Session 2
The Analytics of Fiscal Redistribution

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Learning Event on the Commitment to Equity Methodology
Tulane University and the World Bank
Washington, DC
February 18-20, 2015

This presentation is based on:

Lustig, Nora, Ali Enami and Rodrigo Aranda. *The Analytics of Fiscal Redistribution.* Chapter in Lustig, Nora and Sean Higgins, editors, Commitment to Equity Handbook: Estimating the Redistributive Impact of Fiscal Policy. (Forthcoming)

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Fiscal Policy and Inequality
Three Key Questions

- Does the net fiscal system decrease inequality?

- Is a particular tax or transfer equalizing or unequalizing?

- What is the contribution of a particular tax or transfers (or any combination of them) to the change in inequality?

Fiscal Policy and Poverty
Three Key Questions

- Does the net fiscal system decrease poverty?

- Does the net fiscal system make the poor poorer?

- What is the contribution of a particular tax or transfers (or any combination of them) to the change in poverty?
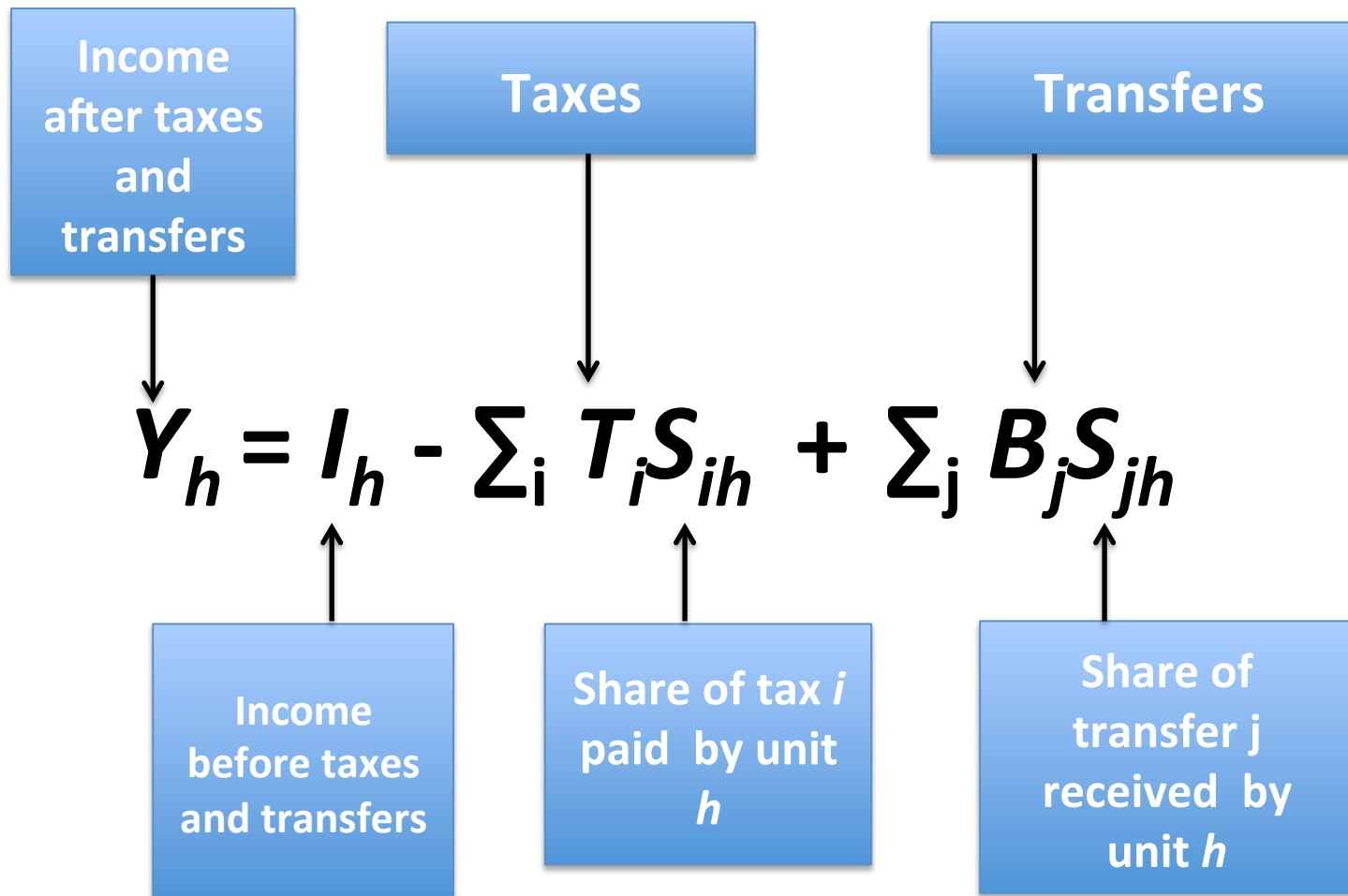
Key questions will be addressed for two main cases

- Single-intervention system:
  - Tax
  - Transfer
- Multiple-interventions system
  - Lambert's conundrum and the startling consequences of path dependency

Assumptions

➤ **No reranking:** the ordering of individuals in the post-fiscal state is the same as in the pre-fiscal state: i.e., no swapping of places

➤ **Dominance:** pre-fiscal and post-fiscal Lorenz curves do not cross (and the difference is statistically significant)

➤ **Same pre-fiscal (original) income distribution:** rules out comparisons of redistributive or poverty reducing capacity of fiscal systems across countries and over-time

Fiscal Incidence Analysis

Income after taxes and transfers

Taxes

Transfers

$$Y_h = I_h - \sum_i T_i S_{ih} + \sum_j B_j S_{jh}$$

Income before taxes and transfers

Share of tax i paid by unit h

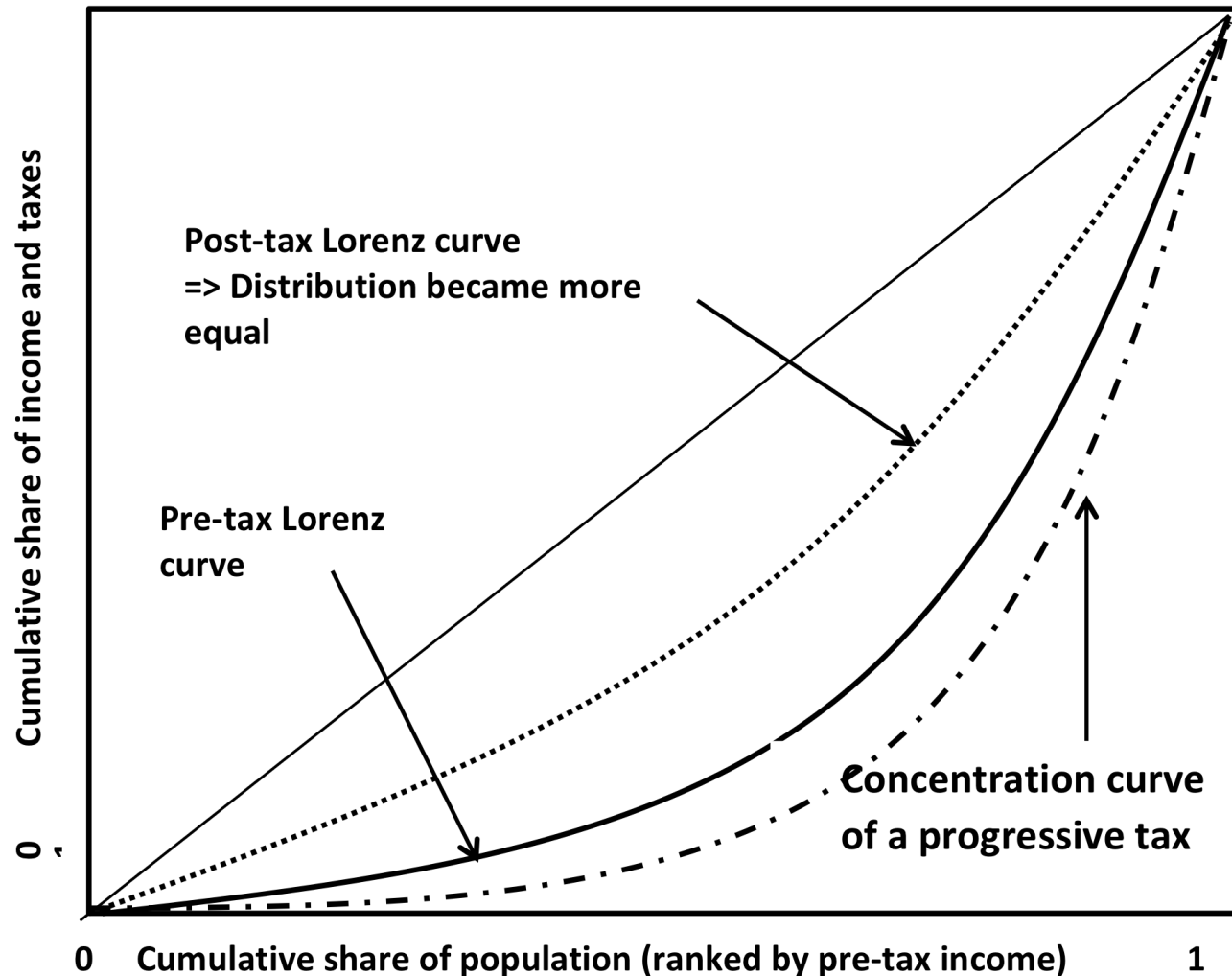**Share of transfer j received by unit h**

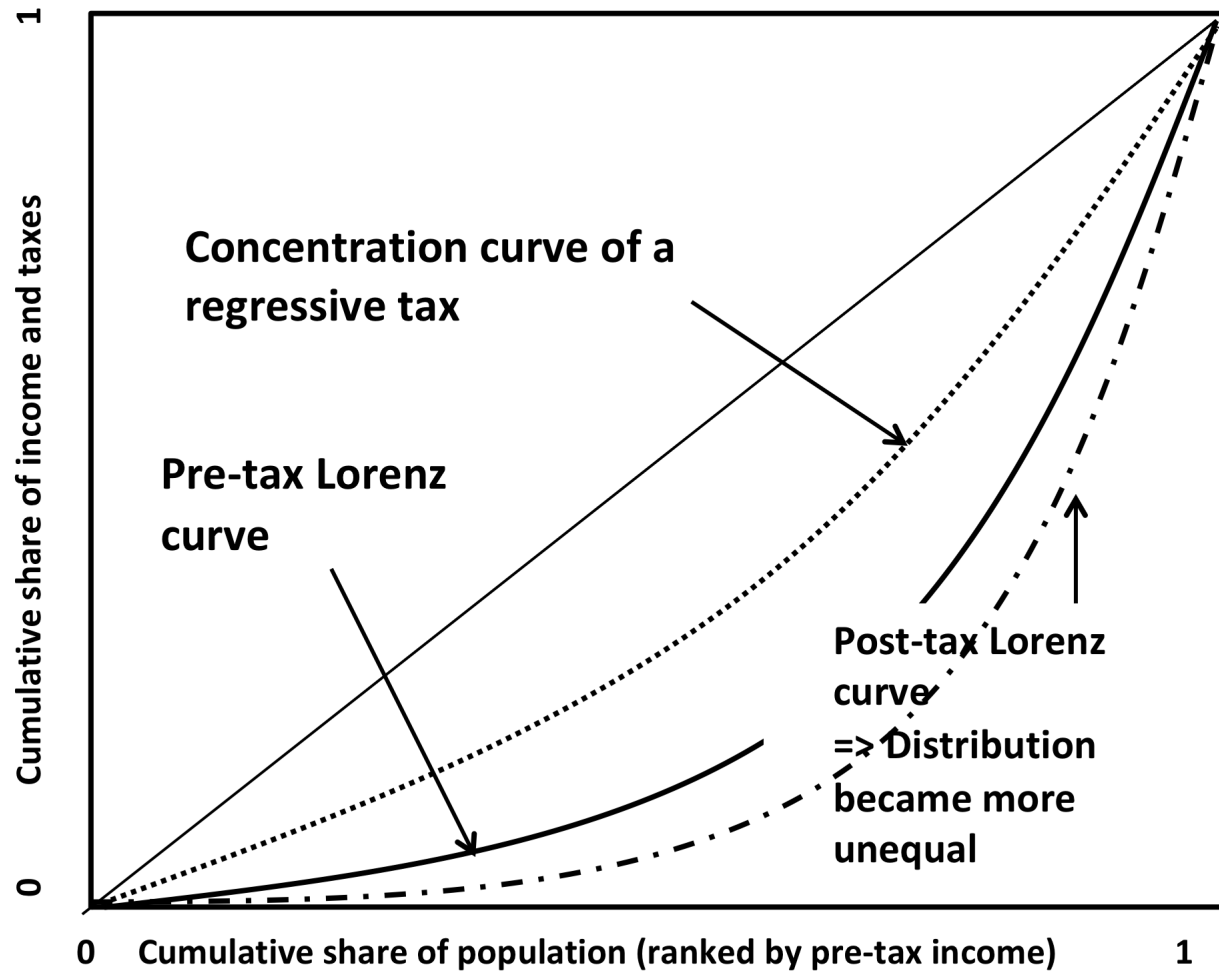# FISCAL SYSTEM WITH A SINGLE INTERVENTION

Single Intervention: Tax

- Progressivity measures

    ➢ Concentration curve

    ➢ Concentration coefficient

    ➢ Kakwani Index

Concentration Curve Progressive Tax

**Post-tax Lorenz curve
=> Distribution became more equal**

Pre-tax Lorenz curve

Concentration curve of a progressive tax

Cumulative share of income and taxes

0

0   Cumulative share of population (ranked by pre-tax income)   1

Concentration Curve

Concentration Coefficient: CC

Vertical Axis

Cumulative proportion of income, tax or transfer

$$Gini = A / (A+B)$$

$$CC = A / (A+B)$$

A

B

Line of equality

Gini coefficient/concentration index

Lorenz/concentration curve

100%

80%

60%

40%

20%

0%

0%   20%   40%   60%   80%   100%

Cumulative proportion of population ranked by income
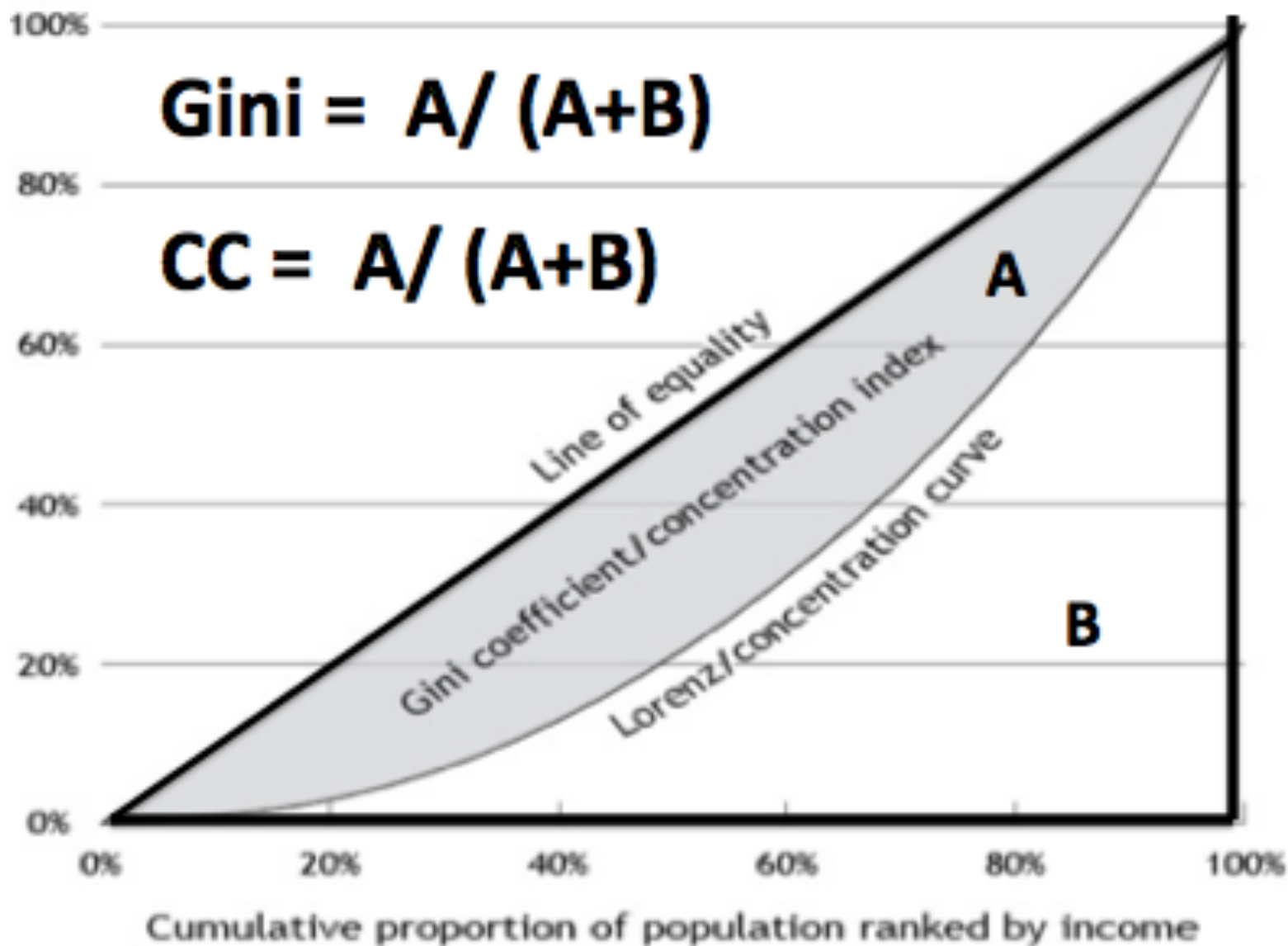
Kakwani Index: Tax

The Kakwani index of progressivity of a tax **t** is defined as:

$$K_t = CC_t - G_x$$

Where:

- G_x is the Gini coefficient of pre-tax income
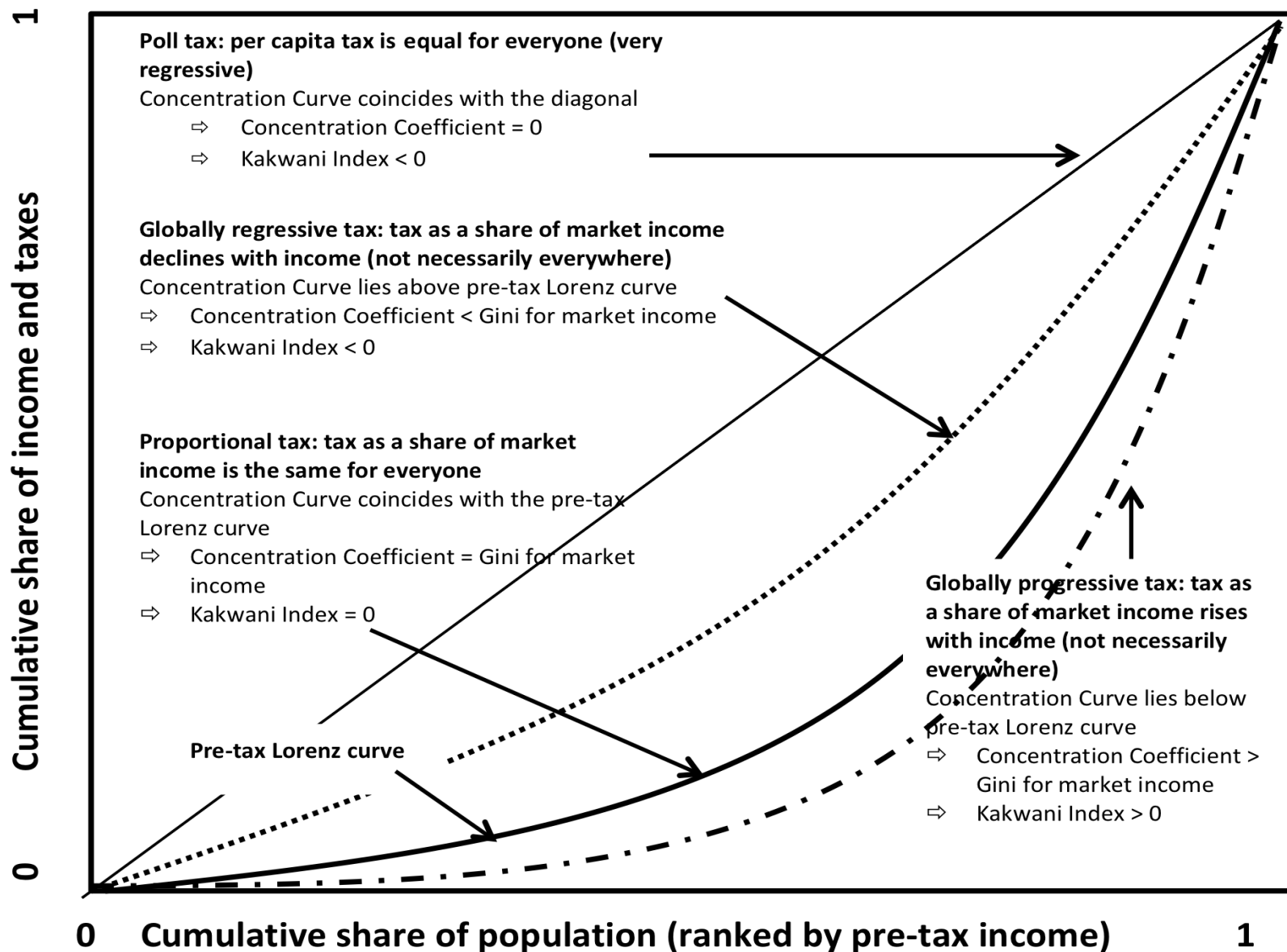- CC_t is the concentration coefficient of the tax **t**

Kakwani Index

➢Progressive Tax: $K_t = CC_t - G_x > 0$

➢Proportional Tax: $K_t = CC_t - G_x = 0$

➢Regressive Tax: $K_t = CC_t - G_x < 0$

Progressivity of Taxes: A Diagrammatic Representation

Cumulative share of income and taxes

1

Poll tax: per capita tax is equal for everyone (very regressive)
Concentration Curve coincides with the diagonal
⇨   Concentration Coefficient = 0
⇨   Kakwani Index < 0

Globally regressive tax: tax as a share of market income declines with income (not necessarily everywhere)
Concentration Curve lies above pre-tax Lorenz curve
⇨   Concentration Coefficient < Gini for market income
⇨   Kakwani Index < 0

Proportional tax: tax as a share of market income is the same for everyone
Concentration Curve coincides with the pre-tax Lorenz curve
⇨   Concentration Coefficient = Gini for market income
⇨   Kakwani Index = 0

Globally progressive tax: tax as a share of market income rises with income (not necessarily everywhere)
Concentration Curve lies below pre-tax Lorenz curve
⇨   Concentration Coefficient > Gini for market income
⇨   Kakwani Index > 0

Pre-tax Lorenz curve

0

0   Cumulative share of population (ranked by pre-tax income)   1

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Conclusion

In a world with just a *single* tax

➢   A necessary and sufficient condition for a tax to be equalizing is to have a positive Kakwani index

➢   A necessary and sufficient condition for a tax to be unequalizing is to have a negative Kakwani index

Progressivity: Everywhere vs. Global

- A tax can be progressive and equalizing even if it is not progressive *everywhere* as long as it is *globally* progressive

- The toy example below illustrates this point

Toy Example: An Everywhere vs. Globally Progressive Tax

	Everywhere Progressive Tax						
Population	Pre-tax Income	Lorenz Curve Pre-tax	Tax Rate Everywhere Progressive Tax	Tax paid	Post-tax Income	Lorenz Curve Post-tax	Difference between post- and pre-tax Lorenz curves
1	$10.00	10%	0%	$0.00	$10.00	13%	2.50%
2	$20.00	30%	10%	$2.00	$18.00	35%	5.00%
3	$30.00	60%	20%	$6.00	$24.00	65%	5.00%
4	$40.00	100%	30%	$12.00	$28.00	100%	0.00%
	$100.00		20%	$20.00	$80.00		

	Globally Progressive Tax						
Population	Pre-tax Income	Lorenz Curve Pre-tax	Tax Rate Progressive Not Everywhere	Tax paid	Post-tax Income	Lorenz Curve Post-tax	Difference between post- and pre-tax Lorenz curves
1	$10.00	10%	0%	$0.00	$10.00	13%	2.50%
2	$20.00	30%	10%	$2.00	$18.00	35%	5.00%
3	$30.00	60%	0%	$0.00	$30.00	73%	12.50%
4	$40.00	100%	45%	$18.00	$22.00	100%	0.00%
	$100.00		20%	$20.00	$80.00		

Single Intervention: Transfer

- Progressivity measures

  - ➤ Concentration curve
  - ➤ Concentration coefficient
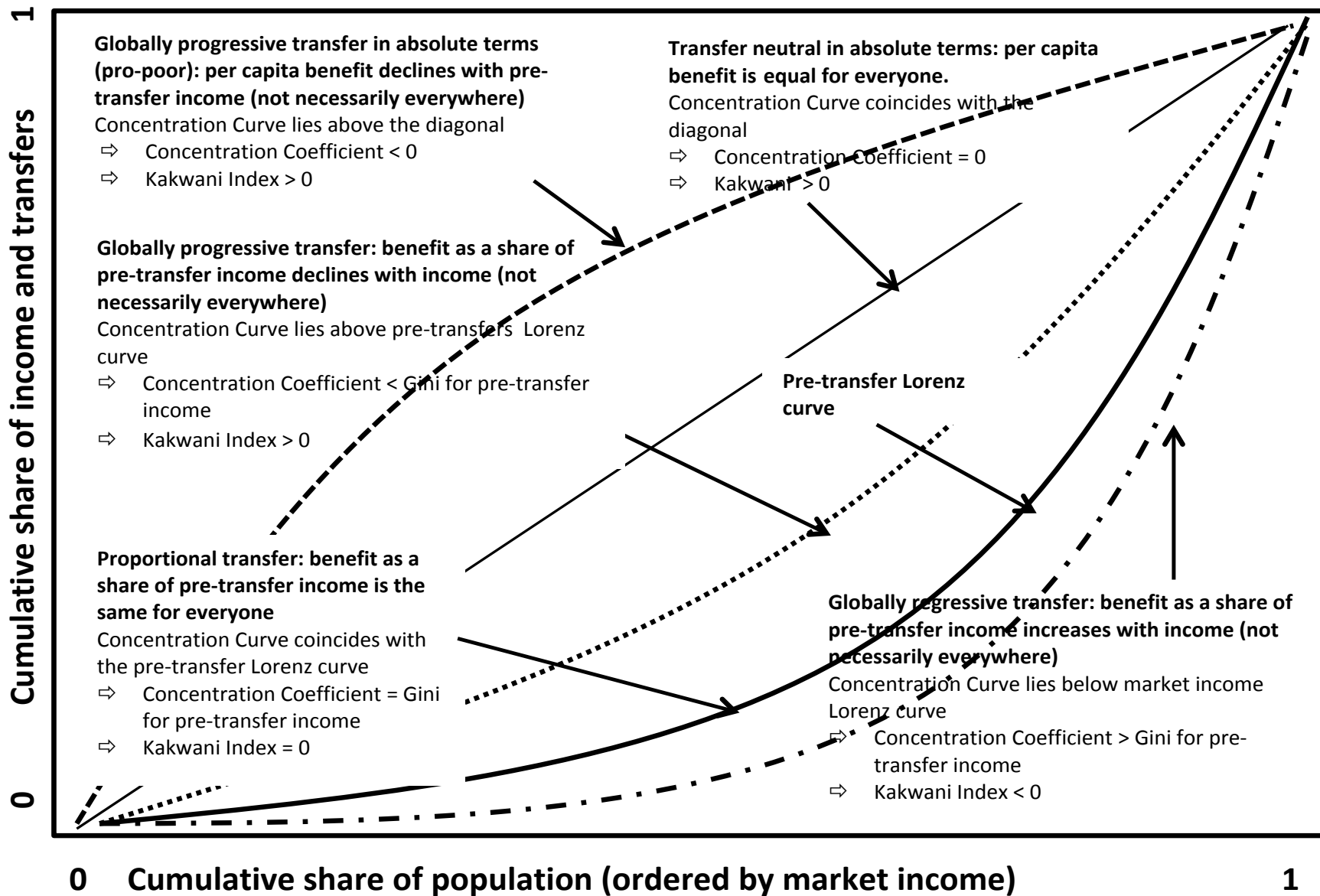 - ➤ Kakwani Index

Kakwani Index: Transfer

The Kakwani index of progressivity of a transfer **B** is defined as:

$$K_B = G_x - CC_B$$

Where:
- G_x is the Gini coefficient of pre-tax income
- CC_B is the concentration coefficient of the transfer **B**

➤ Note that the Gini coefficient and the concentration coefficient are in reversed order from the Kakwani index for a tax

Progressivity of Transfers: A Diagrammatic Representation

Cumulative share of income and transfers

1

0

Globally progressive transfer in absolute terms (pro-poor): per capita benefit declines with pre-transfer income (not necessarily everywhere)
Concentration Curve lies above the diagonal
⇨ Concentration Coefficient < 0
⇨ Kakwani Index > 0

Transfer neutral in absolute terms: per capita benefit is equal for everyone.
Concentration Curve coincides with the diagonal
⇨ Concentration Coefficient = 0
⇨ Kakwani > 0

Globally progressive transfer: benefit as a share of pre-transfer income declines with income (not necessarily everywhere)
Concentration Curve lies above pre-transfers Lorenz curve
⇨ Concentration Coefficient < Gini for pre-transfer income
⇨ Kakwani Index > 0

Pre-transfer Lorenz curve

Proportional transfer: benefit as a share of pre-transfer income is the same for everyone
Concentration Curve coincides with the pre-transfer Lorenz curve
⇨ Concentration Coefficient = Gini for pre-transfer income
⇨ Kakwani Index = 0

Globally regressive transfer: benefit as a share of pre-transfer income increases with income (not necessarily everywhere)
Concentration Curve lies below market income Lorenz curve
⇨ Concentration Coefficient > Gini for pre-transfer income
⇨ Kakwani Index < 0

0   Cumulative share of population (ordered by market income)   1

CEQ Logo: Can you guess what it symbolizes?

COMMITMENT TO EQUITY

Impact on Inequality Depends On…

- Progressivity of the tax or the transfer

- Level of the tax or the transfer

➢ A large regressive tax can be more equalizing than a small progressive one as shown in next slide

Redistributive Effect and the Progressivity and Level of Taxes

	Gross Income		Tax A=50.5%		Net Income under A		Tax B=1%		Net Income under B	
	Income	Distribution	Tax	Distribution	Income	Distribution	Tax	Distribution	Income	Distribution
1	21	21%	1	2%	20	40%	0	0%	21	21%
2	80	79%	50	98%	30	60%	1	100%	79	79%
Total	101	100%	51	100%	50	100%	1	100%	100	100%

Source: Duclos and Tabi, 1996, Table 1.

FISCAL SYSTEM WITH MULTIPLE INTERVENTIONS

Fiscal Policy and Inequality
Three Key Questions

- Does the net fiscal system decrease inequality?

- Is a particular tax or transfer equalizing or unequalizing?

- What is the contribution of a particular tax or transfers (or any combination of them) to the change in inequality?

Does the net fiscal system decrease inequality?

Let's define the Redistributive Effect of the net fiscal system as

$$RE_N = G_x - G_N$$

Where G_x and G_N are the Gini coefficient before and after the tax and the transfer, respectively

Does the net fiscal system decrease inequality?

From Lambert (2001), we know that RE_N is equal to the weighted sum of the redistributive effect of taxes and transfers

$$RE_N = \frac{(1-g)RE_t + (1+b)RE_B}{1-g+b}$$

Where

- RE_t and RE_B are the Redistributive Effect of the tax and the transfer, respectively
- **g** and **b** are the tax and transfer level: i.e., total taxes and total transfers divided by total pre-tax and pre-transfer income, respectively

Does the net fiscal system decrease inequality?

For the net fiscal system to be equalizing:

$$RE_N = \frac{(1-g)RE_t + (1+b)RE_B}{1-g+b} > 0$$

Condition 1:

$$\rightarrow RE_t > -\frac{(1+b)}{(1-g)}RE_B$$

Does the net fiscal system decrease inequality?

Tax		Transfer	
		Regressive	Progressive
	Regressive	Never Equalizing	Equalizing only if Condition 1 holds
	Progressive	Equalizing only if Condition 1 holds	Always Equalizing

Condition 1:

$$\rightarrow RE_t > -\frac{(1+b)}{(1-g)} RE_B$$

Is a particular tax or transfer equalizing?

- If there is a single intervention in the system, any of the progressivity measures discussed earlier will give an unambiguous answer

- If there is a tax **and** a transfer, then this is no longer the case

  ➤ A regressive tax can be equalizing and the reduction in inequality be larger with the tax than without it

Lambert's Conundrum

	1	2	3	4	Total
Original income x	10	20	30	40	100
Tax Liability t(x)	6	9	12	15	42
Benefit level b(x)	21	14	7	0	42
Post-benefit income	31	34	37	40	142
Final income	25	25	25	25	100

Source: Lambert, 2001, Table 11.1, P. 278

Lambert's Conundrum

- The Redistributive Effect of the tax in this example is equal to -0.05, highlighting their regressivity

- The Redistributive Effect of the transfer is equal to 0.19

➢ Yet, the Redistributive Effect of the net fiscal system is 0.25, higher than the effect without the taxes!

Lambert's Conundrum
Path Dependency

- If a tax is regressive vis-à-vis the original income but progressive with respect to the less unequally distributed post-transfer income

➢ Regressive taxes *can* exert an equalizing effect over an above the effect of progressive transfers

When could a regressive tax exert an equalizing force?

For the reduction in inequality to be higher with the tax than without it, the following condition must hold:

$$RE_N = \frac{(1-g)RE_t + (1+b)RE_B}{1-g+b} > RE_B$$

Condition 2

$$\rightarrow RE_t > -\frac{(g)}{(1-g)}RE_B$$

Is a tax equalizing?
Answer for a system with a tax and a transfer

Adding a tax that is:		Transfer	
		Regressive	**Progressive**
Tax	**Regressive**	Never more equalizing	More equalizing only if Condition 2 holds
	Progressive	More equalizing only if Condition 2 holds	Always more equalizing

Condition 2

$$\rightarrow RE_t > -\frac{(g)}{(1-g)} RE_B$$

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Equalizing Regressive Taxes Exist in Real Life

- The US and the UK had regressive equalizing taxes in the past (O'Higgins & Ruggles, 1981 and Ruggles & O'Higgins, 1981)

- Chile's 1996 fiscal system had equalizing regressive taxes (Engel et al., 1999)
  - Redistributive Effect of Net Fiscal System (taxes and transfers together = 0.0583 (decline in Gini points)
  - Redistributive Effect of System with Taxes only = - 0.0076
  - Redistributive Effect of System with Transfers but without Taxes = 0.0574
- ➤ Note that 0.0583 > 0.0574

Is a particular tax or transfer equalizing?

- ➢ Conditions to determine whether a transfer is equalizing are also available (in chapter but not presented here)

- ➢ The results shown above can be generalized to m taxes and n transfers (in chapter but not presented here)

- ➢ Note that the results do not depend on the tax and the transfer being of the same level (see conditions 1 and 2 above)

Path Dependency Underscores the Importance of Comprehensive Analysis

- Obvious reason
  - To capture the full effect of the net fiscal system

- More subtle but fundamental reason

  - Assessing the progressivity of a tax or a transfer in isolation can give the wrong answer to the question: Is the tax or the transfer equalizing?

  - Think of the example of Chile just shown above

How assessing the impact of a tax in isolation could give you the wrong answer

- Chile's 1996 fiscal system had equalizing regressive taxes (Engel et al., 1999)

    - Redistributive Effect of Net Fiscal System (taxes and transfers together = 0.0583 (decline in Gini points)

    - Redistributive Effect of System with Taxes only = - 0.0076

    - Redistributive Effect of System with Transfers but without Taxes = 0.0574

- ➢ If you focused on the effect of the tax in isolation, you would have concluded the tax is unequalizing since its Redistributive Effect is negative and equal to - 0.0076

- ➢ However, the regressive tax exerts an equalizing force when applied to the system with the transfers in place: 0.0583 > 0.0574

What is the contribution of a particular tax or transfer to the change in inequality?

- Sequential method
  - May give the wrong answer to the "with vs. without comparison" because it ignores path dependency
- **Marginal contribution method (same for poverty)**
  - Gives correct answer to the "with vs. without comparison" but does not fulfill the principle of aggregation: i.e., the sum of the marginal contributions will not equal the total change in inequality (except by coincidence)
- Average Contribution with all paths considered (Shapley value)
  - Fulfills the principle of aggregation, takes care of path dependency but the answer may be different from the marginal contribution => problematic

Calculating the Marginal Contribution of a Tax

The marginal contribution of a tax is defined as

$$MC_t = G_{x+B} - G_{x+B-t}$$

Where G_{x+B-t} and G_{x+B} are the Gini coefficient of incomes after the tax and the transfer and after the transfer only, respectively

If $MC_t > 0,$ remember, the tax is equalizing

Sequential vs. Marginal Contribution
Why the sequential method can be misleading

- Chile's 1996 fiscal system (Engel et al., 1999)

  - Redistributive Effect of Net Fiscal System (taxes and transfers together = 0.0583 (decline in Gini points)
  - Redistributive Effect of System with Taxes only = - 0.0076
  - Redistributive Effect of System with Transfers but without Taxes = 0.0574

Sequential vs. Marginal Contribution
Why the sequential method can be misleading

Sequential contribution method

- If you calculated the contribution of taxes to the change in inequality by subtracting the Gini after taxes from the Gini pre-tax-pre-transfers, you would have concluded that the contribution of taxes was unequalizing to the tune of

  -0.0076

  which is inconsistent with the fact that if you take the taxes out, the reduction in inequality is smaller

Sequential vs. Marginal Contribution
Why the sequential method can be misleading

Marginal contribution method

➢ The marginal contribution of adding the tax to the system with the transfer in place is equal to the difference of the Redistributive Effect of the net fiscal system and the Redistributive Effect of the system without the taxes (with transfers only)

$$0.0583 - 0.0574 = 0.009$$

A positive value which is consistent with how adding the tax causes inequality to fall

Relaxing Assumptions

- **Reranking**: individuals can swap positions in the post-fiscal income ordering; true of all systems in the real world

- **No dominance:** post-fiscal Lorenz curve crosses the pre-fiscal Lorenz curve; normative parameter must be explicitly introduced (will not be covered today)

- **Different pre-fiscal (original) distributions:** comparing the inequality- and poverty-reducing capacity of fiscal systems across countries and over time (will not be covered today)

Reranking

- Reranking diminishes the redistributive capacity of fiscal policy
- Think of the following extreme example
  - ➤ The fiscal system only causes individuals to swap places but the incomes of poorest, second poorest, up to the richest individual stay the same
  - Post-fiscal inequality after taxes and transfers will remain unchanged
  - Fiscal policy only produced a lot of "churning"

Estimating the Effect of Reranking

The Redistributive Effect (Gini for income before taxes and transfers minus Gini for income after taxes and transfers) can be written as

$$RE_N = (G_x) - (G_N)$$

By adding and subtracting CC_N^X, we can rewrite the Redistributive Effect as:

$$RE_N = (G_x - CC_N^X) - (G_N - CC_N^X)$$

where CC_N^X is the concentration coefficient for income *after* taxes and transfers

Estimating the Effect of Reranking

Then, the Redistributive Effect can be written as:

$$RE_N = VE - RR$$

where:

- **VE**, the vertical equity component, is known as the Reynolds-Smolensky Index. If there is no re-ranking, RE = VE by definition because the concentration coefficient for income after taxes and transfers will be identical to the Gini coefficient for income after taxes and transfers
- **RR,** the reranking component, is known as the Atkinson-Plotnick index of horizontal inequity. If there is no reranking, this term will equal zero

Thus, **RR** can be calculated as:

$$RR = VE - RE_N$$

How important is reranking in actual fiscal systems?

- In some countries, the reranking effect can be huge.
- For example, in Bolivia the redistributive effect before in-kind transfers is zero. The fiscal system only induced reranking

(Decline in Gini Points; shown as positive)	South Africa (2010)	Bolivia (2009)	Brazil (2009)	Indonesia (2012)
Gini (Market income)	0.771	0.503	0.579	0.418
Gini (Post-fiscal income)	0.695	0.503	0.546	0.416
Redistributive Effect[1]	0.077	0.000	0.033	0.002
Vertical Equity (VE)[2]	0.083	0.003	0.048	0.007
Reranking Effect (RR)[3]	0.006	0.003	0.014	0.005
RR/VE	0.075	1.000	0.300	0.706

Source: Lustig, Nora. 2015. "Fiscal Policy, Inequality and the Poor in the Developing World.." *CEQ Working Paper No. 23*, Center for Inter-American Policy and Research and Department of Economics, Tulane University and Inter-American Dialogue. Forthcoming.

Reranking and the Marginal Contribution of Fiscal Interventions

- If there is reranking, conditions 1 and 2 discussed above apply to the vertical equity (VE) component of

$$RR = VE - RE_N$$

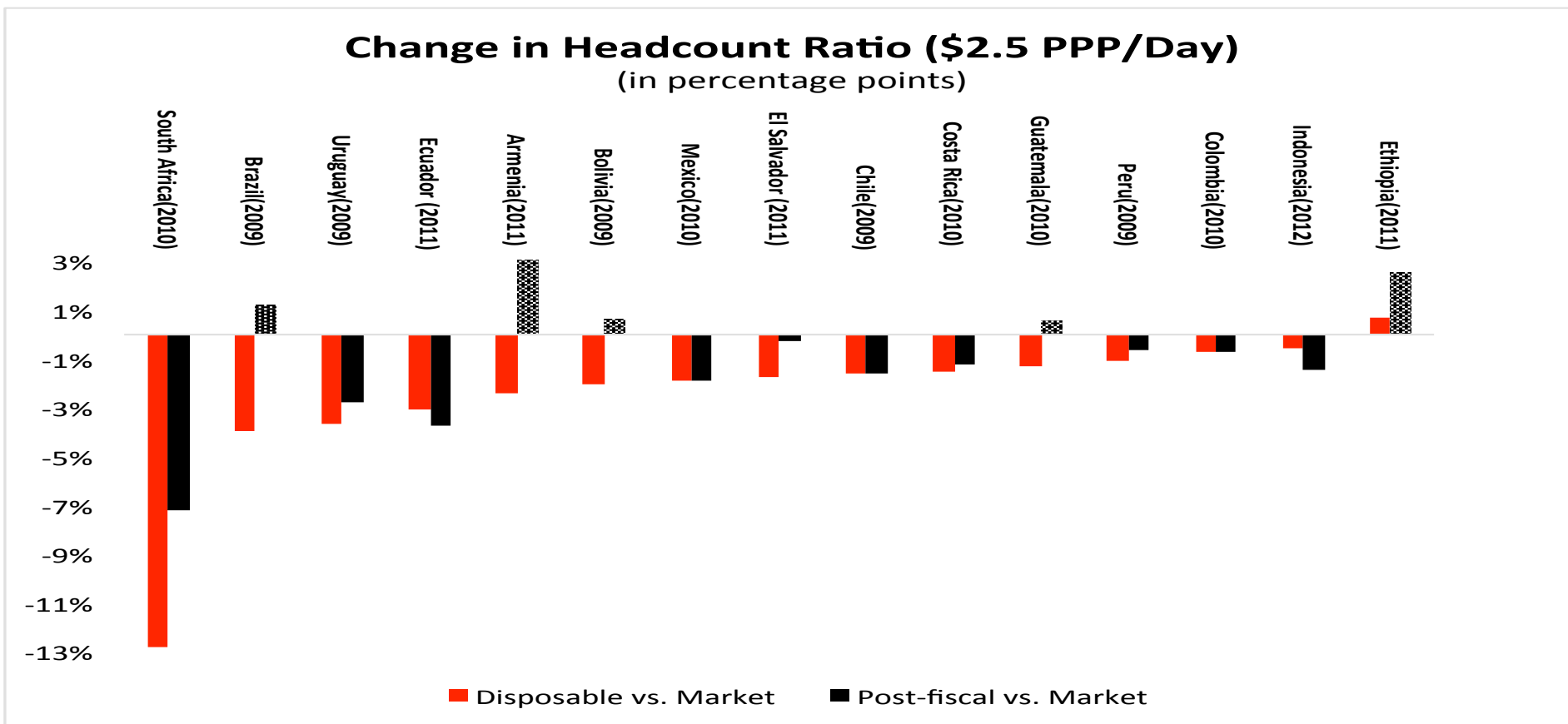# Comparing Impact of Fiscal Systems Across Countries and Over Time

- Determining when a fiscal intervention or a system is more equalizing than another in cross-country and over-time comparisons involves comparing cases with different pre-tax-pre-transfer income distributions

- Two methods have been proposed:

- Select a country or a time period as baseline

- "Transplant and compare" method (Dardanoni and Lambert, 2000)

Poverty Impact

- Determining when a fiscal intervention is poverty-reducing
  - Compare standard poverty measures using the marginal contribution approach

- **Fiscal policy can increase poverty to the point that it is left higher than before taxes and transfers**
  - Showed in Session 1 that we found this in five out of thirteen countries in CEQ

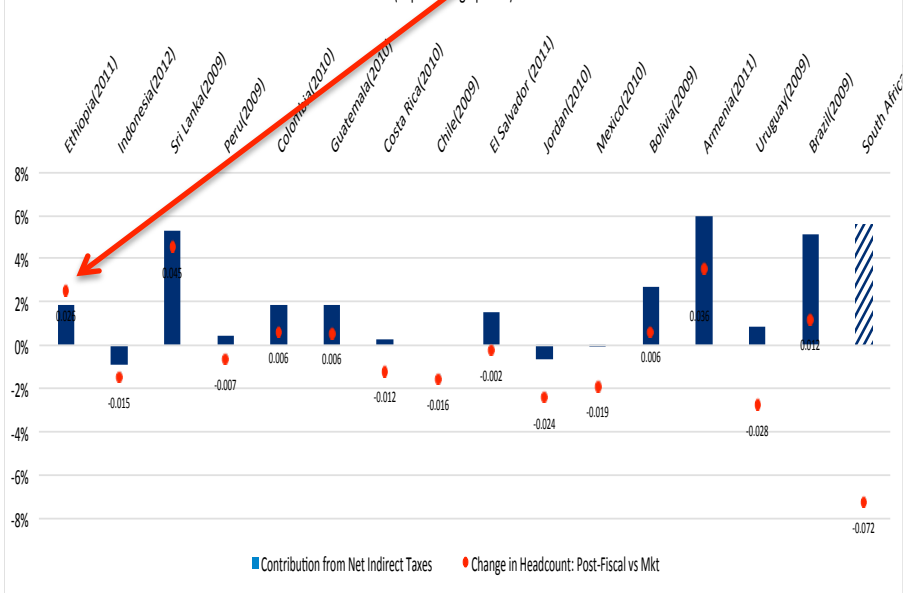# Indirect Taxes increase poverty over and above market income poverty in 5 cases

Change in Headcount Ratio ($2.5 PPP/Day)
(in percentage points)

Legend: ■ Disposable vs. Market ■ Post-fiscal vs. Market

Countries: South Africa(2010), Brazil(2009), Uruguay(2009), Ecuador (2011), Armenia(2011), Bolivia(2009), Mexico(2010), El Salvador (2011), Chile(2009), Costa Rica(2010), Guatemala(2010), Peru(2009), Colombia(2010), Indonesia(2012), Ethiopia(2011)

Source: Lustig, Nora. 2015. "Fiscal Policy, Inequality and the Poor in the Developing World.." *CEQ Working Paper No. 23*, Center for Inter-American Policy and Research and Department of Economics, Tulane University and Inter-American Dialogue. Forthcoming.

Poverty Impact

➢ **A tax system can be equalizing but poverty-increasing and poverty can end up above what prevailed before fiscal policy**

- Example Ethiopia

- Do not use word "regressive" for a poverty increasing intervention

Note that Net Indirect Taxes can be equalizing and yet poverty increasing: Ethiopia

Poverty Impact

- Even if poverty measures do not increase, the poor can be made poorer by the fiscal system and some of the nonpoor can be made poor

- In Brazil, more than a third of the pre-fiscal policy poor are made poorer by fiscal policy (excluding transfers in-kind, of course)

➤ Fiscal Impoverishment Index

Higgins, Sean and Nora Lustig. 2014. *Measuring Fiscal Impoverishment.* Mimeo, Department of Economics, Tulane University, November.

Main messages

➢ To determine whether a fiscal intervention is equalizing or not, one must assess its contribution with the other interventions in place

  ➢ A regressive tax, for example, can exert an equalizing force that is over and above a system without that regressive tax

➢ To measure the size of the contribution, use the marginal contribution method but remember that adding the marginal contributions will not be equal to the total change

➢ The impact of a tax on inequality and poverty can go in opposite directions: e.g., equalizing and poverty increasing

➢ An important proportion of the poor may be left poorer (in cash) by the fiscal system, and current measures may not alert us to this: new measure of *fiscal impoverishment* does

Readings

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Additional Readings

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- Shorrocks, Anthony F. 2013. *Decomposition procedures for distributional analysis: a unified framework based on the Shapley value.* Journal of Economic Inequality. Published on line, January 2012.

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Thank you!