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Original citation:
Klein, Alexander and Ogilvie, Sheilagh (2013) Occupational structure in the Czech lands under the second serfdom. Working Paper. Coventry, UK: Department of Economics, University of Warwick. (CAGE Online Working Paper Series).
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Occupational Structure in the Czech Lands Under the Second Serfdom

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Occupational Structure in the Czech Lands
Under the Second Serfdom[1]

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Version date: 9 November 2013

Abstract

A shift in occupational structure towards non-agricultural activities is widely viewed as a key component of European economic growth during the early modern 'Little Divergence'. Yet little is known about this process in those parts of eastern-central Europe that experienced the early modern 'second serfdom', the massive increase in the institutional powers of landlords over the rural population. We analyze non-agricultural occupations under the second serfdom using data on 6,983 Bohemian villages in 1654. Bohemia resembled other eastern-central, nordic and southern European economies in having a lower percentage of non-agricultural activities than western Europe. But Bohemian serfs engaged in a wide array of industrial and commercial activities whose intensity varied significantly with village characteristics. Non-agricultural activity showed a significant positive relationship with village size, pastoral agriculture, sub-peasant social strata, Jews, freemen, female household heads, and village mills, and a significant negative relationship with arable agriculture and urban agglomerations. Non-agricultural activity was also positively associated with landlord presence in the village, although the relationship turned negative at higher values and landlord presence reversed the positive effects of female headship and mills. Under the second serfdom, landlords encouraged serf activities from which they could extort rents, while stifling others which threatened their interests.

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1. Introduction

Change in occupational structure – particularly the shift away from agriculture towards industry and services – is increasingly viewed as a key indicator of economic growth. Debates about the early modern 'Little Divergence', during which the economies of the north Atlantic seaboard are thought to have decisively pulled ahead of the rest of Europe, centre partly on rival estimates of the size of the non-agricultural sector in different periods and places.[2] Non-agricultural activity is viewed as indicating that agricultural productivity had risen enough to release labour and that specialization was increasing efficiency, generating gains from trade, widening consumer choice, and creating incentives to reallocate time to market work.[3] Some scholars go so far as to ascribe a positive causal role specifically to the growth of rural non-agricultural activities. Theories of proto-industrialization, which focus exclusively on export-oriented rural manufactures, have been questioned.[4] But studies of modern developing economies find that the rural nonfarm sector, producing mainly for local markets, can significantly benefit economic growth via production and consumption linkages.[5] Occupational structure in general and rural non-agricultural intensification in particular are thus important economic indicators and potential engines of growth.

Despite the theoretical importance ascribed to non-agricultural activity, we still lack evidence of its quantitative importance in different European economies during the 'Little Divergence', or the factors that favoured or hindered it. Economic historians are gradually compiling data for the advanced economies of northwest Europe, particularly England, but have hardly touched upon slower-growing parts of the continent. In particular, little is known of occupational structure in those many parts of central and eastern Europe which, between about 1500 and 1750, were subject to the second serfdom, the enormous growth in the institutional powers of the landlords over rural people's economic options.

This paper addresses that gap by investigating occupational structure in mid-seventeenth-century Bohemia (the modern Czech Republic). From the sixteenth to the late eighteenth century, Bohemia was subject to the second serfdom. In the seventeenth century it also suffered economic and demographic devastation as a result of the Thirty Years War

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[2] See, most recently, Broadberry, Campbell and Van Leeuwen (2013); Clark (2013).
[3] See Crafts (1989); De Vries (2008); Allen (2009).
[4] See the discussion in Ogilvie and Cerman (1996).
[5] Haggblade, Hazell and Reardon (2007).

(1618-1648), followed by forced emigration of non-Catholics in the 1650s. During the two centuries before serf emancipation 1781, Bohemia had little claim to be an economically successful society. Its rural economy in particular suffered from lack of information, sparse transactions in many sectors, high risks, frightening insecurity, grinding poverty, and starvation for some of the poorest. Living standards, at least as far as these can be measured by life expectancies, were low by western European standards. After 1781, Bohemia developed into the economic powerhouse of the Habsburg lands, but in the seventeenth century it lay definitively on the low-performing side of the early modern 'Little Divergence'.[6]

We analyze occupational structure and its socioeconomic correlates in early modern Bohemia using an unusually detailed cross-sectional source, the *Berní Rula*, a national tax register commissioned in 1654. For two reasons, we focus on rural non-agricultural occupations. First, as discussed above, economists and historians hypothesize that rural nonfarm activity was not only a symptom but also a potential engine of economic growth. Second, the rural economy comprised most of the labour force and was much more thoroughly subjected to the second serfdom than urban centres, which enjoyed a number of institutional advantages favouring the practice of crafts, commerce, and other non-agricultural occupations by their burghers. The 1654 tax register records information not only on occupation but also on a wide variety of other characteristics for thousands of Bohemian villages, enabling us both to derive a proxy measure for rural non-agricultural activity and to analyze what local characteristics were associated with variations in its intensity. This makes it possible to quantify rural occupational structure in an entire early modern European economy and to explore what factors favoured or hindered it. The findings shed light both on the shift away from agriculture during the early modern 'Little Divergence' and on the operation of the second serfdom.

2. Berní Rula: Data Description

In 1654, after the Thirty Years War, the Austrian Habsburg rulers of Bohemia commissioned a tax register called the *Berní Rula*. This register listed each landholding in the

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[6] Klíma (1955, 1957, 1959, 1974, 1979); Míka (1960); Petráň (1963, 1964); Maur (1964, 1965, 1976a, 1976b, 1981, 1990); Janoušek (1967); Svoboda (1969); Myška (1979); Ogilvie (2001, 2005a, 2005b); Ogilvie and Edwards (2000); Klein (2013).

country, along with its holder, for the purpose of establishing tax liabilities and reorganizing the tax system. This paper analyzes rural occupational structure using data from the 1654 *Berní Rula* for nearly 7,000 villages, covering approximately 70 per cent of the land area of seventeenth-century Bohemia.

The *Berní Rula* was concerned to record all fiscally relevant information on each holding and everything attached to it, including the characteristics of the householder (if any) currently occupying it. A Bohemian 'holding' was typically either a peasant farm with more than enough arable land to feed an average family, a smallholding with some arable land but not enough for self-sufficiency, or a cottager holding with just a house and garden. The main reason the *Berní Rula* registrars focused on the holding rather than the holder was to control attempts at tax evasion whereby two or more holders would occupy a single holding for the duration of the enumeration process, temporarily vacating normally occupied and taxable holdings. A subsidiary reason the register focused on holdings was to collect information on the damage caused by the Thirty Years War and on the economic situation of newly settled holders who had been granted tax exemptions. For these reasons, the 1654 registrars meticulously recorded *all* holdings, including empty ones, regardless of whether they were suitable for occupation, and subsumed them in the final tax burden.[7]

The *Berní Rula* recorded five general types of information, covering the geographical and institutional characteristics of the settlement, the current state of the holding, the land attached to the holding, the livestock on the holding, and the characteristics of the holder.

The settlement in which the holding was located was described in terms of both geographical location and institutional status. Geographical location was recorded via the specific name of the settlement, the feudal estate to which that settlement was subject, and the administrative region (Czech *kraj*, German *Kreis*) in which that estate was located. The institutional status of the settlement was recorded in multiple ways. There was a fundamental distinction between urban settlements, which enjoyed an array of legal and institutional privileges, and rural settlements, which lacked those entitlements. Urban settlements were further categorized into subject towns (those feudally subject to a noble landlord), royal towns (feudally subject to the crown), and free towns (not tied in feudal subjection). Rural

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[7] The institutional and political aspects of the organization of the *Berní Rula* are discussed in Pekař (1932); Berní Rula 1 (1950); Ogilvie and Cerman (1995); Cerman and Zeitlhofer (2002); and Matušíková and Ogilvie (2006).

settlements – the ones analyzed in this paper – were categorized as being feudally subject to a great noble lord, a minor knight, the crown, a religious institution, or a town.

The current state of the holding was registered primarily in terms of whether it was currently occupied or lying empty at the time of registration in 1654. In the case of an empty holding, the register recorded whether it was currently being *used* by a non-resident individual or family, by the village community, by the feudal landlord, or by no user at all. The register also commented fairly systematically on whether a holding was in good condition, in poor condition, burnt down, partly collapsed, or completely collapsed; whether it had been newly settled between 1651 and 1654 and in which year; and whether the construction of new buildings was in progress.

The land appertaining to each holding was precisely quantified. A first measure was the total area of arable land on the holding, measured in *strych* (approximately 0.29 hectares). A second was the area of arable devoted to winter crops: these were the cereals sown in the autumn which germinated before winter arrived, and either persevered or grew under snow cover before continuing their life cycle in springtime, maturing in late spring or early summer; they generally had a much higher yield than spring cereals because they could use snow as moisture for growth. A third measure was the area of arable on the holding devoted to spring crops: these were the cereals planted in early springtime which matured later in the summer; they generally required more irrigation and had a lower yield than winter cereals. The register also frequently recorded the presence of a mill, brewery, inn, sawmill, or smithy on the holding. For some parts of Bohemia, but unfortunately not all, the registers recorded forest, gardens, vineyards, hop-fields, and unused land (fallow or waste) attached to each holding, and some even recorded the quality of the soil.

The livestock attached to the holding were carefully recorded, partly because enserfed peasants were obliged to deliver to their landlords forced labour services with draft animals. For each holding, the register listed the number of working animals (sometimes broken down into oxen and horses), the number of cattle (sometimes divided into mature and immature animals), and the number of pigs. Some regions also recorded the number of sheep and goats.

The current human occupant of the holding, if any, was described in some detail. The register recorded the name of the holder, from which his or her gender can be derived. The register also recorded the holder's social stratum which, as discussed in Section 7 below, was legally defined and had far-reaching implications for the person's entitlements to engage in

particular economic activities and his or her obligations to render particular services and payments, both to the overlord and to the crown. Finally, the 1654 register recorded what occupation, apart from farming that holding, was pursued by the holding's occupant – the focus of the present paper.

3. Characteristics of Early Modern Bohemian Occupational Structure

But is there any point in analyzing non-agricultural activity in a serf economy? Under the second serfdom, which gathered force in Bohemia from the second half of the sixteenth century onwards, the economic options of serfs were subjected to increasingly severe constraints by the institutional powers of their landlords. Were serfs able to move into non-agricultural activities or, indeed, to choose their occupations at all? Much historiography portrays eastern European serfs as having been actuated by Chayanovian peasant mentalities that caused them to prefer subsistence farming and avoid markets and money, precluding a shift towards rural industry or commerce.[8] Other strands of the historiography argue that even if serfs had wished to shift out of agriculture to specialize in industrial or commercial activities, landlords prevented them because it diverted serfs' efforts from the agricultural production from which lords could extort rents and labour dues; if serfs participated in non-agricultural activity at all, it was merely when they had to render forced labour services in centralized manorial manufactories.[9] If such assumptions were true, the rural economy under the second serfdom should have been exclusively agricultural. Do quantitative data for seventeenth-century Bohemia bear out these assumptions?

We have compiled a data set from the 1654 *Berní Rula* which encompasses more than 70 per cent of the total land area of Bohemia in 1654, and covers 7,257 villages on 893 feudal estates.[10] Of these villages, 274 were completely empty in 1654, yielding a data set of 6,983 occupied villages whose structure we analyze. For each village, we calculated the percentage of holders recorded as practising an occupation outside agriculture. These occupations did not include labour by serfs in centralized manorial factories, to the extent that it was taking place. Rather, the occupations recorded in the *Berní Rula* were ones undertaken by individual serf

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[8] For a critical survey of this literature, see Ogilvie (2001), 430-5; Ogilvie (2013).
[9] For a detailed exposition of this view in the context of proto-industrialization in Europe between c. 1500 and c. 1850, see Kriedte, Medick and Schlumbohm (German orig. 1977, English transl. 1981).
[10] Červený et al. (2003), xxii.

households on their own initiative, ranging from primary non-agricultural occupations such as miner and charcoal burner, through craft occupations such as smith, tinker, tanner, miller, tailor, weaver, and cooper, to commercial and administrative occupations such as merchant, petty trader, tavern-keeper, parish clerk, and schoolmaster.

The occupations recorded in the *Berní Rula* should probably be regarded as a minimum measure of non-agricultural activity since, like most pre-modern registers, this one was drawn up with a primary focus on real estate. However, the *Berní Rula* had no reason to under-record non-agricultural activity to a greater extent than other pre-modern documentary sources. On the contrary, several characteristics of the *Berní Rula* justify regarding the information it contains on rural nonfarm activity as a reliable proxy measure of underlying occupational structure.

First, the *Berní Rula* neither rewarded nor penalized the state tax commissioners, the manorial authorities, or the serfs themselves for reporting non-agricultural activity. Tax liability was determined via a standardized tax unit (the *osedly*) calculated on the basis of the number of serfs of each legal stratum, with one *osedly* defined as equal to one 'peasant', four 'smallholders', or eight 'cottagers'. The earning capacities of the taxpayer, whether from agriculture or other activities, did not influence the data collected; insofar as the tax burden was subsequently adjusted (e.g. to take account of variations in soil quality or farm size) this was a response appeals by landlords which were not foreseen at the time the data were collected.[11] Since the rules concerning how tax information would be collected and how the tax burden would be calculated were announced before the *Berní Rula* commissioners collected their information, and did not refer to agricultural occupations, there were no incentives for misreporting the latter.

Second, although the *Berní Rula* commissioners were not instructed to do so, they did record non-agricultural occupations copiously for inhabitants of towns.[12] This demonstrates the detail with which, when they visited a settlement, the commissioners inquired into the economic circumstances of each taxpayer, and provides reassurance on the question of under-reporting.

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[11] Pekař (1932), 4-5, 9; Berní Rula I (1950), 38-40.
[12] Pekař (1932), 9.

Table 1: Summary Statistics of Villages in Bohemia, Berní Rula 1654

Variable	Obs	Mean	Std. Dev.	Min	Max
percentage of non-agricultural occupations	6983	0.06	0.15	0.00	1.00
number of holdings	6983	11.44	10.79	1	133
percentage of empty holdings	6983	0.14	0.20	0.00	0.99
total arable land of occupied holdings per holder	6983	26.31	23.32	0.00	390
number of working animals per holder	6983	1.80	1.16	0.00	11
number of cattle per holder	6983	2.47	1.35	0.00	34
percentage of 'cottagers'	6983	0.24	0.29	0.00	1.00
percentage of smallholders'	6983	0.13	0.22	0.00	1.00
percentage of 'freemen'	6983	0.02	0.13	0.00	1.00
percentage of Jews	6983	0.001	0.03	0.00	1.00
percentage of female household heads	6983	0.032	0.10	0.00	1.00
presence of a town on an estate	6983	0.55	0.50	0	1
presence of a mill	6983	0.06	0.23	0	1
percentage of holders with less than 15 strych	6983	0.36	0.34	0.00	1.00
presence of landlord in at least 1 holding	6983	0.07	0.25	0	1
number of holdings held/used by landlord	6983	0.15	0.80	0.00	19
percentage of arable land held/used by landlord	6910	0.02	0.09	0.00	1.00

Sources: see text

Third, different state commissions do not appear to have adopted different practices relating to the recording of non-agricultural occupations. We carried out statistical tests which established that the percentage of non-agricultural occupations recorded was not significantly related to any measurable characteristic of recording conventions, including the identity or composition of the state commission assigned to draw up the *Berní Rula* in particular regions and estates.

Fourth, as we shall see, the rural non-agricultural occupations recorded in the *Berní Rula* yield estimates of the overall size of the non-agricultural sector in mid-seventeenth-century Bohemia which are consistent with the few available data for comparable early modern economies in eastern-central, nordic and southern Europe.

Finally, as the econometric analyses in later sections show, the percentage of rural non-agricultural occupations recorded in the *Berní Rula* varied substantially across Bohemian localities, in ways that were significantly related to other socioeconomic characteristics of rural settlements.

What emerges, then, when we investigate rural occupational structure in mid-seventeenth-century Bohemia? Table 1 presents descriptive statistics for the 6,983 villages in our data set. The proportion of householders in Bohemian villages engaging in non-agricultural activities in 1654 varied between zero and 100 per cent of all household heads in a village, with an average of 6.7 per cent. These findings decisively refute the traditional assumptions discussed above, according to which serfdom precluded rural non-agricultural activity except in the framework of serf labour in centralized demesne manufactories. Rather, 1 in 15 Bohemian serf households was engaged in a non-agricultural activity sufficiently prominent to be recorded in a tax register primarily focussed on landholding and agriculture.

Table 2 places these findings in the context of other parts of early modern Europe, while recognizing that compiling occupational data for the period before 1800 is still a work in progress.[13] The first step was to use the findings on *rural* occupational structure in our sample to calculate estimates of *overall* occupational structure in the Bohemian economy as a whole. Our data set of 6,983 occupied villages and 274 unoccupied ones covers c. 70 per cent of the area of Bohemia but excludes the capital city Prague and a number of other urban centres. Combining our findings on rural occupational structure with plausible assumptions

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[13] On the paucity of data on European occupational structure before the nineteenth century, see De Vries and Van der Woude (1997), 527.

Table 2: Percentage of Non-Agricultural Activity in Rural Areas and Whole Economy, Various European Societies, 1381-1800

Society	Date	Rural non-agricultural (%)	Total non-agricultural (%)	Source
England: 892 settlements	1381		33.0	Broadberry, Campbell & Van Leeuwen (2013), 17 (Table 1).
England: Rutland (Cornwall)	1522	22.8		Broadberry, Campbell & Van Leeuwen (2013), 18 (Table 2).
England: Coventry + Babergh + Rutland	1522		31.8	Broadberry, Campbell & Van Leeuwen (2013), 18 (Table 2).
Poland: Greater Poland	1580	10.4		Gieysztor (1997), 567 (Table 96).
Poland: Lesser Poland	1580	12.3		Gieysztor (1997), 567 (Table 96).
Poland: Mazowsze	1580	6.9		Gieysztor (1997), 567 (Table 96).
Poland: total	1580	10.2		Gieysztor (1997), 567 (Table 96).
Bohemia: 6,983 villages	1654	6.7	18.2-31.3	Berní Rula data set.
Netherlands: total	1675		60.0	De Vries & Van der Woude (1997), 527.
England: total	1700		54.0	Broadberry, Campbell & Van Leeuwen (2013), 19 (Table 3).
Netherlands: Friesland	1749	38.0	56.0	De Vries & Van der Woude (1997), 525 (Table 11.3).
Netherlands: Veluwe	1749	34.0	53.0	De Vries & Van der Woude (1997), 525 (Table 11.3).
Netherlands: Overijssel	1795	40.0	54.0	De Vries & Van der Woude (1997), 525 (Table 11.3).
Italy: Santo Marco dei Cavoti	c. 1750	< 10.0	10.0	Curtis (2013), 26 with n. 150
Italy:Locorotondo	c. 1750	< 14.0	14.0	Curtis (2013), 26 with n. 150
Netherlands: total	c. 1750		59.0	De Vries & Van der Woude (1997), 528 (Table 11.5).
Finland: total	1754		21.3	Mitchell (1981), 163.
England: total	1755		56.0	Shaw-Taylor (2009); Shaw-Taylor et al. (2010).
Finland: total	1769		19.8	Mitchell (1981), 163.
Netherlands: total	c. 1800		59.0	De Vries & Van der Woude (1997), 528 (Table 11.5).

about the size and occupational structure of the missing regions and urban centres yields an estimated overall percentage of non-agricultural occupations which lies in the range between 18.2 per cent (excluding Prague and assuming towns were 55 per cent non-agricultural) and 31.3 per cent (including Prague and assuming towns were 100 per cent non-agricultural). Table 2 shows that the percentage of non-agricultural activity in Bohemia in 1654 was very similar to that for Poland in 1580, southern Italy around 1750, and Finland in the 1750s and 1760s. These eastern-central, southern, and nordic European regions were, as late as the eighteenth century, characterized by a percentage of non-agricultural activity of 6-14 per cent in rural areas and 10-30 per cent overall. This contrasts starkly with England and the Netherlands, which from a very early date were characterized by a percentage of non-agricultural activity of 20-40 per cent in rural areas and 30-60 per cent overall. The non-agricultural sector in seventeenth-century Bohemia was thus noticeably smaller than in the precociously advanced north Atlantic economies, but comparable in size to what is known of other economies in eastern-central, southern, and nordic Europe.

As Table 1 reveals, moreover, there was very substantial variation across Bohemian rural settlements, with some villages in which all householders undertook non-agricultural activities and others in which no-one did so. This raises the puzzle of what gave rise to such wide variation in the same rural economy at the same period. Exploring this question may help shed light on the wider issue of why occupational structure varied so greatly across different parts of Europe in the era of the 'Little Divergence'.

A first step is to delve more deeply into the differences between the Bohemian villages with and without non-agricultural activities. As Table 3 illustrates, the Bohemian villages in which at least some householders engaged in non-agricultural activities had more households on average than purely agricultural villages, and contained more 'sub-peasants' (smallholders and cottagers), freemen, Jews, female household heads, and mills. They also had fewer empty holdings, a smaller average holding size, and fewer working animals and cattle per holding.

Interestingly, the number of holdings held or used by the landlord was higher in those villages, though the percentage of village land held or used by the landlord was lower. The precise implications for serfs of having some holdings in the village currently used by the landlord are complex, as we shall see during the econometric analysis. It is possible that the presence of the landlord or his agent on a holding in the village might have offered greater

Table 3: Summary Statistics of Villages in Bohemia by Percentage of Non-Agricultural Occupations, Berní Rula 1654

Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
	Percentage non-agricultural occupations > 0					Percentage non-agricultural occupations = 0				
percentage of non-agricultural occupations	1822	0.22	0.22	0.01	1.00	5161	0.00	0.00	0.00	0.00
number of holdings	1822	17.57	14.81	1	133	5161	9.28	7.90	1	99
percentage of empty holdings	1822	0.12	0.17	0.00	0.88	5161	0.14	0.21	0.00	0.99
total arable land of occupied holdings per holder	1822	21.91	18.41	0	240	5161	27.86	24.64	0	390
number of working animals per holder	1822	1.48	1.00	0	8	5161	1.92	1.19	0	11
number of cattle per holder	1822	2.38	1.12	0	14	5161	2.51	1.43	0	34
percentage of 'cottagers'	1822	0.29	0.28	0.00	1.00	5161	0.22	0.29	0.00	1.00
percentage of smallholders'	1822	0.17	0.23	0.00	1.00	5161	0.11	0.22	0.00	1.00
percentage of 'freemen'	1822	0.02	0.15	0.00	1.00	5161	0.01	0.12	0.00	1.00
percentage of Jews	1822	0.004	0.05	0.00	1.00	5161	0.0002	0.01	0.00	1.00
percentage of female household heads	1822	0.034	0.06	0.00	0.50	5161	0.032	0.11	0.00	1.00
presence of a town on an estate	1822	0.57	0.49	0	1	5161	0.54	0.50	0	1
presence of a mill	1822	0.02	0.40	0	1	5161	0.01	0.08	0	1
percentage of holders with less than 15 strych	1822	0.48	0.32	0.00	1.00	5161	0.32	0.34	0.00	1.00
presence of landlord in at least 1 holding	1822	0.08	0.27	0	1	5161	0.06	0.25	0	1
number of holdings held/used by landlord	1822	0.165	0.82	0	16	5161	0.146	0.79	0	19
percentage of arable land held/used by landlord	1804	0.016	0.08	0.00	1.00	5106	0.018	0.09	0.00	1.00

Sources: see text

possibilities of manorial information, monitoring and control over villagers' activities. In that case, this variable might be interpreted as a proxy measure of the local strength of the second serfdom, although only at its 'intensive margin' (stronger versus weaker enforcement of an existing institutional system), not at the 'extensive margin' (presence or absence of the institutional system altogether). These interpretive issues are explored in greater depth in Section 10 below.

Table 4 shows that the 6.8 per cent of villages with at least one holding currently being used by the landlord differed from those without in many ways. They had more households, a higher percentage of empty holdings, smaller plots of arable land, slightly fewer working animals, many fewer cattle, and a lower percentage of cottagers, freemen, and female household heads. Slightly higher non-agricultural activity was thus only one of many distinctive characteristics of villages in which at least one holding was being used by the landlord.

The figures on early modern Bohemian rural occupational structure and its socioeconomic correlates presented in Tables 1-4 are unconditional averages, of course, and we must be careful in interpreting such simple correlations. For one thing, they do not control for other village characteristics; for another, they do not say anything about causality. It could be that the characteristics we observe in the villages with non-agricultural occupations in fact encouraged those activities, but it also could be that non-agricultural activity in a village caused the village to develop specific characteristics. Moreover, villages with certain underlying characteristics might attract both non-agricultural activities and other phenomena such as female headship, cattle-raising, or the desire of the landlord to occupy holdings there.

The findings from Tables 1-4 thus call for a multivariate analysis of the relationship between rural non-agricultural activities and village characteristics under the second serfdom, to which we now turn.

Table 4: Summary Statistics of Villages in Bohemia by Presence of Landlord, Berní Rula 1654.

Variable	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
		Landlord Present in Village					Landlord Not Present in Village			
percentage of non-agricultural occupations	472	0.063	0.14	0.00	1.00	6511	0.057	0.15	0.00	1.00
number of holdings	472	13.62	10.47	1	118	6511	11.28	10.80	1	133
percentage of empty holdings	472	0.29	0.20	0.00	0.86	6511	0.13	0.19	0.00	0.99
total arable land of occupied holdings per holder	472	25.05	16.39	0	121	6511	26.40	23.75	0	390
number of working animals per holder	472	1.78	1.05	0	6.5	6511	1.81	1.17	0	11
number of cattle per holder	472	2.20	1.14	0	11.5	6511	2.49	1.37	0	34
percentage of 'cottagers'	472	0.21	0.26	0.00	1.00	6511	0.24	0.29	0.00	1.00
percentage of 'smallholders'	472	0.13	0.23	0.00	1.00	6511	0.13	0.22	0.00	1.00
percentage of 'freemen'	472	0.002	0.02	0.00	0.50	6511	0.02	0.13	0.00	1.00
percentage of Jews	472	0.003	0.05	0.00	1.00	6511	0.001	0.03	0.00	1.00
percentage of female household heads	472	0.029	0.08	0	1	6511	0.033	0.10	0	1
presence of a town on an estate	472	0.38	0.49	0	1	6511	0.56	0.50	0	1
presence of a mill	472	0.06	0.24	0	1	6511	0.06	0.23	0	1
percentage of holders with less than 15 strych	472	0.34	0.31	0.00	1.00	6511	0.36	0.35	0.00	1.00
presence of landlord in at least 1 holding	472	1	0	1	1	6511	0	0	0	0
number of holdings held/used by landlord	472	2.23	2.21	1	19	6511	0	0	0	0
percentage of arable land held/used by landlord	470	0.26	0.22	0.00	1.00	6440	0.00	0.00	0.00	0.00

Sources: see text

4. The Multivariate Analysis of Early Modern Bohemian Occupational Structure

We undertook a multivariate regression analysis to investigate the relationship between the percentage of holders employed in non-agricultural occupations in a Bohemian village in 1654 and the characteristics of that village. The explanatory variables included measures of the village's size, its arable sector, its pastoral sector, its social composition, its female headship, the presence of mills, the proximity of towns, and landlord presence in the village. The general regression equation we estimated can be written as follows:

$NonagricEmpl_{ij} = \alpha + \beta_1(Village\ Size)_{ij} + \beta_2(Arable\ Sector)_{ij} + \beta_3(Pastoral\ Sector)_{ij} + \beta_4(Social\ Composition)_{ij} + \beta_5(Other\ Characteristics)_{ij} + \beta_6(Landlord\ Presence)_{ij} + \delta_j + \varepsilon_{ij}$ (1)

$NonagricEmpl_{ij}$ is the percentage of non-agricultural activity in village i located on an estate j, α is a constant term, δ_j is an estate j fixed effect, and ε_{ij} is an error term. The β-coefficients represent the vectors of estimated coefficients, since each set of explanatory variables contains several regressors.

Village Size is captured by two variables: the number of occupied holdings in the village (largely exogenous); and the percentage of empty holdings in the village (to control for the effects of the Thirty Years War and post-war emigration). For all practical purposes, the number of holdings in a Bohemian village in 1654 can be regarded as exogenous to the current occupational structure of that village. It was not possible to migrate freely into a Bohemian village and set up a new household there: an in-migrant had to take on an existing holding or live as a lodger with an existing householder. The number of holdings in a village, therefore, was the outcome not of short-term, individual choices, but rather of a long-term process of development. Initially, it was determined by the original village settlement charter, typically dating from the medieval period, which legally fixed the number, size, and legal stratum of all holdings in the village. This number could be modified gradually over ensuing centuries via manorial and communal pressure and negotiation: typically, the number of holdings of the 'peasant' stratum remained almost static, while the number of 'sub-peasant' (smallholder and cottager) holdings gradually increased.[14] In principle, therefore, the number of holdings in a village could be influenced over very long periods by economic opportunities (including non-agricultural ones) which exerted pressure on the manorial and

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[14] For a discussion of this process, see Cerman (1995); Ogilvie and Cerman (1995).

communal institutions that decided on whether new holdings could be established. In the short to medium term, however, it could not be changed. For all practical purposes, the number of holdings in a Bohemian village at any given date during the second serfdom was determined institutionally and historically, and was thus exogenous to the current occupational structure of that village.

Arable Sector is captured in our regressions by the number of *strych* of arable land per holder in the village.[15] The size of arable land attached to each holding resembles the number of holdings in the village in being fixed legally and institutionally via the original village charter. In Bohemia until 1869, each landholding was legally impartible: its owner was not allowed to sell or bequeath any land separately from the rest of the farm.[16] The average amount of arable land per village holding could change through the formation of new 'sub-peasant' holdings with smaller amounts of arable land but, as discussed above, this was a gradual process which took place over a period of generations or centuries, via institutional and social negotiation. For all practical purposes, the average area of arable land per holding in a village at any given date during the second serfdom was exogenous to the current occupational structure of that village.

Pastoral Sector is measured by two variables: the number of working animals per holder and the number of cattle per holder. In actuality, there is a case for regarding working animals as part of the arable sector, since they were mainly used to draw ploughs and other equipment used in arable cultivation. The number of working animals was to some extent institutionally fixed via the manorial rental charter (*Urbar*) which legally obliged each holder of a particular status of holding to keep a enough draft animals to supply a specified quantity of draft services to the landlord's demesne, although they were also used in serfs' own arable cultivation. The number of cattle (non-working animals) was also to some extent institutionally determined, since it reflected the holder's ownership of private pasture or access to communal grazing. But the number of cattle on a holding was also partly a choice variable, reflecting the availability of household labour and the opportunity costs of allocating it to tend animals. To some extent, thefore, a household was likely to have chosen the number of cattle it owned simultaneously with its decision about engaging in non-agricultural activity, as we discuss below in Section 6.

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[15] As mentioned above, 1 *strych* = c. 0.29 hectares.
[16] Zeitlhofer (2011), 133; Velková (2012), 510.

Social Composition is captured in our regression model by the percentage of holders in the village identified as belonging to each legally defined social stratum. The *Berní Rula* identified each taxpayer according to his or her institutionally defined social category: town burgher (*měšťan, Bürger*); peasant (*sedlák, rolník, Bauer*); smallholder (*zahradník, Gärtner*), cottager (*chalupník, Häusler*), inmate-lodger (*podruh, Hausgenosse*), freeman (*svobodník, Freibauer*), and Jew (*žid, Jude*). As mentioned above, it was not possible for a new holder to migrate freely into any Bohemian village and settle there: he or she had to live on an existing holding of defined social stratum. The relative size of each stratum in the village was laid down in the original village settlement charter and modified, if at all, very gradually by pressure on manorial and communal institrutions over a period of centuries. For all practical purposes, the size of the various legal strata in a Bohemian village at any given point during the second serfdom was exogenous to the current occupational structure of the village.

The *Other Characteristics* in our regression model include four further variables with the potential to affect occupational structure. The first is the percentage of holders in the village with less than 15 *strych* (c. 4.3 hectares) of arable land, since this was the amount required for an average early modern central European family to live completely from farming.[17] The legal impartibility of Bohemian holdings, together with the slow historical process by which new and smaller holdings were permitted to form in Bohemian villages, meant that this variable was exogenous to the current occupational structure of the village.

A second 'other' characteristic was the presence of a mill in the village. The location of mills in pre-modern economies depended primarily upon natural endowments, specifically the existence and hydrological characteristics (water volume, depth, flow gradient) of the watercourse providing the energy to drive the mill. Building a mill was a non-trivial undertaking, moreover, which was unlikely to be initiated in response to short-term fluctuations in local demand for milling power. The presence of a village mill was therefore exogenous to the current occupational structure of the village.

A third 'other' characteristic was the presence of a town on the estate in which the village was located. In early modern Bohemia, a town was not simply a settlement that was larger in size than a village; rather, it was an institutional entity with a distinctive legal status. A Bohemian town was a settlement that had been granted privileges by the landlord, the crown, or another authority which endowed its inhabitants with specific social and economic

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[17] Mattmüller (1983), 42; Cerman (1996), 190.

entitlements. Town presence was thus exogenous to the current occupational structure of any village on the estate.

A final 'other' characteristic was the percentage of female household heads in the village. This was a choice variable with potential two-way causal links with occupational structure, raising issues of endogeneity which are discussed below in Section 9.

A final set of variables in our regression model consists of three alternative measures of *Landlord Presence*. First, we use a dummy variable indicating the presence in that village of a holding described as being held or used by the landlord. Second, we use the number of holdings in the village which are described as being held or used by the landlord. Finally, we use the percentage of arable land in the village which is described as being held or used by the landlord. The presence of the landlord on village holdings was not a permanent characteristic of the village in question, but rather a relatively short-term phenomenon. Manorial court records in mid-seventeenth-century Bohemia show clearly that landlords regarded empty holdings as an undesirable and, they hoped, temporary result of mortality or emigration, which should either be filled as soon as possible with new serfs or be dissolved and engrossed into the manorial demesne.[18] As discussed below, because the presence of the landlord occupying or using a temporarily empty serf holding was a choice variable on the part of the landlord, it had potential two-way causal links to the current occupational structure of the village. The presence of the landlord on village holdings could affect local occupational choices; but local occupational structure could also attract the landlord to move into village holdings. The resulting endogeneity of landlord presence and occupational structure are discussed in detail in Section 10.

Four major econometric issues arose in our analysis. The first was potential multicollinearity among the explanatory variables. One notable advantage of our data set is the availability of information on an unusually large number of village characteristics. But this raised the problem that some of these characteristics may be highly correlated with one another. To establish the extent of the problem, we calculated correlations among the explanatory variables and variation inflation factors for each of the explanatory variables.

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[18] Cerman (1996); Ogilvie (2001); Cerman and Zeitlhofer (2002).

The correlations were small and the variation inflation factors less than 2, indicating that multicollinearity was not an issue.[19]

Second, our dependent variable is censored at zero, so we use a Tobit estimator. The Tobit estimator, however, makes a parametric assumption about the distribution of the error term ε_{ij}. To check the sensitivity of our results to that assumption, we used estimators which relax the assumption: ordinary least squares (OLS) and the pseudo-Poisson maximum likelihood estimator (PPML). OLS is a widely used estimator which belongs to a class of semiparametric estimators relaxing parametric assumptions concerning the error term.[20] Even though the OLS estimator does not deal with the problem of censoring, we used it as an initial robustness check. The PPML estimator also relaxes parametric assumptions concerning the error term and provides consistent estimates, even if the error term is misspecified.[21] Recent research also shows that the PPML estimator is robust to the presence of a very large percentage of zero values in a data set. We took advantage of that feature, and re-estimated regression equation (1) using this estimator.[22]

Third, the literature on Bohemia, as well as on many other early modern European economies under serfdom, emphasizes that landlords differed greatly in how they administered their estates and hence in the economic constraints they imposed on the rural population.[23] As a consequence, each village might be influenced by an unobserved effect of the particular estate to which it was subject.[24] We controlled for such unobservable estate-effects using estate-specific dummies δ_j. In addition, however, we regarded it as prudent to allow for arbitrary correlation and heteroskedasticity of errors within estates.[25] This is because in the case of correlation or heteroskedasticity within clusters – in our case among the villages subject to a particular estate – the usual standard errors will be biased downwards, prompting us to identify estimated coefficients as statistically significant even

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[19] The only exception is the 'percentage of peasants' which is correlated with the 'percentage of cottagers' and the 'percentage of smallholders' respectively. This is not surprising, given that these were the three largest rural social strata. We discuss this issue in later sections of the paper.

[20] E.g. Ichimura (1993).

[21] Gouriéroux et al. (1984a, 1984b).

[22] Santos Silva and Tenreyro (2006), (2011). One of the properties of PPML is that the dependent variable does not have to be an integer: see Gouriéroux et al (1984a, 1984b) and Cameron and Trivedi (1998). We therefore estimated PPML with the dependent variable being the number of non-agricultural occupations in a village as well as their percentage. The estimation used a Stata user-written command ppml.

[23] Ogilvie and Edwards (2000); Dennison and Ogilvie (2007); Dennison (2011); Ogilvie (2013).

[24] Concrete evidence of this phenomenon on two Bohemian estates is discussed in Ogilvie and Edwards (2000).

[25] Wooldridge (2010), 867.

though they might not actually be so. To remedy this, we used cluster-robust standard errors at the estate level.

A final econometric issue was the presence of outliers. Our data set contained observations with extreme values for four variables: village size, female headship, farm size, and animal numbers. First, there were 490 villages with fewer than 2 occupied holdings and 5 villages with over 100. By the standards of Bohemia in 1654, where the mean village had 11 occupied holdings, these villages were outliers. Second, the dataset contained 147 villages with over 30 per cent female household heads, which was nearly ten times the mean female headship rate for Bohemian villages in the early modern period.[26] Third, the data set contained 100 villages with over 100 *strych* arable land per holding, which was nearly four times the average for Bohemia in 1654. Finally, there were 55 villages with more than 5 working animals per holding, which was extremely high given that the mean was less than 2 animals per holding. Because these observations fell so far outside the norm for early modern Bohemia, it is possible that they reflect inaccuracies in the data sources or peculiar local circumstances.[27] This possibility is a matter of particular concern given that the Tobit estimator is highly sensitive to extreme values of variables.

We therefore estimated our models both with and without the observations affected by these extreme values. Although the models were not affected by the inclusion or exclusion of observations with extreme village size, farm size, or animal numbers, they were strongly affected by the 147 observations with extremely high percentages (over 30 per cent) of female household heads. These villages were outliers in two respects, since they were also extremely small: 77 per cent of them had only 1, 2 or 3 occupied holdings, a fact that contributed to generating extreme values of female headship for purely arithmetical reasons.[28] Since these 147 villages had 10 times the average female headship rate, predominantly consisted of settlements with 3 holders or fewer, and accounted for only 2.1 per cent of all

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[26] On female headship in Bohemia in 1654, see Table 1 below; on female headship in Bohemia at various dates between 1591 and 1722, see Ogilvie and Edwards (2000), esp. 969 (Table 1).

[27] An example of unusual local circumstances is a situation in which a village had an extremely small number of occupied holdings; such a village was not only an outlier in itself, but its very small number of holdings would in turn tend, for purely arithmetical reasons, to generate extreme values of variables (such as female headship) calculated as a percentage of occupied holdings or those (such as mean size of arable or mean number of working animals) calculated as an average across occupied holdings.

[28] The unusually small size of the 147 villages with over 30% female headship can be seen from the following frequency distribution: 22% had only 1 occupied holding, 42% had 1-2 holdings, 77% had 1-3 holdings, 93% had 1-6 holdings, and 98% had 1-10 holdings (and were thus below the mean village size in 1654). For comparison, of the 6,386 villages with 30% or lower female headship, 9% had only 1 occupied holding, 16% had 1-2 holdings, 23% had 1-3 holdings, 44% had 1-6 holdings, and 67% had 1-10 holdings.

observations, we regarded the models estimated excluding these extreme observations as more reliable. The models reported in Tables 5-7 are therefore those estimated excluding these outlier values for female headship. A more radical treatment of the outlier issue, which additionally excludes observations with fewer than 2 or more than 100 holders, with more than 100 *strych* average holding size, and with more than 5 working animals per holding, is reported in Appendix B.

The regression result for the basic specification is presented in Table 5, column 1. Holding constant all variables included in the regression, the percentage of non-agricultural activity is positively related to the size of the village, the percentage of smallholders and cottagers, the presence of a mill, female household headship, the number of (non-working) cattle per holder, and the presence of holdings used by the landlord. It is negatively related to the area of arable land per holder, the number of working animals per holder, and the presence of a town on the estate.

Before discussing the economic implications of these findings, we must take account of the fact that parts of Bohemia had been a battleground at one or more points during the Thirty Years War. As mentioned earlier, the *Berní Rula* carefully recorded the presence of empty and ruined holdings, and this enables us to calculate a measure of war destruction: the percentage of empty holdings in a village. Controlling for empty holdings is important not only because it holds constant the effects of the Thirty Years War, but also because it accounts for a potential bias in our landlord presence variable, since the use of an empty holding by a landlord might also be picking up the effect of the war. The specification in Table 5 column 2 takes these factors into account, and finds that the percentage of empty holdings is negatively associated with the percentage of non-agricultural activity in a village. Its presence in the equation does not change the statistical significance of the original variables, but it does non-trivially increase the magnitude of the coefficient on the variable measuring landlord presence. This indicates that our suspicions were right: the landlord presence variable was indeed picking up the negative effect of empty holdings on non-agricultural activity, which must therefore be controlled for.[29]

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[29] We see that the estimated coefficients of the variables in the category 'other village characteristics' also changed their magnitudes, which indicates that they were also picking up the effect of empty holdings in the village, further corroborating the importance of controlling for it.

Table 5: Regression Analysis of the Determinants of Non-Agricultural Activity in Rural Bohemia in 1654 (Tobit Model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Size of Village							
number of holdings	0.0051***	0.0053***	0.0052***	0.00532***	0.00528***	0.00528***	0.0054***
	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]
percentage of empty holdings		-0.179***	-0.185***	-0.179***	-0.1791***	-0.172***	-0.159***
		[0.0019]	[0.002]	[0.0019]	[0.0018]	[0.0021]	[0.00183]
Arable Sector							
total arable land on occupied holdings per holder	-0.0013***	-0.0012***	-0.0011***	-0.001***	-0.00065***	-0.00066***	-0.00066***
	[0.00003]	[0.00003]	[0.00003]	[0.00003]	[0.00003]	[0.00003]	[0.00003]
Pastoral Sector							
number of working animals per holder	-0.01565***	-0.0189***	-0.0184***	-0.01563***	-0.0121***	-0.011***	-0.0126***
	[0.00046]	[0.00045]	[0.00048]	[0.00046]	[0.00046]	[0.00045]	[0.00046]
number of cattle per holder	0.0113***	0.0127***	0.0124***	0.0117***	0.0114***	0.0097***	0.0111***
	[0.00025]	[0.00025]	[0.0003]	[0.00025]	[0.00024]	[0.00024]	[0.00024]
Social Strata							
percentage of 'cottagers'	0.169***	0.17***		0.182***	0.11***	0.097***	0.108***
	[0.0008]	[0.0009]		[0.0009]	[0.00121]	[0.00123]	[0.00121]
percentage of 'smallholders'	0.302***	0.296***		0.308***	0.219***	0.208***	0.22***
	[0.001]	[0.00101]		[0.00101]	[0.00142]	[0.00151]	[0.00142]
percentage of 'freemen'				0.199***	0.1949***	0.19991***	0.195***
				[0.0014]	[0.00139]	[0.00138]	[0.00139]
percentage of Jews				0.93***	0.82***	2.89***	0.82***
				[0.0009]	[0.00145]	[0.0086]	[0.0014]
percentage of 'peasants'			-0.22***				
			[0.001]				
Other Village Characteristics							
presence of mill	0.3704***	0.3703***	0.368***	0.371***	0.368***	0.363***	0.367***
	[0.00134]	[0.00133]	[0.0014]	[0.00131]	[0.00131]	[0.00129]	[0.00131]

percentage of female household heads	0.0742***	0.0635***	0.0629***	0.0629***	0.0605***	0.0448***	0.057***
	[0.0033]	[0.0034]	[0.0039]	[0.0035]	[0.00354]	[0.0036]	[0.00357]
presence of a town on estate	-2.339***	-2.338***	-2.329***	-2.569***	-2.5439***	-2.5259***	-2.544***
	[0.00073]	[0.00073]	[0.00086]	[0.00075]	[0.00073]	[0.00075]	[0.00074]
percentage of holders with less than 15 str of arable land					0.12***	0.13***	0.119***
					[0.00138]	[0.00139]	[0.00139]
Second-Serfdom Proxies							
presence of a holding held/used by landlord	0.067***	0.091***	0.0915***	0.0912***	0.0925***		
	[0.00045]	[0.00087]	[0.00088]	[0.00087]	[0.00087]		
percentage of arable land held/used by landlord						0.224***	
						[0.003]	
number of holdings held/used by landlord							0.009***
							[0.00029]
Constant	0.333***	0.331***	0.322***	0.311***	0.265***	0.276***	0.269***
	[0.00081]	[0.00081]	[0.00098]	[0.00084]	[0.00081]	[0.00082]	[0.00082]
Estate Dummies	YES	YES	YES	YES	YES	YES	YES
N	6836	6836	6836	6836	6836	6768	6836
Log-likelihood value	-1641.4	-1628.4	-1629.9	-1620.5	-1614.04	-1569.01	-1621.2
Sigma	0.2816	0.28143	0.2809	0.2808	0.28005	0.2759	0.2804
Pseudo-R^2	0.463	0.467	0.4668	0.4699	0.472	0.475	0.4697

Sources: see text

A second factor that had to be more deeply explored was the social composition of a village. The relative size of the three main social strata of peasants, smallholders and cottagers is widely regarded as an important indicator of local economic and social orientation in early modern Bohemia.[30] Motivated by this consideration, the regression specifications in Table 5 columns 3, 4 and 5 undertook a closer investigation of the relationship between rural non-agricultural activity and village social structure. The specification in column 3 focuses on the 'peasant' strata, who had the most arable land and thus the greatest capacity to specialize in agricultural as opposed to non-agricultural occupations.[31] The specification in column 4 includes the freemen and Jews, who would be expected to specialize in non-agricultural occupations, a frequent reason for their receiving manorial permits to settle on the estate. The specification in Table 5 column 5 controls for social structure in a different way, by including the variable registering the proportion of holdings with fewer than 15 *strych* (c. 4.3 hectares) of arable land, the minimum size necessary to support a family of average size solely from arable cultivation.[32] In all cases, including these social-composition variables produces significant coefficients with the predicted signs – negative in the case of peasants, positive in the case of all other strata – and leave the significance and the magnitude of most other coefficients unchanged.[33]

A third factor we explore more deeply through alternative specifications is the presence of the landlord. The specifications in Table 5 columns 1-5 captured landlord presence using only a simple dummy variable indicating whether at least one holding in the village was currently used by the landlord. The data, however, enable us to delve into landlord presence more deeply, since we also have information on the number and the size of holdings that were in landlord occupation. The regression specifications in columns 6 and 7 explore the effect on occupational structure of these more precise measures of landlord presence in the village. We estimated all specifications reported in Table 5 columns 1-5 using these alternative measures of landlord presence, but columns 6 and 7 present only the specification in column 5, using the two alternative measures of landlord presence.[34]

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[30] Ogilvie and Cerman (1995); Cerman (1996).
[31] We exclude the social categories of ''smallholder' and cottager' respectively because of multicollinearity with the social category of 'peasant'.
[32] Mattmüller (1983), 42; Cerman (1996), 190.
[33] The only variables showing a non-trivial change in magnitude are those measuring social strata. This is understandable because the strata of smallholders and cottagers had smaller plots than the stratum of peasants, creating a collinearity with the percentage of holders having fewer than 15 *strych* of arable land. We re-estimated that regression specification without the social strata categories and the results were similar.
[34] Other results are available from the authors upon request; they are very similar to the ones in columns 1-5.

Having explored specifications that take account of alternative measures of landlord presence, as well as differences in war damage and social stratification, we are now in a position to discuss our multivariate findings on the characteristics associated with rural non-agricultural activity in this economy under the second serfdom.

5. Economies of Agglomeration

Changes in occupational structure in early modern Europe are widely regarded as resulting partly from increases in settlement size: a growth in the size of villages, creating larger pools of demand for secondary- and tertiary-sector goods; and the early modern urbanization of European societies in general, creating economies of agglomeration.[35] Intuitively appealing though this idea is, it still lacks theoretical underpinning or quantitative confirmation. In theory, both a larger size of rural settlements and the proximity of urban centres could have created economies of agglomeration: positive externalities in the form of improved information flow, specialization, division of labour, or the ability to attract more suppliers and customers. But the effect of such agglomeration economies on the density of non-agricultural activities in villages were multiple and could go in opposing directions.

A first positive effect would be exercised by the size of the village itself. Holding other factors constant, one would expect larger village size to create agglomeration economies that encouraged non-agricultural occupations in the village, both by reducing production costs in such occupations and by increasing the demand for their products.

A second effect, also positive, would be exercised by having a large settlement, particularly an urban centre, nearby: holding other factors constant, one might expect proximity to a town to increase density of non-agricultural occupations in a village if the town created a demand for rural goods and services (e.g. demand for rural spinning by urban weavers or for rural plank- and shingle-making by urban builders) or if the town exported urban consumption aspirations (e.g. by inspiring rural women to purchase small luxuries, creating demand for village shops). This would be consistent with the theory of an early modern Consumer and Industrious Revolution after c. 1650, which is supposed to have seen a shift towards market participation by social groups that had previously provisioned

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[35] See De Vries and Van der Woude (1997), 520ff; Van den Heuvel and Ogilvie (2013), 78-82.

themselves through household production. This would tend to increase the density of non-agricultural activities in rural areas, where a larger percentage of inhabitants had traditionally engaged in self-provisioning because of access to land and livestock. [36]

A third effect of proximity to larger urban centres, by contrast, would be negative. The density of crafts and services in a nearby town might substitute for such non-agricultural activities in the village itself, whether because of production efficiencies or as a result of institutional privileges of town burghers entitling them to suppress rural competitors.

The agglomeration economies for non-agricultural activities created by proximity to larger clusters of producers and consumers were therefore likely to depend both on whether such clusters were located in the village in question or in nearby settlements, and on whether nearby settlements complemented or substituted for local activities. Bohemia was much less urbanized than the northwest regions of Europe for which these hypotheses about early modern agglomeration economies were originally formulated. Bohemia had also suffered prolonged warfare and recent re-Catholicization which by 1654 had further depopulated both its villages and its towns, while enhancing the security benefits of urban centres. Furthermore, Bohemian towns possessed a number of institutional privileges entitling their guilded craftsmen and merchants to suppress rural competition to a degree no longer possible in north Atlantic economies such as the Netherlands or England by the mid-seventeenth century.[37] Bohemia therefore provides a good laboratory for exploring the traction of hypotheses about agglomeration economies for early modern Europe beyond the north Atlantic societies.

Our findings for Bohemia in 1654 show that village size, measured by the number of occupied holdings in the village, exercised a statistically significant positive effect on the intensity of non-agricultural activities locally. This finding is consistent with those for western Europe – the Netherlands, Flanders, England, and a variety of German territories – where recent studies have found settlement size to be associated with a significantly higher density of one specific non-agricultural activity, retailing.[38] This suggests that in early modern Europe, *local* agglomeration economies – i.e. those exercised inside a particular settlement – were not restricted to urban centres, but also prevailed in villages. Moreover, it

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[36] De Vries (2008); Van den Heuvel and Ogilvie (2013).

[37] For concrete examples of urban coercion of rural craftsmen in seventeenth-century Bohemia, see Ogilvie (2001), 449-50. On the practical economic powers of urban privileges in different early modern societies, see Cerman and Ogilvie (1996); Ogilvie (2005c, 2007, 2011).

[38] Ogilvie (2010); Ogilvie, Küpker and Maegraith (2011); Van den Heuvel and Ogilvie (2013).

shows that this phenomenon was not restricted to western European societies but can also be observed in eastern-central Europe under the second serfdom. Simply increasing the size of rural settlements seems likely to have increased the density of non-agricultural activities, regardless of other facilitative or preventive pressures. This would lead one to predict an increasing density of non-agricultural activities as Bohemia underwent its gradual demographic recovery between the mid-seventeenth and early eighteenth century, regardless of the intensification of the second serfdom. This opens up avenues for future research into occupational structure as reflected, for example, in the Theresian Cataster of 1748-57.[39]

By contrast, the influence of *urban* agglomeration economies on rural non-agricultural activities, which in theory might be either positive or negative, emerges as strongly and significantly negative in the Bohemian context. In all specifications in Table 5, the presence of a town on the estate reduced the density of non-agricultural activities on the villages of that estate, even controlling for other characteristics of the estate and the villages in question. In Bohemia, at least, the presence of urban centres did not favour rural non-agricultural activity but stifled it, indicating a competition effect between urban and rural areas.

These findings help to flesh out early indications from the northwest corner of Europe for which the theories about early modern agglomeration economies were originally formulated. A recent econometric study of retail density in the early modern Netherlands, for instance, found that in the most successful and highly developed Dutch provinces, North and South Holland, urbanization did not stifle retail density in villages, but rather stimulated it. However, in the poorest Dutch provinces in the east of the country, where towns enjoyed greater institutional privileges compared to villages, there was a much wider gap in retail density between towns and villages, suggesting that in these provinces urban retail services substituted for village retailing.

Bohemia was much more similar to the eastern than to the western Dutch provinces. Early modern Bohemian towns enjoyed considerable institutional privileges giving their craftsmen and merchants legal advantages over village competitors. In some Bohemian towns the inhabitants were not subject to serfdom at all; even in towns subject to serfdom, townsmen enjoyed institutional advantages denied to villagers. Townsmen often used their greater wealth, their municipal organs, and their guilds to lobby overlords for regulations

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[39] Chalupa et al. (1964).

protecting urban craftsmen and traders from rural competition. In the 1660s, for instance, the butchers' guild of the Bohemian town of Frýdlant brought a peasant from a nearby village before the landlord's court for violating the guilded butchers' privileges by trading in cattle; the villager was sentenced to a large fine payable to the landlord, a smaller fine payable to the guild, and a prohibition against continuing his commercial activities.[40] In the 1680s, likewise, the Frýdlant potters' guild complained to the landlord's court that an impoverished serf from a nearby village had been digging clay, building a kiln, and making pottery, 'which is counter to the privileges which the guild possesses'; the manorial court punished the villager with a large fine.[41] As late as the mid-eighteenth century, the Theresian Cadaster reported that villages around the Bohemian town of Cheb were prohibited from admitting any new inhabitants practising non-agricultural occupations; if villagers required non-agricultural products, even agricultural equipment, they were required to obtain it from craftsmen in the town. Weavers in villages near Cheb were also prohibited from operating a larger number of looms, which would have competed with town weavers.[42] Although such urban lobbying was probably not always successful, town burghers evidently often secured at least some of their demands, enabling them to stifle rural crafts and commerce to some extent, if only by increasing their costs, imposing risks of prosecution, or pushing them into the black market.[43]

Pressures such as these appear to have operated sufficiently strongly in Bohemia in 1654 to counteract the stimulative effect on rural nonfarm activity which would be predicted by hypotheses about urban agglomeration economies based on richer and more highly developed regions of Europe. The findings for Bohemia, as for the eastern Netherlands, show that urbanization was not invariably a positive development indicator in early modern Europe. Certain types of urban centre could stifle the development of rural areas, and thus the productivity of large swathes of the pre-industrial population. This suggests caution in using the size of urban centres as a metric for pre-modern European economic growth in the absence of other development indicators.

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[40] Státní Oblastní Archiv Litoměřice, Pobočka Děčín, Fond Rodinný Archiv Clam-Gallasů, Historická Sbírka, Kart. 80, Amtsprotokolle 1661-4, fol. 57, 01.08.1662.
[41] Státní Oblastní Archiv Litoměřice, Pobočka Děčín, Fond Rodinný Archiv Clam-Gallasů, Historická Sbírka, 2. část, dodatky (Frýdlant) 11, Amtsprotokolle 1685-7, fol. 31r, 24.04.1686.
[42] Chalupa et al. (1964), Svazek 1, Rustikál (Kraje A-Ch), 283.
[43] Ogilvie (2001), 449-50; Ogilvie (2005b).

6. Agicultural Characteristics

Analyzing *non*-agricultural activities requires controlling for the characteristics of agriculture, which remained by far the most important sector of most early modern economies outside England and the Netherlands.[44] Agriculture affects non-agricultural activity in two ways. Directly, it produces raw materials used in industries (flax and wool for weavers, grain for brewers and bakers, etc.) and goods traded by service-sector occupations (such as merchants and retailers). Given transport costs and institutional barriers (which may have been stronger in Bohemia because of the administrative autonomy of estates under different great landlords), local availability of such raw materials could lower input costs for secondary- and tertiary-sector activities. But agriculture also affects non-agricultural activity indirectly, by influencing opportunity costs – the costs in terms of foregone alternatives. Since the main alternative to industry and commerce was agriculture, the technological and geographical characteristics of farming in a locality contributed to shaping the costs of industry and trade in that locality. The opportunity cost (in terms of foregone agricultural income) of producing industrial raw materials was partly determined by local agricultural characteristics, and the productivity of agriculture influenced the opportunity cost of the labour supply to non-agricultural activities.[45]

Motivated by these considerations, we included in our regression equation measures of the agricultural characteristics of each village, relating to both the arable and the pastoral sector: the area of occupied arable land per holder; the number of working animals (oxen and horses) per holder; and the number of (non-working) cattle per holder. In theory, larger arable and pastoral resource endowments could create two countervailing effects on non-agricultural activities: a positive effect by generating plentiful and cheap local supplies of agricultural products for further industrial processing, trading, and transporting; and a negative effect by increasing the opportunity cost of allocating labour, land and capital to non-agricultural activities. The regression results in Table 5 show that the dominant effect was negative for arable production (as measured by the size of arable land and the number of working animals) but positive for pastoral production (as measured by the number of non-working cattle).

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[44] See Table 2 above; and De Vries and Van der Woude (1997), 525 (Table 11.3).
[45] See Ogilvie (1993) for a detailed discussion of the effect of agriculture on opportunity costs in proto-industries.

The potential for a negative relationship between arable farming and the density of non-agricultural activities is mentioned in some earlier Czech historiography.[46] The argument put forward there focuses mainly on the decision-making of smallholders and cottagers: a small plot of arable land was not enough to provide a livelihood for the family, creating a need to engage in non-agricultural activity to obtain additional income. This is corroborated by the positive coefficients on the percentage of holders with less than fifteen *strych* of arable land and on the percentage of smallholders and cottagers. Opportunity cost considerations also explain the negative coefficient on the number of working animals (horses and oxen). These were the animals used to cultivate arable land, so in a village with more of them, fewer inhabitants would have incentives to look for an occupation outside agriculture. In addition, the institutional powers of landlords under the second serfdom required working animals to provide forced labour services on the landlord's demesne, leaving their labour power unavailable to be exploited by serfs in non-agricultural occupations such as transport or commerce. However, it is striking that these three variables registering the importance of arable cultivation in the village *all* simultaneously show a statistically significant relationship with the intensity of non-agricultural activity, suggesting that they exercised *independent* effects on the incentives of villagers to move into alternative occupations. Opportunity cost considerations may have meant that in villages with lower endowments of arable land, even members of the 'peasant' stratum, who could have supported their families solely from farming, faced lower opportunity costs of engaging in non-agricultural activity because the alternative of devoting human and animal labour to cultivating larger tracts of arable land was not available to them.

By contrast, pastoral agriculture, as measured by the number of (non-working) cattle, was positively associated with rural non-agricultural activity. This supports the hypothesis that pastoral production encouraged non-agricultural activities because animals were valuable inputs in diversifying into secondary- or tertiary-sector work, such as cheese-making, tanning, butchering, or trading in the cattle, leather and dairy products. These complementarities between pastoral agriculture and rural nonfarm activity evidently outweighed any tendency for the two activities to increase each other's opportunity costs in terms of labour, land or capital deployment.

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[46] E.g. Petráň (1963)

These results have wider implications. First, the strong and pervasive negative relationship between arable agriculture and rural non-agricultural activity is consistent with the opportunity cost of inputs, particularly labour, playing an important role in determining the intensity of non-agricultural activities. That is, serfs' time- and resource-allocation decisions took account of the opportunity cost of inputs in different activities. This finding would decisively refute any Chayanovian view that peasants in general (and eastern European serfs in particular) lacked the concept of wage, did not calculate the cost of land, rejected credit and interest on loans, or ascribed a 'subjective' value rather than a money price to their time.[47]

Second, these findings establish definitively that the relationship between non-agricultural activity and the other explanatory variables holds even when agricultural characteristics are controlled for. That is, non-agricultural work was not merely something that serfs fell back upon when they could not earn a living from agriculture, but was instead a positive choice they took in response to other aspects of their constraint structure.

7. Social Structure

Bohemia, like many parts of early modern central and eastern Europe, was a society in which each member of the rural population had a legally designated social status. This status was assigned according to whether the individual (or the head of his or her household) held landed property, and what the legal status and manorial burdens of that property were. Generally, a person changed social status when his or her household changed its landholding, although outsiders such as Jews could not change legal status. Although terminology varied, and there were some overlaps between strata, nearly every settled inhabitant of the Bohemian countryside was a member of a household belonging to one of the following groups: peasant, smallholder, or cottager.

At the top were the 'peasants' (Czech *sedlák* or *rolník*, German *Bauer*), who typically held enough arable land to live entirely from farming (i.e., over 4-5 hectares), owed the highest feudal dues and state taxes, and had to perform the largest amount of regular labour

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[47] On this view, see for instance, Chayanov (repr. 1986); Kriedte, Medick and Schlumbohm (1981); Thomas and Znaniecki (1958). For a critical consideration of this view using qualitative data on early modern Bohemian serfs, see Ogilvie (2001).

services, in principle with draft animals but also sometimes with human labour. Then came a stratum of smallholders (Czech *zahradník*, German *Gärtner*), who held some arable land but usually not enough to survive on (generally less than 5 hectares), owed lower dues and taxes, and rendered services with human labour only. The lowest stratum of independent holdings were those of the cottagers (Czech *chalupník*, German *Häusler*), who held only their own cottages surrounded perhaps by a kitchen-garden, owed some dues and taxes, and had to perform services with human labour only, and at a lower level than the two higher strata.

All other serfs lived in the households of members of these three strata, either as family members, as servants, or as inmate-lodgers (Czech *podruh*, German *Hausleute* or *Hausgenoßen*). An inmate-lodger might even be married and have childeren, but he or she lived on a holding owned by a peasant, a smallholder, or a cottager, either in a separate building or in lodgings within the building occupied by the main household. The more economically independent among the inmate-lodger stratum were increasingly obliged to pay dues to the manor and carry out labour services or compulsory wage-labour on demand, but were not regarded as independent householders.

Outside these four groups – peasants, smallholders, cottagers, and inmate-lodgers – there dwelt in Bohemian villages a few scattered individuals who did not belong to any serf stratum. The two most common types were the freeman (Czech *svobodník*, German *Freibauer*), who had a status similar to that of a free farmer in a non-serf society; and the Jew (Czech *žid*, German *Jude*), who was tolerated in Bohemian rural society under legal 'privileges' purchased from the crown and from the overlord of the estate. In addition, there were some members of a few professions – some pastors, village clerks, schoolmasters, and millers – who were not members of the basic serf strata, but were also not freemen or Jews. Those with no recorded social stratum, however, made up a tiny proportion of the Bohemian rural population in 1654.

The terminology used to describe these different strata and different sub-strata within them varied across different estates, different villages in the same estate, and even across time in the same village. The peasants could be divided into full- (or draft-) peasants (who had larger holdings and carried out their labour services for the landlord with draft animals) and half- (or hand-) peasants (who had smaller holdings and rendered their manorial services with human labour), as well as into peasants who owed services to the manor, to the church, or to the village headman. The smaller hand-peasants might shade over into the larger

smallholders. The smallholders could be divided into hereditary- (or field-) smallholders who had larger holdings, which may have been hived off from peasant holdings; and commons-smallholders whose holdings generally included less arable land and had been formed by enclosing plots on the village commons. The cottagers could be divided into commons-cottagers whose holdings were also created by enclosing plots from the commons, riverside-cottagers whose holdings encroached on the meadowland along waterways, and ordinary cottagers whose holdings were created from land whose origins had been forgotten. The inmate-lodgers often subdivided into two groups. The upper (and smaller) group occupied separate dwellings (albeit on holdings belonging to members of other strata) and pursued independent livelihoods, often with families of their own; they were occasionally listed as independent units by the manor, to which they delivered some minor dues and services, and were sometimes (though not always) given the designation 'lodgers with houses'. This was to distinguish them from the lower (and more numerous) stratum of true lodgers, who occupied rooms in households headed by peasants, smallholders and cottagers. These true lodgers sometimes had spouses and offspring, but were not usually economically independent enough to be regarded by the manor as able to pay dues. As far as actual property-ownership was concerned, there was some overlap between each of the social groups except for the inmate-lodgers who did not own real estate. But the legal definition of the holding's stratum, and the associated economic obligations and privileges, were not correspondingly fluid: they were legally fixed.[48]

This means that social stratum in early modern Bohemia was not, as in western Europe, defined economically (in terms of landholding or occupation) or socioculturally (in terms of education, speech or consumption habits), but institutionally and legally, within the framework of the manorial system. The initial allocation of landholdings at the foundation of a Bohemian village, the number of centuries during which generations of non-inheriting offspring or in-migrants exerted pressure to carve out smallholdings or cottager holdings in the interstices of communal and manorial regulation, the varying incentives of different types of overlord (e.g. minor knights compared to great noble seigneurs) to permit or compel the settlement of sub-peasant strata, and even the differing manorial strategies pursued in neighbouring domains under the same overlord, are thought to have influenced the social

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[48] For more detail on the social strata in early modern Bohemian villages, see Ogilvie and Cerman (1995); Cerman (1996); and Cerman and Zeitlhofer (2002).

composition observed in each Bohemian village by the mid-seventeenth century.[49] As a consequence, the relative size of the three main legally defined social strata within a Bohemian village in 1654 can be regarded as a variable that was in the short term exogenously imposed on that village, rather than chosen by the householders concerned, and hence as a measure of the opportunities and constraints faced by its inhabitants.

Rural social structure, as measured by the relative size of these institutionally defined social strata, is regarded as an important indicator of the economic and social orientation of villages in early modern Bohemia, as well as in other eastern-central European societies subject to strong manorialism.[50] Traditional Czech historiography argued that a preponderance of 'sub-peasant' strata (i.e. smallholders, cottagers, and inmate-lodgers) made a village more likely to move into proto-industrial activities such as linen-weaving since such people lacked other means of supporting their families. However, Cerman's study of the Bohemian estates of Frýdlant and Liberec showed that it was initially peasants, members of the upper rural stratum, who were the dominant participants in rural linen production; later, when rural spinning and weaving became primarily an occupation practised by smallholders and cottagers, it remained a pursuit only of a minority of these sub-peasants, who were reliant on a variety of other livelihoods, many of them agricultural, especially work as farm labourers for larger peasants.[51] It therefore remains an open question whether a village with larger strata of smallholders and cottagers was likely to have a higher or lower intensity of non-agricultural activity.

To investigate this question, the regression specifications in Table 5 columns 3 and 4 explored the relationship between different measures of village social composition on the one hand and the intensity of rural non-agricultural activity on the other. The specification in column 3 focused on the stratum of peasants, and found that a higher proportion of peasants in the village was negatively related to the intensity of non-agricultural activity there.[52] Column 4 included the social categories of freemen and Jews and found that they were positively associated with rural non-agricultural activities. This is consistent with the institutional status of these 'outsider' strata: freemen were allowed to practise any occupation, and were sometimes granted permits to live on Bohemian estates precisely

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[49] Ogilvie and Cerman (1995); Cerman (1996).
[50] See the literature surveyed in Cerman (1996, 2002, 2012).
[51] See especially Cerman (1996).
[52] We exclude the variables measuring the size of the 'smallholder' and 'cottager' strata because of multicollinearity with the size of the 'peasant' stratum.

because they had craft or service skills unavailable locally; Jews, by contrast, were forbidden to practise agriculture so they had to engage in non-agricultural activities. In all cases, including these social-composition variables left the statistical significance of other variables unchanged. This confirms the predictions of the traditional historiography: although non-agricultural occupations were practised by all social strata in early modern Bohemia, holding other village characteristics constant such occupations were practised to a greater degree in villages with a higher proportion of sub-peasant or outsider strata.

It might be argued that the positive link between a sub-peasant social composition and the density of non-agricultural activity in a village simply reflects lack of agricultural land on the part of the smallholders and cottagers, and does not relate to the legal or institutional aspects of their social status. But doubt is cast on this idea by the regression specification in Table 5 column 5 which controls for the proportion of holdings in the village with fewer than 15 *strych* of arable fields, the minimum necessary to support a family of average size solely from arable cultivation.[53] The coefficient on this variable shows the expected positive relationship with the percentage of non-agricultural occupations, and leaves the significance and the magnitude of almost all other explanatory variables virtually unchanged. The 'social strata' variables (percentage of cottagers and percentage of smallholders) are the only ones that show a non-trivial change in magnitude when this farm size variable is included. This is understandable because the smallholder and cottager strata had smaller plots of land than the peasant stratum, creating collinearity with the percentage of holders with less than 15 *strych* of arable land.[54] However, although including the percentage of holdings with less than 15 *strych* changes the magnitude of the coefficients on the percentage of smallholders and cottagers, it does not render them statistically insignificant. Both sets of variables continue to show significant positive relationships with the density of non-agricultural activity in a village, even controlling for one another. This is not wholly surprising since, as discussed above, the social composition of a village did not simply register the distribution of landholdings of different size, but rather reflected a conglomeration of institutional and historical characteristics of the village. Confirmation of the quasi-exogenous impact of village social composition on the opportunities and constraints of serfs is provided by the fact that *both* the percentage of sub-peasant strata *and* the percentage of smaller landholdings in

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[53] Mattmüller (1983), 42; Cerman (1996), 190.
[54] We re-estimated that regression specification without social strata categories and the results were similar.

the village showed an independent positive association with the intensity of non-agricultural activities there.

8. Village Mills

Water-driven mills were a major source of energy in the pre-industrial economy, which otherwise relied on the organic energy provided by human labourers and draft animals. Mills had an advantage over human and animal labour in that they provided larger and more continuous energy supplies and were therefore particularly suitable for energy-intensive activities. Although watermills were most commonly used to grind grain into flour, they were also important for a wide variety of other activities: cracking the husks of malted barley and other grains to brew beer, cutting logs into planks, fulling woollen cloths, tanning leather, driving hammers for iron forges, running blast furnaces, crushing iron and other metal ores, slitting bars of iron into rods, sharpening tools, pressing oil out of hemp and other seeds, pulping rags for paper, and driving bellows for smithies. Even mills that were solely used to grind grain into flour or crack the husks of brewing grains tended to attract ancillary non-agricultural activities, especially transportation services, brewing, and baking, which benefited from proximity to cheap sources of energy and processed grain. But the capacity of watermills to be used as energy sources meant that they typically attracted a very broad array of industrial, transportation, and commercial activities.

Motivated by these considerations, we included in our regressions a dummy variable registering the presence or absence of a mill in the village. Although the *Berní Rula* did not usually record the specific purpose for which a village mill was used, there was firm justification for expecting a positive association between the presence of a mill and the intensity of non-agricultural activities in a village since, as we shall discuss shortly, there is considerable evidence in the secondary literature that in Bohemia, as in other pre-modern European economies, water-driven mills were used for a wide variety of purposes in addition to processing grain.

This hypothesis was confirmed by our econometric analysis, as Table 5 reveals. The presence of a mill was positively and significantly associated with the intensity of non-agricultural activities in the village, controlling for most other village characteristics. The

only exception, as we shall see shortly, was the presence in the village of holdings currently used by the landlord, which significantly altered the impact of the presence of a mill in ways that illuminate the concrete operations of the second serfdom in Bohemia.

9. Female Headship

The same emerges for a further important variable, the female household headship rate. Many studies suggest a positive relationship between the intensity of non-agricultural activities and women's economic autonomy. The most widely employed indicator of female autonomy, which has been used successfully to analyze early modern societies as diverse as early modern Bohemia, England, Germany and the Netherlands, is the percentage of independent households headed by women. In a number of historical studies, female household headship has been found to manifest a positive association with various types of secondary- and tertiary-sector activity.[55] However, although the historiography universally suggests a positive link between non-agricultural activity and female headship, it is less clear about the causal relationship.

On the one hand, it is possible that high female autonomy exerted a positive causal influence on the local intensity of non-agricultural activities. Although contemporaries often deplored the existence of households headed by women, and urged the propriety of all households being headed by both a 'house-father' and a 'house-mother', with gender-specific economic roles, in practice they acknowledged the demographic realities of frequent and early widowhood and the fact that some widows might fail to remarry. In that unfortunate situation, they commonly described women as unsuited to agriculture and advocated crafts and small-scale trading as best suited for the weaker sex. A second reason to expect a positive association between female headship and non-agricultural activities is that women may have been relatively productive in industrial and commercial activities because these could be more often be carried out in domestic locations and thus combined more easily with household production (especially child care, an important consideration for widows). Physical differences between the sexes are also thought to have played a role, with men specializing in activities such as agriculture which require greater upper-body strength while

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[55] For studies using this measure, see Ogilvie and Edwards (2000) on Bohemia; Ogilvie (2003) on Germany; Van den Heuvel and Ogilvie (2013) on the Netherlands; and Todd (1994) on England.

women specialized in crafts and commerce requiring endurance, dexterity, communication or calculation skills. For these reasons, if female headship was high in a village for exogenous reasons (e.g. warfare or gender-specific emigration diminishing the number of marriageable males), this might have increased the density of non-agricultural activities there.

But causation might also go in the opposite direction. If the intensity of non-agricultural activities was high for exogenous reasons – the ones we seek to identify in this paper – that might have increased female headship by enabling more women to support families independently.

Furthermore, underlying factors might have facilitated both female headship and non-agricultural activity: more flexible institutions could have removed barriers both to women seeking to support themselves independently in all occupations (not just non-agricultural ones) and to all economic agents (not just women) in seeking to undertake non-agricultural activities.

The econometric problems created by these two-way causal links could not be solved using an instrumental variable (one correlated with female headship but not with the percentage of holders practising non-agricultural occupations) because the determinants of female headship rates in pre-industrial societies are still not fully understood. Our alternative solution was to estimate our regressions with and without the female headship variable in order to establish whether female autonomy was significantly associated with the percentage of non-agricultural activities and whether any such association was positive or negative. Taking female headship into account hardly altered the estimated coefficients on other variables, justifying this approach. The only exception was when we interacted female headship with measures of landlord presence in the village, the effect of which we discuss in the next section.

The average female headship rate across the entire data set for Bohemia in 1654 was just over 3 per cent. This is much lower than the 10-15 per cent normally observed in western European rural settlements, but lies in the range observed in other studies of eastern-central European societies in this period, including Bohemia.[56] However, there was also considerable variation: in some of these early modern Bohemian rural settlements over 8 per cent of households were headed by women, while in others no households had female heads.

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[56] Ogilvie and Edwards (2000), esp. 971 (Table 2).

The econometric analysis established that female headship was indeed positively related to the percentage of holders practising non-agricultural occupations. As Table 5 shows, in all regression specifications – i.e., controlling for all other village characteristics – higher female headship was associated with a significantly higher percentage of holders practising non-agricultural occupations. Our findings for Bohemia are thus consistent with those for other early modern European economies which have revealed the existence of a positive association between female headship and the density of non-agricultural occupations. Indeed, our findings strengthen that conclusion by confirming that it holds even controlling for settlement size, agricultural structure, social composition, and other village characteristics. It also shows that this positive association prevailed not just in economically advanced western Europe but also under the second serfdom which, as has emerged from other studies and will be discussed shortly, often acted to reduce female household headship.[57]

This opens up perspectives for deeper micro-level analyses to investigate gender-specific patterns of non-agricultural activity at the household level. Such investigations in turn may help resolve the endogeneity between the two variables, i.e., whether female headship increased the density of non-agricultural activity or vice versa. In any case, there is now little doubt that there was a significant, systematic, and pervasive association between the expansion of non-agricultural activities in early modern European rural societies and women's economic autonomy, even controlling for other factors.

10. The Second Serfdom

One of the most prominent of these factors is the second serfdom, the institutional framework within which inhabitants of early modern rural Bohemia made their economic decisions. From the sixteenth century through to serf emancipation in 1781, Bohemian landlords expanded demesne operations, increased their extraction of money rents and labour dues, extended them to previously exempt social groups, levied new dues on activities such as rural crafts, proto-industries, commerce and forestry, set up market monopolies, and expanded their institutional interventions in the economic and demographic decisions of their

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[57] For quantitative and qualitative evidence concerning this negative relationship in early modern Bohemia, see Ogilvie and Edwards (2000), 980-9.

rural subjects. These developments can already be observed in parts of Bohemia from the mid-sixteenth century onwards, are thought to have intensified during and after the Thirty Years War (1618-1648), and endured until emancipation in the later eighteenth century; some of the institutional powers of the great landlords over the rural population outlasted the 1781 emancipation patent and survived well into the first half of the nineteenth century.[58]

The rich historiography on the second serfdom is deeply divided concerning its impact on occupational structure. On the one hand, as discussed in the introduction, traditional 'manorial dominance' views argue that under serfdom landlords stifled non-agricultural activities altogether.[59] On the other, a revisionist strand of scholarship has contended that the second serfdom did not constrain serf choices. One variant of this revisionist approach, which one might call the 'serf autonomy' view, argues that under serfdom landlords were largely unable to control economic or demographic decisions inside serf villages and hence did not affect economic activity there.[60] Another variant of the revisionist strand of scholarship goes so far as to argue that eastern European economies under serfdom were actually just as dynamic as western European economies where peasants were free: entrepreneurial landlords often actively encouraged industrial and commercial enterprises.[61] A more recent, 'institutional' approach argues for replacing *a priori* assumptions about serfdom with a rigorous analysis of how the specific constraints imposed by different manifestations of serfdom affected the incentives of serfs, overlords, and village communities.[62] This approach would predict that although the overarching institutional framework of serfdom tended to distort resource allocation in ways that stifled broader economic growth, certain institutional rules within the system of serfdom entitled landlords to extract rents from particular non-agricultural activities, which they therefore had incentives to encourage.

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[58] For a recent survey of the literature, with a detailed consideration of the economic impact of these institutional constraints, see Klein (2013).
[59] See, for instance, Kriedte, Medick and Schlumbohm (1977).
[60] For a critical analysis of the 'communal autonomy' view of Bohemian serfdom, see Ogilvie (2005a).
[61] For a recent exposition of the 'revisionist' approach to serfdom, see Cerman (2012).
[62] For an exposition of this 'institutional' approach to serfdom in the context of Bohemia, Germany, Russia, and England, see Ogilvie (2013); Klein (2013); Dennison (2013); and Briggs (2013).

10.1. The Econometric Findings

This continuing debate about the second serfdom motivated our search for ways of exploring its economic effects. The historiography suggests that although the legal definition of serfdom was homogeneous across early modern Bohemia, how these institutional rules were implemented in practice could vary significantly. One possibility is that the presence of the landlord using or occupying one or more holdings in the village might be a proxy measure of the intensity of manorial interest, information, and potential control over the serfs' economic decisions in that village. However, to interpret this proxy measure of local institutions properly it is important to recognize the complexities it raises.

The first complexity arises from the general difficulty of measuring institutional constraints quantitatively. The precise ways in which landlords regulated serfs' economic activities and the powers they had to enforce their regulations varied enormously. Quantitatively exploring the significance of a variable registering the presence or absence of 'the landlord' using or occupying a holding in the village is better than having no quantitative measure at all of the 'second serfdom'. But it does not reveal the details of the economic impact of landlord powers within the village. In particular, the *Berní Rula* contains no concrete information on how the landlord was using or occupying village holdings, the type of personnel (if any) he might have appointed to exercise this use or occupancy, the degree to which such personnel were able to monitor or control serfs' activities, or the incentives those personnel might have had to exercise such control.[63]

The second complexity arises from the fact that, as already mentioned, landlord presence in village holdings measures the second serfdom at the 'intensive margin' (stronger versus weaker enforcement of an existing institutional system) but not the 'extensive margin' (presence or absence of the institutional system altogether). In other words, this variable does not make it possible to compare Bohemian villages with and without the second serfdom, but rather only to draw comparisons among villages which were all subject to the second serfdom, some of which may have experienced more intensive direct monitoring and control than others. This variable can capture only those effects of the second serfdom which depended on direct local enforcement inside villages. It cannot measure those effects of the

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[63] The one exception is that the *Berní Rula* records, for all holdings in the village (including those currently being held or used by the landlord), whether land is under arable cultivation or lying unused; this indicates that the arable portion of such holdings was being used by the landlord for arable cultivation.

second serfdom that were generated by more general institutional constraints on factor markets, product markets, or demographic decisions, which depended on manorial enforcement that was implemented outside an individual settlement, for instance through the manorial court, manorial administrators, manorial tax-collectors, or demesne foremen. Nor, of course, can it capture those aspects of the second serfdom implemented via collaboration among landlords or enforcement by the state.[64]

The third complexity arises from the probability that the presence of the landlord in a village had a two-way relationship with non-agricultural activity there. On the one hand, landlord presence could affect non-agricultural activity by hindering or encouraging serfs in practising such occupations. But conversely, an existing cluster of non-agricultural activities could attract the landlord to use or occupy holdings in the village, with the aim of extorting rents from them. This creates a serious problem of endogeneity, which cannot be solved by instrumental variables since the determinants of variations in the intensity of the second serfdom or the presence of landlords in serf villages are not well understood. We therefore estimated the regressions with and without the variables measuring landlord presence, as well as using several alternative measures of such presence, in order to investigate how robust the relationship was to different specifications and how it affected the coefficients on other variables. We also used interaction terms to try to shed light on the endogeneity issue. The results enable us to characterize the complex relationship between landlords and serfs' occupational decisions more clearly, while still leaving a number of open questions for future research.

The traditional 'manorial dominance' approach to serfdom, at least in its more extreme manifestations, is refuted by our findings. Mid-seventeenth-century Bohemia was no autarkic or purely agricultural economy in which landlords stifled all rural nonfarm activity. On the contrary, as we have seen, the *Berní Rula* recorded an array of non-agricultural activities covering the entire spectrum from locally-oriented crafts, to proto-industries exporting to supra-regional markets, to retail trades, and even to merchant commerce. Rural nonfarm activity was less widespread than in western Europe but not stifled altogether.

However, the revisionist 'serf autonomy' view, according to which landlords were unable to affect economic life inside serf villages, is also refuted by our findings. The

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[64] For a consideration of the wider growth impact of the second serfdom in Bohemia and other parts of eastern-central Europe, see Klein (2013); and Ogilvie (2013).

econometric analysis shows a significant association between non-agricultural activity and landlord use of holdings in a village, controlling for other village characteristics. Table 5 column 1, the simplest specification, already showed that the presence of at least one holding in the village occupied or used by the landlord was associated with a significantly higher intensity of non-agricultural activity by the inhabitants of the village. This result became more striking in the specification in column 2, which controlled for the percentage of empty holdings in the village on the grounds that the use of an empty holding by a landlord might also be picking up the effect of the war. This specification showed that the percentage of empty holdings was negatively related to the percentage of non-agricultural occupations in a village, and caused the magnitude of the relationship between non-agricultural activity and the landlord presence variable to increase non-trivially.[65] The significantly positive relationship between non-agricultural activity and landlord presence is also observable in the specifications in Table 5 columns 3-5, which (as discussed in Section 8 above) control for different measures of village social structure.

Up to this point, we restricted ourselves to capturing landlord presence using only a simple dummy variable indicating the presence or absence of at least one holding used by the landlord. The data, however, enabled us to delve more deeply into landlord presence, since we also have information on the number and the size of holdings occupied by the landlord. The regression specifications in Table 5 columns 6 and 7 explore the relationship between non-agricultural activity and these more precise measures of landlord presence. We estimated all specifications reported in Table 5 columns 1-5 using these alternative measures of landlord presence, but present only the specification in column 5.[66] The overall picture remained unchanged, regardless of which proxy we used, although the estimated coefficients unsurprisingly varied in magnitude. Specifically, the percentage of the village's arable land occupied by the landlord had the largest estimated association with percentage of households engaged in non-agricultural occupations, while the number of holdings occupied by the landlord had the smallest estimated relationship. But all three measures of the intensity of landlord presence in the village were positively and significantly associated with a higher density of non-agricultural activities there.

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[65] The estimated coefficients of the variables in the category 'other village characteristics' also changed their magnitudes, which indicates that they were also picking up the effect of empty holdings in the village, further corroborating the importance of controlling for it.

[66] Other results are available from the authors upon request; they are very similar to the ones in columns 1-5.

It might superficially seem that the positive relationship between non-agricultural activity and landlord presence in 1654 provides support for the second variant of the revisionist approach to serfdom, according to which serfdom was no barrier to economic dynamism since landlords in fact encouraged serf enterprises. But deeper analysis shows that the interrelationship between landlord presence and rural nonfarm activity was far more complex.

A first complexity arises when one examines whether the association between non-agricultural activity and landlord presence was actually a simple linear one. To explore whether the positive coefficient in Table 5 was merely a snapshot of one part of a curvilinear relationship, Table 6 presents the results of introducing into the regression specifications in Table 5 columns 6-7 two alternative quadratic terms: the square of the percentage of arable land held or used by the landlord; and the square of the number of holdings held or used by the landlord. It turns out that the association between non-agricultural activity and landlord presence was indeed non-linear, since the quadratic terms are negative and statistically significant. Whereas a certain degree of landlord presence in the village was positively associated with non-agricultural activities, once landlord presence reached a certain point the relationship turned negative.

A second set of complexities emerges when we delve more deeply into the interactions between landlord presence and two other village characteristics which previous studies of early modern Bohemia suggest were strongly affected by landlords' interventions: female household headship[67] and the presence of water-driven mills.[68] To this end, we estimated the regression specification in Table 5 column 5, but with the addition of interaction terms between landlord presence and female headship, as well as landlord presence and village mills. The results, presented in Table 7, show that the original explanatory variables retain similar statistical significance and magnitudes to the ones they have in Table 5, providing further reassurance of their robustness. Landlord presence shows an overall positive relationship with non-agricultural activity, but the interaction terms are negative. On their own, both landlord presence and female headship were associated with an increase in non-agricultural activity, but when the landlord was using holdings in the village female headship was linked to a decrease in non-agricultural employment. Likewise, on their own both landlord presence and village mills were positively associated with non-agricultural

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[67] Ogilvie and Edwards (2000).
[68] Maur (1976), 44-5; Maur (1990), 109-12.

Table 6: Regression Analysis with Second-Serfdom Non-Linear Terms (Tobit Model)

	(1)	(2)
Size of Village		
number of holdings	0.0053***	0.0054***
	[0.00002]	[0.00002]
percentage of empty holdings	-0.173***	-0.169***
	[0.0025]	[0.0017]
Arable Sector		
total arable land on occupied holdings per holder	-0.00067***	-0.00065***
	[0.00003]	[0.00003]
Pastoral Sector		
number of working animals per holder	-0.0112***	-0.0119***
	[0.00045]	[0.00046]
number of cattle per holder	0.0097***	0.011***
	[0.0002]	[0.0002]
Social Strata		
percentage of 'cottagers'	0.097***	0.111***
	[0.00124]	[0.00121]
percentage of 'smallholders'	0.208***	0.221***
	[0.0016]	[0.0014]
percentage of 'freemen'	0.199***	0.195***
	[0.00138]	[0.00138]
percentage of Jews	2.89***	0.825***
	[0.009]	[0.0014]
Other Village Characteristics		
presence of mill	0.363***	0.368***
	[0.0013]	[0.00132]
percentage of female household heads	0.044***	0.053***
	[0.0038]	[0.0035]
presence of a town on estate	-2.525***	-2.543***
	[0.00074]	[0.00074]
percentage of holders with less than 15 str of arable land	0.131***	0.119***
	[0.00139]	[0.00139]
Second-Serfdom Proxies		
percentage of arable land held/used by landlord	0.301***	
	[0.026]	
(percentage of arable land held/used by landlord)^2	-0.124***	
	[0.032]	
number of holdings held/used by landlord		0.047***
		[0.0011]
(number of holdings held/used by landlord)^2		-0.005***
		[0.0001]
Constant	0.276***	0.267***
	[0.00082]	[0.00082]
Estate Dummies	YES	YES

	6768	6836
N		
Log-likelihood value	-1568.9	-1616.1
Sigma	0.276	0.280
Pseudo-R^2	0.475	0.471

Sources: see text

Table 7: Regression Analysis with Second-Serfdom Interactions (Tobit Model)

	(1)	(2)	(3)
Size of Village			
number of holdings	0.00529***	0.00529***	0.00538***
	[0.00002]	[0.00002]	[0.00002]
percentage of empty holdings	-0.179***	-0.172***	-0.164***
	[0.0018]	[0.002]	[0.0017]
Arable Sector			
total arable land on occupied holdings per holder	-0.00065***	-0.00066***	-0.00066***
	[0.00003]	[0.00003]	[0.00003]
Pastoral Sector			
number of working animals per holder	-0.012***	-0.011***	-0.0122***
	[0.00045]	[0.00045]	[0.00046]
number of cattle per holder	0.011***	0.0097***	0.011***
	[0.00024]	[0.00024]	[0.00024]
Social Strata			
percentage of 'cottagers'	0.111***	0.097***	0.109***
	[0.00121]	[0.00123]	[0.00121]
percentage of 'smallholders'	0.219***	0.207***	0.2205***
	[0.00142]	[0.0015]	[0.00142]
percentage of 'freemen'	0.191***	0.199***	0.193***
	[0.00138]	[0.00137]	[0.00138]
percentage of Jews	0.832***	2.887***	0.824***
	[0.001]	[0.009]	[0.0014]
Other Village Characteristics			
presence of mill	0.376***	0.367***	0.372***
	[0.0014]	[0.00137]	[0.0013]
percentage of female household heads	0.087***	0.058***	0.072***
	[0.005]	[0.0046]	[0.0042]
presence of a town on estate	-2.54***	-2.53***	-2.546***
	[0.00073]	[0.00074]	[0.00073]
percentage of holders with less than 15 strych of arable land	0.12***	0.13***	0.119***
	[0.00138]	[0.00139]	[0.00139]
Second-Serfdom Proxies with Interactions			
presence of mill x presence of a holding held/used by landlord	-0.13***		
	[0.0057]		
percentage of female household heads x presence of a holding held/used by landlord	-0.36***		
	[0.038]		
presence of a holding held/used by landlord	0.115***		
	[0.0019]		
presence of mill x percentage of arable land held/used by landlord		-0.217***	
		[0.022]	

percentage of female household heads x percentage of arable land held/used by landlord	-0.96***		
	[0.13]		
percentage of arable land held/used by landlord	0.258***		
	[0.005]		
presence of mill x number of holdings held/used by landlord			-0.029***
			[0.0014]
percentage of female household heads x number of holdings held/used by landlord			-0.128***
			[0.0137]
number of holdings held/used by landlord			0.0223***
			[0.0007]
Constant	0.262***	0.275***	0.267***
	[0.00081]	[0.00082]	[0.00082]
Estate Dummies	YES	YES	YES
N	6836	6768	6836
Log-likelihood value	-1611.6	-1568.05	-1619.14
Sigma	0.279	0.276	0.2803
Pseudo-R^2	0.473	0.476	0.4704

Sources: see text

activity, but when the landlord was using village holdings the association between non-agricultural activity and milling turned negative.

Landlord presence thus manifested a complex and multi-faceted relationship with occupational structure under the second serfdom. The superficially positive association was in fact only the initial upward slope of an inverted-U relationship, with a small degree of landlord presence associated with greater non-agricultural activity but greater landlord presence associated with less. Furthermore, landlord presence reversed the positive relationship between non-agricultural activities and two of its major correlates, female headship and the presence of mills.

Qualitative and institutional evidence on Czech economic history helps explain these findings. Bohemian landlords engaged in a wide array of institutional interventions in the rural economy under the second serfdom, gathering force from the second half of the sixteenth century onwards, but intensifying during and after the Thirty Years War, when loss of population, declining agricultural prices, and rising wages put pressure on the profitability of landlords' estates. At least four types of manorial intervention had the potential to affect rural nonfarm activity by serfs, both positively and negatively: direct manorial involvement in industrial enterprises using serf labour; permitting serfs to engage in crafts and commerce in return for paying dues; granting of monopolistic milling licenses; and controlling access to landholdings to ensure land rents and labour dues. These four landlord strategies created multiple and often contradictory incentives for serfs to engage in nonfarm occupations.

10.2. Demesne Manufactories

First, landlords directly intervened in the non-agricultural sector by establishing demesne manufactories.[69] The making of iron and glass was particularly profitable, leading to a proliferation of ironworks and glassworks operated directly by the manorial administration.[70] Commercial fish-farming was another widespread demesne enterprise, in which landlords mobilized their control over both land and labour to set up extensive non-agricultural enterprises on their estates. Many Bohemian landlords also set up demesne

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[69] Janoušek (1967), 12; Svoboda (1969), 74; Kočí (1963), 336; Maur (1976), 49; Maur (1981), 207, 211; Maur (1990), 114, 120; Klíma (1955), 131, 154; Myška (1979), 55-8.
[70] A detailed discussion is in Myška (1979). Maur (1976) documents similar tendencies (45-7).

breweries and distilleries, using labour from serfs to transport grain to the plant and manorial powers to oblige serfs to purchase quotas of beer and spirits.[71]

Bohemian landlords' expansion of demesne enterprises does not directly explain the non-agricultural occupational structure in the *Berní Rula,* which solely reflects serfs' own nonfarm activities. But demesne enterprises affected serf occupations indirectly via manorial labour demand. In attempting to increase the profitability of their estates by diversifying into non-agricultural activities, Bohemian landlords confronted the problem of obtaining industrial labour. After the Thirty Years War, market wages were high because labour was scarce, as a result both of wartime depopulation and of religious emigration after 1651. Landlords tried to reduce wage costs by replacing hired labour, for which they had to pay high market wages dictated by labour scarcity, with coerced labour, which they could use their institutional powers under the second serfdom to extort from serfs.[72] Demesne ironworks, glassworks, breweries, distilleries, and commercial fish-farming operations often mobilized 'Robot', feudal labour services which serfs were obliged to deliver to the overlord under the manorial system. Even more often, landlords demanded so-called 'forced wage-labour', whereby serf labourers, although paid to work in the lord's demesne enterprises, were compulsorily obliged to accept such work in return for below-market wage rates. At the same time, however, landlords were aware of the low quality of coerced work, and therefore used it to replace hired workers only in the lowest-skilled, least quality-sensitive tasks, mainly manual labour.[73] In the well-documented case of iron-making, for example, no serf labour was employed in the actual production and processing of iron, which required highly skilled and careful workers, but auxiliary operations such as transportation of raw materials were done mostly by serf labour.[74]

The demand for labour in demesne enterprises created incentives for landlords to expand their activities into villages that already had labourers who were not fully employed in agriculture, in order to take advantage of local labour pools. External workers were far more expensive: they had to be compensated to migrate; they had to be attracted through the offer of market wages; and, since they were not serfs subject to the local landlord, they could not be coerced or controlled through his institutional powers under the second serfdom. Local

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[71] Cerman (1996); Ogilvie (2001); Ogilvie (2005d), 421-4.
[72] Kočí (1963), 336; Maur (1976), 119-20; Maur (1965), 288, 297; Svoboda (1969), 77.
[73] Petráň (1963), 165-6; Maur (1976), 93, 121; Maur (1981), 208.
[74] Maur (1976), 120-21; Myška (1979), 59-61. Similar situation was in other industries such as brewery and milling (Maur (1976), 121).

serf workers were easier and cheaper to obtain in villages where they were not fully involved in agriculture. This motivated landlords to establish a presence in villages where such activities were already highly developed, in order to monitor and mobilize local non-agricultural labour pools.

10.3. Rent Extraction from Serf Enterprises

A second manorial intervention which interacted with serfs' non-agricultural activity was the increasing practice of granting permits for serfs to engage in crafts and commerce in return for paying fees to the manor. Depopulation resulting from the Thirty Years War and post-war religious ejections shrank the pool of artisans and craftsmen in towns.[75] Landlords profited by granting licenses to rural weavers and spinners in return for annual rents, loom fees, and spinning dues.[76] Any serf or freeman who wanted to produce glass in rural Bohemia had to obtain the landlord's permission to use the land for constructing the glassworks as well as to build new houses for the workers. Rural bakers, butchers, potters and other craftsmen were often obliged to pay license fees to the manor in return for permission to practise their crafts. Such industrial or commercial dues from serfs might proliferate in the presence of demesne manufactories, since ironworks and glassworks often led to building villages around the plant to house workers, enabling additional rents to be extracted from crafts and commercial operations servicing the manufactory and the surrounding industrial settlement.[77]

The fact that Bohemian landlords could use their institutional powers to extract rents from their serfs' non-agricultural activities reduced manorial incentives to forbid serf non-agricultural activity although, as we have seen, urban guilds sometimes put pressure on landlords to restrict the expansion of rural industries. Indeed, landlords had a positive incentive to encourage any serf non-agricultural activity from which they could extort a share of the proceeds. The institutional characteristics of the Bohemian second serfdom were thus not inconsistent with a positive association between landlord presence and certain forms of

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[75] Klíma (1955); Klíma (1957).
[76] Klíma (1955), 444-5; Klíma (1957), 90-1. Similar explanation is provided by Petráň (1963), 277.
[77] Klíma (1955), 153-4. Glass-making is not the only non-agricultural activity which was subjected to rent-extraction by landlords. For example, Míka (1960), 142-3, documents cases for various tertiary-sector activities, while Maur (1990), 113, documents rent extraction in other non-agricultural activities.

rural nonfarm activity by serfs. This does not, however, establish whether any such association was causal or in which direction causation ran.

On the one hand, landlords had incentives to encourage non-agricultural activities in villages because of the rents they could extract from those activities. Once they had encouraged such activities, they had an incentive to establish a presence on holdings in such villages in order to monitor payment of rents and fees. On the other hand, landlords had an incentive to occupy or use holdings in those villages which already had high level of non-agricultural activities. Existing non-agricultural activities in a village might attract manorial attention and create incentives for a manorial presence in the village to ensure that any manorial dues payable by rural craftsmen were properly delivered and that activities that might threaten manorial interests were controlled. Such considerations make it likely that the positive association between at least a small degree of landlord presence and greater non-agricultural activity in a village – the upward slope of the inverted-U curve – resulted more from landlords being attracted to industrial or commercial villages than from industry and commerce being attracted to villages where landlords were present.

10.4. Milling Monopolies

Bohemian landlords also sought to extract rents from the rural economy by limiting competition, with knock-on effects on non-agricultural activity.[78] One major sector in which Bohemian landlords sought revenues by limiting competition was milling.[79] Many Bohemian landlords assigned each of the villages on the estate to a mill owned by the landlord, obliged villagers to use only these mills, and forbade them to use mills belonging to peasants, towns, or other landlords. Another tactic was to grant a non-manorial mill a monopsony over particular groups of villagers and oblige the miller to pay a fee to the manor in return – i.e. to share some of his monopoly rents with the landlord.[80] Landlord presence on holdings within a village could facilitate surveillance over local activities including violations of manorial milling prerogatives, whose frequency is attested by manorial court records.[81] The presence of manorial personnel using holdings in a village made it possible for the manor to monitor

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[78] Examples of those practices are documented in Krofta (1949), 209-15, Klíma (1955), 78-80, Janoušek (1967), 14-6; and Ogilvie (2001).
[79] Maur (1990), 109.
[80] Maur (1976), 44-5; Maur (1990), 109-12; Ogilvie (2001), 446.
[81] Ogilvie (2001), 446.

the activities of the miller and any spin-off activities, and to burden them with additional dues, increasing their costs and stifling the intensity of non-agricultural activity that the presence of a mill in the village would otherwise have encouraged.

The nexus of incentives created by manorial milling prerogatives is consistent with the negative coefficient in Table 6 on the interaction term between mills and landlord presence. Independently, both mills and landlord presence were associated with higher non-agricultural activity. But in villages where both coexisted, the landlord's presence reversed the positive effect of mills. The two different institutional components of the second serfdom – the extraction of manorial rents from serfs' non-agricultural occupations and the extraction of manorial rents from mills – exercised countervailing effects on the overall intensity of rural nonfarm activity.

10.5. Regulation of Access to Landholdings

Landlord powers under the second serfdom also pursued policies in completely different spheres, such as access to landlholdings, which then had unintended knock-on consequences for the non-agricultural sector. Manorial restrictions on access to landholdings affected widowed female farmers particularly strongly.[82] As discussed above, female headship in the 1654 *Berní Rula* was very low by western European standards. An econometric analyses of a sample of Bohemian villages found that between 1591 and 1722, the period generally regarded as seeing the greatest intensification of the Bohemian second serfdom, there was a significant decline both in the level of female headship and in the elasticity of female headship with respect to socioeconomic influences favouring female economic independence. Local sources reveal manorial administrators dissolving female-headed households as poor fiscal risks and yielding to rent-seeking by village communities and other serfs who sought to take over women's farms for their own ends.[83]

As discussed in Section 9, female household headship by itself was positively associated with rural non-agricultural activities. But as Table 7 shows, in villages with landlord presence, this relationship not only ceased to be positive, but actually turned

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[82] For discussions of restrictions on women's property rights in Bohemian law and on different Bohemian estates before and after serf emancipation, see Ogilvie and Edwards (2000); Velková (2010), 257-9; Velková (2012), 508.
[83] Ogilvie and Edwards (2000).

negative. Independently, both female headship and landlord presence were associated with a higher intensity of non-agricultural activity. But in villages where both co-existed, the landlord's presence reversed the positive relationship between female headship and non-agricultural activities, thus stifling a major source of non-agricultural initiative emanating from the serfs themselves. Even where landlords were motivated to encourage non-agricultural occupations in order to extract rents from them, manorial policies to restrict female headship exercised a countervailing negative impact on non-agricultural activity.

These negative interaction effects between landlord presence and other factors – female headship, milling – which normally favoured rural nonfarm activity draw attention to a much broader consideration. The second serfdom was a multi-faceted institutional system which consisted of a multifarious and ever-proliferating conglomeration of policies and regulations by which landlords sought to extract rents from their serfs.[84] Where landlords could see a way of extracting rents by permitting their serfs to engage in non-agricultural activities, they were understandably willing to do so. This incentive may have been especially strong in villages where the landlord was able to establish a foothold making it possible to monitor and profit from local non-agricultural activities. But landlords also engaged in *other* rent-seeking activities, such as creating milling monopolies and restricting female headship, which increased the costs and risks for serfs to engage in non-agricultural activities. It seems likely that this underlies the negative coefficients on the interaction terms between landlord presence and female headship or milling. This may also explain why the relationship between non-agricultural activity and landlord presence followed an inverted-U shape: after a certain point, heavy landlord presence in the village meant that manorial encouragement of specific non-agricultural activities was outweighed by the stifling effect of broader manorial rent-extraction.

The multiple effects of manorial rent extraction may also account for the low overall proporation of rural non-agricultural activity in Bohemia, which paralleled that in other European societies in which landlords enjoyed strong institutional powers. As Table 2 showed, rural non-agricultural activity in early modern Bohemia, Poland and Finland was substantially lower than in western European economies. Many Bohemian villages in 1654 had no serfs pursuing non-agricultural occupations, and the average proportion of rural non-agricultural activity was quite low. In Bohemia, landlords permitted non-agricultural

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[84] Ogilvie (2013); Klein (2013); Dennison (2011, 2013); Briggs (2013).

activities under circumstances in which they were institutionally and logistically able to extract rents from them, including in villages where they had at least some local presence. But the wider panoply of manorial rent-extraction imposed heavy costs and risks on serf entrepreneurship, creating an institutional environment in which it was difficult for non-agricultural activity to expand beyond a certain level. Thus although local manorial oversight might motivate landlords to permit some rural nonfarm enterprises, the general framework of the second serfdom exercised broader negative effects on rural non-agricultural activity.[85]

11. Conclusion

Changes in occupational structure, particularly the growth of rural non-agricultural activities, are widely viewed as key indicators and potential contributors to economic growth during the early modern 'Little Divergence'. But we still know little about occupational structure in those many European economies that experienced the intensification of landlord powers under the early modern second serfdom. This paper sought to address this gap by presenting quantitative evidence on occupational structure in a richly documented eastern-central European society under the second serfdom and analyzing its socioeconomic correlates.

Our quantitative evidence for some seven thousand Bohemian villages in 1654 adds substance to the impression gained from less systematic sources for other societies, that eastern-central, nordic and southern Europe had a lower intensity of non-agricultural activities than the Netherlands or England during the 'Little Divergence'. On the other hand, Bohemia was not purely agricultural under the second serfdom: its rural economy was characterized by a rich array of rural industrial and commercial activities and although many Bohemian villages were purely agricultural, there were also some where all households were involved in industry or commerce.

Controlling for other village and estate characteristics, rural non-agricultural activity in early modern Bohemia was significantly and positively associated with village size, pastoral agriculture, sub-peasant social strata, Jews, freemen, female household heads, and mills. It was negatively related to arable agriculture and the presence of towns. These highly

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[85] For an analysis of how these constraints on growth were exercised, see Klein (2013).

significant statistical relationships refute traditional assumptions about Chayanovian peasant behaviour, suggesting instead that Bohemian serfs decided how to allocate time and other resources according to their relative productivities in alternative activities. The negative association between rural nonfarm activity and urban proximity casts intriguing doubt on the hypothesis, derived from western Europe, that urban centres uniformly benefited economic growth. At least in this eastern-central European economy, towns stifled rural crafts and commerce, possibly because of urban privileges giving town burghers and guilds institutional entitlements to hinder rural competitors.

Our econometric analysis found a positive association between landlord presence in a village and rural nonfarm activities, but the relationship turned negative at higher levels and landlord presence reversed the otherwise positive non-agricultural effects of female headship and village mills. Our findings for early modern Bohemia do not, therefore, imply that the second serfdom encouraged rural dynamism. Rather, they illuminate the multiplicity and complexity of the links between landlords' rent-extraction and serfs' economic decisions. The non-agricultural activities observed in seventeenth-century Bohemia arose overwhelmingly from the initiative of serfs themselves. Landlords permitted those non-agricultural activities by serfs from which they could obtain rents for themselves, while stifling non-agricultural initiatives – such as those surrounding female household heads and village millers – that threatened manorial rent extraction. These wider unintended consequences of manorial constraints may help explain why Bohemia, like other societies in which landlords enjoyed strong institutional privileges, had lower levels of non-agricultural activity than western European societies during the early modern 'Little Divergence'.

Appendix A: Robustness Checks

As mentioned earlier, given the parametric nature of the Tobit estimator, we estimated regression equation (1) with less restrictive OLS and PPML estimators. OLS served as a first way of examining our data, but does not deal with problems of censoring. PPML allowed us to deal with the large number of observations with the value zero for our dependent variable and with the parametric assumptions of the Tobit estimator. In both cases, the results presented in Tables 5 and 6 were confirmed.[86]

We also estimated alternative regression specifications. Specifically, we explored the arable sector in greater detail by using total land per holder instead of arable land per holder, accounting thus for fallow land. We also used the total land used for spring and winter crops separately: the results were similar to those reported in Tables 5 and 6.

We also experimented with the 'social strata' categories and the number of holders with less than 15 *strych* of land by sequentially including each of them in the regression specifications. We did this in order to account for potential multicollinearity of those regressors. Reassuringly, the results were similar to those reported in Tables 5 and 6.

Finally, we explored the information on breweries and ironworks provided in the *Berní Rula*, since these centralized manorial enterprises represented a different type of rural non-agricultural activity than the household-based serf enterprises recorded for ordinary taxpayers. Here we did not find any robust and statistically significant results, probably because of the small number of observations (there were only 12 villages with recorded breweries and only 6 with ironworks, in a data set of 7,257 villages).

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[86] The results are available from the authors upon request.

Appendix B: Estimation with More Radical Treatment of Outliers

Table 5a: Regression Analysis of the Determinants of Non-Agricultural Occupations in Rural Bohemia in 1654 (Tobit Model)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Size of Village							
number of holdings	0.0042***	0.0043***	0.0043***	0.0042***	0.0042***	0.0043***	0.00429***
	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]
percentage of empty holdings		-0.15***	-0.16***	-0.15***	-0.151***	-0.14***	-0.13***
		[0.0015]	[0.0017]	[0.0015]	[0.0014]	[0.0018]	[0.0014]
Arable Sector							
total arable land of occupied holdings per holder	-0.00118***	-0.0012***	-0.0008***	-0.00119***	-0.0005***	-0.0005***	-0.0005***
	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]	[0.00002]
Pastoral Sector							
number of working animals per holder	-0.009***	-0.012***	-0.01***	-0.0089***	-0.006***	-0.0056***	-0.007***
	[0.0003]	[0.0003]	[0.0004]	[0.0003]	[0.0003]	[0.0003]	[0.0003]
number of cattle per holder	0.0005***	0.00089***	-0.00009	0.0005***	0.0004**	0.0001***	-0.0003
	[0.0002]	[0.0002]	[0.0003]	[0.0002]	[0.0002]	[0.0002]	[0.0002]
Social Strata							
percentage of 'cottagers'	0.14***	0.14***		0.15***	0.09***	0.08***	0.09***
	[0.0007]	[0.0008]		[0.0008]	[0.0001]	[0.001]	[0.0001]
percentage of 'smallholders'	0.28***	0.27***		0.28***	0.21***	0.20***	0.20***
	[0.0009]	[0.0009]		[0.0009]	[0.001]	[0.001]	[0.001]
percentage of 'freemen'				0.13***	0.09***	0.1***	0.1***
				[0.001]	[0.0009]	[0.0009]	[0.0009]
percentage of Jews				2.59***	2.50***	2.49***	2.49***
				[0.0016]	[0.0019]	[0.006]	[0.0016]
percentage of 'peasants'			-0.22***				
			[0.001]				
Other Village Characteristics							
presence of mill	0.30***	0.29***	0.298***	0.299***	0.298***	0.295***	0.297***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.00103]
percentage of female household heads	0.047***	0.029***	0.024***	0.021***	0.018***	0.020***	0.015***

57

	[0.002]	[0.0025]	[0.003]	[0.002]	[0.0025]	[0.0027]	[0.002]
presence of a town on estate	-1.773***	-1.77***	-1.76***	-1.79***	-1.78***	-1.77***	-1.79***
	[0.0005]	[0.0005]	[0.0007]	[0.0005]	[0.0005]	[0.0005]	[0.0005]
percentage of holders with less than 15 str of arable land					0.108***	0.11***	0.106***
					[0.00112]	[0.00113]	[0.00113]
Second-Serfdom Proxies							
presence of a holding held/used by landlord	0.066***	0.085***	0.087***	0.086***	0.087***		
	[0.0003]	[0.00068]	[0.00069]	[0.00068]	[0.00068]		
percentage of arable land held/used by landlord						0.23***	
						[0.003]	
number of holdings held/used by landlord							0.0095***
							[0.0002]
Constant	0.41***	0.41***	0.408***	0.28***	0.21***	0.19***	0.21***
	[0.00057]	[0.0006]	[0.0007]	[0.00059]	[0.00058]	[0.00058]	[0.00058]
Estate Dummies	YES	YES	YES	YES	YES	YES	YES
N	5937	5937	5937	5937	5937	5907	5937
Log-likelihood value	-1125.2	-1112.0	-1110.7	-1095.7	-1090.1	-1072.5	-1099.2
Sigma	0.23	0.23	0.228	0.228	0.227	0.225	0.2276
Pseudo-R^2	0.54	0.545	0.546	0.55	0.55	0.56	0.551

Sources: see text

Appendix B: Estimation with More Radical Treatment of Outliers
Table 6a: Regression Analysis with Second- Serfdom Non-Linear Terms (Tobit Model)

	(1)	(2)
Size of Village		
number of holdings	0.00432***	0.00431***
	[0.00002]	[0.00002]
percentage of empty holdings	-0.146***	-0.144***
	[0.0023]	[0.0013]
Arable Sector		
total arable land of occupied holdings per holder	-0.00053***	-0.00051***
	[0.00002]	[0.00002]
Pastoral Sector		
number of working animals per holder	-0.0055***	-0.0059***
	[0.0003]	[0.0003]
number of cattle per holder	0.0009***	-0.0004**
	[0.0002]	[0.0002]
Social Strata		
percentage of 'cottagers'	0.087***	0.095***
	[0.001]	[0.00098]
sh percentage are of 'smallholders'	0.198***	0.21***
	[0.0014]	[0.0012]
percentage of 'freemen'	0.11***	0.099***
	[0.0009]	[0.0009]
sh percentage are of Jews	2.491***	2.497***
	[0.007]	[0.001]
Other Village Characteristics		
presence of mill	0.295***	0.297***
	[0.001]	[0.001]
percentage of female household heads	0.012***	0.011***
	[0.0029]	[0.0025]
presence of a town on estate	-1.77***	-1.79***
	[0.0005]	[0.0005]
percentage of holders with less than 15 str of arable land	0.11***	0.106***
	[0.00114]	[0.00113]
Second-Serfdom Proxies		
percentage of arable land held/used by landlord	0.27***	
	[0.023]	
(percentage of arable land held/used by landlord)^2	-0.06**	
	[0.03]	
number of holdings held/used by landlord		0.044***
		[0.001]
(number of holdings held/used by landlord)^2		-0.0049***
		[0.0001]
Constant	0.19***	0.21***
	[0.0006]	[0.0006]
Estate Dummies	YES	YES

N	5907	5937
Log-likelihood value	-1072.5	-1092.9
Sigma	0.225	0.227
Pseudo-R^2	0.556	0.553

Sources: see text

Appendix B: Estimation with More Radical Treatment of Outliers
Table 7a: Regression Analysis with Second-Serfdom Interactions (Tobit Model)

	(1)	(2)	(3)
Size of Village			
number of holdings	0.0042***	0.0044***	0.0043***
	[0.00002]	[0.00002]	[0.00002]
percentage of empty holdings	-0.15***	-0.142***	-0.143***
	[0.00143]	[0.0012]	[0.00141]
Arable Sector			
total arable land of occupied holdings per holder	-0.00050***	-0.00051***	-0.00053***
	[0.00002]	[0.00002]	[0.00002]
Pastoral Sector			
number of working animals per holder	-0.006***	-0.004***	-0.005***
	[0.0003]	[0.0003]	[0.0003]
number of cattle per holder	0.0004**	-0.0001	-0.0009***
	[0.0002]	[0.0002]	[0.0002]
Social Strata			
percentage of 'cottagers'	0.093***	0.088***	0.094***
	[0.001]	[0.00101]	[0.001]
percentage of 'smallholders'	0.207***	0.19***	0.208***
	[0.0012]	[0.0013]	[0.0012]
percentage of 'freemen'	0.08***	0.1***	0.09***
	[0.00092]	[0.00092]	[0.00093]
percentage of Jews	2.49***	2.48***	2.488***
	[0.02]	[0.006]	[0.002]
Other Village Characteristics			
presence of mill	0.3***	0.29***	0.3***
	[0.00114]	[0.00113]	[0.0011]
percentage of female household heads	0.05***	0.037***	0.039***
	[0.00396]	[0.00385]	[0.0036]
presence of a town on estate	-1.78***	-1.77***	-1.79***
	[0.0005]	[0.0005]	[0.0005]
percentage of holders with less than 15 *strych* of arable land	0.109***	0.11***	0.106***
	[0.00112]	[0.00114]	[0.00113]
Second-Serfdom Proxies with Interactions			
presence of mill x presence of a holding held/used by landlord	-0.099***		
	[0.005]		
percentage of female household heads x presence of a holding held/used by landlord	-0.49***		
	[0.03]		
presence of a holding held/used by landlord	0.11***		
	[0.002]		
presence of mill x percentage of arable land		-0.12***	

held/used by landlord	[0.02]		
percentage of female household heads x percentage of arable land held/used by landlord	-1.57*** [0.14]		
percentage of arable land held/used by landlord	0.3*** [0.005]		
presence of mill x number of holdings held/used by landlord			-0.023*** [0.002]
percentage of female household heads x number of holdings held/used by landlord			-0.28*** [0.016]
number of holdings held/used by landlord			0.046*** [0.001]
Constant	0.22*** [0.0006]	0.2*** [0.0006]	0.22*** [0.0006]
Estate Dummies	YES	YES	YES
N	5937	5874	5904
Log-likelihood value	-1087.2	-1069.5	-1092.5
Sigma	0.227	0.225	0.228
Pseudo-R^2	0.5554	0.555	0.551

Sources: see text

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