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An Investigation into Changes in Income Inequality in St. Lucia (1995-2007) following the Liberalization of International Banana Marketing

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Abstract

A reduction in the level of income inequality could be considered one of the factors necessary for sustainable development in the Caribbean, and it has been often suggested that a liberalized trade regime is one of the means to achieve this outcome. This paper reports on an examination of the change in inequality in St. Lucia following the liberalization of international banana marketing using household expenditure survey data (1995 and 2005) and income tax filer data for 1998 and 2007. The non-parametric bootstrap was used to compute Gini coefficients. This method was combined with Davidson's (2009) method for computing standard errors, to conduct reliable statistical inference on the Gini coefficients to assess the change in inequality, at the national level, between 1995 and 2007. It was concluded that there is evidence of a reduction in income inequality based on significant differences in the Gini coefficient between the two periods for both sets of data. While the quality of the data may preclude a concrete discussion of major policy implications, it can be suggested that the attempt by the government of St. Lucia to mitigate the effect of the loss of employment due to the subsequent contraction of the banana industry may have been effective. Thus, despite the massive exit of the work force from agriculture, other employment opportunities in the construction and service sectors as well as social safety nets such as a farmers pension plan compensated for the anticipated decline in household income due to liberalization of the international banana market. Additionally, government programs undertaken to restructure the competitiveness of the industry may have had a positive impact on income inequality. Further study of the relationship between government programs and income inequality following the liberalization is therefore warranted.

Keywords: St. Lucia, banana, trade, income inequality, Gini coefficient, non-parametric bootstrap
Subtheme Category: Trade Policy of Agribusiness Development

1.0 Introduction

During the 1960s, banana became one of the most important crops for a number of Caribbean islands such as St. Lucia, providing direct employment and export earnings for several decades, along with a strong positive multiplier effect on other sectors of the economy (IMF 2002; Perville 2006). The economic success of banana in the Caribbean was made possible in part, due to its relationship with European

countries. Until the early 1990s, individual European countries applied their own rules for Caribbean imports. For example, France imported bananas from Guadeloupe and Martinique, while the UK imported bananas mainly from its former colonies such as St. Lucia. Without this support, it would have been difficult for Caribbean producers to survive due to economies of scale in production that were being realized by their competitors. The majority (69%) of banana farms in

Dominica, St. Lucia and St. Vincent were about 1 acre in size and most were situated on hilly terrain. In addition, higher freight charges, due to smaller volumes, made Caribbean bananas uncompetitive in terms of price (Payne 2006). After the formation of the Single European market in 1993, the European Union (EU) Common Market Organization for Bananas (COMB - EC Banana Regime) was established to govern the banana trade in the EU. This aim of the regime was to maintain support for former EU member colonies in the African Caribbean and Pacific (ACP) region and to prevent internal conflict within the newly formed body (Anderson 2003). However, the EU regime was inefficient, created consumer losses in welfare (Borrell and Yang 1999, and Sutton 1997), and in 1998, the WTO ruled that this EU regime was discriminatory. When the dispute was finally settled, the EU agreed to replace the quotas that had protected APC countries with a tariff that was to be eventually eliminated.

According to Alexandraki and Lankes (2004), St. Lucia was among the ten countries most exposed to losses from the change in EU preferences. In St. Lucia, before the 1998 World Trade Organization (WTO) ruling, banana was an important contributor to the country's GDP. Banana exports contributed 10.3% of GDP in 1990, but by 2006 it had declined to 1.9% of GDP (IMF 1999; IMF 2008). In the 1980s - 1990s approximately 30,000 persons were employed in banana production (IMF 2002; ECCB 2008). The number of banana farmers fell from 10,000 in the 1990s, to 4,800 by 2000, with only 2000-3000 expected to remain in production after the industry had adjusted fully (IMF 2004). The Central Statistical Office of St. Lucia (KAIRI 2006) reported that there was also significant increase in unemployment because of the reduction in banana exports and associated industries such as the manufacture of shipping boxes for banana export. The government of St.

Lucia anticipated negative effects and with the aid of STABEX (Système de stabilisation des recettes d'exportation) funds, from the EU, implemented programs to ameliorate the harm to the banana industry. Social recovery programs such as adult education and a farmers' pension scheme were also undertaken (IMF 2002).

Given the importance of banana to the economy, the liberalization would be expected to have had impacts manifested in a variety of economic indicators, although there would be debate as to whether these would be positive or negative. Some economists would argue that liberalization would eventually benefit an open economy like St. Lucia, while others would argue that growing poverty and inequality would be the result. With this in mind, the focus of this paper is on an investigation into how income inequality changed in St. Lucia following the liberalization of banana marketing in the EU.

1.1 Objectives

As is the case with many smaller Caribbean islands, there is limited availability of data for St. Lucia, so this prevented an investigation into the direct relationship between trade liberalization and income distribution. However this paper answers the following related questions; was there a change in inequality measured by household expenditures in St. Lucia following the liberalization of banana marketing? For a subset of the population who are tax payers, how has income inequality changed in St. Lucia between 1998 and 2007? The paper proceeds with a brief overview of the St Lucian economy, and then presents the theoretical framework and methods, estimation results, analysis and conclusions.

1.2 The Economy of St. Lucia

St. Lucia is an island state situated in the Eastern Caribbean with an area of 620 km² of which 4.9% is categorized as arable land. It has a population of 168,000 that was estimated to be growing at a rate of 2%, in 1997. However, by 2006 the growth rate had declined to 1.4 % (IMF 2008). In 2008, St. Lucia had a GDP per capita of US\$5,546, high enough to be considered to be a middle income country (World Bank 2008), with a small open economy and highly dependent on foreign trade to sustain economic growth. The inflation rate for 2004 was 1.4% increasing to 3.9% in 2005 and falling to 1.8% in 2010. In 2008, the unemployment rate was 15.7% down from 21% in 2004 (Central Statistical Office (CSO) St. Lucia 2008). In 1995, almost a quarter (24.1%) of the population was categorized as poor (those living below the poverty line¹), rising to 28.8% in 2005. The proportion of poor households moved from 18% in 1995 to 21% in 2005. The poverty gap² increased from 8.6% in 1995 to 9% in 2005. The working poor were employed in agriculture and manufacturing, and the declines in the banana and the manufacturing or assembly sectors were identified as the main reasons for the increasing incidence of poverty (KAIRI 2006b). Even so, as measured by KAIRI (2006a), the Gini coefficient, which measures inequality in the population, was 0.5 and 0.42 in 1995 and 2005 respectively, suggesting a decrease in inequality. However, the observed difference was not subjected to statistical testing, so it could just be due to chance, and therefore unreliable from a statistical point of view.

1 The poverty line in St. Lucia is set at US\$1.27 per day and is the minimum amount of money necessary to meet basic survival needs food, clothing shelter, (KAIRI, 2006).

2The poverty gap measures the mean distance below the poverty line as a percentage of the poverty line, where this mean is taken over the whole population

2.0 THEORETICAL FRAMEWORK: MEASURING INEQUALITY AND THE STATISTICAL SIGNIFICANCE OF CHANGES

2.1 The Gini Coefficient

The Gini coefficient is a widely used measure of inequality in a population. It lies between zero and one, with values closer to zero indicating higher equality. The Gini coefficient (G) can be defined as (Davidson, 2008a)

$$G = 1 - 2 \int_0^1 L(y) dy \quad (1)$$

Here L is the function describing the Lorenz curve and y is income.

2.2 The Bootstrap

The Gini coefficient is often reported for the same country at different points in time or for cross-country comparisons, without mention of the size of the standard errors. However, by reporting the standard errors reliable inferences can be made about the statistical significance of the changes observed in the Gini. Unlike estimators such as the mean, for which the standard error can be calculated using the standard formula: for many measures, such as measures of inequality, the calculation of the standard error is not as straight forward (Efron and Tibshirani 1993). The bootstrap is often the chosen method because of its ease of use and accuracy. No analytical expression for the estimator is needed, regardless of the complexity of the computation for deriving it (Efron and Tibshirani 1993; Boos 2003; Chernick 2008). (Efron and Tibshirani 1993; Moran 2003). A further advantage of the bootstrap is that it can be used even if the data are multimodal or skewed, so that a linear approximation is not necessary (Chernick 2008). In fact Davidson (2009) also showed that the bootstrap gave a more

reliable estimator than that derived through asymptotic approximations. The bootstrap procedure is preferred since it minimizes the error in rejection probability in a fixed sample, and it is considered a superior approach to the estimation of critical values when compared with those obtained from asymptotic theory (Davidson and MacKinnon 2006).

The notation defining the terms used in the description of the bootstrap is as follows:

1. θ A parameter of the distribution F of a random variable
2. $\theta = t(F)$ The parameter θ is a function of t of F
3. $\hat{\theta}$ The parameter estimate (estimator) obtained from a sample of the population.
4. $\hat{\theta} = t(\hat{P})$ The estimator is a function of the empirical distribution \hat{P}
5. $\hat{\theta}^*$ The bootstrap estimate of the parameter
6. se Standard error
7. $\hat{se}_{\hat{P}}^*$ The bootstrap standard error of the empirical distribution.

The bootstrap is a re-sampling procedure that replicates the procedure by which the original data were collected with replacement. For each re-sampled distribution, the statistic of interest is calculated. After the chosen number of replications, the values of the statistic are used to compute a suitable measure such as the standard error. The re-sampling procedure ensures the sampling distributions generated remain IID, (independent and identically distributed).

Each of the bootstrap samples has a sample size of n elements and is drawn from the empirical distribution \hat{P} .

$$s((x^{*1}), (x^{*2}) \dots x^{*B})) \quad (2)$$

B is the number of the replicates drawn from the original data set X and used to obtain x^* . Heres(*) is the operator used to calculate the statistic. This method can be used because according to the law of large numbers, as the number of replications gets very large, the bootstrap standard error³ approaches the standard error of the empirical distribution.

2.3 Estimating Standard Errors for the Gini

In order to make inferences about the Gini coefficient, it is necessary to calculate its standard error, although this is not straightforward. Davidson (2009) made note of the interest in the literature given to the problem of estimating the Gini standard error when a plug-in estimator is used for which no assumption is made about its distribution. He observed that there have been a number of approaches to the problem, but that these were not satisfactory for one reason or another. For a randomly drawn sample of size n, that is IID, Davidson (2009) showed how to compute an asymptotically correct standard error for the Gini coefficient and it is his method that is adopted here. First, the Gini is defined as in equation 3.

$$\hat{G} = \frac{2}{\hat{P}n^2} \sum_{i=1}^n y_{(i)} \left(i - \frac{1}{2} \right) - 1 \quad (3)$$

Where

3 The definition of standard error being the general term for the standard deviation of a summary statistic (Efron&Tisbhirani 1993; 40)

$y_{(i)}$ = the order statistics for income (income data, ordered from smallest to largest)
 n = number of observations
 i = observation number
 \bar{y} = average income based on the sample

The bias corrected Gini coefficient is calculated by multiplying the above Gini expression above by $(n/n-1)$. Following Davidson (2009), the procedure for calculating the Gini is:

1. Compute the vector:

$$w_i = \frac{1}{2n} (2i-1)y_{(i)} \quad (4)$$

2. Calculate the mean of w_i $\hat{I} = \frac{1}{n} \sum_{i=1}^n w_i$ (5)

3. Calculate the bias corrected Gini

$$\tilde{G} = \left(\frac{n}{n-1} \right) \left(\frac{2\hat{I}}{\bar{y}-1} \right) \quad (6)$$

To compute the variance and standard error, the vector v_i is formed as the partial sums of the income data. The steps are summarized as follows:

$$v_i = \frac{1}{n} \sum_{j=1}^i y_{(j)}$$

Note that: $v_1 = (1/n)y_{(1)}$

$$v_2 = (1/n)(y_{(1)} + y_{(2)})$$

$$v_3 = (1/n)(y_{(1)} + y_{(2)} + y_{(3)}) \text{ and so on} \quad (7)$$

Create the following vector and calculate its mean and variance

$$\tilde{Z}_i = -(\tilde{G}+1)y_{(i)} + 2(w_i - v_i) \quad (8)$$

$$\bar{Z} = \sum_{i=1}^n \tilde{Z}_i \quad (9)$$

$$\tilde{V}(\tilde{G}) = \sum_{i=1}^n (\tilde{Z}_i - \bar{Z})^2 \cdot \left(\frac{1}{(n\tilde{y})^2} \right) \text{ and } \tilde{V}_G^2 = (\tilde{V}(\tilde{G}))^{1/2} \quad (10)$$

To test for the difference between two Gini coefficients Davidson (2009) recommends first to define the standard errors as $\tilde{\sigma}_{G1}$ and $\tilde{\sigma}_{G2}$. The test statistic for two independent populations used to test whether the two Gini coefficients are the same is:

$$T = (\tilde{G}_1 - \tilde{G}_2) / (\tilde{\sigma}_{G1}^2 + \tilde{\sigma}_{G2}^2)^{1/2}. \quad (11)$$

Davidson (2009) suggested that when his estimate of the standard error of the Gini coefficient is used together with the bootstrap, reliable inferences can be made and he also showed how the bootstrap p-value could be calculated.

3.0 Data sources and treatment

The first data set are annual household expenditure data, obtained from the 1995 and 2005 household surveys conducted by the Central Statistical Office of St. Lucia, although these data do not constitute a panel data set. The data set for 2005 contains 1222 households (4319 persons) while the 1995 data set contains 600 households (2200 persons). This represents 2.7 and 2 percent of the population respectively. An adjustment for size of household was made to account for the fact that in households with children, the needs are different from those without children. The adjustment was made using a household equivalence scale. This is an index number used adjust the data so as to compare welfare or real income across households (Deaton and Muellbauer 1980), based the poverty gap (p) at market

prices for a household, with A adults and K children. The equivalence scale is defined as the ratio of expenditures needed for a family unit, relative to expenditures needed for a reference unit (usually a family of four; two adults and two children). There are several equivalence scales that could be used, and the one used here is a square root scale and is equal to the household income divided by the square root of the household size.⁴

The second data set contains individual income tax data obtained from the Inland Revenue Department of St. Lucia and contains an annual panel data set from 1998-2008 for 14,000 persons. It was used to investigate the changes in income inequality from 1998-2008 for taxpayers in St. Lucia. Both data sets are assumed to meet the quality requirements as described by Deininger and Squire (1996).

A cursory investigation of the income tax data suggested that there might be measurement error arising from data input and reporting bias (under reporting or over reporting by respondents). To account for this, a balanced trim of the distributions, involving the removal of 5% and 1% of both tails is conducted. Adjustment is made on both tails since there is no reason to believe that data contamination arose from an economic phenomenon that affected one tail more than the other (Cowell et al. 1999).

For some households, total expenditure was recorded as zero. This suggests that the household made no purchases, yet this is a bit unrealistic. Since it occurs in a small number of instances, these observations were dropped. Where there is zero income in the income tax data set, there was no information on the unit for that year (Personal communication, Leon)⁵. This means the individual either did not earn

income or did not report it. When Cowell et al. (1999) conducted analysis on the sensitivity of their results to the presence of zero incomes, they found that dropping or keeping the zero incomes had no effect on the direction of inequality in their study. The income tax data were adjusted by the consumer price index for 2007 to allow for comparability, following Deaton (1997).

4.0 EMPIRICAL RESULTS

4.1 Hypothesis Testing for the Difference in Gini Coefficients

As previously noted, the method proposed by Davidson (2009) for the calculation of the Gini coefficient, along with its standard error was presented as being advantageous over those computed using a jackknife method, which does not provide reliable estimates for the standard error. Using the data on per capita expenditure, the procedure outlined by Davidson (2009) was used to determine if there is a statistically significant difference between Gini coefficients for 1995 and 2005.

The null hypothesis is:

$$H_0: \text{Gini}_{2005} - \text{Gini}_{1995} = 0.$$

The p-value as described by Davidson (2009) is used to evaluate the strength of result. Rejection of the null hypothesis occurs if the bootstrap p-value is less than the chosen level of significance. Following this analysis it is possible to state whether changes in inequality between 1995 and 2005 were statistically significant.

The number of replications was chosen as 1000, with replacement, in accordance with Kennedy (2006), since a large number is needed to have an accurate calculation of the tails of the distributions and there is virtually no cost to having a large number of repetitions.

⁴(<http://www.oecd.org/els/social>).

⁵ Marlene Leon Inland Revenue Department Government of St. Lucia April 7, 2009

4.2 Expenditure data descriptive statistics and bootstrapped Gini coefficients

The unit of observation is the individual and the unit of measure is expenditure measured in Eastern Caribbean dollars (with EC \$1 worth US\$0.37). The variable representing expenditure is per capita equivalent adult expenditure (Pcexpae), and summary statistics are presented in Table 4.1. It can be seen that the mean per capita adult equivalent expenditure in 2005 was \$10,615 which was almost 20 times higher than the 1995 value of \$520. This discrepancy is most likely due to the survey methods. The survey instrument used in 1995 to collect expenditure data was based on recall, whereas the survey instrument for 2005 included a diary in which respondents logged their expenditure and repeated visits were made to households during the data collection period. Deaton (1997) explained that relying on recall often results in downward-biased estimates. It is therefore likely that measurement error due to this recall bias was the reason for the small values in 1995 compared to the 2005 expenditure values.

The difference in average income for 1995 and 2005 was tested using the Mann-Whitney U test (similar to the t-test but it is used with income data since these are not normally distributed (Bernstein and Bernstein 1999)). The difference in average income was shown to be statistically significant, with a z-value of 66.7 and a p-value of near zero, not a surprising result given the magnitude of the difference.

The median income is less than the mean, so half of the population receives an income less than the mean. The standard deviation is greater than the mean which tends to be the case with income distribution data which is usually positively skewed.

The results of the bootstrapped Gini coefficient based on the expenditure data (Pcexpae) for 1995 and 2005 are presented below. These statistics were calculated with the full set of data, followed by recalculation after having trimmed 1% and 5% of the observations, at both ends of the distribution. The bootstrap was done in a two stage process, using the STATA command (Ineqerr) that replicates the original data generating process, which used a two stage stratified procedure in which the district was the first stage of the selection process.

The estimated Gini coefficients indicate that there was less inequality in expenditure in 2005 compared to 1995, and it can be seen that the direction of inequality does not change even when the data were trimmed at 1% and 5%. Based simply on the assessment of the 95% confidence intervals, it could be inferred that the difference in the Gini coefficient between 1995 and 2005 is not statistically significant at a 5% level.

The bootstrap replications of the Gini coefficient are presented below in Figures 4.1 and 4.2 where it can be seen that these are fairly normally distributed permitting the use of the Students-t test for hypothesis testing.

The bias corrected Gini is calculated by multiplying the observed Gini by $(n/n-1)$, yielding a Gini of 0.466 and 0.430 for 1995 and 2005 respectively. These were used to test the null hypothesis that there was no difference between the two years. The test statistic for the difference was calculated using equation (11) and resulted in $t = -1.178$, which for a two-tailed test is not significant at the 5% level. However, the t-test for the trimmed data at 1% and 5% are not consistent with this since their t-values are -1.739 and -2.10 respectively, indicating that it is possible to reject the null hypothesis. Using these results, there is evidence of a statistically significant improvement in the Gini coefficient between 1995 and 2005.

4.3 Descriptive statistics for income tax data and bootstrapped Gini coefficients

Summary statistics for the income tax data for 1998 and 2007 are presented below in Table 4.3. It can be seen that the variance of the distributions is higher in 1998 than in 2007, indicating that there is less spread in income in 2007. The mean income increased between 1998 and 2007 by 90%, in parallel with the median.

The Gini coefficient was calculated as previously, for the full data set and the data trimmed either one or five percent (Table 4.4). The pattern is consistent with a general movement towards a reduction in income inequality, and is consistent with what was observed using the expenditure data.

As before, the Gini coefficients were tested to determine if there had been a statistically significant change between 1998 and 2007. The analysis in Appendix 1 shows that these changes in inequality measured by the Gini coefficients are statistically significant at the 5% level for the original data and the trimmed data.

5.0 Conclusion

In St. Lucia, the liberalization of international banana marketing by the EU was followed by a marked decline in banana production, an increase in unemployment, and a decrease in welfare, at least in the short term. On the other hand, the likely longer term effect of trade liberalization on income distribution could not have been predicted *a priori* because of the particular economic, institutional, political, and social context in relation to other countries. Economic theory would suggest an improvement over time. While it was not possible to establish a direct causal relationship between the liberalization of banana marketing and changes in income distribution in St. Lucia,

it was possible to examine the changes in inequality between the period leading up to and following liberalization. This was accomplished by calculating Gini coefficients for these two time periods, using expenditure data from household surveys of 1995 and 2005 and income tax data for the period 1998 to 2007.

Implications of Study

The results indicate that when using household expenditure data, the changes observed in inequality between 1995 and 2005 were mixed in terms of statistical significance. When the entire data set was used, the apparent improvement in income inequality was of mixed significance and inconclusive. This underlies the need for calculating and reporting tests of statistical significance when evaluating changes in the Gini coefficient between two points in time. With regards to the use of income tax data, changes in income inequality were uniformly significant between 1998 and 2007. In fact, the improvement in the income distribution between these points in time was highly significant. Thus, we can have confidence in these results.

Despite the high levels of unemployment recorded after the collapse of the industry, there is evidence that inequality declined for tax payers in the years following the liberalization. It is possible that excess labour migrated easily into other sectors such as tourism and manufacturing. The programs instituted with the support of STABEX funding may be another explanation. Another factor to consider, as suggested by Li et al. (1998), is that the factors that affect income inequality, such as access to loans, credit and other institutions remain fairly constant over time within countries, and these helped support the transition to the new reality. So it is possible that there were no major changes in these areas and this is reflected in the improvement observed in

the Gini coefficient for the period under study.

Finally, it must be acknowledged that the quality of the data available for this study presented a challenge to the analysis, and this challenge is not unique to St. Lucia. Consistent and reliable data is an important factor limiting sound economic policy analysis in many of the smaller Caribbean islands, as it is in developing countries in other regions. Higher quality data is necessary to provide a solid foundation for more economic analysis and policy recommendations for smaller islands like St. Lucia.

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Table 4.1 Descriptive statistics for household expenditure (Pcexpae) for 1995 and 2005

	1995	2005
No of observations	2,324	4,318
Standard Deviation	609.7	10,853.3
Mean EC\$	519.6	10615.4
Median EC\$	333	7532
Minimum EC\$	0	755
Maximum EC\$	9699	141,320

Table 4.2 Bootstrapped Gini Coefficients for 1995 and 2005

	1995	2005	1% trim 1995	5% trim 1995	1% trim 2005	5% trim 2005
Gini	0.466	0.430	0.427	0.3501	0.395	0.327
Bias	- 0.00546	- 0.00342	- 0.0038	- 0.0010	- 0.0016	0.0014
Standard error	0.0232	0.01624	0.0134	0.0098	0.0126	0.0109
95% lower limit	0.4234	0.3947	0.4023	0.331	0.373	0.3102
95% upper limit	0.5097	0.4589	0.4510	0.3733	0.4246	0.3505

Table 4.3 Summary statistics for income tax data, 1998 and 2007

Statistic	1998	2007
N	9721	7100
Max	6,184,058	725,298
Min	0	0
Zeros	21	6
SD	79,715	28,408
Mean	16,746	31,831
Median	10300.00	26208
Variance	6,354,631,923	807,059,350

Table 4.4 Gini coefficients for the income tax data 1998-2007

Year	Gini coefficient
1998	0.553
1998 1% trim	0.491
1998 5% trim	0.449
2007	0.402
2007 1% trim	0.371
2007 5% trim	0.291

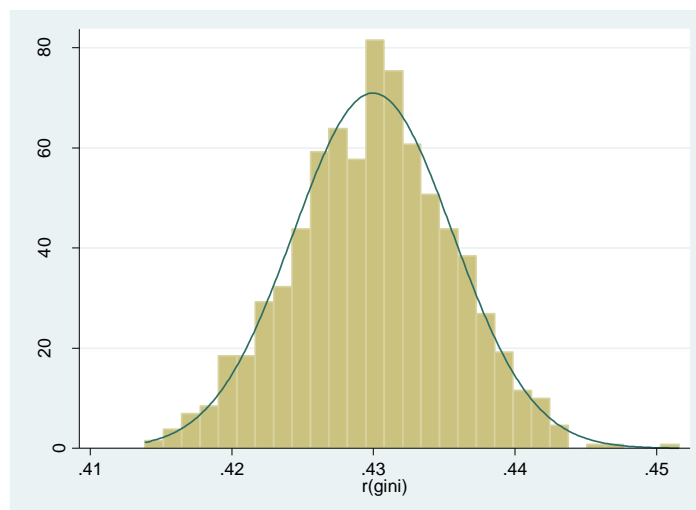


Figure 4.1 Bootstrap of the Gini Coefficient (2005)

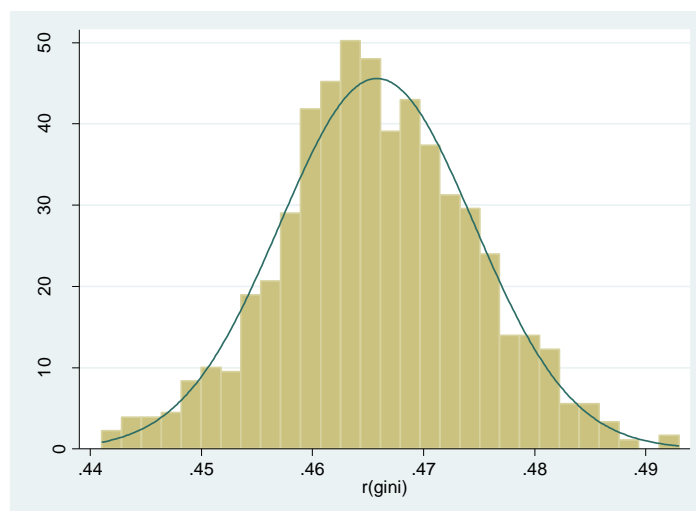


Figure 4.2 Bootstrap of the Gini Coefficient (1995)

APPENDIX 1

Calculation of the t-value for income tax data for 1998 and 2007

no trim		
Gini 1998	0.553	
Gini 2007	0.402	
se 1998	0.0208	
se2007	0.0043	
t value		-7.11
1% trim		
Gini 1998	0.491	
Gini 2007	0.371	
se 1998	0.002	
se 2007	0.003	
t value		-33.28
5% trim		
Gini 1998	0.449	
Gini 2007	0.294	
se 1998	0.0025	
se 2007	0.0022	
t value		-46.54