Digital safety nets: a roadmap*

Alex Karaivanov (Simon Fraser), Benoit Mojon, Luiz Pereira da Silva and Rob Townsend (MIT)

Presentation at PIER-BoT, 28 August 2023

* Disclaimer: the presentation reflects the views of the authors and not necessarily the ones of the BIS.

Additional disclaimer

This paper is not about Thailand!

Motivation: Risk Mangement and Importance for Central Banks

- **Income risk** remains prevalent, various levels, for households, firms, regions, and countries

- **Policies and institutions to limit damage from risk**
  - In **developed economies:** financial markets that allow saving and borrowing; private and public social insurance; safety nets for unemployment, health risks, and old age
  - In **EMDEs, double problem**: larger income shocks, and limited safety nets/ low financial inclusion
    - 1.4 billion remain unbanked, only 40% are saving
    - can cause self-employed to fall into or stay in **poverty traps**
    - households do not undertake or are constrained in entrepreneurial activities
  - **However, rapid progress of financial inclusion through smart phones**

- **Central Bank concerns**
  - Financial inclusion with large welfare upside
  - Macroeconomic effects: lack of income insurance can deepen economic downturns, lower investment/ potential **growth**

Outline

- A typology of «safety nets» in an ad hoc 2 economic agents economy

- The Karaivanov-Townsend (2014) estimation of «safety nets» welfare gains
  - The case of Thai rural households
  - The case of Re-insurance of EA member states national unemployment insurances
  - The case of Spanish corporates

- Conclusion

A typology of risk sharing schemes in a 2 agents economy

- Assume 10 periods in the life of agents A and B

- Each period their gross income can take any value between 1 and 19

- E,t (Income,t+1)=10

Period	Gross income	
	A	B
1	14	3
2	9	7
3	2	15
4	8	11
5	17	18
6	15	5
7	8	3
8	9	11
9	19	2
10	19	12

Gross income: —— Agent A   —— Agent B

A typology of risk sharing schemes in a 2 agents economy

- **Flat tax and transfers:** within each period, 10 percent tax is collected from both agents and transferred to the agent with income below 5.

- **Savings only**: each agent saves income in excess of 10 and can use the savings to smooth disposable income (DI) in periods when their gross income is less than 10.

- **Transfers**: the agent with higher income in a period transfers to the other agent 25% of the difference in their gross incomes.

Pay off structure for various ad hoc «safety nets» I

Period	Gross income		Disposable income					
			Flat tax and transfers		Savings only		Transfers	
	A	B	A	B	A	B	A	B
1	14	3	12.6	4.4	10	3	11.25	5.75
2	9	7	9	7	10	7	8.5	7.5
3	2	15	3.5	13.5	5	10	5.25	11.75
4	8	11	8	11	8	10	8.75	10.25
5	17	18	17	18	10	10	17.25	17.75
6	15	5	15	5	10	10	12.5	7.5
7	8	3	7.2	3.8	10	10	6.75	4.25
8	9	11	9	11	10	10	9.5	10.5
9	19	2	17.1	3.9	10	5	14.75	6.25
10	19	12	19	12	10	10	17.25	13.75
			Figure 1.A		Figure 1.B		Figure 1.C	

Note: the table reports the gross income flow of agents A and B as a randomly drawn value between 1 and 19.

Comparing savings only and transfers
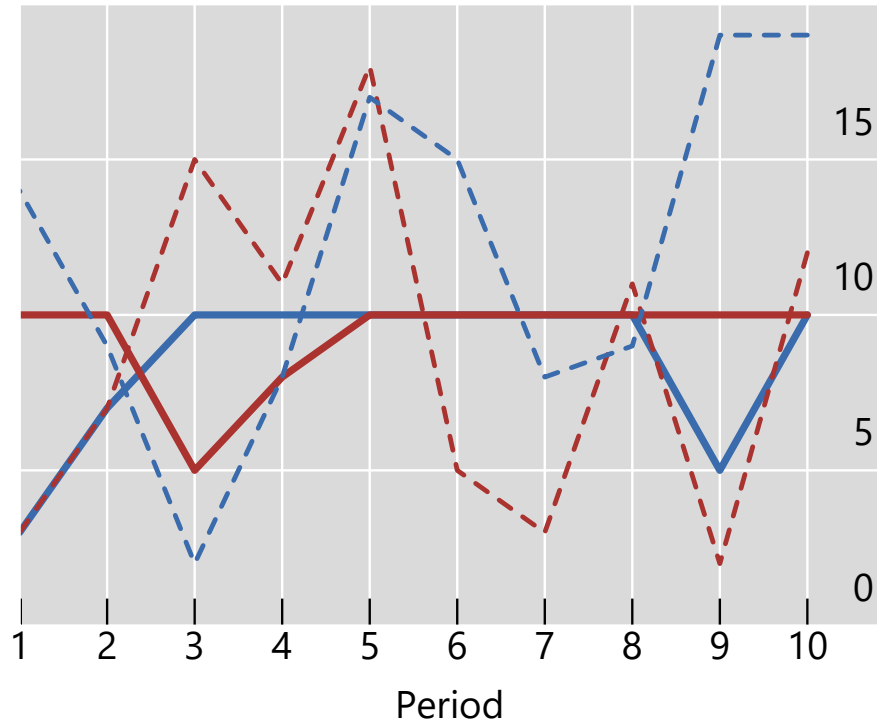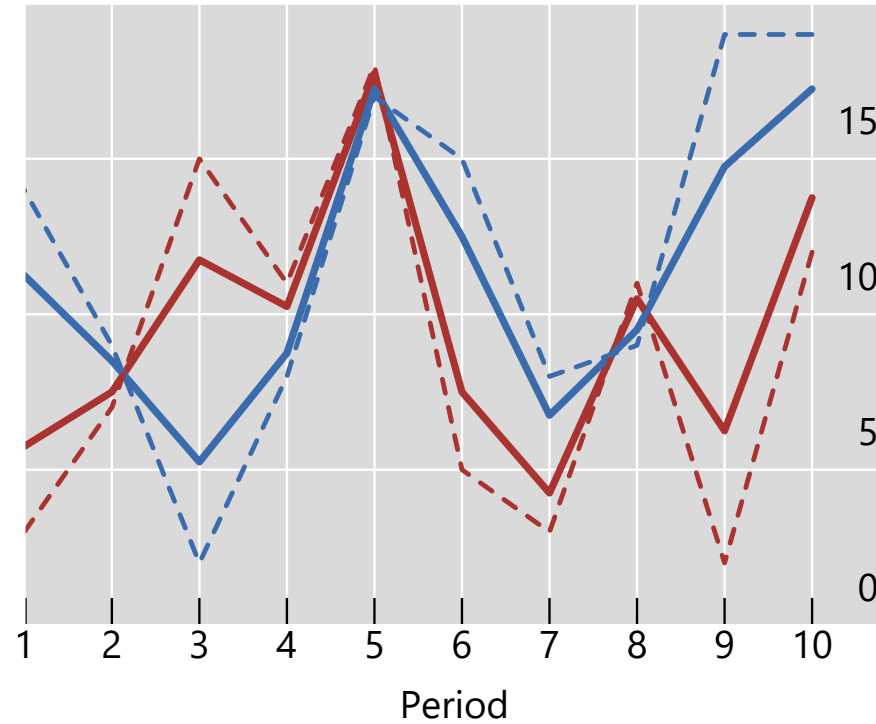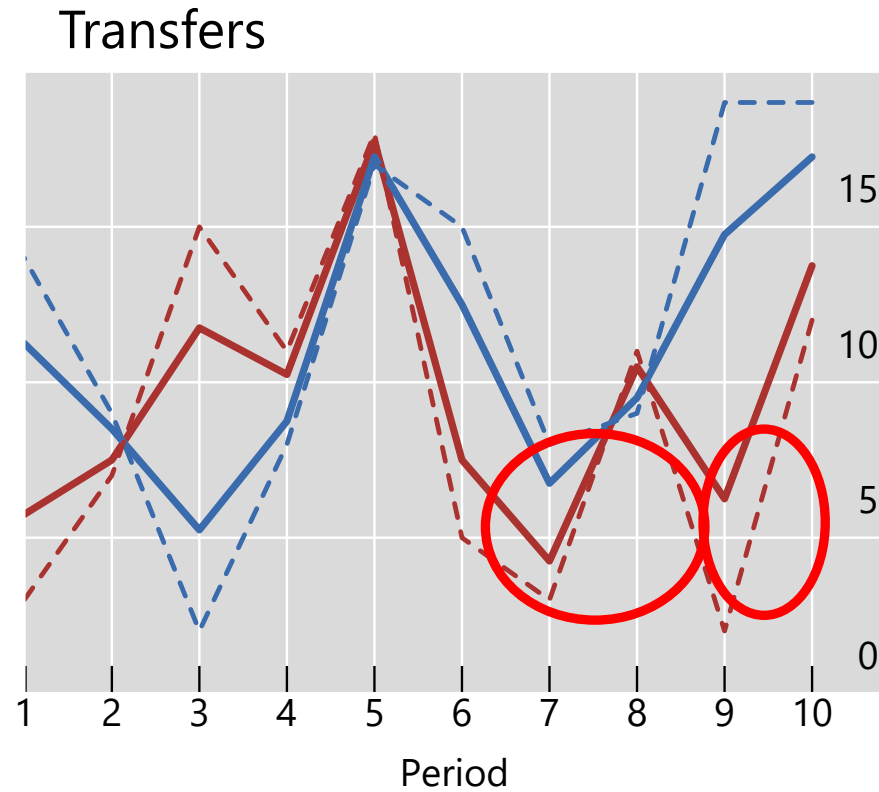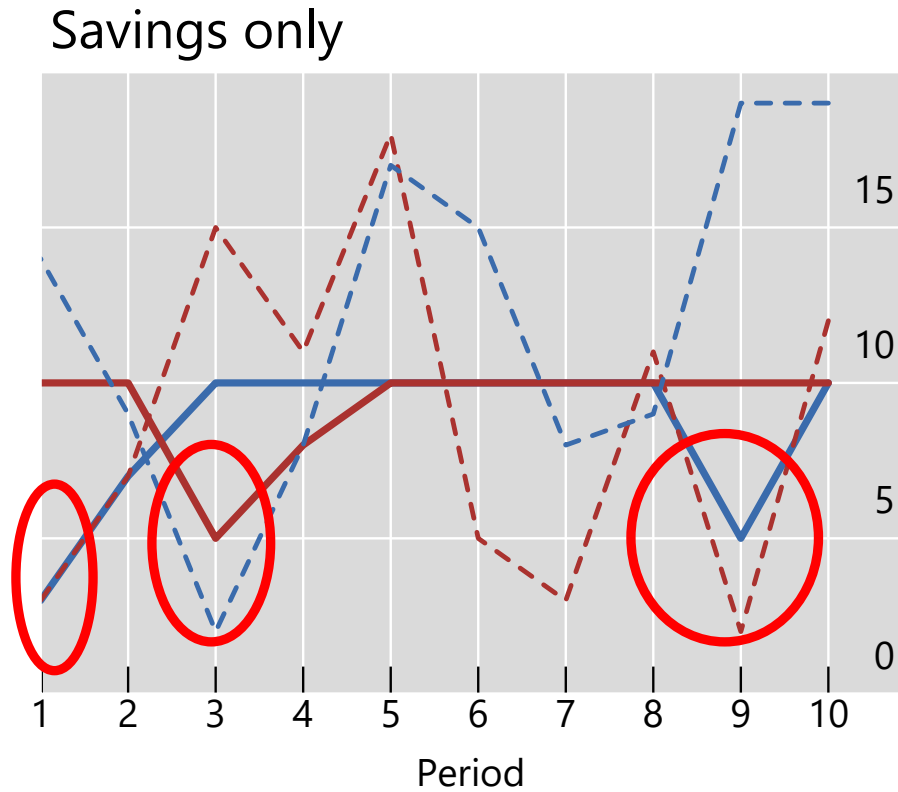

Savings only

Transfers

Gross income:
Disposable income:

Agent A: - - - - - ─────
Agent B: - - - - - ─────

Comparing savings only and transfers

Savings only

Transfers

Period

Period

Gross income: Disposable income:

Agent A:

Agent B:

Various alternative safety nets

● **Type 1 safety net with savings and transfers (Limited commitment)**: transfers as above combined with saving in periods when their income is larger than 10. Pooled savings can be used in subsequent periods when their individual income after transfer income is less than 10.

Limited commitment: Any period, transfers ≤2 and transfers+savings≤5.

Transfers from past savings are split equally up to their disposable income reaching 10.

● **Type 2 safety net with savings and transfers**: **transfers are based on observed aggregate income**.

▪ Half of aggregate income in excess of 20 is requested from each agent and pooled;

▪ the pooled funds are then used in any following period in which aggregate income is less than 20 (each agent receives half of the difference between 20 and aggregate income, if feasible).

● **Type 3 safety net with savings and transfers**: **transfers are based on observed individual income**.

▪ each agent contributes to a savings pool any income above 10 and

▪ he/she receives a transfer equal to the difference between 10 and their income when the income is less than 10,

▪ subject to the available pooled funds

Pay off structure for various ad hoc «safety nets» II

Period	Gross income		Type 1 savings and transfers		Savings pot	Type 2 savings and transfers		Savings pot	Type 3 savings and transfers		Savings pot
						Disposable income					
	A	B	A	B		B	A		A	B	
1	14	3	10	5	2	14	3	0	10	7	0
2	9	7	9.5	8.5	0	9	7	0	9	7	0
3	2	15	4	10	3	2	15	0	7	10	0
4	8	11	10	10	2	8	11	0	9	10	0
5	17	18	12.25	13	11.75	9.5	10.5	15	10	10	15
6	15	5	10	10	11.75	15	5	15	10	10	15
7	8	3	10	10	2.75	12.5	7.5	6	10	10	6
8	9	11	10	10	2.75	9	11	6	10	10	6
9	19	2	14	6.75	3	18.5	1.5	7	10	10	7
10	19	12	14	10	10	13.5	6.5	18	10	10	18
			Figure 1.D			Figure 1.E			Figure 1.F		

Note: the Table reports the gross income flow of agents A and B as a randomly drawn value between 1 and 19.

Pay off structure for various ad hoc «safety nets» - Graphically III

Aggregate information
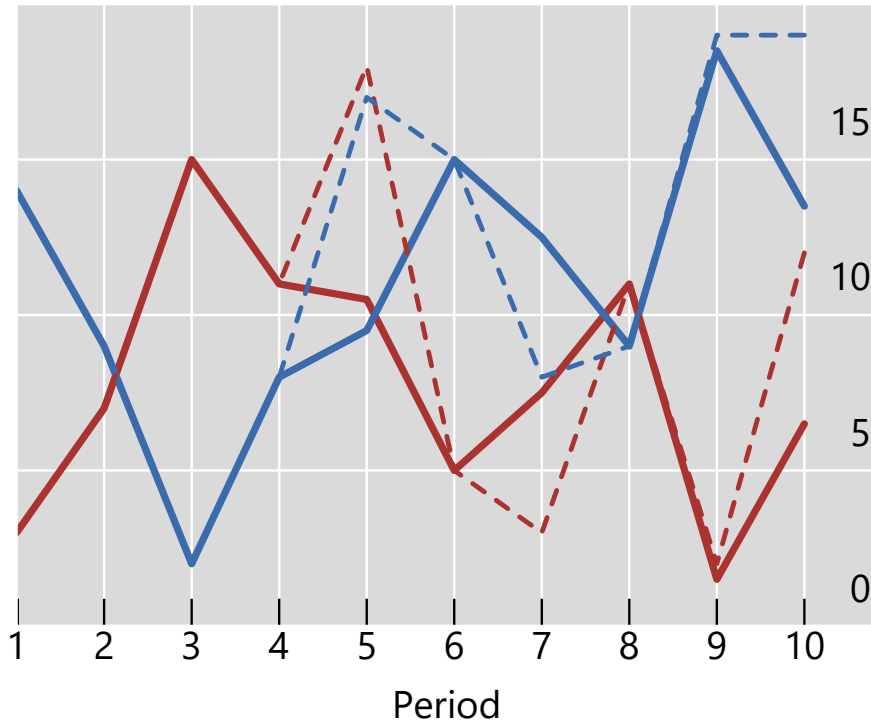
Individual information

Period
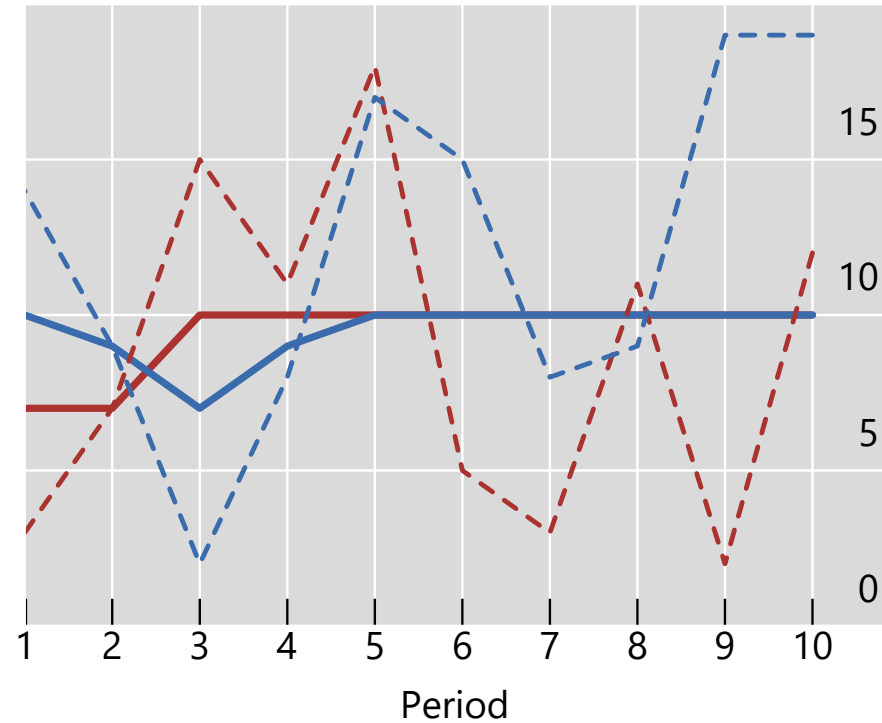
Gross income: Disposable income:

Agent A: - - - - -   ————

Agent B: - - - - -   ————

Examples of overcoming information asymmetries through code

- **Means to overcome limited commitment and lack of trust**
  - Informal systems (families,…)
  - Exclusion from the trading platform (excessive social costs)
  - Collateral and **escrow accounts**

	Gross income		Escrow account		Disposable income	
Period	Agent A	Agent B	Agent A	Agent B	Agent A	Agent B
6	9	7	2.25	1.75	6.75	5.25
7	2	15			6	15
-						
8	9	11	2.25	2.75	6.75	8.25
9	19	2			19	7

Illustration: Gains from programmable contracts, even with only 2 periods

Two-period example $(q_H = 5, q_L = 1$ *with probability* $1/2; u(c) = \ln(c); \beta = R = 1)$
legend: $H = $ *high income,* $L = $ *low income,* $\tau = $ *transfer*

transfers	period 1		period 2				expected utility
	τ_H	τ_L	τ_{HH}	τ_{HL}	τ_{LH}	τ_{LL}	
autarky	0	0	0	0	0	0	1.61
full insurance (first best)	−2	2	−2	2	−2	2	2.20
saving only	−1.4	0	1.4	1.4	0	0	1.73
hidden income	−1.8	0.9	1.1	1.1	−0.2	−0.2	1.88
limited commitment	−2.1	0.7	0	1.9	0	0.7	2.03
hidden income + limited commitment	−1.7	0.5	1.2	1.2	0	0	1.85

- Voluntary premia: benefit of some insurance despite all obstacles; dominates autarky and self-insurance
- Hidden income: voluntarily announce high income; receive something back later but uniform over states
- Limited commitment: pay high premium at current high income, gain of receiving indemnity later in low income states

Main lessons and way forward

- Benefits to inter-temporal smoothing and pooling idiosyncratic risk
  - The pay off structure is quite different across «safety nets»
  - Implies different levels of "welfare"

- Many of these risk sharing schemes can be implemented in code
  - including with Bayesian real time updating of agents' preferences
  - Experimentation via RCT

- A necessary preliminary step is to assess what "financial regime" agents are "subject to"
  - The co-movement of gross and disposable income changes across regimes
  - This is the main contribution of Karaivanov and Townsend (2014)

The Karaivanov-Townsend (2014) algorithm

- Assess the financial regime various agents are in through maximum likelihood estimation

- Pecking order of income insurance across financial regimes
  - Autarky: zero insurance
  - Savings only: some self insurance
  - Savings and borrowing: ability to borrow on top
  - Moral hazard: ability to modulate repayments depending on one's ex post income
  - Limited commitment: same
  - Full risk-sharing: first best allocation in full information

- Data on income and expenditure of agents can be use to assess their financial regime and the welfare gains of progress toward better safety nets

Example 1: 140 Rural Thai households without family network

- We focus on this group of Thai households from the Townsend Thai database because KT(2014) have showed they are the least insured

	With family network	**Without family network**
Rural	LC regime or B&L	Our 140 household sample «Savings only»
Urban	LC regime	LC regime or B&L

- KT estimates for this group of Thai housholds
  - ▪ CRRA with a 2.9 risk aversion
  - ▪ Their level of financial constraints corresponds to Savings only

    (Vuong's Max likelihood test)

140 Thai households: distribution of income
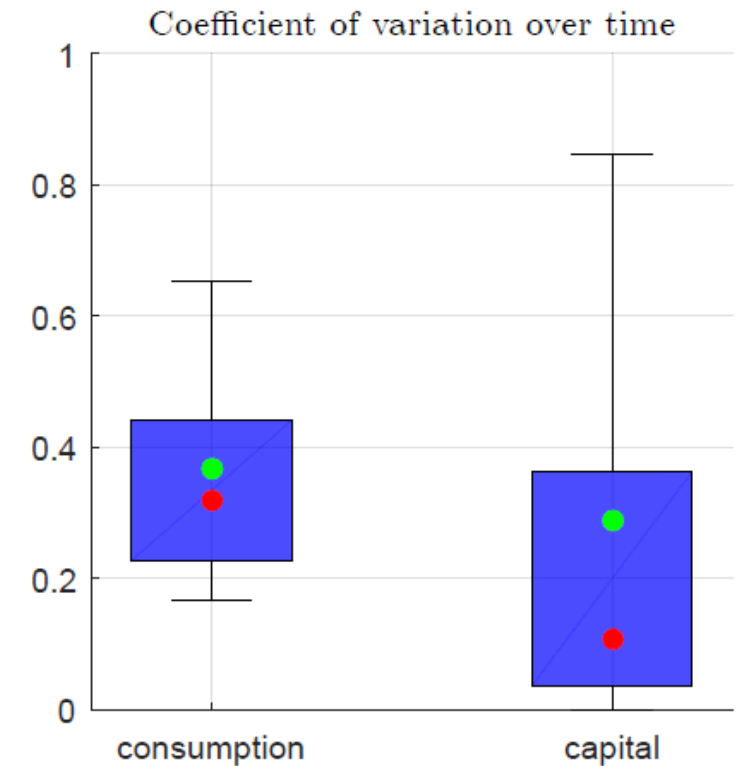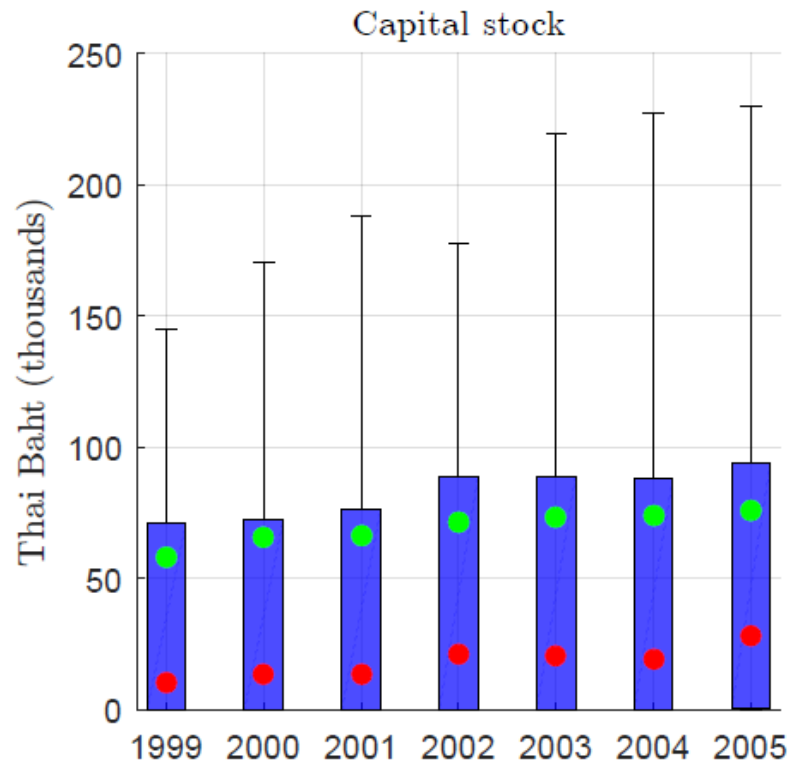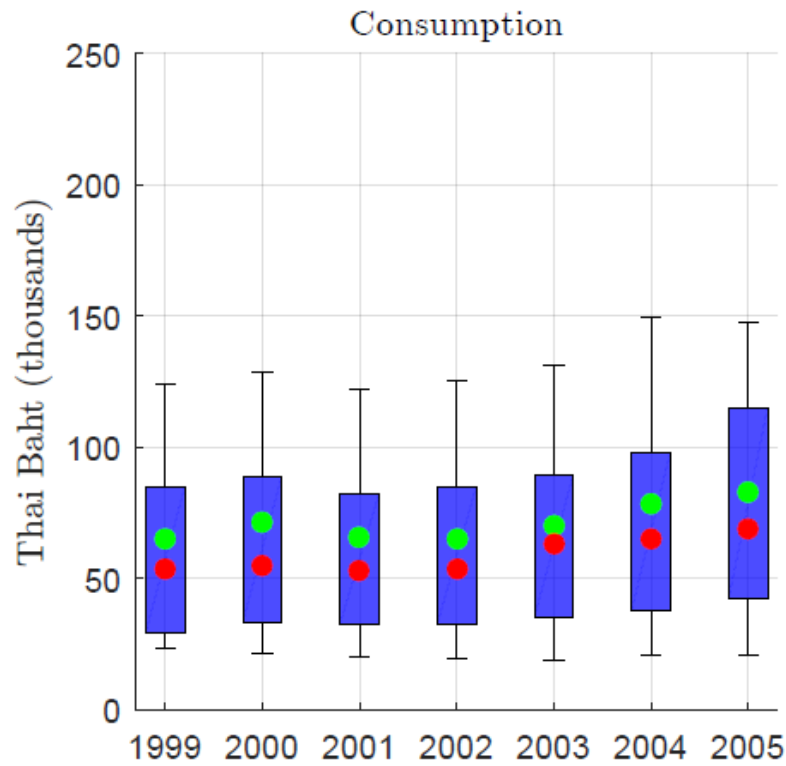
Simulation exercise

- What capital and consumption would these Thai households experience across 3 financial régimes
    - Savings only (close to their situation for the 6 years of the survey)
    - A borrowing and lending scheme across the 140 households
    - An insurance plateform that can pool income risks across the 140 households

- Taking their realised income and their initial level of capital as given
    - We assume uniform preferences across households
    - Zero initial savings in savings only
    - Zero initial borrowing or savings in B&L
    - Zero ex ante profits for the insurance plateform in the LC insurance regime

Gains from Insurance – Capital smoothing
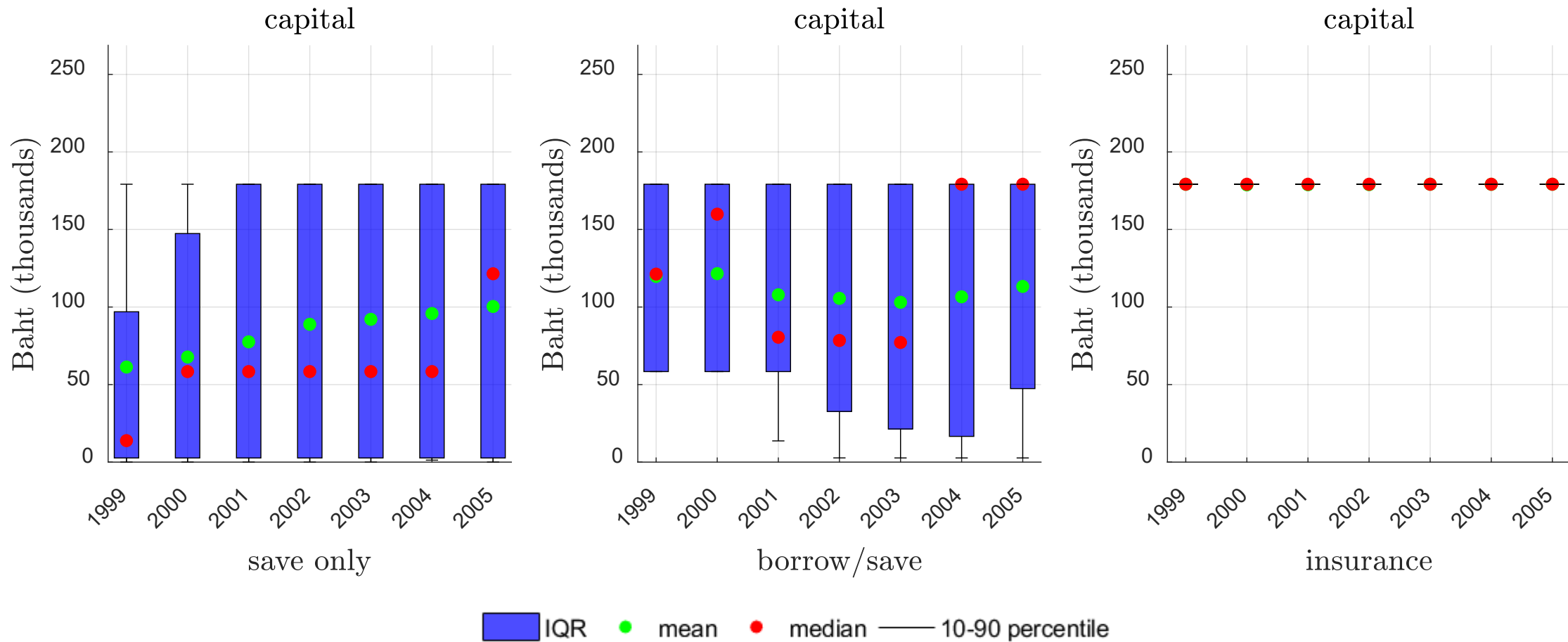
Gains from Insurance – Consumption smoothing
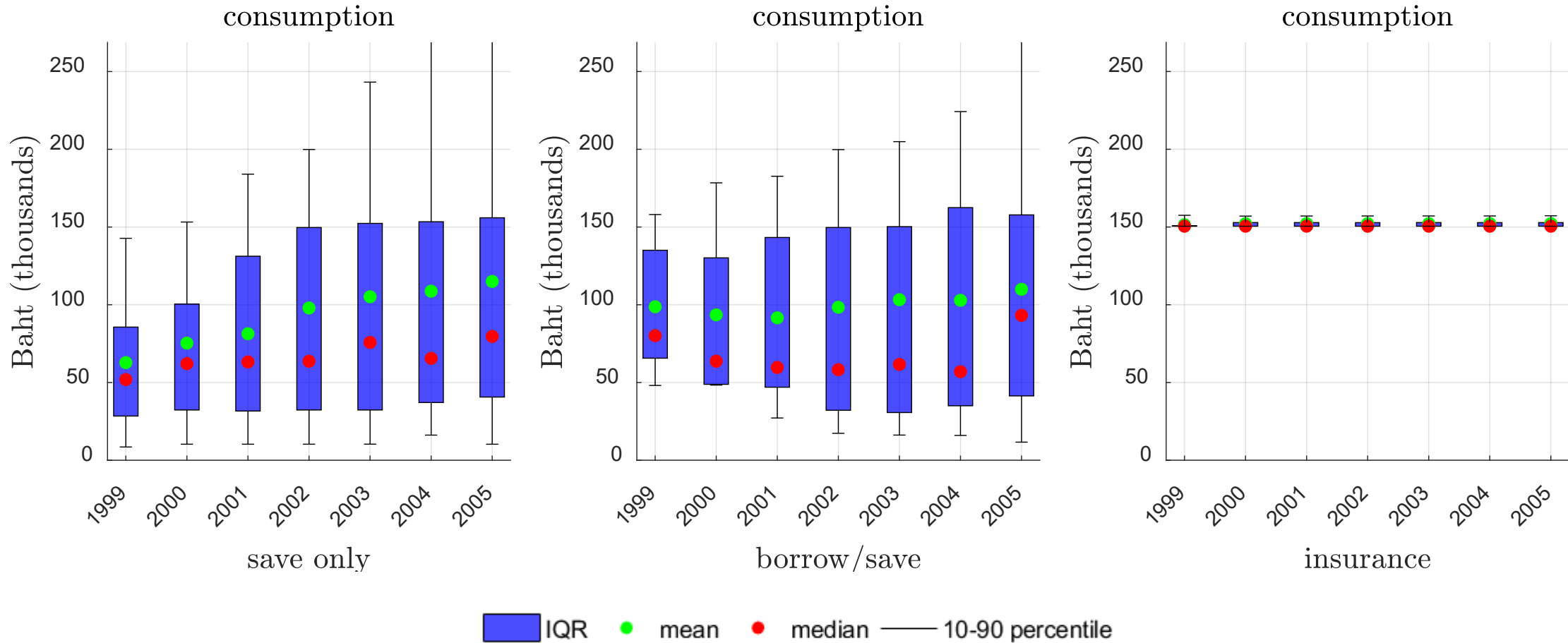
Overcoming poverty trap thanks to insurance
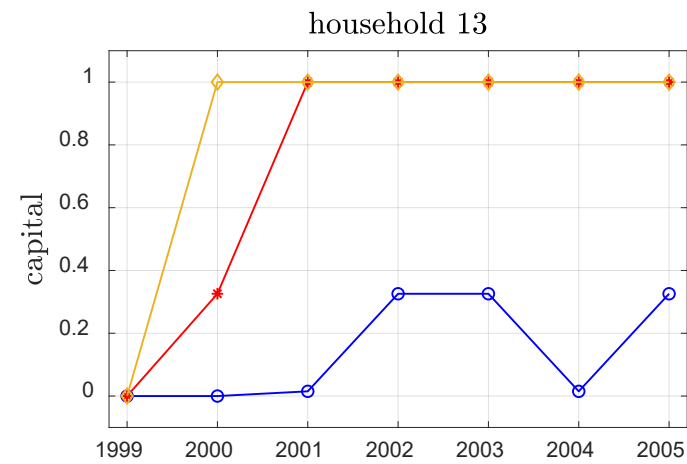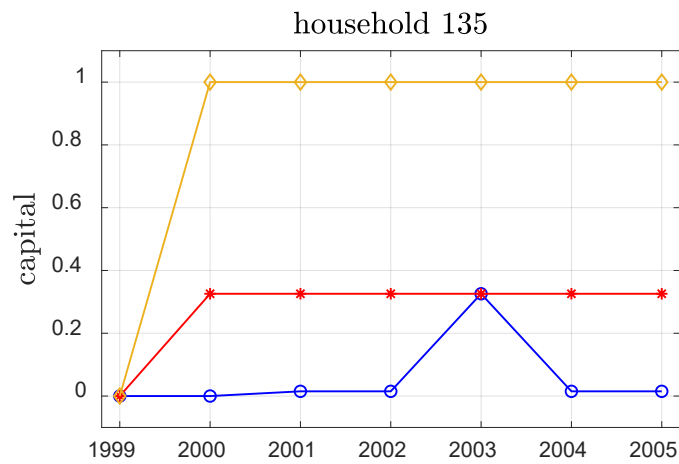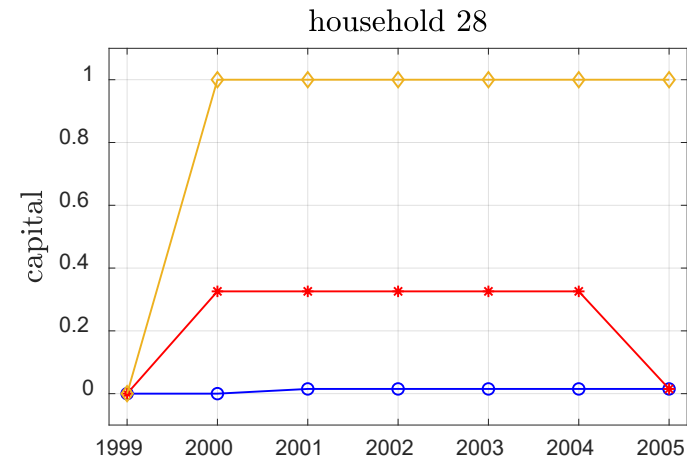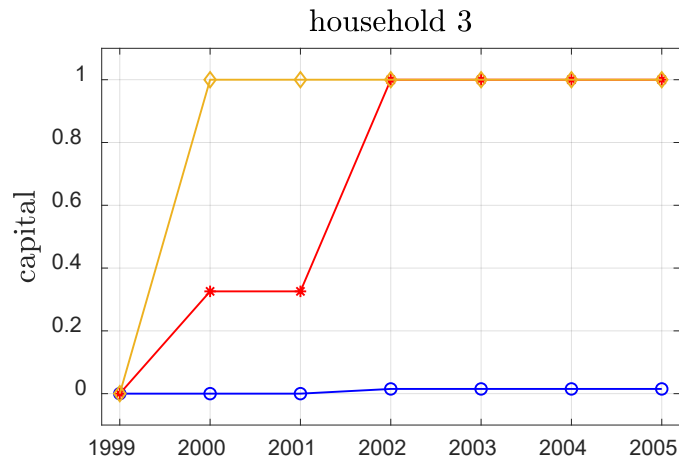
Insurance premia and indemnity
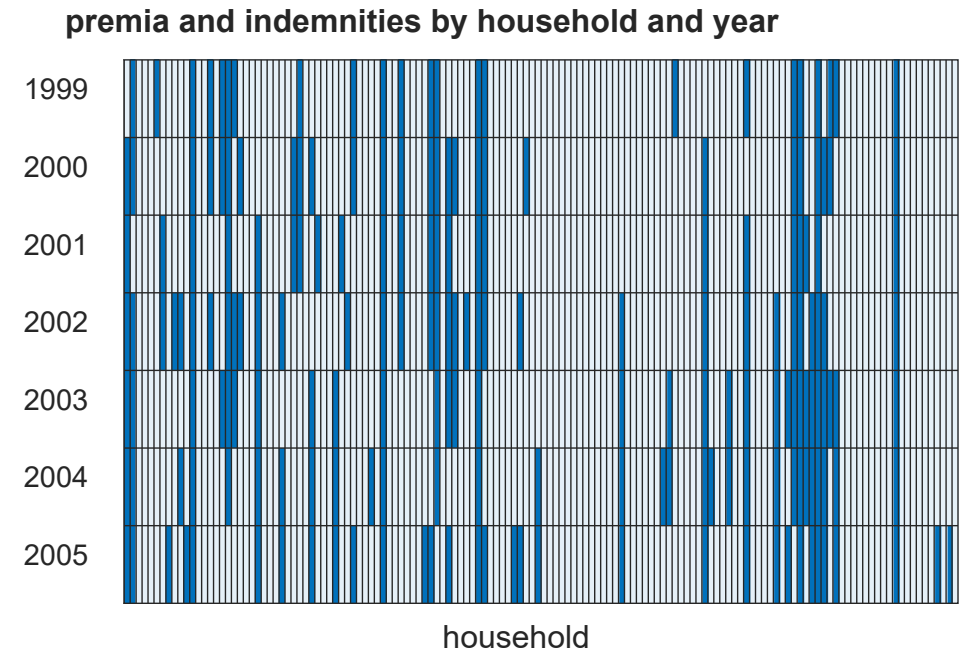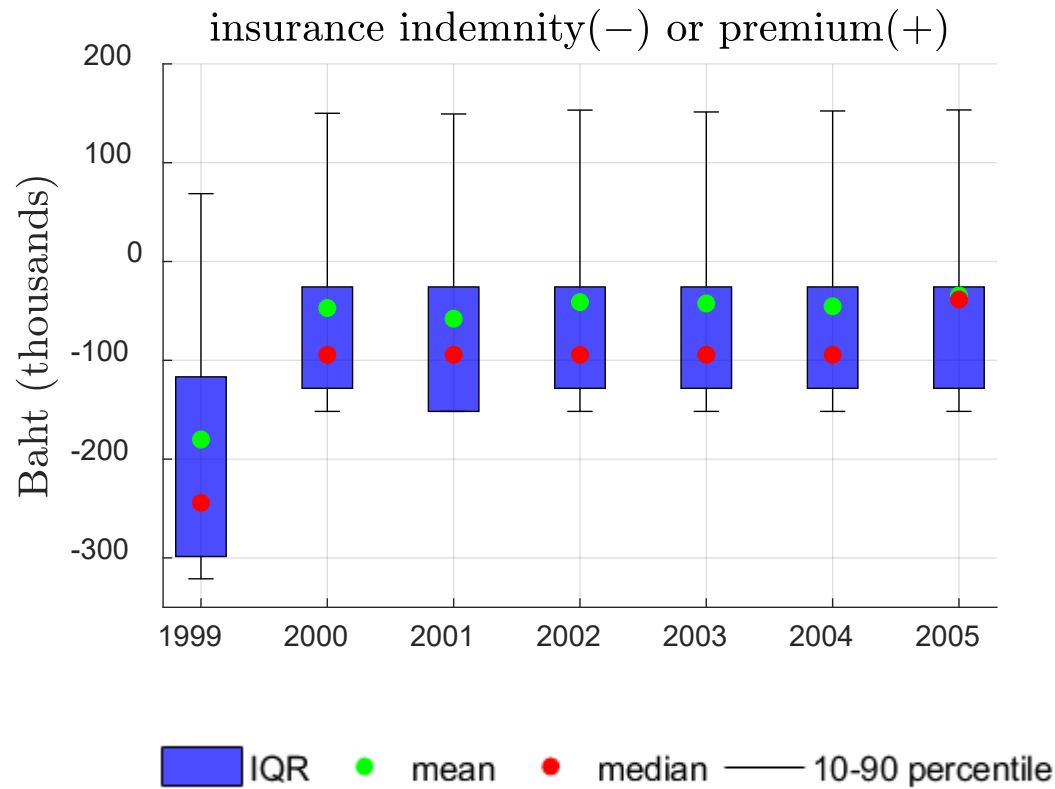
Example 2: Euro area risk-sharing across 17 national unemployment insurances

- The euro area sovereign debt crisis precedent
  - Lack of risk sharing in the euro area
  - Set up of the ESM
  - The capital market union is under developped
  - Proposals to set up a re-insurance scheme for euro area natinonal unemp. insurances

- Existing literature
  - Half a dozen papers comparing various rules of thumbs (Berger, Dell'Arricia, Obstfeld)
  - Dolls (2020): overview and own ad hoc proposal
    - Double trigger for indemnity: dU>1% and U>7yearsMA(U)
    - Double trigger for contribution: dU<0 and U< 7yearsMA(U)
  - Super effective risk sharing

Apply the KT algorythm to design a safety net for EA Unemp insurances

- Simulation exercise: compare savings only to LC insurance

- Use the data on unemployment from 17 countries from 2000 to 2019
  - Country level unemployment expenditures (Eurostat)
  - Country level unemployment income = rate * mean salary * employees (OECD)

- We look at smoothing not at transfers
  - Each U(t) is normalized by the country median U
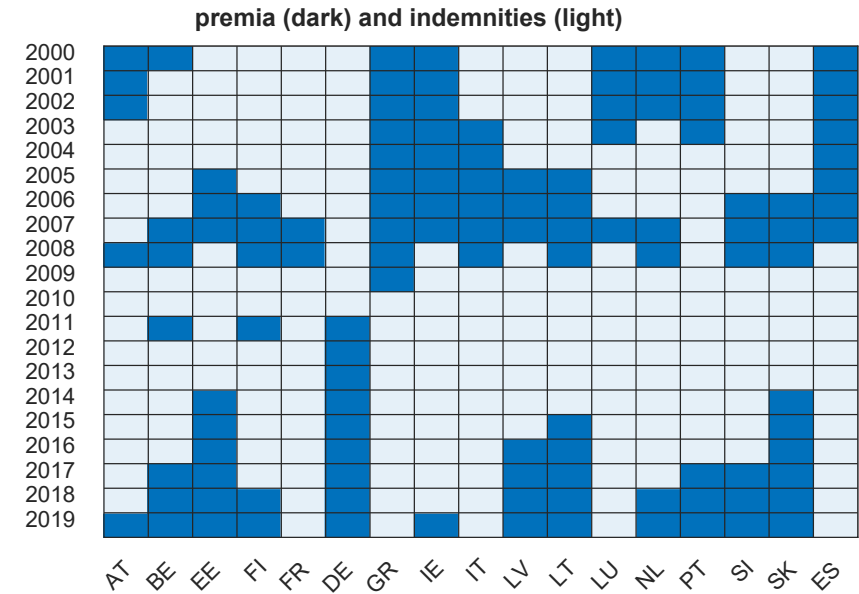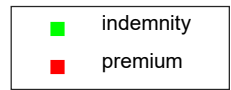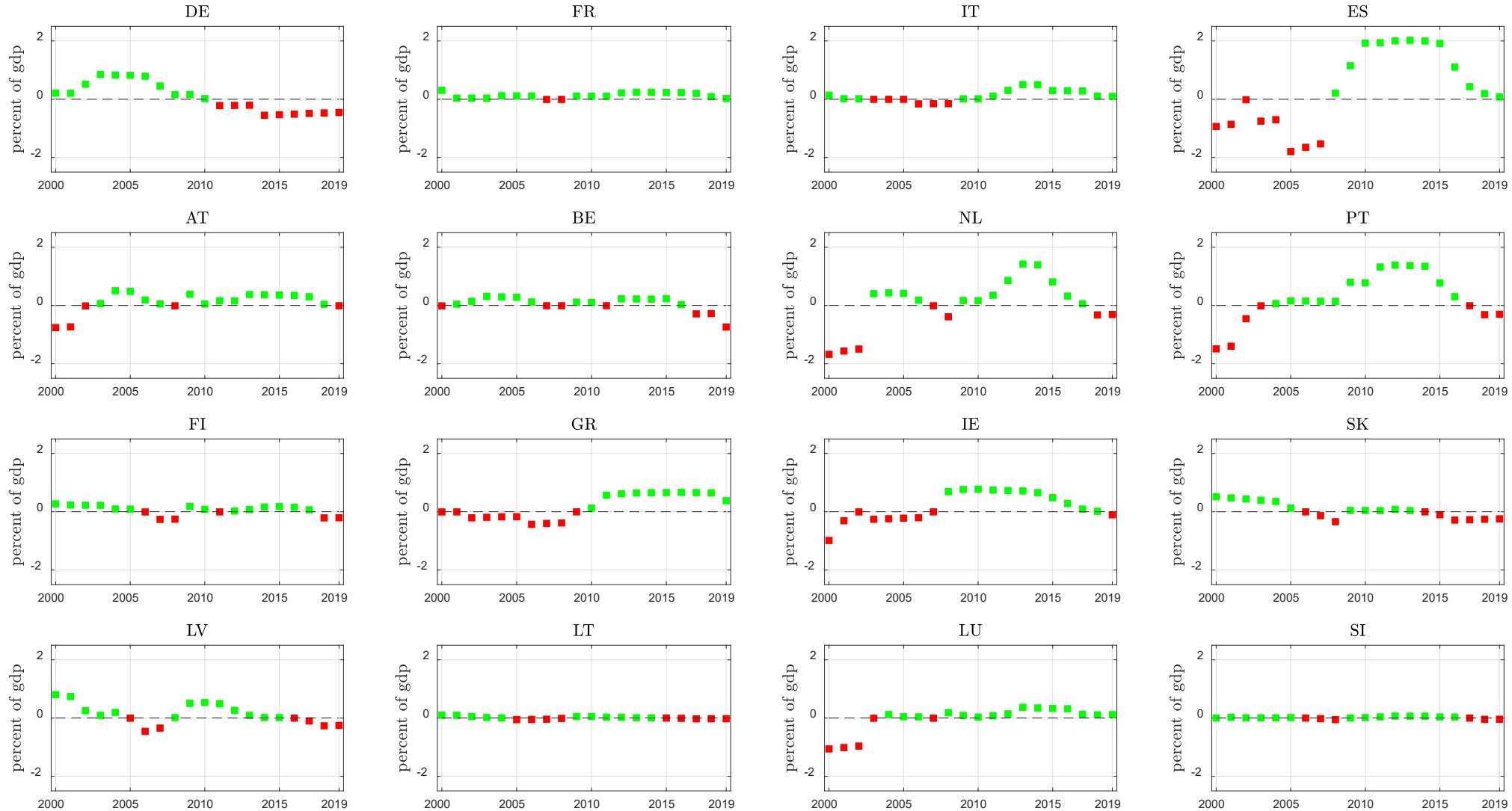 - U expenditure and income are normalized by median income for the period

Distribution and time variation of 17 national unemployment rates
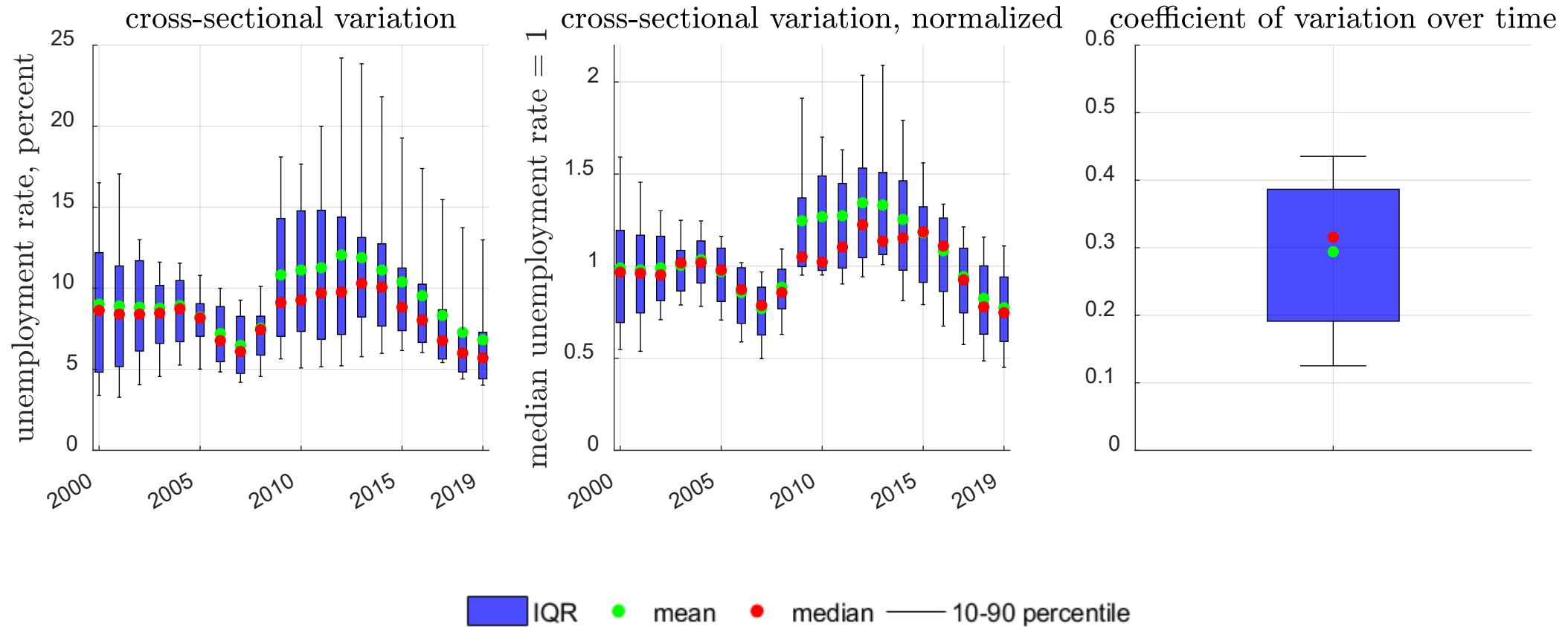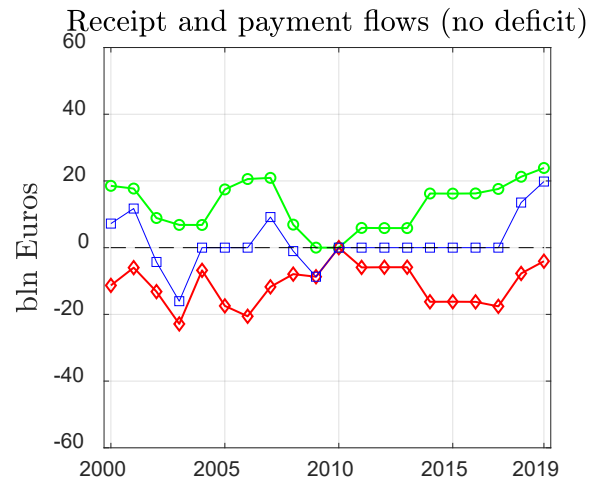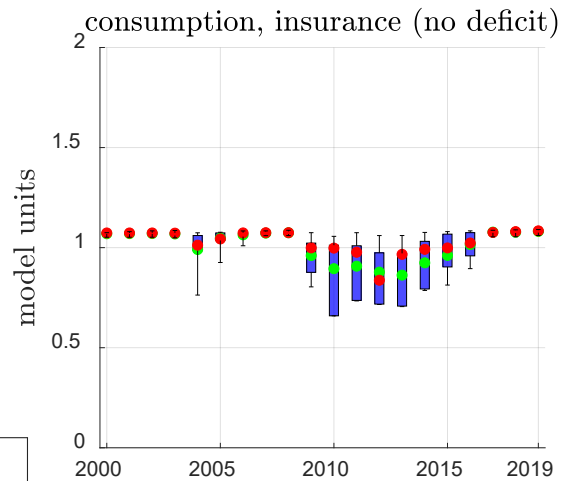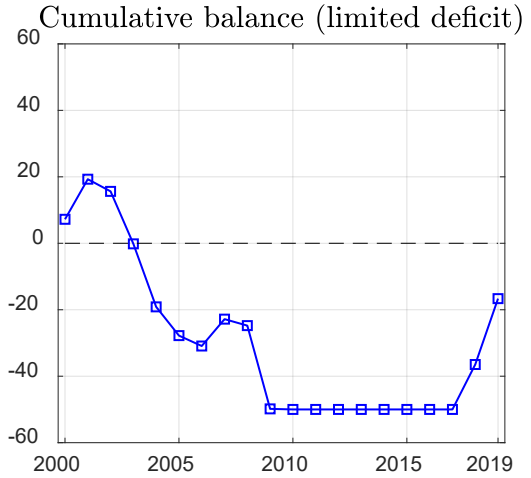
Gains from risk-sharing – consumption smoothing

consumption, save only

consumption, risk-sharing scheme

premia (dark) and indemnities (light)
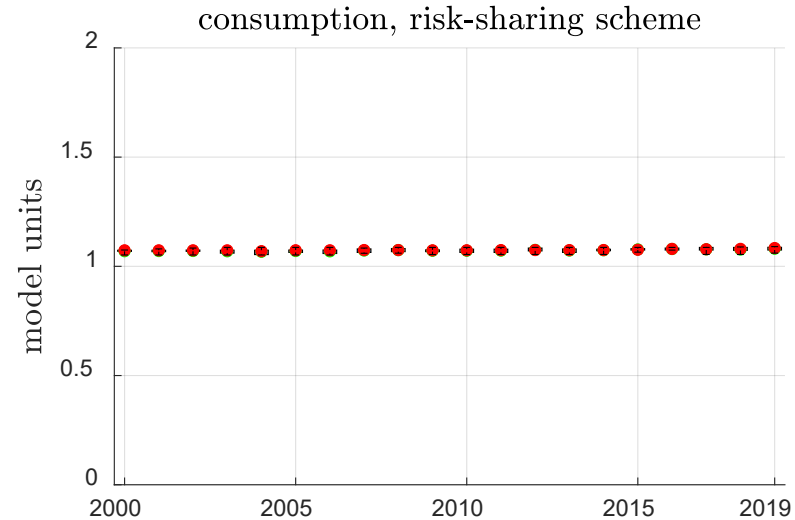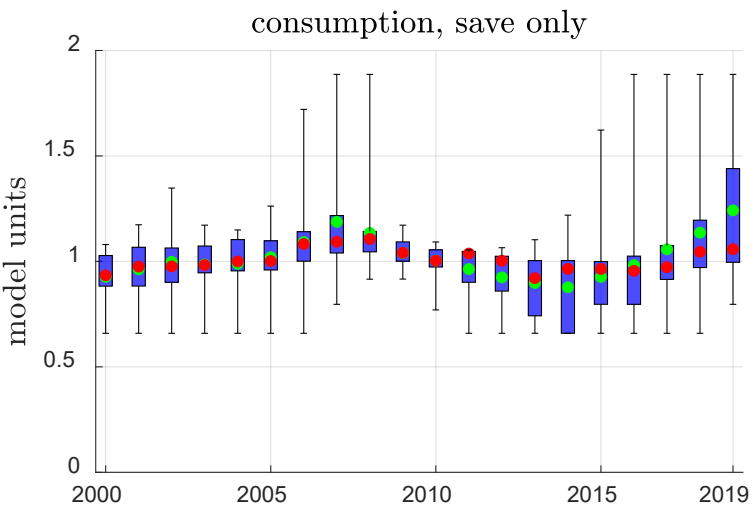
IQR   ● mean   ● median   —— 10-90 percentile

◆ BIS

Risk-sharing transfers as share of GDP

Risk-sharing scheme – limited or no deficit
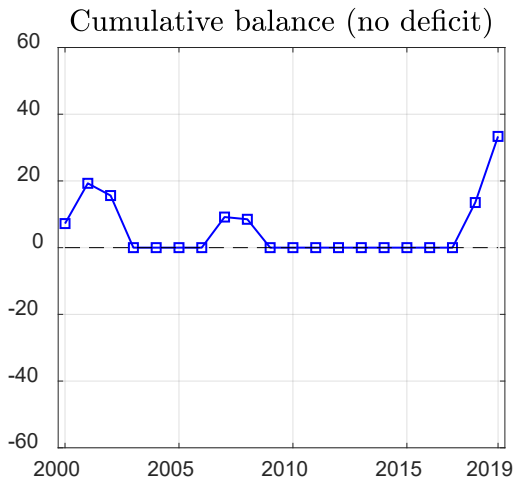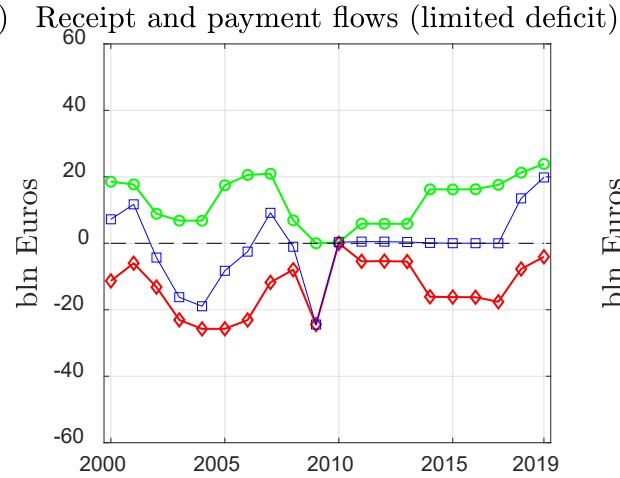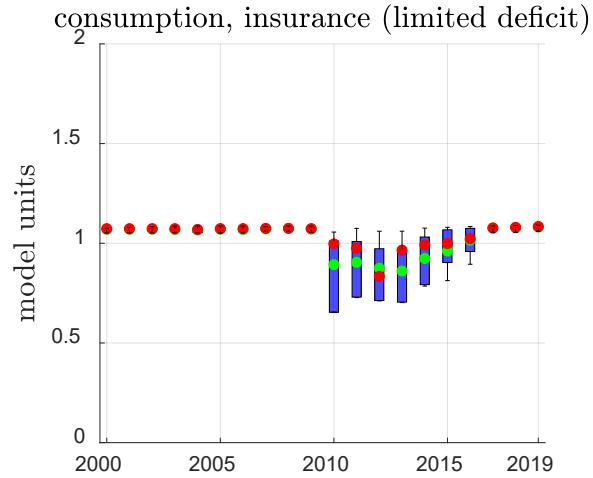
Example 3: 14 K Spanish firms, 2004-2007 (Karaivanov, Saurina and Townsend, 2019)
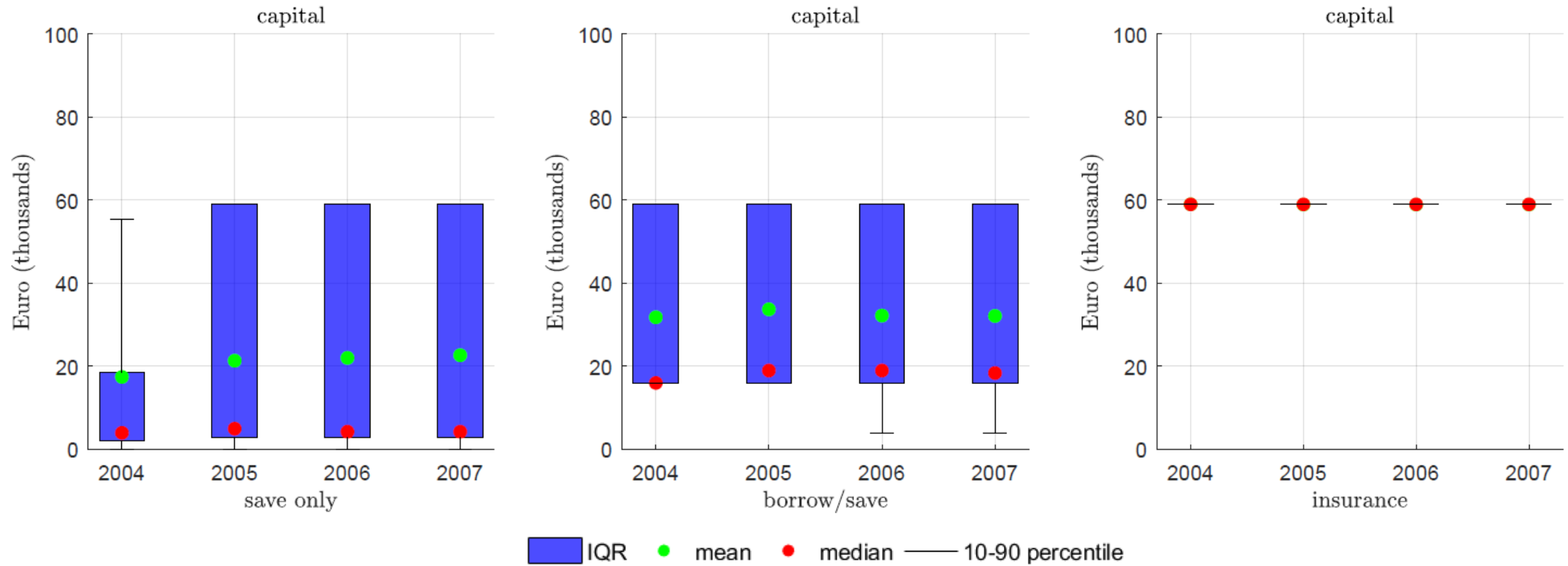
Conclusions

- The purpose of financial inclusion is to expand access to inter temporal and intra temporal insurance: we provide a roadmap

- Gains from risk sharing are large for various groups of economic agents
  - Multiples of annual median income for our 140 Thai households (given their estimated preferences) from savings only to limited commitment
  - Better risk sharing would reduce poverty traps and the depth of recession

- The KT algorythm can be used for any group of economic agents

- Smart contracts can be implemented by digital platforms and smartphone finance