Malthus in Germany? Reproductive Success and Status in pre-industrial Germany

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30 August 2024

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August 2024

Abstract

This paper studies the individual-level assumptions of the Malthusian model in pre-industrial Germany. By exploiting the demographic records of 150,000 individuals from the historical county of Wittgenstein, I test for status gradients in child mortality (the Malthusian positive check) and marital fertility (preventive check). While I find no evidence for a status gradient in child mortality, I find strong evidence for a status gradient in fertility. The richest families had, on average, one-and-a-half extra children compared to their poorer compatriots. Turning to the mechanics of the preventive check, this was driven by delayed marriage in low-status families. Disaggregation of my dataset into six periods reveals that this fertility differential began to disintegrate around 1800. I provide tentative evidence that urbanisation and industrialisation contributed to this demographic change.

JEL Classification: J12, J13, N34, N94

Keywords: German Economic History, Malthus, Demographic History, European Marriage Pattern

*I would like to express my deepest gratitude to Eric Schneider for his excellent supervision. I also extend my thanks to Oliver Brufal, Neil Cummins, Richard Franke, Morgan Kelly, and Matteo Pograxha. for their feedback. Special thanks go to the seminar participants at the Center for Economics, Policy and History (CEPH), the IPECE workshop, and the IEA conference for their insightful comments and suggestions. I am particularly grateful to Robert Stelter and Georg Fertig for bringing my attention to the dataset and providing crucial input during the early stages of this project. I also wish to thank Katrin Moeller for her work in coding occupations into OhdAB. Lastly, this paper would not have been possible without the monumental efforts of the late Jochen Mehldau, who compiled the Wittgensteiner Familiendatei and made it accessible through the Landesarchiv Nordrhein-Westfalen.

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Introduction

Malthus lived at the dusk of the laws of population he described. Still, his articulation of demographic dynamics has persisted, informing how contemporary economists conceptualise pre-industrial societies (Galor and Weil 2000; Voigtländer and Voth 2013). With subsistence, at best growing linearly, a binding constraint to population – which can increase exponentially – societies are trapped in an equilibrium where population growth is nil, living standards are determined chiefly by population, and any gains from technological progress are swallowed up by the population growth they induce (Clark 2007). Malthus argued that this subsistence constraint operated through two checks. The positive check; a negative relationship between mortality and living standards. And the preventive check; a positive relationship between fertility and living standards (Malthus 2008). These checks should be observable at the population-level and here, they have been studied extensively (Pfister and Fertig 2020; Fernihough 2013; Crafts and Mills 2009; Lee and Anderson 2002). However, we should also observe them as reproductive inequality at the individual-level. Studies at this individual level are rare outside England and France (Cummins 2020; Croix, Schneider, and Weisdorf 2019; Boberg-Fazlic, Sharp, and Weisdorf 2011). This paper will contribute to filling this gap by investigating reproductive inequality in pre-industrial Germany.

Since I cannot directly observe living standards in historical populations, I proxy for them using occupational status. To this end, I operationalise reproductive inequality as a positive status gradient in marital fertility (preventive check) and a negative status gradient in under-15 mortality (positive check). Historical sources containing the detailed individual-level data necessary to test these relationships are rare. However, building on the invaluable work of family historians, this paper draws upon the one-place study (Ortsfamilienbuch) of the rural county Wittgenstein, encompassing the complete family reconstitution of 16 parishes in Westphalia (Mehldau 2011).[1] This source is suitable for this study for three reasons. First, it is extensive both in depth and temporal scope, containing demographic histories for over 150,000 individuals across five centuries. Second, over 24 per cent of men have their occupation recorded. This compares favourably to the preeminent family reconstitution projects for France or England

[1]The unknown county has a connection to the known philosopher. The family of Ludwig Wittgenstein can be traced to the town of Laasphe, where in 1808, his great-grandfather – Moses Meyer – assumed the surname Meyer-Wittgenstein. (Bartley 1999)

(Wrigley and Schofield 1981; Henry and Houdaille 1973). Third, its intensive breadth – capturing contingent parishes in two sovereign principalities instead of a range of remote parishes – sets it apart since this reduces the migration-induced censoring of life histories.

Turning to my findings, the historical population of Wittgenstein was subject to considerable reproductive inequality. Although I find no evidence for a positive check – low- and high-status families had similar levels of child mortality – my results support the presence of the preventive check; high-status families had, on average, one-and-a-half extra children when compared to low-status families. I check whether controlling for the extensive margin of fertility – namely childlessness and celibacy – influences this result, but it does not. To elucidate the mechanism of reproductive inequality in Wittgenstein, I turn to the inner workings of the preventive check. I estimate the status gradients in the starting (proxied by mother's age at marriage), the spacing (proxied by the average birth interval), and the stopping of reproductive behaviour (proxied by mother's age at last birth). In accordance with Malthus, I find no clear status gradient in spacing or stopping, implying natural fertility within marriage, but a significant gradient in starting, showing that mothers of lower socioeconomic status tended to delay marriage. Later age of marriage amongst lower-class individuals can account for the entirety of the preventive check. Last, I can explore temporal variation in the preventive check by disaggregating the dataset into six periods. The preventive check disappeared at the end of the 18th century, almost a century before the fertility transition (Knodel 1974). I interact status with couple-level dummy variables denoting (1) whether a couple married in an urban parish and (2) whether the husband engaged in a proto-industrial occupation. Here, I show that the preventive check was a rural phenomenon, with its disappearance hastened by increasing urbanisation rates. Further, I provide tentative evidence suggesting that the preventive check's demise was partly driven by the advent of new industrial employment opportunities, which reduced the barriers to marriage, breaking the 'chain between reproduction and inheritance' (Tilly and Tilly 1971). Although these estimates are non-causal and the factors non-exclusive, they can inform our understanding of the drivers of early demographic change.

Aside from the many who use Malthus to explain living standards and population size pre-1800, some go as far as stressing the dynamics of the Malthusian model itself as a *prima causa* of modern economic growth (Clark 2007; Galor and Moav 2002). This latter, neo-Malthusian literature, foregrounds how differential rates of reproductive success led to a proliferation of growth-inducing traits, ultimately culminating in the Industrial Revolution. Although these theories are contested, they point to the importance of reproductive inequality in structuring economic relationships and determining the direction of economic change. As such, the value of understanding the nature and channels of reproductive inequality in pre-industrial Germany is evident. Further, although the mechanics of the Malthusian era are asserted with credence by many authors, multiple empirical contributions illustrate that pre-industrial demographic regimes do not obey Malthus as closely as some authors presume (Dennison and Ogilvie 2014; Croix, Schneider, and Weisdorf 2019; Edwards and Ogilvie 2019; Cinnirella, Klemp, and Weisdorf 2017). This paper contributes to this strain of the literature by adding a case removed from the extremes of France and England as the vanguard of fertility decline and industrialisation, respectively. The striking similarities between the English and German demographic regimes raise poignant questions about the 'exceptionalism' attributed to England in some neo-Malthusian theories. Further, exploring the factors that could alter the reproductive inequalities of the pre-industrial age contributes to our understanding of the drivers of demographic change.

The next section reviews existing tests of the Malthusian model. Section three discusses the data and Wittgenstein in more detail. Section four elaborates on my empirical approach. Section five presents the results. Section six discussed my findings in light of the survival-of-the-richest hypothesis.

2 Testing Malthus

Malthus first defined his Principles of Population in a 1798 essay composed in response to the utopian speculations of his contemporaries (Malthus). The central tenet of his demographic model is that "Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio" (Ibid). With subsistence always a binding constraint for population, he saw his contribution less in identifying this *a priori* truth and more in describing how population is kept in check (Wrigley 1986). The checks on population come in two varieties. The positive check constrains population growth by increasing mortality. The unfortunate strata of society that are exposed to the binding constraint of subsistence die due to "war, pestilence, and famine". The preventive check operates through fertility; here, births are reduced pre-emptively to avoid the wrath of the positive check. Due to the unchanging "passion between the sexes", Malthus does not allow for fertility control within marriage. As such, the preventive check could operate only through delaying marriage or celibacy (Malthus 2008).

Macro-level inquiry into population-level outcomes prevails among empirical studies of the Malthusian checks. Subsequent generations of studies focused on estimating the checks in the short-run using bivariate relationship between vital rates and grain prices; and in the long-run by turning to the structural relationships between population and real wages (Pfister and Fertig 2020). Pfister and Fertig (ibid.) test the long and short-term checks for Germany. They find that the preventive check persisted throughout the 19th century, while the positive check was present as an instantaneous response to real wage shocks but not as a long-term association. Given the macro predictions of the Malthusian model and the relative scarcity of individual-level records necessary to conduct micro-analysis, the focus on population-level outcomes is unsurprising. Still, inferring the individual-level associations from such population-level relationships constitutes an ecological fallacy.[2] Additionally, the focus neo-Malthusian authors head to individual-level associations necessitates scrutinising them. Using evidence from population-level studies to argue for or against neo-Malthusian growth theories would be fruitless since they do not base their models on the population-level outcomes of the Malthusian model but on the implied reproductive inequality.

Individual-level studies of the Malthusian model belong to two strands of historical demographic research. The first evaluates how demographic variables respond to economic pressure by drawing upon the historical event analysis pioneered by the Eurasian Population and Family History Project (Bengtsson, Campbell, and Lee 2004). This methodology enables authors to evaluate the contemporaneous demographic adaption of historical populations to economic shocks. Using the Wittgenstein reconstitution, Thiehoff (2015) employs this methodology to show individual-level responses to changes in material living standards. The second strand examines cross-sectional associations between socioeconomic status and demographic outcomes for couples. Since I am interested in lifetime outcomes for couples of different classes, the latter approach is better suited for the questions at the centre of this paper. Additionally, if the adaptions to economic pressure identified by historical event analysis are not transitory (i.e a reduction in fertility is offset by a subsequent increase) I should be able to capture their impact on reproductive success in cross-section. The same holds for alternative mechanisms of Malthusian

[2] The same holds in the opposite direction; individual-level associations between income and fertility/mortality do not necessitate the same association between aggregate income and crude birth or death rates.

inequality, such as unequal access to property (niche hypothesis) (Fertig 2019). If the population was kept in check by "the chain between reproduction and inheritance" (Tilly and Tilly 1971) preventing lower-class couples from attaining the economic base necessary for establishing a family, this should be evident in the status gradients in celibacy and age at marriage. As such, testing the Malthusian model by turning to the cross-sectional associations between status and demographic variables promises to paint the fullest picture of how Malthusian forces shaped pre-industrial society in Wittgenstein.

Most papers taking this approach focus on England or France. For England, Clark and Hamilton (2006) and Clark and Cummins (2015) use probate records to identify a strong association between wealth and fertility among English men before 1800. Using the Cambridge Group reconstitution, Boberg-Fazlic, Sharp, and Weisdorf (2011) reaffirm the findings of Clark, Cummins, and Hamilton. The advantage of the reconstitution is that it is more representative and broader. The disadvantage is that wealth and income are not observed directly. However, since parish registers observed occupation for a subset of the population, occupational status – as a proxy for income and wealth – is used. Using the same dataset, Croix, Schneider, and Weisdorf (2019) revise earlier estimates by accounting for the extensive margin of fertility (celibacy and childlessness). Although they identify a status gradient in fertility, once the extensive margin is accounted for, the middle-class has higher net fertility than the upper-class. None of these studies find conclusive evidence for a positive check. By using records of property transfer, Kelly and Ó Gráda (2014) extend the scope of inquiry into the high middle-ages. They find that before the introduction of the Tudor poor laws, the positive check affected both high and low-income families with a disproportionat impact on the poor.

For France, individual-level associations have been tested by Weir (1995) and Cummins (2020). Weir links tax records to a family reconstitution for a small town outside Paris; he finds evidence for a strong positive and preventive check. However, given the small sample size, the external validity of these findings should be interpreted with caution. Cummins draws upon a much larger sample, using the Henry reconstitution of 41 French villages. He finds no evidence for the positive check but evidence for a preventive check, which was weaker than in England and had disappeared by the late 18th century.

Several papers tested the individual-level dynamics of the Malthusian model outside of Europe. Kumon and Saleh (2023) are the first to illuminate the existence of the pre-industrial preventive check in the Middle East and North Africa. Studies for East Asia document that here too, upper-class families had higher fertility rates (Lee and Feng

1999; Lee and Park 2019). However, here, the dynamics diverge, with higher fertility rates attributable to variation in marital fertility – through infanticide, abstinence, or breastfeeding practices – instead of marriage behaviour and celibacy.

3 Data

3.1 One-place Studies

As evident above, the study of pre-industrial demography requires a set of sources distinct from those employed for later epochs. In Europe, census or population registry data with sufficient granularity to construct individual life and family histories are seldom available prior to the mid-19th century (Campbell 2015). In light of this, researchers have turned to probate records, crowd-source genealogies, or family reconstitutions. Family reconstitutions have high coverage at the intensive margin. Still, due to the labour-intensive process of linking demographic events, reconstitutions tend to focus on singular, or at most, a collection of parishes and rarely capture urban populations (Blanc 2023). Although crowd-source genealogies have advantages at the extensive margin – capturing 'substantial spatial variation' – low coverage at the intensive margin makes them a suboptimal source for studying the Malthusian assumptions (ibid.). In the absence of probate records, family reconstitutions are the best-suited source for the research questions posed in this paper (Alter 2019). Here, without a preeminent family reconstitution project for Germany, the question remains whether the one-place study constitutes a viable alternative. One-place studies, as a unique source for German demographic history, have been exploited in seminal studies by Knodel (1987) and Imhof (1990). However, not all one-place studies fulfil the criteria of a scientific family reconstitution. The oversampling of genealogies of particular interest to the researcher or including demographic events from outside the study area can bias demographic measures by obscuring the population at risk. Still, a subset of all one-place studies constitutes sources on par with scientific family reconstitutions (Knodel and Shorter 1976).

3.2 Wittgenstein

The Wittgenstein one-place study compiled by Jochen Mehldau appears a perfect exemplar of this. Its exceptional scientific rigour (citing the specific source for each demographic event) and breadth (capturing the universe of ecclesiastically recorded demographic events for an entire county instead of one parish) set it apart within the universe of one-place studies. The Wittgenstein one-place study encompasses 150,000 individuals across 42,000 couples. The core of the study draws upon the complete registers of 16 parishes (11 Reformed-protestant, 1 Lutheran-protestant, 4 Roman-catholic) (Mehldau 2011).

Notably, the approach of the Wittgenstein reconstitution is micro-historical. Instead of locking at a broad sample of remote parishes, I observe one cluster of neighbouring parishes. This is advantageous since much early-modern migration occurred over short distances (e.g. neighbouring parish) and will ergo not censor life histories in my sample (Clark 1979; Patten 1976). Moreover, Wittgenstein constitutes a valuable case study. Wittgenstein is nestled in the Rothaargebirge – a low-mountain range – in the south-east of Westphalia. Before the Reichsdeputationshauptschluss of 1803, the territory was split between the two principalities of Sayn-Wittgenstein-Hohenstein in the south and Sayn-Wittgenstein-Berleburg in the north (Köbler 2007).[3] Protestantism was adopted early; most of the population was Reformed Protestant, with a sizable Lutheran minority and smaller Roman Catholic and Jewish ones. Given its mountainous geography, extensive forests, and low agricultural suitability, Wittgenstein was characterised by fragmented farming instead of larger estates. Compounded by a partible inheritance structure, this meant that most inhabitants of Wittgenstein practised some degree of subsistence agriculture. In the later part of our study period, the first-order geography, which had initially retarded Wittgenstein's development, favoured the development of forestry and metallurgy proto-industries. Wittgenstein's major export was charcoal, primarily to its more industrialised neighbours. Aside from artisans, a small textile cottage industry constituted an additional source of employment (Klein 1936; Fremdling 1986). Still, although it was located at the border of the economically dynamic Rhineland, its infrastructural backwardness and geographical remoteness isolated Wittgenstein from modernising tendencies late into the 19th century (Klein 1936). Although it would be misguided to claim that these two principalities are wholly representative of German demographic behaviour, these traits of Wittgenstein – subsistence agriculture and the development of proto-industry – make it a pertinent case for understanding demographic behaviour and change in rural Germany.

[3] A substantial step in the secularization and mediatization of the late Holy Roman Empire.

3.3 Inclusion restrictions

Since one-place studies link records from outside the core area of the study to include the greatest possible number of links, they are at risk of over-sampling genealogies of particular interest to contributors or greater ease of access. To remedy this issue, I include only couples whose marriage was recorded in the core parishes, constituting the complete reconstitution at the heart of the one-place study (56.58 *per cent* of couples).[4] To limit confounding age effects on reproductive success, only bachelor-spinster marriages are included (83.64 *per cent* of remaining couples). Individuals are not observed across all their lifetime but instead, only enter observation at discrete instances when specific demographic events occur. Since migration is such an unobserved event, I need to account for the migration-induced censoring of life histories (Campbell 2015). To this end, only non- and in-migrants prior to marriage are included (50.61 *per cent* of remaining couples).[5] Last, although the reconstitution contains records from as early as 1525, observations from before 1650 are treated with caution. An 1876 law transferring the responsibility for recording demographic events from the ecclesiastic to the secular realm marks the end of parish registers as a reliable source. To ensure that most time at risk of birth is observed for all included couples, all marriages before 1830 are included. These restrictions result in a sample of 8,298 couples and 43,495 births (Tab. 1).

4 Empirical Strategy

I test for the individual-level manifestations of the Malthusian model in cross-section. Reproductive success is a composite of how many children were born (preventive check), and how many died prior to reaching maturity (positive check). As such, the demographic outcomes of primary interest are gross marital fertility and childhood mortality. This is in line with Malthus's articulation, who argued that childhood mortality was the primary mechanism of the positive check (Malthus 2008). Here I study under-15 mortality instead of infant mortality to capture how many children died before reaching reproductive age. Further, I can reasonably assume that children would have stayed in their parents' household until this age. Estimates using mortality to a higher age would overstate mortality given outmigration-induced censoring of records. As outlined by

[4] 100 *per cent* of couples is defined as all inferred couples contained in the Wittgenstein one-place study.

[5] I also run regressions based on a sample that's only restricted by mothers' death (59.9 *per cent* of remaining families), allowing for the out-migration of fathers. This has a negligible effect on results, so only the stricter restriction is reported throughout.

TABLE 1. Summary Statistics

Demographic Variables	Mean	Std. dev	Minimum	Maximum
Gross Marital Fertility	5.19	2.97	0	16
Net Marital Fertility	3.58	2.31	0	12
Probability of Childlessness	0.05	0.22	0	1
Share of under-5 mortality	0.26	0.24	0	1
Share of under-15 mortality	0.31	0.26	0	1
Mother's age at marriage	24.70	5.84	11	55
Father's age at marriage	28.41	6.20	14	70
Mother's age at last birth	37.66	6.20	15	55

Status Categories	Obs. Couples (Husband's Status)	Obs. Births (Father's Status)	HISCAM Status (out of 100)	Skill-level (Out of 5)
Rank 1	456	2067	47.56	1.87
Rank 2	4007	20945	56.18	1.02
Rank 3	1150	5800	50.08	2.09
Rank 4	1198	6033	52.61	2.47
Rank 5	488	2599	59.60	3.12
Rank 6	811	4528	75.07	3.56
Rank 7	188	1080	95.78	3.85
Observations	8298	43495		

Note: All summary statistics in panel 1 are calculated at the level of couples.
HISCAM status and skill-levels are calculates as the mean score amongst all couples in the Status category.
Skill-level is based on the OhdAB occupational classification scheme.

Croix, Schneider, and Weisdorf (2019) the preventive check can operate through both the intensive margin (gross marital fertility conditional of having fertility greater than zero), and the extensive margin. The extensive margin of fertility is determined by childlessness and celibacy. My baseline estimates account for childlessness; celibacy is investigated as a separate outcome. Additionally, to better understand the preventive check, outcomes of secondary interest include the starting, stopping and spacing of the reproductive period. Given Malthus's conceptualisation of the "passion between the sexes" the preventive check should operate through later starting, but not through earlier stopping or greater spacing.

All relationships are tested using one baseline regression that estimates the effect of occupational status on these different demographic outcomes. Marriage period fixed effects (α_t) are included to account for non-status induced temporal variation. Parish fixed effects (τ_p) are included to account for environmental factors. All standard errors are clustered at the parish level, β_1 – capturing the association between the demographic outcome and occupational status – is the coefficient of interest.

$$Y_{i,t,p} = \alpha_t + \tau_p + \beta_1 \cdot \sum \text{Status}^{u}_{i,t,p} + \mathbf{X}'\gamma + \epsilon_{i,t,p} \quad (1)$$

In the patriarchal context of rural pre-industrial Germany, male status was the pre-eminent determinant of household status and income. Hence, socioeconomic status ($\text{Status}^{u}_{i,t,p}$) is approximated by the husband's/father's occupational status throughout. Occupational labels were cleaned and manually coded into HISCO, a historical occupational classification scheme, yielding 303 unique occupations. Using HISCO, all occupations were assigned HISCAM occupational scores (0-100). HISCAM is based on the observed stratification of social interactions in historical societies – as such, it is distinct from class schemes that assign occupations to social groups based on the post-factum conceptualisation of status (Lambert et al. 2013). The recommended universal HISCAM scale was used since the German-specific one relies on too small a sample.

Second, occupations were sorted into status categories. A set of discrete categories allows for more flexibility than a continuous scale such as HISCAM. Not only can they account for a non-linear relationship between status and demographic outcomes, but they also do not necessitate defining the position of every occupation in relation to all other occupations. The primary coding I pursue is a variation of the seven wealth/status categories defined by Clark and Hamilton (2006). Here, groups are based on wealth categories derived from probate records for England and the Tables des Successions et Absences for France (Clark and Cummins 2015; Cummins 2020). One downside is that I do not observe wealth and can therefore not check whether the groups align as they do in England and France. Still, given their tested applicability to different European contexts and the comparability to other studies they enable, they are the preferred status measure in this paper. I amend the status categories to the specific context of Wittgenstein. Specifically, I merge the farmer and the unobserved categories and assign them to rank 2, below workers but above labourers/servants. Pastors were only incentivised to note done occupation if it diverged from the norm. Since most inhabitants in Wittgenstein practised small-hold agriculture, the unobserved category is assigned to small-hold farming. Additionally, with few wealthy farms in Wittgenstein, classifying farmers as rank five does not correspond to the socioeconomic realities of this study. Hence, rank two was chosen to better represent their position in Wittgenstein.[6]

[6]Results are robust to not adapting the seven wealth/status categories to the specific context of Wittgenstein. See subsection 6.3.

Some individuals have multiple recorded occupations. This is the result of occupational mobility, differing occupational names being used, or people pursuing multiple occupations. Throughout, to account for this mobility, I use the highest status occupation recorded.[7] Table 1 includes summary statistics for couples married in Wittgenstein according to the seven-level scale.

Turning to the outcome variables, when testing for the status gradient in fertility, $Y_{i,t,p}$ denotes gross marital fertility at the couple level. When testing for the status gradient in mortality, I estimate equation (1) at the individual level for all children born in my sample. Here, $Y_{i,t,p}$ is a dummy variable that takes value one if the child died prior to turning 15. A problem when estimating child mortality from family reconstitution data is that infant deaths often went unreported in parish registers. To account for this I follow the approach in Cummins (2020); mortality is adjusted using a repeated naming strategy (Houdaille 1976; Cummins 2020). In pre-modern Europe, when a child died, the subsequent same-sex child was often given the same forename. Therefore, where a child has a subsequent sibling of the same forename and is not linked to a burial record, it is assumed to have died as an infant.

Prior papers have tested the positive check by estimating the relationship between status and the proportion of children dying at the couple level. Since the proportion of children dying is a function of both childhood mortality and gross marital fertility, this approach introduces bias if a status gradient in fertility is present. Even if the probability of a child dying is equivalent across status groups, variation in the denominator could introduce spuriously significant associations between status and mortality. As such, I prefer estimating this association at the individual level using a binary outcome variable.

I account for the extensive margin of fertility by estimating equation (1) for childlessness and at the individual level for celibacy. An individual observation is deemed celibate if I observe their birth and death in the county but no marriage or out-of-wedlock births. Celibacy is evaluated separately for women and men. Since it is less likely I record an occupation for men that never married, I use father's occupational status when studying celibacy. To elucidate the mechanics of the preventive check, I estimate regressions where $Y_{i,t,p}$ denotes mother's age at marriage (starting), mother's age at last birth (stopping), and the average birth interval (spacing). Here I restrict my sample to complete marriages, where both spouses survived to 50, to ensure these estimates are

[7]Results are robust to replication using their lowest status occupation. See subsection 6.3.

not coloured by the death of either spouse. Since birth intervals increase with age, I control for marriage duration, proxied for by age at marriage.

Unless otherwise stated, regressions with a continuous outcome variable are estimated using ordinary least squares. Those with a binary outcome variable are specified using a logistic model and estimated using maximum-likelihood. To account for the discrete count nature of births per family, regressions pertaining to fertility were also specified using negative binominal and poisson models. However, since this did not affect the results, I only report results using OLS (see Table A1).

5 Results

5.1 Positive and Preventive Check

I first turn to the status gradient in adjusted under-15 mortality at the individual level. Here, I estimated the effect of fathers' status on the log-odds of a child dying prior to turning 15. Column (1) reports results with HISCAM as treatment variable. In column (2) the treatment is a set of dummy variables for the seven status categories, here the lowest rank (labourers/servants) constitute the omitted reference category. The latter is my preferred specification, since it allows for a non-linear relationship between status and the demographic outcome.

Neither HISCAM, nor the seven status categories reveals a association between status and adjusted under-15 mortality. Given the absence of any discernible evidence for a status gradient in mortality the existence of a positive check at the individual-level can be rejected. This finding is broadly consistent with evidence for France and England (Boberg-Fazlic, Sharp, and Weisdorf 2011; Clark and Cummins 2015; Cummins 2020). Notably this does not run counter to a Malthusian interpretation; he allows for the ascendancy of the preventive over the positive check. Although the laws of population condemned the lower classes to a life of distress and precarity, if the preventive check was sufficiently strong, a status-gradient in mortality could be avoided with the positive check acting only as a "last most dreadful resource of nature". This interpretation is also supported by Kelly and Ó Gráda (2014) findings that in late-medieval England a status-gradient in mortality only emerged in periods of sustained famine.

To test for the preventive check, I turn to gross marital fertility at the couple level. The estimates reported in columns (3) and (4) of Table 3 are conditional on marriage but not on the birth of a child. As such the reported coefficients already account for status

TABLE 2. The Effect of Status on Reproductive Success

	Under-15 Mortality		Gross Fertility	
	(1) HISCAM	(2) Status Class	(3) HISCAM	(4) Status Class
HISCAM	1.000		0.017***	
	(0.001)		(0.004)	
Rank 2 (Smallhold Farmer)		1.103		0.632***
		(0.072)		(0.114)
Rank 3 (Workers)		1.077		0.625***
		(0.086)		(0.171)
Rank 4 (Craftsmen)		1.109		0.652***
		(0.080)		(0.140)
Rank 5 (Traders/Clerks/Supervisors)		0.939		0.906***
		(0.083)		(0.160)
Rank 6 (Professionals/Academics)		1.008		1.197***
		(0.079)		(0.156)
Rank 7 (Gentry/Executive Officials/Officers)		1.177		1.514***
		(0.126)		(0.243)
Constant	0.246***	0.320***	4.142***	4.498***
	(0.026)	(0.047)	(0.208)	(0.108)
Period FE	✓	✓	✓	✓
Parish FE	✓	✓	✓	✓
Observations	22470	43495	4321	8298
Parishes (clusters)	16	16	16	16
pseudo – R^2	0.006	0.005		
R^2			0.025	0.034

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

differentials in childlessness. Both HISCAM (col. 3) and the seven status categories (col. 4) indicate a status gradient in gross marital fertility. By taking the coefficient for HISCAM in column (3) and multiplying it by the difference between the lowest and highest status occupation in my sample, I find that the highest status couples had one extra child compared to the lowest status couples (~5.3 versus ~4.3). Column (4), which allows for a non-linear association between status and gross marital fertility, reveals that this likely underestimates the true magnitude of the preventive check. Here, couples of the highest rank had 1.5 extra children compared to those of the lowest rank (~6.0 versus ~4.5). Beyond the stark difference between the lowest and highest ranks, gross marital fertility increases with each rank in column (4). However, differences in gross fertility across the middle ranks (2 through 4) are small and statistically insignificant. This may indicate that the status categories do not capture the nuances of the socioeconomic structure in Wittgenstein. All three categories encompass considerable variation in occupational status as measured by HISCAM. For example, amongst rank 4 (craftsmen) variation is large both within trades (apprentice vs master) and between trades (grain miller vs court gunsmith). The status coding may capture the general trend in fertility but fail to identify differences at a more granular level. Or else, with differences amongst the middle ranks similarly muted in studies for England or France, this could tell us something about the general shape of the preventive check in early-modern North-Western Europe. Instead of a linear relationship between status and gross marital fertility, the two may be related via a piecewise function, with status only mattering for couples at the extreme ends of the distribution.

Still, higher levels of gross marital fertility amongst the two uppermost ranks – both when compared to the lowest, and the middle ranks – support the presence of a preventive check in Wittgenstein.

5.2 Celibacy and Childlessness

Even if a population exhibits a strong status gradient in fertility, this does not produce the anticipated outcomes if the extensive margin of fertility runs counter to the preventive check. This appears to be the case in England, where higher rates of celibacy and childlessness amongst the upper status ranks changed the shape of the preventive check. Croix, Schneider, and Weisdorf (2019) show that once celibacy and childlessness are accounted for traders and farmers with large landholdings had the greatest reproductive success. Although columns (3) and (4) of Table 2 provide some evidence that this was not the case in Wittgenstein, it is important to further elucidate how celibacy and childlessness varied with status.

First, I estimate equation (1) using a logistic model for a dummy variable denoting whether a family remained childless. 4.69 *per cent* of couples in the full sample remained childless. The results in Table A2 column (1) do not reveal a status gradient in childlessness. Ranks 2, 3, 4, and 5 all have significantly lower odds of remaining childless than the base category of labourers/servants. However, the odds of remaining childless are statistically indistinguishable across all ranks but the base category. As such, the significant coefficients are driven by a higher probability of remaining childless amongst the poorest inhabitants of Wittgenstein and not by a gradient overall.

Celibacy cannot be estimated at the couple-level. Instead, I look at the life courses of all surviving children born in Wittgenstein. To ensure that celibacy is not biased upwards for more mobile classes, only individuals whose burial is recorded in Wittgenstein are included. I estimate the status gradient in celibacy for women and men separately, for both women and men, status is proxied by the occupational status of their father.

For men, I use father's status since men who remained celibate are much less likely to have had their occupation recorded. For both men and women, there is no evidence of a status gradient in celibacy. When using father's status, no groups have a statistically different likelihood of remaining celibate. When using men's own-status only the bottom two ranks – namely servants/labourers and small-hold farmers – exhibit statistically distinguishable, and higher odds of remaining childless. This could be a manifestation of dynamics described by Guinnane and Ogilvie (2013), whereby certain groups of men were excluded from the marriage market.[8]

The results in Table A2 show that in Wittgenstein, the extensive margin of fertility did not change the shape of the preventive check. Contrary to Croix, Schneider, and Weisdorf (2019) findings for England, here differential probabilities of remaining childless and celibate exacerbated the status gradient in fertility by reducing the number of children born to the lowest status ranks.

5.3 Starting, Stopping and Spacing

Having established the presence of the preventative check, I turn to its inner workings. Gross fertility for a couple is a function of when reproductive behaviour begins (starting), when reproductive behaviour ceases (stopping), and how frequently births occur within this period (spacing). Assuming that couples begin reproductive behaviour upon marriage, starting is measured by mother's age at marriage. Following Knodel (1987), the attempt to stop reproductive behaviour is measures by mother's age at last birth. Measuring deliberate spacing is complicated since it is subject to a plethora of nonvolitional factors (e.g. infant feeding practices) (ibid.). However, since the Malthusian system is defined by outcomes more so than by the underlying causes, I measure spacing – irrespective of whether is the product of deliberate fertility control – using the average birth interval. Birth intervals tend to increase with duration of marriage, ergo I control for this potential confounder. To ensure my results are not obscured by incomplete marriages, in columns (3) to (6) the sample is restricted to complete marriages where both spouses survived to 50.

Columns (1) and (2) report statistically significant coefficients for the associations between mother's age at marriage and husband's status. In couples of the highest rank, women were 4.5 years younger at marriage then their compatriots of the lowest rank.

[8] This is supported by higher rates of celibacy amongst men (25.07 *per cent*) when compared to women (16.71 *per cent*).

TABLE 3. Mechanics of the Preventive Check

	Starting		Stopping		Spacing	
	(1)	(2)	(3)	(4)	(5)	(6)
	age at marriage		*age at last birth*		*avg. birth interval*	
HISCAM	-0.046***		0.002		-2.359***	
	(0.008)		(0.006)		(0.304)	
Rank 2		-3.226***		-0.403		-44.685
		(0.267)		(0.341)		(27.699)
Rank 3		-2.134***		0.226		-54.309
		(0.405)		(0.371)		(45.729)
Rank 4		-2.497***		0.286		-53.351*
		(0.410)		(0.369)		(27.084)
Rank 5		-3.043***		0.702*		-82.145***
		(0.406)		(0.349)		(18.055)
Rank 6		-3.761***		0.470		-80.540**
		(0.211)		(0.293)		(37.391)
Rank 7		-4.502***		0.449		-135.493**
		(0.566)		(0.765)		(49.388)
Constant	28.082***	27.567***	39.083***	39.012***	1318.344***	1236.992***
	(0.491)	(0.275)	(0.329)	(0.303)	(42.451)	(35.241)
Parish FE	✓	✓	✓	✓	✓	✓
Period FE	✓	✓	✓	✓	✓	✓
Marriage Duration					✓	✓
Observations	4321	8298	2990	5715	2452	4689
Parishes (clusters)	16	16	16	16	14	15
R^2	0.053	0.069	0.015	0.010	0.035	0.018

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)
Columns (5) and (6) contain less observations and parishes since the average birth interval is conditioned on gross fertility greater than two.

Although less pronounced, this is replicated when status is proxied by the occupational status of the bride's father (see Table A3). These class differences in female age at marriage concur with earlier findings for Germany based on the parish of Belm (Schlumbohm 1992). However, while Schlumbohn looks only at differences between land-rich and landless peasants, the detailed occupational data of the Wittgenstein reconstitution enables to evaluate the relationship between status and demographic outcomes in a more granular manner.

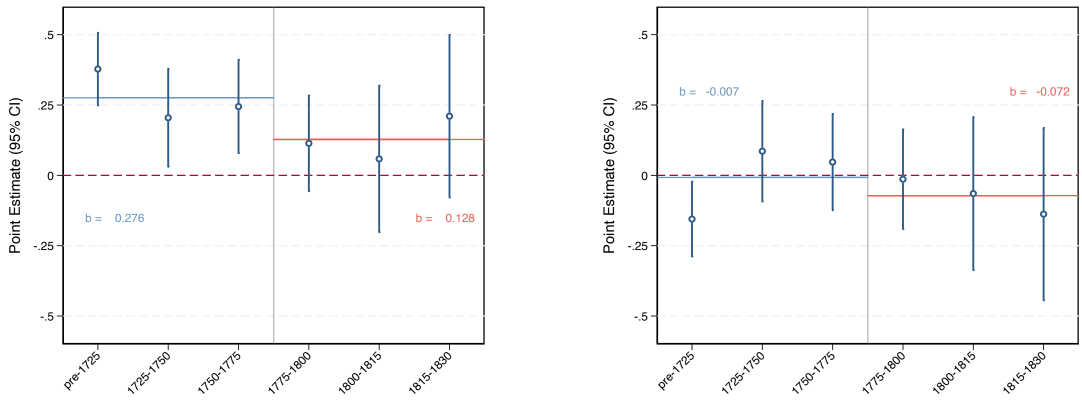
Turning to mother's age at last birth no status gradient emerges (see cols. 3 and 4). Reproductive behaviour ceased around 39 years of age for women irrespective of husband's status. For spacing, the coefficient for HISCAM in column (5) is statistically significant at the 99 per cent level. However, the seven status categories do not support a clear status gradient. Families of rank five through seven had significantly shorter birth intervals, but no general gradient emerges.

This murky relationship between status and birth spacing, runs counter to Malthus articulation of natural fertility. Similarly, it also clashes with Knodel's finding that, spacing – and even more so deliberate spacing – cannot be identified in pre-industrial Germany (Knodel 1987). Here the distinction between deliberate and non-deliberate spacing is of relevance. One explanation is that, even under natural fertility, variation in non-volitional factors affecting birth intervals across social groups could explain the significant coefficients in columns (5) and (6). For example, this could be the product of different breastfeeding practices, or nutrition effects during periods of economic stress (Jaadla et al. 2020; Thiehoff 2015). Alternatively, Dribe and Scalone (2010) use event history analysis to re-evaluate the data used by Knodel (1987) and show that there was deliberated fertility adjustment via spacing during such periods of economic stress. They cite the rapid response to the price shocks as evidence that this adjustment is the product of deliberate spacing instead of hardship induced subfecundity. Scalone and Dribe identify class differentials in this response. As such, the significant coefficients for ranks five and seven, could be driven by these groups not being subject to the same fertility responses as the remaining population.

Still, even if columns (5) and (6) provide some evidence for non-parity dependent fertility control, the results in Table 4 broadly support a Malthusian interpretation, whereby delayed marriage was the central mechanism of the preventive check. This is reaffirmed by controlling for mothers age at marriage when estimating the status gradient in fertility. The affect of status – both measured by HISCAM and the classes – is attenuated and rendered insignificant for many ranks, while age at marriage remains highly significant (see Table A4). The prevalence of starting as the primary mechanism of the preventive check concurs with findings for pre-industrial England and France (Clark and Cummins 2015; Cummins 2020).

5.4 Temporal Trends

Beyond identifying the presence of the preventive and absence of the positive check in Wittgenstein, it is worth evaluating whether these associations are static across time. To study change over time, I disaggregate the reconstitution into six periods by marriage date. Given lower data availability, the first period subsumes all observations prior to 1725. Since the sample size per period becomes small, temporal variation should be interpreted with caution. Instead of using the seven status ranks I aggregate up to three classes and plot the coefficient for the upper-most class (ranks 6 & 7) by period.



(a) Gross Fertility (b) Child Mortality

FIGURE 1. Normalised coefficient for ranks six and seven by sub-period.

For the positive check, the coefficient is only marginally significant in the first period. It is insignificant across all other periods and reveals no temporal trend. Since the first period subsumes the devastation, repeated harvest failures, and breakdown of governance during and after the 30-year war, the significant coefficient here may identify the presence of a status-gradient in child mortality during periods of greater hardship. This would support the interpretation of the positive check put forward by Kelly and Ó Gráda (2014).

For the preventive check a more dynamic picture emerges. Here there is a clear and stable difference between the gross marital fertility of the upper-class and the remaining population for the first three periods. The preventive check is statistically insignificant, and of a much lower magnitude in the three later periods. This trend is reaffirmed when plotting coefficients for HISCAM (see Figure 2). Even when discounting the fact that the coefficient is insignificant in the later periods, it is evident that the system of reproductive inequality changed in Wittgenstein around the turn of the 18th century. This shift in reproductive inequality around 1800 is a novel finding for Germany.

This change coincides with similar trends identified for France and England. Similarly to the dynamics Clark and Cummins (2015) observe in England overall marital fertility remained largely unchanged (gross marital fertility 5.3) but the fertility of the highest status groups decreases, while that of lower status groups increased to compensate. The question remains whether the same mechanism drive the change in all three countries. For England Clark and Cummins find that disappearance of the reproductive inequality was mostly attributable to changes in fertility within marriage. In France the change seems to have been driven by the deterioration of the status gradient in mother's age at marriage, potentially because of the social forces of the French revolution (Cummins

TABLE 4. The disappearance of the Preventive Check

	Gross Fertility		
	(1)	(2)	(3)
HISCAM	0.020^{***}	0.018^{***}	0.021^{***}
	(0.005)	(0.003)	(0.005)
HISCAM × Urban	-0.007		-0.007
	(0.007)		(0.007)
HISCAM × Industrial		0.004	0.004
		(0.002)	(0.002)
Constant	4.117^{***}	4.063^{***}	4.037^{***}
	(0.190)	(0.190)	(0.178)
Parish FE	✓	✓	✓
Period FE	✓	✓	✓
Observations	4321	4321	4321
Parishes (clusters)	16	16	16
R^2	0.026	0.026	0.026

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

2020). To better evaluate the mechanism underlying the change in Wittgenstein I re-estimate equation (1) for starting, stopping and spacing for the two sub-periods. The results in Table A5 reveal that the dynamics of reproductive inequality fall somewhere between France and England. Although age at marriage converged across ranks two through seven after 1775, a slight gradient in starting persists into the 19th century. Although a considerate change, the change in starting alone cannot account for the disappearance of the preventive check. Changes in marital fertility and marriage behaviour must have acted in conjecture. This is also reaffirmed by shifts in the status-differences in spacing from the first to the second period.

Assessing various candidate explanations for this change within an intensive case-study is difficult. Changes that affected the entire study area, such as cultural changes brought about by the French Revolution, or institutional changes brought about by the absorption into Hesse-Darmstadt in 1806, are difficult to evaluate. The latter was too late to explain the shifts to reproductive inequality identified post 1775, but the former constitutes a potential explanation. Still, although such cultural and institutional explanations are beyond the scope of this study, I can exploit variation across couples to investigate other candidate explanations pertaining to urbanisation, and proto-industrialisation, particularly with regard to the levelling of the status-gradient in starting.

Wittgenstein encompassed two towns, although they were comparatively small, they constituted important centres for trade and commerce in the principalities. The inclusion of towns, and ergo the possibility of comparing demographic behaviour between towns and the surrounding villages is a novel contribution of this study. Greater mixing between status ranks, better employment opportunities or exposure to novel ideas and customs could have affected the fertility gradient in towns. To test whether any of these factors were at work I estimate equation (1) for an interaction term of the status ranks and a dummy variable equal to one if a couple married in one of the towns. This exercise reveals that the status gradient in gross marital fertility was a rural phenomenon. All status ranks had a gross marital fertility statistically indistinguishable from the lowest rank in the two towns. Still the question remains whether urbanisation could explain why the status gradient disappears for the entire population after 1775. Although a contributing factor, with modest, and very gradual urbanisation in Wittgenstein (25 *per cent* in 1650 to 30 *per cent* in 1800) this explanation cannot account for the sudden disappearance of the preventive check at the end of the 18th century.

Proto-industrialisation offers another candidate explanation. Tilly and Tilly (1971) argue that novel employment opportunities brought about by the expansion of export industries broke "the chain between inheritance and reproduction". To evaluate if this was the case in Wittgenstein I check whether status affected fertility amongst men employed in industry. I go through all the occupations in my dataset and identify those connected to the proto-industries of metallurgy, forestry and textile production. Additionally, I also include occupations related to the construction or running of railways. I estimate equation (1) for an interaction term of the status ranks and a dummy variable equal to one if the husband ever had an occupation coded as proto-industrial. Since most occupations coded as industrial fall into ranks three through five, point estimates for the other ranks are unreliable, to account for this I use HISCAM. The results reported in Table 4 indicate that the preventive check did not operate for couples with husbands working proto-industrial jobs. This is not the result of most proto-industrial jobs being located in the urban parishes, with occupations dispersed across parishes evenly. As such the marked increase in proto-industrial occupations, from three *per cent* in 1650 to ~19 *per cent* in 1850 likely contributed to the disappearance of the preventive check to a greater extent than urbanisation.

Although it is beyond the scope of this paper to comprehensively, causally identify the factor which led to the disappearance of the preventive check in cross-section the modernising forces of urbanisation and proto-industrialisation are part of the causal nexus underpinning this demographic change.

6 Robustness

6.1 Occupational Coding

To ensure that the results reported in section 5 are not the product of the manual coding of occupational labels to HISCO this paper employs novel automatic occupational standardisation using OccCANINE (Dahl and Vedel 2024). The manual coding and OccCANINE disagree in some nuances of HISCO classification. Still results using both are statistically indistinguishable for both child mortality and gross fertility (see Table A6).

6.2 Ownership Status

As noted in section 5.1 the status coding I employ may not adequately capture the socioeconomic stratification of society in Wittgenstein. In particular it does not directly capture ownership structures. This is a caveat to my results if occupational status and ownership status – particularly through inheritance – are distinct channels through which the preventive check can operate. Fertig (1999) points to such a dynamic across parishes in Westphalia, whereby patterns of family formation shifted from being determined by ownership to depending on non-agricultural earnings. If Wittgenstein was subject to such dynamics the preventive check may have persisted post-1800 albeit via a different channel.

For the potential channel of inheritance/ownership I can rule this out by exploiting information on ownership status included in the reconstitution for a subset of my sample (18 *per cent*). In descending order individuals are assigned the ranks of Hauserben – owners of farmland; Beisitzer – owners of lesser property, and Unbehauste Beisitzer – landless peasants. Ownership status and occupational status are far from perfect correlates. Ergo, my results for occupational status do not necessarily capture the effect of ownership on fertility. Running my baseline regression for only the subset with ownership status reveals that the highest rank had higher gross fertility (~1 child extra) while couples of the two lower ranks had statistically indistinguishable gross fertility (see Table A7). However, when running regressions that incorporate both ownership and occupational status, the latter is rendered insignificant, indicating that occupational status outweighs ownership status as a driver of fertility in Wittgenstein.

Further, to ensure I am identifying the disappearance of the preventive check and not a shift in explanans from occupation to ownership status I replicate section 5.4 for ownership status (see Table A7). Alike occupation status, the significant effect of ownership status on gross fertility disappears around 1800.

6.3 Occupational Status

Further to ensure the results reported are not the product of the specific occupational status classifications I use results are replicated for alternative classifications. First to add greater granularity and better understand the flatness of the status gradient in gross fertility across the middle ranks I combine the seven status categories with a measure of skill requirement based on the OhdAB occupational classification scheme (see Table A8).[9] Occupations of ranks three and four with above-median skill-level are sorted into new categories. Given these additional categories, a clearer status gradient emerges, with skilled-Workers (Rank 3 – highly skilled) now ranked above Traders/Clerks/Supervisors (Rank 5) but below Professionals/Academics (Rank 6). Further, to alleviate concerns that the seven status categories drive the results all specifications are re-estimated using HISCLASS (see Table A9). Here both the absence of the status gradient in child mortality and the presence of a status gradient in gross fertility is replicated. When assigning status to individuals with multiple listed occupations I use the occupation with the highest status to account for occupational mobility. Table A10 shows that my findings are robust to using the lowest status occupation. Last, Table A11 illustrates that the adaption of the seven-status ranks to the socioeconomic context of Wittgenstein does not drive my results. Using the original classification yields a comparable gradient.

6.4 Reporting Practices

Another concern could be that my results are coloured by variation in recording practices across different pastors that is not adequately captured by my fixed-effect structure. To alleviate this concern I re-estimate my primary specification with a parish-period fixed-effect. The latter should approximate the change of pastors across time and space. The results reported in Table A13 are equivalent to those reported in Table 2.

6.5 Migration

As stated in section 2.3 only non-migrants and in-migrants prior to marriage are included in my sample to account for the censoring of fertility histories among couples that migrated after marriage. This censoring can become problematic via two related, albeit

[9] The Ontology of German historical professional and official titles (OhdAB) is a germany specific classification sheme for historical occupations. (Moeller, Müller, and Nasarek 2023)

distinct routes. First, if the demographic behaviour of the uncensored subset of the population, is not representative of the general population, results are subject to selection bias. Second, if migration is a function of both the exposure and outcome – e.g. if celibacy and low status are associated with greater rates of emigration – this introduces collider bias since the inclusion restrictions condition the sample on migration.[10] Ergo, if either (1) out-migrants behaved differently to the general population, or (2) the decision to migrate is a function of demographic outcomes and socioeconomic status, the results presented in section 4 are subject to migration-induced bias.

To circumvent the imperceptibility of out-migrant outcomes Croix, Schneider, and Weisdorf (2019) suggest looking at the differences between in-migrants and non-migrants. This test for selection bias is contingent on the assumption that the unobserved out-migrants (who likely immigrate to a similar nearby parish) are virtually the same group as observed in-migrants (who likely emigrated from such a parish). In the Wittgenstein reconstitution, where short-distance migrants are observed as non-migrants, this appears unlikely. However, a comparison between the two groups still yields some insights. Estimating the primary specification for in- and non-migrants, reveals that the status gradient does not vary strongly (see Table A13). Although this does not imply that out-migrants do not display distinct associations, it lends some support to the robustness of my findings.

To evaluate whether collider bias effects my results I need to evaluate whether migration is a function of both status and demographic outcomes. Although demographic outcomes are unobservable, I can evaluate occupational for out-migrants after marriage. The average status for out-migrants is lower than that of in- and non-migrants. A individual-level logistic regression, estimating the effect of father's occupational status on the choice to emigrate for all children born in Wittgenstein, reveals that the observed heterogeneity is driven by a lower propensity to migrate amongst the two uppermost ranks (see Table A14). This relationship between status and migration only biases results if migration is also affected by the demographic outcome in question. Turning to the example of celibacy, if rates of out-migration are greater amongst celibate women – to migrate to an urban centre with a larger marriage market, for example – the results reported in Table 4 likely underestimate rates of celibacy amongst women with lower social status since these are *a priori* more likely to be part of the excluded group. For such an association to

[10] For a fuller discussion of collider bias see Schneider (2020)

drive results, the demographic outcomes would have to be a central driver of the migration decisions. Since it is impossible to verify whether the outcome affects migration, all results presented in section 5 need to be interpreted under the identifying assumption of no such association. This assumption is more likely to hold for some results than for others. While it is likely that celibacy is associated with greater rates of out-migration, the same does not necessarily apply to fertility or mortality.

7 Discussion

Having established the presence of the preventive check in Wittgenstein, and its disappearance around 1800 it is worth briefly discussing these results in the context of neo-Malthusian growth theories that foreground reproductive inequality ("survival-of-the-richest") as the *prima causa* of modern economic growth.

First, given strong differences in gross and net fertility between high- and low-status families survival-of-the-richest clearly operated in Wittgenstein prior to 1800. However, as also highlighted by Boberg-Fazlic, Sharp, and Weisdorf (2011) greater reproductive success alone is a necessary but not sufficient condition for the theories of Clark, Galor and Moav. Their mechanism rests upon the strong persistence – either genetically or culturally – of traits across generations. A glance at our data reveals that the rich in survival-of-the-richest do not remain rich. Regardless of their reproductive success, the share of the upper-most ranks do not increase across periods. Since the two uppermost ranks where less likely to migrate, this implies downward mobility. For the mechanism of 'survival of the richest' to operate, pro-growth traits would have to persist across generations amongst families in lower socioeconomic classes. Such multi-generational persistence of behavioural traits lies beyond what has been proven scientifically (Bowles 2007; Bowles, Gintis, and Osborne Groves 2005; Dohmen et al. 2012).

My findings present another challenge to the survival-of-the-richest thesis. If the reproductive advantage of the upper strata of society is promulgated as the *prima causa* of the Industrial Revolution in England, how come it is consistently replicated for other study areas that industrialised later? Here my results favour another candidate explanation, identifying survival-of-the-middle-class instead of survival-of-the-richest as a driver of growth. By accounting for greater celibacy and childlessness Croix, Schneider, and Weisdorf (2019) turn the status gradient into a status parabola with the middle-class outbreeding the rest of the population. In Wittgenstein the extensive margin of fertility does not change the shape of the status gradient. As a unique feature of the English demographic regime survival-of-the-middle-class could displace survival-of-the-richest as a demographic explanation of England's unique development trajectory

Conclusion

Concurring with Wrigley (1986) evaluation, I too find that "in the main Malthus stands to test well". By drawing upon the intensive case study of the rural county of Wittgenstein, I was able to show that prior to 1800, at the individual-level the demographic regime in parts of pre-industrial Germany was subject to Malthusian forces. A strong preventive check, operating chiefly through mother's age at marriage, prevailed over the positive check. Although the laws of population condemned the lower classes to a life of distress and precarity, a sufficiently strong preventive check renders the positive check a "last most dreadful resource of nature" is times of pronounced scarcity (Malthus 2008; Kelly and Ó Gráda 2014). The extensive margin of fertility does not change the shape of the status gradient in gross fertility. Reproductive inequality favoured the uppermost strata of society in Wittgenstein. These findings not only provide a clearer picture of demographic dynamics in pre-industrial Germany but also contribute to broader debates about the origins of modern economic growth. By challenging the narrative of England's exceptionalism with regards to survival-of-the-richest they support the survival-of-the-middle-class thesis. Additionally, the disappearance of the preventive check around 1800 in Wittgenstein adds to the body of evidence for earlier shifts in the demographic regime across Europe that prefigured the fertility transition by decades. It speaks to the proto-industrialisation literature. Tentative estimates indicate that both industrialisation and urbanisation contributed to this demographic change. Here the advent of new employment opportunities during early industrialisation and their impact on family formation serves as an attractive candidate explanation for these early changes. A deeper understanding of the causes and consequences of the disappearance of the preventive check constitutes an important research avenue. These demographic shifts occurred in Germany, France and England within a relatively short time span. Comparing the similarities and differences in these demographic shifts across Germany, France, and England will be crucial to expanding understanding of the nexus between demographic and economic change.

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A Appendix

TABLE A1. The Effect of Status on Fertility (Negative Binominal Model)

	Gross Fertility	
	(1) HISCAM	(2) Status Class
HISCAM	0.003***	
	(0.001)	
Rank 2 (Smallhold Farmer)		0.131***
		(0.024)
Rank 3 (Workers)		0.131***
		(0.036)
Rank 4 (Craftsmen)		0.136***
		(0.030)
Rank 5 (Traders/Clerks/Supervisors)		0.188***
		(0.035)
Rank 6 (Professionals/Academics)		0.238***
		(0.030)
Rank 7 (Gentry/Executive Officials/Officers)		0.298***
		(0.048)
Constant	1.290***	1.209***
	(0.075)	(0.051)
Parish FE	✓	✓
Period FE	✓	✓
Observations	4321	8297
Parishes (clusters)	16	16
pseudo – R^2	0.004	0.006

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A2. Childlessness & Celibacy

	Childlessness	Male Celibacy		Female Celibacy
	(1)	(2)	(3)	(4)
	Husband's Status	*Father's Status*	*Own Status*	*Father's Status*
Rank 2	0.805	0.992	2.923***	1.003
	(0.134)	(0.070)	(0.336)	(0.178)
Rank 3	0.741	0.873	0.300***	0.825
	(0.138)	(0.073)	(0.053)	(0.121)
Rank 4	0.703*	0.971	0.261***	0.920
	(0.127)	(0.111)	(0.032)	(0.146)
Rank 5	1.165	0.830**	0.315***	0.786
	(0.208)	(0.065)	(0.059)	(0.131)
Rank 6	0.673	0.889	0.180***	0.848
	(0.190)	(0.099)	(0.076)	(0.188)
Rank 7	1.022	0.839	0.124***	0.680***
	(0.191)	(0.241)	(0.051)	(0.091)
Constant	0.052***	0.060***	0.043***	0.450***
	(0.009)	(0.010)	(0.010)	(0.063)
Parish FE	✓	✓	✓	✓
Period FE	✓	✓	✓	✓
Observations	8297	9251	9251	10166
Parishes (clusters)	16	15	15	16
pseudo – R^2	0.012	0.027	0.155	0.018

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A3. Starting (cont.)

	Father's Age at Marriage	Mother's Age at Marriage
	(1)	(2)
	Own Status	*Father's Status*
Rank 2	-2.444***	-0.986*
	(0.235)	(0.529)
Rank 3	-1.845***	-1.210**
	(0.183)	(0.498)
Rank 4	-1.601***	-0.941
	(0.209)	(0.629)
Rank 5	-1.860***	-0.724
	(0.370)	(0.479)
Rank 6	-2.832***	-1.352**
	(0.442)	(0.617)
Rank 7	-2.820***	-2.431***
	(0.434)	(0.401)
Constant	30.531***	25.267***
	(0.204)	(0.500)
Parish FE	✓	✓
Period FE	✓	✓
Observations	8297	4891
Parishes (clusters)	16	14
R^2	0.037	0.084

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A4. Gross Fertility and Age at Marriage

	Gross Fertility	
	(1) HISCAM	(2) Status Class
HISCAM	0.006**	
	(0.002)	
Rank 2 (Smallhold Farmer)		-0.089
		(0.133)
Rank 3 (Workers)		0.149
		(0.154)
Rank 4 (Craftsmen)		0.095
		(0.142)
Rank 5 (Traders/Clerks/Supervisors)		0.228
		(0.162)
Rank 6 (Professionals/Academics)		0.359**
		(0.146)
Rank 7 (Gentry/Executive Officials/Officers)		0.512*
		(0.280)
Mother's Age at Marriage	-0.235***	-0.223***
	(0.005)	(0.006)
Constant	10.751***	10.638***
	(0.193)	(0.237)
Parish FE	✓	✓
Period FE	✓	✓
Observations	4321	8297
Parishes (clusters)	16	16
R^2	0.240	0.213

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A5. Mechanics of the Preventive Check

	Starting		Stopping		Spacing	
	(1) pre-1775	(2) post-1775	(3) pre-1775	(4) post-1775	(5) pre-1775	(6) post-1775
Rank 2	-2.902***	-3.552***	-0.297	-0.467	-62.445	-16.382
	(0.211)	(0.491)	(0.503)	(0.361)	(49.233)	(33.961)
Rank 3	-2.308***	-1.952***	0.518	0.062	-97.278*	-20.646
	(0.214)	(0.623)	(0.490)	(0.513)	(45.655)	(55.250)
Rank 4	-2.476***	-2.467***	0.128	0.410	-100.745*	-19.107
	(0.294)	(0.647)	(0.524)	(0.518)	(53.203)	(26.503)
Rank 5	-2.549***	-3.576***	1.124***	0.328	-67.952	-90.961***
	(0.567)	(0.787)	(0.314)	(0.547)	(38.998)	(29.302)
Rank 6	-3.847***	-3.373***	0.911**	-0.361	-78.123	-113.199**
	(0.309)	(0.474)	(0.408)	(0.527)	(56.852)	(41.015)
Rank 7	-4.924***	-3.616**	0.197	1.015	-175.592***	-72.824
	(0.732)	(1.494)	(0.912)	(0.776)	(51.450)	(85.572)
Constant	27.114***	27.982***	39.006***	38.959***	1137.362***	1317.495***
	(0.192)	(0.507)	(0.420)	(0.358)	(45.522)	(46.179)
Parish FE	✓	✓	✓	✓	✓	✓
Period FE	✓	✓	✓	✓	✓	✓
Marriage Duration					✓	✓
Observations	4416	3881	3012	2702	2223	2465
Parishes (clusters)	14	16	14	16	12	15
R^2	0.058	0.079	0.012	0.014	0.025	0.028

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A6. Gross Fertility & OccCANINE

	Gross Fertility	
	(1) Manual HISCO	(2) OccCANINE HISCO
HISCAM	0.017***	0.016***
	(0.004)	(0.003)
Constant	4.142***	4.216***
	(0.208)	(0.190)
Parish FE	✓	✓
Period FE	✓	✓
Observations	4321	4217
Parishes (clusters)	16	16
R^2	0.025	0.024

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

TABLE A7. Fertility and Ownership Status

	Gross Fertility			
	(1)	(2)	(3)	(4)
	Full period	pre-1775	post-1775	Full period
Beisitzer (2)	0.507	1.361**	0.298	0.208
	(0.418)	(0.603)	(0.428)	(0.424)
Hauserben (3)	1.513***	2.586***	1.157	0.819
	(0.503)	(0.599)	(0.685)	(0.527)
Unknown Status				0.791*
				(0.442)
Rank 2				0.538***
				(0.129)
Rank 3				0.606***
				(0.178)
Rank 4				0.628***
				(0.149)
Rank 5				0.828***
				(0.169)
Rank 6				1.094***
				(0.174)
Rank 7				1.412***
				(0.262)
Constant	4.284***	3.316***	4.570***	3.844***
	(0.404)	(0.556)	(0.438)	(0.410)
Parish FE	✓	✓	✓	✓
Period FE	✓	✓	✓	✓
Observations	1560	637	923	8297
Parishes (clusters)	15	13	15	16
R^2	0.050	0.063	0.054	0.038

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Categories are Unbehauste Beisitzer (1)
and Servants/Labourers (Rank 1)

TABLE A8. The Effect of Skill-Status on Reproductive Success

	Under-15 Mortality	Gross Fertility
	(1)	(2)
Rank 2	1.106	0.628***
	(0.072)	(0.116)
Rank 3 (low-skill)	1.107	0.512***
	(0.092)	(0.168)
Rank 3 (high-skill)	0.986	0.968***
	(0.097)	(0.195)
Rank 4 (low-skill)	1.079	0.585**
	(0.086)	(0.219)
Rank 4 (high-skill)	1.151*	0.732***
	(0.093)	(0.155)
Rank 5	0.948	0.905***
	(0.084)	(0.159)
Rank 6	1.007	1.198***
	(0.077)	(0.154)
Rank 7	1.177	1.517***
	(0.132)	(0.238)
Constant	0.307***	4.499***
	(0.046)	(0.109)
Parish FE	✓	✓
Period FE	✓	✓
Observations	43487	8297
Parishes (clusters)	16	16
pseudo – R^2	0.005	
R^2		0.034

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A9. The Effect of HISCLASS on Reproductive Success

	Under-15 Mortality	Gross Fertility
	(1)	(2)
Unobserved	1.137	0.743***
	(0.104)	(0.151)
Unskilled Workers	1.100	-0.108
	(0.191)	(0.378)
Lower-skilled Workers	1.141	0.680***
	(0.130)	(0.206)
Farmers	0.972	0.493
	(0.273)	(0.929)
Foremen & Skilled Workers	1.105	0.866***
	(0.114)	(0.229)
Lower Managers, Professionals & Clerks	1.006	0.896***
	(0.107)	(0.141)
Managers & Professionals	1.063	1.326***
	(0.105)	(0.171)
Constant	0.292***	4.393***
	(0.049)	(0.152)
Parish FE	✓	✓
Period FE	✓	✓
Observations	43487	8297
Parishes (clusters)	16	16
pseudo $- R^2$	0.005	
R^2		0.034

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Unskilled Farm-workers

TABLE A10. The Effect of Lowest Status on Reproductive Success

	Under-15 Mortality		Gross Fertility	
	(1) HISCAM	(2) Status Class	(3) HISCAM	(4) Status Class
HISCAM	0.999		0.020^{***}	
	(0.002)		(0.005)	
Rank 2 (Smallhold Farmer)		1.063		0.483^{***}
		(0.047)		(0.115)
Rank 3 (Workers)		1.004		0.529^{***}
		(0.045)		(0.154)
Rank 4 (Craftsmen)		1.085		0.639^{***}
		(0.066)		(0.121)
Rank 5 (Traders/Clerks/Supervisors)		0.897		0.956^{***}
		(0.062)		(0.127)
Rank 6 (Professionals/Academics)		0.953		1.094^{***}
		(0.048)		(0.172)
Rank 7 (Gentry/Executive Officials/Officers)		1.372^{***}		1.257^{**}
		(0.161)		(0.584)
Constant	0.259^{***}	0.322^{***}	4.071^{***}	4.656^{***}
	(0.036)	(0.037)	(0.285)	(0.090)
Parish FE	✓	✓	✓	✓
Period FE	✓	✓	✓	✓
Observations	22470	43487	4321	8297
Parishes (clusters)	16	16	16	16
$pseudo - R^2$	0.006	0.005		
R^2			0.023	0.032

Robust clustered standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A11. Original Status Categories and Reproducitve Success

	Under-15 Mortality	Gross Fertility
	(1)	(2)
Unobserved	1.106	0.637***
	(0.072)	(0.111)
Rank 2 (Workers)	1.075	0.624***
	(0.086)	(0.171)
Rank 3 (Craftsmen)	1.113	0.650***
	(0.081)	(0.140)
Rank 4 (Traders/Clerks/Supervisors)	0.947	0.905***
	(0.083)	(0.160)
Rank 5 (Farmers)	0.990	-0.049
	(0.142)	(0.593)
Rank 6 (Professionals/Academics)	1.007	1.196***
	(0.077)	(0.156)
Rank 7 (Gentry/Executive Officials/Officers)	1.177	1.512***
	(0.132)	(0.244)
Constant	0.307***	4.499***
	(0.045)	(0.108)
Parish FE	✓	✓
Period FE	✓	✓
Observations	43487	8297
Parishes (clusters)	16	16
pseudo – R^2	0.005	
R^2		0.034

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A12. The Effect of Status on Reproductive Success with Pastor FEs

	Under-15 Mortality		Gross Fertility	
	(1) HISCAM	(2) Status Class	(3) HISCAM	(4) Status Class
HISCAM	1.000		0.017***	
	(0.001)		(0.003)	
Rank 2 (Smallhold Farmer)		1.088		0.589***
		(0.072)		(0.114)
Rank 3 (Workers)		1.054		0.595***
		(0.080)		(0.154)
Rank 4 (Craftsmen)		1.096		0.620***
		(0.082)		(0.130)
Rank 5 (Traders/Clerks/Supervisors)		0.942		0.885***
		(0.082)		(0.159)
Rank 6 (Professionals/Academics)		1.003		1.162***
		(0.081)		(0.147)
Rank 7 (Gentry/Executive Officials/Officers)		1.183		1.466***
		(0.127)		(0.256)
Constant	0.055***	1.200**	4.128***	4.534***
	(0.004)	(0.100)	(0.201)	(0.104)
Parish FE	✓	✓	✓	✓
Period FE	✓	✓	✓	✓
Pastor FE	✓	✓	✓	✓
Observations	22467	43479	4318	8295
Parishes (clusters)	16	16	16	16
pseudo – R^2	0.011	0.009		
R^2			0.048	0.046

Robust clustered standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A13. Migrant Status and the Preventive Check

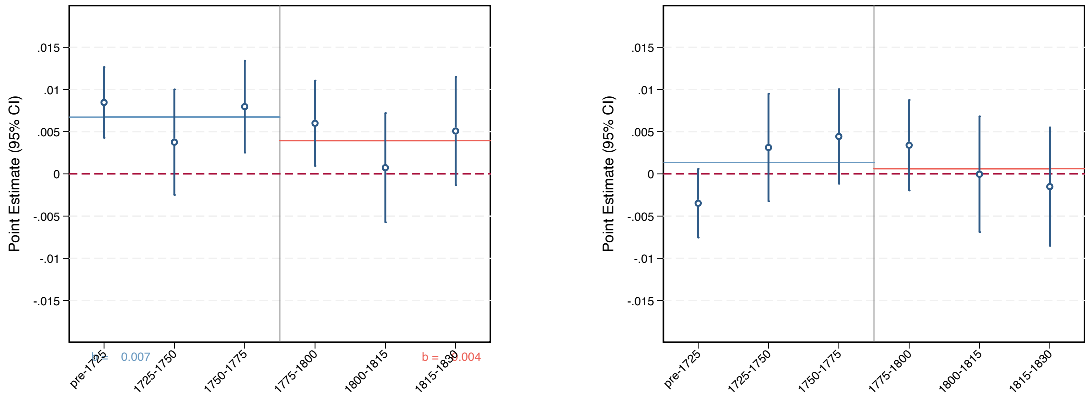
	Gross Fertility	
	(1)	(2)
	Non-Migrants	In-Migrants
Rank 2	0.472***	0.945*
	(0.105)	(0.447)
Rank 3	0.568***	0.810**
	(0.162)	(0.336)
Rank 4	0.513***	1.199**
	(0.132)	(0.407)
Rank 5	0.883***	1.211**
	(0.181)	(0.516)
Rank 6	1.066***	1.424**
	(0.163)	(0.491)
Rank 7	1.483***	1.261***
	(0.314)	(0.336)
Constant	4.717***	3.603***
	(0.102)	(0.348)
Parish FE	✓	✓
Period FE	✓	✓
Observations	7144	1153
Parishes (clusters)	16	16
R^2	0.036	0.037

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)

TABLE A14. Propensity to Migrate

	Out-Migrated
	(1)
	Father's Status
Rank 2	0.794***
	(0.043)
Rank 3	0.866***
	(0.046)
Rank 4	0.912
	(0.059)
Rank 5	1.026
	(0.086)
Rank 6	0.748***
	(0.038)
Rank 7	0.712***
	(0.068)
Constant	1.083
	(0.146)
Parish FE	✓
Period FE	✓
Observations	43043
Parishes (clusters)	16
pseudo – R^2	0.113

Robust clustered standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Reference Category is Servants/Labourers (Rank 1)



(a) Gross Fertility

(b) Child Mortality

FIGURE 2. Normalised coefficient for HISCAM by sub-period.