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Did the Black Death cause economic development by 'inventing' fertility restriction?

Jeremy Edwards[a] and Sheilagh Ogilvie[b]

[a]Faculty of Economics, University of Cambridge, Sidgwick Avenue, Cambridge CB3 9DD, UK, jsse12@yahoo.co.uk
[b]All Souls College, University of Oxford, Oxford, OX1 4AL, UK, sheilagh.ogilvie@all-souls.ox.ac.uk

Abstract

The Black Death is claimed to have caused the European Marriage Pattern in England by raising pastoral wages and thus delaying female marriage. We show that this argument does not hold. There is no consensus that late female marriage emerged in rural England after the Black Death. Women wanting to do pastoral work in medieval England did not have to remain unmarried, so improved pastoral opportunities did not necessitate later marriage. Nor does the quantitative relationship between pastoralism and female marriage age in England provide support for this argument. Fertility restriction was not exogenously triggered by the Black Death.

JEL classifications: E020, J120, J130, N130, N330.

1. Introduction

The European Marriage Pattern (henceforth EMP) is the term used by historical demographers to describe the family system during the early modern period in most Scandinavian countries, England, the Low Countries, the German-speaking area, and northern France (Hajnal, 1965, 1982). It involved women marrying late or not at all, nuclear-family households, and the circulation of young people between households as servants before marriage. Fertility consequently lay below the biological maximum and, because marriage involved forming a new household, responded to economic conditions.

Historical demographers have long speculated that the EMP calibrated population to resources, freeing economies from Malthusian limits (Wrigley and Schofield, 1981; Laslett, 1988). Fertility restriction is a necessary condition for sustained growth in many models of long-run economic development, and some recent contributions to the literature go further, arguing that the EMP caused European economic growth (Greif, 2006; Voigtländer and Voth, 2006; Greif and Tabellini, 2010; De Moor and Van Zanden, 2010; Foreman-Peck,

2011; Foreman-Peck and Zhou, 2018; for counter-arguments see Dennison and Ogilvie, 2014, 2016).

Marriage and fertility decisions are influenced by economic considerations, so one objection to claiming a causal role for the EMP is that the EMP is an endogenous rather than an exogenous variable when explaining differences in living standards across pre-industrial economies. But, if it could be shown that the EMP was the result of an exogenous shock, this objection would not apply. Voigtländer and Voth (2013) (henceforth VV) contend that the EMP was caused by the Black Death, an epidemic that killed upwards of one-third of the European population around 1,350. The Black Death was clearly an exogenous shock, so if VV are correct in arguing that it caused the EMP, this means that the EMP can reasonably be taken as an exogenous influence on European growth, and hence an important cause of economic divergence between Europe and other continents.

The VV argument also has the attractive feature that, although based on evidence for England, it is in principle capable of explaining why the Black Death did not generate the EMP everywhere. VV argue that in England the Black Death increased demand for women's labour as servants in pastoral work instead of as wives in arable work, causing females to marry later, reducing fertility, and increasing per capita income. However, VV's theoretical analysis shows that if, for example, total factor productivity in arable was high relative to that in pastoral agriculture, the Black Death was unlikely to lead to lower nuptiality and fertility. VV argue that this is why the EMP failed to emerge after the Black Death in Southern Europe, Eastern Europe, or China.

VV therefore provide a unifying framework to explain pre-industrial demographic and economic divergence. Unfortunately, as this article shows, their analysis cannot be sustained. As Section 2 explains, VV's argument is based on two key premises: first, that the EMP emerged in rural England immediately after the Black Death; and second, that women could work in pastoral agriculture only as servants, which required them to remain unmarried. However, Section 3 shows that these key premises are empirically incorrect. The debatable evidence on medieval English demography supports profoundly divergent conclusions about when the EMP developed, ranging from well before the Black Death to nearly 200 years after it. In so far as there is a consensus, it is that the EMP did not emerge in rural England soon after the Black Death. Furthermore, women in medieval England did not have to be unmarried to work in pastoral agriculture, so the crucial mechanism in VV's argument which generates lower fertility as a result of the shift to pastoral agriculture does not apply. VV contend that their argument is empirically supported by two positive causal relationships, one between pastoralism and the proportion of unmarried women in a cross-section of English counties in the later 14th century, the other between pastoralism and female marriage age in English counties several centuries later. However, Section 4 shows that the former relationship cannot be supported by the data VV use; that the latter relationship is not relevant to the central claim of VV's analysis, since it refers to female marriage age several hundred years after the Black Death; and that even if the latter relationship were relevant, the claim that it existed turns out to be incorrect. Section 5 concludes that the EMP in England was not exogenously triggered by a medieval epidemic and a consequent shift in factor proportions. This, we point out, has wider implications for the view that the EMP played a causal role in pre-industrial economic growth.

2. The VV argument

VV's argument is based on their view of the effects of the Black Death in England. A first component of this view is that the EMP did not exist before 1350 but emerged immediately afterwards, a claim we examine in the next section. A second component of the VV argument is based on the fact that after c. 1350, real wages for agricultural workers increased, as did pastoral relative to arable prices (Broadberry *et al.*, 2015, pp. 60–1). Because women have a comparative advantage in animal care, higher pastoral prices enabled women to earn higher wages in the pastoral sector.

It is important to recognize that higher female wages after the Black Death would not inevitably lead to later marriage and lower fertility. The substitution effect of higher wages is to delay marriage. But the income effect, if marriage and children are normal goods, is to make people marry earlier (Dennison and Ogilvie, 2016). Furthermore, almost all European societies experienced the Black Death, but not all had the EMP. A convincing argument that the Black Death moved the English economy from a steady state with high fertility and low per capita incomes to one with lower fertility and higher per capita incomes has to explain why higher female wages in pastoral agriculture lowered fertility in England but not everywhere the Black Death occurred.

VV's theoretical model of the emergence of the EMP after the Black Death is able to do this. However, it is critically dependent on two questionable assumptions.[1] The first is that women's preferences between consumption and children involve a basic-needs level of consumption such that, for consumption below this level, increases in income do not lead to additional children but result entirely in additional consumption. This assumption ensures that higher pastoral sector wages initially result in a substantial drop in fertility. Fertility subsequently rises when income exceeds the basic-needs level. If women did not have a basic-needs level of consumption, the VV model would not generate EMP behaviour in response to increased pastoral wages. This assumption is also crucial in enabling VV's model to explain why the Black Death did not result in the emergence of the EMP everywhere. The centrality of this very specific assumption about preferences for generating EMP behaviour in the VV model raises a fundamental question about the general validity of the VV analysis, because any assumption about preferences is inherently untestable.

The second key assumption is that in order to work in the pastoral sector, women have to be servants and thus remain unmarried. This can be tested. It will fail to hold if peasant households can engage in pastoral agriculture, since women will then be able to work in the pastoral sector while being married and having children, even if servants working for landlords have to remain unmarried. It will also fail if women who are married can be employed in the pastoral sector, for example as wage-labourers, since then they will not have to avoid marriage to benefit from high pastoral earnings, even if peasant households do not engage in pastoral agriculture. In either case, the central link in VV's model—the trade-off that women face between work in the pastoral sector and marriage—will break, and VV's account of how the Black Death caused the emergence of the EMP in England will not apply.

1 For a detailed discussion of the VV model and these assumptions, see online Appendix Section A1.

3. Are the key premises of the VV analysis consistent with the evidence?

3.1 When did the EMP emerge?

VV state that 'there is a consensus that EMP only became fully developed after the Black Death in 1348–1350' (VV, p. 2228). Unfortunately, no such consensus exists. The evidence is so ambiguous that historical demographers disagree fundamentally about when the EMP developed.[2]

The originator of the EMP concept was Hajnal, whose best guess in 1965 was that the EMP dated from 'somewhere about the sixteenth century' (Hajnal, 1965, p. 134). By 1982, he had changed his mind, writing that behaviour consistent with the EMP 'can be traced back for perhaps four centuries prior to 1600' (Hajnal, 1982, p. 477).

Hajnal based this conclusion on studies suggesting that 13th-century England manifested all the social practices associated with the EMP: life-cycle servanthood, little labour market segmentation by sex, legal entitlements enabling spinsters to work, female geographical mobility, marriage dependent on ability to form a new household, bilateral kinship, frequent remarriage, and narrow spousal age-gaps (Smith, 1979, 1983, 1990a, 1990b; Hallam, 1985; Goldberg, 1991). Recent analyses provide further support for these findings (Bennett, 2019a, 2019b).

So debatable is the evidence, however, that other medievalists contend that England had early marriage until after 1500 (Hatcher, 1977, pp. 56–7; Razi, 1980, pp. 50, 63, 137; Bailey, 1996, pp. 2–9, 12–7; Mate, 1998, pp. 29, 49; Mate, 1999, pp. 59–60; Hatcher, 2003, pp. 89–96; Benedictow, 2012, pp. 11–23). In their view, for 150 years after the Black Death, mortality stayed so high that maintaining observed population size required early and universal marriage (Hatcher, 1977, pp. 65–6; Hatcher, 1986, pp. 21–2; Bailey, 1996, p. 16; Hatcher, 2003, pp. 100–4; Benedictow, 2012, pp. 25–8). There is no evidence, these scholars argue, that female servants proliferated after 1350 or more women delayed marriage to stay in service, especially not in the countryside (Bailey, 1996, pp. 7–8, 11–14, 17; Mate, 1998, p. 45; Mate, 1999, pp. 59–60). In large towns, some women delayed marriage until their mid-20s, but it cannot be shown that 'the *majority* of women, over the country at large, married late' (Mate, 1999, p. 60). Short-term wage labour was so attractive compared to servanthood between 1350 and 1500 that 'women could and did combine early marriage with casual employment' (Bailey, 1996, pp. 14).

A few scholars speculate that nuptiality changed around 1350—but in contradictory directions. Hatcher and Razi hold that the Black Death increased wages and land availability, enabling couples to marry earlier (Hatcher, 1977, pp. 56–7; Razi, 1980, pp. 63, 131–8; Bailey, 1996, p. 3). Early marriage was compatible with female employment because married women often worked as wage-labourers (Bailey, 1996, pp. 13–4; Mate, 1999, p. 59). In contrast, Goldberg argues that the Black Death created *urban* jobs for unmarried females, so marriage age rose in towns but stayed low in the countryside long after 1350 (Goldberg, 2013, pp. 13–4, 24–6).

In sober fact, the data are inadequate to reach a definitive conclusion about when the EMP emerged. Reliable nuptiality statistics require parish registers and village censuses, which are unavailable for England before the 1540s (Dennison and Ogilvie, 2016, p. 211).

2 For further detail on the dating of the EMP, see online Appendix Section A2.

But no historical demographer argues that the EMP emerged in the *rural* economy immediately after the Black Death.

3.2 Life-cycle servanthood

A second problem arises with the assumptions VV make about servanthood. A defining characteristic of the EMP is widespread life-cycle servanthood by unmarried persons (Hajnal, 1982, pp. 452–3, 470–6; Smith, 1983, pp. 108–9, 113–5, 129–31; Laslett, 1988, pp. 237–8; Poos, 1991, pp. 183–206; Bailey, 1996, pp. 5–6; Whittle, 2017, p. 2; Bennett, 2019a, 2019b). But VV assume that women could only work in pastoral agriculture as unmarried servants, which presumes that life-cycle servanthood was already fully formed in 1350. However, their source is Kussmaul (1981), whose evidence applies to 1538–1840. She conjectures in an appendix that life-cycle servanthood might have been widespread in the 15th century, but acknowledges this as speculative (Kussmaul, 1981, Appendix 7). As discussed above, the data required to establish when life-cycle servanthood became pervasive in rural England are ambiguous, causing medievalists to reach widely divergent conclusions.

Whatever one's view on whether life-cycle servanthood was common in England before or after the Black Death, VV's analysis appears inconsistent. If life-cycle servanthood was so fully formed in 1350 that women had to be servants in order to do pastoral work, this implies that the EMP predated the Black Death, and thus cannot have been caused by it. If the EMP emerged only after the Black Death, then life-cycle servanthood cannot have been widespread in 1350 and VV's assumption that women could only do pastoral work as unmarried servants is not tenable.

A further problem arises with the explanation VV give for why the EMP did not emerge everywhere after the Black Death. Their Corollary 2 in principle explains why the Black Death might have led to the emergence of the EMP in England but not in other European societies or in China (VV, 2013, pp. 2250–2). But this explanation of why the EMP did not emerge in Eastern Europe or China requires women in these countries to have been able to work in pastoral agriculture only as unmarried servants, since that is a key assumption of the VV model. However, eastern Europe and China did not have life-cycle servanthood (Hajnal, 1982, pp. 461–2, 467, 473–4; Laslett, 1983, pp. 526–7). Thus VV's model cannot explain why the EMP did not emerge in those societies.

3.3 Did English peasants engage in pastoral agriculture?

VV's model assumes that medieval peasant households did not engage in pastoral production, so peasant women had to delay marriage and work for landlords to profit from rising pastoral earnings. This is factually inaccurate. Medieval English peasants normally engaged in both arable and pastoral agriculture. They did this using land they held as tenants, grazing rights on communal village pasture, and pasturage on the post-harvest stubble of the village's open arable fields.[3]

Before the Black Death, the amount of land and livestock owned by the average peasant was relatively small, although in aggregate the peasants of a village could own hundreds or even thousands of sheep (Power, 1941, p. 20; Dyer, 1981, pp. 5, 30; Masschaele, 1997, pp. 45–6; Dyer, 2005, p. 78). Even at this low level, however, peasants produced arable and pastoral output for sale as well as consumption. Most peasants had to pay money rents,

3 For further detail on peasants' pastoral production, see online Appendix Section A3.

and a peasant family with sheep or cattle could seldom consume all the wool or hides, which were therefore sold on the market (Power, 1941, p. 3).

The assumption that pastoral technology was available only to landlords is thus untenable. An alternative assumption which would yield similar results is that pastoral production required a minimum amount of land (VV, 2013, fn. 27 p. 2238). If such a minimum scale existed, the evidence above shows it did not preclude pastoral production by numerous peasants. However, if peasants produced only a small share of pastoral output and landlords dominated the sector, VV's assumption of a minimum land requirement for pastoral production would be an acceptable simplification.

But there is overwhelming evidence that landlords did not dominate medieval pastoral production. Sheep were an extremely important part of the pastoral sector, and English peasants produced at least as much wool as large landowners. In the early 14th century, England exported about 30,000 sacks of wool in a typical year. Masschaele (1997, pp. 52–3) estimates that on average a maximum of 5,000 sacks were produced annually by ecclesiastical estates and 8,550 by lay estates. Over half of early-14th-century English wool exports were thus produced by peasants. If domestic wool consumption comprised 25% of the quantity exported, then peasants produced almost 65% of total English wool (Masschaele, 1997, pp. 52–3). Bridbury (1977, pp. 398–9) and Campbell (2000, pp. 158–9) provide somewhat different estimates, but also conclude that peasants produced a very substantial share of wool sold in medieval England. An individual peasant typically produced only a small quantity of pastoral output, but there were nearly a million peasant holdings and only 20,000 landlord demesnes.[4] Consequently, most of the cattle and pigs in late-13th-century England were also kept by peasants (Dyer, 2005, p. 89). Peasants operated on a small scale but were very numerous, so they contributed substantially to pastoral production even before 1350.

After the Black Death, labour costs rose, grain prices fell, and prices for meat, milk, cheese, and wool rose. Pastoral agriculture required only one-fifth of the labour per unit land needed for arable cultivation (Campbell, 2000, p. 10). Peasants responded to these price signals by shifting from arable to pastoral production (Mate, 1987, p. 525; Dyer, 2005, pp. 129, 169). Peasant sheep, cattle, and pig holdings were much higher in the late 14th century and throughout the 15th than before the Black Death (Dyer, 1981, p. 30).

One way peasants expanded pastoral production was by leasing pastures from landlords (Dyer, 1981, pp. 4–5; Watkins, 1989, p. 18). Such leases already occurred before 1350 but proliferated rapidly thereafter, and by c. 1450 most landlords had abandoned direct exploitation of their demesnes (Lomas, 1978, pp. 339–40, 345, 352; Campbell, 2000, pp. 3, 58–60; Dodds, 2008, p. 77). This enabled many more peasants to get access to grazing and begin raising livestock (Bailey, 1989, pp. 257–8; Watkins, 1989, p. 19; Campbell, 1992, p. 113; Bailey, 2007, pp. 220–1; Hare, 2011, pp. 78–9, 101–5). Some peasants who leased land after the Black Death became large-scale producers, and thus can no longer be described as peasants, although they still leased rather than owned the land they worked. These lessees did not easily fit conventional social categories, and were described as 'farmers' by contemporaries (Dyer, 2005, pp. 194–5, 207). But in one study of 15th-century Wiltshire, at least 39% of lessees originated as local customary tenants, i.e. peasants (Hare, 2011, p. 101). Many demesnes were leased to multiple lessees, in which case peasants were invariably involved (Dyer, 1981, pp. 4–5). Peasants thus also produced pastoral output as demesne lessees.

4 The basis for the estimate of 20,000 demesnes is explained in Section A3 of the online Appendix.

It might still be argued that, although peasants engaged in pastoral production, peasant wives only did arable work.[5] However, this idea would be hard to justify given women's higher productivity in pastoral than arable work, and the evidence does not support it. The sparse surviving evidence confirms unambiguously that medieval peasant wives were fully involved in the household's production in field and pasture (Power, 1975, p. 71; Goldberg, 1991, p. 82). Once married, women did very similar tasks to those they had performed as unmarried servants, in particular pastoral work (Goldberg, 1991, p. 82; Mate, 1999, p. 16). The peasant housewife bore the main responsibility for the daily care of the cows and sheep which many peasant households kept. Peasants' wives and daughters were expected to feed animals, help with calving and lambing, wean calves and lambs, milk cows and ewes, and make butter and cheese (Hilton, 1975, pp. 101–2; Hanawalt, 1986a, p. 10; Goldberg, 1991, p. 82; Goldberg, 1992a, p. 110; Mate, 1999, pp. 31–2; Bardsley, 2007, pp. 63, 66). After the Black Death, the greater role of peasants in the pastoral sector made such activities even more important for peasant housewives (Mate 1999, pp. 31–2). Medieval coroners' reports show morning and noon peaks in peasant women's accidental deaths, resulting partly from women 'working with large animals' (Hanawalt, 1986a, p. 8). In medieval and early modern peasant households, milking and dairying were exclusively female occupations (Whittle, 2005, p. 69).

During the winter, peasant housewives cared for cows, sheep, and pigs when they were penned outside, sheltered in byres, or housed under the family roof. In other seasons, married peasant women took animals to pasture and herded them in the environs of the village (Hanawalt, 1986a, p. 9; Bardsley, 2007, p. 66). Medieval law-courts record peasant women being prosecuted 'for illegally trespassing with animals in the common field' (Graham, 1992, p. 129). Landlords prosecuted peasant wives for animal-related offences, as in 1331 when a married woman in Wiltshire was punished for taking her cow out of the landlord's pinfold (Müller, 2013, pp. 106–7). Pastoral production was sufficiently central to peasant housewives' responsibilities that in 1403 a Bothall woman bequeathed cows to two married women tending her in her final illness (Goldberg, 1995, p. 179).

Married peasant women also carried out all the tasks involved in procuring and tending the household's sheep. Rural court records show the peasant housewife purchasing sheep and, along with the resident daughters, washing and shearing them (Goldberg, 1992a, p. 110; Bardsley, 2007, p. 66). Archival records describe peasant women 'clipping sheep in the pasture for their wool' (Hanawalt, 1986a, p. 13).

The peasant housewife was the person mainly responsible for selling pastoral output—eggs, butter, cheese, yarn—in local markets and towns (Goldberg, 1991, p. 82; Dyer, 2005, pp. 28, 89). Married peasant women had individual control over the money they earned by selling pastoral products (Hanawalt, 1986a, pp. 15–6).

A woman who married a peasant did not, therefore, cease to do pastoral work. She could benefit from the post-1350 shift to pastoral agriculture by working with the family's own livestock. These empirical findings invalidate a central assumption of the VV model.

3.4 Did married women work for landlords?

VV's model assumes that women could only work for landlords as unmarried servants. This ignores the fact that the medieval agricultural labour force consisted not just of unmarried servants working for landlords and peasant families working for themselves, but also

5 For further detail on peasant women's pastoral activities, see online Appendix Section A4.

of independent labourers, including married women.[6] In the late 14th century, a large manor would employ four to ten unmarried servants, but one to two dozen labourers (Dyer 2005, p. 229). Labourers were recruited from poor peasant households and included married females (Middleton, 1979, pp. 159–62; Hanawalt, 1986a, p. 11; Smith, 1990b, p. 53; Bardsley, 2007, p. 63). Consequently, the work profile of women married to wage-earning men may not have been 'dissimilar from that of many single women' (Goldberg, 1986a, p. 34).

After 1350, rising wages pulled wives previously doing unpaid household work into wage-earning employment (Dyer, 2005, pp. 222–3). The Black Death triggered a shift from servanthood by unmarried individuals to wage-labouring by married couples. Labour scarcity meant workers could get steady work as higher-wage labourers, reducing the attraction of low-wage servanthood contracts whose main advantage was security (Bailey, 1996, pp. 13–4). Humphries and Weisdorf (2015, pp. 417–23) show that for at least 150 years after the Black Death, day-wages earned by female labourers were substantially higher than the daily remuneration implied by annual contracts for female servants, possibly because servants were more vulnerable to legal wage ceilings. The daily nominal remuneration implied by annual servanthood contracts hardly changed from 1350 to 1500. The price level rose immediately after 1350, but stabilized from the later 14th century on (Broadberry *et al.*, 2015, p. 191). Consequently, the Black Death did not increase female servants' wages in nominal terms and may even have reduced them in real terms. The higher female labourers' wages meant that from 1350 to 1500 a woman needed to work casually for only about 100 days a year to achieve the same earnings as a female servant from an annual contract.

Females—including married women—certainly made up a non-trivial proportion of English labourers after the Black Death. In Essex in 1352, over 15% of the 1,559 female labourers prosecuted for charging wages above the legal ceilings were certainly married (Poos, 1991, p. 226). On one Essex demesne in 1483–4, women provided approximately one-third of all person-days worked by labourers; 6 of the 16 named female labourers were recorded as married (Poos, 1991, pp. 214, 217). On one Cheshire estate in 1498–1520, almost one-third of the 45 female day-labourers were married (Youngs, 1999, p. 157). Married women enjoyed good access to labouring jobs because they got employment via husbands and were exempt from socio-legal pressures to become servants (Youngs, 1999, p. 157–8; Humphries and Weisdorf, 2015, p. 411–2). Married female labourers performed the pastoral tasks normal for maidservants and peasant housewives, as on one Essex estate in 1483–4 where a married woman was paid to milk cows (Poos, 1991, p. 217). Sparse documentation means that most descriptions of the precise work of female labourers date from after c. 1480, but there is no reason the many married female labourers recorded before that date should not also have done pastoral tasks, given the evidence that housewives did pastoral work on the peasant holding.

Married women also did other pastoral work for landlords. One 13th-century Lancashire estate hired married vaccary keepers who organized livestock care using their wives, offspring, and hired herdsmen. The wives and daughters were responsible for milking, butter-churning, cheese-making, and marketing. When the vaccary keepers moved the herds seasonally, their wives and daughters remained at the home farm to tend calves, milk cows, and make cheese. In the 1290s, three such vaccaries were operated by women, probably widows previously running them with husbands (Atkin, 1994, p. 17). Another instance

6 For further detail, see online Appendix Section A5.

of family-based pastoral employment of married women comes from a 15th-century Sussex manor, which employed married male shepherds and dairymen helped by wives and daughters (Mate, 1999, p. 32). In 1509, a demesne in Suffolk employed a married woman to manage the dairy and do other pastoral work (Whittle, 2005, p. 70).

A medieval woman thus did not have to stay unmarried to do pastoral work for a landlord. Many land-poor households could only survive if both husband and wife worked for landlords as wage-labourers. Such labourers did pastoral as well as arable work. Married women also worked for landlords in vaccary-keeping familial teams and as managers of demesne dairies. Women did not have to remain unmarried to benefit from rising pastoral wages paid by landlords after the Black Death, contrary to a key assumption of the VV model.

3.5 An unacceptable simplification

Any theoretical model has to make simplifying assumptions. But these are only acceptable if they abstract from non-essential complications without being crucial for the results of the model. The VV model is not an acceptable simplification, because it assumes away important aspects of the choices facing medieval English peasant women. Married females could work in pastoral agriculture both as wage-labourers for landlords and as peasant housewives on the family holding. If VV's model was altered by dropping the assumption that women had to choose between marriage on the one hand and pastoral employment as a servant on the other, higher wages for women in pastoral agriculture would no longer entail lower fertility. The result in VV's model that forms the basis of their argument that the Black Death led to the EMP depends critically on this untenable assumption.

Our emphasis on the fact that married women could work in pastoral agriculture does not mean that we regard servants as a minor source of hired labour, though, as we have noted, there is evidence suggesting that servants became a less important part of the labour force in the aftermath of the Black Death. Our point is that the existence of these pastoral employment opportunities for married women cannot be assumed away when analysing how the Black Death affected fertility. The higher wages in pastoral agriculture were available to both unmarried women working as servants and married women working as day-labourers, though the Humphries-Weisdorf evidence suggests that wages for the former increased much less than the latter, if at all. The effect of these higher wages on fertility will depend on several things. One is the relative sizes of the substitution and income effects that higher wages have on marriage and children. Another is women's attitudes to risk, since servanthood offers more secure employment than does working as a day-labourer. These considerations are missing from VV's analysis of the effects of higher pastoral wages on women's marriage and labour supply decisions. A satisfactory analysis will require recognition of heterogeneity in women's preferences with respect to marriage and risk. Lacking such analysis, it is not possible to state on theoretical grounds that rising pastoral earnings after the Black Death delayed marriage and reduced fertility.

4. Is there evidence of a causal relationship between pastoral agriculture and lower fertility?

Can it be argued that it does not matter that the VV theoretical model is driven by inaccurate assumptions, since the empirical findings support its predictions? The answer is no. The evidence advanced by VV does not in fact support the predictions of their model.

4.1 Pastoralism and the proportion of never-married females in 1381

The central argument of VV is that the expansion of pastoral agriculture after the Black Death caused lower nuptiality, because women could only do pastoral work outside marriage. VV believe that this view is supported by evidence of a causal relationship between the proportion of pastoral land in a county and the proportion of unmarried women there in the late 14th century (see VV (2013) Table 3). There are no data for the proportion of unmarried women in English counties at this time, but VV argue that an acceptable proxy is the proportional decrease in the number of taxpayers in a county between the 1377 and 1381 poll tax returns.

There are several reasons this argument fails to convince, which we discuss in Section A6 of the online Appendix. We show there that the fall in taxpayer numbers from 1377 to 1381 resulted from under-recording of an unknown combination of poor not-currently married men, poor not-currently married women, and poor married persons of both sexes, a combination that almost certainly varied across counties. Hence the regression results in Table 3 of VV (2013) do not tell us anything about the relationship between pastoral land and the proportion of never-married fertile women, which is what is needed in order to test VV's theory. VV's theory cannot be supported by the 14th-century data they mobilize.

4.2 Pastoralism and female age at first marriage

VV claim that their central argument is also supported by evidence that locations which were more pastoral before and after the Black Death had later female marriage age in the 1600–1837 period. VV's Table 4 appears to show that female age at first marriage (henceforth FAFM) in 1600–1837 was higher in locations that were (i) more pastoral before the Black Death and (ii) shifted more towards pastoral production after it. Their Table 5 appears to show that FAFM in 1600–1837 was higher in locations which had a contemporaneous pastoral marriage seasonality.

There are problems, as we shall see, with the empirical analysis reported in VV's Tables 4 and 5. But, even if there were no such problems, these regressions do not support VV's argument that the Black Death caused the EMP. At most, these tables show that FAFM several hundred years after the Black Death was related to measures of past and contemporaneous pastoralism. If female marriage age is assumed to be persistent across several centuries, VV's claim that the shift to pastoral production made women delay marriage immediately after the Black Death is one possible explanation for why FAFM in the 1600–1837 period was higher in locations which had more pastoral agriculture before or after the Black Death. But there are other possible explanations rooted in the 1600–1837 period itself. One is the increasing regional specialization of agriculture, the growth of urban markets, and the adoption of new crops and techniques from the 17th century onwards. Regions agronomically suited to growing particular crops specialized more heavily in arable cultivation, while those more suited to running sheep for wool, fattening cattle, or raising dairy animals shifted more strongly to pastoral production (Overton, 1996, pp. 103–5, 131; Coward and Gaunt, 2017, p. 516). Regional specialization made those locations that were relatively pastoral in 1290 even more so in the 18th century, as formerly mixed farms converted to sheep-raising, cattle-raising, or specialized dairying. This 18th-century intensification of the pastoral specialization of already predominantly pastoral regions was likely to have increased the demand for female labour, creating incentives for women to delay marriage. The general point is that any link between marriage behaviour in

the 1600–1837 period and the regional distribution of pastoral agriculture can be accounted for by other explanatory mechanisms than the Black Death.

Quite apart from their dubious relevance to the Black Death, there are a number of problems with the results that VV present about the relationship between pastoralism and FAFM 1600–1837. When these problems are addressed, there is no evidence of a positive causal relationship between these variables.

The dependent variable in VV's Tables 4 and 5 is the mean FAFM in the parishes located in a particular county, observed at five different periods (1625, 1675, 1725, 1775, and 1819).[7] VV Table 4 has two regressors relevant to their argument. One is the share of pastoral land in a county in 1290 (henceforth *Pastoral 1290*), which is interpreted as measuring the extent of pastoral agriculture before the Black Death. The other is the county-level number of deserted medieval villages per 100,000 acres (henceforth *DMV*), which is interpreted as measuring the shift from arable to pastoral production after the Black Death (VV Appendix, p. 25). Both variables raise measurement issues, for reasons discussed in detail in the online Appendix Section A5. In particular, *DMV* does not register desertion of villages in the aftermath of the Black Death, but rather over the entire period from the late eleventh to the 18th century. Hence it cannot be interpreted as a measure of the shift from arable to pastoral production following the Black Death, and the case for including it as a regressor is weak. Our preferred specification therefore omits *DMV* as a regressor. For a clear comparison with VV, we also report in Section A6 of the online Appendix results from regressions that retain *DMV*.

The relevant regressor in VV's Table 5 is the county-level share of parishes with spring marriage seasonality c.1560—c.1820. Kussmaul (1990) argues that marriage frequency which was high in spring but low in autumn indicates pastoralism, since pastoral workers typically married after lambing and arable workers after harvest. VV thus measure pastoralism by calculating the county-level share of parishes with spring marriage seasonality (henceforth *Pastoral Marriage*) using Kussmaul's 542 English parishes from 1561 to 1820.

To identify the causal effect of pastoralism on FAFM, instrumental variable (henceforth IV) estimation is necessary because a regression of FAFM on pastoralism variables and time-period variables almost certainly omits variables that influenced FAFM. VV Tables 4–5 report just-identified IV estimates using ln*(daysgrass)* as an IV for *Pastoral 1290* and *Pastoral Marriage*. The variable *daysgrass* is the number of days on which grass can grow in each county, based on 20th-century climate data (Down *et al.*, 1981). In their online Appendix, VV use crop suitability—measured as the share of each county's area reaching a threshold yield for at least one of wheat, barley or rye—as a second IV to obtain over-identified estimates.[8]

Pastoral 1290, *Pastoral Marriage*, and *DMV* are all measured at the county level, while FAFM is measured at the parish level. VV therefore allow for the regression errors to be clustered at the county level. There are only 15 counties in their FAFM dataset, while the standard cluster-robust variance estimate assumes that the number of clusters tends to infinity. Cameron *et al.* (2008) recommend using a version of the wild cluster bootstrap (WCB) to estimate the cluster-robust variance matrix when the number of clusters is small. We therefore report confidence intervals obtained from such a procedure, using the Stata

7 See online Appendix Section A8 for a fuller discussion of this and other variables used in the regression analysis.

8 VV (2013), online Appendix, p. 18.

Table 1. IV and OLS estimates of the effect of the share of pastoral land in 1290 and pastoral marriage seasonality on female age at first marriage

	Estimation method				Estimation method			
	IV using ln(*daysgrass*) (1.1)	IV using crop suitability (1.2)	IV using ln(*daysgrass*) and crop suitability (1.3)	OLS (1.4)	IV using ln(*daysgrass*) (1.5)	IV using crop suitability (1.6)	IV using ln(*daysgrass*) and crop suitability (1.7)	OLS (1.8)
Pastoral 1290	5.962	1.766	3.179	2.730	–	–	–	–
95% confidence interval	[3.83, 8.10] [1.12, 9.15]	[−3.38, 6.91] [−6.07, 6.09]	[−0.89, 7.25] [−∞, −13.9] U [−8.42, 6.28]	[−1.13, 6.60] [−1.92, 6.07]	–	–	–	–
Elasticity	0.137	0.040	0.073	0.063	–	–	–	–
Pastoral Marriage	–	–	–	–	9.488	3.667	7.321	3.288
95% confidence interval	–	–	–	–	[7.24, 11.74] [6.71, 12.33]	[−4.82, 12.15] [−∞, 10.43]	[3.31, 11.33] [−∞, −14.6] U [−3.06, 15.69]	[−1.90, 8.48] [−1.89, 9.03]
Elasticity	–	–	–	–	0.040	0.016	0.031	0.014
Effective *F* statistic	124.58	44.23	18.68	–	90.71	13.38	18.27	–
p-value of exogeneity test	0.000 0.033	0.295 0.338	0.625 0.722	–	0.000 0.029	0.906 0.916	0.013 0.142	–
p-value of test of just-identified estimates	– –	– –	0.127 0.089	– –	– –	– –	0.167 0.077	– –
p-value of *J* test	–	–	0.030	–	–	–	0.023	–
Adjusted R^2	0.264	0.347	0.354	0.355	0.192	0.381	0.301	0.382

Source: Authors' estimates.

Notes: The number of observations for all equations is 112. All equations include four time-period dummy variables as regressors, the coefficients of which are not reported. These estimates were obtained using the Stata command *ivreg2* (Baum *et al.*, 2010). In each pair of confidence intervals and *p*-values, the upper one is based on Stata's finite-sample adjustment and the lower one is based on the WCB. The elasticities correspond to the point estimate at sample mean values. The effective *F* statistic is that of Montiel Olea and Pflueger (2013). The *Pastoral Marriage* regressions are weighted by the number of parishes in each county for which the marriage pattern was reported by Kussmaul (1990).

boottest command of Roodman *et al.* (2019). For comparability with VV, we also report 95% confidence intervals based on the clustered standard errors from Stata's finite-sample adjustment, though in contrast to VV we use a small-sample adjustment for these.

The first four columns in Table 1 report estimates of the effect of *Pastoral 1290* on FAFM using the 112 observations in VV's FAFM dataset. All regressions in the table include four time-period dummy variables as regressors, the coefficients of which are not reported. For each pair of reported confidence intervals and p values in Table 1, the upper one is obtained using Stata's finite-sample adjustment, while the lower one is obtained using the WCB with Rademacher weights and 9,999 replications.

Equation (1.1) in Table 1 uses ln*(daysgrass)* as the single IV for *Pastoral 1290*, as VV do in their Table 4. The effective F statistic provides no evidence of weak IV problems.[9] There is clear evidence of a positive effect of *Pastoral 1290* on FAFM, though the elasticity corresponding to the point estimate is a modest 0.137.[10] A regression-based version of the Hausman test rejects the null hypothesis that *Pastoral 1290* can be treated as an exogenous variable, so just-identified IV estimation using ln*(daysgrass)* is preferable to ordinary least squares (OLS).

If crop suitability is also a strong IV for *Pastoral 1290*, it should be used as an IV together with ln*(daysgrass)* for inference; otherwise sample information would be wasted. Equation (1.2) in Table 1 shows the just-identified IV estimates using crop suitability. The effective F statistic shows that crop suitability is a strong IV. However, there is no clear evidence of a positive effect of *Pastoral 1290* on FAFM, the elasticity corresponding to the point estimate is very small, and the exogeneity test provides no evidence that IV estimation is necessary.

Using both IVs also makes it possible to test the over-identification restriction and hence whether ln*(daysgrass)* and crop suitability are valid IVs for *Pastoral 1290*. Equation (1.3) shows the results. The effective F-statistic suggests that this regression does not suffer from serious weak-IV problems.[11] The standard test of over-identification is Hansen's J statistic, but this may not be appropriate when the number of clusters is small. We therefore report as over-identification tests for Equation (1.3) both the p-value of the J-statistic and p-values of tests of the difference between the estimates of *Pastoral 1290* in Equations (1.1 and 1.2). The two latter tests are based on clustered standard errors from Stata's finite-sample adjustment and from the WCB procedure. The J test rejects the over-identification restriction in (1.3) at conventional levels. The p-value of the WCB test of the difference between the two just-identified IV estimates of the effect of *Pastoral 1290* in Equations (1.1 and 1.2) is 0.089, though it is 0.127 if the less satisfactory Stata finite-sample adjustment is used. In any case, because the most serious consequences of an incorrect decision in an over-identification test arise from type II error, failure to reject the restriction at p values of 0.10–0.15 does not mean that the test has been passed, since its power will be low. These

9 With a single IV, the Montiel Olea-Pflueger (2013) critical values for the null hypothesis that the TSLS estimator has a bias no larger than 5% and 10% of the worst case are 37.418 and 23.109, respectively.

10 Here and subsequently all reported elasticities are calculated at sample mean values.

11 With two IVs, the Montiel Olea-Pflueger (2013) critical values for the null hypothesis that the TSLS estimator has a bias no larger than 5% and 10% of the worst case are 23.097 and 14.713, respectively.

over-identification tests show that at least one of ln*(daysgrass)* and crop suitability does not satisfy the exclusion restriction required to be a valid IV.

The number of days on which grass can grow indicates climatic conditions which are positively associated with pastoral agriculture, while crop suitability indicates land conditions which are negatively associated with pastoral agriculture. These variables certainly reflect natural influences on the extent of pastoral agriculture in different English counties. But it is extremely unlikely that a location's climatic and land suitability for pastoral agriculture should affect FAFM in 1600–1837 solely via the share of pastoral land in 1290, which is the condition required for these variables to be valid IVs. As discussed above, the 18th-century intensification of regional specialization in pastoral production was likely to have influenced FAFM. From the 17th century onwards, there was also a gradual shift from sickles to scythes in harvesting grain (Roberts, 1979, pp. 16–8; Snell, 1985; Overton, 1996, p. 188). This decreased female relative to male productivity in arable agriculture and gradually reduced women's relative wages between the late 16th century and c. 1725 (Roberts, 1979, pp. 18–9). Other things equal, this would have reduced female labour force participation in arable regions, motivating women to marry earlier. Since the technological shift did not affect women's labour productivity in pastoral regions, it would have left female labour force participation there unchanged and FAFM in those regions unaffected. As a result, a positive relationship between pastoral regions and FAFM was likely to emerge in the early modern period, since arable regions saw falling female labour productivity and stronger marriage incentives for women, while pastoral regions did not.

These developments make it probable that climatic and land conditions in a particular location directly affected FAFM there in 1600–1837, in addition to any effect that may have operated via the share of pastoral land in 1290. If so, both ln*(daysgrass)* and crop suitability are invalid IVs. The over-identification tests suggest that at least one IV is invalid, and even if one of the two variables is a valid IV, there is no way of knowing which it is. Thus we do not believe that it is possible for any of Equations (1.1–1.3) to yield causal estimates of the effect of *Pastoral 1290* on FAFM. At best, VV's data make it possible to estimate an association between *Pastoral 1290* and FAFM. Equation (1.4) shows that this association is very small and poorly determined. Furthermore, the exogeneity tests in (1.2) and (1.3) provide no evidence that the IV estimates in these equations are preferable to the OLS ones in (1.4).

Equations (1.5–1.8) in Table 1 show estimates of the effect of roughly contemporaneous spring marriage seasonality on FAFM in 1600–1837. A detailed discussion of these results is not necessary, because they resemble those in Equations (1.1–1.4). When ln*(daysgrass)* is used as the single IV for *Pastoral Marriage*, in Equation (1.5), there is no evidence of weak-IV problems, and the effect of *Pastoral Marriage* on FAFM is precisely estimated. When crop suitability is used, in (1.6), there is evidence of weak-IV problems, and the estimated effect of *Pastoral Marriage* is poorly determined.[12] The case for focusing on the over-identified IV estimates in (1.7) is less compelling, since crop suitability is not a strong IV. Nevertheless, the tests of the over-identification restriction in (1.7) suggest that at least one of the two IVs is not a valid IV for *Pastoral Marriage*. The *J* test rejects the over-identification restriction at conventional levels, and the *p*-value of the WCB test of the

12 With a single IV, the Montiel Olea-Pflueger (2013) critical values for the null hypothesis that the TSLS estimator has a bias no larger than 20 and 30% of the worst case are 15.062 and 12.039 respectively.

difference between the two IV estimates in Equations (1.5 and 1.6) is 0.077. Thus it is not possible to obtain causal estimates of the effect of *Pastoral Marriage* on FAFM. The most that VV's data permit is an estimate of the association between them, which Equation (1.8) shows to be extremely small and poorly determined. Even if one were to focus on the largest and most precise IV estimate, in (2.1), its economic significance is tiny, with the elasticity corresponding to the point estimate being 0.04.

VV's estimates of the causal effect of *Pastoral 1290* and *Pastoral Marriage* on FAFM several hundred years after the Black Death are based on the use of IVs which fail to satisfy the exclusion restriction. Furthermore, the VV estimates do not use the recommended WCB procedure for obtaining standard errors when the number of clusters is small. The estimates reported in Table 1 show that there is no evidence of an economically or statistically significant relationship between these pastoralism measures and FAFM. Quite aside from the dubious pertinence of a relationship between pastoralism and FAFM post-1600 to the immediate demographic effects of the Black Death in 1350, there is no evidence that any such relationship existed.

5. Conclusion

Did the Black Death create the EMP, thereby freeing Western Europe from Malthusian limits on growth? Careful examination reveals pervasive problems with this argument, affecting the basic premise, the underlying theoretical model, and the empirical analysis.

There is no evidence that the EMP originated in rural England in the aftermath of the Black Death. The evidence on medieval English demography is so sparse and fragile that scholars disagree fundamentally about marriage age before the 1540s, the earliest date for which parish register data are available and family reconstitution is therefore possible. The one point on which there appears to be a consensus among historical demographers who study medieval England is that, whenever the EMP did emerge in the English countryside, it was not directly after the Black Death. VV's basic premise is wrong.

Women's wages in pastoral agriculture increased after the Black Death, but the effect of higher wages on marriage and fertility is ambiguous in general because wages have income and substitution effects that work in opposite directions. VV's theoretical model predicts that these higher wages led to later marriage and lower fertility on the basis of one untestable assumption about preferences, and two testable ones about women's labour market opportunities: first, that women could only work in the pastoral sector if they worked for landlords; and second, that in order to work for landlords, women had to remain unmarried. If either one of these two testable assumptions does not hold, VV's model does not predict that EMP behaviour will emerge after an increase in the aggregate land-labour ratio. The historical evidence makes it quite clear that these two testable assumptions did not hold in medieval England.

The quantitative evidence presented by VV is also flawed. VV claim that there is a cross-sectional relationship between pastoralism and the proportion of never-married fertile women in late-14th-century England, but the proxy they use for the latter in their empirical analysis is best interpreted as measuring the proportion of poor people in a location, not the proportion of never-married fertile women there. VV's evidence of a positive relationship between pastoralism and female marriage age in the period c. 1600–1837 disappears once the appropriate procedure for obtaining a cluster-robust variance matrix with a small number of clusters is employed and careful attention is paid to the validity of the IVs. But

even if this problem did not exist, a relationship between pastoralism and female marriage age several hundred years after the Black Death is not relevant to VV's argument about the demographic effects of the Black Death.

What are the wider implications of being forced to abandon the argument that the Black Death led to the emergence of the EMP in England? If it were the case that the exogenous shock of the Black Death led to the emergence of the EMP, then the EMP could be taken as an exogenous cause of higher living standards in those societies that had it. However, as we have shown, the claim that fertility restriction in England was caused by the Black Death does not stand up to scrutiny. This means that analyses of the causal effects of fertility restriction on pre-industrial growth have to take account of the effects of living standards on marriage and fertility as well the reverse effects. Further research will be required to understand when and how pre-industrial people managed to calibrate their fertility to the productive capacities of the economy, thereby freeing themselves of Malthusian shackles on growth. The EMP is not an exogenous cause of economic development.

Supplementary material

Supplementary material is available on the OUP website. This material comprises the online Appendix, the data file, and the replication files.

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