"For The Benefit of the Church and the State."

Education and Agricultural Structure in an Early Modern Proto-Industrial Area in Switzerland

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Short Draft

Along with enlightenment debates, elementary education became a major concern in the proto-industrializing areas of Zurich and eastern Switzerland after 1750. Promoted by progressive elite "Learned Societies", Zurich developed into a centre of early modern popular enlightenment (Siegert, 1997). In this context, the Zurich church authorities carried out a survey among their parsons to evaluate "the state of education" in their function as supervisors of schools in 1771/72. It was soon followed by a revised and clearly more utilitarian school ordinance: "[...] for the promotion of prosperity of a people, apart from God's grace, most is indisputably based and dependent on a good education and faithful instruction of the tender dear youth in all useful and beneficial knowledge for which the basis must be laid by public schools" (Canzley der Stadt Zürich, 1778). The ordinance required more "school supply" by expanding regular schooling during summer. By stricter control of attendance, it also aimed at increasing "demand" – without implementing severe enforcement mechanisms, however, as schools were predominantly financed by local

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parishes and communes. In addition, even though Zurich's Protestant church organisation expanded into the condominium of Thurgau, it held no political power in the area where denominational parity was prevalent.

Another core topic of Zurich's popular enlightenment was agricultural reform, especially after the 1770/71 hunger crisis had revealed the deficiencies of local production in the increasingly proto-industrial economy. Here, the economic commission of the "Naturforschende Gesellschaft" ("Society of Natural Sciences") studied the state of agricultural production on the countryside: They organised "farmers' talks" during which they not only collected information on land-use but also gave advice on innovative agricultural techniques and crops like potatoes. During the hunger crisis of 1770/71, they additionally collected parish-wide tithe statistics. The suggested measures include many of those Mokyr (2009, p. 178) identifies in his seminal book on "The Enlightened Economy": new crops with a higher nutritional value such as potatoes, an increase in arable land due to deforestation and clearing of wasteland including enclosures – with suspending tithes for some years in the case of Zurich –, and a more intensified use of arable land by combining grain crops with pasturage, the latter of which increased soil fertility via nitrogen-fixing clover fields and manuring by cattle fed with legumes.

It is the spread of such "useful knowledge" in the area of agriculture after 1750 that Mokyr (2009, p. 184-188) observes, too, and that may have induced a small-scale "Agricultural Revolution" (p. 181). One of Zurich's enlightenment masterminds, Hans Caspar Hirzel, actually contributed to this debate. His influential 1761 book on a local model farmer entitled "The Rural Socrates" was translated, among others, by Arthur Young as an attachment to his "Rural Oeconomy" Essays (Young, 1770).

The effects of these efforts to implement mass education as a means to improve productivity can be quantified some 30 years later, when the short-lived Helvetic Republic carried out another education survey, as well as a cadastre, as means of "nation building". Echoing studies which found effects of land-use and ownership structure on economic development, as well as on investments in education and human capital (Nilsson, 1999; Banerjee and Iyer, 2005; Clark and Jamelske, 2005; Jones, 2020; Galor, Moav, and Vollrath, 2009;

Beltrán Tapia and Martinez-Galarraga, 2018; Andersson and Berger, 2019), the relationship between educational investments and agricultural structure can be roughly quantified by combining regional land-use data with the extensive school surveys.

Table 1: Descriptives 1771/72

	N	Mean	Std. dev.	Min	Max
Math	345	0.25	0.43	0.00	1.00
log Weeks	345	3.27	0.40	1.79	3.95
Public Classroom	333	0.38	0.48	0.00	1.00
Pupil Share Winter	345	0.13	0.04	0.04	0.29
Pupil Share Summer	256	0.06	0.03	0.01	0.20
Girl Share Winter	294	0.06	0.02	0.02	0.14
Boy Share Winter	294	0.07	0.02	0.02	0.14
Tithe Share 1771/72	235	0.85	0.16	0.27	1.00
Share Arable Land	100	0.56	0.20	0.08	0.78
log Altitude	353	6.19	0.17	5.85	6.72
log Ruggedness	353	2.00	3.10	-4.61	5.77
Market Place	352	0.09	0.29	0.00	1.00
Trade Route Village	353	0.38	0.49	0.00	1.00
Main School	353	0.43	0.50	0.00	1.00

These early-modern data from north-eastern Switzerland thus provide us with the possibility to quantitatively assess elementary human capital accumulation at a time when the idea of mass education and "the usefulness of knowledge" was only just emerging – and for an area on the brink of industrialisation (Pfister, 1992; Braun, 2005). As most of the data is proto-statistical in nature, and had to be transcribed "by hand" from the archival (StAZH B IX 2, 1771; StAZH B IX 1, 1772; StAZH B IX 91, 1772-1779; StAZH B IX 87, 1762-1775; Pfister, 1992; StAZH K I 87-256, 1801; StATG 1'24'0, 1801-1803; StATG 1'24'1, 1801-1803) and edited sources (Staatsarchiv Zürich (StAZH), 2012; Schmidt and Tröhler, 2015), imprecisions and gaps could not be avoided. And yet, key indicators like the number of weeks in the school year, the provision of a public school room, and the share of elementary pupils in the local population all tend to increase between the two points in time. The largest

Table 2: Descriptives 1799

	N	Mean	Std. dev.	Min	Max
Math	586	0.45	0.50	0.00	1.00
log Weeks	560	3.36	0.39	2.08	3.95
Public Classroom	583	0.41	0.49	0.00	1.00
Pupil Share Winter	577	0.15	0.05	0.02	0.38
Pupil Share Summer	466	0.08	0.04	0.01	0.19
Girl Share Winter	536	0.07	0.03	0.01	0.17
Boy Share Winter	536	0.07	0.03	0.01	0.22
Share Arable Land	429	0.53	0.20	0.00	0.88
log Altitude	593	6.22	0.19	5.85	6.88
log Ruggedness	593	2.19	2.99	-4.61	5.78
Market Place	593	0.11	0.31	0.00	1.00
Trade Route Village	593	0.36	0.48	0.00	1.00
Main School	593	0.42	0.49	0.00	1.00
Denomination	593	1.35	0.68	1.00	4.00

– and probably the most interesting – jump is evident in the share of school offering math in their standard curriculum, which had traditionally consisted of reading and some writing. As numeracy was a core skill to acquire and implement "useful knowledge", it serves as the main outcome variable in the cross-sectional analyses for the two years.

The logit regressions for 1771/72 (see table 3) shows that math was significantly more prevalent in Thurgau, and in market towns (cols 1-4). The share of arable land, which is only available for parts of Zurich, has no effect on the results (cols 5-8). The probability that maths was offered was significantly smaller in areas with a higher tithe-share (cols 9-12) – in accordance with the literature –, while this control shows a significantly positive effect with a higher share of pupils in the population. Other key educational inputs do not have any effect on math teaching. This changes drastically in 1799 (see table4). In schools with a longer school year, the probability that math was taught was significantly higher. In addition, more summer pupils as well as more school boys among the population also significantly increased the probability that math was taught. Both the extension of the school year, regular summer educa-

tion and more attendance had been demanded by the revised utilitarian school ordinance, and these measures are clearly correlated with curricular content.

This stark difference of the prevalence of math in the curriculum with a longer school year in 1799 raises the question whether useful knowledge – in the form of math teaching and numeracy at the elementary level – may have had an impact on agricultural reform. Even though the share of traditional crop-based field may be a rather rough measure of the agricultural state of Zurich's rural dominion, the Economic Commission's and the government's efforts clearly aimed at intensifying production by increasing manuring via dairy farming and overcoming the traditional three-field rotation system. Both measures tended to reduce the relative share of arable land in favour of pasturing – as can be seen for Great Britain between 1700 and 1850 (Mokyr, 2009, p. 178).

To quantitatively assess potential effects of educational input and useful knowledge on agricultural change, a difference-in-difference (DiD) approach is applied, using only those school location for which there is information on arable field shares in both years (see table 5). Even though this reduces the number of observations, there are still some small, but significant, effects: a higher share of pupils in winter schools as well as a higher share of girls in schools significantly reduced the share of arable field in the school commune. When controlling for boy shares, a longer school year and the probability that math was taught had the same reducing effect on arable land. All these educational input factors may be interpreted as a supportive attitude toward education among Zurich's rural population whose acquisition of useful knowledge and human capital seems to have helped to implement agricultural reform – as was intended by the enlightened elites. Thus, the Uster (StAZH E I 21.8.41) parson's 1771/72 statement that "[t]hese times also begin to become enlightened times for the farmer, in which he learns to think and calculate" seems to be supported by the quantitative evidence.

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Table 3: OLS 1771 Math

	(1) Math	(2) Math	(3) Math	(4) Math	(5) Math	(6) Math	(7) Math	(8) Math	(9) Math	(10) Math	(11) Math	(12) Math
Math												
log Weeks	0.35	0.48	1.03*	1.03	-0.15	-0.07	-0.09	-0.38	0.28	0.30	0.32	0.31
	(0.55)	(0.66)	(0.59)	(0.64)	(1.46)	(1.24)	(1.43)	(1.39)	(0.59)	(0.63)	(0.59)	(0.61)
Public Classroom=1	0.20	-0.02	0.05	-0.09	0.04	0.85	0.43	0.42	0.33	0.31	0.52	0.24
	(0.45)	(0.43)	(0.45)	(0.46)	(1.06)	(1.03)	(1.22)	(1.06)	(0.59)	(0.55)	(0.59)	(0.58)
Main School=1	-0.13	0.03	-0.08	-0.08	-0.79	-1.63	-1.12	-1.02	-0.11	0.03	-0.13	-0.12
	(0.38)	(0.43)	(0.41)	(0.40)	(1.30)	(1.56)	(1.46)	(1.31)	(0.55)	(0.55)	(0.56)	(0.53)
log Altitude	-2.35	-2.33	-2.28	-2.82	-4.15	1.32	-3.54	-3.57	-2.53	-3.50	-2.07	-3.09
	(1.72)	(1.80)	(1.83)	(2.05)	(5.54)	(6.03)	(5.79)	(5.57)	(2.60)	(2.31)	(2.53)	(2.84)
log Ruggedness	0.00	-0.01	0.02	0.01	-0.05	0.01	-0.02	-0.03	-0.06	-0.05	-0.05	-0.05
	(0.05)	(0.05)	(0.05)	(0.05)	(0.09)	(0.11)	(0.09)	(0.09)	(0.07)	(0.08)	(0.08)	(0.07)
Trade Route Village=1	0.02	-0.33	0.05	0.01	-0.94	-0.97	-0.26	-0.23	0.18	-0.04	0.27	0.18
	(0.38)	(0.45)	(0.40)	(0.40)	(1.05)	(1.15)	(0.95)	(0.85)	(0.61)	(0.61)	(0.62)	(0.60)
Market Place=1	1.21**	1.06	1.07*	1.16*	1.90	2.12*	1.31	1.52	0.78	0.71	0.66	0.77
	(0.55)	(0.67)	(0.58)	(0.60)	(1.26)	(1.19)	(1.08)	(1.16)	(0.66)	(0.74)	(0.69)	(0.68)
TG	2.27***	1.89**	1.49*	1.46*								
	(0.71)	(0.89)	(0.77)	(0.76)								
Protestant, Parity	-1.47**	-0.92	-0.43	-0.49								
	(0.66)	(0.91)	(0.77)	(0.72)								
Pupil Share Winter	7.73				-9.28				14.56*			
	(5.96)				(25.12)				(7.84)			
Pupil Share Summer		9.94				28.15				18.82**		
		(9.26)				(25.96)				(8.32)		
Girl Share Winter			17.33				-1.72				30.89*	
			(13.11)				(41.08)				(17.02)	
Boy Share Winter				10.66				-18.64				20.82*
				(9.65)				(32.27)				(11.49)
Share Arable Land					4.98	5.44	5.33	6.06				
					(3.08)	(6.30)	(4.26)	(4.44)				
Tithe Share 1771/72									-4.57**	-6.26**	-4.48**	-4.52**
									(2.08)	(2.47)	(2.01)	(2.10)
Constant	10.54	10.66	7.87	11.65	23.03	-14.51	17.58	19.43	14.74	22.85	11.62	18.73
	(11.59)	(11.99)	(12.35)	(14.20)	(38.84)	(45.93)	(42.43)	(37.25)	(18.67)	(16.57)	(18.07)	(20.16)
Observations	321	237	282	282	93	83	82	82	222	188	207	207

Standard errors adjusted for intragroup (parish) correlation in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: OLS 1799 Math

	(1) Math	(2) Math	(3) Math	(4) Math	(5) Math	(6) Math	(7) Math	(8) Math
Math								
log Weeks	2.06***	1.95***	2.01***	2.06***	1.90***	1.73***	1.80***	1.87***
	(0.37)	(0.41)	(0.38)	(0.37)	(0.41)	(0.47)	(0.43)	(0.43)
Public Classroom=1	0.09	0.12	0.12	0.14	0.23	0.19	0.27	0.28
	(0.23)	(0.26)	(0.24)	(0.24)	(0.27)	(0.30)	(0.28)	(0.28)
Main School=1	-0.02	0.08	0.02	0.00	0.05	0.10	0.09	0.07
	(0.23)	(0.24)	(0.24)	(0.24)	(0.25)	(0.26)	(0.26)	(0.26)
log Altitude	-1.06*	-0.13	-0.75	-0.72	-0.81	-0.40	-0.68	-0.69
	(0.63)	(0.71)	(0.64)	(0.64)	(0.86)	(0.92)	(0.90)	(0.90)
log Ruggedness	-0.06*	-0.09**	-0.07*	-0.06*	-0.05	-0.08*	-0.05	-0.05
	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.05)
Trade Route Village=1	-0.31	-0.22	-0.26	-0.26	-0.18	-0.20	-0.09	-0.11
	(0.22)	(0.25)	(0.23)	(0.23)	(0.29)	(0.32)	(0.31)	(0.31)
Market Place=1	0.31	0.40	0.33	0.42	0.75	0.81	0.77	0.81
	(0.44)	(0.45)	(0.45)	(0.45)	(0.52)	(0.53)	(0.55)	(0.55)
TG	1.36***	1.41***	1.14***	1.08***	1.03**	1.98**	0.67	0.59
	(0.36)	(0.50)	(0.38)	(0.39)	(0.48)	(0.84)	(0.48)	(0.49)
Protestant, Parity	-0.36	-0.07	-0.14	-0.10	-0.34	-1.02	0.11	0.14
	(0.38)	(0.58)	(0.41)	(0.41)	(0.57)	(0.97)	(0.60)	(0.59)
Catholic, Parity	-0.53	-0.18	-0.27	-0.21	0.14	-0.06	0.70	0.73
	(0.53)	(0.71)	(0.57)	(0.58)	(1.16)	(1.72)	(1.60)	(1.60)
Catholic	1.04	1.13	1.31	1.42	0.71		0.87	1.19
	(0.81)	(1.30)	(0.88)	(0.90)	(1.49)		(1.49)	(1.51)
Pupil Share Winter	3.14				4.06			
	(2.10)				(2.60)			
Pupil Share Summer		6.80**				7.58**		
		(3.26)				(3.70)		
Girl Share Winter			5.20				6.42	
			(4.08)				(5.02)	
Boy Share Winter				9.50**				9.90**
				(3.90)				(4.77)
Share Arable Land					-0.01	-0.20	0.04	-0.04
					(0.90)	(0.87)	(0.94)	(0.95)
Constant	-1.33	-6.86	-2.97	-3.72	-2.62	-4.49	-3.00	-3.41
	(4.30)	(4.75)	(4.39)	(4.40)	(5.99)	(6.44)	(6.37)	(6.32)
Observations	537	440	501	501	392	354	366	366

Standard errors adjusted for intragroup (parish) correlation in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: DiD Arable Field

	(1)	(2)	(3)	(4)
	Share Arable Land	Share Arable Land	Share Arable Land	Share Arable Land
log Weeks	-0.02	-0.02	-0.04	-0.04*
	(0.03)	(0.03)	(0.03)	(0.02)
Math=1	-0.02	-0.03	-0.02	-0.03*
	(0.02)	(0.02)	(0.01)	(0.02)
Public Classroom=1	0.02	0.01	-0.00	0.01
	(0.02)	(0.01)	(0.02)	(0.02)
Pupil Share Winter	-0.54*			
	(0.29)			
Pupil Share Summer		-0.42		
		(0.28)		
Girl Share Winter			-0.80*	
			(0.45)	
Boy Share Winter				0.34
				(0.56)
Constant	0.70***	0.67***	0.77***	0.71***
	(0.08)	(0.09)	(0.08)	(0.09)
Observations	172	160	158	158

Standard errors adjusted for intragroup (parish) correlation in parentheses.

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$