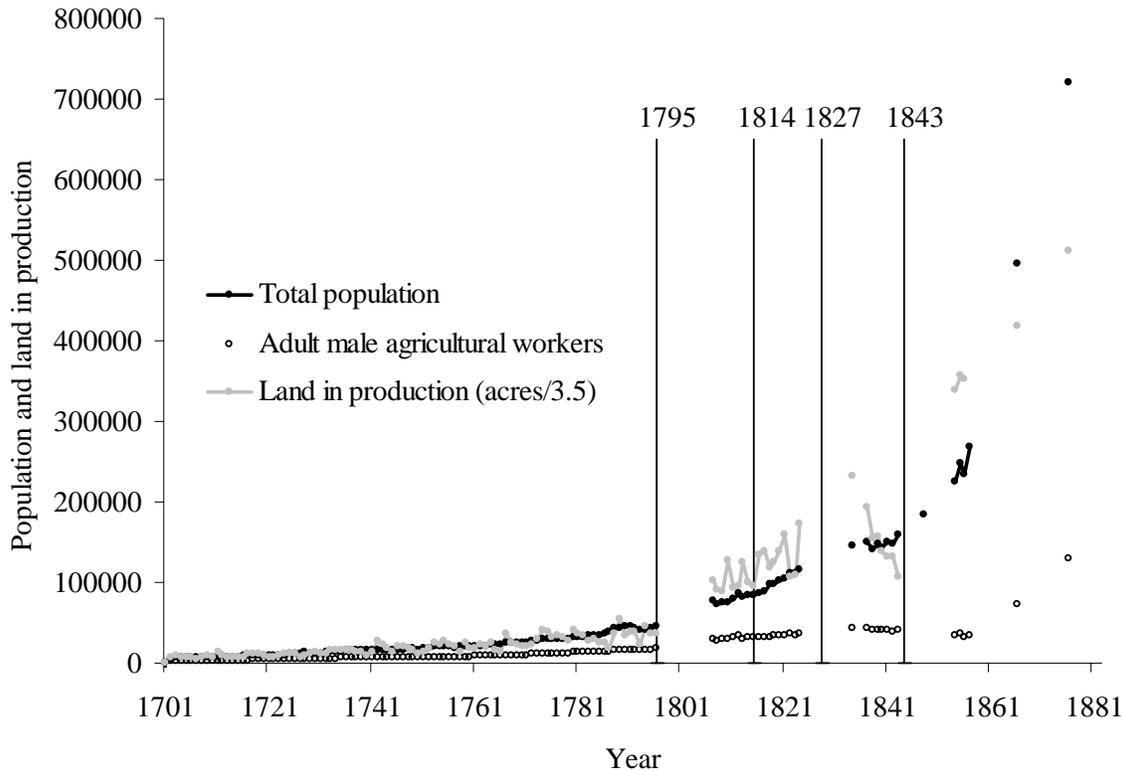
In seeking to explain the boom it is interesting to make a breakdown of labor productivity. One way that we can think of output per worker is simply as the product of acres per worker and output per acre. Making this decomposition for the Cape colony in the nineteenth century reveals that output per acre was virtually unchanged over the whole period. But there was a large spike in acres per worker after 1843; it reached a peak in 1855 before slumping back again to its initial level by 1865. This is shown in figure 3 below. Notice also that real output per acre and the number of acres per worker tend to be inversely correlated. This is for two reasons. First, as each worker has more acres to cultivate we would expect him to have less time to devote to each acre and this will push down yields (so land productivity will fall even though labor productivity is rising). Second, increasing the land-labor ratio generally involved bringing more land into production. *Ceteris paribus*, this marginal land would have been of lower quality and this would have put downward pressure on average output per acre. The only period when the series move together – rather than inversely – is in the 1850s, when they both rise together. This is what we would expect following the improvement in the security of property rights. Landowners not only wanted to bring more land into production but also now wanted to invest in more fixed capital in order to improve its yield. Therefore, output per acre and acres per worker both rose at the same time for a short period.

**Figure 3. Decomposing the variation in labor productivity, 1701-1875.**



The exceptional spike in the land-labor ratio that occurred in the 1850s is consistent with our argument that reforming the laws of land ownership was economically extremely important. As soon as property rights in land were secured by a move to freehold tenure it became worthwhile to invest in the land. This enabled more land to be brought into production quite rapidly. But the supply of labor was inelastic and therefore the land-labor ratio rose very rapidly, which in turn generated a sharp increase in both labor productivity and real wages. However, this was not a long-run equilibrium. High real wages and the increased availability of cultivable land attracted thousands of British migrants to the Cape colony, which drove down labor productivity and real wages to a more sustainable level. This is illustrated in figure 4 below, where the series on land in production jumps after 1842, a decade before the jumps in total population and the number of agricultural workers. It is important to be clear on this point. The acreage in production was not responding to an increase in population; the population was responding (up to 1865, at least) to the increase in acreage. In fact, there was also an unanticipated positive shock that substantially boosted the population of the Cape colony after 1865: the discovery of diamonds in 1867 and gold in 1886. But these events fortuitously followed the increase in the Cape's ability to feed itself, rather than led it.

**Figure 4. Population, agricultural workforce and land in production, 1701-1875.**



The data on labor productivity are consistent with our story on output growth. So are the data on land productivity, although the high year-on-year yield fluctuations make it impossible to draw firm conclusions. The main arable crop in terms of volume and value was wheat. Wheat yields averaged around 6 bushels per acre in the period 1833-42, which was extremely low by international standards. Wheat yields climbed to 7 bushels per acre in 1865 and 9 bushels per acre in 1875; this is what we would expect to see in response to the spread of irrigation and other fixed capital equipment. It would be interesting to complete the picture with data on capital and total factor productivity but, unfortunately, data limitations prevent such an exercise.

**4. Conclusions.** At three points in time there were important, discrete and exogenous changes in the colonial and institutional basis of the Cape colony in southern Africa. In 1795 Britain replaced Holland as the colonial power, whilst maintaining Dutch institutions and customs; in 1827 the British system of adversarial and common law justice was introduced; and in 1843 property rights in land were made more secure. Throughout this period the geographical endowment, notably in terms of the disease environment, was held constant. This identifying variance has enabled us to undertake time series tests of the effects on economic growth of legal origins and the security of property rights (as proposed by LLSV), legal origins and the evolution of legal systems (as proposed by BDL), and endowments and colonial origins (as proposed by AJR).

We find that improving the security of property rights in land had an immediate, positive and large effect on the rate of growth of output and productivity – just as LLSV would predict and just as Adam Smith was arguing back in 1776. After the

transformation of property rights the Cape changed from being the worst-performing colony to being the best-performing colony in terms of economic growth. By contrast, we find that improving the ability of the legal system to evolve by switching to a common law system had no effect on the rate of economic growth – contrary to the predictions of BDL. We find that changing the colonial power from Holland to Britain had an immediate, positive and large effect on the rate of growth of output – contrary to the predictions of AJR. Our finding that better or worse institutions can be introduced into a particular colony (that is, we can change the identity of the colonial power from Holland to Britain and we can improve the security of property rights in land, and both of these have an immediate and positive effect on economic growth) suggests that the link between geographical endowment and the quality of institutions is not robust – contrary to the predictions of AJR. The growth trajectory of the Cape colony changed very rapidly following changes in its institutional base. This suggests that modern developing countries are not necessarily doomed to be prisoners of either their endowments or their inherited institutions.

**Appendix 1. The population of the Cape colony.** Van Duin and Ross transcribed the Opgaaf census returns of the Dutch East India Company. They report population data from 1701 onwards, broken down by district and type of person (male/female, adult/juvenile, white/black, freeman/slave).<sup>7</sup> I have not been able to verify directly the accuracy of the transcription, since I do not read Dutch and have not consulted the original sources, but Van Duin and Ross seem to have taken reasonable care in transcribing the data. For example, they explain that some individual entries have been corrected because they appear to be slips of the pen. However, the handling of the data after transcription does not appear to have been as thorough and transparent as one might like, and here I note four caveats.

First, Van Duin and Ross appear to have made many arithmetic errors in adding up the data. When I entered the district-level data and tried to match my population totals with that of Van Duin and Ross there was usually a discrepancy of several hundred persons out of a total of around 30 000 persons. Second, it is difficult to work out to what the data actually refer because the titles of the tables provided by Van Duin and Ross are rather misleading. For example, table 1 in appendix 2 bears the legend “Population, total Cape Colony”. But it turns out that this total does not include the East India Company Establishment (i.e. Company personnel), nor their families and personal slaves, nor the East India Company slaves. In that sense, it is a rather unusual concept of ‘total’. Third, there appears to be no data at all concerning the families and personal slaves of the East India Company Establishment. The East India Company Establishment itself is accounted separately and does not enter into the total for the Cape district; the implication of footnote 1 on p. 126 is that the families and personal slaves of the Company Establishment did not enter into the total for the Cape district either. Since the families and personal slaves are not accounted separately anywhere else, this implies that they are completely missing from the enumeration. After 1730 the Company Establishment was never less than 1 000 people, and after 1781 rarely less than 2 000 people. If each Company employee had, say, four other people in his household then this would imply an under-enumeration of 4 000 to 8 000 persons out of a total population of 25 000 to 40 000. This error is therefore quite substantial. Fourth, the data for all types of person are missing for a number of years, such as 1761, 1771, 1781 1794 and a few others; and the data for free blacks are completely missing prior to 1720 and after 1773.

I have therefore treated the data as follows. First, the data for missing years have been linearly interpolated. Second, the population totals for free blacks have been linearly extrapolated prior to 1720 and after 1773 (a regression reveals that a linear trend of an increase of 3 persons per annum provides a very good fit of the data from 1720 to 1773). Third, I have multiplied the figures on Company Establishment by five to compensate for the absence of their households from the enumeration data. I arrived at the estimate of four unenumerated persons per household as follows. Over the period 1701-95 the ratio of white women and children to white men in the Cape district averaged 2.45; we can interpret this (somewhat simplistically) as one wife and 1.45 children per male. I assume that the average family structure of Company Establishment men was the same as other households in Cape district. I then added on a rather arbitrary 1.55 slaves per household, giving a total of four unenumerated persons. With some care and persistence it would probably be possible to improve upon this estimate by looking at the documentary

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<sup>7</sup> Van Duin and Ross, *The Economy*, pp. 112-26.

sources about particular families in the period, but this is rather beyond the scope of the present paper.

The British continued with the Dutch model of an annual census once they had established themselves in power, and for the period 1806-23 these census returns are reproduced in the *Records of the Cape Colony*.<sup>8</sup> British efforts thereafter became more sporadic; whilst there was good coverage in the period 1833-42, we are reduced to approximately quinquennial observations in the period 1847-75.<sup>9</sup> It is also important to get a breakdown of the total population by sex in order to generate a more precise estimate of total labor inputs. Whilst modern populations in the developed economies are split approximately equally between men and women – with slightly more women than men, owing to their greater longevity – this was definitely not the case in frontier societies of the eighteenth and nineteenth centuries. Adult males were more likely to migrate and survive and the proportion of males in the total population was therefore typically much higher than one half. My estimates of both the total and the male populations of the Cape colony are reported in table A1 below.

We need one more piece of information in order to calculate agricultural productivity: the proportion of the population working in agriculture. Data on occupation is considerably more difficult to find than data on population. Moreover, since we are concerned only with arable agriculture, we would ideally like to split up the agricultural workforce into arable and pastoral workers. We would also like to split up the agricultural workforce into males and females because the labor input of a female is generally reckoned to have been only two-thirds of that of a male. (This is plausible, given the heavy physical element of agricultural work at this time, although the precise fraction of two-thirds is simply a crude estimate based on the ratio of male to female wages). I have tackled this problem as follows.

First, I assume for simplicity that all arable workers were males and that all pastoral workers were females. This is a crude assumption but captures the basic fact that many of the tasks of pastoral agriculture were undertaken by women (such as dairy work and much of the herding), whereas the major arable tasks were typically the preserve of men (plowing, reaping, carting). Since I am interested only in arable productivity in this analysis, I can therefore content myself with estimating the total number of adult males employed in agriculture.

Second, from 1856 onwards we have direct evidence from the census of the number of workers in arable agriculture.

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<sup>8</sup> Theal, *Records*, vol. 6, p. 75, p. 248, p. 442; vol. 7, p. 239, p. 477; vol. 8, p. 233; vol. 9, p. 48, p. 299; vol. 10, p. 228; vol. 11, p. 51, p. 238, pp. 438-9; vol. 12, pp. 128-9, pp. 414-5; vol. 13, pp. 354-5; vol. 14, pp. 246-7; vol. 15, pp. 198-9; vol. 16, pp. 488-9.

<sup>9</sup> British Parliamentary Papers, 1836, vol. 46, pp. 638-41, pp. 648-9; 1839, vol. 45, pp. 747-7; 1840, vol. 43, pp. 622-3, pp. 630-3; 1844, vol. 1846, pp. 405-7, pp. 410-13; 1849, vol. 52, p. 359; 1857, vol. 40, p. 293, pp. 300-1; 1859 (session 2), vol. 31, p. 402; Government of the Cape of Good Hope, *Census of 1865*; *Census of 1875*.

**Table A1. Population of the Cape Colony, 1701-1875.**

<b>Year</b>	<b>Total</b>	<b>Males</b>	<b>Agric</b>	<b>Year</b>	<b>Total</b>	<b>Males</b>	<b>Agric</b>	<b>Year</b>	<b>Total</b>	<b>Males</b>	<b>Agric</b>
<b>1701</b>	5481	2492	<i>1903</i>	<b>1752</b>	19636	9492	<i>7248</i>	<b>1803</b>			
<b>1702</b>	5925	2657	<i>2029</i>	<b>1753</b>	19900	9970	<i>7613</i>	<b>1804</b>			
<b>1703</b>	5953	2726	<i>2081</i>	<b>1754</b>	20531	10261	<i>7836</i>	<b>1805</b>			
<b>1704</b>	5978	2770	<i>2115</i>	<b>1755</b>	20781	10298	<i>7864</i>	<b>1806</b>	76855	43004	28438
<b>1705</b>	6034	2870	<i>2191</i>	<b>1756</b>	18159	9395	<i>7174</i>	<b>1807</b>	73482	41639	27379
<b>1706</b>	6012	2852	<i>2178</i>	<b>1757</b>	19698	9823	<i>7501</i>	<b>1808</b>	73873	42147	29412
<b>1707</b>	6091	2933	<i>2240</i>	<b>1758</b>	19769	9907	<i>7565</i>	<b>1809</b>	75538	42477	29427
<b>1708</b>	6261	3054	<i>2332</i>	<b>1759</b>	19918	10268	<i>7841</i>	<b>1810</b>	80443	44972	30928
<b>1709</b>	7470	3656	<i>2792</i>	<b>1760</b>	20462	10607	<i>8100</i>	<b>1811</b>	87018	48278	32958
<b>1710</b>	7651	3757	<i>2869</i>	<b>1761</b>	21017	10934	<i>8349</i>	<b>1812</b>	81964	45249	30661
<b>1711</b>	8017	3758	<i>2870</i>	<b>1762</b>	20923	11080	<i>8461</i>	<b>1813</b>	84373	46888	31534
<b>1712</b>	7649	3761	<i>2872</i>	<b>1763</b>	21805	11592	<i>8852</i>	<b>1814</b>	84657	47105	31442
<b>1713</b>	7649	3890	<i>2970</i>	<b>1764</b>	23756	12219	<i>9331</i>	<b>1815</b>	85739	46795	30998
<b>1714</b>	7395	3631	<i>2773</i>	<b>1765</b>	23532	12447	<i>9505</i>	<b>1816</b>	88486	48461	31390
<b>1715</b>	8003	3830	<i>2925</i>	<b>1766</b>	25098	12910	<i>9858</i>	<b>1817</b>	97535	53200	32682
<b>1716</b>	8511	4295	<i>3279</i>	<b>1767</b>	24629	12727	<i>9719</i>	<b>1818</b>	98844	54318	33570
<b>1717</b>	8947	4533	<i>3462</i>	<b>1768</b>	24892	12890	<i>9843</i>	<b>1819</b>	101657	55478	33348
<b>1718</b>	9097	4597	<i>3510</i>	<b>1769</b>	25530	13041	<i>9958</i>	<b>1820</b>	105356	57104	34126
<b>1719</b>	9224	4732	<i>3613</i>	<b>1770</b>	25905	13168	<i>10055</i>	<b>1821</b>	112147	60414	35524
<b>1720</b>	9271	4633	<i>3538</i>	<b>1771</b>	26804	13509	<i>10316</i>	<b>1822</b>	111451	60086	35200
<b>1721</b>	9341	4682	<i>3575</i>	<b>1772</b>	27923	13869	<i>10591</i>	<b>1823</b>	116204	62617	36617
<b>1722</b>	9688	4832	<i>3690</i>	<b>1773</b>	29276	14352	<i>10960</i>	<b>1824</b>			
<b>1723</b>	10095	5174	<i>3951</i>	<b>1774</b>	29908	14577	<i>11131</i>	<b>1825</b>			
<b>1724</b>	10548	5490	<i>4192</i>	<b>1775</b>	29738	14742	<i>11257</i>	<b>1826</b>			
<b>1725</b>	10585	5790	<i>4421</i>	<b>1776</b>	30368	15254	<i>11648</i>	<b>1827</b>			
<b>1726</b>	11198	6057	<i>4625</i>	<b>1777</b>	30543	15757	<i>12032</i>	<b>1828</b>			
<b>1727</b>	12563	6545	<i>4998</i>	<b>1778</b>	30389	16056	<i>12261</i>	<b>1829</b>			
<b>1728</b>	12366	6449	<i>4925</i>	<b>1779</b>	31748	16932	<i>12929</i>	<b>1830</b>			
<b>1729</b>	12078	6350	<i>4849</i>	<b>1780</b>	31867	16846	<i>12864</i>	<b>1831</b>			
<b>1730</b>	12489	6507	<i>4969</i>	<b>1781</b>	32302	16851	<i>12867</i>	<b>1832</b>			
<b>1731</b>	13261	5926	<i>4525</i>	<b>1782</b>	34052	17066	<i>13032</i>	<b>1833</b>	145042	75599	43193
<b>1732</b>	13511	6970	<i>5322</i>	<b>1783</b>	33773	17277	<i>13193</i>	<b>1834</b>			
<b>1733</b>	13225	7148	<i>5458</i>	<b>1784</b>	34943	18164	<i>13870</i>	<b>1835</b>			
<b>1734</b>	14767	7576	<i>5785</i>	<b>1785</b>	36611	18682	<i>14266</i>	<b>1836</b>	150110	76987	43398
<b>1735</b>	15130	8001	<i>6110</i>	<b>1786</b>	37955	19312	<i>14747</i>	<b>1837</b>	140429	72280	39862
<b>1736</b>	15659	8501	<i>6492</i>	<b>1787</b>	44308	21683	<i>16557</i>	<b>1838</b>	147341	75485	41417
<b>1737</b>	15133	8430	<i>6437</i>	<b>1788</b>	44106	20967	<i>16011</i>	<b>1839</b>	143271	73949	40026
<b>1738</b>	15828	8551	<i>6530</i>	<b>1789</b>	45228	21362	<i>16313</i>	<b>1840</b>	150255	76578	40145
<b>1739</b>	15448	8423	<i>6432</i>	<b>1790</b>	44664	21391	<i>16334</i>	<b>1841</b>	147021	75028	38056
<b>1740</b>	16356	8593	<i>6562</i>	<b>1791</b>	43564	21336	<i>16293</i>	<b>1842</b>	159451	82025	40208
<b>1741</b>	16200	8356	<i>6381</i>	<b>1792</b>	40154	20477	<i>15636</i>				
<b>1742</b>	16825	8870	<i>6773</i>	<b>1793</b>	41272	20601	<i>15713</i>	<b>1847</b>	185000		
<b>1743</b>	15764	8354	<i>6379</i>	<b>1794</b>	42857	21633	<i>16519</i>				
<b>1744</b>	15728	8157	<i>6228</i>	<b>1795</b>	44441	22665	<i>17308</i>	<b>1853</b>	224827	113240	34306
<b>1745</b>	16332	8276	<i>6320</i>	<b>1796</b>				<b>1854</b>	248625	124431	35578
<b>1746</b>	16603	8431	<i>6438</i>	<b>1797</b>				<b>1855</b>	234345	118010	31733
<b>1747</b>	17228	8484	<i>6479</i>	<b>1798</b>	62000			<b>1856</b>	267096		33638
<b>1748</b>	17427	8535	<i>6518</i>	<b>1799</b>							
<b>1749</b>	16364	8505	<i>6495</i>	<b>1800</b>				<b>1865</b>	496381	255760	73140
<b>1750</b>	17986	8927	<i>6817</i>	<b>1801</b>							
<b>1751</b>	18346	9126	<i>6969</i>	<b>1802</b>				<b>1875</b>	720984	369628	128600

Third, for the years 1833 and 1836-9 the population sources give us the total number of workers in agriculture, industry and commerce in each district of the Cape colony. If the total number of agricultural workers was less than 65 per cent of the total number of males in the district, then I assumed that all the agricultural workers were male. I chose this 65 per cent cut-off somewhat arbitrarily to reflect the fact that many males were not adult and the fact that some males would have worked in other sectors. If the total number of agricultural workers was greater than 65 per cent of the total number of males in the district, then I assumed that 65 per cent of the total number of males in the district were agricultural workers and that the remaining agricultural workers were women. This enables me to estimate that total number of males working in agriculture in the Cape colony in the period 1833-9. This procedure suggests that overall around 56 per cent of agricultural workers were male. This seems plausible because I would expect female workers to be more concentrated in domestic work and industries such as cloth production; it is also consistent with the later census data.

Fourth, I calculated the proportion of the total male population that was working in agriculture in each year in the period 1833-9 (around 55 per cent) and then regressed this series on a time trend. This revealed that the proportion was falling by 0.5 per cent per annum and the coefficient was highly statistically significant. This result seems plausible, since I would generally expect a frontier economy to be gradually moving away from its agricultural basis over time. I extrapolated the proportion of males working in agriculture back to 1806, at which point it was 76 per cent, and I assumed that the proportion was constant at this level between 1701 and 1806.

Fifth, moving forwards in time, I linearly interpolated the proportion of males working in agriculture between 1839 and 1856.

Whilst these assumptions are crude, I do not believe that it is possible to do substantially better given the current availability of data: hopefully the situation will improve in the future. We will also see that the general results of this paper are not very sensitive to the precise assumptions about the proportion of males in agriculture. For the convenience of other researchers, my estimates are reproduced in table A1, where “Agric” is the total number of adult male workers in agriculture; figures in italics are estimated.

**Appendix 2. Wheat output.** The primary data series on arable output during the period of Dutch rule in the Cape colony is that provided by the Opgaaf returns. The Opgaaf recorded the output declared by farmers for the purposes of taxation. Since there were essentially no independent checks on the farmers’ declarations, we can immediately see that the Opgaaf returns are likely to underreport true output – farmers were likely to conceal some of their output in order to lighten the burden of taxation. The question then arises as to how much output went unrecorded and whether it was constant over time. Before constructing a new set of output estimates, it is important to see why the existing estimates are unsatisfactory and how we might improve upon them. Hence I begin by reworking the estimates of Van Duin and Ross and showing how the errors and imprecisions in their calculations lead to a substantial under-estimate of total output.<sup>10</sup> I then derive my own, alternative estimates.

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<sup>10</sup> Van Duin and Ross, *The Economy*, pp. 21-6.

**Reworking Van Duin and Ross: 1789-95.** The Opgaaf records the amount of wheat entered for market consumption (which was taxed) and the amount of wheat set aside for seed (which was not taxed). There was a third category called ‘Bread Corn’ which was essentially on-farm consumption and which was neither recorded nor taxed. The problem is to estimate the true values for each of these categories for a particular year or years, and then compare them to the recorded values; this will enable us to estimate a correction factor for underreporting which we can then use to reflate the official annual returns for other years.

Let us first deal with bread corn. For five years in the early eighteenth century, we know the ratio of bread corn to the Opgaaf seed return; on average, it was 4.228.<sup>11</sup> Following Van Duin and Ross, I proceed on the assumption that this ratio was constant over time and that I can estimate the amount of bread corn each year by multiplying the Opgaaf seed return by 4.228. Following Van Duin and Ross, I also assume that the quantity of seed was underreported by the same proportion as the quantity of marketed (i.e. taxable) output. The rationale for this is that the tax collectors would have a fairly good idea of the yield-seed ratio, so the farmers would have to underreport the amount of seed that they used (even though it was tax free) because otherwise the tax collectors would realize that they were underreporting their marketable output. Van Duin and Ross then write down the following equation:

$$Q = a*(TAXABLE + 5.228*SEED) \quad \text{(Equation 1)}$$

where  $Q$  is total output,  $a$  is the correction factor for underreporting,  $TAXABLE$  is the taxable output recorded in the Opgaaf and  $SEED$  is the quantity of seed recorded in the Opgaaf.<sup>12</sup>

The error in equation 1 comes from the fact that Van Duin and Ross are also multiplying the bread corn estimate by the correction factor,  $a$ . There is no reason to suppose that the bread corn estimates from the early eighteenth century are underreported, so there is no justification for reflating the quantity of bread corn. According to Van Duin and Ross, what we observe in the early eighteenth century is the ratio of the (accurately reported) bread corn to the (underreported) seed. Hence to accurately estimate bread corn in the later period, we need to multiply the ratio that we derived from the early eighteenth century data by the (underreported) seed from the later period.<sup>13</sup> So the correct equation should be:

$$Q = a*(TAXABLE + SEED) + 4.228*SEED \quad \text{(Equation 2)}$$

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<sup>11</sup> Van Duin and Ross, *The Economy*, p. 98. The figures are: 1709, 3.39; 1710, 6.39; 1711, 4.21; 1713, 4.18; 1715, 2.97. Van Duin and Ross assume that bread corn was three times the quantity of seed corn. I see no reason to use a less precise number when a more precise number is available, so I take the ratio to be the mean value of the available data – that is, 4.228.

<sup>12</sup> Note that we have 5.228 times the amount of seed because bread corn was 4.228 times the amount of seed and seed itself was 1 times the amount of seed:  $1+4.228=5.228$ .

<sup>13</sup> In fact, we will see below that there is good reason to believe that in the early eighteenth century *neither* the seed *nor* the bread corn were underreported. We consider this issue in due course.

It turns out that this correction makes a substantial difference to the results. The average total output in the first years of British rule (1798-1806), when the output returns are believed to have been fairly complete, was 102 812.3 mudden.<sup>14</sup> Following Van Duin and Ross, suppose that this was also the true output in the final years of Dutch rule (1789-95). The average Opgaaf returns for those years was 20 724 mudden of marketable output and 3 345 mudden for seed. Then:

$$102\,812.3 = a*(20\,724 + 3\,345) + 4.228*3\,345 \quad (\text{Equation 3})$$

This implies that  $a$  is 3.68. Putting the same numbers into (the incorrect) equation 1 implies that  $a$  is 2.69. Thus my estimate for the marketable output is 76 346 and for the non-marketable output (bread and seed) is 26 538. The Van Duin and Ross estimate for the marketable output is 55 198 and for the non-marketable output is 47 615.<sup>15</sup>

Van Duin and Ross present three checks on their estimate. First, they rearrange their equation to derive the implied yield-seed ratio, which they take to be:

$$\text{TAXABLE/SEED} + 5.228 \quad (\text{Equation 4})$$

They then calculate that the implied yield-seed ratio is 9.94; since this is the same as the ratio observed in the early nineteenth century (when the British administrators were collecting more accurate data), they argue that this offers corroboration of their methods. But, notice first that their equation 4 cannot be derived from their equation 1. Equation 1 actually implies that the yield-seed ratio is:

$$a*(\text{TAXABLE} + 5.228*\text{SEED})/a*\text{SEED} \quad (\text{Equation 5})$$

Hence their estimates imply a yield-seed ratio of 11.29. Notice second that their argument is entirely spurious. Effectively, all that Van Duin and Ross are doing in equation 4 is multiplying TAXABLE and SEED by  $a$  and then taking the ratio. If we multiply the numerator and denominator of any fraction by the same factor, then its value will remain unchanged. The correction factor  $a$  could be 1 or 1 million and the estimate of the yield-seed ratio provided by Van Duin and Ross in equation 4 would be unchanged: hence this simply cannot act as a check on their estimated value of  $a$ .

The second check on their output estimate proposed by Van Duin and Ross comes from the barrier across the Cape Town road that recorded all movements of wheat. In the three years 1792-4 we know that 63 332, 69 695 and 58 893 mudden of wheat went to the Cape Town market. Of course, we might suppose that some marketed grain did not reach Cape Town (it could be sold to consumers outside the city) and that the farmers might have avoided the barrier whenever possible (since they were habitually underreporting the amount of grain that they marketed). To the extent that these two causes led to an under-registration of grain at the barrier, the average barrier returns of 63 973 can be

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<sup>14</sup> This is the average of 1798 (110 025 mudden) and 1806 (95 599.5 mudden). Strictly speaking, this is not the total output, which was actually rather higher. But it is the total output measured on the same geographical basis as the figures in the Opgaaf, which is the relevant consideration here.

<sup>15</sup> In fact, the Van Duin and Ross estimate of marketable output is 62 171 because they inexplicably revise their estimate of  $a$  up from 2.76 to 3.

regarded as a lower bound estimate of the marketed output. Yet this lower bound estimate already exceeds the 55 192 estimated by Van Duin and Ross.

The third check on their output estimate proposed by Van Duin and Ross comes from the *dispensier* of the Dutch East India Company. He was the official responsible for Company grain purchases in the Cape and a person whom we might suppose to have been well informed about agricultural conditions. He estimated that a successful harvest would yield 70 000 to 80 000 mudden of marketed grain. This is rather more similar to my estimate of 76 346 mudden than to the Van Duin and Ross estimate of 55 192 mudden.

Finally, there is a fourth check that we can make which is carefully avoided by Van Duin and Ross, even though they make use of it for the early eighteenth century (as I discuss further below). That is, we can estimate total output based on total consumption, since everything that is produced must be consumed.<sup>16</sup> There were 31 948 inhabitants of the Cape Colony in 1793 and it is estimated that each of them consumed around 2.5 mudden of wheat per annum.<sup>17</sup> Passing ships, of which there were 128 in 1793, generally loaded up around 40 mudden of grain each.<sup>18</sup> And exports in 1793 were 9 679 mudden.<sup>19</sup> This implies a total consumption of 117 979 mudden. If I take my estimate of marketed grain (76 346 mudden) and add to it the bread corn that was consumed on the farm (14 143 mudden) then I get an estimate of grain production (net of seed) of 90 489 mudden. Obviously, my estimate based on the Opgaaf is rather lower than the estimate derived from the consumption side. Notice, however, that the 1793 consumption estimate is also much higher than either of the output estimates generated by the British in 1798 and 1806, which average only 102 812 mudden. This suggests to me that the coefficient on population of 2.5 mudden that I used in the consumption model is rather high, probably because it does not allow for the systematic differences between the diets of slaves and freemen. The average estimated European consumption of eight bushels per head applies to a free population. By contrast, the Cape colonists seem to have fed their slaves around 5 bushels of bread grain (which I take to be wheat) per annum and 3 bushels of peas and beans.<sup>20</sup> Given that there were 13 842 freemen and 14 747 slaves in the colony in 1793, this would lead to an *average* per capita wheat consumption of 6.45 bushels (2.17 mudden).

The first conclusion to be drawn from all this is that my estimate of a marketable output of 76 276 mudden may be slightly low but is much more consistent with the evidence than the Van Duin and Ross estimate of 55 192 mudden. This implies that my correction factor of 3.68 is more appropriate than the alternative of 2.69. The second conclusion to be drawn from all this is that the margins of error in this type of calculation are likely to be large and that this is not a very satisfactory way of proceeding. This is an issue to which we return below.

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<sup>16</sup> Of course, there might be some wastage and therefore we would expect the production estimate to be a little higher than the consumption estimate. However, it seems reasonable to suppose that farmers kept this wastage to a minimum, just as they do today.

<sup>17</sup> Van Duin and Ross, *The Economy*, p. 25. Note that 2.5 mudden equals 7.43 bushels; in Europe in this period grain consumption was generally reckoned to be about 8 bushels per head.

<sup>18</sup> Van Duin and Ross, *The Economy*, p. 127.

<sup>19</sup> Van Duin and Ross, *The Economy*, p. 129.

<sup>20</sup> Anon., "Return", p. 216.

**Reworking Van Duin and Ross: 1701-48.** It is only after 1748 that there is a really noticeable difference between the trend in exports and the trend in the Opgaaf returns. On this basis, Van Duin and Ross argue that the level of evasion was probably lower (and fairly constant) in the years before 1748 and then increased substantially up to the late eighteenth century.<sup>21</sup> The issue is then to calculate the level of evasion between 1701 and 1748. Unfortunately, the method that they adopt to do this is fundamentally flawed.

Van Duin and Ross take a sample of four years in which harvests were very low (1726-7 and 1739-40) and argue that in those years the quantities of wheat production and consumption were probably equal in the local market. They then calculate the total consumption for these years implied by the consumption model that I used above; then they show that this is 1.3 times the Opgaaf returns for marketable output in these years. They then take 1.3 as their correction factor for the period 1701-48. This strategy makes no sense. First, notice that wheat production must *always* equal wheat consumption.<sup>22</sup> Moreover, we have direct evidence on wheat exports. In this situation, there is no reason for Van Duin and Ross to restrict their calculations to the years 1726-7 and 1739-40; they can calculate consumption in every year and compare it to the Opgaaf returns, knowing that on average this will give an accurate estimate of the correction factor. In this sense, Van Duin and Ross are throwing away data that they could have used and the accuracy of their estimate of the correction factor will be greatly reduced. Second, it is highly likely that evasion will be systematically lower in years when the harvest is poor because farmers have less to hide. In this sense, the Van Duin and Ross estimate is almost certainly biased downwards.

There is no benefit to redoing these calculations at this point. However, I shall return to this point below.

**Reworking Van Duin and Ross: 1749-1772.** Van Duin and Ross apply the correction factor that they calculate for the late eighteenth century to all the years after 1772 (although they do not offer any justification for this). Given a correction factor of 1.3 for the years up to 1748, it then remains for them only to estimate the changing correction factor for the years between 1748 and 1773. In the absence of any evidence on the issue, they simply linearly interpolate so that their correction factor rises by 0.3 every five years. This is obviously not particularly compelling.

**My estimates.** There are three aspects to consider when we estimate an output series: the level, the trend and the fluctuations. Each of these elements must be estimated accurately if our series is to be useful for economic analysis. Following the discussion above, it seems highly unlikely that Van Duin and Ross have accurately fixed the level or the trend in wheat output. By contrast, the fluctuations are probably reasonably accurate. Notice that the fluctuations in wheat yields (and therefore output) are always large relative to the mean level of yields; this is simply a product of the fact that wheat yields are strongly influenced by the weather and that the weather varies greatly from one year to the next. If the average level of yields is 1 then we find that yields in England in the early nineteenth century commonly fluctuated between 0.6 and 1.4. According to the Opgaaf returns, the

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<sup>21</sup> Van Duin and Ross, *The Economy*, p. 25.

<sup>22</sup> Of course, there could be some storage from one year to the next. But farmers cannot build up stocks indefinitely, so production and consumption must be equal on average.

level of variability was the same in the Cape Colony in the eighteenth century as it was in England slightly later. This seems to me to be highly plausible and suggests that the Opgaaf returns do indeed capture the year-on-year fluctuation in yields. We can now frame our problem more clearly: how can we adjust the level and trend of the Opgaaf series whilst retaining the fluctuations?

Simple logic tells us that the trend in output must equal the trend in consumption, since output must equal consumption on average. I will therefore use a variant of the consumption model that I developed above to estimate the trend in output.

The final issue is to estimate the level of consumption at either the beginning or the end of the period.<sup>23</sup> The output calculations that I made above for the years 1789-95 were not very satisfactory because they did not mesh very well with the consumption estimates and they were based on data from 1798-1806, which might themselves not be wholly accurate and might not be representative of the situation a decade earlier. By contrast, the data for the early period are much more promising, and here we need to look again at the years 1709-15 when the Dutch East India Company put exceptional effort into collecting output data.

I used the consumption model outlined above to estimate annual consumption back to 1701. I then divided that series by the consumption estimates implied by the Opgaaf returns (that is, the taxable output plus bread corn). This ratio is plotted in figure A1 below. Since the Opgaaf returns fluctuate wildly with the harvest, whilst population changes gradually, the ratio of the two series also fluctuates wildly. Hence the ratio is unlikely to be accurate for any one year but nonetheless is likely to be quite informative over a period of years. Van Duin and Ross argue that the data collected in the period 1709-15 are not obviously more complete than those collected in other years: figure A1 strongly suggests the contrary. The ratio of Opgaaf to consumption can be taken as a guide to the level of underreporting; over the whole period it averages 0.47, suggesting an average correction factor of 2.13. But notice that underreporting does indeed seem to grow after 1748, as Van Duin and Ross suggest. And notice also that the ratio of Opgaaf to consumption was far higher in the period 1710-14 than at any other time.<sup>24</sup> Given how thoroughly the Company officials were questioning farmers about what was happening to their grain (in terms of market, seed and bread corn), it seems to me quite likely that the farmers felt obliged to give returns that were fairly accurate. Nonetheless, the Opgaaf returns in those years still came to only 85 per cent of the consumption estimates. Should we therefore conclude that the Opgaaf returns were underreporting 15 per cent of output? I do not think so: I believe that the consumption model is overestimating output by 15 per cent. Recall from above that the 1793 output estimate based on the consumption model was 117 978, whilst the output estimate from the corrected Opgaaf returns was only 102 812. This means that the estimate based on the Opgaaf returns was only 87 per cent of the estimate based on the consumption model. Thus the discrepancies between the two methods of estimating output are remarkably close in 1710-14 and 1793. Since there is reason to believe that the consumption figures are too high (owing to the effect of slave

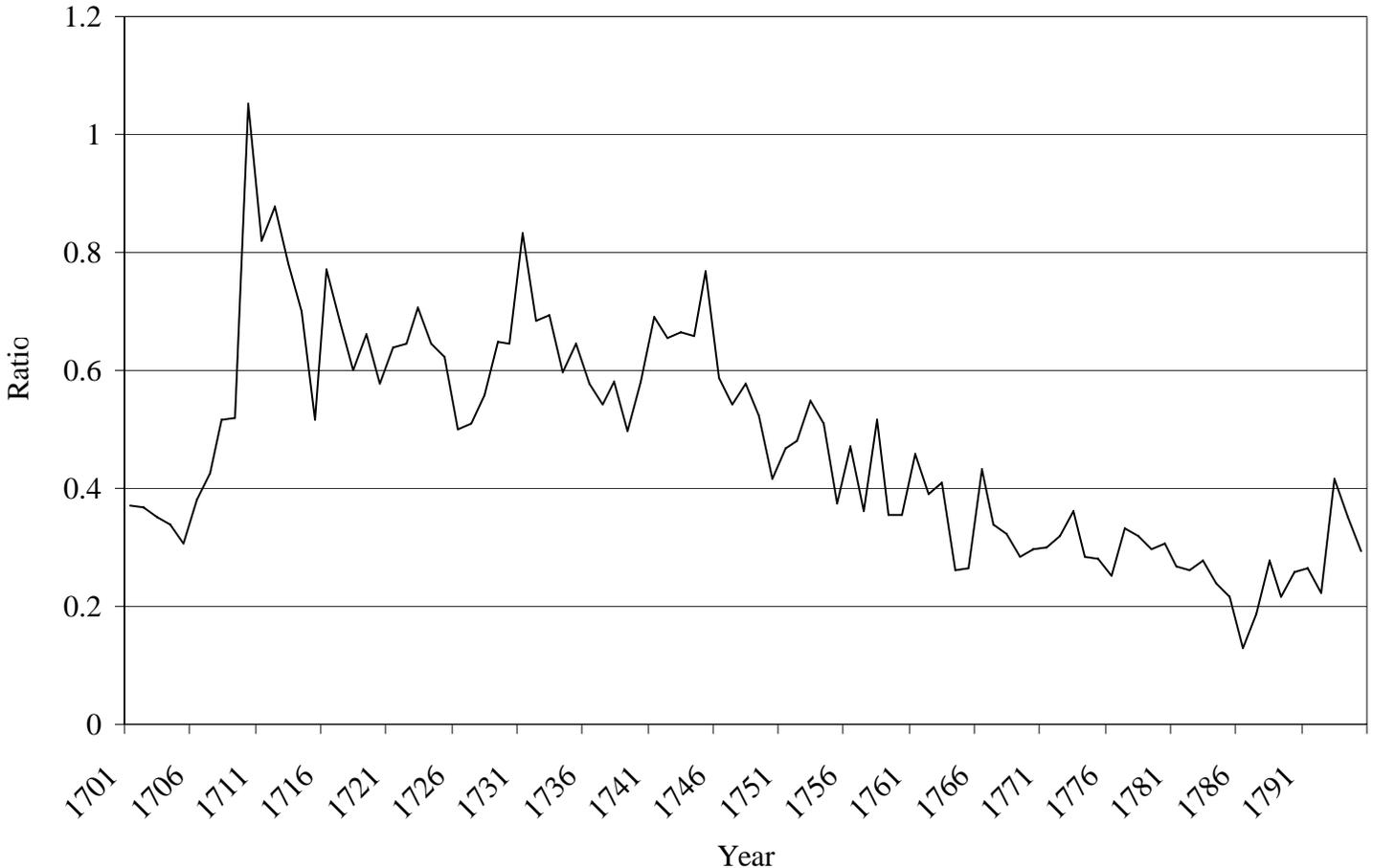
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<sup>23</sup> If we know the trend and the level at one end, then the level at the other end follows automatically.

<sup>24</sup> The years 1709 and 1715 were not noticeably different from earlier and later years; I suspect that the investigative machinery of the Company was not functioning with full rigor in those years and that the data that they collected was therefore rather less accurate. Hence in the following analysis I am going to concentrate on the five-year period 1710-14.

diets on total consumption), I suggest that the most plausible way of reconciling the estimates is to revise downwards the consumption estimates. If we assume that average per capita consumption was 2 mudden per annum, rather than 2.5, then the estimates from the consumption model exactly match both the Opgaaf returns for 1710-14 and the corrected Opgaaf returns for 1789-95.

**Figure A1. The ratio of Opgaaf to consumption.**



I put these three elements together as follows. I take the Opgaaf returns of 1710-14 as my base level. Then I use the consumption model (now with a coefficient of 2 on population) to estimate the underlying output in each year; I reflate this using the Opgaaf seed/yield ratio to get gross output and I extract the trend. I apply the trend to my base level and then superimpose the fluctuations from the Opgaaf returns as follows. I take a nine-year rolling average of the Opgaaf returns and calculate the ratio of the central year to the average.<sup>25</sup> I then take my constructed series based on the consumption model and the benchmark of 1710-14 and multiply each year by the ratio that I estimate from the

<sup>25</sup> I progressively shrink the sample window in the early and later years of the sample in order that I can still estimate the ratio that I need even though there are fewer than nine years of data.

Opgaaf data. In figure A2 below I plot for each year my estimates of total output, the uncorrected Opgaaf data, and the Van Duin and Ross correction of the Opgaaf data.<sup>26</sup>

**Figure A2. Three estimates of total wheat output.**

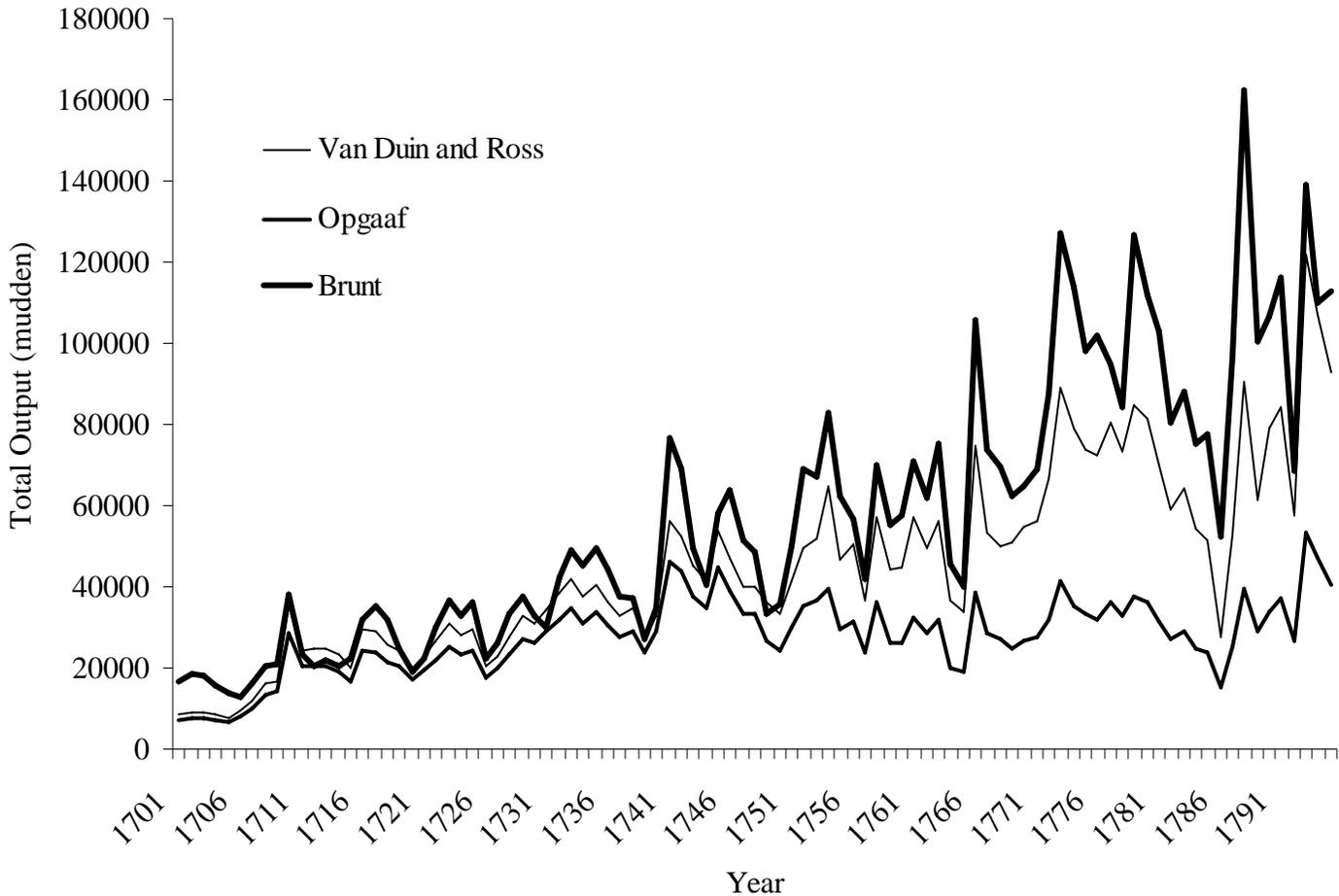


Figure A2 shows that my output estimates are somewhat higher than those of Van Duin and Ross, and much higher than the Opgaaf. The standard deviations of both my series and that of Van Duin and Ross are higher than that of the Opgaaf series, but this is only because the means are also higher: the coefficients of variation are the same, by construction.

The data for the period after 1795 are much more straightforward. The British seem to have collected fairly accurate data on agricultural output in the Cape colony, just

<sup>26</sup> I have added an estimate for bread corn to the Opgaaf totals for seed and marketed output: otherwise it would not reflect total output. The Van Duin and Ross estimates for total output are not available in *The Economy*; both table 2 in Appendix 7 and graph III.3 show only (marketed output + exports + shipping), and hence ignore on-farm consumption. Thus I have added on-farm consumption to their estimates, based on equation 2 above.

as they did in other colonies such as Canada, Australia and New Zealand. Hence we have annual data on wheat output for 1806-23, 1833, 1836-42, 1853-5, 1865 and 1875.<sup>27</sup>

**Appendix 3. Other arable outputs.** In order to estimate total arable output I need to estimate the output of the arable crops other than wheat. The Opgaaf returns give the same type of information for barley and rye that they give for wheat. For other arable crops there is no information at all available. I now consider each of these crops in turn.

Estimating rye output is particularly problematic because the importance of rye appears to be falling over time. The Opgaaf figures suggest that the output of rye was five times that of barley in 1701 (about 2 500 mudden) but had declined to zero by the late eighteenth century, by which time the output of barley had quadrupled. If I used a model of rye consumption analogous to my model of wheat consumption then the output of rye could never fall – it would have to rise in line with population because I would be multiplying population by a constant. Moreover, it is not clear how else I could hope to estimate the correct trend, since there was probably a change over time in the level of evasion (and hence the correction factor). Although the total output of barley was rising over time, it is noteworthy that it too was falling substantially in importance compared to wheat, suggesting that using a model based on population is unlikely to really get at the heart of the problem. I suggest that the best way forward in these circumstances is the following. Suppose that the level of evasion for barley and rye was the same as that for wheat. Then the proportions of wheat, barley and rye reported each year in the Opgaaf returns would be accurate, even though the levels would be too low. So I can estimate the total output of barley and rye by multiplying my estimate of total wheat output by the proportions of barley and rye in total grain output, as measured by the Opgaaf returns.<sup>28</sup> The results of this exercise are graphed in figure A3 below and reported in table A2 for the convenience of future researchers. The striking aspect of the graph is the unimportance of barley and rye compared to wheat, particularly later in the eighteenth century. This mirrors the declining importance of rye in England in this period.

The other arable crops that are potentially important are oats, peas and beans. The crop returns gathered by the English from 1806 onwards, which are fairly complete, suggest that oats were of very minor importance at the outset of the nineteenth century. In 1806 oats comprised only 4.0 per cent of the volume of output, and the trend was rapidly upwards.<sup>29</sup> This suggests that in the eighteenth century the importance of oats was probably close to zero. This is supported by two other pieces of evidence. First, the fact that oats never appeared in the Opgaaf suggests that the oat crop was not very large – otherwise it would have been taxed. Second, the Cape farmers relied a lot on oxen to power their farms, rather than horses, and oxen ate grass rather than oats. Hence the

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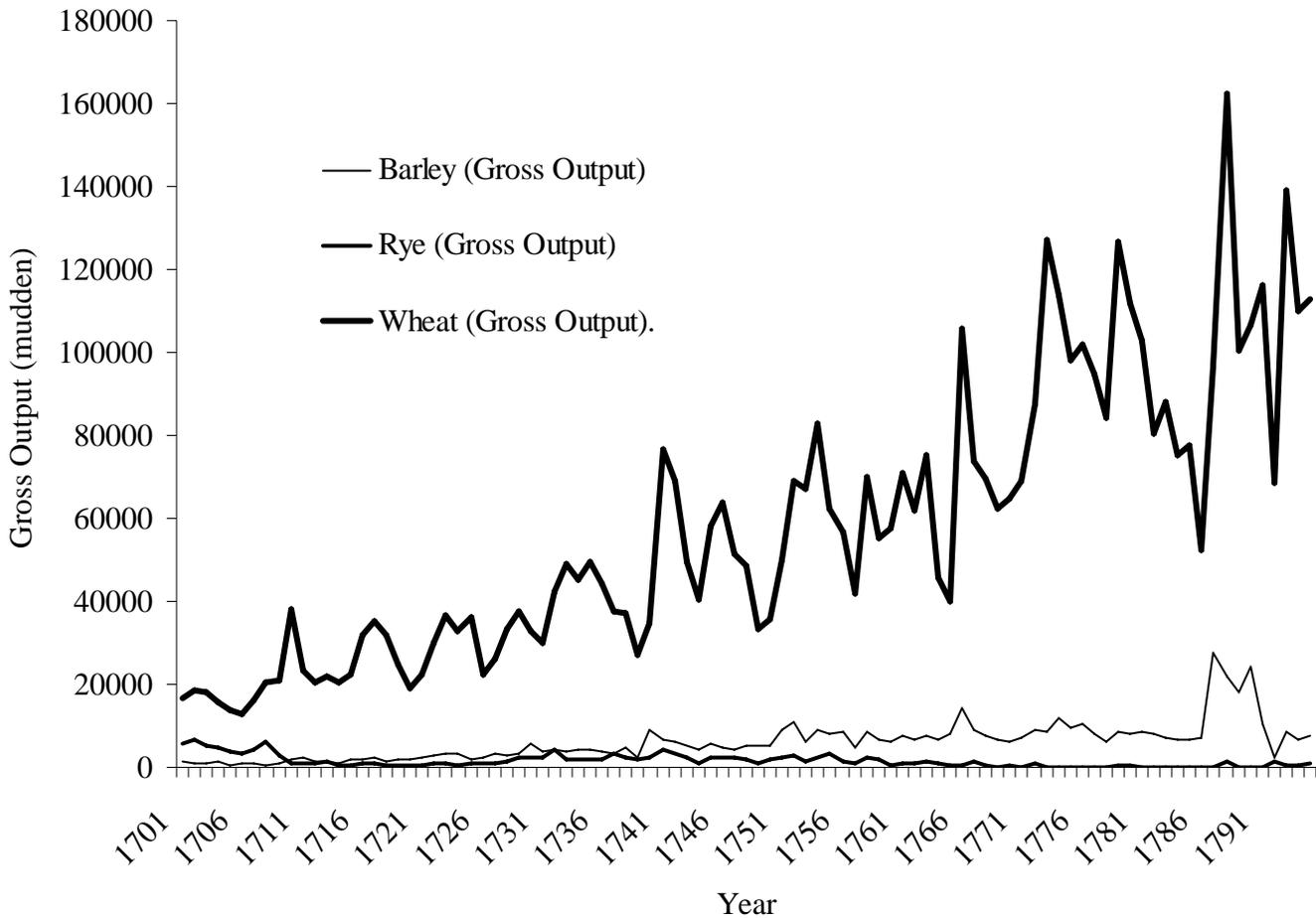
<sup>27</sup> Theal, *Records*, vol. 6, p. 75, p. 248, p. 442; vol. 7, p. 239, p. 477; vol. 8, p. 233; vol. 9, p. 48, p. 299; vol. 10, p. 228; vol. 11, p. 51, p. 238, pp. 438-9; vol. 12, pp. 128-9, pp. 414-5; vol. 13, pp. 354-5; vol. 14, pp. 246-7; vol. 15, pp. 198-9; vol. 16, pp. 488-9; British Parliamentary Papers, 1836, vol. 46, pp. 638-41, pp. 648-9; 1839, vol. 45, pp. 747-7; 1840, vol. 43, pp. 622-3, pp. 630-3; 1844, vol. 46, pp. 405-7, pp. 410-13; 1857, vol. 40, p. 293, pp. 300-1; Government of the Cape of Good Hope, *Blue book for 1874*, BB5; Government of the Cape of Good Hope, *Blue book for 1878*, Q8.

<sup>28</sup> I base my analysis on the data in Van Duin and Ross, *The Economy*, pp. 133-4. In the case of wheat, Van Duin and Ross, *ibid.* p. 33, argue that the “Reaped” category excludes seed and on-farm consumption; I assume that this is also the case for barley and rye.

<sup>29</sup> Theal, *Records*, vol. 6, 76.

demand for oats was likely to be very limited before the British arrived. Extrapolating the oat output data for 1806-23 backwards gives an estimated output of zero in 1803, and I assume that it was constant at that level for earlier years. The situation for peas and beans is similar to that for oats, with the modification that peas and beans seem to have been even less important and the first data do not begin until 1833.<sup>30</sup> At that point, peas and beans combined accounted for 0.4 per cent of arable acreage. Hence it seems reasonable to exclude them from our analysis of the earlier period and assume that the output was zero. The sources for the period after 1795 for barley, rye and oats are the same as for wheat.<sup>31</sup>

**Figure A3. Estimated gross output of wheat, barley and rye.**



<sup>30</sup> BPP 1836, vol.46, pp. 638-41, 648-9.

<sup>31</sup> Note that in 1853 the agricultural returns combined oats and rye, and in 1854-5 they combined barley and rye. The combined barley and rye output of 1854 is higher than the barley output of 1853 by 121 381 bushels; I therefore assume that rye output was 121 381 bushels in every year from 1853 to 1855 and back out estimates of oat and barley output accordingly.

**Table A2. My estimates of the gross output of wheat, barley and rye, 1701-1875 (bu).**

Year	Wheat	Barley	Rye	Year	Wheat	Barley	Rye	Year	Wheat	Barley	Rye
1701	48950	3923	17468	1752	204816	32101	7835	1803			
1702	54870	3270	19886	1753	198969	18203	4020	1804			
1703	54275	3071	15619	1754	246935	26850	7341	1805			
1704	47142	3617	14257	1755	185382	23658	9387	1806	410116	203403	62461
1705	40806	1637	11730	1756	168632	25122	4952	1807	352250	155815	74872
1706	37638	2985	9598	1757	123869	14645	2996	1808	381709	141926	10869
1707	47436	2774	13079	1758	208530	25519	6594	1809	595136	158190	13236
1708	60493	1312	18956	1759	164549	19802	5400	1810	369549	165237	15031
1709	62122	3349	9170	1760	171557	18956	1770	1811	390580	172283	11183
1710	113840	5700	2656	1761	210548	22113	2962	1812	514166	196296	5861
1711	69592	6812	3109	1762	183849	20446	2368	1813	403268	172638	7818
1712	60279	4709	3138	1763	223883	22098	3726	1814	356289	155546	5288
1713	65026	3821	3811	1764	136105	19950	2328	1815	553877	210813	12913
1714	60799	2946	1165	1765	118479	23454	2058	1816	558680	231666	13360
1715	66701	5525	936	1766	314844	42096	1034	1817	443440	202011	15393
1716	95463	5311	2633	1767	219745	26243	4434	1818	485764	192547	19982
1717	105009	7759	2251	1768	205968	22181	1961	1819	529310	202973	18633
1718	94255	4846	1897	1769	186042	19767	120	1820	574889	259592	23746
1719	73617	5087	1414	1770	192535	18432	719	1821	295045	208834	23401
1720	56201	5013	1216	1771	205400	20694	66	1822	249969	250233	30725
1721	66400	7468	1816	1772	259776	26743	2672	1823	415860	392696	109833
1722	89706	8167	2220	1773	378401	25224	706	1824			
1723	109498	9701	2960	1774	338592	35362	456	1825			
1724	97098	9278	2056	1775	291850	28598	283	1826			
1725	107699	6196	2198	1776	302292	30946	161	1827			
1726	66020	6396	2474	1777	282325	24725	386	1828			
1727	77857	9472	3362	1778	250427	18700	251	1829			
1728	98723	8953	3699	1779	376079	26134	1608	1830			
1729	111340	9230	7491	1780	332607	24448	733	1831			
1730	97939	16789	7564	1781	305032	25961	389	1832			
1731	89741	10780	7258	1782	238693	24118	0	1833	528147	286197	33432
1732	126459	12215	12978	1783	262325	21413	0	1834			
1733	145353	11123	6308	1784	223558	19667	306	1835			
1734	133986	13276	5848	1785	230227	19598	0	1836	466299	218409	34258
1735	146698	13287	5132	1786	155170	20869	0	1837	494280	220534	38464
1736	131983	11396	5667	1787	287816	82371	327	1838	463691	180847	29907
1737	112365	9814	9504	1788	482355	64504	3762	1839	395329	203323	32010
1738	110648	13731	7213	1789	299306	53102	515	1840	443454	244500	36471
1739	81266	7731	6366	1790	317550	72023	317	1841	471804	295718	46653
1740	102935	26849	6556	1791	345836	31175	702	1842	592054	271983	61027
1741	227409	19305	13149	1792	203302	7472	4453				
1742	205314	18476	10314	1793	413812	24950	1891	1847			
1743	146836	15422	7664	1794	326214	20481	2020				
1744	119869	13007	3290	1795	335892	22169	2770	1853	864272	302753	121381
1745	172716	17050	6473	1796				1854	1012488	302753	121381
1746	189262	14533	7069	1797				1855	994273	278856	121381
1747	153174	12391	6725	1798				1856			
1748	144002	15543	4956	1799							
1749	99615	15970	3051	1800				1865	1389766	308318	174071
1750	106517	16166	5168	1801							
1751	148434	26970	7727	1802				1875	1687936	447992	214260

**Table A3. My estimates of the gross output of oats, 1803-1875 (bu).**

Year	Output										
1806	28696	1814	136510	1822	242280	1830		1838	187860	1853	725139
1807	26856	1815	141131	1823	291439	1831		1839	185759	1854	925235
1808	74229	1816	140831	1824		1832		1840	167063	1855	2308777
1809	83864	1817	154825	1825		1833	237012	1841	215006	1856	
1810	95982	1818	153688	1826		1834		1842	286075		
1811	84773	1819	183135	1827		1835				1865	433342
1812	130316	1820	224838	1828		1836	241186	1847			
1813	108448	1821	210141	1829		1837	211535			1875	918494

**Appendix 4. Output prices.** Price data are more scarce than quantity data for the Cape colony in the eighteenth century, which is rather unusual in historical work. Van Duin and Ross give both the values and the quantities for a group of arable exports.<sup>32</sup> From this it is possible to infer export prices (since the price is simply the value divided by the quantity) and this is the approach that I have followed. I have some reservations concerning this approach because it is often the case that the level of export prices is not a good guide to the level of domestic prices, owing to factors such as a systematic price differential between locations involved in the export trade and locations where domestic consumption occurred. However, there are two points to note in this case. First, virtually all wheat in the Cape was sold in Cape Town and virtually all exports went from Cape Town; in that sense, the domestic and export markets were intimately linked and prices are likely to be the same in the two sectors. Second, export prices are likely to capture accurately the trend in prices even if they do not capture accurately the level of domestic prices; this is an important property when measuring changes in output and productivity over time, one of our main concerns in this paper.

There are two other problems with the export price data. The first problem is that the export value data (and hence export prices) are available only in the period 1749-93. However, a regression of export prices on a time trend reveals no significant trend; I therefore simply assume the price was constant before 1749 at the 1749 level. Whilst this will induce some error for any particular year, it is probably quite a good guide to prices on average. Notice also that the year-on-year variability of export prices is not excessively high, with a coefficient of variation of 0.35. The second problem is that we have export values only for a composite category called “All Grains and Pulses”. Thus the price that I calculate will actually be a mixture of the wheat, barley, rye, pea and bean prices. But I am going to use this as my estimate of the price of wheat (the major crop); this estimate of the wheat price will be completely accurate only if the price of wheat is the same as the prices of the other crops. If the prices of the other crops are higher or lower than the estimated wheat price will be biased upwards or downwards accordingly. However, whilst this is a problem in theory, it is not a problem in practice because wheat was effectively the only crop to be exported.<sup>33</sup> For example, pulses (that is, peas and beans) constituted only 3.7 per cent of the export category of “All Grains and Pulses” in the period 1749-93. Hence any biases will be extremely small.

The export data do not give any prices for barley and rye, so I estimate them. The first price data that we have are for the period 1833-55. I calculated the ratios of the

<sup>32</sup> Van Duin and Ross, *The Economy*, pp. 128-9.

<sup>33</sup> Van Duin and Ross, *The Economy*, pp. 129.

barley and rye prices to the wheat price. The ratios have no significant time trend and the year-on-year variation is quite low, with a coefficient of variation of only 0.16. Hence I simply assume that the price relatives for the eighteenth century were the same as the average price relatives for the period 1833-55, and hence I can estimate the absolute barley and rye prices from the wheat price. My estimates for each of the price series are reported in tables A4 and A5 below.<sup>34</sup>

**Table A4. Prices of wheat, barley and rye (English d/bu).**

Year	Wheat	Barley	Rye	Year	Wheat	Barley	Rye	Year	Wheat	Barley	Rye
1749	41	17	20	1789	120	50	58	1829	68	25	28
1750	47	19	23	1790	39	16	19	1830	69	26	28
1751	44	18	21	1791	36	15	18	1831	70	26	28
1752	45	19	22	1792	36	15	18	1832	71	26	29
1753	45	19	22	1793	36	15	17	1833	72	27	29
1754	42	17	20	1794	36	15	17	1834	73	27	29
1755	41	17	20	1795	36	15	17	1835	74	27	30
1756	41	17	20	1796	36	15	18	1836	75	27.5	30
1757	40	17	19	1797	37	15	18	1837	93	42	42
1758	40	16	19	1798	38	16	18	1838	100	54	42
1759	39	16	19	1799	39	16	19	1839	163	53	56
1760	40	17	20	1800	40	16	19	1840	103	34	57
1761	39	16	19	1801	41	17	19	1841	73	29	40
1762	11	5	6	1802	42	17	20	1842	76	36	35
1763	40	17	19	1803	43	17	20				
1764	42	18	21	1804	44	18	20	1853	96	48	60
1765	46	19	22	1805	45	18	20	1854	98	39	53
1766	40	17	20	1806	46	18	21	1855	90	37	49
1767	40	17	20	1807	47	19	21	1856	98	42	49
1768	40	17	20	1808	48	19	21	1857	106	46	49
1769	40	17	20	1809	49	19	22	1858	113	51	49
1770	36	15	18	1810	50	19	22	1859	121	56	50
1771	36	15	18	1811	51	20	22	1860	102	58	76
1772	36	15	17	1812	52	20	23	1861	120	61	76
1773	30	13	15	1813	53	20	23	1862	166	70	83
1774	31	13	15	1814	54	21	23	1863	164	72	87
1775	30	13	15	1815	55	21	24	1864	162	74	91
1776	28	12	14	1816	56	21	24	1865	161	76	96
1777	33	14	16	1817	57	22	24	1866	159	77	100
1778	36	15	18	1818	58	22	24	1867	157	79	104
1779	30	13	15	1819	59	22	25	1868	155	81	108
1780	31	13	15	1820	60	23	25	1869	153	83	112
1781	30	12	15	1821	61	23	25	1870	151	85	117
1782	38	16	18	1822	62	23	26	1871	150	87	121
1783	37	15	18	1823	62	23	26	1872	148	88	125
1784	36	15	18	1824	63	24	26	1873	146	90	129
1785	36	15	17	1825	64	24	27	1874	144	92	134
1786	37	15	18	1826	65	24	27	1875	123	73	100
1787	39	16	19	1827	66	25	27				
1788	36	15	17	1828	67	25	28				

<sup>34</sup> Figures in italics in table A3 are estimated by linear interpolation unless otherwise stated. In table A4 the prices for oat hay are in d/ton.

**Table A5. Prices of oats, oat hay, maize/millet, peas/beans, potatoes (English d/bu).**

Year	Oats	Oat hay	Maize/ Millet	Peas/ beans	Pots.	Year	Oats	Oat hay	Maize/ millet	Peas/ beans	Pots.
1836	23	32	46	66	37	1853	48		60	48	54
1837	41	70	52	74	38	1854	50		61	88	51
1838	54	109	79	91	60	1855	46		58	85	49
1839	39	106	85	100	61	1859	67		92	121	86
1840	34	63	53	89	45	1860	70		77	124	71
1841	26	62	46	79	43	1861	74		81	111	79
1842	37	65	55	84	47	1862	62		95	132	83
						1874	119		110	136	103

**Appendix 5. Acreages and yields.** From 1833 onwards we know the acreage in production of each of the major field crops. However, we do not have the acreage of fallow land (that is, land that is generally in production but is the resting phase of the crop rotation). Fallow land is important because a common way to increase the productivity of arable land was to reduce the amount of time that it was left fallow by introducing new types of crop. Thus failure to take account of fallow land could lead to errors in the measurement of productivity changes over time. Van Duin and Ross suggest that land was fallowed for two or three years after taking two grain crops, so I have therefore assumed that fallow land constituted 56 per cent ( $=2.5/4.5$ ) of total acreage. From 1833 onwards we know also the annual yield of each crop.

For the earlier years we know the total output of the major field crops but we do not know for any of them either the yield per acre or the acreage in production. However, over the period 1833-55 there was no significant increase in crop yields and it seems likely that the level of yields was similar in earlier years. I therefore assume that crop yields in the period 1701-1823 were the same as the average for 1833-42. Dividing the total output in each year by the assumed crop yields generates an estimate of the acreage of each crop. I then assume that fallow was 56 per cent of total acreage.

The data for yields and total acreage are reported in tables A6 and A7 below. The acreages of wheat, barley and rye individually can be calculated by dividing total output (to be found in table A1 above) by the individual crop yields. Note that the total arable acreage reported below is sometimes greater than the sum of the acreages of wheat, barley and rye because it incorporates the acreages of minor field crops such as peas, beans and tobacco. Note also that the acreage estimates are excessively volatile. This is because the true yield (and therefore the total output) fluctuated a lot from year to year, whereas my estimate of the acreage before 1833 is derived by dividing the fluctuating output by a constant yield. The acreage estimates are probably fairly accurate when averaged over any five-year period, but the estimate for any particular year could be significantly out.

**Table A6. Crop yields per acre (oat hay in lbs, all other crops in bu).**

Year	Wheat	Barley	Rye	Oats	Maize/ millet	Peas/ beans	Potatoes	Oat hay
1701-1823	6.18	10.01	5.48					
1833	4.24	7.04	2.58	4.77	4.02	4.49	13.09	97.50
1834								
1835								
1836	4.35	6.12	2.52	6.63	16.52	5.20	44.52	123.26
1837	6.16	7.45	5.80	5.79	8.94	9.41	11.53	95.87
1838	5.35	6.06	4.07	6.11	14.16	7.54	19.57	115.79
1839	5.28	9.46	5.78	5.55	10.91	8.56	40.54	194.81
1840	6.11	11.39	6.77	5.44	17.06	11.55	21.50	116.88
1841	6.92	12.90	6.55	7.07	15.05	11.80	21.91	235.45
1842	11.02	19.64	9.76	9.62	10.68	6.22	17.77	297.26
1853	5.61	11.26	7.64	6.63	9.23	4.61	13.73	461.42
1854	6.26	10.86	7.64	8.40	6.36	5.62	11.48	304.27
1855	6.35	11.36	7.64	20.13	5.68	5.16	15.39	369.56
1865	6.87	8.92	7.15	4.35	6.50	4.58	14.38	570.85
1875	8.96	15.35	4.99	8.01	8.47	7.46	41.22	817.41

**Table A7. Total arable acreage.**

Year	TOTAL	Year	TOTAL	Year	TOTAL	Year	TOTAL	Year	TOTAL
1701	25879	1728	39478	1755	76673	1782	92333	1818	439681
1702	28880	1729	45691	1756	69082	1783	100329	1819	483312
1703	26867	1730	42542	1757	49625	1784	85947	1820	555107
1704	23833	1731	38080	1758	84373	1785	88234	1821	370559
1705	20043	1732	54121	1759	66584	1786	61191	1822	381850
1706	18317	1733	58016	1760	67454	1787	123450	1823	603173
1707	23266	1734	54172	1761	82850	1788	191677		
1708	30106	1735	58509	1762	72510	1789	121131	1833	810879
1709	27138	1736	52945	1763	88016	1790	131946	1834	
1710	43822	1737	47023	1764	54998	1791	133219	1835	
1711	28147	1738	46337	1765	49258	1792	77533	1836	679141
1712	24295	1739	33942	1766	124527	1793	157059	1837	543184
1713	26101	1740	46209	1767	87732	1794	124212	1838	547991
1714	23278	1741	92542	1768	80787	1795	128423	1839	486756
1715	25913	1742	83146	1769	72233			1840	462964
1716	37035	1743	60079	1770	74543	1806	359090	1841	464486
1717	40904	1744	47921	1771	79467	1807	316589	1842	377396
1718	36188	1745	69379	1772	101696	1808	313565		
1719	28529	1746	75082	1773	143740	1809	446936	1853	1187382
1720	22090	1747	61319	1774	131422	1810	329438	1854	1247299
1721	26602	1748	57962	1775	112811	1811	335195	1855	1233988
1722	35411	1749	41114	1776	117091	1812	435218		
1723	43265	1750	44541	1777	108514	1813	353367	1865	1462074
1724	38285	1751	63283	1778	95490	1814	334583		
1725	41510	1752	85010	1779	143470	1815	473239	1875	1792570
1726	26492	1753	78190	1780	126903	1816	483368		
1727	31859	1754	98962	1781	117062	1817	416714		

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