Economics in Action: Course Work Task 2

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Comparison of Inequality Using Lorenz Curve and Gini Coefficient

One of the methods used to assess and compare level of inequality within and between regions is distribution of income among households represented in a form of a graph named Lorenz curve. In addition, because charts require more complex interpretation approach than numbers, Gini coefficient calculated based on the source data is often used to express and compare inequality among different populations.

Lorenz curve is a line chart plotting cumulative share on income against cumulative share of household on total population, both expressed as percentage(Gastwirth, 1971). In figure 1, the black line is a Lorenz curve for a fictional economy. In a situation of perfect equality, the black curve would follow the gray line, forming a perfect line, as marginal 1% of households would possess 1% of total income.

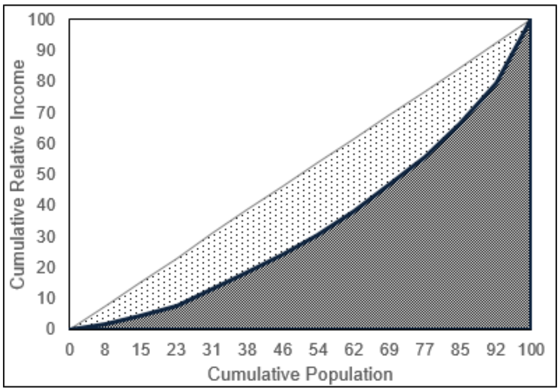


Figure 1: Example Lorenz Curve

Gini coefficient is a figure expressing how far from perfect equality the analyzed distribution is. Essentially, it equals the ratio of the dotted area to the whole area below the gray curve, i.e. the sum of the shaded area and the dotted area. For the scenario of perfect equality this value would be equal to 0(The World Bank,, 2016). Provided that $\int_0^1 y_i\ dx = \frac{1}{2}$, the gini coefficient is equal to $2 \times (0.5 - \int_0^1 L(x)\ dx)$. However, because real-world data do not enable exact deduction of the mathematical $L(x)$ formula for Lorenz curve, statistical methods are used.

Exemplifying rendering of a Lorenz curves for model populations firstly requires reordering of the data in ascending order by income. Both given populations consist of three individuals whose incomes are $A : y_i = \{100,\ 20,\ 40\}$ and $B : y_i\{180,\ 20,\ 120\}$. Computation of relative cumulative values for income ($cml\%y_N = \frac{\sum_{i=1}^{n}(y_n)}{\sum_{i=1}^{N}(y)}$) and population ($cml\%N = \frac{n}{N}$) follows. The results are shown in table 1. Row where $n = 0$ was added in order to display origin of the curve correctly in a spreadsheet processor.

n	y_n	$cml\%N$	$cml\%y_N$
0	0	0%	0%
1	20	33%	12.5%
2	40	67%	37.5%
3	100	100%	100%

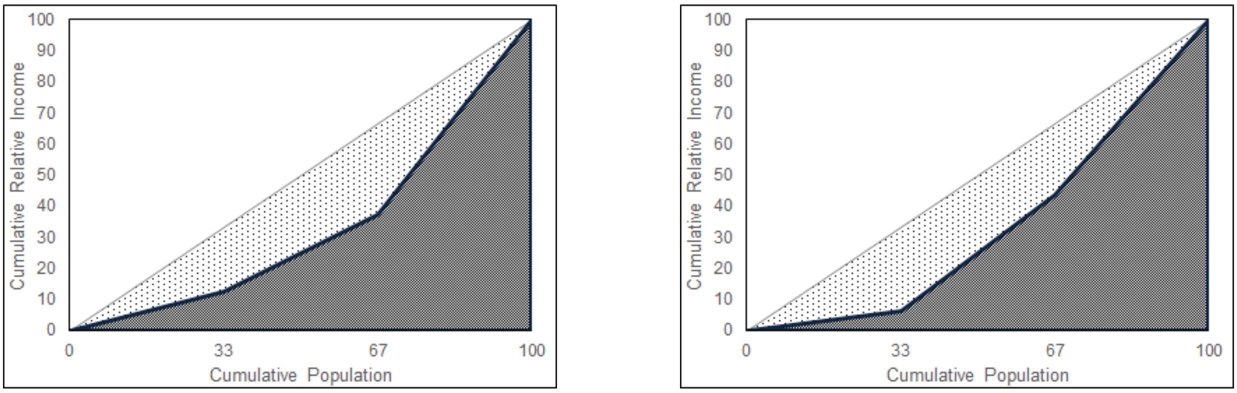
(a) Case A

n	y_n	$cml\%N$	$cml\%y_N$
0	0	0%	0%
1	20	33%	6.25%
2	120	67%	43.75%
3	180	100%	100%

(b) Case B

Table 1: Data necessary for drawing the Lorenz curve

As figure 2 shows, Lorenz curves for the two different cases were produced. While the curve for case A seems to show a higher gap between the middle and richest third of population, case B presents with a curve more bowed in the poorest third. In order to compare the level of inequality between those two populations, three methods are used: Lorenz dominance, Gini coefficient, and generalized Lorenz dominance.



(a) Case A (b) Case B

Figure 2: Lorenz curves for model populations

In order for a wealth distribution to be Lorenz dominant, the cumulative relative income must be higher at all values of cumulative share on population, compared to the other distribution. Represented graphically, the curve of Lorenz dominant distribution has to be above the distribution with lower level of equality(Basso, 2016). Effectively, this implies that such type of dominance can only exist under the condition that the two curves do not cross.

Applying this on the example populations, figure 3 shows both curves plotted in the same chart. Because of the fact that they cross in proximity of 50% of cumulative share on total population, neither one of them Lorenz dominates the other. In result of this, it is not possible to determine, which of the distributions is more equal, based on this concept.

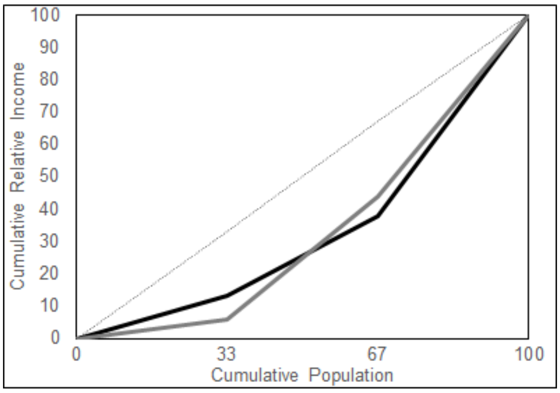


Figure 3: Comparison of Lorenz Curves for Case A (black) and B (gray)

The next approach used for comparison of wealth distribution is calculation of Gini coefficient. Statistical method of calculation of Gini coefficient can be written as $G = 1 - \frac{\sum_{i=1}^{N}[[2(N-i)]\times y_i]}{N^2 \times \bar{y}}$ where N is the total population, y_i is income for the current individual, and $\bar{y}$ represents the mean income in the population.

$$G_A = 1 - \frac{[[2(3-1)+1]\times 20] + [[2(3-2)+1]\times 40] + [[2(3-3)+1]\times 100]}{3^2 \times [\frac{20+40+100}{3}]} = \dots$$

$$\dots = 1 - \frac{5\times 20 + 3\times 40 + 1\times 100}{\frac{1040}{3}} = 1 - \frac{100+120+100}{480} = 1 - \frac{2}{3} = \frac{1}{3}$$

$$G_B = 1 - \frac{5\times 20 + 3\times 120 + 1\times 180}{9\times \frac{320}{3}} = 1 - \frac{640}{960} = 1 - \frac{2}{3} = \frac{1}{3}$$

Because the Gini coefficient for both populations is $G_A = G_B = \frac{1}{3}$, it is not resolutive in the comparison of equality of given wealth distributions.

Comparison using generalized Lorenz dominance is the last of three methods applied on these cases. The concept is identical to the Lorenz dominance, with the difference of multiplication of the cumulative share on income by the mean income, in order to include the absolute wealth of the two populations as whole. In result, only the distribution with higher mean income can be subject to generalized Lorenz Dominance.

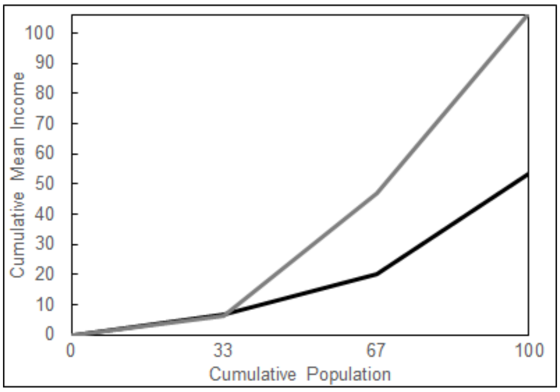


Figure 4: Generalized Lorenz dominance

		Case A		Case B	
n	$cml\%N$	$cml\%y_N$	$cml\%y_N \times \bar{y}$	$cml\%y_N$	$cml\%y_N \times \bar{y}$
0	0%	0%	0	0%	0
1	33%	12.5%	6.67	6.25%	6.67
2	67%	37.5%	20.00	43.75%	46.67
3	100%	100%	53.33	100%	106.67
$N = 3$		$\bar{y} = 53.\bar{3}$		$\bar{y} = 106.\bar{6}$	

Table 2: Table

The figure 4 displays the wealth distribution of population B seems to present with generalized Lorenz dominance. Relating to the source values proves this assumption correct, however, it is necessary that unrounded values are used. Due to the fact that $N_A = N_B = 3$, it is also possible to verify this by observning $y_{A1} = y_{B1} = 20$. Subsequently, it is proven true that $GL_B(\frac{n}{N}) \geq GL_A(\frac{n}{N})$, i.e. the wealth distribution in population B is GL dominant to the one in population A.

In conclusion, Lorenz curve is a graphical representation of income distribution used for description and comparision of inequalities among countries. The methods used to determine the absolute and relative level of equality based on the Lorenz curve include Lorenz dominance, Generalized Lorenz dominance, and Gini coefficient. The solved example proved existence of income distributions, for which it is necessary to use all of these mechanisms in order to assess them correctly.

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Role of Central Bank in an Economy

National central banks are institutions, which control the money markets in their respective economies. Their main goal is to establish and maintain price stability in an economy in order to facilitate growth of its real total output driving the country to enter and remain in a state of feasible inflation rate and high employment (Casu *et al.*, 2006). In order to achieve this, they use tools of monetary policy, focusing on inflation targeting. These tools mainly consist of open market operations, reserve requirements, manipulation of discount rates, and quantitative easing.

In order for a central bank to be able to exercise the monetary policy tools, they need to have certain position in the economy. It has been argued what the ideal extent of central bank independence is, however, central banks in developed countries mostly function autonomously and adapt to macroeconomic policies implied by the government(Bohm, 2007). One of the key indicators to the extent of independence of central bank is who sets its targets, which for example include the aforementioned 2% CPI inflation rate, which is set in case of Bank of England .

Central banks have multiple functions in the economy, which effectively contribute to their ability to create and use the tools to regulate the money market.

Firstly, due to the fact they issue and control the physical circulating currency in given country or currency union, they are able to influence the overall supply of narrow money. In the United Kingdom, there is currently about GBP 75.6 million worth of banknotes and coins in circulation (M0), which however only forms about 3.54% of the M4, which represents the total amount of broad money in the economy (Bank of England,, 2016b). Because of this proportion of M0 on M4, this function is not effective in contribution to the monetary policy, as the effect on the money supply would take very long time. For this reason, the literal meaning of the phrase “printing money” may only be useful in economies with low proportion of credit money.

Secondly, they have the power to control the amount of credit money that is created by the commercial banks by establishing a reserve requirement, which is a fraction of the deposits in the commercial banks, which is stored by the central banks in order to regulate further lendingCasu *et al.* (2006). Practical example of reserve requirement can be seen in case of the Czech National Bank, which obliges the commercial banks to store 2% of all deposits with withdrawal period shorter than 2 years(Czech National Bank,, 2016). The Bank of England does not impose such regulation in this exact definition, it however sets capital requirement, which is a fraction of deposits to be stored in by the commercial banks in form of liquid assets.

The next function of central banks is to act as lenders to commercial banks, which need to increase their short-term liquidity. These loans are provided for a collateral in form of the banks financial assets, such as government or corporate bonds, which present with a low level of liquidity. Owing to this, such loans are one of the least risky, which is why their interest rate is lowest in the economy, often referred to as base rate(Casu *et al.*, 2006). Changes in this interest rate negatively affect the amount of such loans the banks will take, which in result reflects on the interest rates paid on deposits and loans at the commercial banks, which in turn alters the total amount of money loaned. Such intervention is called discount window. Currently, the discount rate of Bank of England is 0.5%, as it was gradually decreased in result of the 2008 recession(Bank of England,, 2016a).

Finally, the central bank can exercise open market operations in order to directly influence the amount of money in the economy and the interest rate. This is done by selling or purchasing government debt securities to the private sector, i.e. households and firms in the non-bank private sector. If the central bank sells government bonds, the supply of money shifts to the left, causing the nominal interest rates to increase, which further leads to decrease of credit money created. Analogically, when the government bonds are repurchased, newly created money is injected in the economy, shifting the money supply to the right and decreasing the nominal interest rate.

An unconventional type of open market operation is quantitative easing, which was created after the 2008 financial crisis, when banks needed to further increase the money supply, while the interest rate were already close to zero. In this type of operation, the central bank purchases long-term government bonds as well as debt of the public, such as mortgages for money created electronically (Bank of England,, 2015).

In conclusion, this essay has summarized the main roles of the central banks in their economies and related them to monetary policy tools, which are being used in order to stabilize the money market and facilitate growth.

Section word count: 801

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