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Revealing the Willingness To Pay for income insurance in agriculture

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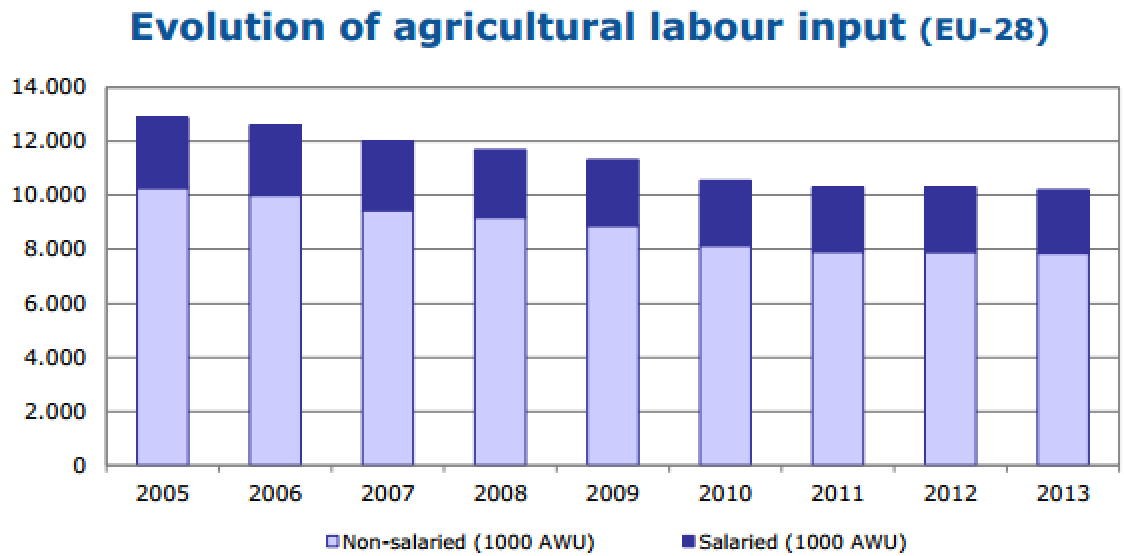
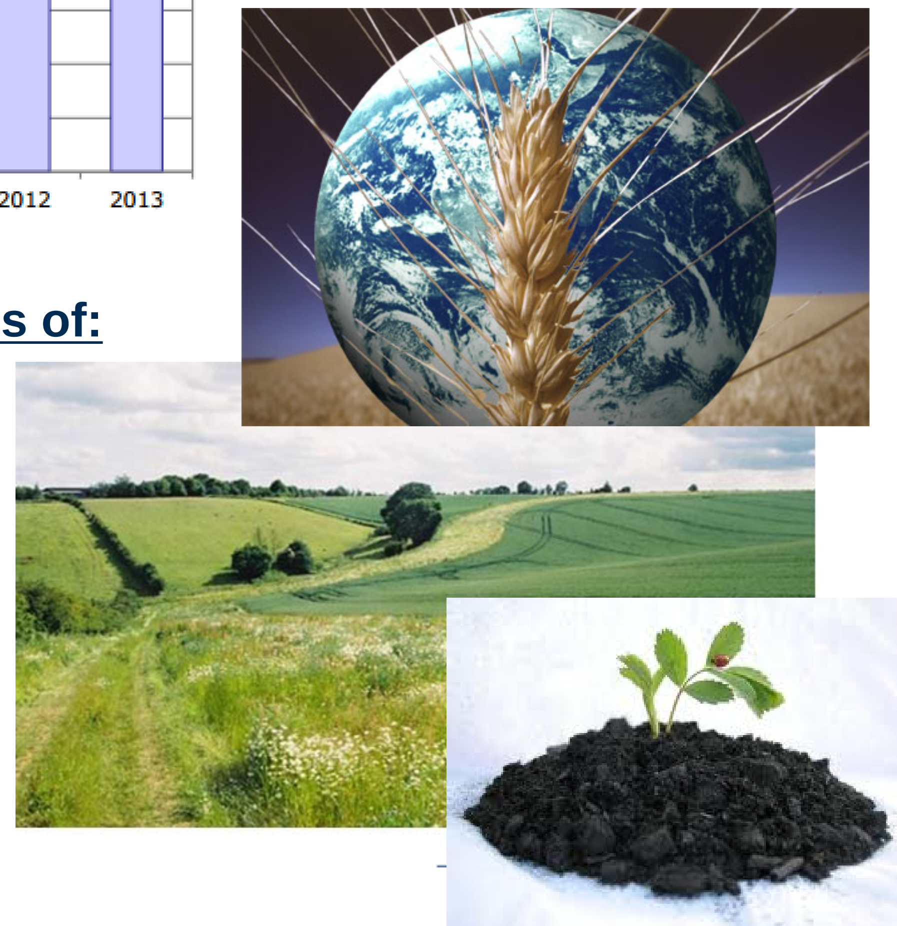
1. The Policy Context



- Agriculture has a *marginal and decreasing* share of EU GDP and labor…



- **<u>…But still has a strategic role in terms of:</u>**
- Food security
- Food supply independence
- Habitat and landscape protection
- Carbon dioxide sequestration
- Management of water bodies
- Soil & Biodiversity conservation

2. The Policy Context (II)

- The EU has put much effort during the last decades in guaranteeing a stable agricultural output through **income protection:**
  - Agricultural input subsidies
  - Price stabilization within the framework of the CAP (pre-decoupling)
  - *Ex-post* emergency responses
  - Public works (e.g., dykes to prevent floods in agricultural areas or reservoirs to cope with the marginal impact of drought events)

Recently, these policies have shown signs of exhaustion…

…and insurance has gained *momentum*

3. Why agricultural insurance?

- Agricultural insurance poses a series of advantages as compared to conventional policies:
  - Partially privately-funded (releasing pressure over public budget)
  - If properly designed, it does not distort trade (EC, 2011)
  - Encourages adoption of sustainable farming practices to reduce risk exposure & premiums (e.g., water saving technologies) (Surminski, 2009; Warner et al., 2009)
  - Sufficiently insured events are inconsequential in terms of foregone output (Von Peter et al., 2012)

4.

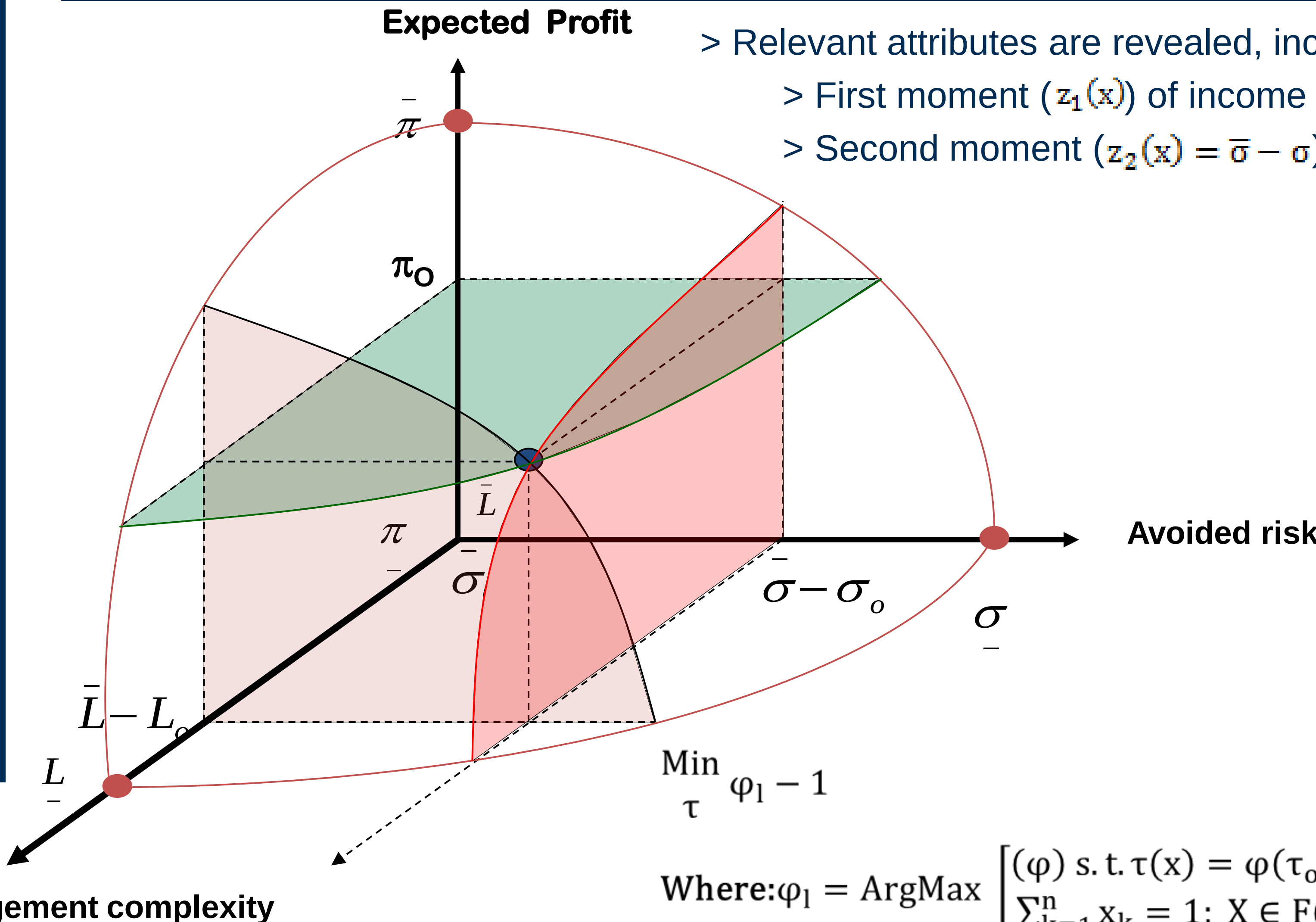
Agricultural insurance – State of the art

- Asymmetric information and systemic risk result in higher premiums
- Subsidization is necessary to guarantee affordability
- Cost assessments are common
- But what about ***demand***?

This work estimates farmers' WTP for income insurance using:

- **Revealed preferences models**
- **Certainty equivalent theory**

5. Revealing the preferences – the relevant attributes



> Relevant attributes are revealed, including:
  > First moment ($z_1(x)$) of income PDF ($g(\pi(x))$)
  > Second moment ($z_2(x) = \bar{\sigma} - \sigma$) of income PDF

$$\underset{\tau}{\text{Min}}\ \varphi_l - 1$$

$$\text{Where:} \varphi_l = \text{ArgMax} \begin{bmatrix} (\varphi)\ \text{s.t.}\ \tau(x) = \varphi(\tau_o(x));\ 0 \le x_i \le 1; \\ \sum_{k=1}^{n} x_k = 1;\ X \in F(x); \text{for all}\ \tau \epsilon P(z) \end{bmatrix}$$

$$l = (1 \ldots .2^m)$$

6. Revealing the preferences – The utility function

> In equilibrium the MTR equals the MSR

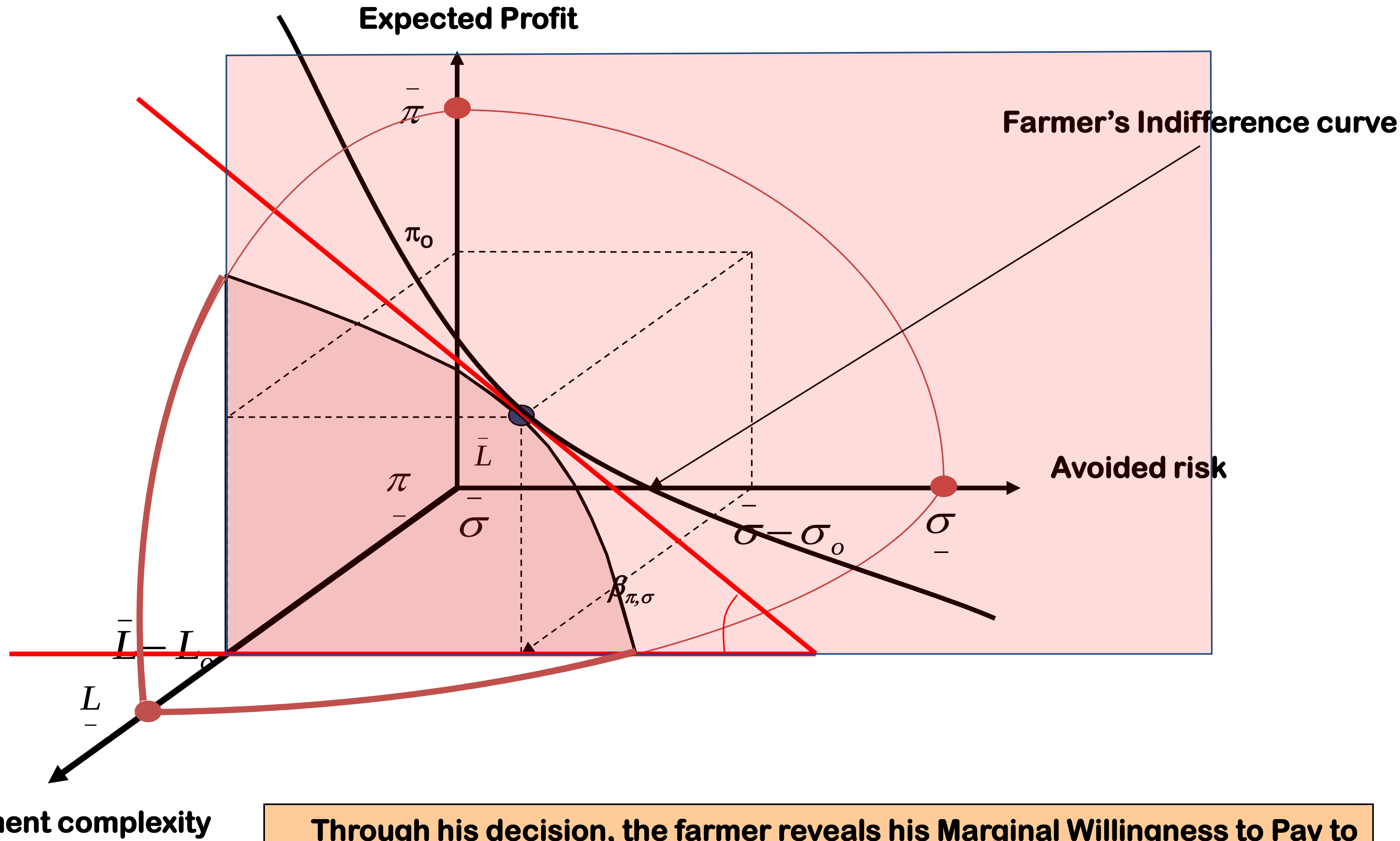
$$\beta_{kp} = MTR_{kp} = MSR_{kp} = -\frac{\partial U / \partial z_p}{\partial U / z_k}; p, k \in (1, .. l); p \neq k$$

> Efficiency frontier is known -enough to integrate a utility function (observed decision = optimal decision)

> Taking a Cobb-Douglas function:

$$U(\tau) = z_1^{\alpha_1} z_2^{\alpha_2} \prod_{r=3}^{l} z_r^{\alpha_r} \quad \sum_{r=1}^{l} \alpha_r = 1$$

$$-\frac{\partial U / \partial z_p}{\partial U / z_k} = -\frac{\alpha_p}{\alpha_k} \frac{z_k}{z_p}$$

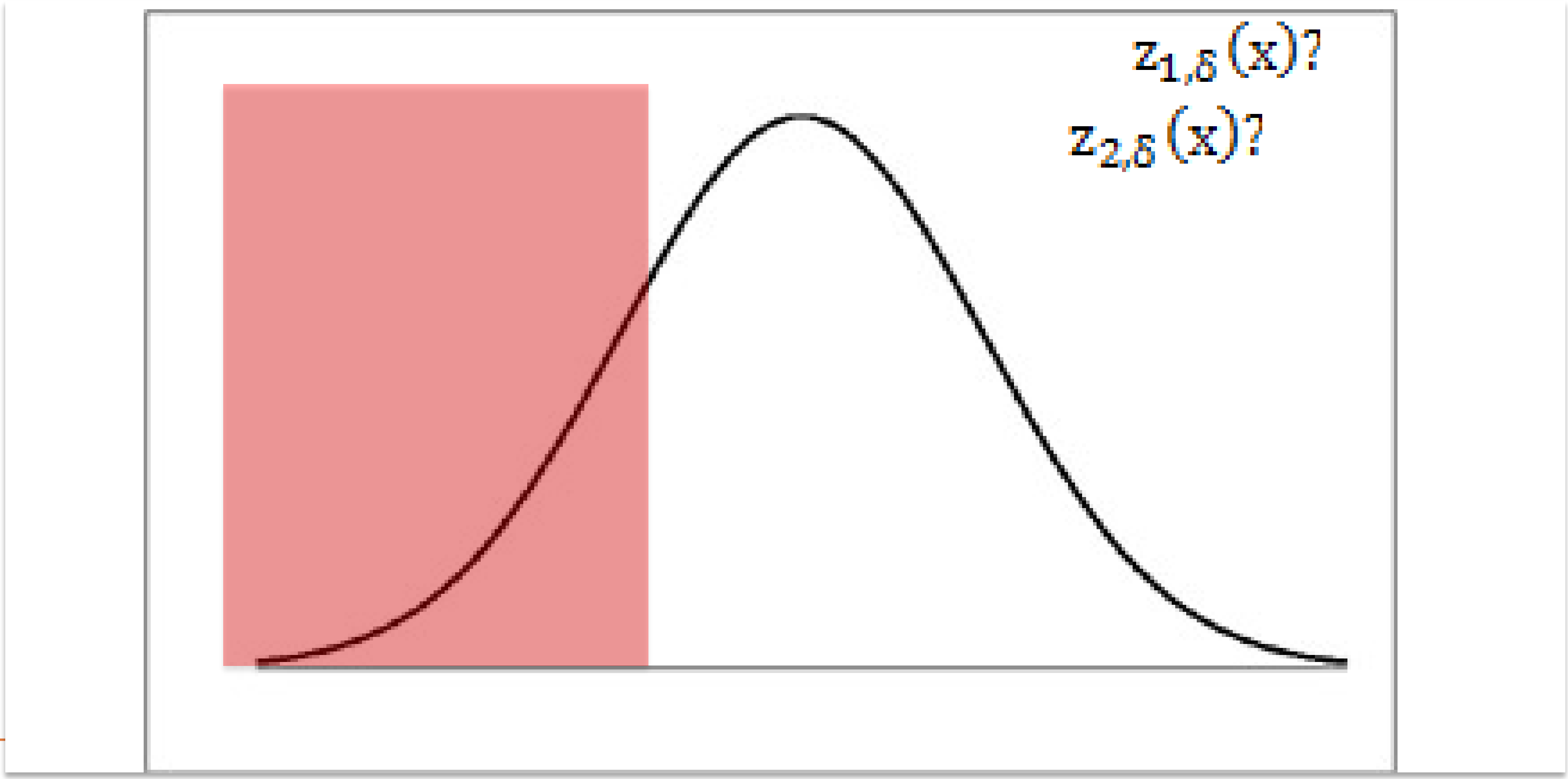


Through his decision, the farmer reveals his Marginal Willingness to Pay to avoid a certain risk, the tangent of the angle β_1, which is the same as the Marginal Relation of Transformation between net margin and risk (according to the choice possibilities frontier) and the Marginal Relation of Substitution between these two attributes (according to farmer's implicit preferences)

7. The Certainty Equivalent (CE)

> The CE is the certain amount of money equally desirable to a risky asset:

$$U(\tau) = U_{CE}(\tau) = CE^{\alpha_1}\,\overline{\sigma}^{\alpha_2}\prod_{r=3}^{l} z_r^{\alpha_r} \qquad CE = \left(\frac{U(\tau)}{\overline{\sigma}^{\alpha_2}\prod_{r=3}^{l} z_r^{\alpha_r}}\right)^{\frac{1}{\alpha_1}}$$



8. The Willingness to Pay for income insurance

> With income insurance, expected income and risk avoidance are higher:

$$CE_{\delta} > CE$$

> Finally:

$$WTP_{\delta} = CE_{\delta} - CE$$

> Now the WTP for different degrees of insurance coverage(δ) is obtained

> Simulations implemented in Noroeste Agricultural District (AD) in SE Spain

> Now also working in the Emilia Romagna Region (N Italy)

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Results (I)

Table 1. Alpha coefficients and calibration errors

Variable	α_1	α_2	α_3	α_4	e_f	e_τ	e_x	e
Value	0.18	0.11	0.30	0.41	8.31%	3.75%	5.30%	3.25%

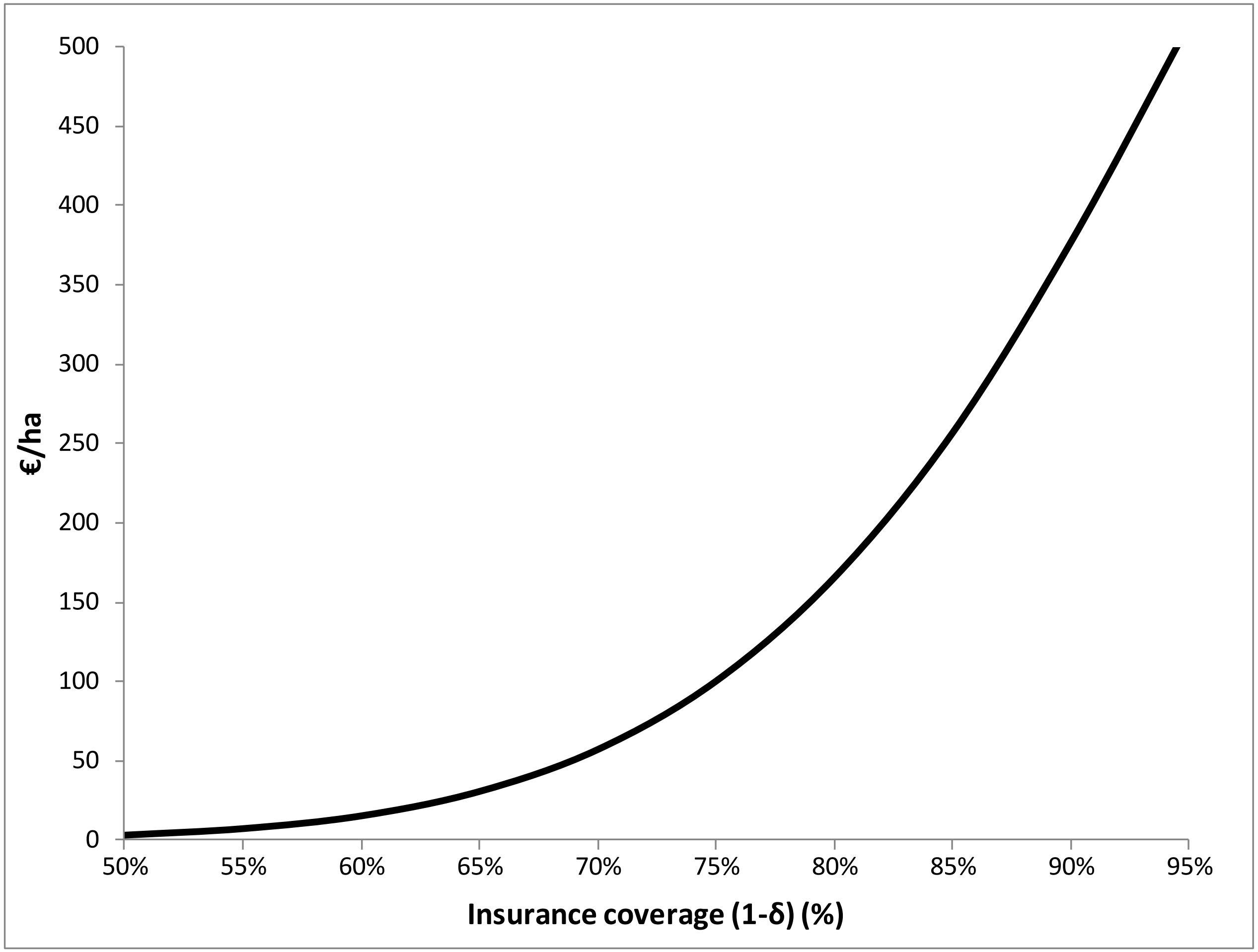
Table 2. Attributes' numerical values

Variable	No insurance ($\delta = 1$)	$\delta = .4$	$\delta = .3$	$\delta = .2$
$z_{1,\delta}(x)$ (€/ha)	1869.2	1871.2	1876.3	1892.1
$z_{2,\delta}(x)$ (€/ha)	130.9	134.5	144.6	171.3
$\bar{\sigma}$	463.6	463.6	463.6	463.6
$\sigma_\delta(\pi(x))$	332.7	329	319	292.3
$z_{3,\delta}(x)$ (# daily wages/ha)	18.5	18.5	18.5	18.5
$\bar{N}$	32.3	32.3	32.3	32.3
$N(x)$	13.9	13.9	13.9	13.9
$z_{4,\delta}(x)$ (# daily wages/ha)	4.1	4.1	4.1	4.1
$\bar{H}$	10.4	10.4	10.4	10.4
$H(x)$	6.3	6.3	6.3	6.3

10.

Results (II)

Figure 1. WTP for income insurance with different deductibles (δ), €/ha



11. Conclusions (I)

> Developing affordable and solvent income insurance is a challenging task

> While supply dynamics are increasingly known, demand remains uncertain.

> (Limited) available research comprises:

> > *Ex-post* studies with *hard data* (i.e., stated)

> > *Ex-ante* studies with *soft data* (i.e., observed)

> This research offers an *ex-ante* study using *hard data*

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12. Conclusions (II)

> WTP for customary deductibles in Spain Є [4%, 20.2%]

> Current premiums (only yield insurance, Spain) Є [6%,8%]

> Seems there is room for the development of more comprehensive agricultural insurance

Thanks for your attention

The research leading to these results has received funding from the FP7 Project ENHANCE (Enhancing risk management partnerships for catastrophic natural disasters in Europe - GA 308438)

enhance

Partnership for Risk Reduction

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Annex

Error terms

-The relative distance between the observed crop pattern and the model's one:

$$e_x = \frac{1}{n}\sum_{k=1}^{n}\left(\frac{\left({x_i^o}^2 - {x_i^*}^2\right)^{1/2}}{x_i^o}\right)$$

-The distance between the observed attributes and the attributes' efficiency frontier:

$$e_f = (\varphi - 1)$$

-The distance between the observed attributes and the calibrated ones:

$$e_\tau = \frac{1}{l}\sum_{r=1}^{l}\left(\frac{\left({z_r^o}^2 - {\tau_r^*}^2\right)^{1/2}}{z_r^0}\right)$$

Finally, the mean calibration error is defined as a combination of these three calibration errors:

$$e = \frac{\sqrt{e_x + e_\tau + e_f}}{3}$$