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Forest income and capital accounting
RECAMAN PROJECT

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Agroforestry Accounting System (AAS)

Commercial and environmental values

- **Accounting for**
  - Flows: price x quantity
  - Capital: future discounted capital income flows

Main commercial values:

- Timber growth and felling (age structure)
- Cork growth and stripping
- Natural grass and acorn fodder
- Hunting (age structure)
- Mushrooms
- Others

Main environmental values :

- Public recreation
- Owner amenitiy self-consumption
- Forest landscape production
- Threatened biodiversity
- Carbon sequestration
- Others

Production account

- **Total output**
  - SNA outputs
  - Non-SNA outputs (acorn, natural fodder, natural growth, hunting and scarce environmental values)

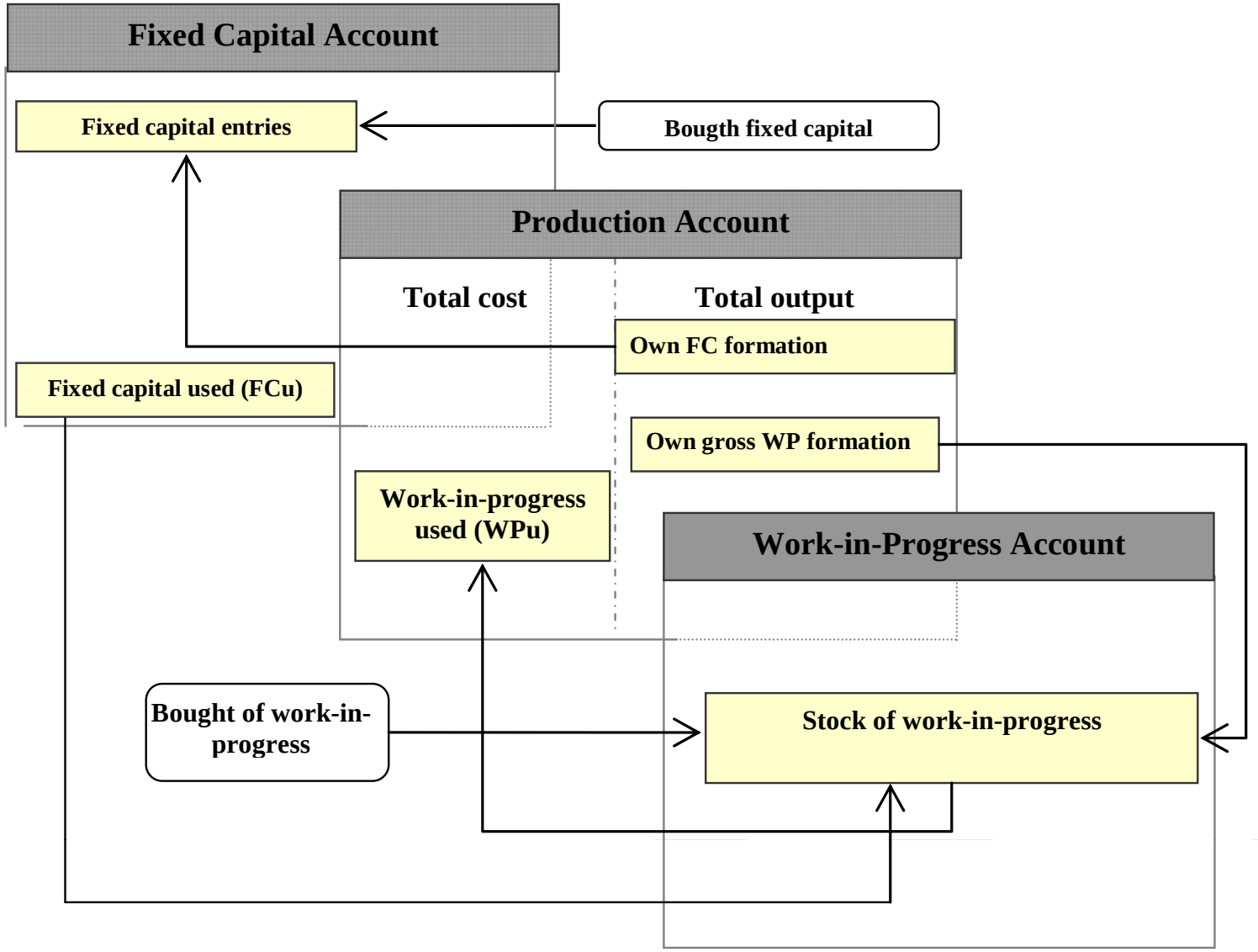
- **Total cost**
  - SNA costs
  - Non-SNA costs (intermediate output, works in progress used, carbon, government expenditures)

Capital (present discount values)

- **Work in progress balance sheet (inventories)**
  - Standing timber, cork and fuelwood
  - Game inventories.

- **Fixed capital assets balance sheet**
  - Land (timber, cork, acorn, commercial recreation, owner amenity self-consumption, carbon sequestration, landscape, threatened biodiversity, free public environmental recreation)
  - Biological ressources (standing trees yielding repeat outputs and big game reproductive female, others).
  - Others

Production and capital accounts



AAS and SNA comparison

Class	Commercial goods and services		Environmental goods and services[1]	Total
	SNA (1)	Omitted (2)		AAS (4) =1+2+3
1. Total output (TO) (1.1+1.2)	TO_{SNA}	$TO_{C,O}$	TO_{E}	TO_{AAS}
1.1 Final output (FO)	FO_{SNA}	$NG_{PR,FOR} + FO_{PU,C} + FO_{GAM}$	$FOa_{E} + FO_{PU,E}$	PF_{AAS}
1.2 Intermediate output (IO)		IO_{C}	IO_{E}	IO_{AAS}
2. Intermediate consumption (IC)	IC_{SNA}	$WPu_{C} + IO_{C} + IC_{PU,C} + IC_{CIN}$	$IC_{PU,E}$	IC_{AAS}
3. Gross value added (GVA) (1-2)	GVA_{SNA}	$GVA_{C,O}$	GVA_{E}	GVA_{AAS}
4. Consumption of fixed capital (CFC)	CFC_{SNA}	$CFC_{PU,O} + CFC_{CIN}$	$CFC_{PU,E}$	CFC_{AAS}
5. Net value added (NVA) (3-4)	NVA_{SNA}	$NVA_{C,O}$[1]	NVA_{E}	NVA_{AAS}
6. Capital revaluation (Cr) (6.1+6.2)		Cr_{C}	Cr_{E}	Cr_{AAS}
6.1 Working in progress revaluation (WPr)		WPr_{C}	WPr_{E}	WPr_{AAS}
6.2 Fixed capital revaluation (FCr)		FCr_{C}	FCr_{E}	FCr_{AAS}
7. Destruction of capital (Cd) (7.1+7.2)		Cd_{C}	Cd_{E}	Cd_{AAS}
7.1 Working in progress destruction (WPd)		WPd_{C}	WPd_{E}	WPd_{AAS}
7.2 Fixed capital destruction (FCd)		FCd_{C}	FCd_{E}	FCd_{AAS}
8. Capital adjustments (Caj)[2]		Caj_{C}	Caj_{C}	Caj
9. Capital gain (CG) (4+6-7+8)		CG_{C}	CG_{E}	CG_{AAS}
10. Total income at market prices (TI) (5+9)	NVA_{SNA}	$NVA_{C,O} + CG_{C}$	$NVA_{E} + CG_{E}$	TI_{AAS}

:

AAS and SNA total income comparison

"**From a theoretical point of view, [total] income is often defined as the maximum amount that a household, or other unit, can consume without reducing its real net worth**" (SNA 2008, para. 8.25, p. 160).

$$\mathbf{TI_{AAS} = NVA_{AAS} + CG_{AAS} = NVA_{SNA} + NVA_{NSNA} + CG_{AAS}}$$

$$\mathbf{NVA_{NSNA} = VAN_{C,O} + VAN_{E}}$$

AAS Production account: $\mathbf{NVA_{AAS}}$
AAS Capital balance account: $\mathbf{CG_{AAS}}$

SNA Objective is narrower than AAS's: to measure market final outputs and costs and government non-market services expenditures yielding a *partial* **net value added** ($\mathbf{NVA_{SNA}}$) and does *not measure* $\mathbf{VAN_{C,O}}$, $\mathbf{VAN_{E}}$ and CG.

Forest Net Value Added of SNA

$$\mathbf{NVA_{SNA} = TO_{SNA} - IC_{SNA} - CFC_{SNA}}$$

$$\mathbf{NVA_{SNA} = FO_{PR,SNA} - RM_{PR,SNA} - SS_{PR,SNA} - CFC_{PR,SNA}}$$

$$FO_{PR,SNA} = FOe_{T,CO,F} + FOe_{PN,CN} + GFCF_{P,CON,EQ,PR} + FOo_{PR;SNA}$$

$FOe_{T,CO,F}$: Extractions of timber, cork and firewood.

$FOe_{PN,CN}$: Extractions of pine nut and chest nut fruits.

$GFCF_{P,CON,EQ,PR}$: Private (PR) own gross fixed capital formation of plantations (P), constructions (CON) and equiepments (EQ).

$FOo_{PR;SNA}$: Other private SNA commercial forest final outputs.

Forest Commercial Net Value Added omitted by SNA

$$NVA_{C,O} = NG_{PR,FOR} - WPu_{PR,FOR} + NVA_{PU,C} + NVA_{GAM}$$

$NG_{PR,FOR}$: Natural growth of timber, cork and firewood.

$WPu_{PR,FOR}$: Working in progess used of initial timber, cork and firewood extracted.

$NVA_{PU,C}$: Commercial public net value added from government direct management forest expenditures.

NVA_{GAM}: Game net value added.

Forest Environmental Net Value Added

$$NVA_E = TO_E - IC_{PU,E} = IO_{PU,E} + FOa_E + FO_{PU,E} - RMaf_{PU,E} - SSce_{PU,E}$$

$$FO_{PU,E} = FOr_{PU,E} + FOfl_{PU,E} + FOtb_{PU,E} + FOmu_{PU,E} + FOcf_{PU,E}$$

$IO_{PU,E}$: Public environmental intermedite output.
FOa_E: Land owner auto-consumption of private environmental services.
$FOr_{PU,E}$: Forest free visits recreation.
$FOfl_{PU,E}$: Forest landscape stated option value.
$FOtb_{PU,E}$: Forest threatnned biodiversity stated existence value.
$FOmu_{PU,E}$: Forest mushroom collected by the public.
$FOcf_{PU,E}$: Forest carbon fixation by timber, fruit trees and shrubland growth.
$RMaf_{PU,E}$: Forest green water consumption by woody vegetations over grassland.
$SSce_{PU,E}$: Forest carbon emission by tiember and shrubland extractions.

Forest Commercial and Environmental Capital Gains

CG = Cr – Cd + Caj

Cr = Cf + Cw – Ci – Ce

Cr: capital revaluation from WP and FC balance sheets accounts.

Caj: Capital adjustments responds to the accounting rules for separating capital income on net operation margin/surplus and capital gain.

AAS and SNA Forest Private Total Income Comparison

$$TI_{AAS,PR} = TI_{PR,FOR} + TI_{PR,CIN} + FOa_{E} + TI_{PR,OO}$$

$$TI_{PR,FOR} = NVA_{PR,FOR} + CG_{PR,FOR}$$

$$NVA_{PR,FOR} = NVA_{SNA} + IO_{PR,FOR} + NG_{PR,FOR} - WPu_{PR,FOR}$$

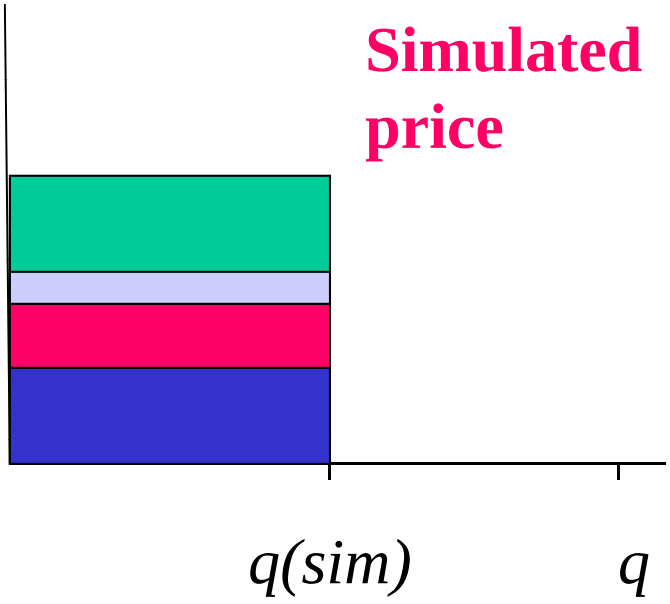
$TI_{PR,OO}$: Other commercial income omitted by SNA.

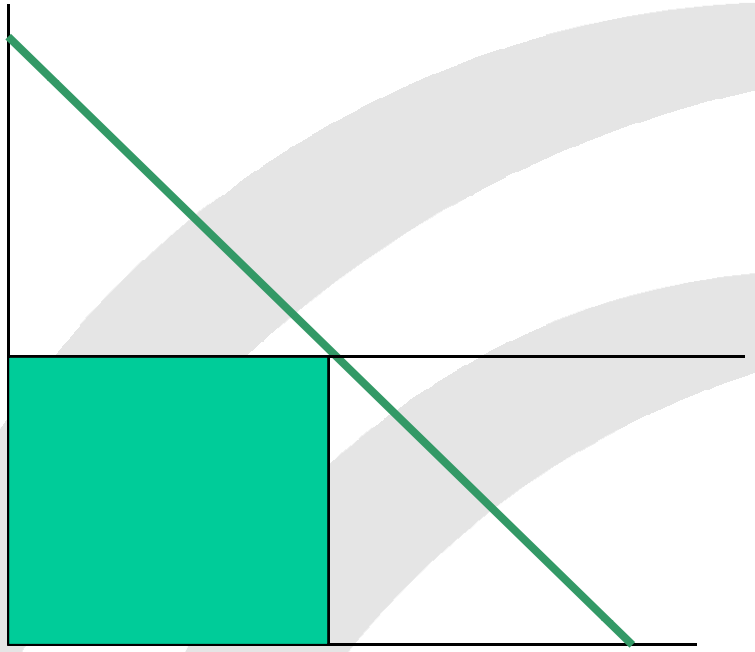
$PI_{PR,FOR}$: Commercial intermediate output from livestock and game forest grazing of natural grass and fruits.

Simulated Exchange Value (SEV)

Environmental marginal values

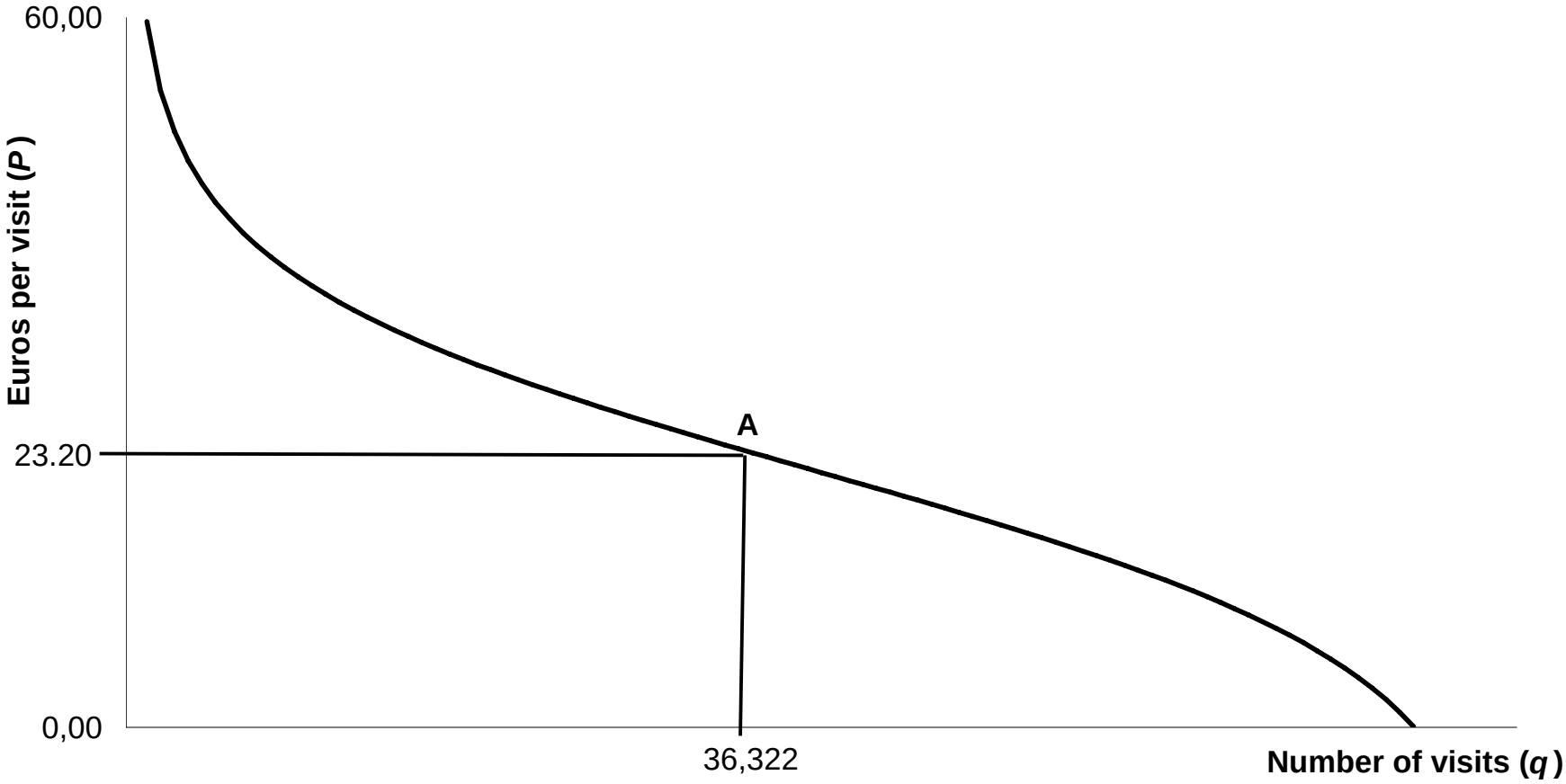
- *Free public recreation*
- *Produced landscape*
- *Threatened biodiversity*
- *Owner amenitiy self-consumption*



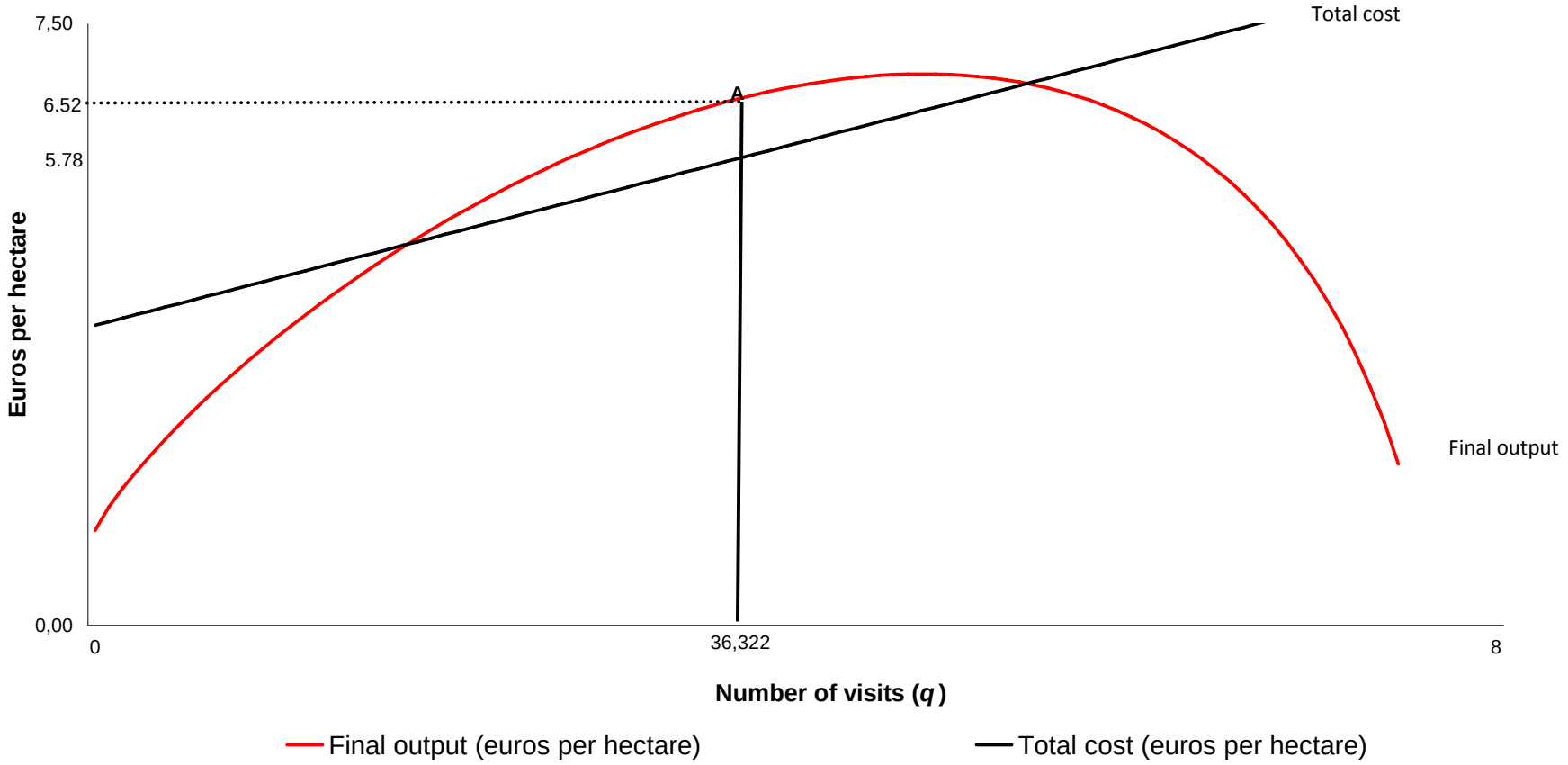


Hipotetical market

Free access recreational services (demand)



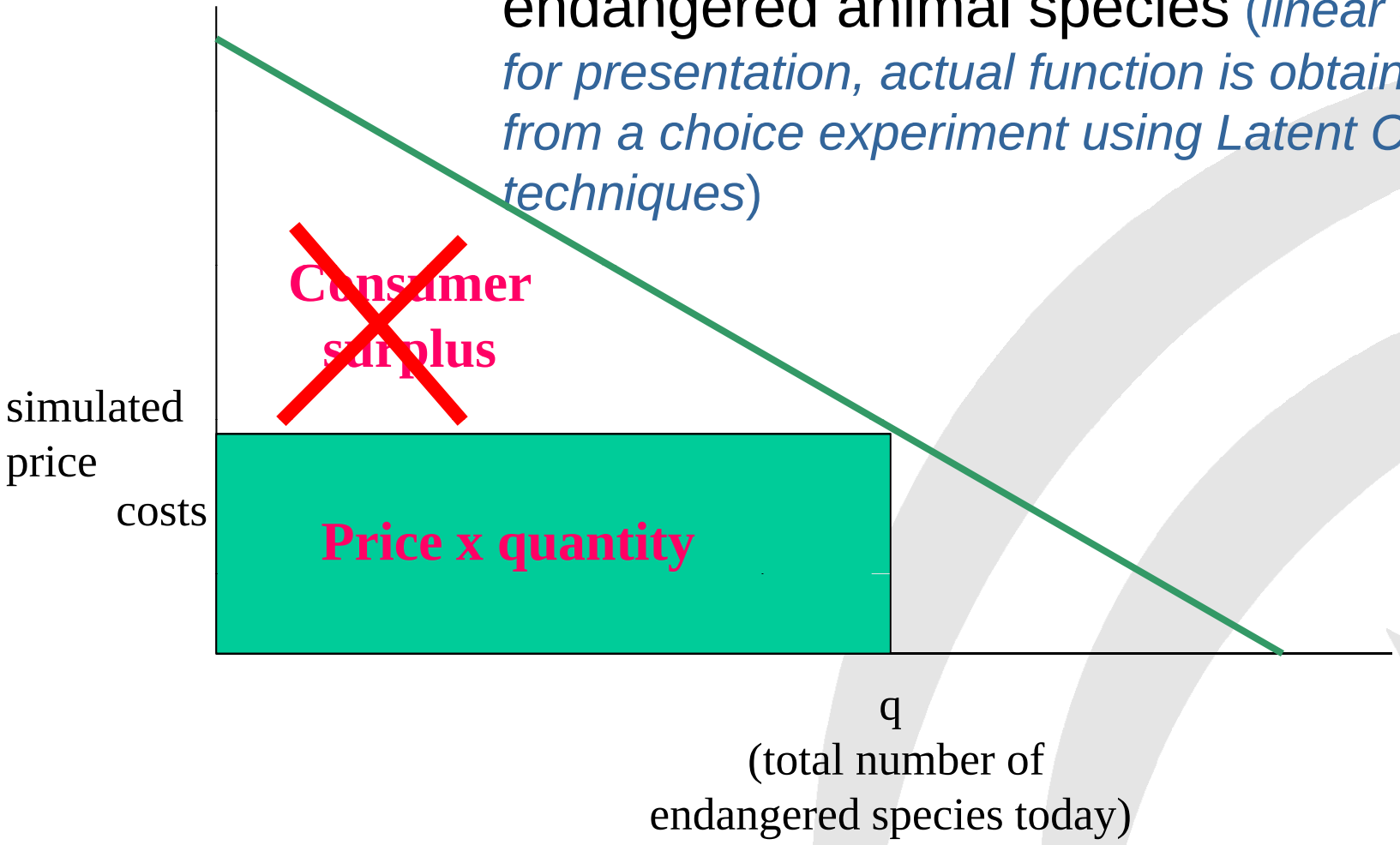
Simulated Exchange Value Method



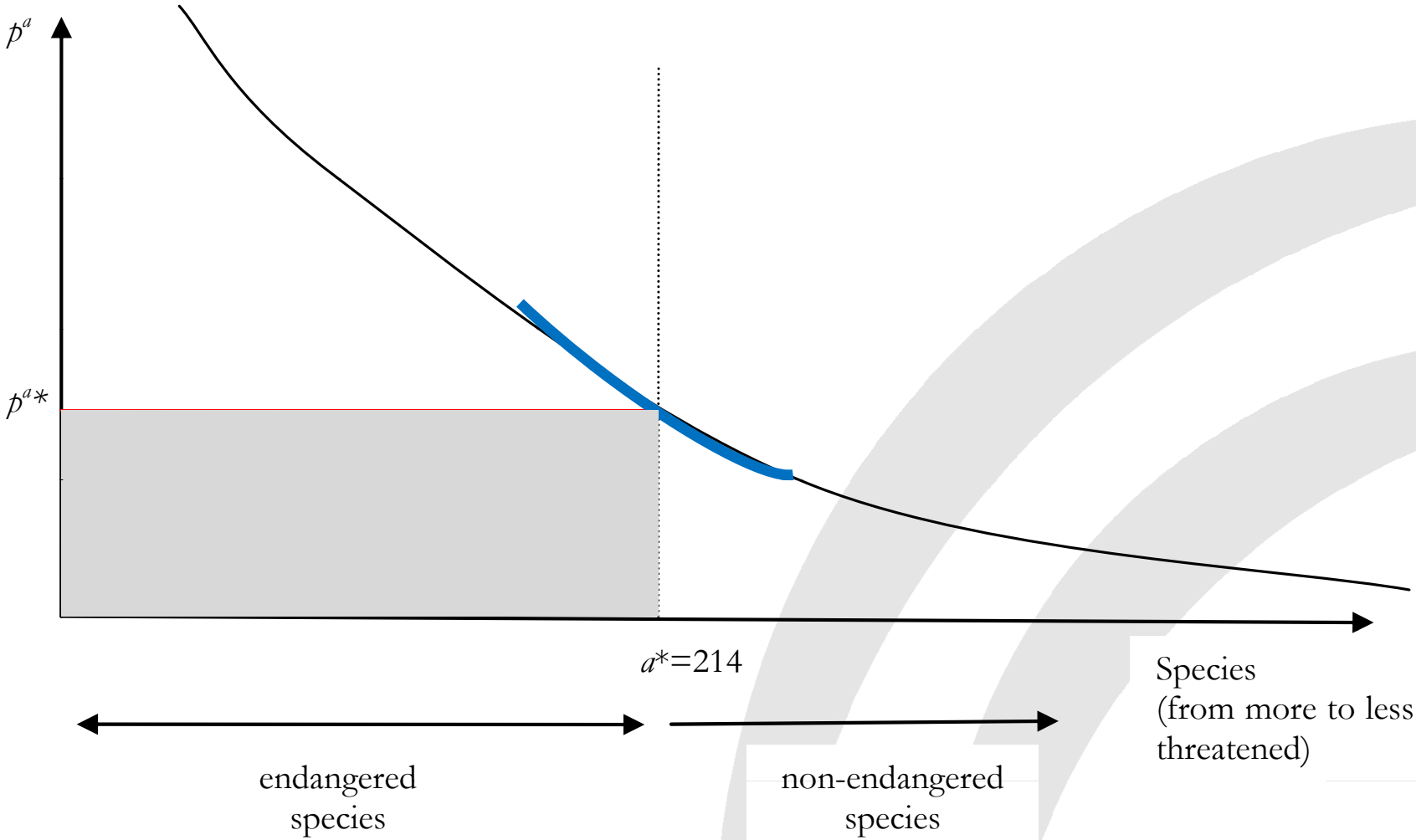
- **Simulated MARKET: demand and cost functions**
  - Monopoly
  - Perfect competition

Endangered species: marginal valuation

- WTP to avoid the increase in endangered animal species (*linear only for presentation, actual function is obtained from a choice experiment using Latent Class techniques*)

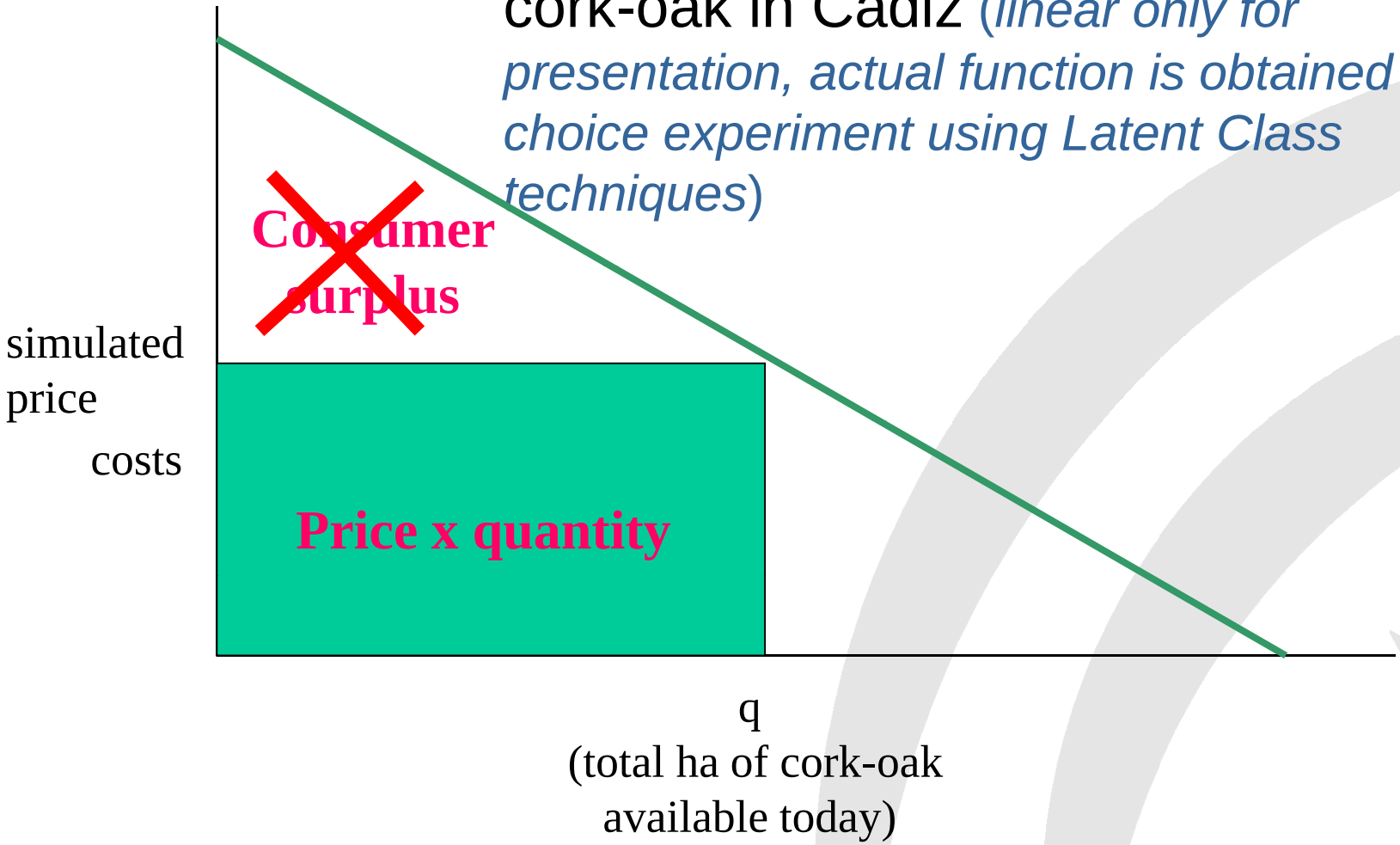


Endangered species: marginal valuation II



Landscape values: marginal valuation

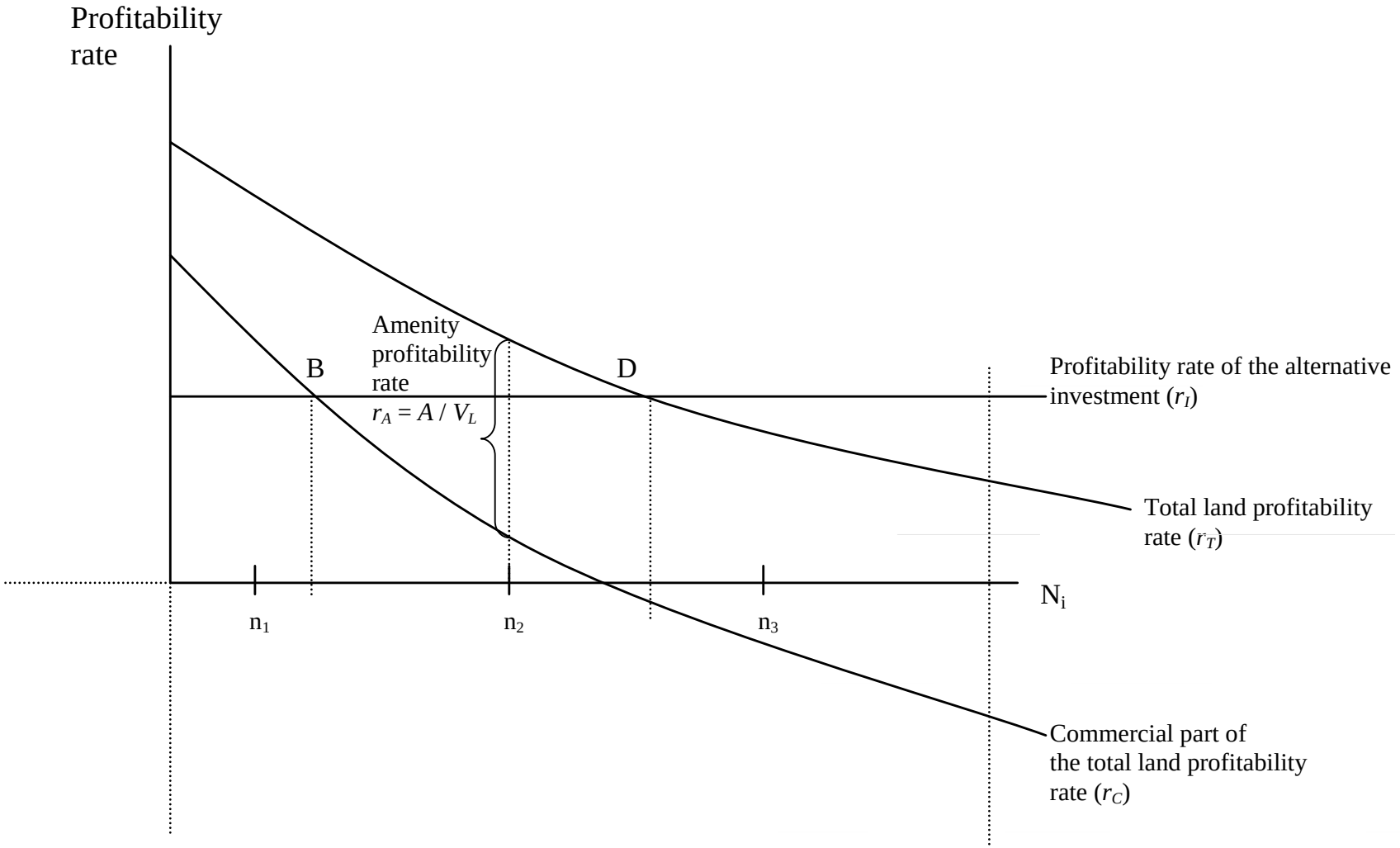
- WTP to increase one hectare of (e.g.) cork-oak in Cádiz (*linear only for presentation, actual function is obtained from a choice experiment using Latent Class techniques*)



Owner's amenity self-consumption I

- Recreational and other types of amenities consumed by the land-owner
- This value is capitalized in the market for land
- If enough data are available one can decompose the price (hedonic method) and then convert the capital value into an equivalent flow
- Since land transactions are not transparent enough we use contingent valuation
- This method allows to estimate directly flows

Owner's amenity self-consumption II



RECAMAN PROJECT
Mediterranean *Monte* Ecosystems
Total Income Green Accounting

RECAMAN Project

PROJECT COORDINATOR: Pablo Campos.

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- Instituto de Políticas y Bienes Públicos (IPP-CCHS-CSIC): Begoña Álvarez-Farizo, Pablo Campos, Alejandro Álvarez, Alejandro Caparrós, Bruno Mesa, Paola Ovando, José Luis Oviedo and Nuria Ruiz (8).
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- Université Montesquieu-Bordeaux IV: Marc Leandri (1).
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- Consejería de Medio Ambiente de la Junta de Andalucía/Dirección General de Gestión del Medio Natural: Francisca de la Hoz and José Ramón Guzmán (2).

PERIOD: 2008-2013.

TOTAL BUDGET FROM ANDALUCÍA GOVERNMENT: 8,219,415€

RECAMAN: Objective and Methods

- **Objective:**
  - **Developing** and **implementing** by the Government of *Andalucía* a **forestland and natural grassland ecosystems green accounting system** (**AAS**) for measuring **Hicksian Green Total Social Sustainable Income (TI) and capital (C).**

- **Methods:**
  - Land cover unit: tree, shrub and natural grass.
  - Commercial good and services: SNA 2008 *criteria*.
  - Consumer surplus is not taken into account.
  - Environmental valuation criterion: simulated market exchange price.
  - Contingent valuation and choice experiment.
  - Production function
  - Agroforestry Accounting System (AAS).

Andalusian *montes* study case

Andalusian montes (61% forest, 21% shrubland, 10% natural grassland, and 8% other forestland) extend on 4.7 million hectares, which is 54% of *Andalusian* total surface (Source: SIOSE 2005 (Junta Andalucía, 2011).

Ownership: 72% private and 28% public.

Montes estates over 300 hectares concentrate most of montes surface.

Andalusian *montes* are recognized as high nature-value ecosystems.

RECAMAM: Primary Data

- Forest National Inventory for forests and woodlands (age structure)
- Land cover and land use data GIS
- Prices of over 4,000 transactions per year on forest products
- Above 50 Revenues and costs in depth analysis of *montes* estates (including crops and livestock)
- 800 interviews to *montes* non-industrial landowners
- 4,000 interviews to free access visitors (CV and choice exp)
- 5,600 interviews to households (CV and choice exp)
- 800 interviews to hunters
- 800 interviews to *montes* hunting estates
- 4,000 interviews to mushroom gatherers
- Public expenditures on *montes* disaggregated by montes activities

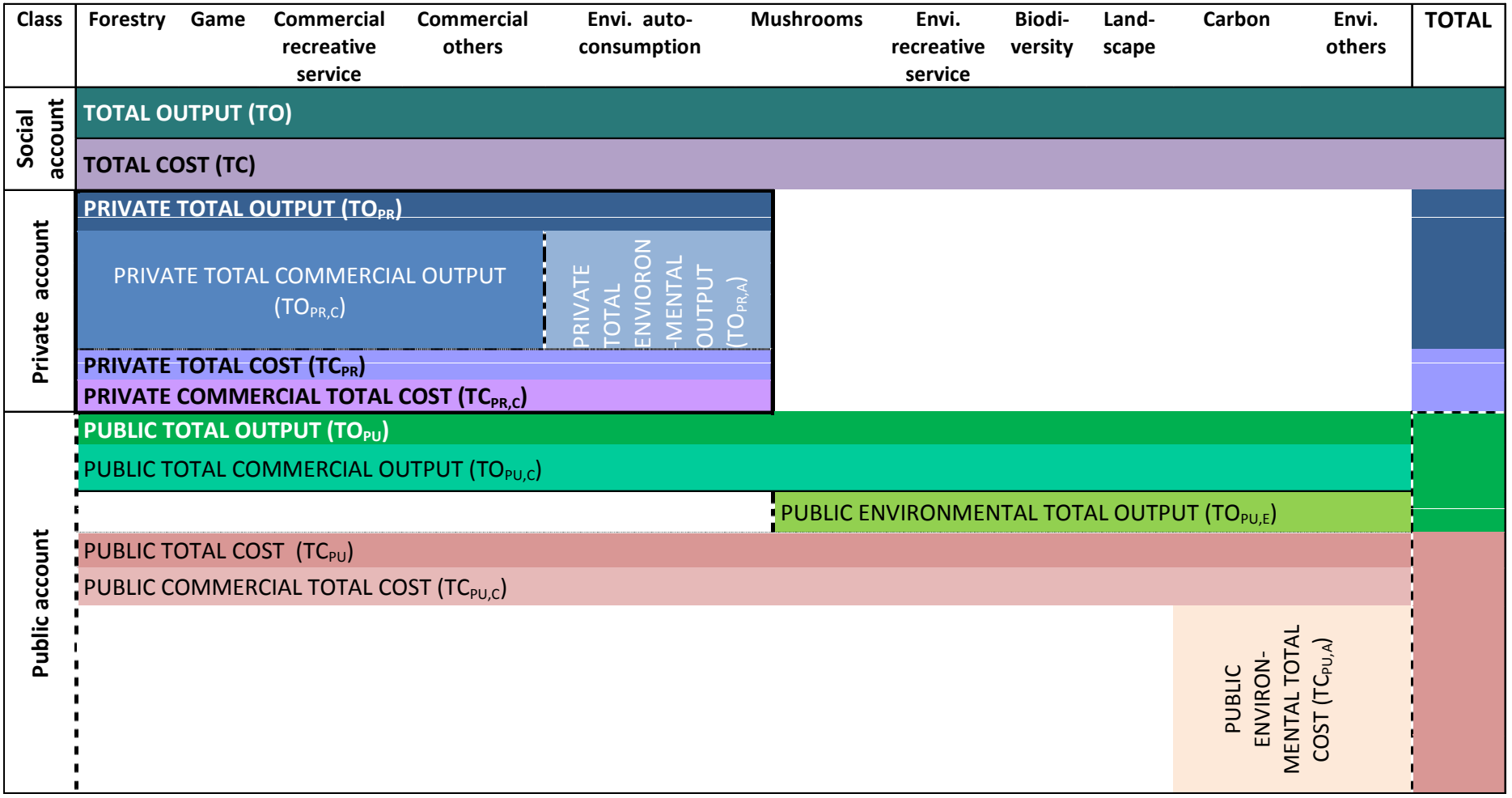
Information sources and valuation methods

Goods and services	Unit	Quantity	Price
1. Standing trees (St)	t	NFI/AAS	M/NPV
2. Natural mortality of trees (Mt)	t	PF/AAS	M/NPV
3. Thinning and clearing (Tc)	t	PF/AAS	M/NPV
4. Timber and firewood natural growth (NGtfi)	m^3	PF/AAS	M/NPV
5. Cork natural growth (NGc)	kg	PF/AAS	M/NPV
6. Acorns intermediate output (IOa)	kg	PF/S/AAS	M/NPV
7. Natural grass intermediate output (IOng)	kg	PF/S/AAS	M/NPV
8. Capital game animals (Cgam)	a	PF/AAS	M/NPV/AAS
9. Hungting captures (HCgam)	a	PF/AAS/CV	M/CV/AAS
10. Commercial recreative services (RS_C)	vi	AAS	M
11. Environmental autoconsumption (FOa_E)	ha	AAS/CV	CV
12. Stated environmental land market price (L_E)	ha	AAS/CV	CV
13. Mushroom picking up (MH)	kg	CV	M/CV
14. Net forest carbon sequestration (NFC)	t	NFI/PF/ AAS	M/NPV
15. Forest free water consumption (FGWc)	m^3	AMA/PF	PF
17. Public recreative services ($FOr_{PU,E}$)	v	CV/AAS	CV/PF
18. Forest landscape ($FOl_{PU,E}$)	ha	CE/PF	CE/PF
19. Threatened biodiversity ($FOtb_{PU,E}$)	N	CMA/AAS	CV/CE/PF

Forest Production Account

Class	Forestry (FOR) 1	Services (SER) 2	Game (GAM) 3	Livestock (LIV) 4	Agriculture (AGR) 5	Total 6=1+2+3+4+5
1. Total output (TO)						
1.1 Intermediate output (IO)						
Intermediate raw materials (IRM)						
Intermediate services (ISS)						
1.2 Final output (FO)						
Final output sales (FOs)						
Gross fixed capital formation (GFCF)						
Gross working in progress formation (GWPF)						
Autoconsumption of final output (FOa)						
Public environmental final output ($FO_{PU,E}$)						
Other final output (FOo)						
2. Total cost (TC)						
2.1 Intermediate consumption (IC)						
Raw material (RM)						
Own (RMo)						
Bougth (RMb)						
Services (SS)						
Own (SSo)						
Bougth (SSb)						
Work in progress used (WPu)						
2.2 Labour cost (LC)						
Employees (ELC)						
Self – employed (SLC)						
2.3 Consumption of fixed capital (CFC)						
3. Net operating margin (NOM = TO – TC)						

Social, Private an Public Production Accounts



Forest Capital Balance

Class	Opening	Entries				Withdrawals				Revaluations	Closing
	(C_O)	Bougth (C_B)	Own (C_{OW})	Others (C_{EO})	Total (C_E)	Used (C_U)	Destructions (C_D)	Others (C_{SO})	Total (C_W)	(C_R)	(C_C)
Capital (C) (1+2)											
1. Working in progress (WP)											
Timber and firewood (WP_{TFI})											
Cork (WP_C)											
Game (WP_{GAM})											
Livestock (WP_{LIV})											
Others (WP_O)											
2. Fixed Capital (FC)											
Land (FC_L)											
Biological Resources (FC_{BR})											
Plantations (FC_P)											
Constructions & equipments (FC_{CE})											
Others (FC_O)											

Land: *timber, cork, fruit (acorn, chest nut, pine nut and wild olive), natural grass, game, environmental autoconsumption, mushroom, carbon, commercial recreation, public recreation, landscape, threatened biodiversity, and others.*

Biological resources: *trees yielding repeated timber products, trees yielding repeated non timber products, trees without cutting planning, reproductive and draught power livestock, big game females (except wild boar female), and others.*

RECAMAN: Results

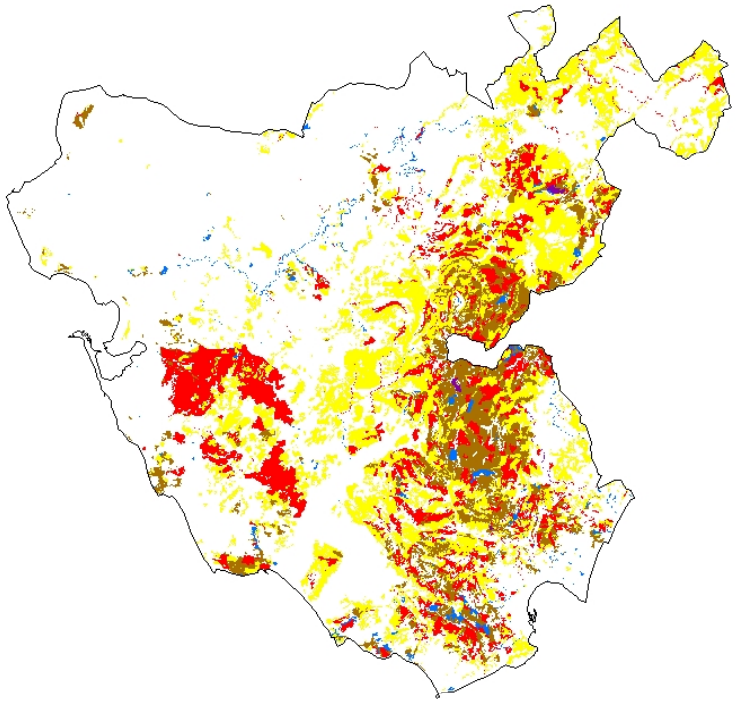
- Provisional results available in May 2012
  - Commercial and non-commercial values
  - Flow values and capital values
  - Spatially explicit results (2-3 ha SIOSE poligons/teselas) for $4.7 * 10^6$ ha

- Final results available from May 2013 onwards
  - Annual update of results thereafter

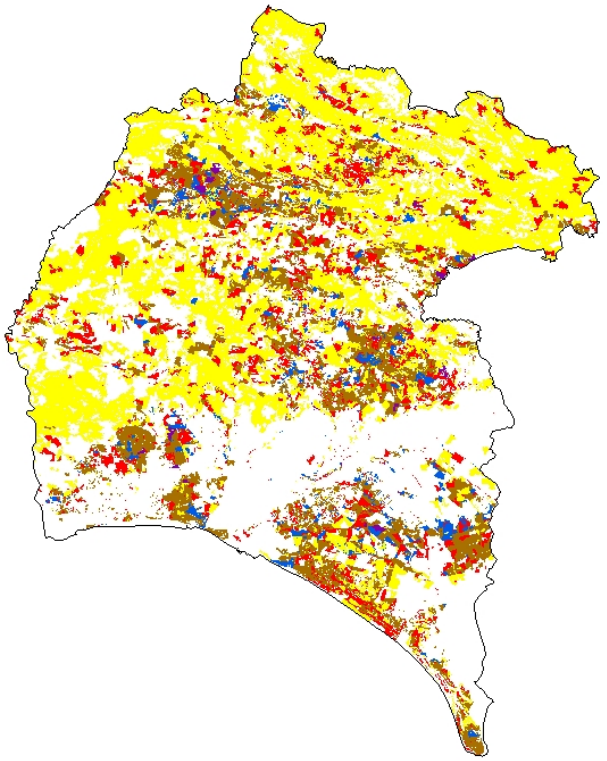
Previous results at micro scale

Class	Guadarrama pines				Monfragüe cork-oaks			
	ESA 95		Public environmental	AAS	ESA 95		Public environmental	AAS
	EAF 97	Omitted			EAF 97	Omitted		
	1	2	3	4=1+2+3	1	2	3	4=1+2+3
Total output (TO)	**235**	**394**	**235**	**864**	**538**	**138**	**17**	**693**
Intermediate output (IO)		12		12		16		16
Livestock-grazing (GR)		*12*		*12*		*16*		*16*
Final output (FO)	235	382	235	852	538	122	17	677
Timber (TH)	*235*			*235*				
Cork (CS)					*462*			*462*
Firewood (FH)					*76*			*76*
Hunting (HR)		*3*		*3*		*37*		*37*
Mushrooms (MC)			*24*	*24*				
Owners' self-consumption (SC)		*379*		*379*		*85*		*85*
Min		*199*		*199*		n.a.		
Max		*379*		*379*		*85*		*85*
Public access recreation (VR)			*178*	*178*			*8*	*8*
Min			*38*	*38*			*3*	*3*
Max			*178*	*178*			*8*	*8*
Conservation, visitors (VC)			*33*	*33*			*9*	*9*
Total cost (TC)	**100**	**62**		**162**	**192**	**6**		**198**
Intermediate consumption (IC)	45	48		93	48	6		54
Private (PIC)	*45*			*45*	*48*			*48*
Governmental[a] (GIC)		*48*		*48*		*6*		*6*
Labour (L)	47	14		61	142			142
Private (PL)	*47*			*47*	*142*			*142*
Governmental[a] (GL)		*14*		*14*		n.a.		
Fixed capital consumption (FCC)	8			8	2			2
Net operating margin (NOM)	**135**	**332**	**235**	**702**	**346**	**132**	**17**	**495**
Gross value added at market prices (GVA)	**190**	**346**	**235**	**771**	**490**	**132**	**17**	**639**
Net value added at market prices (NVA)	**182**	**346**	**235**	**763**	**488**	**132**	**17**	**637**

Results will be GIS based



Leyenda
Provincia de Cádiz
Volumen con corteza total m3/ha
0.0
0.1 - 25.0
25.1 - 50.0
50.1 - 100.0
100.1 - 200.0
200.1 - 466.0



Leyenda
Provincia de Huelva
Flujo total de carbono (IAVC) t/ha
0.0
0.1 - 0.7
0.8 - 1.5
1.6 - 3.0
3.1 - 4.5
4.6 - 7.5

Conclusions

- **Non-market valuation techniques** (CV, choice…) can be used for green national accounting to estimate demand functions which, together with appropriate costs functions, allow to **simulate markets** for non-commercial values (yielding *prices x quantity* estimates).

- The application to the Mediterranean *monte* in Andalusia (RECAMAN) proves the viability of the ***Simulated Exchange Value Method*** approach on a large scale for *free public recreation, produced landscape, threatened biodiversity* and *owner amenity self-consumption* ***flow*** *and* ***capital*** *values.*

- **Natural Ecosystems** Hicksian **Green TSI** and **Total capital** could be measured with **enough theoretical SNA consistency;** thus, avoiding waiting for the **golden measure** that probably will come much too late.

- **RECAMAN** provisional results available in May 2012 and **final results** available from May 2013 onwards (annual update of results thereafter).

ACKNOWLEDGMENTS

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Thank you for your attention

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