Title: "AJAE appendix for To risk or not to risk? Risk management and farm productivity"

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Note: The material contained herein is supplementary to the article named in the title and published in the American Journal of Agricultural Economics (AJAE).

Appendix I: Total Factor Productivity

Ordinary least squares (OLS) estimates of production functions can be biased in case of unobservable productivity shocks, which can result in correlation between the level of output and inputs. For instance, in response to market signals, a profit maximizing farm can decide to reduce (increase) the amount of output by reducing (increasing) inputs.

To solve this potential source of endogeneity bias, Olley and Pakes (1996) (OP) and Levinsohn and Petrin (2003) (LP) developed estimators that use proxy variables for the unobservable shocks: investment is used by OP and intermediate inputs is used by LP. In this article we decided to follow the LP approach because of the advantages that intermediate inputs can have over investments: i) investment data are only available for farms with non-zero investments, while use of intermediate inputs (e.g. energy and fertilizers) is almost always reported; ii) intermediate inputs are more responsive to productivity shocks due to lower costs of adjustment.

Consider the following log-linear production function:

(A1) $$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \mu_{it}$$

Where y_{it} is gross revenue of farm *i* in period *t* and *l*, *k* and *m* are labor, capital and materials (intermediate inputs), respectively. The error term can be decomposed into two parts by semi-parametric estimation:

(A2) $$\mu_{it} = \varpi_{it} + \varepsilon_{it}$$

Where ε_{it} is an error term uncorrelated with input choices; ϖ_{it} is a state variable that impacts the productivity shock, unobserved by the farm but not by the econometrician if a valid proxy is available. Assuming that the demand for the intermediate input m_{it} depends on the firm's state variables k_{it} and ϖ_{it}, and that this demand function monotonically increases with TFP, then the (log of) TFP can be expressed:

(A3) $$\hat{\varpi}_{it} = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_m m_{it}$$

We estimate equation (A3) with generalized method of moments (GMM) estimator using gross revenues from wheat production as the dependent variable and seed expenditure as intermediate inputs (table A1).

The original data for capital (tractors value) are for all agricultural production and include crops other than wheat. We adjust this variable by multiplying it by the ratio of wheat area over total utilized area (Matsushita, Yamane and Asano 2016). Because tractors value and seed expenditure are monetary variables, they are deflated using EUROSTAT price indexes for agricultural inputs.

Table A1. Results of TFP estimation using LP

Dep. Var.= Wheat revenues		LP
Labour	(Annual labor units)	0.273***
		(0.033)
Capital	(Value of tractors)	0.453*
		(0.263)
Materials	(Seed expenditure)	0.276*
		(0.155)
Return to Scale		1.002
Wald test of constant returns to scale:		
Chi2 = 0.00 (p = 0.9961)		

Notes: Variables are log-transformed. Statistical significance at the 1% (***), 5% (**) and 10% (*) levels. Clustered standard errors at *country*year* level in parenthesis. A sum of coefficients >1 and insignificant Wald test indicate increasing return to scale.

Appendix II: Testing the validity of the selection instrument

In order for the MESR model to be properly identified, we verified the goodness of the exclusion restrictions by performing a falsification test. The aim was to check if the selected instrument is significant in the estimation of the selection equation (adoption of the risk management tool), but not in the estimation of the outcome variable (TFP).

Table A2.1 shows that the instrument used can be considered valid: it is a statistically significant driver of the decision of adopting the risk management portfolios (multinomial logit, significant $\chi 2$), but not of the TFP of the farms that did not adopt risk management (OLS, insignificant F-stat) (Di Falco, Veronesi and Yesuf 2011).

In addition to the falsification test, we also tested the selection instrument for exogeneity (table A2.2). We use the Durbin and the Wu-Hausman tests for 2SLS estimators (Durbin 1954; Wu 1974; Hausman 1978) and the C (Sargan 1958) statistic test for GMM estimators. Table A2.2 shows the results of the tests. Since they are all not statistically significant, we cannot reject the null hypothesis that our instrument must be treated as exogenous.

Table A2.1 – Results of the falsification test

	OLS	*Multinomial Logit Model*														
	Dep.Var.=TFP	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
		I	D	V	C	I,D	I,V	I,C	D,V	D,C	C,V	I,D,V	I,D,C	I,C,V	D,C,V	I,D,C,V
Age	0.058***	-0.010	-0.027***	-0.015	0.015	-0.012	-0.017	-0.061***	-0.012	-0.022	-0.012	-0.027**	-0.027	-0.014	0.000	-0.002
	(0.021)	(0.012)	(0.010)	(0.013)	(0.021)	(0.012)	(0.013)	(0.020)	(0.011)	(0.016)	(0.014)	(0.012)	(0.022)	(0.015)	(0.013)	(0.012)
Gender	2.006***	0.163	-0.007	-0.865*	-0.129	-0.852**	-0.327	0.422	-0.899**	0.576	16.931	-0.918**	-1.620**	-0.568	-0.109	1.313*
	(0.629)	(0.490)	(0.389)	(0.443)	(0.668)	(0.405)	(0.487)	(0.824)	(0.416)	(0.643)	(2099.825)	(0.449)	(0.643)	(0.537)	(0.509)	(0.699)
Married	0.260	-0.933**	-0.422	-1.428***	-0.307	0.154	-0.227	-0.141	-0.750**	-1.089**	-0.414	-0.213	16.443	-0.377	-1.314***	-0.379
	(0.847)	(0.399)	(0.376)	(0.395)	(0.829)	(0.429)	(0.412)	(0.635)	(0.370)	(0.469)	(0.429)	(0.380)	(1543.175)	(0.442)	(0.379)	(0.382)
Education	-0.100	-0.107	-0.195	-0.118	-0.463	0.357	-0.204	-0.318	-0.138	-0.224	0.498	0.502*	-1.352*	0.027	0.229	0.236
	(0.508)	(0.330)	(0.301)	(0.349)	(0.575)	(0.309)	(0.334)	(0.460)	(0.305)	(0.446)	(0.346)	(0.299)	(0.721)	(0.377)	(0.320)	(0.307)
Off-farm	0.288	-0.296	-0.599*	-0.230	1.125**	-0.566	-0.396	1.731***	-1.513***	0.104	-0.126	-1.050**	-1.320	-0.625	-0.660	0.126
	(0.529)	(0.366)	(0.340)	(0.444)	(0.474)	(0.374)	(0.445)	(0.433)	(0.575)	(0.521)	(0.468)	(0.516)	(1.085)	(0.593)	(0.499)	(0.402)
Farm size	-0.015	0.581***	0.072	0.724***	0.130	0.634***	1.423***	0.433**	0.939***	-0.312*	0.486***	1.567***	1.034***	0.535***	0.705***	0.912***
	(0.179)	(0.120)	(0.105)	(0.139)	(0.202)	(0.119)	(0.142)	(0.191)	(0.126)	(0.162)	(0.152)	(0.132)	(0.238)	(0.170)	(0.146)	(0.137)
Land tenure	-0.872	-0.085	0.424	-1.078**	1.259	0.314	-0.315	-0.574	-1.085***	-0.248	-1.199**	-1.412***	-1.958***	-1.519***	-1.337***	-1.769***
	(0.759)	(0.444)	(0.409)	(0.449)	(0.973)	(0.431)	(0.432)	(0.660)	(0.400)	(0.594)	(0.477)	(0.410)	(0.738)	(0.502)	(0.430)	(0.420)
Subsidies	-0.283	-0.320**	0.751***	-0.070	-0.105	0.331**	-0.219	0.249	0.473***	1.215***	-0.022	0.206	0.480*	-0.078	0.130	-0.055
	(0.285)	(0.149)	(0.142)	(0.166)	(0.268)	(0.154)	(0.152)	(0.241)	(0.150)	(0.200)	(0.178)	(0.149)	(0.260)	(0.192)	(0.167)	(0.153)
Liquidity	0.057	0.425	0.100	-0.445	-0.733	-0.095	0.140	-0.372	0.241	-0.039	-0.001	-0.531**	-0.474	0.016	-0.317	-0.157
	(0.399)	(0.274)	(0.239)	(0.281)	(0.454)	(0.259)	(0.273)	(0.390)	(0.246)	(0.358)	(0.295)	(0.252)	(0.455)	(0.308)	(0.264)	(0.252)
Perception	0.992**	0.818***	-1.096***	-0.513*	-0.488	-0.298	0.887***	-0.774*	-0.231	-1.006***	0.077	-0.387	-1.630***	0.030	0.252	0.257
	(0.435)	(0.315)	(0.242)	(0.287)	(0.434)	(0.264)	(0.305)	(0.405)	(0.255)	(0.360)	(0.312)	(0.258)	(0.478)	(0.320)	(0.280)	(0.265)
Market shocks	0.887**	0.988***	-0.383	0.186	0.367	0.936***	0.077	16.283	0.686**	0.164	0.431	0.673**	0.558	0.618*	0.922***	0.603**
	(0.409)	(0.320)	(0.247)	(0.299)	(0.469)	(0.299)	(0.282)	(813.489)	(0.267)	(0.387)	(0.320)	(0.271)	(0.507)	(0.341)	(0.294)	(0.273)
Price variability	-8.149***	0.924	-6.623***	0.612	0.454	-2.709*	0.591	-3.883	-0.061	-5.218*	0.080	-1.153	-2.507	-1.024	-2.620*	-5.157***
	(2.279)	(1.128)	(1.645)	(1.215)	(2.399)	(1.561)	(1.186)	(3.009)	(1.126)	(2.842)	(1.347)	(1.281)	(2.684)	(1.602)	(1.498)	(1.550)
Unions	0.045	-0.384	-0.907*	-0.266	-14.216	0.001	-0.277	-14.845	0.029	-0.121	-0.102	-0.789*	-17.182	0.975**	0.282	0.478
	(0.812)	(0.552)	(0.533)	(0.489)	(1251.247)	(0.490)	(0.473)	(861.521)	(0.437)	(0.656)	(0.487)	(0.448)	(1695.986)	(0.474)	(0.446)	(0.436)
*Country*Year*	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Constant	1.419	-0.735	-1.457	1.035	-2.428	-3.508**	-3.868***	-16.301	-4.040***	-4.799***	-17.724	-4.287***	-19.865	-0.181	-1.852	-2.807*
	(2.344)	(1.341)	(1.207)	(1.444)	(2.351)	(1.387)	(1.471)	(813.491)	(1.350)	(1.826)	(2099.826)	(1.377)	(1543.177)	(1.684)	(1.488)	(1.480)
N	139															
R^2	0.272															
F-stat	0.000															
χ2		58.840***														

Note: Standard errors in parentheses. Statistical significance at the 1% (***), 5% (**) and 10% (*) levels.

Table A2.2 – Results of the endogeneity tests

	2SLS	*GMM*
	Dep.Var.=TFP	*Dep.Var.=TFP*
Age	0.024***	0.024***
	(0.005)	(0.005)
Gender	0.147	0.147
	(0.177)	(0.176)
Married	-0.168	-0.168
	(0.117)	(0.114)
Education	-0.024	-0.024
	(0.121)	(0.118)
Off-farm	0.529***	0.529***
	(0.173)	(0.176)
Farm size	-0.106	-0.106
	(0.124)	(0.121)
Land tenure	0.719**	0.719**
	(0.356)	(0.358)
Subsidies	-0.225***	-0.225***
	(0.063)	(0.067)
Liquidity	-0.005	-0.005
	(0.111)	(0.106)
Perception	0.042	0.042
	(0.104)	(0.099)
Market shocks	-0.109	-0.109
	(0.154)	(0.157)
Price variability	0.775	0.775
	(0.686)	(0.770)
*Country*Year*	YES	YES
Constant	3.542***	3.542***
	(1.000)	(1.032)
N	2100	2100
R^2	0.025	0.025
Durbin $\chi 2$ *(p-value)*	0.907 (0.341)	
Wu-Hausman F (p-value)	0.899 (0.343)	
C Sargan $\chi 2$ *(p-value)*		0.937 (0.333)

Notes: Statistical significance at the 1% (***), 5% (**) and 10% (*) levels. Standard errors in parentheses.

Appendix III: Technical information about the survey instrument

- Universe and target population: Farmers that grew wheat in 2012/2013 in France and Hungary.
- Population size: 43,680 in France; 49,550 in Hungary (source: Eurostat)
- Sample dimension: 700 farms, of which 350 in France and 350 in Hungary.
- Sampling design: stratified multi-stage with random selection of the final sample units.
- Sampling errors: in France a confidence interval (2δ) of ±8.7%; In Hungary ±7.9%. Significance level of 95.5%.
- Fieldwork Period: from 25/11/2013 until 20/01/2014.
- Number of interviewers: total of 51 interviewers, coordinated by 2 fieldwork directors and 4 supervisors (2 per country). In France: 19 interviewers. In Hungary: 32 interviews.
- Steps to contact the farmers: In Hungary through the Agrarian Local Offices in the municipalities with higher presence of wheat growers. In France, through pre-existing statistics and databases.
- Interview locations: 285 in France; 163 in Hungary.
- Average length of the questionnaire: 50 mins.

Appendix IV: Data file and code

The file AJAE MS 17128 data.dta contains the dataset used for the estimations of the article *To risk or not to risk? Risk management and farm productivity* (authored by Mauro Vigani and Jonas Kathage) in .dta format, while the file AJAE MS 17128 data.txt contains the same dataset but in a tab-delimited text file format. See table 1 of the manuscript for a description of the variables.

Estimations of the Multinomial Endogenous Switching Regression model were implemented in Stata using the user-written command selmlog, developed by Bourguignon, Fournier and Gurgand (2004). The option dmf(2) was used to perform the variant of the Dubin-McFadden (1984) correction method suggested in Bourguignon, Fournier and Gurgand (2004); while the option bootstrap with the number of replications equal to the sample size was used to estimate the standard errors.

The multinomial logit models presented in table 3 and in table A2.1 were implemented using the mlogit Stata command.

For the falsification test in table A2.1 we used the post-estimation command test after the command reg.

For the endogeneity tests in table A2.2 we used the post-estimation command endogenous after the commands ivregress 2sls and ivregress gmm.

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