The efficiency and equity of carbon tax revenue recycling: A multi-criteria analysis

Emmanuel Combet and **Aurélie Méjean**

Séminaire Fondation Tuck

Rueil-Malmaison, 13 March 2017

I. Introduction

Carbon pricing

- efficient way to mitigate climate change (Pearce, 1991)
- however, concerns about:
  - competitiveness distortion
  - negative impact on the poorest households (Ekins, 1999)
- social impact of carbon pricing depends on the use of tax revenues
- implementation hindered by disagreements about this

Two polar views on revenue recycling:

- reduce distortionary taxes (indirect compensations)
- redistribute revenues directly to household through lump-sum transfers (direct compensations)

I. Two polar views on revenue recycling

- Indirect transfers (cuts in distortionary taxes)
  - usually superior in terms of allocatice efficiency (higher employment and GDP)
  - ... therefore may also improve the situation of the most vunerable groups

- Direct transfers (lump-sum transfers)
  - direct and guaranteed compensation to all, including the most vulnerable (whose energy bills are a large part of income)

I. Normative vs. positive dimensions

- In a nutshell, optimal policy depends on:
  - ethical judgements defining the social objective (e.g. environmental quality, private consumption, inequality reduction)
  - economic model used (e.g. functioning of markets, income distribution)

- As models have encompassed a wider variety of normative and positive assumptions, the consensus on the best revenue-recycling strategy has weakened

I. This paper

This paper:

- clearly separates the positive features of the economic model and the normative evaluation of policies.
- recognizes that no social objective function pre-exists the analysis
- considers macroeconomic behaviours far distant from the well theoretically-founded model of a perfect market economy
- represents the dilemma between equity and efficiency in a realistic way

Method:

- model of an open economy in general equilibrium
- multi-criteria analysis, focus on the equity-efficiency trade-off
- sensitivity analysis

I. Summary of results

- Lump-sum transfers vs. labour tax cuts boils down to a trade-off between controlling production costs and redistributing wealth directly
  - lump-sum transfers: rising production costs due to higher energy costs not counterbalanced by lower labour costs
  - ... but reduce inequalities and a direct way of redistributing wealth if insufficient information on the most vulnerable households
- Hybrid solutions strike a compromise by redistributing some wealth to the poorest household while using some revenues to cut labour taxes
- The dilemma depends on the characteristics of the economy
  - the gap between options widens when limiting the increase of production costs is crucial
  - labour tax cuts superior to lump-sum transfers in an open economy
- General conclusion: no recycling scheme is universally superior, the performance depends on the economic context, the inequalities considered, the level of inequalities that a society finds acceptable

II. Analytical framework

- comparative statics: distorts the 'image' of a no-policy economy hit by an external shock (the carbon tax)
  - model is not used as an optimisation tool
  - a type of 'conterfactual retrospective': what would be the effect on 2004 France if a carbon tax had been put in place in 1984?
- policies: two polar schemes and hybrid recycling schemes
- multi-criteria analysis: focus on the equity-efficiency trade-off
  - two criteria for each dimension (i.e. two distributive indicators and two aggregate indicators)
- central case: oil importing economy, with high pre-existing taxes on labour, high final energy consumption, a non-clearing labour market, open market for goods
- sensitivity analysis

II. The model

- model of an open economy in general equilibrium (with unemployment and high dependence on fossil fuels)
- 3 types of agents (households, government, firms) and the rest of the world
- households are disaggregated into 20 classes
- 4 types of production: crude oil, automotive fuels, other energy goods, composite good (all non-energy goods and services)
- hybrid model: describes energy volumes from the harmonisation of national accounts statistics with energy balances and energy prices statistics in the reference year

II. The effect of a carbon tax

- A carbon tax increases production costs, hence general price inflation, lower aggregate demand
- Labour tax cuts can lower labour costs
  - overall effect on internal demand is unclear: domestic agents face higher energy bills; but also lower non-energy prices, and employment and income increase thanks to improved trade balance
  - also ultimate effect is unclear, as the positive effect of lower labour taxes on labour costs may be offset by higher after-tax wages
  - low substitution possibilities in the demand side may lead to a higher CPI, hence upward pressure on wages: workers may succeed in getting higher after-tax wages, cancelling out the cost reduction from lower labour taxes
- Lump-sum transfers feed the household budget
  - labour costs remain high
  - production prices tend to increase, as higher energy costs are not compensated by lower labour costs
- Both revenue recycling options feed demand, although via different channels
  - Labour tax cuts, by moderating prices, primarily benefit external demand
  - Lump-sum transfers, by feeding the budget, sustain internal demand

III. Results

1. Two polar cases
2. Hybrid recycling schemes
3. Sensitivity analysis

1. Labour tax cuts: a strong form of double dividend

Macroeconomic impacts of a €300/tCO_2 tax recycled in labour tax cuts compared to the case without a carbon tax in 2004

Recycling	labour tax cuts
Total CO_2 emissions	−34.1%
Real gross domestic product	+1.9%
Effective consumption (aggregate)	+1.5%
Total employment (full time equivalent)	+3.5%
Government expenditure	+5.4%
Real investment	+1.9%
Producer price of the composite good	−1.0%
Labour intensity of the composite good	+1.4%
Effective consumption	+1.5%

- strong form of double dividend: the reform improves the initial overall tax system
- unemployment decreases, household demand and consumption rise

1. Labour tax cuts stop the spread of rising production costs

Sources of variation of the composite producer price if carbon tax proceeds are used to cut labour taxes, compared to the case without a carbon tax

Use of tax proceeds (€300/tCO_2)	labour tax cuts
Producer Price of the composite good	−0.1%
Decreasing returns to scale and technical progress	+0.1%
Cost of energy	+1.6%
Net wages	+1.5%
Payroll taxes	−3.6%
Other	−0.6%

- spread of rising production costs has stopped, domestic production remains competitive
- counterbalancing force: upward pressure on wages increasing purchasing power of households

1. Labour tax cuts: increased inequalities

Distributional impacts of a €300/tCO_2 tax recycled in labour tax cuts compared to the case without a carbon tax

Recycling		labour tax cuts
Effective consumption	TOTAL	+1.5%
	Poor (F0-5)	+1.1%
	Lower class (F5-35)	+1.2%
	Middle class (F35-65)	+0.9%
	Upper class (F65-95)	+1.8%
	Rich (F95-100)	+3.8%
	Gini index	+2.0%

- more consumption inequality (consumption of the poor increases less than that of the rich)
- energy expenses of the poor increase more (except residential energy, cf. rebound effect)
- the poor are closer to their basic needs, and have lower elasticity of substitution between energy and composite

1. Labour tax cuts vs. lump-sum transfers

Macroeconomic impacts of a €300/tCO_2 tax recycled in labour tax cuts or lump-sum transfers, compared to the case without a carbon tax in 2004

Recycling	labour tax cuts	lump-sum transfers
Total CO_2 emissions	−34.1%	−34.8%
Real gross domestic product	+1.9%	−0.7%
Effective consumption (aggregate)	+1.5%	+0.4%
Total employment (full time equivalent)	+3.5%	+0.3%
Real investment	+1.9%	−0.7%
Producer price of the composite good	−1.0%	+3.7%
Labour intensity of the composite good	+1.4%	+0.8%
Effective consumption	+1.5%	+0.4%

- comparable levels of emission reduction
- labour tax cuts: higher employment and effective consumption
- lump-sum transfers: rising production costs spread throughout the economy (higher energy costs are not counterbalanced by lower labour costs)
  - this leads to degraded terms of trade and lower purchasing power of households, lower demand for domestic products, hence lower employment

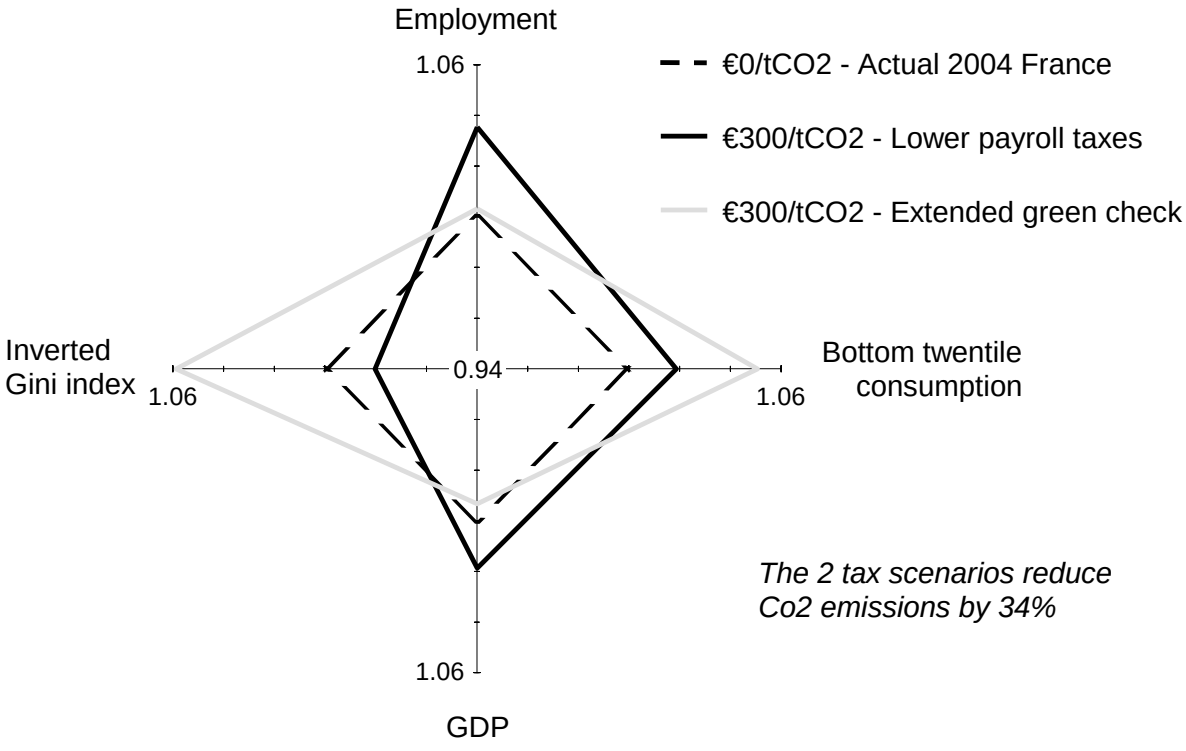
1. Labour tax cuts vs. lump-sum transfers: distributional impact

Distributional impacts of a €300/tCO_2 tax recycled in labour tax cuts or lump-sum transfers, compared to the case without a carbon tax

Recycling		labour tax cuts	lump-sum transfers
Effective consumption	TOTAL	+1.5%	+0.4%
	Poor (F0-5)	+1.1%	+5.1%
	Lower class (F5-35)	+1.2%	+2.7%
	Middle class (F35-65)	+0.9%	+0.2%
	Upper class (F65-95)	+1.8%	−0.9%
	Rich (F95-100)	+3.8%	−0.6%
	Gini index	+2.0%	−5.5%

- lump-sum transfers are strongly progressive
  - consumption of the poor increases, leading to reduction of consumption inequality
- equity-efficiency dilemma between labour tax cuts and lump-sum transfers!

1. A trade-off between equity and efficiency



Variations of the consumption of the bottom twentile and GDP are in real terms. The inverted Gini index is computed on consumption rather than income.

- the redistributive effect of uniform labour tax cuts does not offset the regressive effect of higher energy bills
- direct redistribution (lump-sum transfers) narrow inequalities at the cost of lower employment and production

2. Hybrid recycling schemes

- All include a system of direct compensation to households
- Funds not used to finance direct compensation are recycled in labour tax cuts
- Ordered below with increasing share of revenues to lump-sum transfers

- (a) Generalised tax credit: lump-sum to all households, corresponding to the tax levied on basic energy needs (56% of the before-tax energy consumption of the bottom twentile).
- (b) Targeted tax credit with accompanying measures: restricts the previous tax credit to the 80% lower-income households (remaining tax proceeds goes to labour tax cuts), additional measures for the energy poor households (inc. provision of energy efficient equipment)
- (c) Mixed recycling: lump-sum to all households, corresponding to the tax levied on their energy expenses only. The carbon tax levied on production is recycled in labour tax cuts.

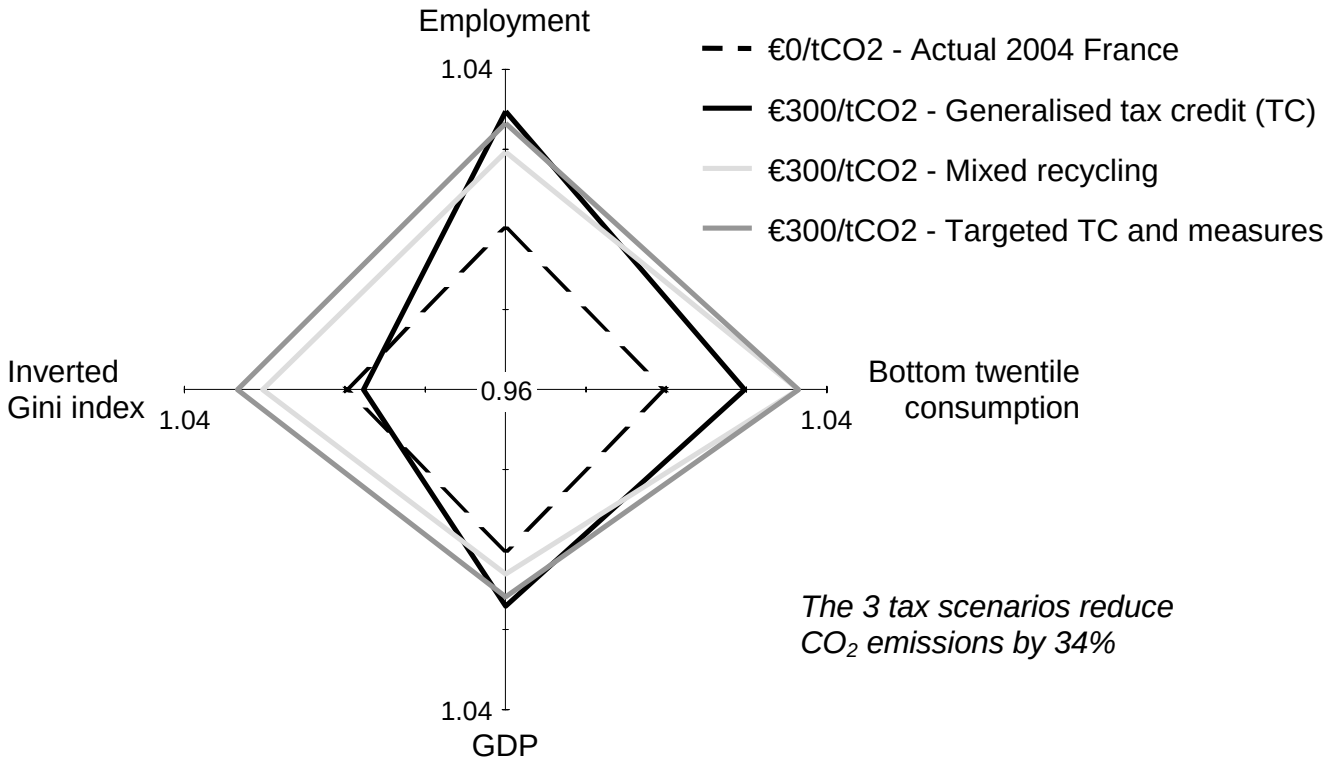
2. Hybrid recycling schemes

Macroeconomic and distributive performance of three hybrid revenue recycling schemes (€300/tCO_2 tax).

Type of direct compensation	Generalised tax credit (1)	Targeted tax credit (2)	Mixed recycling (3)
Share of tax proceeds to lump-sum transfers	+16.3%	+24.3%	+42.8%
Producer price of the composite good	−0.2%	+0.3%	+1.3%

- the cost of direct compensations depends on the resources devoted to their funding
  - if larger resources, less revenues available to control the rise of production costs

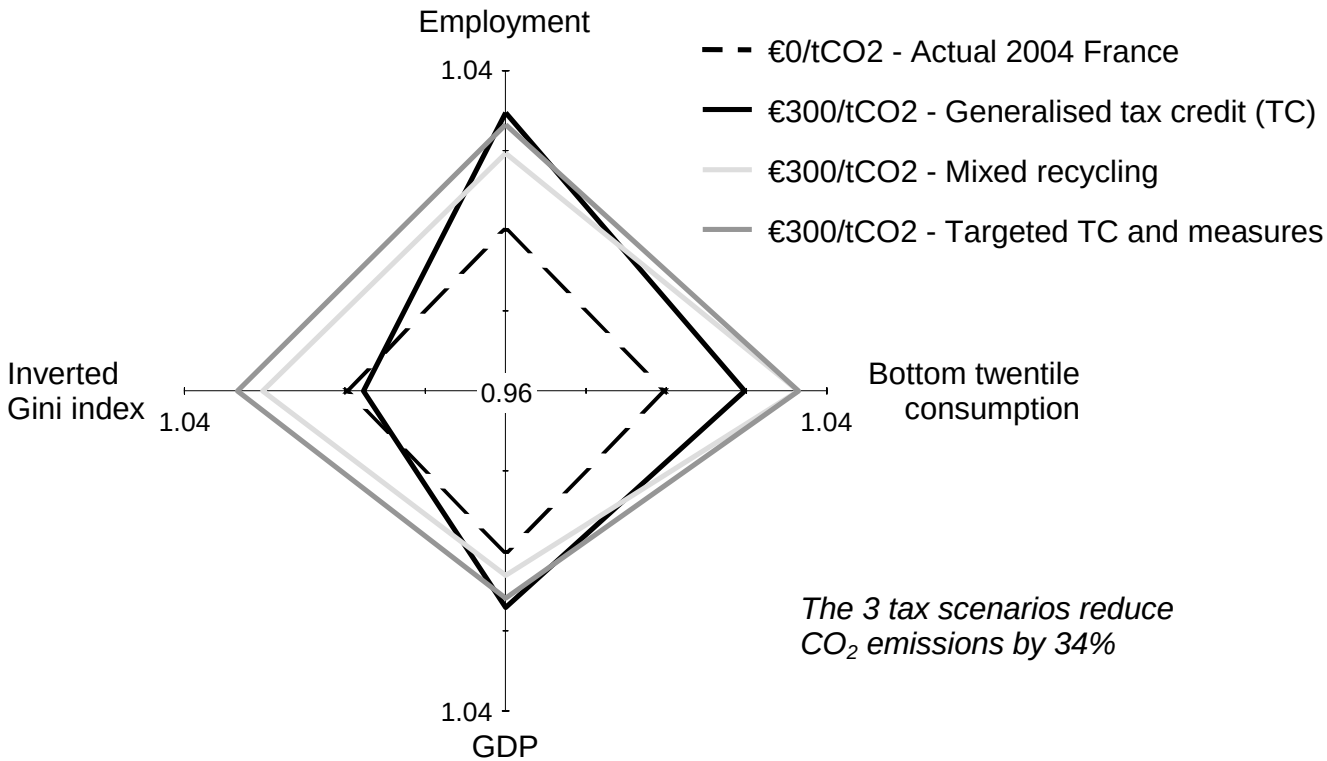
2. Hybrid recycling: there is room for compromise



Variations of the consumption of the bottom twentile and GDP are in real terms. The inverted Gini index is computed on consumption rather than income.

- 2/3 proposals perform better than the historical situation on all dimensions

2. Hybrid recycling: there is room for compromise



The 3 tax scenarios reduce CO_2 emissions by 34%

Variations of the consumption of the bottom twentile and GDP are in real terms. The inverted Gini index is computed on consumption rather than income.

- the targeted tax credit with measures performs best on all dimensions

3. Sensitivity analysis: set-up

- Central case:
  - flexibility of wages: elasticity of nominal wages to the unemployment rate = -10%
    - wages respond negatively to unemployment (tensions in the labour market decrease) and positively to consumer prices (workers wish to index their income on the cost of living)
  - terms of trade: domestic price elasticity of exports = -0.06; domestic price elasticity of imports = 0.01
  - constraint on public debt: balanced government budget (i.e. no debt creation)

- Sensitivity analysis:
  - flexibility of wages: fully flexible or fixed wages
  - terms of trade: price elasticities of imports and exports either reduced or increased by 1/3
  - horizontal vs. vertical inequalities

3. Fully flexible wages

Trade: central case	-10% elasticity of wages (central case)			Fully flexible wages		
	labour tax cuts	lump -sum	hybrid	labour tax cuts	lump -sum	hybrid
Employment	+3.5	+0.3	+2.7	+0.0	+0.0	+0.0
Real GDP	+1.9	-0.7	+1.2	+1.0	-0.9	-0.9
Gini index	+2.0	-5.5	-2.6	+3.1	-5.2	+2.7
Cons. of the poorest 5%	+1.1	+5.1	+3.3	-1.6	+4.6	-1.3

- central case: labour tax cuts are clearly superior to lump-sum transfers in terms of employment and GDP
- fully flexible wages: all recycling strategies have comparable effects on employment and GDP
  - fully flexible wages maintain full employment, hence little impact of tax reform on aggregate indicators
- lump-sum recycling is superior to labour tax cuts, as performs better along the distributive dimensions, cf. (Proost and Regemorter, 1995)

3. Fixed wages

Trade: central case	-10% elasticity of wages (central case)			Fixed real wages		
	labour tax cuts	lump -sum	hybrid	labour tax cuts	lump -sum	hybrid
Employment	+3.5	+0.3	+2.7	+10.2	-11.5	-3.2
Real GDP	+1.9	-0.7	+1.2	+7.4	-10.0	-3.5
Gini index	+2.0	-5.5	-2.6	+0.4	+9.4	+9.4
Cons. of the poorest 5%	+1.1	+5.1	+3.3	+6.8	-12.5	-6.8

- fixed wages: more contrasts between recycling strategies
- labour tax cuts even clearly superior to lump-sum transfers
  - carbon tax that would otherwise weigh on households (higher CPI) is shifted to productions costs to keep real wages constant
  - higher real-wage costs (combined with higher energy costs) lead to lower profitability of firms
  - higher prices to preserve profitability, hence lower demand, investment, employment
- effect is mitigated with labour tax cuts, cf. (Proost and Regemorter, 1995)
- labour tax cuts can increase GDP under fixed real wages because production costs can decrease via the taxation of non-wage income, contrasts with (Proost and Regemorter, 1995)

3. Relatively open economy

Wages: -10% elasticity	Trade (central case) labour tax cuts	lump -sum	hybrid	Relatively open economy labour tax cuts	lump -sum	hybrid
Employment	+3.5	+0.3	+2.7	+3.8	-0.7	+2.6
Real GDP	+1.9	-0.7	+1.2	+2.1	-1.6	+1.1
Gini index	+2.0	-5.5	-2.6	+2.0	-5.0	-2.4
Cons. of the poorest 5%	+1.1	+5.1	+3.3	+1.4	+3.5	+3.1

- open economy: more contrasts between recycling strategies
- labour tax cuts even clearly superior to lump-sum transfers
  - labour tax cuts help to maintain low production costs and low domestic prices
  - crucial to sustain high GDP and employment when domestic producers face international competition
- distributive parameters: gap narrows between options in an open economy
  - lump-sum transfers directly redistribute wealth but bring lower employment and GDP, which indirectly impacts the ultimate distribution

3. Relatively closed economy

Wages: -10% elasticity	Trade (central case) labour tax cuts	lump -sum	hybrid	Relatively closed economy labour tax cuts	lump -sum	hybrid
Employment	+3.5	+0.3	+2.7	+3.1	+2.0	+2.8
Real GDP	+1.9	-0.7	+1.2	+1.4	+0.9	+1.3
Gini index	+2.0	-5.5	-2.6	+2.0	-6.3	-2.9
Cons. of the poorest 5%	+1.1	+5.1	+3.3	+0.5	+7.8	+3.6

- closed economy: trade-off between controlling production costs and redistributing wealth is less compelling
  - the mechanism that would damage the competitiveness of domestic firms when those are hit by a carbon tax is mitigated when assuming a lower price elasticity of imports and exports.

3. Vertical vs. horizontal equity

Impact of the type of distribution considered on policy performance

Trade and wages: central case	Vertical equity (20 income groups) labour tax cuts	lump-sum	hybrid
Employment	+3.5	+0.3	+2.7
Real GDP	+1.9	-0.7	+1.2
Gini index	+2.0	-5.5	-2.6
Consumption of the poorest 5%	+1.1	+5.1	+3.3

Trade and wages: central case	Horizontal equity (6 territorial groups) labour tax cuts	lump-sum	hybrid
Employment	+3.6	+0.3	+2.6
Real GDP	+1.9	-0.7	+1.1
Gini index	+13.4	+35.9	+17.0
Consumption of rural households	+0.0	-4.0	-1.9

- Very similar results in terms of employment and GDP
  - second order effect of income distribution on aggregate indicators because of no geographical segmentation of labour market in the model

3. Vertical vs. horizontal equity

Impact of the type of distribution considered on policy performance

Trade and wages: central case	Vertical equity (20 income groups) labour tax cuts	lump-sum	hybrid
Employment	+3.5	+0.3	+2.7
Real GDP	+1.9	-0.7	+1.2
Gini index	+2.0	-5.5	-2.6
Consumption of the poorest 5%	+1.1	+5.1	+3.3

Trade and wages: central case	Horizontal equity (6 territorial groups) labour tax cuts	lump-sum	hybrid
Employment	+3.6	+0.3	+2.6
Real GDP	+1.9	-0.7	+1.1
Gini index	+13.4	+35.9	+17.0
Consumption of rural households	+0.0	-4.0	-1.9

- Results greatly differ along equity indicators
  - share of energy expenditures in household budget varies more according to the degree of urbanization (between 2.5% and 9.5%) than according to income (between 5.3% and 8.5%)

3. Vertical vs. horizontal equity

Impact of the type of distribution considered on policy performance

Trade and wages: central case	Vertical equity (20 income groups) labour tax cuts	lump-sum	hybrid
Employment	+3.5	+0.3	+2.7
Real GDP	+1.9	-0.7	+1.2
Gini index	+2.0	-5.5	-2.6
Consumption of the poorest 5%	+1.1	+5.1	+3.3

Trade and wages: central case	Horizontal equity (6 territorial groups) labour tax cuts	lump-sum	hybrid
Employment	+3.6	+0.3	+2.6
Real GDP	+1.9	-0.7	+1.1
Gini index	+13.4	+35.9	+17.0
Consumption of rural households	+0.0	-4.0	-1.9

- Both lump-sum and hybrid recycling increase inequalities: counter-intuitive?
  - revenue recycling options do not distinguish between rural and urban households
  - lump-sum transfers very small compared to the burden of the tax on rural households, who may disproportionately suffer from lower GDP and employment

IV. Summary of results

- Lump-sum transfers vs. labour tax cuts boils down to a trade-off between controlling production costs and redistributing wealth directly
  - lump-sum transfers: rising production costs due to higher energy costs not counterbalanced by lower labour costs
  - ... but reduce inequalities and a direct way of redistributing wealth if insufficient information on the most vulnerable households
- Hybrid solutions strike a compromise by redistributing some wealth to the poorest household while using some revenues to cut labour taxes
- The dilemma depends on the characteristics of the economy
  - the gap between options widens when limiting the increase of production costs is crucial
  - labour tax cuts superior to lump-sum transfers in an open economy

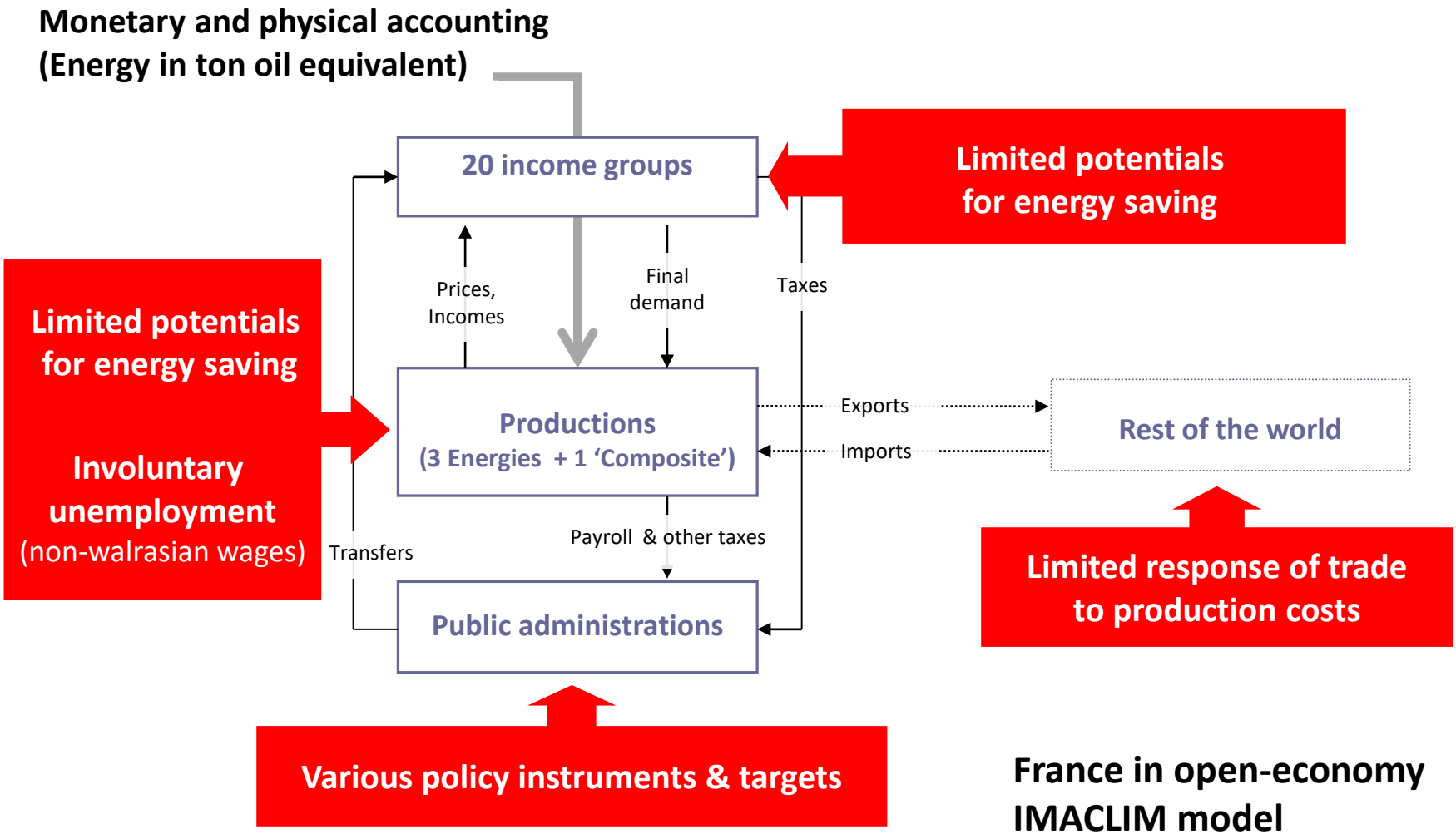
IV. Policy conclusion

- Our core analysis considers an oil importing economy, with high pre-existing taxes on labour, high final energy consumption compared to intermediate energy consumption, a non-clearing labour market and an open market for goods.
- In this context, the best recycling option is to limit lump sum compensations to those to the most vulnerable households, and allocate the remaining share of the revenues to reduce the existing tax burden bearing on production costs
- Sensitivity analysis shows that the superior policy depends on the context: the performance of policies depends on the energy and macreconomic context, the type of inequalities considered, and the level of inequalities that a society finds acceptable
- General conclusion: no recycling scheme is universally superior
- This calls for country-specific analyses

Thank you!

back-up

The model


Monetary and physical accounting
(Energy in ton oil equivalent)
20 income groups
Limited potentials
for energy saving
Prices,
Incomes
Final
demand
Taxes
Limited potentials
for energy saving
Involuntary
unemployment
(non-walrasian wages)
Productions
(3 Energies + 1 'Composite')
Exports
Imports
Rest of the world
Transfers
Payroll & other taxes
Public administrations
Limited response of trade
to production costs
Various policy instruments & targets
France in open-economy
IMACLIM model

Carbon tax in France

- 7€/tCO_2 en 2014, 14.50 €/tCO_2 en 2015, à 22€/tCO_2 en 2016 et 30.5 €/tCO_2 en 2017 (100€/tCO_2 en 2030)
- Recettes: 0.3 G€ (2014), 2.3 G€ (2015) et 3.8 G€ (2016). En 2016, les recettes ont contribué, à hauteur de 3 G€, au financement du Crédit d'impôt pour la compétitivité et l'emploi.
- A compter de 2017, une part des recettes de la composante carbone (1.7 G€ en 2017) sera affectée au compte d'affectation spécial pour la transition énergétique, contribuant ainsi au financement des énergies renouvelables.
- Effets positifs sur l'activité et l'emploi atendus, réduction de la dépendance au pétrole, amélioration de la balance commerciale, croissance de filières liées à la transition énergétique, économies par les ménages et les entreprises en incitant à une amélioration de l'efficacité énergétique.