Harvest Dynamics in a Subsistence Economy

You Reap What You Sow

Cliff Bekar

Lewis & Clark College, Portland OR
Dept. Of Economics

Cliometric Society Session @ WEAI, Portland OR
July 3rd 2016

The nature of the harvest

Research question: Were harvests in pre-industrial England "self-contained?"

Beveridge

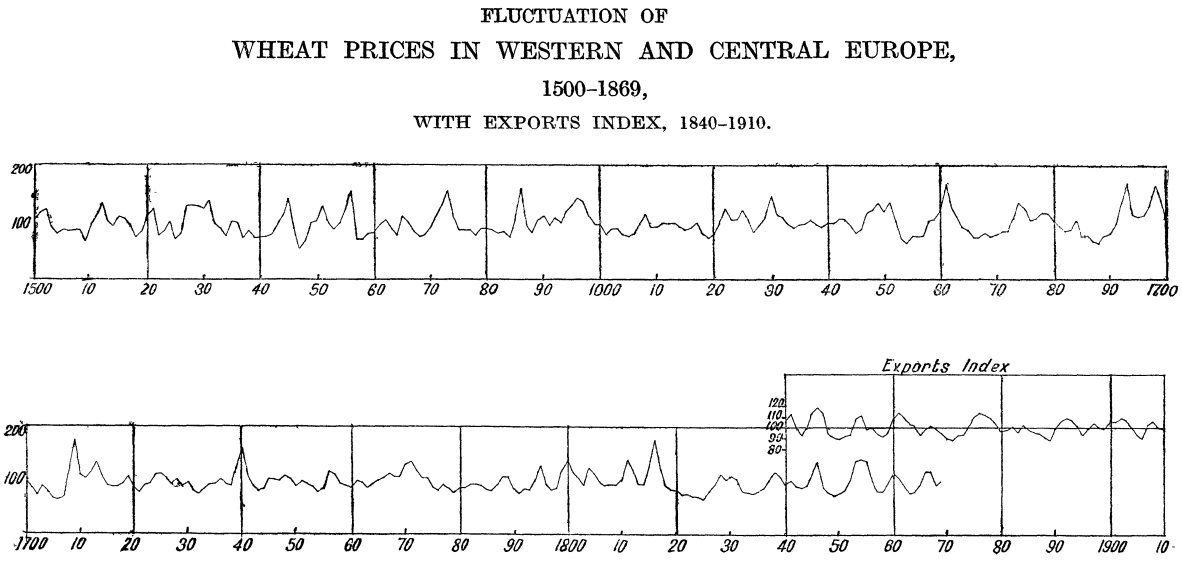
Long-run cycles in the weather

Hoskins

Consumption of seed corn

Modern literature

Grain stores



Our findings:

- seed yield evidence from the Winchester Estates (1268-1349) is consistent with Hoskins' hypothesis
- same evidence suggests persistent harvests were not responsible for runs in grain prices

A simple model of the harvest

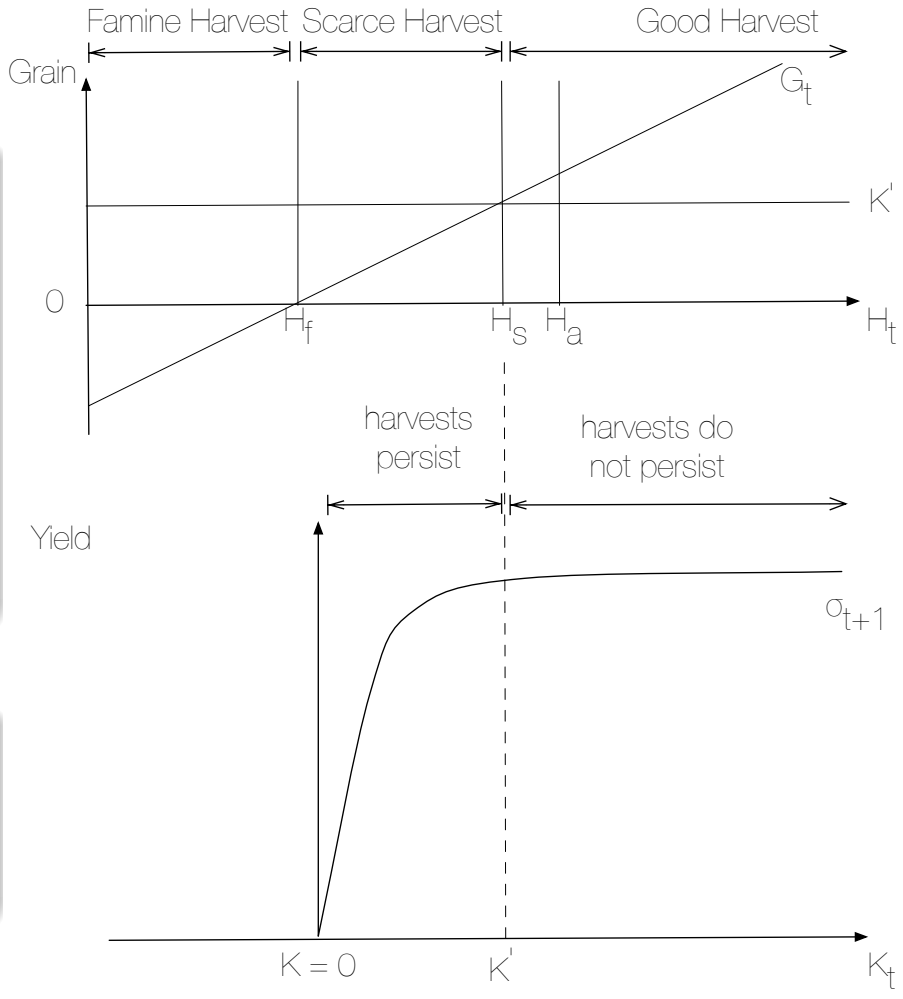
Assumptions

- agents allocate annual harvest between **consumption**, **stores**, and **seed**
- agents face subsistence constraint ($\underline{C}$)
- yields (σ) increase in sow rates (K) at a diminishing rate
- yields are non-increasing in sow rates beyond K'

Definition: "grain on hand"

= harvest + stores - subsistence

$$G_t = H_t + S - \underline{C}$$



Implications:

- only *famine* and *scarce* harvests persist
- harvests persist at the level sow rates are *chosen* (i.e., the manor)

Empirical results

Reproducing tests from the literature

- yields lower after scarce harvest ✓
- yields display autocorrelation ✓
- yields display too few runs ✓

Data

- **Source:** Titow (1972)
- **Coverage:** 38 Manors from the Winchester Estates
- **Period:** 1268 - 1349

Table 1: Mean yields by manor following average ($\hat{H}$) and scarce (H_s) harvests.

	Sub-period					
	1268-74	1283-92	1297-1302	1305-18	1324-32	1335-49
Wheat						
following $\hat{H}$	1.21	1.25	1.42	1.21	1.32	1.12
following H_s	0.88	0.91	1.03	0.93	1.03	0.89
difference	**0.33****	**0.34****	**0.39****	**0.29****	**0.29****	**0.23****
Barley following						
following $\hat{H}$	1.94	1.69	1.91	1.87	1.95	1.98
following H_s	1.25	1.26	1.44	1.45	1.38	1.42
difference	**0.69****	**0.43****	**0.47****	**0.42****	**0.57****	**0.56****
Oat following						
following $\hat{H}$	1.43	1.37	1.38	1.25	1.24	1.14
following H_s	1.04	1.01	1.44	1.09	1.09	1.00
difference	**0.39****	**0.36****	**-0.06**	**0.16****	**0.15****	**0.14****

Notes: ** difference in means significant at 1% level.

Table 2: Correlation coefficient between yields and harvest quality.

	Wheat		Barley		Oats	
	$\hat{H}$	H_s	$\hat{H}$	H_s	$\hat{H}$	H_s
1268-1274	0.42**	-0.23**	0.71**	-0.32**	0.61**	-0.30**
1283-1292	0.54**	-0.32**	0.54**	-0.27**	0.59**	-0.32**
1297-1302	0.63**	-0.29**	0.58**	-0.32**	0.56**	0.04
1305-1318	0.40**	-0.23**	0.53**	-0.26**	0.37**	-0.09
1324-1332	0.55**	-0.28**	0.73**	-0.30**	0.31**	-0.16
1335-1349	0.25**	-0.18**	0.67**	-0.26**	0.48**	-0.11

Notes: ** significant at 1% level.

Table 3: The frequency of consecutive scarce harvests.

	Period					
	1268-74	1283-92	1297-1302	1305-18	1324-32	1335-49
Predicted frequency	1.0%	1.5%	1.0%	1.0%	3.0%	2.5%
Observed frequency	2.0%	3.0%	2.5%	2.0%	5.0%	3.0%

Empirical results

Table 4: Conditional and unconditional probabilities of harvest type.

	Sub-period					
	1268-74	1283-92	1297-1302	1305-18	1324-32	1335-49
$Prob(H_{g,t}\|H_{g,t-1})$	94%	92%	94%	96%	87%	86%
$Prob(H_g)$	89%	87%	88%	93%	82%	83%
Difference	**5**%	**5**%	**6**%	**3**%	**5**%	**3**%
$Prob(H_{s,t}\|H_{s,t-1})$	42%	44%	33%	37%	48%	38%
$Prob(H_s)$	10%	12%	11%	6%	17%	18%
Difference	**32**%	**32**%	**22**%	**31**%	**31**%	**20**%

Table 5: Regression, wheat yields per acre (38 Winchester manors 1268-1349).

	Yield by manor					Average yield
	(1)	(2)	(3)	(4)	(5)	(6)
Model	Pooled	Pooled	GLS	FE	FE	FE
Options	robust	robust	standard	standard	robust	robust
No. Obs	(1692)	(1692)	(1692)	(1692)	(1692)	(1692)
Lagged sow rate	0.13**	0.13**	0.17**	0.13**	0.13	0.06
	(0.03)	(0.02)	(0.02)	(0.03)	(0.10)	(0.04)
Lagged scarce harvest	-0.22**	-0.22**	-0.25**	-0.11**	-0.12**	0.01
	(0.02)	(0.02)	(0.04)	(0.02)	(0.02)	(0.01)
Lagged fodder crops	-0.13**	-0.12**	-0.20**	-0.13**	-0.13**	0.00
	(0.02)	(0.02)	(0.07)	(0.03)	(0.02)	(0.01)
Rainy weather	-0.07**	-0.07**	-0.07*	-0.07*	0.13	-0.08**
	(0.03)	(0.03)	(0.03)	(0.03)	(0.10)	(0.01)
Dry weather	0.14**	0.14**	0.13**	0.15**	0.14**	0.06**
	(0.03)	(0.04)	(0.04)	(0.03)	(0.10)	(0.04)
Cold weather	0.03	0.03	0.04	0.04	0.13	0.00
	(0.03)	(0.03)	(0.04)	(0.03)	(0.10)	(0.01)
Hot weather	0.00	0.00	0.00	0.03	0.13	0.02**
	(0.03)	(0.05)	(0.03)	(0.02)	(0.10)	(0.01)
Manor controls	yes	no	no	no	no	no
Population controls	yes	no	no	no	no	no
F-stat [p-value]	14.76 [0]	35.60 [0]	125.5 [0]	16.94 [0]	8.19 [0]	4719 [0]
R-squared	0.15	0.14	–	0.13	0.13	0.08

Standard errors are in parentheses. Significant at the ** 1% level, * 5% level.

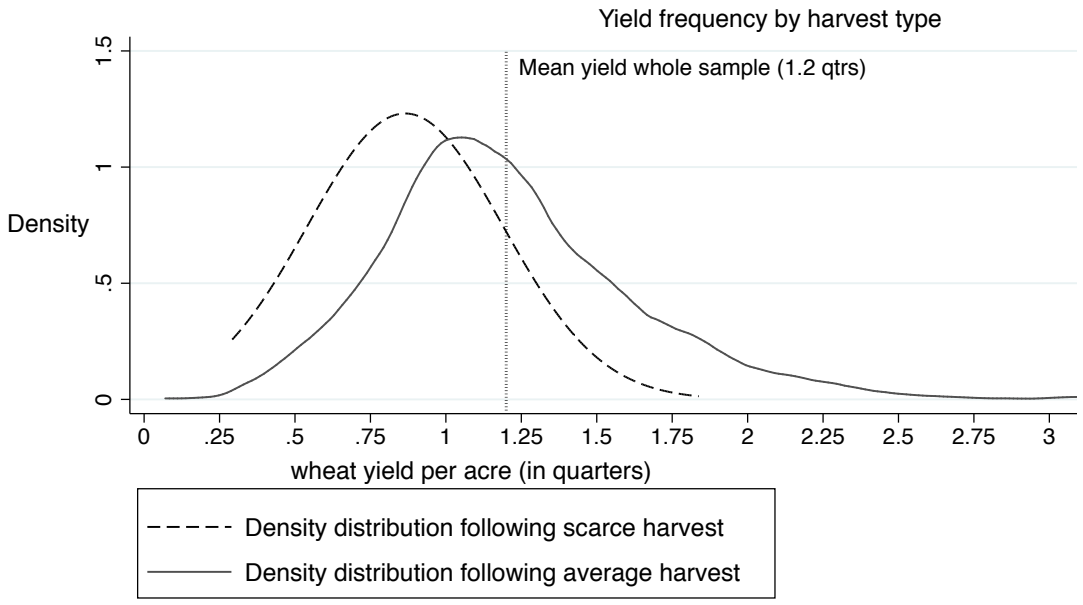
Information content of the harvest

- scarce harvests increase probability of subsequent scarce harvest ✓
- lagged harvests predict lower yields ✓

Conclusions

Effects of scarce wheat harvest

- a scarce harvest in t reduces the expected mean yield in $t+1$ by $10\% - 20\%$
- a scarce harvest in t shifts the distribution closer to a subsistence event in $t+1$ by $25\% - 50\%$ of one standard deviation
- a scarce harvest in t increases probability of a scarce harvest in $t+1$ by 200% - 300%



So...

- Hoskins is correct, poor harvests persisted, but correlation of yields between manors is low enough that the impact of *"Hoskin's effect"* on regional grain supplies was likely quite small
- Results do tell us something about the structure of risk faced by peasants