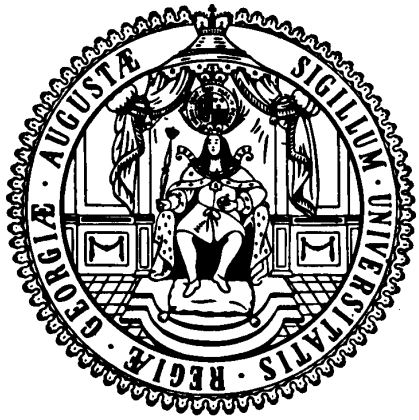
Ibero-Amerika Institut für Wirtschaftsforschung
Instituto Ibero-Americano de Investigaciones Económicas
Ibero-America Institute for Economic Research
(IAI)

Georg-August-Universität Göttingen
(founded in 1737)



Diskussionsbeiträge · Documentos de Trabajo · Discussion Papers

Nr. 119

The Colonial Origins of Inequality: Exploring the Causes and Consequences of Land Distribution

E.H.P. Frankema

October 2005

Platz der Göttinger Sieben 3 · 37073 Goettingen · Germany · Phone: +49-(0)551-398172 · Fax: +49-(0)551-398173
e-mail: uwia@gwdg.de · http://www.iai.wiwi.uni-goettingen.de

The Colonial Origins of Inequality: Exploring the Causes and Consequences of Land Distribution

E.H.P. Frankema

Groningen Growth and Development Centre
University of Groningen

October 2005

Abstract
Recent literature has pointed out that the historical distribution of assets is crucial in explaining the observed rigidity in post-war income inequality levels. This paper explores the causes and consequences of historical land distribution employing new and existing estimates of land inequality in cross-country OLS regressions. The two central questions addressed are 1) what explains the cross-country variation in land inequality at the end of the colonial period? 2) how does initial land inequality relate to current income inequality? It is shown that land distribution is determined by (colonial) institutions responding to relative factor endowments and natural geographic conditions as the disease environment and the feasibility to grow particular food- or cash-crops. Local conditions and institutional responses differed largely from region to region. Whereas the direct relation between initial land inequality and income inequality appears to be weak, controlling for (colonial) institutional variables reveals a strong relation between initial land inequality and current (1990's) income inequality. High levels of income inequality, specifically in Sub Saharan Africa and Latin America, are shown to have fundamentally different colonial origins.

JEL Classification Numbers: N30, N50, O15, P51

Keywords: colonial institutions, geography, factor endowments, land distribution, income distribution

The author wishes to thank Jan Pieter Smits, Bart van Ark, Marcel Timmer, Stephan Klasen, Denis Cogneau, Peer Vries and Jan Luiten van Zanden for their useful comments on earlier drafts.

Correspondence: Ewout Frankema, Groningen Growth and Development Centre, www.ggdc.net, Faculty of Economics, University of Groningen, P.O.Box 800, 9700 AV, Groningen, The Netherlands, *e-mail*: e.h.p.frankema@eco.rug.nl, tel. +31 50 363 3758, fax +31 50 363 7337

1 Introduction

In a survey of inequality literature Helpman concludes that "*although we can argue with limited confidence that inequality within a country slows growth, we can not say much about the channels through which this influence plays out*" (Helpman 2004: pp. 93-94). Lacking knowledge of the determinants of personal income inequality, the relationship between income inequality and growth is hard to underpin theoretically. The linear equation that is widely applied in regression studies is based on partial theory and responds weakly to empirical testing.[1] Research is further constrained by the lack of a comprehensive theoretical framework and scarcity of reliable data. Literature therefore has stressed the need to accumulate more compatible data (Deininger and Squire 1996, Atkinson 2002), to decompose personal income distribution into its functional income distribution components and to pay more attention to the historical distribution of assets (Atkinson 1997, Birdsall and Londono 1997).

This paper aims to contribute to this research agenda by exploring the historical roots of land and income distribution. An analysis of the historical determinants of land distribution deepens our understanding of the path dependent characteristics of inequality which in turn contributes to the analysis of the inequality-growth relationship. For this purpose I constructed a dataset including new and existing land distribution estimates for the 20th century. These estimates are analysed in an ordinary cross-country OLS framework. The two central questions addressed are 1) what explains the cross-country variation in land inequality at the end of the colonial period? 2) how does initial land inequality relate to current (1990's) income inequality?

There are various reasons to pay specific attention to land distribution. A practical advantage is that land distribution data can be derived from uniform standardised surveys which make them more compatible, both for spatial and temporal comparisons, than elaborate income distribution estimates (Deininger and Squire 1996, Li, Squire and Zou 1998). But there are important theoretical considerations as well.

The observed rigidity in post-war income inequality levels in a majority of countries indicates that path dependent factors are important. Initial levels of land inequality are a good candidate to reflect the initial conditions of inequality (Birdsall and Londono 1997, Deininger and Squire 1998). In pre-industrial societies land is the primary factor of production and naturally exerts large influence on income and profits. Moreover, land is an important object of wealth investments and the distribution of wealth is particularly persistent over time. Land can be inherited from generation to the next generation but geographically it is immobile. Factors such as labour, knowledge, machinery or ICT can be moved around, yet land can not. Land also depreciates at a slower pace than most other forms of physical and natural

[1] It is likely that levels of income inequality above and below a certain threshold are both negatively associated to growth. High levels of income inequality in Latin America result via various channels into suboptimal economic and social development (Worldbank 2004, Galor and Zeira 1993), whereas very low levels of income inequality, for example in former socialist states, are the result of distorting market interventions impeding on growth.

capital. All these characteristics contribute to an endured impact of land distribution on the distribution of income, assets and wealth (Worldbank 2004).

Taking the argument one step further back, the question becomes whether persistency in inequality can even be related to the determinants of land inequality? Does the historical distribution of land play a central role in the causality chain that shapes the current cross-country variation in levels of income inequality? What would this central role of land distribution look like? The ample historical literature focusing on land inequality in Latin America serves as a good point of departure to assess these questions.

During a period of more than three centuries (1492-1829) Iberian settlers reorganised the pre-Columbian system of agricultural production in order to generate surpluses and redirect labour to mining activities in Mexico and the Andes. Confronted with chronic shortages of labour the *encomienda* (right to taxation and labour tributes) was introduced to supply the large agricultural estates (*latifundias*) and the silver mines with indigenous labour. In the coastal zones of Brazil and on the Caribbean islands tropical cash crops such as sugar and coffee were produced on large scale capital intensive plantations. These plantations were mainly driven by African slave labour. The coexistence of Iberian *latifundias* and indigenous subsistence holdings polarised the distribution of land holdings. The presence of the Catholic church further enhanced this bi-polarity since the clergy bought and inherited land in order to materialize its position as a supreme religious authority (Engerman and Sokoloff 2005, Fernandez-Armesto 2003, Lal 1998).

Natural conditions and relative factor endowments shaped the Iberian strategy of colonial exploitation. The redistribution of land from indigenous peasants to the Creole elite was one of the key elements in this strategy. This colonial heritage subsequently impacted deeply on economic development and income distribution during independence (Engerman and Sokoloff 2005). Exploring the structural factors behind initial land inequality and today's income inequality are the focal point of this paper. For the time being, temporary fluctuations in income inequality as a result of for instance the business cycle or inflationary shocks are considered as part of the ceteris paribus condition.

In section 2 the data and land distribution estimates are discussed and compared to existing datasets. The cross-country variation in land inequality is presented and rudimentary explored. Section 3 provides a brief overview of regression literature in which the land distribution variable is included. In section 4 the hypotheses regarding the causes of land inequality and the relation between land and income distribution are discussed. In section 5 OLS regressions of land inequality are estimated. Section 6 deals with the relationship between initial land inequality and current income inequality. OLS regressions of income inequality are estimated. Section 7 provides a short afterthought on the relation between land inequality and economic development in Latin America. Section 8 concludes.

2 Land distribution: data, sample selection and first impressions

2.1 Data

Cross-country analyses including estimates of land distribution usually refer to two different data sources. The first is a dataset compiled by Taylor and Hudson (1972: pp. 267-269) consisting of 54 gini-coefficients of land distribution in different countries in some year close to 1960. The second dataset was introduced more recently by Deininger and Squire (1998) and consists of 261 gini-coefficients of 103 different countries, of which, so far, 60 different country observations around the year 1960 have been published (Deininger and Olinto 1999: pp. 24). Both datasets mainly rely on the data provided by the *FAO World Census of Agriculture*.[2]

The dataset I constructed for this paper is based on census data from the International Institute of Agriculture (IIA) and the FAO as well. The estimates of land inequality are presented in table A.1 in the appendix. In this table the figures of Taylor and Hudson and Deininger and Olinto (T&H and D&O hereafter) estimates are also included in order to compare. From ca. 250 observations 186 gini-coefficients and theil-coefficients[3] relating to 105 different countries were selected for the dataset (which I will refer to as the Frankema estimates hereafter).

A correlation analysis of the three datasets is presented in table 1. The matrix shows that the D&O and Frankema estimates correlate substantially better than any of these two correlates with the "older" T&H estimates. Although the D&O and Frankema estimates correlate better a correlation-coefficient of 0.90 still leaves room for substantial differences. How can these differences be explained?

Table 1: Correlation of three datasets of land gini's around 1960

	Deininger & Olinto	Taylor & Hudson
Frankema	0,90	0,78
Taylor & Hudson	0,79	1,00

Sources: Taylor and Hudson (1972: pp. 267-269) Deininger and Olinto (2001: pp. 24)

Part of it might be explained by the method employed to calculate the gini-coefficient. The Frankema estimates are based on decile shares as presented in an example calculus in table A.2 (appendix). For the D&O estimates the exact formula and breakdown in shares is not reported. Also the exact year of reference is not reported in the D&O paper, which might also explain part of the gap. Another possibility is that the underlying source data have passed through several revisions or adjustments within the FAO. The estimates D&O present are based on inside sources provided by the FAO to the authors.

In order to calculate a gini-coefficient or a theil-coefficient of land distribution on a national level one needs to combine information regarding the total amount of

[2] This census has been initiated in 1924 by the International Institute of Agriculture (IIA) in Rome. This institute preceded the FAO, which was founded after the Second World War. The World Census of Agriculture has been executed each decennium since the 1930's, with the exception of the 1940's (due to the war).

[3] Gini and Theil. R^2 is 0.98X

agricultural land (excluding communal pastures and forests), the total number of land holdings (farms) and the total amount of land per farm. Although the agricultural surveys of the FAO are rather straightforward, which enhances the spatial and temporal comparability of land inequality estimates, these requirements are not always met.

First of all it should be pointed out that the estimates refer to the distribution of *land holdings*, meaning the disposable amount of land per farm, which is not the same as the land *owned* by the farmer. Land property is generally more unequally distributed than land holdings, depending on the share of land under tenure. The distribution of land holdings may serve as a lower benchmark of the land property distribution, although there is no need to interpret land inequality estimates this way. The distribution of land holdings itself is a clear analytical concept since it captures the "access" to land as a production factor, rather than the more passive distribution of ownership of land as a wealth investment. A limitation of both concepts is that differences in land quality are not taken into account and there is little that can be done to correct this.

Several surveys provide an incomplete coverage of agricultural land or an incomplete coverage of land holdings. For this reason more than 60 observations had to be excluded from the dataset.[4] Around one-third of these were excluded because surveys did not make a distinction between communal land holdings and single private land holdings. Indeed, the estimated land gini's of socialist Eastern European countries in the 1970's and 1980's (see also Deininger and Squire 1998: pp. 266) display extreme land inequality since private small-holders and communal holdings are both counted as individual farm holdings. In fact, these gini's do not properly reflect the inequality of "access" to land and therefore had to be excluded.[5] This problem also occurred in the case of the *ejidos*[6] in Mexico.[7]

An important distinctive feature of the dataset presented here concerns a considerable amount of pre-war estimates derived from the reports of the International Institute of Agriculture (IIA). These "early" observations are necessary to improve the sample used in regressions of land inequality, as I will explain in the next paragraph.

[4] a) Some surveys only include cropland and exclude pastureland. Usually this sample bias applies to countries with a minimal share of pastureland or, countries in which pastures are part of communal estates and therefore not subject to a personal distribution measure. FAO statistics also provide statistics on crop and livestock production, which enables an evaluation of the validity of the surveys that are exclusively based on cropland. In Chad and Botswana the exclusion of pastures in the sample lead to a misrepresentation of livestock production and these countries are therefore excluded from the data set. Also Madagascar and Malawi are excluded because of incomplete coverage. b) In some cases farms are differentiated into traditional indigenous household holdings and European holdings, reflecting the traditional colonial categorisation of land holdings. Surveys taking only one category into account will underestimate actual land inequality For this reason Zimbabwe and Tanzania a.o. are excluded. For Zambia (1960) and Congo (1990) one observation is rejected, yet an alternative observation is accepted.

[5] In the Deininger and Olinto paper former communist Eastern European countries are excluded, but in the study by Deininger and Squire (1998) the East European land gini's are used in an inequality-growth analysis which undoubtedly impacts on the results.

[6] Communal land holdings operated by a group of indegenous farmers.

[7] However, since Deininger and Olinto (2001) obtain estimates of Bolivia, Madagascar, Mexico and Tanzania and Taylor and Hudson (1972) obtain estimates for Luxembourg and Libya I either missed or are more plausible than the estimates I excluded, these estimates are used to complement the regression sample.

2.2 Two samples

The first sample I constructed is referred to as the *1960 sample* and includes 93 countries with an observation in the period 1950-1975. This sample can be used to compare land inequality between countries in a relatively constrained period of time. The second sample is referred to as the *extended sample* and consists of 111 country observations, distributed over the entire twentieth century. This sample includes for each country seperately the land inequality estimate closest to its year of independence and for non-colonial countries the earliest year available. For the majority of Asian and African countries this means an estimate of land inequality around 1960. For most New World countries the ideal benchmark year however refers to the late eighteenth, nineteenth century or early twentieth century. For the majority of these countries the required data is simply unavailable.

How to tackle this problem? The early pre-war observations for New World countries probably reflect the impact of colonial land distribution better than a 1960 benchmark. These observations precede most of the substantial structural changes in land distribution during the twentieth century and in most countries temporal changes in land inequality are small anyway[8] (Li, Squire and Zou 1998). Historical evidence for Latin American countries suggests that major changes in the distribution of land during the nineteenth and twentieth centuries hardly occurred (Engerman and Sokoloff 2001, Worldbank 2004). This rigidity is indeed perfectly illustrated by the time-series data for Argentina, Brazil and Chile in table A.1. Therefore I do not expect that the Latin American estimates pose a real problem.

More insecure are the USA, Canada, Australia and New Zealand. Fortunately, for all of these countries there is an early twentieth century observation available (resp. 1910, 1931, 1910 and 1910). The question is to what extent these estimates reflect the level of land inequality as it took shape during the colonial era? Australia and New Zealand became formally independent shortly after the turn of the century (resp. 1901 and 1907), which minimizes our problem. For the USA (1776) and Canada (1867) I consulted the inequality-index constructed by Adelman and Taft Morris (1988) for the year 1850. Land gini's of 57,1 (USA) and 48,7 (Canada) fit rather well into their conclusions on the wealth distribution of both countries. Perhaps the estimates are a little too high, almost certainly not too low. However, until better estimates become available these figures will be taken for granted.

The extended sample is thus composed of all available post-war observations for Asian and African countries, whereas for the New World countries the earliest available observation is included. For countries without a colonial past (i.e. European, China and Japan) also the earliest observation available is included. This sample gives in my view the best possible reflection of cross-country variation in land inequality during periods of colonisation. I expect the effects of technological and organisational modernisation on the value of the land gini and land theil to be of subordinate importance. Nevertheless thee regression results should always be interpreted with this "ceteris paribus assumption" in mind.

[8] Li, Squire and Zou concluded from an anlysis of variance (ANOVA) that more than 90% of the variation in land inequality is due to cross-country variation and less than 10% due to temporal variation.

2.3 First impressions

What does a first glance at the data reveal? Table 2 presents uncompounded averages of land gini's from the 1960 sample (first column) and the extended sample (fourth column) for 13 regions in the world. Furthermore, the variation within the region is expressed by the coefficient of variation in the second and fifth column, whereas the third and sixth column denote the amount of observations. This regional comparison brings up some interesting questions concerning the causes and consequences of land distribution, which will be briefly addressed.

Table 2: Uncompounded regional averages of land gini's and intra-regional variation (*CV = Coefficient of Variation)*

	1960 sample (1950-1975)			extended sample (20th century)		
	Gini	CV	No. Obs.	**Gini**	CV	No. Obs.
East Asia	**36,5**	0,14	3	**38,4**	0,14	4
South Asia	**53,7**	0,16	6	**53,7**	0,16	6
South East Asia	**49,8**	0,26	6	**47,9**	0,24	8
North Africa and Middle East	**66,9**	0,11	9	**65,1**	0,11	12
South and East Sub Saharan Africa	**64,3**	0,26	10	**62,7**	0,28	12
West and Central Sub Saharan Africa	**47,1**	0,19	11	**45,2**	0,20	14
South America	**82,1**	0,04	10	**79,9**	0,08	11
Central America	**72,3**	0,08	7	**72,3**	0,08	7
Caribbean	**68,3**	0,17	7	**68,1**	0,17	7
Western Offshoots	**68,0**	0,18	4	**64,5**	0,22	4
Western Europe	**60,0**	0,17	14	**63,9**	0,16	14
Eastern Europe	**.**	.	2	**49,3**	0,15	8
Scandinavia	**40,8**	0,17	4	**51,0**	0,19	4
World	**60,9**	**0,25**	**93**	**59,8**	**0,25**	**111**

East Asia: China, Japan, Korea. Rep, Taiwan; **South Asia**: Bangladesh, India, Iran, Nepal, Pakistan, Sri Lanka; **South East Asia**: Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam. **North Africa & Middle East**: Algeria, Cyprus, Egypt, Israel, Iraq, Jordan, Kuwait, Libya, Morocco, Syria, Tunisia, Turkey; **East & South Sub Saharan Africa**: Botswana, Ethiopia, Madagascar, Mauritius, Mozambique, Kenya, Lesotho, Reunion, South Africa, Swaziland, Tanzania, Zambia; **West & Central Sub Saharan Africa**: Burkina Faso, Cameroon, Central African Rep., Cote d'Ivoire, Ghana, Guinea, Liberia, Mali, Niger, Senegal, Sierra Leone, Togo, Uganda; **Western Offshoots**: Australia, Canada, New Zealand, USA; **Western Europe**: Austria, Belgium, France, Germany, Greece, Ireland, italy, Luxembourg, Malta, Netherlands, Portugal, Spain, Switzerland, UK; **Eastern Europe**: Czechoslovakia, Estonia, Latvia, Lithuania, Poland, Romania, Slovenia, Yugoslavia,

The table reveals that the four East Asian countries (South Korea, Taiwan, Japan and China) are among the world's most egalitarian. Ranking all countries from low to high land inequality in the extended sample, South Korea ranks 2, Taiwan 9, Japan 12 and China 20. With the exception of China, the East Asian countries are known for having realised "growth with equity". In literature it is argued that land reforms dismantled the power of landowning elites paving the way for more equitable distributions of assets and income. The dramatic decline (from 53.9 in 1920 to 39.0 in 1960) in the Taiwanese land gini illustrates the impact of the land reforms carried out

during Japanese colonial rule (Fei, Ranis and Kuo 1979, Worldbank 1993, Frankema and Smits 2005).

South Asian and South East Asian land holdings are more skewed and the intra-regional variance is quite large in South East Asia. Land inequality in Malaysia is exceptionally high for Asian standards with a gini of 68.0, which may be pointing at the impact of its large (colonial) rubber economy. Another typical rubber economy, Sri Lanka, is also at the high end with a gini of 62.3. On the lower end we find the labour abundant rice economies such as Bangladesh (41.7) and Laos (38.2). These figures suggest that relative factor endowments (ratio of labour to land) and crop specialisation (rubber, rice) indeed influence the distribution of land.

The intra-regional differences in Sub Saharan Africa are also large. A rough distinction can be observed between South and East Africa versus West and Central Africa: Kenya, Tanzania, Zambia and South Africa are particularly unequal, whereas on the other hand Mali, Burkina Faso, Cote d'Ivoire, Niger and Senegal display land gini's that are far lower than the world's average of 59.8. This categorization does not hold in detail however, since land inequality in Mozambique is much lower than in Liberia for instance. But the general picture of and East-West demarcation is rather obvious and becomes even more visible when West and Central Africa is compared to the high levels of land inequality in North Africa and the Middle East.

The extraordinary high levels of land inequality in Latin American countries appears to be part of a coherent regional pattern. In spite of the differences between the South American, Central American and Caribbean averages, together these three regions display the world's largest inequality in land holdings. In the previously mentioned country ranking the bottom 20 includes 16 Latin American countries! The assertion in the literature that there is a "Latin" effect in Latin American inequality (Worldbank 2004) is fully supported by these figures, with the sole exception being Haiti.

The four Western Offshoots (USA, Canada, New Zealand and Australia) are typical land abundant immigrant countries. It should be noted that the levels of land inequality in the Pacific countries and the North American countries differ largely, flawing the average. These countries have also witnessed quite substantial changes in the distribution of land during the twentieth century. The USA started out at considerably lower levels of land inequality which gradually went up due to large transformations in the scale of production. In relatively equal Canada and relatively unequal Australia, land holdings also became more unevenly distributed. In New Zealand on the other hand, initially high land gini's decreased gradually.

Finally, European intra-regional variation is large, although a rough East-West as well as rough North-South distinction can be made. East European countries and Scandinavian countries are comparatively equal as compare to the highly skewed Catholic countries Spain, Portugal and Italy. Indeed, it is remarkable that land inequality in the former Iberian colonial motherlands is just as high as in a average Latin American country. It is hard to distinguish a trend in land distribution during the twentieth century. Most European countries started out with higher levels of land inequality declining a bit during the century, in spite of tendencies promoting land consolidation, scale economies and mechanisation.

3 Literature assessing land distribution

What role does cross-country variation in land inequality play in the literature? The focus of this section is on regression studies that incorporated the land distribution variable to serve as a proxy for the initial distribution of assets and wealth. Later on, at the end of section 6 I will discuss the question whether land inequality estimates actually are a good proxy for asset inequality.

A major benchmark in this field is the study by Alesina and Rodrik assessing the role of distributive politics (1994). The paper applies the median voter theorem to argue that higher levels of income inequality result in higher demands for income redistribution. The request for redistribution by the "poorer" part of the voters raises taxes which distort the proper functioning of markets. So initial inequality leads to slow growth via the political market. This argument is underpinned by empirical results showing that inequality in initial wealth and income is both negatively correlated with subsequent economic growth.[9] Alesina and Rodrik derive land gini's around 1960 from Taylor and Hudson (1972). Based on the same data Persson and Tabellini (1992) also demonstrate in an OLS framework that land inequality is negatively related to growth.

Birdsall and Londono (1997) argue that the initial distribution of assets is a more important characteristic of the economic structure than the distribution of income. The asset distribution directly impacts on the economic process of resource allocation, whereas income merely reflects the outcome of this process. In particular the initial distribution of education and land are shown to be related significantly to growth, outweighing the effects of initial income inequality.[10] The conclusion is in line with the paper by Galor and Zeira (1993) in which it is argued that limited access of the poor to education and capital markets as a result of initial asset inequality constrains the growth potential (see also Galor, Moav, Vollrath 2003).

Research stressing the importance of asset distribution as a fundamental characteristic of a countries economic structure gained momentum by several papers based on more recent land distribution data, i.e. Deininger and Squire (1998), Li, Squire and Zou (1998) and Deininger and Olinto (1999). In these papers land gini's around 1960 again serve as a proxy for initial asset inequality. All three papers find that there is a significant negative effect of historical land inequality on long run economic growth. In line with Birdsall and Londono (1997) the results suggest that the estimated negative effects of initial asset inequality on growth are much stronger than the estimated effects of income inequality. The insignificance of income inequality in growth regressions has been further underlined by panel data studies that report hardly any or even a slightly positive effect of income inequality on growth (Barro 2000, Forbes 2000).

If initial asset inequality matters indeed, it also raises new questions. Why would asset inequality impact on growth and income inequality not? In other words,

[9] Alesina and Rodrik do not show that there is a direct positive relation between land inequality and the level of taxation. My own calculations show that the correlation-coefficient between land inequality and an index of the fiscal burden derived from ICRG (International Country Risk Guide) is negative, respectively -0,20 (1960 sample) and -0,12 (extended sample). This resutl contradicts the prediction of the theory put forward by Alesina and Rodrik.

[10] Birdsall and Londono do not reveal the source of their land distribution data, but I guess they use the Taylor and Hudson data.

is there no relation between asset and income inequality? Perhaps, the distribution of land holdings around 1960 is not a good proxy for initial asset inequality? What is the relative weight of land in total asset distribution? Deininger and Squire (1998) find that the correlation-coefficient between historical land gini's (1960's) and current income gini's (1990's) is 0.39. (see also Deininger and Olinto 1999). The correlation-coefficient I estimate in section 6 is even lower ranging from 0.19 to 0.23. Why is the correlation between initial asset inequality and subsequent income inequality so weak?

From a theoretical point of view at least three effects of initial land inequality on subsequent income inequality can be distinguished. First, there is a direct income effect of the distribution of land holdings on the distribution of agricultural income. The extent of this effect is positively related to the share of agriculture in GDP. Obviously, in pre-modern economies the distribution of land holdings has a profound effect on income distribution which gradually declines as economies industrialize.

However, investments in agricultural land may be reallocated without necessarily becoming redistributed. The poor need collateral assets, of which land is of prime importance in agricultural societies, to get access to capital loans. In a context of imperfect capital markets, initial land inequality can pose barriers to individual entrepreneurship or investments in human capital. Without government intervention and the supply of public goods this may lead to the persistence of asset and income inequality (Galor and Zeira 1993, De Soto 2000).

A third, indirect, but persistent effect of land inequality on income inequality relates to institutions that have caused land inequality in the first place. If institutions responsible for high land inequality in a pre-modern agricultural society remain in tact during periods of fundamental structural change, the distribution of income will be less responsive to economic dynamics. Given the initial concentration of political and economic power, predatory behaviour is backed by policies suppressing democratic accountability and social development (Olson 2000, Hall and Jones 1999, Bourguignon and Verdier 2000). In the work of Engerman and Sokoloff it is convincingly demonstrated that in comparison to the USA and Canada the investment in public education and the extension of the franchise developed much more slowly in Latin America (Engerman, Haber and Sokoloff 2001, Mariscal and Sokoloff 2000).

Theory thus predicts a strong positive relation between initial asset inequality and subsequent income inequality, but empirical analysis shows this relation is rather weak. Part of this puzzle can be resolved by looking into the historical causes of land distribution more carefully before we turn to the relation between land and income distribution in section 6.

4 The determinants of land inequality: geography, factor endowments and colonial institutions.

The various potential determinants of land distribution that can be derived from the literature can be roughly categorized into three factors. 1) geographic conditions or natural endowments, 2) factor endowments, i.e. the land-labour ratio, and 3) (colonial) rule and institutions. I will discuss these factors in this order.

1) The feasibility to produce particular crops may impact on land distribution via the realisation of technical and organizational scale efficiencies. Testing the hypothesis of Engerman and Sokoloff that "*land endowments of Latin America lent themselves to commodities featuring economies of scale and the use of slave labour*", Easterly concludes that a natural environment suitable to cash-crop production is associated with high levels of income inequality in the long run (Easterly 2002; pp. 3-4, Engerman and Sokoloff 1997). Cash crops such as coffee, cocoa, sugar, rubber and bananas can be produced on large land estates and may require the employment of land and capital intensive production methods. The coexistence of scale intensive holdings and small subsistence holdings skews the distribution of land. (Leamer et. al. 1999, Easterly and Levine 2003).

From similar reasoning follows that specialisation in scale neutral food crops has an equalizing effect on the distribution of landholdings. Major foodcrops such as wheat and maize were historically produced on plots of modest size, whereas rice and millet were and are produced on very small plots of land (Hayami and Ruttan 1985). The hypothesis that can be formulated on the basis of this argument is that countries with natural endowments (soil, climate, water supplies) suitable to growing scale intensive cash crops are likely to have higher levels of land inequality. Since tropical climates generally allow for a larger variety of cash crop production than temperate climates, the geographic position of a country on the globe may also affect the distribution of land.

2) Relative factor endowments shape the relative cost-structure of agricultural production and determine its organizational constraints. Land abundance is likely to invoke land biased, labour saving production methods favouring crops subject to economies of scale. This complements the argument that qualitative land endowments determine the choice for crops and production methods (Easterly 2002). However, the land-labour ratio may also influence institutional developments.

Domar (1970) argues that in (pre-modern) agricultural societies elites face the problem of recruiting sufficient labour to toil their soil. In land abundant countries landless labourers have an opportunity to start farming for their own at the land frontier. In response to conditions of labour scarcity and land abundance the landowning elite tends to develop coercive institutions regarding the markets for labour and land. Slavery and serfdom are examples of such coercive institutions (Domar 1970, Demsetz 2000).

An alternative strategy is to distribute unexploited land resources among the elite or specify property rights conditions in order to restrict access to land of smallholders and landless labourers. In land scarce, labour abundant countries on

the other hand elites are able to extract rents from taxes and trade margins without having to intervene directly into the production process. All these arguments support the hypothesis that low levels of labourdensity create incentives to redistribute land in such a way that it enhances land inequality.

3) The third set of forces directly relates to colonial rule and institutional development. Acemoglu, Johnson and Robinson (2001) demonstrate that the extent of colonial settlement and the characteristics of colonial rule are determined in response to the local natural environment. In areas less favourable to colonial settlement, i.e. with a high disease incidence, institutions were created to extract agricultural or mineral resources from a distance. A strategy of predation induced the development of weak property rights as compared to settler colonies in which institutions were moulded according to the institutions in the motherland and directed towards accumulation of capital and skills. Indeed, the height of settler mortality rates during the colonial era is strongly negatively correlated with the quality of institutions in presently independent countries.

Can the distribution of land be regarded as part of a colonial settlers strategy? Engerman and Sokoloff (1997) argue in favour by pointing at the different style of colonisation in British America versus Latin America. Agriculture in British America became organized around a homogenous group of individual European farmers involved in foodcrop production (wheat) on medium-scale farms. Except for the slave plantations in the Southern states, the equal distribution of land was part of a strategy to attract European settlers to the land frontier and develop the New World. The Iberian colonists on the other hand basically formed a minority in a strange heterogeneous society. The active redistribution of land was part of their strategy to vest and maintain economic and political control. They developed coercive institutions in order to control the scarce sources of indigenous and slave labour. The distribution and organization of land holdings can be regarded as the result of "cooperative" institutions in a typical "immigrant colony" such as British America, and "coercive" institutions in the "settler colonies " of Latin America.

Yet, in areas where settler mortality rates were nearly prohibitive to settlement, the distribution of land was much less of an issue. In the hostile disease environment in West and Central Africa colonists hardly settled. In stead, the British, French, Belgian and Portuguese governments set up institutions to extract rents from natural resources via taxation (Young 1994, Manning 1988). However, in their efforts to raise taxes and increase exports of raw materials colonial governments made use of the traditional rural institutions that were in place at that time, rather than reform these. Given the lack of central political institutions in vastly underpopulated areas, the colonial rulers in fact had little alternatives than to rely on existing fragmented political structures to organise the collection of taxes (Stavrianos 1981, Ayittey 2005). Colonial institutions were devised to control from above rather than penetrate into the daily life and practices of production.[11]

[11] Based on new estimates of historical national accounts for Africa Smits (2005) shows that, in spite of the excessive tax burden the agricultural GDP kept growing. In the long run however, and particularly after the severe shocks in terms of trade in the 1970's, continuous taxation became a burden for further agricultural development (Smits 2005).

Finally, Lal (1998) points out based on a study by Goody (1983), that the nature of inheritance laws may determine the distribution of land in the long run. Goody argues that at the time the Catholic church became institutionalised (4th century A.D.), it devised inheritance laws to support the accumulation of land by the church. The crucial rule was that only a legitimate son was entitled to inherit the land of his parents and in his absence the land fell to the church. Goody shows that the church prohibited polygamy and kinship marriages, and promoted core-family values placing restrictions on sexual intercourse. All these measures reduced the birth rate and consequently the amount of legitimate male heirs.

Lal argues that the presence of the catholic church has added to the historical evolution of inequality in Latin American countries. In fact, if land inequality is persistent indeed, all countries in which the Catholic church has been a factor of importance should be characterised by comparatively high levels land inequality. Table A.1 reveals that apart from Latin American countries, typical Catholic countries in Europe such as Italy, Spain, Portugal, Austria and Belgium are also among the most unequal.

5 The determinants of land inequality: estimating an OLS[12]

In this section the hypotheses developed in section 4 are analysed by means of an ordinary cross-country OLS. The OLS estimates the cross-country variation in the gini and the theil-coefficients of land holdings in the extended sample (introduced in section 2). The variables are listed in table A.1 and denoted as respectively LANDGINI and LANDTHEIL. The estimated equation is specified as $y = \alpha + x' + y' + z' + \varepsilon$, in which y refers to land inequality, α is a constant and ε is an error term capturing the effects of data-errors, omitted variable bias, functional misspecification etc. The vectors x, y and z respectively capture the effects of geographical conditions, relative factor endowments and colonial institutions. First the explanatory variables will be further clarified, followed by a correlation analysis relating the individual explanatory variables to land inequality (table 3), and finally the OLS results will be discussed (table A.3 appendix).

Geographical conditions

Comparative advantages in the production of scale intensive cash crops can be measured in various ways. Two crude proxies of natural suitability to tropical cashcrops used in literature are the absolute latitude of countries scaled between 0 and 1 and the mean annual temperature, denoted respectively by LATITUDE and MEANTEMP (McArthur and Sachs 2001).

Easterly (2002) uses indicators of land use (percentage share of land *actually yielding* a specific crop) and climatic and soil characteristics (percentage share of land that is *suitable* to growing a specific crop). The land use measure is problematic because of it may be endogenous to the distribution of land. The suitability of land to grow particular crops however is an exogenous variable. The FAO provides data on land suitability for SUGAR (cane), BANANAS, COTTON, RICE, MAIZE and

[12] All the data used in the regressions can be obtained from the author in an excelfile.

WHEAT. For COFFEE, COCOA and RUBBER the FAO only provides land use data. The latter three crops are therefore included as dummy variables with a value 1 if countries devote more than 1% of their agricultural land in 1960 to the specific drop and also have a historical record as net exporter of this crop. Trade data are derived from Mitchell's *International Historical Statistics* (2003).

In addition I include a CASHCROP DUMMY to separate all countries that have a natural relative advantage in scale intensive cashcrop production from those that have a relative disadvantage. The dummy is set at 1 if countries produce at least one of the following crops, i.e. bananas, cocoa, coffee, rubber or sugar, and also have more than 10% of total agricultural land suitable (or actually devoted) to growing one or more of these five crops.

Colonial factor endowments

The ratio of labour to land, i.e. relative labour density, during the colonial era is estimated by taking the log of the number of inhabitants per square kilometre of productive land in one of three benchmark years, i.e. 1700, 1800 or 1900. This estimate reflects the potential (rural) labour force excluding those parts of the land surface covered by deserts or mountains that are not fit to cultivation. As the period of European settlement in other regions of the world stretches approximately from 1500 to 1975 the main problem is to choose a year that represents relative factor endowments at the time colonial rule is being implemented. In New World countries the year 1700 or 1800 reflect colonial land-labour ratios better, whereas in African countries and most Asian countries the year 1900 is preferred. Obviously, such a flexible measure just provides a crude indication of relative factor endowments colonial settlers faced, but it precludes the effects of the world wide demographic transition in the twentieth century. Moreover, the lion-share of the variation in relative factor endowments is related to spatial rather than temporal variation. Square kilometres of agricultural area are from Taylor and Hudson (1972: pp. 303-305) and population estimates for 1700, 1800 and 1900 are from Mcevedy and Jones (1978). The variable is denoted as LABOURDENSITY.

Colonial institutions

Acemoglu et.al. (2001) use the log of historical settler mortality rates as a proxy for settler conditions. In this paper the variable SETMORT is specified in the quadratic form to account for the distinction between areas with favourable settler conditions and areas with the most favourable settler conditions. Indeed the latter became in fact immigrant colonies rather than settler colonies, with a relatively equal distribution of land and a marginalised indigenous population.

The impact of the ethnic composition of countries on institutional development and the distribution of land as such can not be represented by the commonly used indicator of ethnic fractionalisation, since this measure does not account for the distinction between indigenous and non-indigenous people, which is crucial. Therefore a dummy is included with a value 1 subject to two conditions: at least 10% of the population is of former European origin and at least 20% of the population is of either indigenous or non-European origin. I denote this variable as

the CREOLE DUMMY. Data on ethnic composition are derived from CIA World Factbook.

The impact of the Catholic church on the distribution of land is captured by taking the log of the percentage share of the population that is considered to adhere to Catholicism in or close to the year 1965 (Taylor and Hudson 1972). The variable is denoted by CATHOLICISM65.

In Table 3 pairwise correlation-coefficients of the explanatory variables with the two indicators of land inequality are reported. These figures provide a first indication of the relative importance of natural endowments, factor endowments and colonial institutions as well as a check whether signs are in line with the formulated hypotheses.

Table 3: Correlation of land inequality

	LANDGINI	LANDTHEIL
LATITUDE	-0,01	-0,11
MEANTEMP	-0,03	0,05
CASHCROP Dummy	0,32	0,38
BANANAS	0,20	0,24
COCOA Dummy	0,12	0,13
COFFEE Dummy	0,25	0,31
RICE	-0,17	-0,11
RUBBER Dummy	-0,13	-0,13
SUGAR	0,23	0,27
WHEAT	0,00	-0,05
LABOURDENSITY	-0,40	-0,36
SETMORT	-0,26	-0,22
CREOLE Dummy	0,44	0,48
CATHOLICISM65	0,46	0,46

Consistent with the expectation the cashcrop dummy is positively associated with land inequality. This aggregate variable scores better than the individual crop variables, which does not surprise. Countries with a natural environment suitable to growing sugarcane, bananas and coffee display higher levels of land inequality, whereas conditions favouring food crops such as rice obtain lower levels of land inequality. The latter does not apply to conditions favourable to producing wheat. Growing rubber, a typical scale intensive cashcrop, is contrary to the expectation, negatively associated to land inequality. Most interesting is perhaps the conclusion that absolute latitude (i.e. distance to the equator) and mean annual temperature do hardly correlate with land inequality. The expectation that tropical climates are better fit to the production of agricultural commodities subject to economies of scale polarizing land distribution cannot be confirmed.

The non-geographic variables all show a stronger correlation with land inequality. Except for settler mortality, which is not yet specified in the hypothesized quadratic form (as it will be in the regression equation), labourdensity, the creole dummy and the spread of catholicism correlate relatively well and have the sign as

expected. So at first glance the specific characteristics of colonial settlement make more of a difference in terms of land distribution, than geography related factors. Does the same picture emerge from the multiple regression analysis?

Table A.3 in the appendix shows the results. It should be noted in advance that the results refer to both samples (gini and theil) and that regressions 1 to 3 are more restricted in terms of number of observations because of the simple reason that estimates of settler mortality rates are scarce and also only apply to former colonial countries. In regression 4 to 6 this variable is excluded raising the number of observations and including countries without a colonial heritage.

The null-hypothesis that the feasibility of cashcrop production does not have a significant impact on the distribution of land is rejected in all specifications at the 95% confidence level. Cash-crops inhibiting economies of scale are positively associated to land inequality. When individual cash-crops such as sugar, coffee or bananas are included this significance disappears. Rice is the only individual crop that is relatively robust and significantly negatively related to land inequality. Other foodcrops such as wheat, maize and millet are completely insignificant. Changes in the composition of the equation and the sample (gini or theil) do not affect the cashcrop dummy variable very much.

Relative factor endowments also play a role in determining the historical distribution of land as was expected. Land abundant countries are characterised by higher levels of land inequality than labour abundant countries and this result is significant at the 95% confidence level except for the theil regression no. 3, which is significant at 90%. The question that is left unanswered however concerns the nature of causality. Does land abundance invoke the production of cashcrops or does it invoke intervention by the (colonial) elites in land and labour markets, irrespective of the type of crop produced?

The first explanation does not rule out the second and vice versa, on the contrary, but it is interesting to test the correlation between historical land abundance (i.e. the inverse of labourdensity) and the extent of cashcrop specialisation in the twentieth century (around 1960). Following the same methods and data employed in constructing dummy variables for cocoa, coffee and rubber, I constructed dummies for specialisation in bananas and sugar.

Table 5: Correlation of land endowments

	Bananas	Cocoa	Coffee	Rubber	Sugar	Coffee + Sugar
Landabundance	0,06	0,14	0,26	-0,20	0,31	0,34

The results presented in table 5 give a mixed picture. The relation between land endowments and the production of bananas and cocoa appears to be weak, whereas rubber is produced more in labourabundant areas. Sugar and coffee however clearly do better in landabundant countries. The aggregate of the Coffee and Sugar dummy has a correlation-coefficient of 0,34.

Crop and factor endowments both play a substantial role in explaining levels of land inequality and there is also some modest evidence that initial factor endowments have determined long run specialisation in crops. Whereas the above analysis confirms the relation between factor endowments, crops and land distribution, there is no evidence at all for a causal relation between tropics, crops and land distribution. Perhaps the influence of a tropical climate on the distribution of land runs via settler conditions?

The regression analysis does not reject the hypothesis that the extent and nature of colonial settlement have shaped the institutions guiding the markets for land and agricultural labour. In colonies with favourable settler conditions distinctive patterns of land distribution have developed. Direct factor market intervention in settler colonies employing a substantial pool of indigenous labour (creole dummy) have lead to high levels of land inequality in general. The significance of the quadratic form of the settler mortality variable and the creole dummy demonstrate that in North America, where settler mortality rates were lowest, land was distributed more equally. European immigrants vested themselves among "equals" and employed their own labour force in food producing family farms. The regression results indeed support the historical analysis of Engerman and Sokoloff (1997, 2001, 2005).

In areas where colonial settlement was difficult because of a hostile natural environment resource extraction was based on taxation. This pattern is characteristic for large parts of Sub-Saharan Africa in general and West and Central Africa in particular. In the latter region land inequality is relatively mild reflecting the persistence of traditional pre-colonial rural institutions that colonial governments (ab)used to collect taxes (Stavrianos 1981). In the next section I will argue that these "extractive" institutions, rather than initial asset inequality in the form of land inequality, explain high levels of income inequality in most West and Central African countries.[13]

The hypothesis, as argued by Lal a.o., that the presence of the catholic church has contributed to land inequality can be reconfirmed on the basis of the analysis presented here, in particular in the regressions with more observations incorporating European countries. Since, the settler mortality variable restricts the sample size to colonised countries in regression 1-3, regressions 4-6 present a better check for the significance of the variables that are not specificly related to a colonial past. Indeed, the spread of catholicism is significant at a 95% confidence level in the specifications excluding settler mortality.

Crops, factor endowments, settler conditions and the characteristics of colonial rule all play a role in assessing the variation in land inequality across

[13] In my opinion the discussion of "developmental" versus "extractive" institutions in Acemoglu et.al. (2001) should be nuanced at two points. First, in so far colonial settlement led to extraordinary forms of land inequality which persistently influenced the distribution of assets and income after decolonisation, the relation between favourable settler conditions and "developmental" institutions is at least ambiguous. And second, colonial institutions in Sub Saharan Africa were not problematic because they ruined the traditional production patterns during colonial times (as suggested on page 137). They were problematic because they were founded on a centralised governance structure that did not exist before. This "control structure" was used in first instance to employ traditional rural institutions to collect taxes, and only in the post-colonial era central governments used it to dismantle or destroy traditional rural institutions in order to redistribute political influence to the level of the national state (Ayittey 2005, Smits 2005).

countries. A typical "unequal" country is a land abundant catholic country whose geographic conditions support the production of coffee and sugar more than the production of rice, which has comparatively favourable settler conditions, such that a minority of white settlers were to dominate a labour force of indigenous people and African slaves. Such a description indeed comes remarkably close to an "average" Latin American country. This pattern is however tested for a sample covering all regions in the world. Whether either geography, or endowments, or colonial institutions matters most is impossible to say on the basis of this analysis. More important at this stage of analysis however is the observation that the large variation in land inequality as well as the complex set of explanatory factors accounting for this spatial pattern, implies that "the initial conditions of inequality" are diverse.

6 Initial land inequality and current income inequality

In this section the relation between initial land inequality and income inequality in the 1990's is investigated. First I discuss the correlation between land and income inequality and the data I used to estimate this relationship. Subsequently hypotheses and variables will be specified, followed by a discussion of the regression results (which are shown in table A.4 in the appendix).

6.1 relating land and income distribution: first impressions

In section 3 the potential effects of land inequality on subsequent income inequality were briefly discussed and placed in three categories: (1) the direct effect of land distribution on agricultural income distribution, (2) the barriers that initial asset and wealth inequality might pose to access capital-markets and education a.o., and (3) the persistency of institutions devised to maintain the distributional status quo and slow down processes of democratisation and civil emancipation.

However, it is was also pointed out that these effects are likely to become weaker over time as countries forge ahead. The direct income effect naturally diminishes as the share of agricultural income in total national income declines. And the latter two effects can also be off-set in the transformation process from a traditional rural society towards an urban industrial society. Institutions and governments are forced to respond to new technologies, media and a growing class of industrial entrepreneurs, which give new support to the voice of people demanding for security and mobility. The redistribution of income, assets and wealth generally receives broad attention as a political theme in transforming societies. So there are various reasons to expect that the relation between land inequality and income inequality is stronger in less-developed agricultural societies rather than modern industrial democratic societies.

What does a correlation analysis show? Deininger and Squire (1998) have calculated the correlation coefficient for a sample of land gini's and income gini's and reported a figure of 0.39 (see also Deininger and Olinto 2001). Their analysis shows that initial land inequality and income inequality is positively related, but correlation

is moderate. The estimates presented here in table 6 (in the first and second column) turn out to be even lower ranging from 0,19 to 0,23.[14]

These estimates are based on the gini and theil-coefficients from table A.1 and a sample of income gini's derived from the World Income Inequality Database (WIID version 1.0). The income inequality sample I constructed consists of high-quality gini-coefficients with a national coverage for the latest year available in the period 1987-1998.[15] The available and accepted observations create a sample of 88 observations for which also land gini's are available. This sample can be extended to 95 observations by releasing some restrictions.[16]

Table 6: Correlation of land and income inequality

	INCOME GINI 1990 95 observations	INCOME GINI 1990 88 observations	INCOME GINI 1990 excl. AFRICA 76 observations*
LANDGINI	0,19	0,19	0,49
LANDTHEIL	0,235	0,22	0,52

* 95 - 19 Sub Saharan African observations

In the third column of table 6 the correlation of land and income inequality is estimated excluding all 19 Sub Saharan African countries. It shows that excluding Sub Saharan Africa raises the correlation coefficient with approximately 30 percentage points from 0,19-0,23 towards 0,49-0,52! This is really surprising! Since most countries in Africa are good examples of the underdeveloped agricultural societies in which the share of agriculture in GDP is still large. Indeed, wouldn't we expect to find a strong relation between the distribution of land holdings and the distribution of income especially in these African countries?

In East and South African countries such as Kenya, Tanzania, South Africa, Zambia, Zimbabwe and Namibia land became highly unequally distributed during colonial times and still is. Farmers of European descent own large estates, which are often held responsible by current governments for persisting economic inequality in these countries.[17] The relatively egalitarian distribution of land in the majority of West and Central African countries however is not consistent with the exorbitant gap between rich and poor observed by income gini's. I argue in line with Acemoglu, Johnson and Robinson that land inequality estimates reveal additional evidence for

[14] The different results reported in this paper versus Deininger and Squire (1998) and Deininger and Olinto (2001) is likely to be the result of differences in land inequality estimates (see section 2) as well as differences in the sample selection of the income inequality data.

[15] The following rules are further applied: income gini's are preffered over expenditure gini's, net income over gross income estimates and household income over personal income estimates. For ca. half of the countries only expenditure gini's are available for the 1990's, which are increased with 5 percentage points to correct for potential underestimation of actual income inequality.[15] I did not correct for gross to net income or personal to household income. In case there was more than one suitable estimate to choose from, or in case estimates differed more than 5 percentage points within the given period, the average is calculated and included.

[16] Additionaly included countries are: Argentina and Uruguay with an income gini for Urban population, Barbados with an income gini for 1979, Switzerland, Trinidad and Tobago and Cyprus with a low-quality income gini which makes sense, and finally Mozambique with an income gini derived from the CIA (2005) World Fact Book, (www.cia.gov/cia/publications/factbook/).

[17] This situation is used by Zimbabwian president Mugabe to gain political support for his land reform policy.

the hypothesis that unfavourable settler conditions induced extractive institutions, which are responsible for high levels of income inequality.

Extractive institutions concentrated on mineral resources rather than agricultural products. Lucrative trade was thrived in gold, diamonds, ivory and slaves during colonial times and during the twentieth century trade shifted towards crude petrol and metals. Tax schemes are also exemplary for the "weak" institutional environment in many African countries. These taxes depress agricultural profits and investments disadvantaging the rural population in favour of the politically more influential urban population (Krueger, Schiff and Valdez 1991, Cheru 2002).

Putting the results together it can be argued that there are quite distinct historical patterns of inequality. The distribution of land in Latin America has (had) a long run impact on the income distribution, since large estate holders had their stakes in agricultural rents and prevent(ed) access of landless peasants to abundant land resources. In West and Central Africa higher access to land did not translate into more equality of economic opportunities however. Income inequality in these countries must be seen in the light of the elite's control over mineral resources and taxation systems biased against the rural population. Let's test this hypothesis.

6.2 estimating OLS regressions of income inequality

The initial distribution of land holdings is not a sufficient neither a necessary initial condition of inequality. Variables capturing the extent of "extractive" institutions should be included to obtain a more efficient model explaining income inequality.

The variable LANDINEQUALITY accounts for the long run impact of initial asset and wealth inequality. Since the regressions are hardly influenced by substituting gini- for theil-coefficients, only the results for the landgini's are presented here. The log of GDP per capita in 1990 is included as an interaction term to allow for the fact that the effects of land inequality decline over time as economies mature. This variable is denoted as GDPPC90 and derived from Maddison (2003).

The role of mineral resource extraction is captured by so-called point-source estimates of natural resources derived from Isham et.al. (2003). The estimate consists of the log of the percentage share in total exports of the one specific mineral (sometimes two) dominating a countries export package. Countries with a diversified agricultural or manufacturing export packages are given the value 0.[18] Mineral resources include crude petrol, gas, coal, ferrous and non-ferrous metals, ivory, diamonds, pearls and wood. Isham et.al also consider agricultural products such as sugar, cotton, coffee, cocoa etc. as part of a point-source exports structure. However, since the impact of these products on income inequality is likely to be captured by the land inequality variable, I excluded the crops. Therefore the variable denoted as MINERALS only refers to the relative dominance in exports of mining products and wood (i.e. forests are excluded from land distribution data).

The hypothesis is that the presence of mineral resources creates incentives and opportunities for rent-seeking and monopolistic behaviour by the political elites. In this context income inequality is likely to be high. Obviously, the effect of mineral resource abundance on income inequality will be stronger in countries in which

[18] Three missing observations for Guinea, Guyana and Libya were included on the basis of UN Trade Statistics.

extractive institutions are in place and property rights are insecure. Therefore the MINERALS variable is interacted with a variable capturing the risk of expropriation, i.e. the same as Acemoglu et.al. use to represent extractive institutions. The variable is denoted as RISKEXPROP90, refers to the year 1990 and is derived from the PRS Group International Countries Risk Guide (ICRG).

To account for the extent of persistency in institutions that control the distribution of assets and income I included a measure of democratic accountability. Path dependency in inequality depends on rational human calculations: those who are in power do not want to give up their privileges and therefore have no incentives to held themselves accountable. The index of democratic accountability is from the ICRG, again for the year 1990, denoted as DEMOCRACY90. The sign is expected to be negative. And finally, a variable denoted as SOCIALIST DUMMY represents the expectation that a (former) socialist government has had an equalizing impact on the income distribution.

The regression results are presented in table A.4 (appendix). Each regression is estimated for both income inequality samples (respectively 95 and 88 observations).

The overall picture that emerges from these regressions is that once we control for the institutional variables and the presence of mineral resources in countries, the relation between initial land inequality and subsequent income inequality appears to be very strong. When controlling for the level of economic development (interacting land inequality with GDP per capita), the significance and explanatory power of the land gini increases enormously. The R-squared jumps from 0,04 in regression 1 immediately to 0,44 in regression 2. The level of significance of the landgini is also very high, with t-statistics in regression 2-6 varying from 3.86 to 8.32! In all these regressions the null-hypothesis that land inequality has no impact on income inequality must be rejected with a probability of more than 99%.

The dummy variable controlling for (former) socialist states and the index of democratic accountability is significant in all regressions at a 95% confidence level. The presence of minerals interacting with the risk of expropriation is significantly positively related to income inequality. In high risk countries the people who are in charge can easily subtract the windfall gains that mineral resource exploitation generate.

In sum, the regression results leave little doubts concerning the lasting impact of land inequality on income inequality. Yet, the distribution of land is perhaps the most important, but certainly not a comprehensive factor of initial asset distribution. In so far inequality plays a role in economic development and growth, the historical sources of income inequality should be acknowledged. These include land inequality, but also the dangerous combination of extractive institutions and mineral resource abundance. Studies incorporating a variable of initial asset inequality that is solely based on land distribution, do not only miss part of the picture, but are also likely to incur biased results.

7 Land inequality and economic development in Latin America

Exploring the causes and consequences of land distribution in a more or less quantitative and systematic manner as done in this paper reveals strong support for literature stressing the role of the historical roots and structural factors accounting for temporal rigidity in income inequality levels. But do these factors also affect economic development? A brief afterthought on Latin America.

Explaining the differences in growth performance in New World countries is a leading theme in the work of Engerman and Sokoloff (2001, 2005). They show that Latin American institutions have persistently restricted access to economic opportunities to substantial parts of the population. Initial inequality in social status (position of slaves and indigenous people), assets and wealth (land, natural resources) has (had) a long lasting effect since the political incentive structure is characterized by maintaining the status quo and rent seeking behaviour. The slow democratization process restricted peoples political participation. Progress in public education has been much slower than in North America, which restricted the opportunities to acquire literacy, skills and develop human networks. Systematic underinvestment in public goods went hand in hand with tax systems benefiting the elites rather than lower income classes.

Complementary literature stresses that the polarised agricultural sector created unbalanced economic growth characterized by suboptimal spill-over effects. The coexistence of *minifundias* and *latifundias* generated insufficient technology and demand spill-overs to support a sustained process of industrialization (Kay 2001, Johnson 1991). Fei and Ranis (1997) describe in detail how backward and forward linkages between agriculture and industry remain underdeveloped in case of unbalanced agricultural technical change. Murphy, Sleifer and Vishny (1989) point out that inequality reduces the domestic demand for basic manufacturing products because middle-classes are thin. Meanwhile the elites engaged in conspicuous consumption spend their capital on imported luxury goods. Low domestic demand for basic manufactures impeded domestic industrialisation.

Inequality obviously has its disadvantages for economic development, yet it did not kill the growth in Latin America! On the contrary, from 1870 to 1929 and from 1950 to 1973 the majority of Latin American countries witnessed favourable rates of growth which matched developments in the West (Maddison 2003). The true question therefore seems to be why Latin American development got stuck somewhere halfway? The analysis of land distribution reveals some important clues, which by no means substitute for other explanations, but can be seen as complementary.

In most Latin American countries coercive land and labour market institutions were created in order to tackle the problems that the Iberian settlers had with a situation of chronic labor scarcity. This situation existed at least until the start of the twentieth century. Already shortly after the Second World War this situation had turned around almost completely, as the informal sector starts to expand rapidly. There is no other region in the world that witnessed such a rapid transformation from a context of labour scarcity towards a context of a sustained labour surplus.

Colonial settlers responded to labour scarcity by dividing the land and restricting the access to land of indigenous peasants. In addition the estate holders introduced labour-saving technological and organizational changes (Hayami and Ruttan 1985). This created the paradoxical situation that in spite of large supplies of land, the absorptive capacity of the agricultural sector in terms of jobs and land for new farms was greatly reduced. meanwhile the demographic transition set in. Rapid urbanization is a stylized fact of Latin American economic development. Indeed, the new generations settled down in the cities. However, formal urban manufacturing and service industries did not provide sufficient jobs to prevent the formation of large informal sectors with underemployed people. One wonders why there has never been a process of de-urbanization or re-agriculturalization in countries that are so richly endowed with land and large urban slums?

8 Conclusion

In this paper new data on land distribution are used to explore the causes and consequences of land inequality. The two central questions addressed are 1) what explains the historical cross-country variation in land distribution? 2) how does initial land inequality relate to present-day income inequality?

Historical land distribution could be explained dependent by the interaction between local endowments and the strategic responses of colonial powers. The conditions of settlement had large consequences for the way in which colonists extracted rents from their colony. In regions with high settler mortality rates, the colonial motherland necessarily adopted a strategy of resource extraction at a distance. In regions with favourable settler climates a direct exploitation of land, labour and mineral resources was feasible.

Direct involvement in the production process required intervention in factor markets. This colonial intervention affected the distribution of land directly, in particular if labour was scarce and land abundant. In this case coercive institutions such as slavery and serfdom were pursued to control the scarce so valuable sources of labour. In areas without such sources of indigenous labour, the exploitation of the land relied on European immigrants. In these immigrant colonies institutional development was rather "cooperative" than "coercive". In those areas where settler mortality rates prohibited settlement institutions can be best denoted as "extractive" (Acemoglu, Johnson, Robinson 2001). Colonial strategies focusing on mineral resource extraction, either via trade or taxation, did not require direct intervention in land markets and left traditional rural institutions in tact.

Local geographic conditions co-determined the feasibility of colonial settlements and strategies. In particular regions with land suitable to the production of sugar and coffee attracted settlers who started large scale capital intensive plantations. On the other hand, in countries with land fit to grow rice, a labour-intensive and scale neutral foodcrop, land holdings became less polarised. Geography thus created a potential context for land inequality. But there is no relation whatsoever between a tropical climate and land inequality.

These determinants together explain a good share of the variation in land inequality between Iberian and British America, between West and East Africa or between Latin America and East Asia. However, these determinants become even more important when we try to explain the variation in income inequality levels across countries that can be observed at present.

High levels of land inequality result in persistent high levels of income inequality. Particularly when initial land inequality is controlled for the level of economic development the factor land turns out to be of prime significance. However, land inequality is neither a necessary nor a sufficient initial condition of inequality. The contrast between West Africa and Latin America tells an interesting story in this respect.

Both regions are characterised by persistent high levels of income inequality. In Latin America persistent income inequality is rooted in factor market intervention and the development of coercive institutions during three centuries of colonial rule. The roots of West African income inequality on the other hand reside in the monopolisation of mineral resources and tax systems that systematically repress agricultural smallholders in favour of the urban population. The origins of a high risk of expropriation and an unequally divided fiscal burden stem from the extractive institutions that were created by the central colonial government. Both regions share the burden of political inflexibility that are characteristic of countries with high levels of initial asset inequality. Those in power want to hold on to what they have and feel threatened by requests for democratic accountability. In both regions initial asset inequality has probably retarded economic development, but the colonial origins of inequality were fundamentally different.

References

Acemoglu, D., Johnson S., Robinson, J.A., (2001) The Colonial Origins of Comparative Development: An Empirical Investigation, *American Economic Review,* 91, 5, 1369-1401

Adelman, I., Taft Morris, C., (1988) *Comparative Patterns of Economic Development 1850-1914*, John Hopkins University Press: Baltimore

Alesina, A., Rodrik, D., (1994) Distributive Politics and Economic Growth, *The Quarterly Journal of Economics*, 109, 2, May, 465-90

Atkinson, A.B., (1997) Bringing Income Distribution in from the Cold, *The Economic Journal*, 107, March, 297-321

Atkinson, A.B., (2000) The Changing Distribution of Income: Evidence and Explanations, *German Economic Review,* 1, 3-18

Atkinson, T. (2002) *Data Matter*, revised version of the Alfred Cowles Lecture presented at the Australasian Meetings of the Econometric Society, Auckland 2001

Ayittey, G.B.N., (2005) Africa Unchained. The Blueprint for Africa's Future, Palgrave Macmillan: New York, Basingstoke

Barro, R.J., (2000) Inequality and Growth in a Panel of Countries, *Journal of Economic Growth*, 5, 5-32

Birdsall, N., Londono, J.L., (1997) Asset Inequality Matters: An Assessment of the World bank's Approach to Poverty Reduction, *The American Economic Review*, 87, 2, May, 32-37

Bourguignon, F., Verdier, T., (2000) Oligarchy, Democracy, Inequality and Growth, *Journal of Development Economics*, 62, 2, 285-313

Cheru, F. (2001) African Renaissance. Roadmaps to the Challenge of Globalization, Zed Books, London

CIA (2005) *The World Factbook* (WFB); www.cia.gov/cia/publications/factbook/

Deininger, K., Squire, L., (1996) A New Data Set Measuring Income Inequality, *The World Bank Economic Review*, 10, 3, 565-591

Deininger. K., Squire, L., (1998) New ways of looking at old issues: inequality and growth, *Journal of Development Economics*, 57, 259-287

Deininger, K., Olinto P., (1999) Asset distribution, inequality, and growth, *World Bank Policy Research Working Paper No. 2375*

Demsetz, H., (2000) Dogs and Tails in the Economic Development Story, in: Menard, C., ed., *Institutions, Contracts and Organizations. Perspectives from New Institutional Economics*, Edward Elgar: Cheltenham UK, Northampton (MA)

De Soto, H., (2000) *The Mystery of Capital,* Bantam Press

Domar, E.D., (1970) The Causes of Slavery or Serfdom: A Hypothesis, *The Journal of Economic History*, 30, 1, The Tasks of Economic History, March, 18-32

Easterly, W., (2002) *Inequality does Causes Underdevelopment: New Evidence*, Center for Global Development, Working Paper no. 1

Easterly, W., Levine, R., (2003) Tropics, Germs, and Crops: how endowments influence economic development, *Journal of Monetary Economics*, 50, 3-39

Engerman, S.L., Haber, S.H., Sokoloff (2001) Inequality, institutions and differential paths of growth among New World economies, in: Menard, C., ed., *Institutions, Contracts and Organizations. Perspectives from New Institutional Economics*, Edward Elgar: Cheltenham UK, Northampton (MA)

Engerman, S.L., Sokoloff, S.H., (1997) Factor Endowments, Institutions, and Differential Paths of Growth Among New World Economies: A View from Economic Historians of the United States, in: Haber, S. (ed) *How Latin America Fell Behind*, Stanford University Press, Stanford CA

Engerman, S.L., Sokoloff, S.H., (2005) *Colonialism, Inequality and Long-Run Paths of Development*, NBER Working Paper 11057, Cambridge MA

FAO (1955) *Report on the 1950 World Census of Agriculture,* Rome

FAO (1971) *Report on the 1960 World Census of Agriculture,* Rome

FAO (1981) *Report on the 1970 World Census of Agriculture,* Rome

FAO, *Report on the 1980 World Census of Agriculture,* Rome

FAO, *Report on the 1990 World Census of Agriculture,* Rome

FAO, IIASA, Global Agro-Ecological Zones (GAEZ); www.fao.org/ag/AGL/agll/gaez/index.htm

FAO, *Statistical Databases* (Faostat); www.faostat.fao.org/

Fei,J.C.H., Ranis, G., Kuo, S.W.Y., (1979) *Growth with Equity. The Taiwan Case*, A World Bank Research Publication, Oxford University Press: New York

Fei, J.C.H., Ranis, G., (1997) *Growth and Development from an Evolutionary Perspective*, Blackwell Publishers: Oxford, Malden MA

Fernandez-Armesto, F., (2003) *The Americas. A Hemispheric History*, The Modern Library: New York

Frankema, E., Smits, J.P., (2005) Exploring the Historical Roots of Eastern Asia's Post-War Catch-Up Growth: A Trade Perspective, 1906-1999, *Journal of the Asia Pacific Economy*, Vol. 10, No. 2, 178-194

Galor, O., Zeira, J., (1993) Income Distribution and Macroeconomics, *The Review of Economic Studies*, vol. 60, no. 1, January

Galor, O., Moav, O., Vollrath, D., (2003) *Land Inequality and the Origin of Divergence and Overtaking in the Growth Process: Theory and Evidence*, CEPR Discussion Paper No. 3817

Goody, J. (1983) *The Development of the Family and Marriage in Europe*, Cambridge University Press: Cambridge

Hall, R.E., Jones, C.I., (1999) Why do some countries produce so much more output per worker than others? *The Quarterly Journal of Economics*, Vol 144, No. 1, 88-116

Hayami,Y., Ruttan, V.W., (1985) *Agricultural Development. An International Perspective*, 2nd edition, The Johns Hopkins University Press: London

Helpman, E., (2004) *The Mystery of Economic Growth*, The Belknap Press of Harvard University Press: Cambridge (MA), London

Institut International d'Agriculture, (IIA), *International Yearbook of Agricultural Statistics 1932-1933,* Rome

Isham, J. Woolcock,M., Pritchett, L., Busby, G., (2003) *The Varieties of Resource Experience: Natural resource Export Structures and the Political Economy of Economic Growth*, Middlebury College Discussion Paper No. 2003-08

Johnson, D.G., (1991) Agriculture in the Liberalization Process, in: L.B. Krause and K. Kihwan (eds.), *Liberalization in the Process of Economic Development*, University of California Press: Berkeley, Los Angeles, Oxford

Kay, C., (2001) *Asia's and Latin America's development in comparative perspective: Landlords, peasants and industrialization*, ISS Working Paper Series No. 336, The Hague

Knack, S., Keefer, P. (1995) Institutions and Economic Performance: Cross Country Tests Using Alternative Institutional Measures, *Economics and Politics,* Vol. 7, No. 3, pp. 207-227

Krueger, A.O., Shiff, M., Valdés, A., (eds.) (1991) *The political Economy of Agricultural Pricing Policy*, A World Bank comparative study, several volumes, The John Hopkins University Press: Baltimore, London.

Lal, D., (1998) *Unintended Consequences. The impact of factor endowments, culture and politics on long-run economic performance*, MIT Press: Cambridge (MA), London,

Leamer, E.E., Maul, H., Rodriguez, S., Schott, P.K., (1999) Does natural resource abundance increase Latin American income inequality ? *Journal of Development Economics*, Vol. 59, pp. 3-41

Li, H., Squire, L., Zou, H., (1998) Explaining International and Intertemporal Variations in Income Inequality, *The Economic Journal* 108, January, 26-43

Maddison, A., (2003) *The World Economy: Historical Statistics*, OECD, Paris

Manning, P., (1988) *Francophone Sub-Saharan Africa 1880-1985*, Cambridge University Press: New York

Mariscal, E., Sokoloff, K.L., (2000) Schooling, Suffrage, and Inequality in the Americas, 1800-1945, in: S. Haber (ed.) *Political Institutions and Economic Growth in Latin America. Essays in Policy, History, and Political Economy*, Hoover Institution Press: Stanford, California

McArthur, J.W., Sachs, J.D., (2001) *Institutions and Geography: Comment on Acemoglu Johnson and Robinson (2000)*, NBER Working Paper 8114, Cambridge MA

McEvedy, C., Jones, R., (1978) *Atlas of World Population History*, Penguin Books: Harmondsworth

Mitchell, B.R., (2003) *International Historical Statistics*, 5th edition, Palgrave Macmillan: London, Basingstoke

Murphy, K.M., Shleifer, A., Vishny, R., (1989) Income Distribution, Market Size, and Industrialization, *The Quarterly Journal of Economics*, vol. 104, no. 3, 537-564

Olson, M., (2000) *Power and Prosperity. Outgrowing Communist and Capitalist Dictatorships*, Basic Books, New York

PRS Group, *International Country Risk Guide* (ICRG); www.prsgroup.com

Persson, T., Tabellini, G., (1992) Growth, distribution and politics, *European Economic Review 36*, pp. 593-602

Smits, J.P., (2005) *Long-Run African Growth, 1910-2000: An Analysis Based on a Broad Capital Concept*, Paper presented at the Sixth European Historical Economics Society Conference, September 9-10, Istanbul

Stavrianos, L.S., (1981) *Global Rift. The Third World Comes of Age*, Quill: New York

Taylor, C.L., Hudson, M.C., (1972) World Handbook of Political and Social Indicators, 2nd edition, Yale University Press: New Haven, London

World Bank (2003) *The East Asian Miracle. Economic Growth and Public Policy*, A World Bank Policy Research Report, Oxford University Press

World Bank (2004) *Inequality in Latin America. Breaking with History?*, World Bank Latin American and Caribbean Studies, Washington D.C.

UNDP, *World Income Inequality Database* (WIID), Version 1.0; www.wider.unu.edu/wiid/wwwwiid.htm

Young, C., (1994) *The African Colonial State in Comparative Perspective*, Yale University Press: New Haven

Appendix

Table A.1: The distribution of land holdings by country, 20th century

		year	Frankema gini	Frankema theil	Taylor & Hudson gini	Deininger & Olinto gini
1	Algeria	1930	59,6	0,326		
2	Algeria	1973	63,5	0,327		
3	Argentina	1914	80,3	0,648		
4	Argentina	1947	80,6	0,648		
5	Argentina	1960	81,4	0,667	86,7	85,6
6	Argentina	1988	81,4	0,645		
7	Australia	1910	73,4	0,489		
8	Australia	1924	67,6	0,376		
9	Australia	1960	82,0	0,651	88,2	85,3
10	Australia	1971	80,5	0,612		
11	Austria	1930	68,4	0,408		
12	Austria	1960	67,1	0,386	70,7	68,8
13	Austria	1990	61,2	0,314		
14	Bangladesh	*1960*				41,8
15	Bangladesh	1977	41,7	0,138		
16	Barbados	1961	81,6	0,795		
17	Barbados	1989	84,8	0,804		
18	Belgium	1930	75,9	0,544		
19	Belgium	1959	60,0	0,276	60,4	
20	Belgium	1970	57,8	0,255		
21	Bolivia	*1960*				76,8
22	Brazil	1920	78,0	0,592		
23	Brazil	1960	78,7	0,608	84,5	84,1
24	Brazil	1985	80,2	0,632		
25	Burkina Faso	1993	39,1	0,112		
26	Cameroon	1972	40,7	0,120		
27	Canada	1931	48,7	0,183		
28	Canada	1961	52,6	0,212		55,1
29	Central African Rep.	1974	33,8	0,082		
30	Chile	1927	83,7	0,746		
31	Chile	1965	86,5	0,823		
32	Chile	1997	84,1	0,752		
33	China	1997	43,8	0,179		
34	Colombia	1960	80,5	0,644	86,4	82,9
35	Colombia	1988	74,3	0,493		
36	Congo, dem. rep (Zaire)	1970	53,2	0,261		
37	Cote d'Ivoire	1974	41,5	0,128		42,3
38	Costa Rica	1963	73,9	0,495	78,2	80,6
39	Cyprus	*1960*				62,0

40	Cyprus	1985	59,8	0,289		
41	Czechoslovakia	1921	63,3	0,329		
42	Denmark	1919	52,2	0,204		
43	Denmark	1933	47,5	0,176		
44	Denmark	1959	44,2	0,141	45,8	43,0
45	Denmark	1989	42,8	0,138		
46	Dominican Republic	1960	74,5	0,542	80,3	
47	Ecuador	1954	80,4	0,671	86,4	84,0
48	Ecuador	1974	77,2	0,552		
49	Egypt	1915	73,0	0,538		
50	Egypt	1930	70,3	0,485		
51	Egypt	1961	63,3	0,343	67,4	54,9
52	El Salvador	1961	78,3	0,624	82,7	82,1
53	Estonia	1925	42,1	0,126		
54	Ethiopia	1977	42,4	0,135		
55	Finland	1929	39,2	0,091		
56	Finland	1959	33,8	0,084	35,1	49,4
57	France	1930	62,9	0,317		
58	France	1963	50,2	0,187		54,4
59	France	1988	54,6	0,226		
60	Gabon	1974	40,2	0,133		
61	Germany	1907	70,4	0,433		
62	Germany	1925	70,5	0,431		
63	Germany, fed. rep	1960	52,4	0,211	66,8	55,4
64	Germany, fed. rep	1971	49,4	0,178		
65	Ghana	1970	53,0	0,226		
66	Greece	1971	47,0	0,166		45,4
67	Greece	1993	53,9	0,226		
68	Guadeloupe	1969	60,0	0,323		
69	Guatemala	1950			86,0	
70	Guatemala	1964	77,0	0,601		85,3
71	Guinea	1989	45,2	0,151		
72	Guyana	1989	63,9	0,399		
73	Haiti	1971	46,2	0,170		
74	Honduras	1952	70,6	0,461	75,7	76,5
75	Honduras	1993	65,3	0,420		
76	India	1960	56,6	0,294	52,2	61,4
77	India	1986	57,9	0,252		
78	Indonesia	1963	52,7	0,265		55,5
79	Indonesia	1973	47,1	0,202		
80	Indonesia	1993	45,4	0,180		
81	Iran	1960			62,5	62,3
82	Iran	1988	67,7	0,375		
83	Iraq	1958	82,0	0,673	88,2	72,6
84	Ireland	1930	55,3	0,234		
85	Ireland	1960	57,5	0,254	59,4	
86	Israel	1970	69,8	0,468		80,0
87	Italy	1930	71,5	0,471		
88	Italy	1960	62,0	0,345	73,2	74,3
89	Italy	1990	73,3	0,500		
90	Jamaica	1961	75,7	0,580	77,0	80,3
91	Japan	1909	40,0	0,126		
92	Japan	1930	39,0	0,118		
93	Japan	1960	39,8	0,108	47,0	43,2
94	Japan	1980	50,3	0,139		
95	Japan	1995	51,1	0,205		
96	Jordan	1983	64,3	0,348		67,7
97	Kenya	1960	76,2	0,589	69,2	75,0
98	Kenya	1974	63,1	0,374		
99	Korea, rep.	1961			38,7	34,0
100	Korea, rep.	1970	30,7	0,078		
101	Korea, rep.	1990	37,2	0,103		

102	Kuwait	1970	72,5	0,456		
103	Laos	1998	38,2	0,107		
104	Latvia	1925	50,4	0,191		
105	Lesotho	1960	38,1	0,123		
106	Lesotho	1990	41,1	0,144		
107	Liberia	1971	68,1	0,441		
108	Libya	1960			70,0	
109	Lithuania	1930	44,0	0,144		
110	luxembourg	1950			63,8	
111	Madagascar	*1960*				80,4
113	Malaysia	1960	68,0	0,454	47,3	64,0
114	Mali	1960	45,1	0,156	47,7	47,8
115	Malta	1960	50,2	0,189	47,8	
116	Mauritius	1930	74,2	0,659		
117	Mexico	1960			69,4	60,7
118	Morocco	1962	57,7	0,263		
119	Mozambique	1999	36,8	0,108		
120	Myanmar	1993	46,3	0,163		44,3
121	Nepal	1971	54,2	0,280		
122	Netherlands	1921	66,2	0,310		
123	Netherlands	1930	56,8	0,249		
124	Netherlands	1959	55,7	0,236	57,9	50,5
125	New Zealand	1910	78,6	0,589		
126	New Zealand	1918	77,6	0,525		
127	New Zealand	1930	76,2	0,527		
128	New Zealand	1960	69,6	0,437	73,4	76,4
129	New Zealand	1972	71,2	0,468		
130	Nicaragua	1963	75,9	0,528	80,1	
131	Niger	1980	31,2	0,070		
132	Norway	1929	60,0	0,282		
133	Norway	1959	36,2	0,098	67,6	39,1
134	Pakistan	1961	44,7	0,166	65,0	55,6
135	Pakistan	1989	55,0	0,244		
136	Panama	1960	69,9	0,429	73,5	80,4
137	Panama	1990	82,2	0,655		
138	Paraguay	1961	86,3	0,849		85,7
139	Paraguay	1991	84,9	0,803		
140	Peru	1961	85,4	0,818	93,3	92,3
141	Peru	1994	81,1	0,714		
142	Philippines	1950	48,2	0,220		
143	Philippines	1960	48,8	0,195	53,4	56,0
144	Philippines	1991	54,7	0,238		
145	Poland	1960	51,1	0,204	46,5	
146	Portugal	1968	75,6	0,554		71,8
147	Portugal	1989	73,5	0,527		
148	Puerto Rico	1930	69,9	0,469		
149	Puerto Rico	1959	70,7	0,468	73,8	
150	Puerto Rico	1987	73,4	0,504		
151	Reunion	1972	63,4	0,377		
152	Romania	1930	43,3	0,183		
153	Saudi Arabia	1972	74,2	0,513		
154	Senegal	1960	46,7	0,162		49,3
155	Senegal	1998	47,8	0,173		
156	Sierra Leone	1970	42,4	0,131		
157	Singapore	1973	29,1	0,081		
159	Slovenia	1991	56,2	0,236		
160	South Africa	1927	62,8	0,323		
161	South Africa	1960	64,3	0,336	70,0	
162	Spain	1960	79,1	0,610	79,7	84,5
163	Spain	1989	80,2	0,636		
164	Sri Lanka	1961	62,3	0,358		65,7
165	Swaziland	1971	83,5	0,776		

166	Sweden	1919	57,3	0,246		
167	Sweden	1961	48,8	0,182	50,6	45,6
168	Switzerland	1929	54,3	0,230		
169	Switzerland	1969	50,4	0,192		50,0
170	Syria	1971	64,3	0,338		
171	Taiwan	1920	53,9	0,227		
172	Taiwan	1960	39,0	0,136	46,3	
173	Tanzania	*1960*				79,0
174	Thailand	1963	44,4	0,145	46,0	42,6
175	Thailand	1993	44,7	0,154		
176	Togo	1961	45,2	0,150		
177	Togo	1970	51,0	0,206		
178	Trinidad and Tobago	1963	69,1	0,446	69,1	
179	Tunisia	1961	61,6	0,314		64,6
180	Turkey	1927	56,3	0,256		
181	Turkey (in deunums)	1960	60,8	0,294	59,2	59,5
182	Turkey	1991	58,5	0,274		
183	Uganda	1963	48,1	0,176		54,9
184	Uganda	1991	57,4	0,277		
185	UK (England and Wales)	1921	62,6	0,308		
186	UK (Scotland)	1925	64,6	0,327		
187	UK (Northern Ireland)	1925	58,9	0,269		
188	UK	1960	68,7	0,399	72,3	67,7
189	UK	1993	64,4	0,340		
190	Uruguay	1937	77,5	0,563		
191	Uruguay	1960	79,1	0,591	82,6	81,3
192	USA	1910	57,1	0,253		
193	USA	1930	60,1	0,305		
194	USA	1959	67,7	0,411	71,0	73,1
195	USA	1987	71,9	0,456		
196	Venezuela	1956			90,9	91,7
197	Venezuela	1961	85,7	0,819		
198	Vietnam (South)	1960	56,2	0,253	58,7	
199	Vietnam	1994	47,4	0,184		
200	Yugoslavia	1950			43,7	
201	Zambia	1971	69,9	0,476		

Sources: IIA, FAO, Decennial censuses, T&H, D&O.

Table A.2: Calculation example of a gini- and theil-coefficient of land distribution (Chile 1965)

The gini- and theil-coefficients of land distribution are compiled from tables that have divided the total number of farm-holdings into land size classes, measured by hectares per holding (step 1). From these tables a decile distribution can be obtained (step 2). The decile distribution serves as input into the formula for the gini- and theil-coefficient (step 3).

step 1	number of holdings	total area in hectares	Average size per holding
less than 1 ha	51.000	22.000	0,43
1 to 2 ha	34.699	46.100	1,33
2 to 5 ha	43.761	138.500	3,16
5 to 10 ha	33.076	230.300	6,96
10 to 20 ha	29.976	413.800	13,80
20 to 50 ha	29.360	911.900	31,06
50 to 100 ha	14.785	1.022.500	69,16
100 to 200 ha	9.164	1.261.500	137,66
200 to 500 ha	6.998	2.167.500	309,73
500 to 1000 ha	3.156	2.143.400	679,15
1000 ha and over	3.324	22.286.230	6704,64
total	**259.299**	**30.643.730**	**118,18**

step 2	Decile distribution of holdings	Decile distribution of land	**Distribution in percentages**
1st decile	25930	11185	**0,000365**
2nd decile	25930	11957	**0,000390**
3rd decile	25930	34450	**0,001124**
4th decile	25930	67543	**0,002204**
5th decile	25930	82788	**0,002702**
6th decile	25930	180544	**0,005892**
7th decile	25930	310357	**0,010128**
8th decile	25930	615528	**0,020087**
9th decile	25930	1243425	**0,040577**
10th decile	25930	28085952	**0,916532**
Total	**259300**	**30643730**	**1,00**

Source: FAO, *Report on the World Census of Agriculture 1960*, Table 1.4, 2.3 and 2.10; pp. 26, 42 and 55 respectively

Step 3

Gini-coefficient: $(\Sigma_{j=1} \Sigma_{k=1} n_j n_k \left| y_j - y_k \right|) / 2n^2 * (1/n) = 17,3 / 20 = 86,5$

Theil-coefficient: $\Sigma_{\iota=1} s_i (\log s_i - \log (1/n)) = 0,823$

n = amount of decile shares = 10
$s_i = s_j = s_k$ = the share of land of the *i*th decile of holdings in total land
(listed in bold, last column)
$(\Sigma_{j=1} \Sigma_{k=1} n_j n_k \left| s_j - s_k \right|)$ = sum of differences of the percentage distribution = 17,3

Table A.3: Regressions of land inequality

	gini	theil	gini	theil	gini	theil	gini	theil	gini	theil	gini	theil
	(1)	(1)	(2)	(2)	(3)	(3)	(4)	(4)	(5)	(5)	(6)	(6)
CASHCROP Dummy	0,08	0,10	0,13	0,16			0,10	0,15	0,16	0,22	0,09	0,14
	2,34	*1,96*	*3,51*	*3,02*			*3,25*	*3,43*	*5,03*	*5,10*	*2,94*	*3,20*
RICE	-0,26	-0,33	-0,22	-0,30			-0,39	-0,50	-0,40	-0,53	-0,37	-0,47
	-2,48	*-2,16*	*-1,90*	*-1,74*			*-4,60*	*-4,19*	*-4,29*	*-4,06*	*-4,18*	*-3,88*
LABOURDENSITY	-0,02	-0,02	-0,04	-0,04	-0,02	-0,02	-0,02	-0,02	-0,03	-0,03		
	-2,66	*-1,99*	*-4,72*	*-3,98*	*-2,44*	*-1,85*	*-2,11*	*-1,55*	*-4,08*	*-3,52*		
SETMORT	0,14	0,18	0,20	0,27	0,16	0,20						
	1,98	*1,77*	*2,59*	*2,35*	*2,04*	*1,91*						
SETMORT^2	-0,02	-0,02	-0,02	-0,03	-0,02	-0,02						
	-2,09	*-1,90*	*-2,91*	*-2,65*	*-2,26*	*-2,16*						
CREOLE Dummy	0,09	0,15			0,10	0,16	0,08	0,12			0,12	0,17
	2,37	*2,71*			*2,36*	*2,47*	*2,04*	*2,22*			*3,08*	*3,25*
CATHOLICISM65	0,02	0,03			0,02	0,03	0,02	0,03			0,02	0,03
	1,63	*1,55*			*1,97*	*1,81*	*3,17*	*2,84*			*2,95*	*2,55*
R2	0,63	0,62	0,53	0,49	0,56	*0,56*	*0,49*	*0,49*	0,37	0,37	0,40	0,42
no. of observations	55	51	55	51	55	51	92	85	92	85	101	94

t-values below coefficients in italics.

Table A.4: Regressions of income inequality

	gini (1)	gini (1)	gini (2)	gini (2)	gini (3)	gini (3)	gini (4)	gini (4)	gini (5)	gini (5)	gini (6)	gini (6)
LANDINEQUALITY	1,27	1,25	1,04	1,04	9,80	9,66	7,55	6,90	9,36	9,26	6,56	6,17
	1,89	*1,74*	*8,32*	*7,90*	*8,17*	*7,72*	*4,81*	*4,26*	*7,90*	*7,50*	*4,24*	*3,86*
LANDINEQUALITY * GDPPC90			-2,34	-2,34	-2,30	-2,29	-1,55	-1,38	-2,14	-2,14	-1,34	-1,24
			-7,98	*-7,61*	*-8,29*	*-7,92*	*-3,82*	*-3,24*	*-7,85*	*-7,51*	*-3,36*	*-2,99*
MINERALS85 * RISKEXPROP90									0,18	0,18	0,16	0,15
									2,35	*2,25*	*2,13*	*1,96*
DEMOCRACY90							-1,84	-2,26			-1,98	-2,20
							-2,42	*-2,83*			*-2,63*	*-2,80*
SOCIALIST DUMMY					-9,10	-9,44	-8,30	-8,79	-9,35	-9,53	-1,18	-1,23
					-3,46	*-3,48*	*-2,07*	*-2,16*	*-2,36*	*-2,34*	*-2,52*	*-2,56*
R2	0,04	0,03	0,44	0,43	0,50	0,51	0,55	0,56	0,56	0,56	0,60	0,60
no. of observations	95	88	93	86	93	86	80	74	80	75	78	73

t-values below coefficients in italics.