Modeling supply and land allocation responses to EU payments

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1.Policy background

- Main policy tools of the CAP arable crop regime:
  - *Intervention price:* minimum guaranteed price (standard "coupled" tool)
  - *Area payments:* crop-specific payments (up to Agenda 2000) based on historical yields and current acreage ("partially decoupled" tools)
  - *Set-aside:* supply control tool for large producers
  - *MTR single farm payment (SFP)* replacing area payments in 2005 ("statically decoupled" payment)

2. General features of the models

- Econometric models (the statistical properties of the results can be analysed)
- Estimated on individual farm data - FADN (especially important for risk analysis)
- Estimated adopting a flexible functional form to approximate the objective function
- Results are country-specific (FADN sample representative at the country level)
- Difficult to use *per se* for simulations (no demand side: exogenous price changes; no aggregate land constraint; large cross effects..)

3. Deterministic model: structure

- Objective function (Profit max):

$$\Pi(p^e, w, s, z, a, b, c) \equiv \max_{y,x,s_1,\dots,s_n} \left\{ p^e y - wx + \sum_{i=1}^{n_p} a_i s_i + b s_r \;\middle|\; \sum_{k=1}^{n} s_k + s_r = s \quad s_r = \frac{c}{1-c} \sum_{i=1}^{n_p} s_i \quad (y, x, z, s) \in T \right\}$$

- System of equation to be estimated:

$$y_i(p^e, w, s, z, a, b, c) = \partial \Pi(.) / \partial p_i \qquad i = 1, \dots, n \qquad \text{(output supplies)}$$

$$x_j(p^e, w, s, z, a, b, c) = -\partial \Pi(.) / \partial w_j \qquad j = 1, \dots, m \qquad \text{(input demands)}$$

$$s_i(p^e, w, s, z, a, b, c) = \partial \Pi(.) / \partial a_i \qquad i = 1, \dots, n_p \qquad \text{(land allocations)}$$

3. Deterministic model: results

- Short-run (own and cross) elasticities of *(y,x,s)* with respect to prices, fixed inputs, payments, set-aside rate
- Impact on yields derived endogenously
- *Note:* in different FADN samples, supply payment elasticities turned out to be positive and statistically significant (evidence of partially coupled payments)

3. Deterministic model: evaluation (a)

- Advantages
  - Obtain specific payment parameters
  - Estimated equations can be used for policy simulations (with caution) in the context of the pre-MTR regime (i.e.: change in payments)

3. Deterministic model: evaluation (b)

- Problems
  - Change in intervention prices cannot be properly modeled
  - The shift to the SFP cannot be simulated (in a static and deterministic world, it is fully decoupled)
  - Price expectations must be modeled properly
  - Proper econometric techniques must be adopted to solve some relevant problems ("incomplete" panel data and corner solutions)

4. Uncertainty model: structure

- Objective function (Expected utility max):

$$U(p^e, w, s, z, V_p, W_0, a, b, c) \equiv$$

$$\max_{y,x,s_1,\dots,s_n} \left\{ W_0 + p^e y - wx + \sum_{i=1}^{n_p} a_i s_i + bs_r - \frac{\alpha_R}{2\left(W_0 + p^e y - wx + \sum_{i=1}^{n_p} a_i s_i + bs_r\right)} y' V_p y \;\middle|\; \sum_{k=1}^{n} s_k + s_r = s \quad s_r = \frac{c}{1-c}\sum_{i=1}^{n_p} s_i \quad (y,x,z,s) \in T \right\}$$

- System of equation to be estimated:

$$y_i(p^e, w, s, z, V_p, W_0, a, b, c) = (\partial U(.)/\partial p_i^e)/(\partial U(.)/\partial W_0) \quad i = 1,\dots,n$$

$$x_j(p^e, w, s, z, V_p, W_0, a, b, c) = -(\partial U(.)/\partial w_j)/(\partial U(.)/\partial W_0) \quad j = 1,\dots,m$$

$$s_i(p^e, w, s, z, V_p, W_0, a, b, c) = (\partial U(.)/\partial a_i)/(\partial U(.)/\partial W_0) \quad i = 1,\dots,n_p$$

4. Uncertainty model: results

- Short-run (own and cross) elasticities of *(y,x,s)* with respect to prices, payments, fixed inputs, set-aside rate, var-cov matrix of output prices, initial wealth
- Impact on yields derived endogenously
- It is possible to distinguish the relative price/payment effects from the insurance effects and wealth effects (Hennessy, 1998)

4. Uncertainty model: evaluation (a)

- Advantages
  - Payment parameters are obtained under a more realistic set of assumptions (farmers are risk averse)
  - Change in intervention prices can be modeled (impact on expected price and variance-covariance matrix)
  - The shift to the SFP can be simulated (setting to 0 the crop-specific payments and adding the discounted value of future payments to farm wealth)
  - The absolute and relative size of the risk-related effects can be evaluated

4. Uncertainty model: evaluation (b)

- Problems
  - No dynamic effect can be evaluated
  - Some relevant problems to be solved in measuring price var-cov matrix and farm wealth

4. Uncertainty model: risk results

- Risk neutrality is rejected
- Estimated relative risk aversion coefficients:
  - small farms (<20 ha) 5.53*
  - medium farms (20-40 ha) 0.45*
  - large farms (>40 ha) 0.05

4. Uncertainty model: price elasticities

	Prices			
	p1	***p2***	***p3***	***p4***
Maize (y1)	**0.146***	**-0.075***	**-0.064***	**-0.036***
Durum wheat (y2)	**-0.208***	**0.361***	**-0.096***	**0.055***
Other cereals (y3)	**-0.260***	**-0.141***	**0.533***	**0.023**
Oilseeds (y4)	**-0.147***	**0.081***	**0.024**	**0.069***
Maize acreage (s1)	**0.066***	**-0.022***	**-0.016***	**-0.021***
Durum wheat acreage (s2)	**-0.081***	**0.088***	**0.038**	**-0.001**
Other cereals acreage (s3)	**-0.201***	**-0.083**	**0.465***	**0.023**
Oilseeds acreage (s4)	**-0.033**	**0.004**	**0.011**	**0.016***

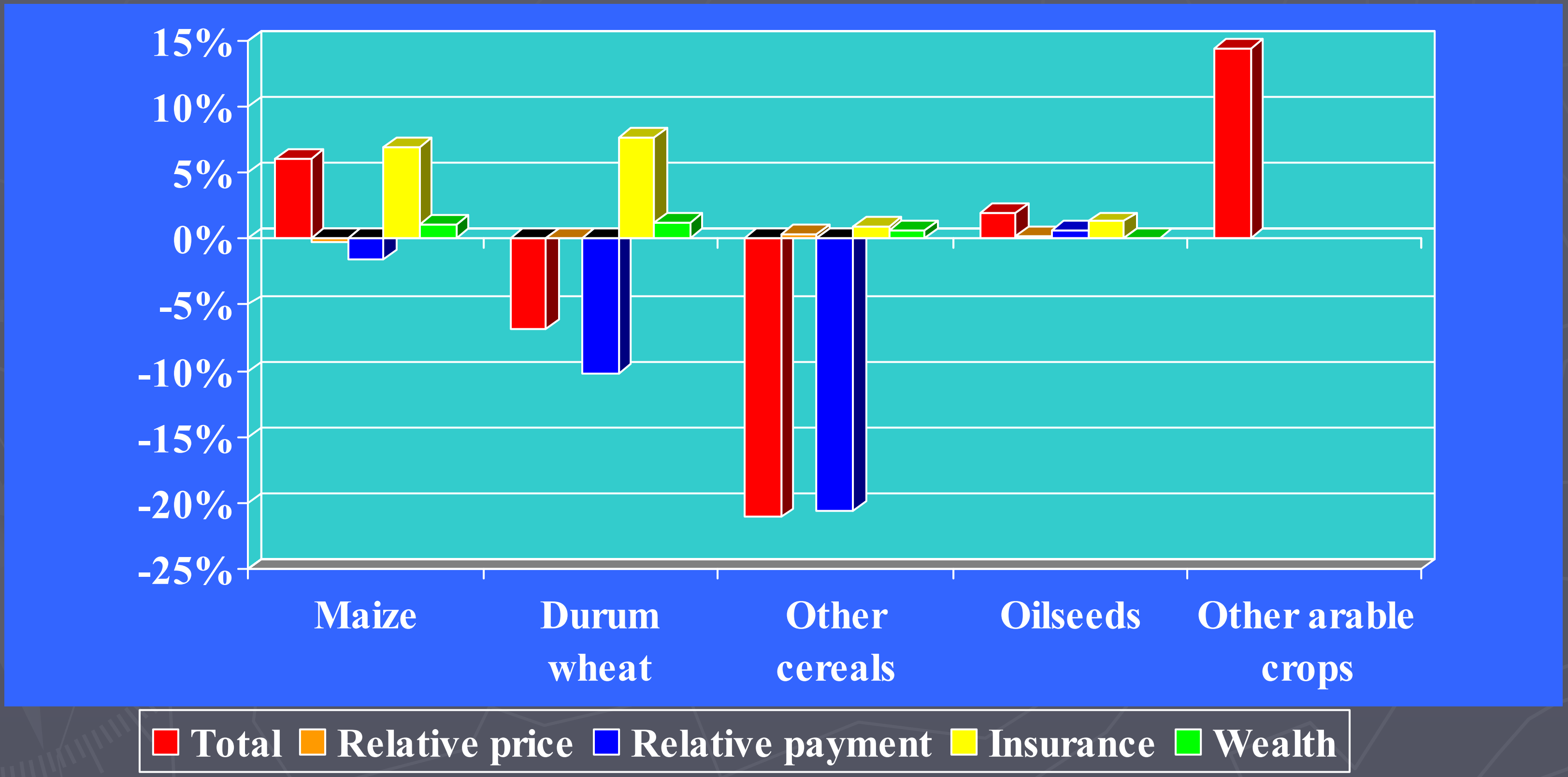
4. Uncertainty model: payment elasticities

	Payments			
	a1	*a2*	*a3*	*a4*
Maize (y1)	0.014*	-0.024*	-0.009*	-0.008*
Durum wheat (y2)	-0.013*	0.072*	-0.011	0.002
Other cereals (y3)	-0.014*	0.046	0.087*	0.01
Oilseeds (y4)	-0.019*	-0.001	0.004	0.015*
Maize acreage (s1)	0.014*	-0.011*	-0.003*	-0.007
Durum wheat acreage (s2)	-0.008*	0.056*	0.011*	0.000
Other cereals acreage (s3)	-0.012*	0.070*	0.088*	0.010
Oilseeds acreage (s4)	-0.007	0.000	0.002*	0.005

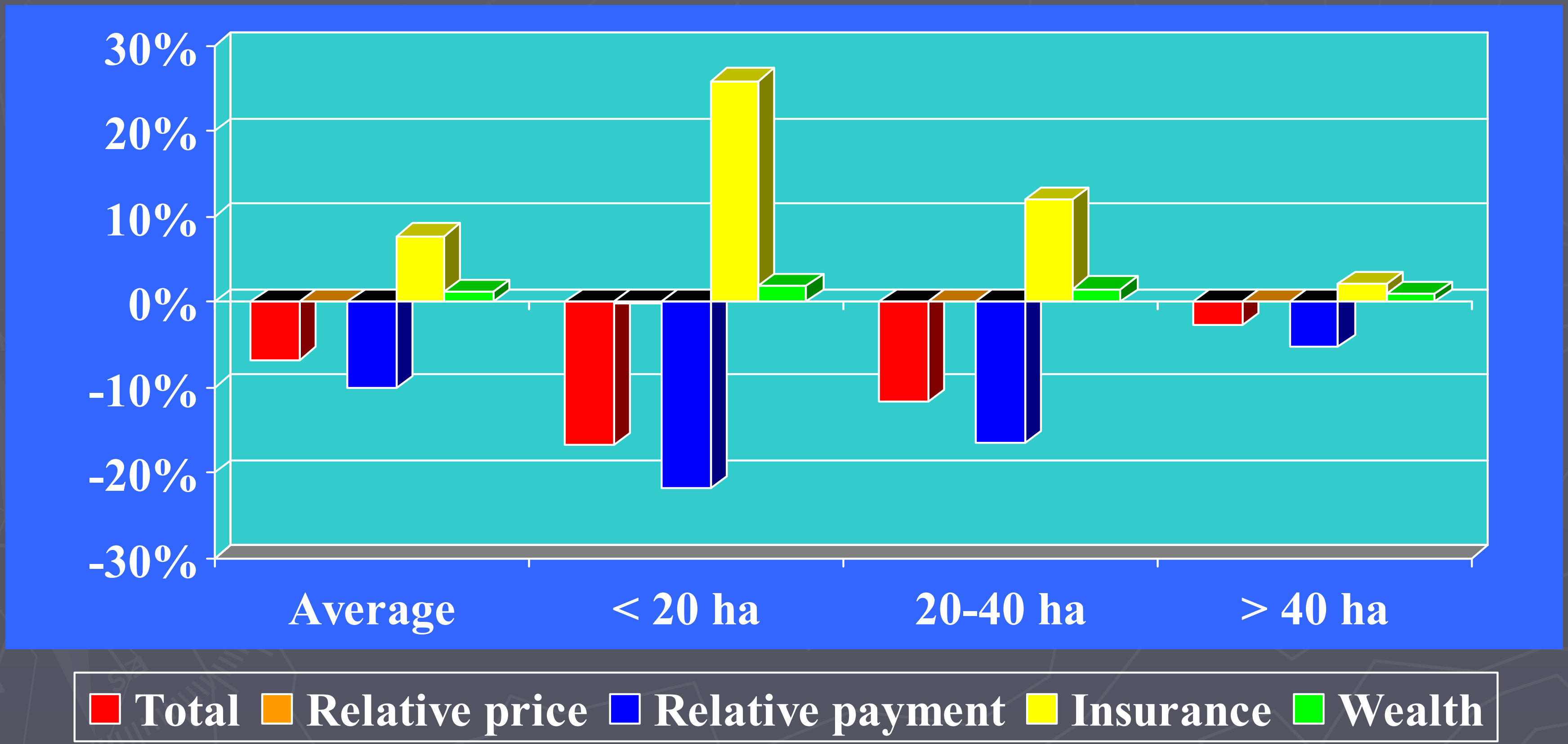
4. Uncertainty model: variance and wealth elasticities

	Variances				*Wealth*
	Var(p1)	*Var(p2)*	*Var(p3)*	*Var(p4)*	
Maize (y1)	**-0.012***	**-0.071**	**0.100***	**0.033**	**1.019***
Durum wheat (y2)	**0.025**	**0.190***	**0.036**	**-0.222***	**0.971***
Other cereals (y3)	**0.040***	**-0.052**	**0.137**	**-0.110***	**1.029***
Oilseeds (y4)	**0.059***	**-0.104**	**0.354***	**-0.218***	**1.105***
Maize acreage (s1)	**-0.001**	**-0.056**	**0.105***	**0.000**	**1.020***
Durum wheat acreage (s2)	**-0.001**	**0.153***	**-0.071**	**-0.104***	**0.970***
Other cereals acreage (s3)	**0.03**	**0.002**	**0.029**	**-0.107***	**1.026***
Oilseeds acreage (s4)	**0.019**	**-0.029**	**0.03**	**-0.026**	**1.083***

4. Uncertainty model: decomposition of acreage effects (shift to SFP)



4. Uncertainty model: decomposition of acreage effects by size (Durum wheat)



5. Investment model: structure

- Objective function (under uncertainty):

$$J\left(p^{e}, w, a, b, c, q, k, Z, t, W_{0}, V_{p}\right) =$$

$$= \max_{I} \int_{t}^{\infty} e^{-rv} U\left(p^{e}, w, a, b, c, q, K(v), I(v), Z, v, W_{0}, V_{p}\right) dv$$

$$s.t.\ \dot{K} = I - \delta K \qquad K(t) = k$$

- System of equation to be estimated:

$$\dot{K}\left(p^{e}, w, a, b, c, q, k, z, t, W_{0}, V_{p}\right) = J_{kq}^{-1}\left(rJ_{q} + k - J_{tq}\right)$$

$$Y\left(p^{e}, w, a, b, c, q, k, z, t, W_{0}, V_{p}\right) = U_{W_0}^{-1}\left(rJ_{p^e} - J_{kp^e}\dot{K} - J_{tp^e}\right)$$

$$X\left(p^{e}, w, a, b, c, q, k, z, t, W_{0}, V_{p}\right) = U_{W_0}^{-1}\left(-rJ_{w} + J_{kw}\dot{K} + J_{tw}\right)$$

$$S\left(p^{e}, w, a, b, c, q, k, z, t, W_{0}, V_{p}\right) = U_{W_0}^{-1}\left(rJ_{a} - J_{ka}\dot{K} - J_{ta}\right)$$

5. Investment model: results

- Short-run (own and cross) elasticities of *(y,x,s)* with respect to prices, payments, fixed inputs, set-aside rate, var-cov matrix, initial wealth, capital rental prices
- Investment demand elasticities with respect to the same set of exogenous variables
- Capital adjustment rates with respect to the long run optimal capital level
- Long run elasticities of output supply, land allocations and all inputs with respect to the same exogenous variables

5. Investment model: evaluation

- Advantages
  - The same features (at least in theory) of the uncertainty model (see previous list)
  - The dynamic investment effects can be evaluated
  - The long run effects can be evaluated
- Problems
  - The uncertainty set-up is needed to model the shift to the SFP (under certainty the impact cannot be captured)
  - The problem of corner solutions is very important
  - The model becomes very difficult to manage empirically

6. Conclusions (a)

- Deterministic model is sufficient to detect the *partially coupled* nature of area payments
- Uncertainty model provides interesting results:
  - The shift to the SFP can be properly modeled
  - Risk neutrality is strongly rejected
  - Risk effects may be relevant (especially the *insurance effects*, while *wealth effects* tend to be small)
  - Cross-crop effects are relevant also for risk behaviour (some crops more attractive because of relative risk patterns)
  - The shift to the SFP will enhance production of "other arable crops"

6. Conclusions (b)

- Uncertainty should be taken into account in more general models (even in a simplified way: see AGLINK)
- Investment results still to come