An Application of the Dagum Type III Model to Measure Household Net Wealth Inequality in Indonesia

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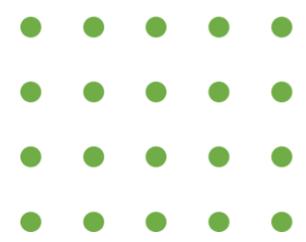## Does Migration Really Help to Narrow the Income Gap, Especially after the Returnee Comes Home?

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Why reducing inequality is important

- Reducing the gap in household living standards in Indonesia is crucial, as ignoring it can lead to serious consequences.
- Inequality limits poor households' access to education and health services, resulting in lower educational attainment and poorer health outcomes compared to richer households.
- A wide gap also entrenches monopoly, corruption, and cronyism, as wealthy groups use these practices to preserve their wealth while poorer households rely on them to improve their living standards.

- Inequality can be measured from household net wealth. This measurement can overcome limitations when using income and expenditure to measure inequality

Household net wealth measurement

Some of its superiority is:

1. Wealth reflects future purchasing power, whereas income is transitory and may not represent long-term economic capacity.
2. Wealth reduces bias by capturing households with high wealth but low income, such as retirees and inheritance recipients.
3. Wealth data are less affected by under-reporting, as households often conceal income or exclude non-market activities from expenditure reports.
4. Wealth measurement further accommodates mismatches between income and expenditure, which commonly diverge at both ends of the distribution.

Household net wealth measurement

- Another characteristic of household net wealth that is different from income or expenditure values is the existence of negative values.

  NW < 0 => Assets < debts
  NW = 0 => Assets = debts
  NW > 0 => Assets > debts

- This results in a concentration of households with low or negative wealth and a highly right-skewed distribution, reflecting a small share of households holding very high wealth levels.
- As a result, inequality measured using net wealth is typically more severe than inequality measured using income or expenditure.
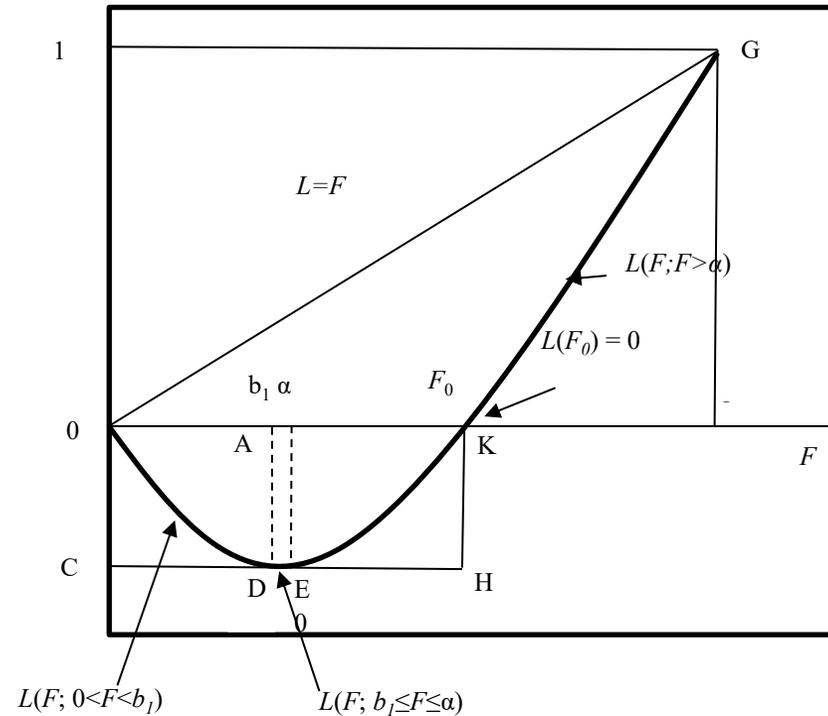
Measuring Household Net Wealth Inequality

Figure 1. Lorenz Curve L(F)=L(F(w)). Source: Dagum (1999)

The presence of negative values is reflected in the Lorenz curve, which lies below the horizontal axis.

Measuring Household Net Wealth Inequality

Accounting for negative values in the Lorenz curve over the interval $(0, F_0)$, the Gini coefficient is defined as twice the area between the line of equality $L = FL = F\alpha \mid L(b_1) \mid$

$$G = \left[2 \int_0^1 (F - L)dF \right] \Big/ [1 + \propto |L(b_1)|]$$

$$G = \left[1 - 2 \int_0^1 LdF \right] \Big/ [1 - \propto L(b_1)]$$

where $\int_0^1 LdF = \int_0^{b_1} LdF + \int_{b_1}^{\propto} LdF + \int_{\propto}^1 LdF$

By using parameters provided by the Dagum Type III model, the Gini Coefficient becomes (Clementi, et.al., 2012):

$$G = \frac{1 - 2\left\{ (1-\alpha)\beta\alpha \left[B\left(\alpha + \frac{1}{\delta}, 1 - \frac{1}{\delta}\right) - B\left(2\alpha + \frac{1}{\delta}, 1 - \frac{1}{\delta}\right) \right] - cb_1 \left(1 - b_1 \left(1 - b_1 2^{-1-1/s} \right) \Gamma\left(1 + \frac{1}{s}\right) \right) \right\}}{1 + \alpha c b_1 \Gamma\left(1 + \frac{1}{s}\right)}$$

That is, the Gini coefficient is twice the integral between the line of equality $L = FL = FOCHK$

- That is, the Gini coefficient is twice the integral between the line of equality L=F and the Lorenz curve, divided by one plus the area of the rectangle OCHK in Figure 1.

- Because negative values can place the Lorenz curve below the horizontal axis, the Gini coefficient may exceed 1.
- This is a theoretically valid outcome, though less meaningful in practical terms.

- We can use `dagumfit` following Jenkins (1999) to produce a more meaningful Gini Coefficient.
- 0 < Gini < 1

Data

Figure 2. IFLS Map
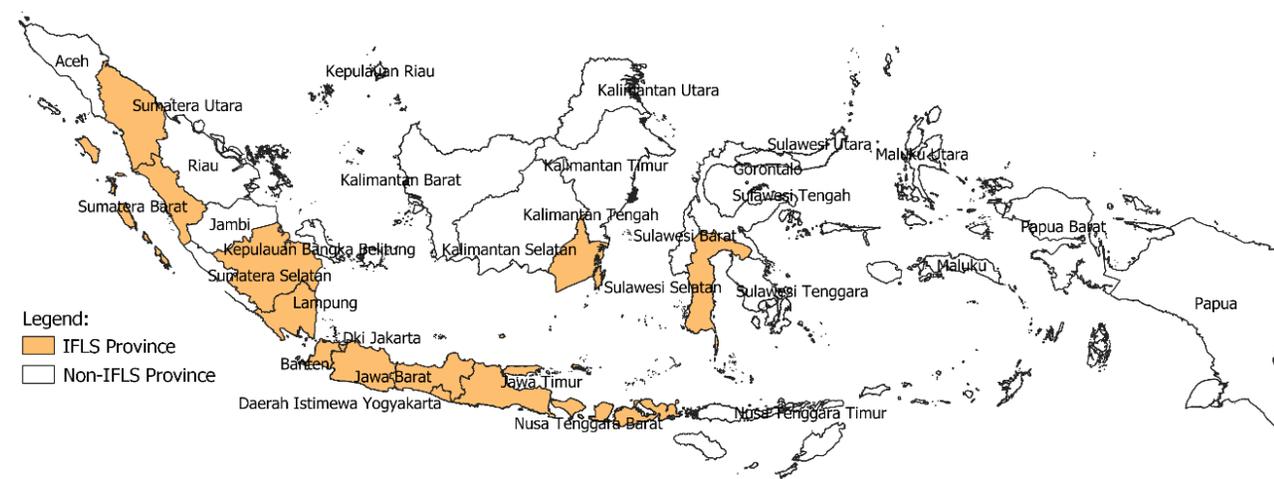
- This study uses household data from the Indonesian Family Life Survey (IFLS) covering 1993–2014.
- The IFLS is the largest longitudinal survey in Indonesia, providing rich information on household characteristics, health, demographic, socio-economic, and community conditions.

- It is representative of approximately 83% of the Indonesian population across 13 of 34 provinces.
- IFLS1 (1993) surveyed 7,224 households. Subsequent waves reinterviewed these households and their split-offs. IFLS2 (1997) with 7,698 HH, IFLS3 (2000) covers 10,574 HH, IFLS4 (2007) covers 13,995 HH, and IFLS5 (2014) covers 16,931 HH.
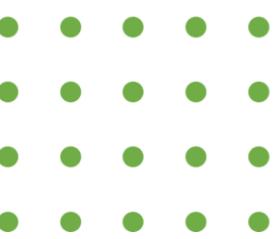
Method

- Household net wealth is calculated as total wealth minus debts.
- Total wealth includes the market value of three asset groups: farm business, non-farm business, and household assets (e.g., house, land, vehicles, savings, furniture).

$$NW = W - D$$

where NW = net wealth, W = total wealth, and D = debts.

Method

- To estimate household net wealth inequality, I applied the Dagum Type III model, as recommended by Brzeziński (2013), Clementi et al. (2018), and Cowell and Van Kerm (2015).
- The estimation uses the maximum likelihood procedure of Jenkins and Jäntti (2005), which improves upon Jenkins (1999) by accommodating negative, zero, and positive values rather than only positive values.
- In Stata, the Jenkins (1999) command is `dagumfit`. This procedure also allows the Dagum Type III parameters, which describe the distribution, to be converted into a single Gini coefficient for straightforward interpretation and comparison over time and across regions.

Graphical Results
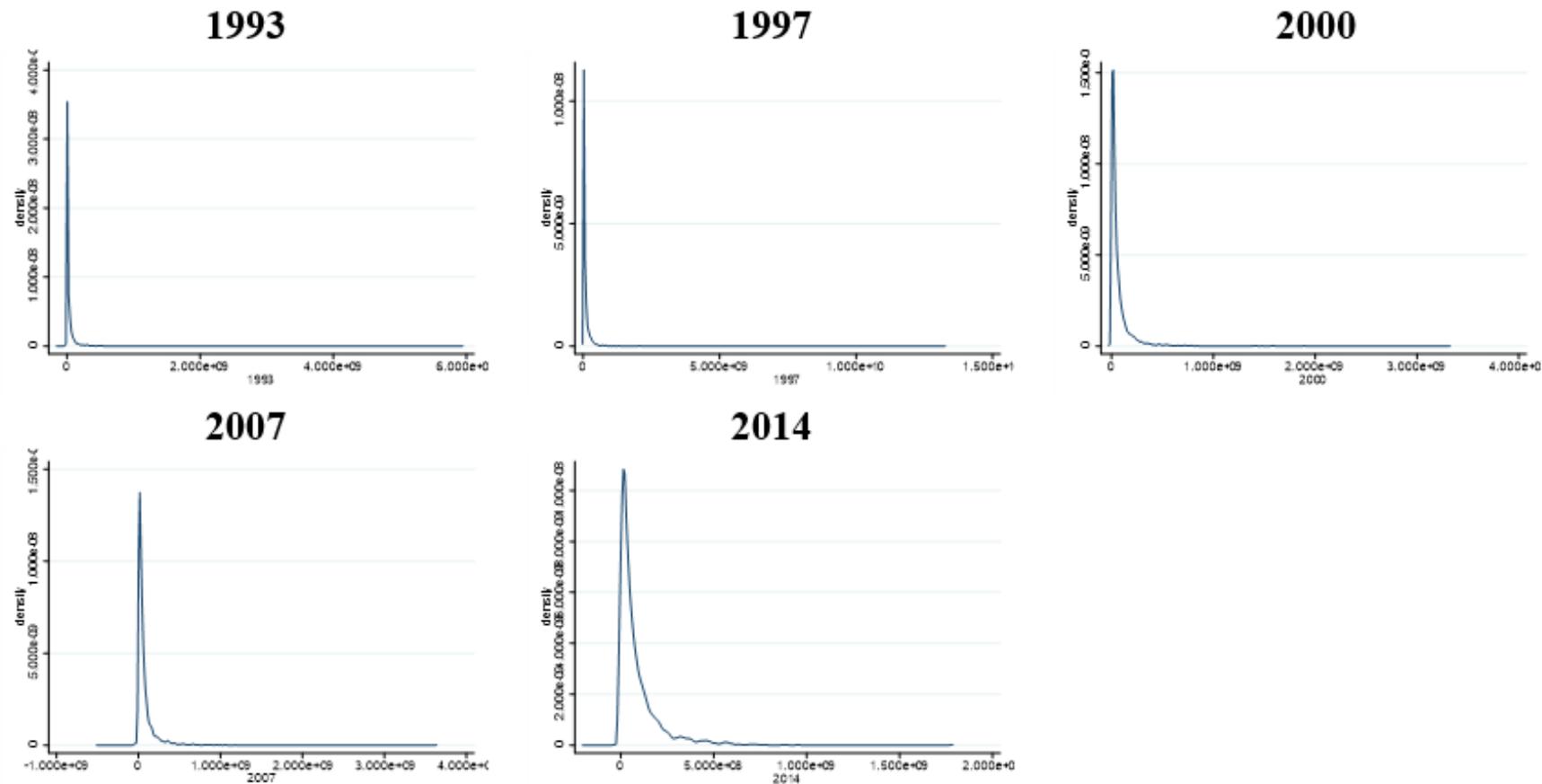
Figures 3. Kernel Density for Indonesian Net Wealth, 1993-2014

- The right skewness: most households hold low levels of wealth, while a small proportion hold very high net wealth.
- The heavy-tailed distribution. Thick upper tails with a concentration of high values.
- Together, these features imply an asymmetric distribution with a long upper tail and large top-wealth shares in Indonesia.

Graphical Results
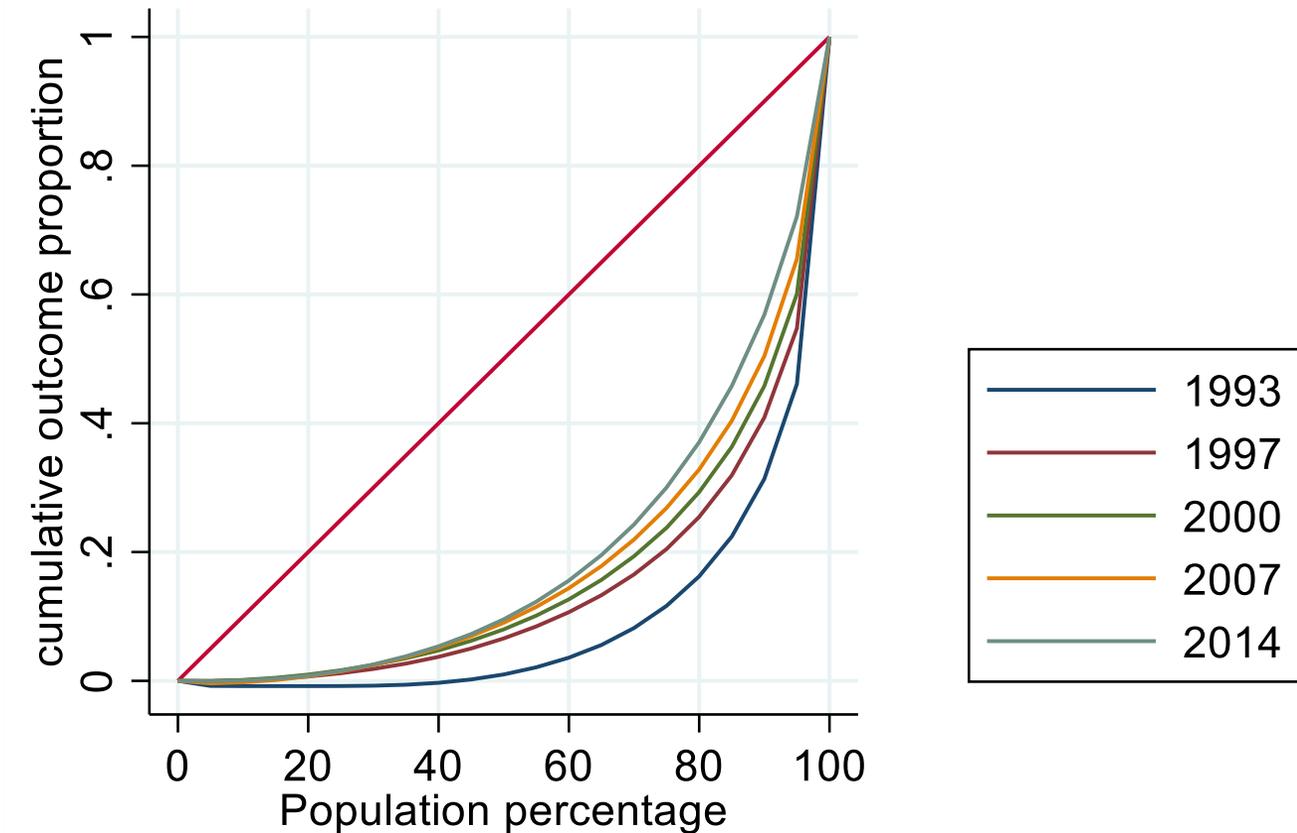
Figure 4. Lorenz Curve

- Lorenz Curve: the greater the distance from the diagonal, the higher the inequality.
- Over 1993–2014, the Lorenz curve is furthest from the diagonal in 1993, indicating the highest level of inequality, and closest in 2014, indicating the lowest inequality.

Numerical Results

- Model selection tests: Dagum Type III model outperforms alternative models such as the Singh–Maddala and Generalised Beta II distributions.

- The Dagum Type III estimation yields parameters that capture inequality across different segments of the distribution:
  α measures inequality among households with negative or zero net wealth,
  β reflects inequality among low- and middle-wealth households,
  δ represents inequality among the wealthiest households, and
  λ indicates overall net wealth dispersion (Table 6).

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Table 6. Estimates Dagum Type III Parameters, 1993-2014

α measures inequality among households with negative or zero net wealth,

β reflects inequality among low- and middle-wealth households,

δ represents inequality among the wealthiest households, and

λ indicates overall net wealth dispersion

	1993	1997	2000	2007	2014
α	1.329***	1.333***	1.42***	1.627***	1.865***
	(0.05)	(0.038)	(0.039)	(0.046)	(0.068)
β (x10^6)	45.9***	54.8***	50.6***	73.6***	127***
	(3.459)	(3.96)	(3.554)	(4.084)	(7.4)
δ	0.43***	0.646***	0.667***	0.532***	0.369***
	(0.026)	(0.036)	(0.039)	(0.028)	(0.021)
λ (x10^{-6})	0.29***	0.283***	0.104***	0.039**	0.093***
	(0.062)	(0.079)	(0.04)	(0.019)	(0.033)
b_1 (NW<0)	0.106***	0.009***	0.006***	0.014***	0.006***
	(0.006)	(0.002)	(0.001)	(0.002)	(0.001)
b_2 (NW=0)	0.105***	0.009***	0.002**	0.009***	0.002**
	(0.005)	(0.002)	(0.001)	(0.002)	(0.001)
b_3 (NW>0)	0.789***	0.982***	0.992***	0.977***	0.992***
	(0.007)	(0.002)	(0.002)	(0.003)	(0.002)
Log-likelihood	-83,639.58	-94,073.72	-94,209.16	-94,478.63	-95,608.44
Mean (Rp.) (x10^6)	59.050	124.300	100.100	92.381	105.900
Median (Rp.) (x10^6)	8.550	32.500	32.700	38.600	49.900
Mean NW>0 (Rp.) (x10^6)	75.283	126.700	100.900	94.955	106.800
Mean NW<0 (Rp) (x10^6)	-3.454	-3.529	-9.599	-25.606	-10.723
Gini	0.811	0.778	0.733	0.671	0.644

Note: ***=p<0.01, **=p<0.05, *=p<0.1. Parentheses show robust standard errors. Estimates parameters and Gini Coefficient is using Stata procedure provided by Jenkins and Jäntti (2005)

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- A declining inequality among households with negative and zero net wealth, as indicated by the increasing value of α.
- Lowest α in 1993: the highest inequality,
- Highest α in 2014: the lowest inequality.
- High inequality in 1993 means uneven development during the 1960s–1990s left households in the lowest wealth class holding very small shares of net wealth.

	1993	1997	2000	2007	2014
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- A similar trend is observed among low- and middle-wealth households, where inequality declines over time, as reflected by the increasing *β*.
- This pattern suggests the emergence of a more visible middle class, driven either by upward mobility of poorer households or downward mobility of previously wealthier households.
- Middle-class consumption in Indonesia has grown by 12% annually since 2002 and now accounts for nearly half of total household consumption.

	1993	1997	2000	2007	2014
α	1.329***	1.333***	1.42***	1.627***	1.865***
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	(0.062)	(0.079)	(0.04)	(0.019)	(0.033)

- In contrast, inequality among the richest households increases over 1993–2014, as indicated by the declining δ.
- This trend may reflect greater entry into the top wealth class due to increased economic participation and improved distribution of development gains following the recovery from the 1997/1998 Asian Financial Crisis.

	1993	1997	2000	2007	2014
α	1.329***	1.333***	1.42***	1.627***	1.865***
	(0.05)	(0.038)	(0.039)	(0.046)	(0.068)
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λ (x10^{-6})	0.29***	0.283***	0.104***	0.039**	0.093***
	(0.062)	(0.079)	(0.04)	(0.019)	(0.033)

- Another feature of the Dagum Type III model is its ability to capture data dispersion through the parameter λ.
- Over 1993–2014, household net wealth in Indonesia becomes more widely dispersed, with the least dispersion in 1993 (highest λ) and the greatest dispersion in 2007 (lowest λ).
- This pattern suggests that development gains, initially concentrated among upper-wealth households, were gradually distributed toward lower-wealth groups over time.

Gini Coefficient

	1993	1997	2000	2007	2014
Gini	0.811	0.778	0.733	0.671	0.644

- While the parameters α, β, δ, and λ are useful for examining within-class inequality dynamics, they are less effective for assessing overall inequality or making comparisons across years.
- Gini Coefficient enables clearer interpretation and comparison over time.
- The estimated Gini coefficients show a declining trend in household net wealth inequality in Indonesia from 1993 to 2014, with the highest inequality in 1993 and the lowest in 2014.

Characteristics

- Together, the Gini estimates and Dagum parameters indicate that high household net wealth inequality in Indonesia is characterised by:
  - High inequality among negative and zero net wealth households (low α)
  - High inequality among low- and middle-wealth households (low β)
  - High inequality among the richest households (low δ)
  - Less dispersed wealth distribution (high λ).

- Conversely, lower overall inequality is associated with lower within-class inequality (higher α, β, and δ) and a more dispersed net wealth distribution (lower λ).

Reducing Inequality among the Poorest Households

- Lowering inequality among the poorest households can be achieved through creating higher net wealth ownership.
- This can be achieved through widening opportunities for household members to gain employment, a promotion, or education, or if the infrastructure is improved.
- Further, increasing local attractiveness should be achieved to prevent over-urbanisation.

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Reducing Inequality among the Middle-class Households

- For middle-class households: create a more visible middle class.
- This can be achieved by creating greater economic opportunities for the poor- and lower classes to join the higher classes faster.
- At the same time, the middle class should be prevented from falling into the lower classes due to economic crisis, crop loss, job loss or death, or other income shocks.
- Should also manage debts carefully because the growth of consumption debts, which are largely consumed by the middle class in Indonesia rise 25-28% annually.

Reducing Inequality among the The Richest Households

- Regarding the richest households, low inequality can be achieved through providing wider access for poorer households to contribute to economic activities.
- This is important to allow poorer households to make higher economic contributions, as this prevents a situation where all the trades are between the richest individuals only, and thus, increases their chances of gaining profits from poorer agents.
- To prevent wealth condensation, a significant proportion of unspent income that is converted into assets, the income tax should be enforced as well as the wealth tax.

Conclusion

- Estimation from the Dagum Type III model shows a right-skewed distribution with long, sparse tails, reflecting many households with very low wealth and few with very high wealth.
- Between 1993 and 2013, inequality declined, as indicated by a decreasing Gini coefficient.
- High inequality is driven by disparities among households with negative or zero wealth, low- and middle-wealth households, the richest households, and a relatively concentrated wealth distribution.
- Reducing inequality within these classes is therefore essential to lowering overall inequality.

Thank you

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