IMPLICATIONS OF CARBON TAXATION ON INEQUALITY AND POVERTY IN MEXICO

X. Labandeira, JM. Labeaga, X. López-Otero and T,.Sterner

16/06/2022

OUTLINE

- Motivation
- Methodology
- Data
- Results
- Next steps

MOTIVATION

MOTIVACION (I)

- Main aim: Analyze the different impacts of carbon taxation in Mexican households at different income levels and locations on inequality, poverty and redistribution. For this we need:

  - To estimate behavioral parameters

  - To simulation the effects on inequality, poverty and redistribution of the introduction of a carbon tax (joint with different compensation packages)

MOTIVACION (II)

- Why this is important for Mexico? They committed under the PA to reduce greenhouse gas emissions, translating it to NDC, where Mexico committed unconditionally to reduce GHG emissions by 22 percent in 2030 compared to the baseline scenario in 2013

- In addition, conditional commitments would increase emissions mitigation to 36 percent in 2030 compared to the BS

- Reforms were initiated in 2013 with many measures: Elimination of PEMEX's monopoly, modification of mechanisms to fix tax on fuels for transport (that were subsidized) by fixed tax rates, introduction of a (low rate) carbon tax and reforming the electricity market

MOTIVACION (III)

- After the election of the new president in 2018, all these reforms were stopped because one of the main objectives of the new government is not increasing energy prices and to get it, Mexico reduced the taxes on fuels through fiscal stimulus (in the last week of 2022 the fiscal stimulus was 100 percent (tax on fuels no longer applied). Moreover, the government subsidized again residential electricity tariffs (households only pay 46 percent of total cost)

- The 2013 reforms also provided for the introduction of an emissions trading system (with some limitations) to be introduced in 2023, which is now under consideration by the government

MOTIVACION (IV)

- Beside the importance of introducing a proper carbon tax, it is crucial to define compensations

	Total	North	Center	South	Urban	Rural
Poverty rate	23.84	21.15	19.25	37.22	17.98	43.19
Gini index	0.3711	0.3618	0.3594	0.3881	0.3547	0.3686

- The Gini using total income is 0.47 in 2022 (compared to an average of 0.32 in OECD countries)

- Using the additional revenue, our model can fix some objective and use revenue to achieve it, imposing behavior of individuals

MOTIVACION (V)

- We consider this study is timely for previous reasons, but also:

    - Updating previous literature with more recent data

    - Simulating higher carbon prices by the need to get a significant reduction of GHG emissions associated with energy consumption

    - Differencing different compensation schemes to achieve the objectives

METHODOLOGY

Methodology (I)

- We assume k =1, …, K are the goods and h = 1, …, H the households

- We have time and regional price variation to which we add individual variation by building Stone prices using the household-specific basket of goods

- Parameters can vary with sociodemographic variables in addition to prices and income (total expenditure)

Methodology (II)

- Starting point:

$$ln\ c(u,p) = ln\ a(p) + \frac{ln\ u\ b(p)}{1 - \lambda(p)ln\ u}$$

$$a(p) = \alpha_0 + \sum_{i=1}^{k} \alpha_i lnp_i + \frac{1}{2}\sum_{i=1}^{k}\sum_{j=1}^{k} \gamma_{ij} lnp_i lnp_j$$

$$b(p) = \prod_{i=1}^{k} p_i^{\beta_i}$$

$$\lambda(p) = \sum_{i=1}^{k} \lambda_i lnp_i$$

Methodology (III)

- Estimation step (demand model):

$$w_i^h = \alpha_i^h + \sum_{j=1}^{k} \gamma_{ij} \, lnp_j + \beta_i ln\left[\frac{m^h}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{ln\left[\frac{m^h}{a(p)}\right]\right\}^2$$

- With associated utility:

$$lnV = \left\{\left[\frac{lnm - lna(p)}{b(p)}\right]^{-1} + \lambda(p)\right\}^{-1}$$

Methodology (III)

- Simulation step (welfare measure):

$$EL^h = c(u_0, \boldsymbol{p^0}) - c(u_0, \boldsymbol{p^1})$$

- Using parameter estimates and evaluating the equation as:

$$lnu_0 = \left\{ \left[\frac{lnm - lna(p)}{b(p)} \right]^{-1} + \lambda(p) \right\}^{-1}$$

DATA

Data

MEXICO

- ENIGH (Encuesta Nacional de Ingresos y Gastos de los Hogares) a bi-annual survey that we use for 2006-2018 for a total of 251,437 households used for esetimation and 62,000 households observed in 2018 used for simulation

- Very detailed information on income, expenditures, demographics (including location), and composition of the household concerning owning of goods, and house characteristics, etc.

Data

	Observations	Mean	Standard deviation	Minimum	Maximum
Food share	230295	0.5344	0.1788	0.0020	1
Magna gasoline share	230295	0.0775	0.1234	0	0.9894
Premium gasoline share	230295	0.0076	0.0459	0	0.8229
LPG share	230295	0.0410	0.0567	0	0.7865
Electricity share	230295	0.0507	0.0599	0	0.9301
Other non-durable goods share	230295	0.2888	0.1364	0	0.9955
Gasoline share	230295	0.0851	0.1278	0	0.9894
Food price	230295	0.8337	0.1673	0.4792	1.0468
Magna gasoline price	230295	0.7294	0.2306	0.3474	1.0793
Premium gasoline price	230295	0.7213	0.2492	0.3386	1.0865
LPG price	230295	0.7439	0.2092	0.3949	1.0968
Electricity price	230295	1.0584	0.3357	0.5533	2.9848
Other non-durable goods price	230295	0.8577	0.1420	0.4288	1.1123
Gasoline price	230295	0.7265	0.2367	0.3397	1.0865
Total expenditure on non-durables	230295	12429.10	7454.99	1497.42	44821.69
Income	230295	36954.51	28754.24	4065.05	182587.4
Gender	230295	0.2593	0.4382	0	1
Age	230295	48.7931	15.6677	12	110
Members ≥12 years	230295	2.9560	1.4244	1	33
Members <12 years	230295	0.8615	1.0809	0	13
Urban	230295	0.6784	0.4671	0	1
Rural	230295	0.3216	0.4671	0	1
North	230295	0.3175	0.4655	0	1
Center	230295	0.4399	0.4964	0	1
South	230295	0.2426	0.4287	0	1
Less than primary education	230295	0.2660	0.4419	0	1
Primary education	230295	0.2307	0.4213	0	1
Secondary education	230295	0.4013	0.4902	0	1
Higher education	230295	0.1021	0.3027	0	1
Number of rooms	230295	3.7005	1.5414	0	23
Rented housing	230295	0.1268	0.3327	0	1
Owned house with mortgage	230295	0.0834	0.2765	0	1
Owned house without mortgage	230295	0.6332	0.4819	0	1
Dwelling in other situation	230295	0.1567	0.3635	0	1
Van	230295	0.1160	0.3202	0	1
Car	230295	0.2703	0.4441	0	1
Radio recorder	230295	0.2002	0.4002	0	1
Radio	230295	0.2039	0.4029	0	1
TV	230295	0.9295	0.2560	0	1
Videotape player	230295	0.0855	0.2796	0	1
Blender	230295	0.8548	0.3523	0	1
Microwave	230295	0.4189	0.4934	0	1
Refrigerator	230295	0.8576	0.3494	0	1
Stove	230295	0.8905	0.3122	0	1
Washing machine	230295	0.6589	0.4741	0	1
Iron	230295	0.7803	0.4141	0	1
Fan	230295	0.5495	0.4975	0	1
Vacuum cleaner	230295	0.0640	0.2447	0	1
Computer	230295	0.2372	0.4254	0	1
Vehicle	230295	0.4793	0.4996	0	1

RESULTS

Results (I). Estimation

Table 2. Marshallian own-price and expenditure elasticities

	Food	Gasoline	LPG	Electricity	Other non-durables
Unconditional demand system					
Own-price	-0.907***	-0.481***	-0.476***	-0.672***	-1.804***
Expenditure	0.622***	1.774***	0.889***	0.271***	1.702***
Conditional on owning a vehicle					
Own-price	-0.840***	-0.557***	-0.408***	-0.671***	-1.498***
Expenditure	0.600***	1.337***	0.818***	1.133***	1.481***
Conditional on not owning a vehicle					
Own-price	-0.950***	-	-0.663***	-0.713***	-2.220***
Expenditure	0.590***	-	0.963***	1.172***	1.883***

Note: *** indicates significance at 1 percent.

Results (II). Scenarios

Table 3. Alternative scenarios

| Energy product | CO_2 tax | |
	REFORM 1 25 $/tCO$_2$	REFORM 2 50$/tCO$_2$
Gasoline	1.157 pesos/l	2.314 pesos/l
Electricity	262 pesos/MWh	525 pesos/MWh
LPG	1.495 pesos/kg	2.989 pesos/kg

Source: Own calculations

Results (III). Price impact

Table 4. Price impact of different alternatives (percent of variation)

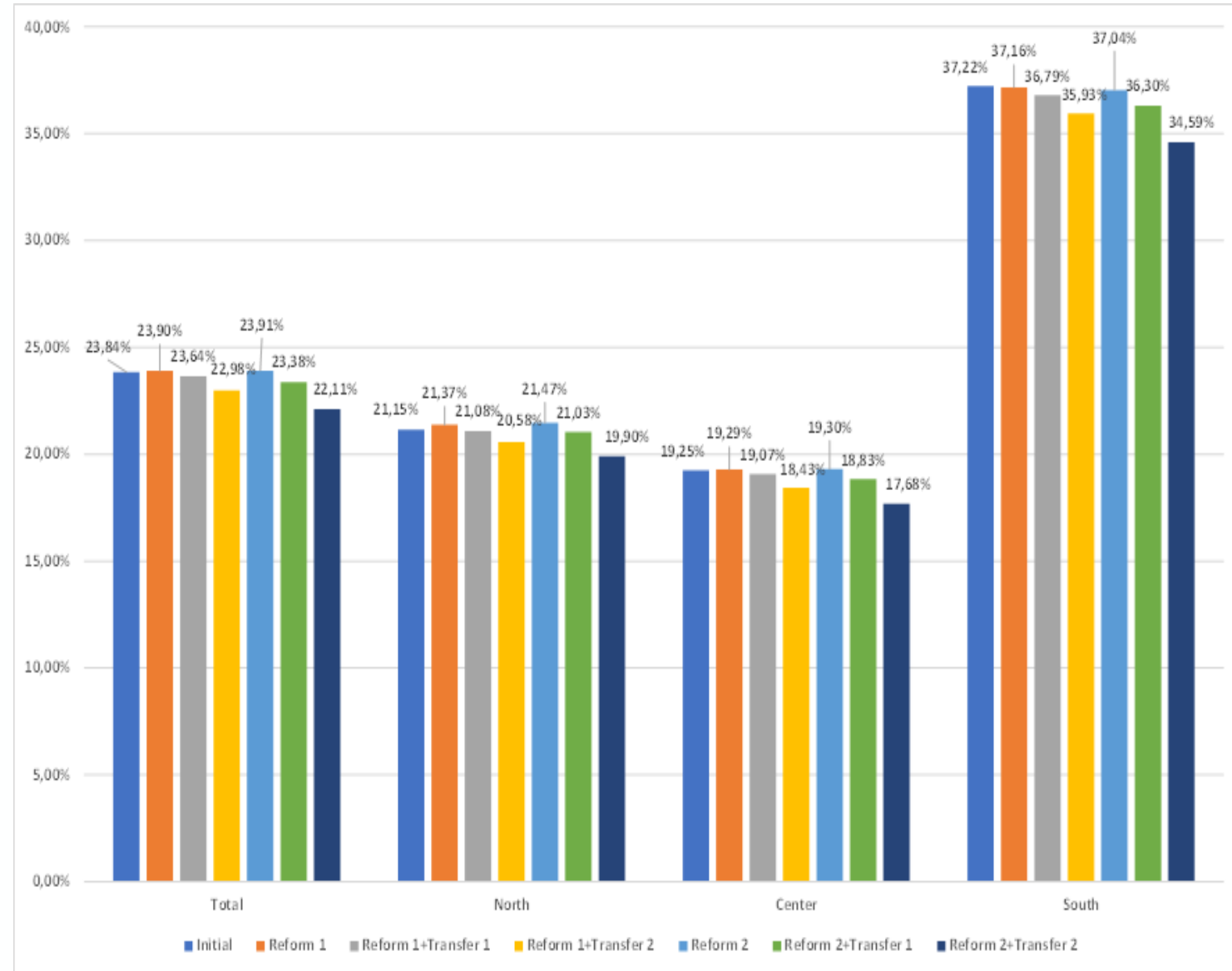| Energy product	CO$_2$ tax	
	REFORM 1 25 $/tCO$_2$	REFORM 2 50$/tCO$_2$
Gasoline	5.73	12.13
Electricity	10.00	20.00
LPG	10.49	22.17

Source: Own calculations

Results (IV). Equivalent gain

Figure 2. Equivalent gain per income decile
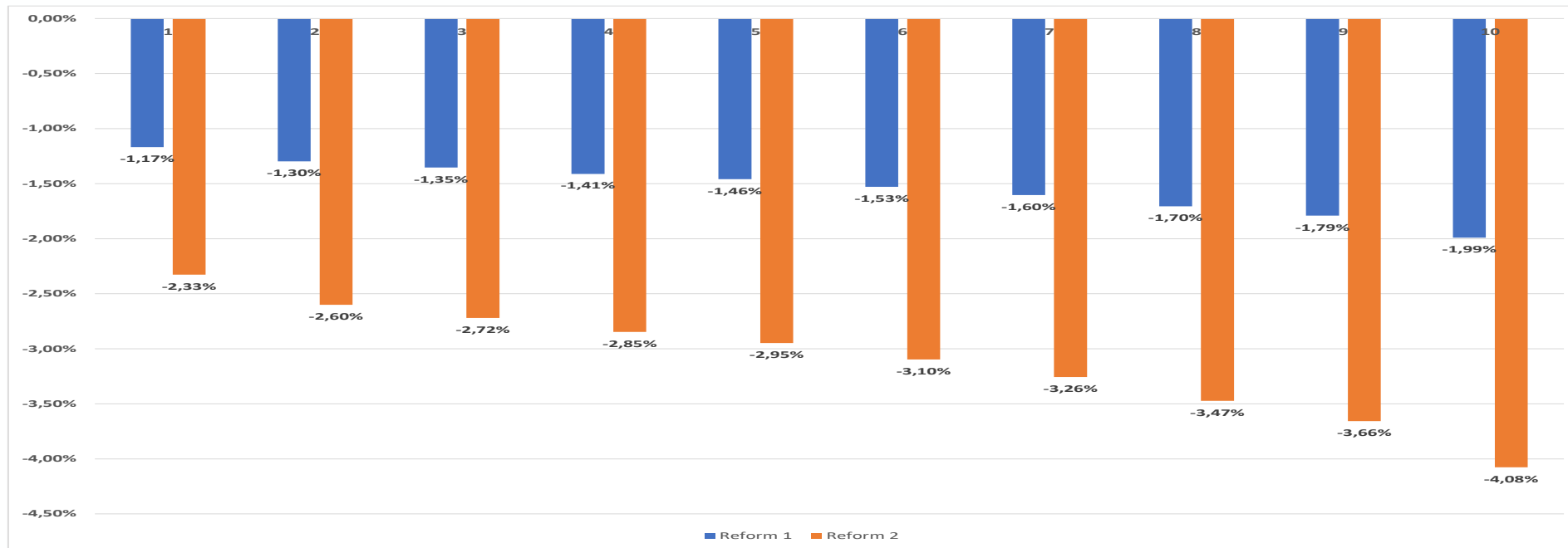
Note. Equivalent gain is defined as the percent of total non-durable expenditure.
Source: Own calculations

# Results (V). Poverty rate by geographical area

Results (VI). Price impact

Table 5. Gini index

	Total	North	Center	South	Urban	Rural
Initial	0.3711	0.3618	0.3594	0.3881	0.3547	0.3686
Reform 1						
No compensation						
	0.3716	0.3625	0.3599	0.3884	0.3552	0.3688
Transfer to all households						
	0.3688	0.3598	0.3573	0.3846	0.3527	0.3646
Transfer to households in the three bottom deciles						
	0.3644	0.3564	0.3540	0.3767	0.3496	0.3548
Reform 2						
No compensation						
	0.3721	0.3631	0.3604	0.3886	0.3557	0.3689
Transfer to all households						
	0.3665	0.3579	0.3554	0.3813	0.3509	0.3608
Transfer to households in the three bottom deciles						
	0.3582	0.3513	0.3490	0.3662	0.3449	0.3421

Results (VII). Poverty rate by rural – urban divide
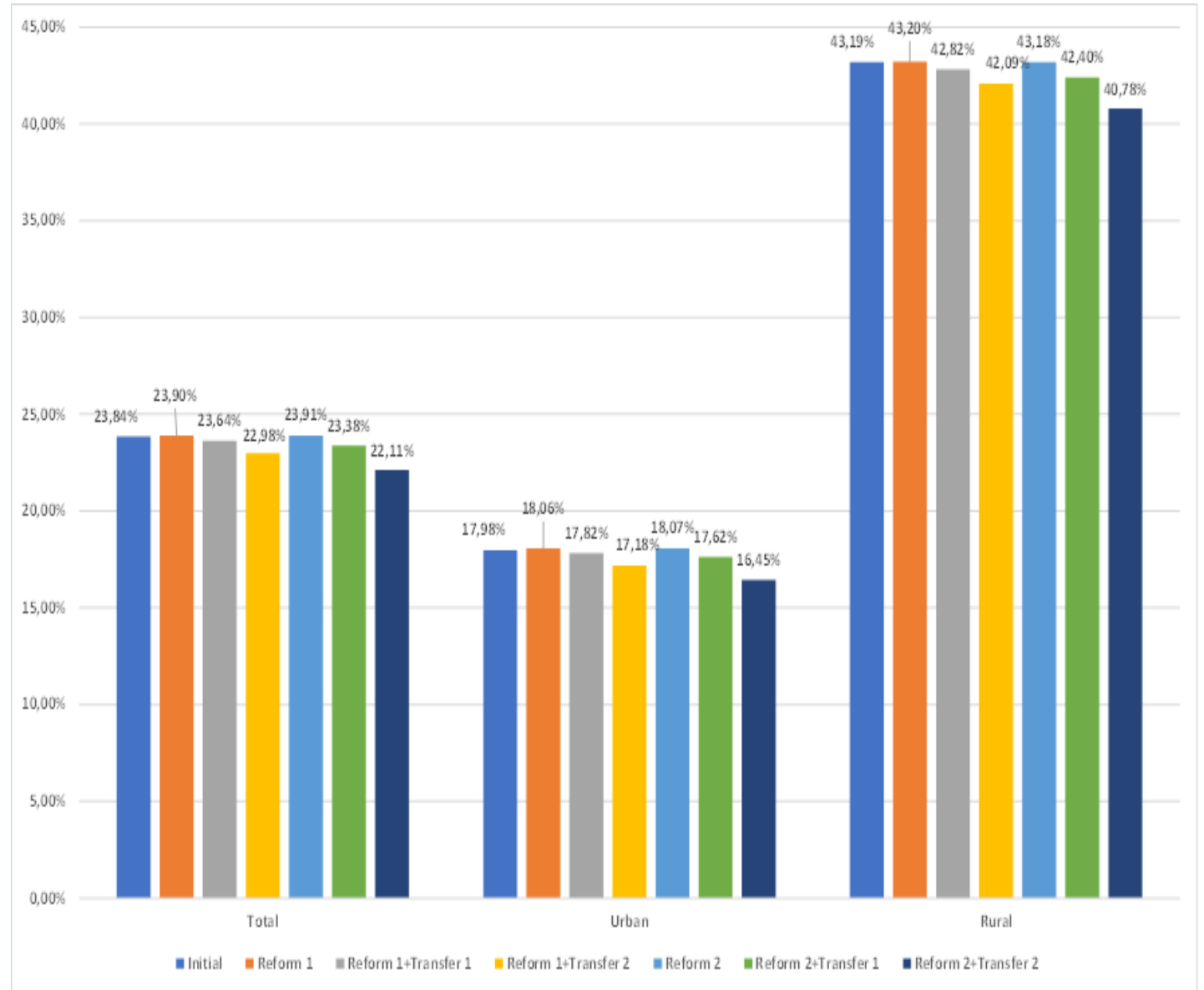
NEXT STEPS

- Any other welfare measure or index?

- Considering inflation today

- Changing the compensation schemes fixing alternative objectives

Acknowledgements