Online Appendix for “Slavery and the British Industrial Revolution” (Not for Publication)

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A Online Appendix

This *Online Appendix* contains an extended discussion of the empirical results presented in Section 7 of the paper. Section A.1 reports additional empirical results; Section A.2 discusses the calibration of the parameters of the theoretical model; and Section A.3 discusses the robustness of our calibration exercise to alternative parameter Values.

A.1 Additional Empirical Results

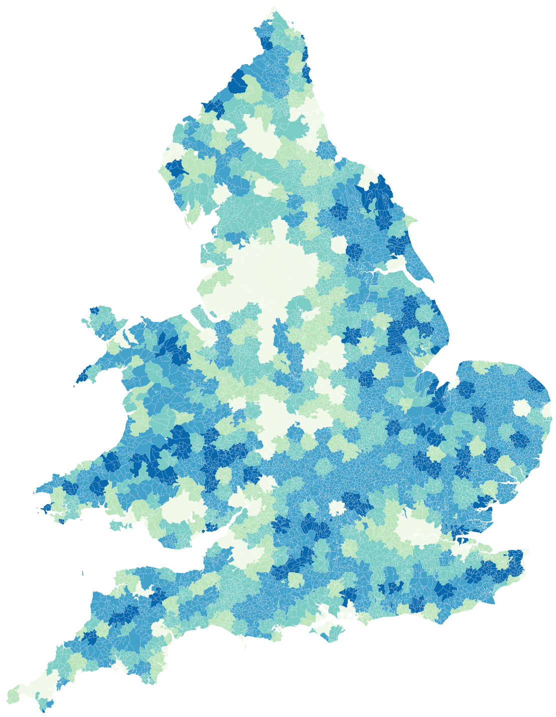
In this section, we report additional empirical results and robustness tests to supplement the main results reported in the paper. In Subsection A.1.1, we provide additional figures for our motivating empirical results in Section 5 of the paper and our main empirical results in Section 7 of the paper. In Subsection A.1.3, we provide further empirical evidence in support of our causal argument linking middle-passage mortality and continued involvement in the slave trade from Section 7.1 of the paper. In Subsection A.1.4, we report addition robustness tests for our instrumental variables (IV) estimation in Section 7.2 of the paper. Finally, Subsection A.1.5, we provide empirical evidence that investments in the Legacies of British Slavery Database decline rapidly with distance and hence are concentrated locally.

A.1.1 Additional Figures

Agricultural Employment Share 1831 In Figure 2b, Section 5 of the paper, we display the manufacturing employment share across the 849 regions in our data in 1831. By that time, the manufacturing employment share for England and Wales as a whole was 42%, and we see the emergence of industrial agglomerations in the North. However, agriculture still employs 29% of the population and there is substantial heterogeneity in agricultural specialization across regions, with agriculture still accounting for more than 60% percent of employment in some counties. In Figure A.1 we display the agricultural employment share across the 849 regions in our data in 1831. Areas with high manufacturing employment shares tend to have low agricultural employment shares, as structural transformation away from agriculture occurs. Comparing Figure A.1 with Figure 2a in the paper, agricultural employment shares and slave-holder compensation are negatively correlated.

Lascelles Family Tree Our instrumental variable connects voyage success for slave-trading ancestors to slaveholding in 1833 using family trees on Ancestry.com, as discussed in Subsection 7.1 of the paper. The idea of tracing the ancestors of slave traders provides an indirect method of linking locations all across England and Wales to the slave trade. Often, families hailing from a particular place would see one of theirs work and live in a major trading port

Figure A.1: Agricultural Employment Share in 1831



Note: Agriculture employment share in each region in the 1831 agriculture census; darker blue colors correspond to higher values; lighter green colors correspond to lower values.

for a few years – but the majority of the family network, including many individuals who invest, inherit or benefit from the business advice of a relative, remained near the ancestral home. For example, the Lascelles family initially hailed from Stank Hall, in Yorkshire; three of the family's male descendants became slave traders, participating in 14 voyages between 1699 and 1736. By 1787, the Lascelles owned 27,000 acres in Barbados, Jamaica, Grenada, and Tobago. All the male lines save one eventually died out, so that only one of them - Henry, second Earl of Harewood (1767-1841) - received slavery compensation under the terms of the 1833 Abolition of Slavery Act, as shown in Figure A.2 below.

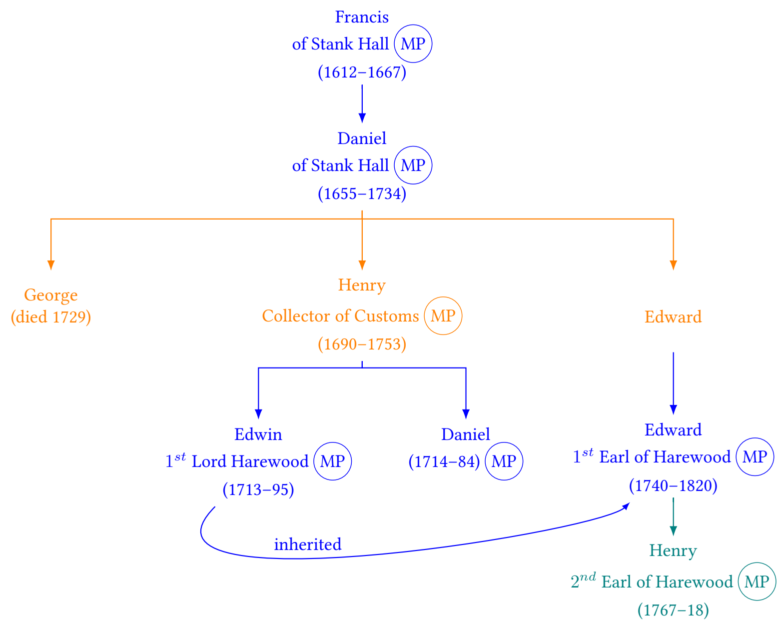
A.1.2 Simulation of Middle Passage Length

We combine modern pilot charts (weather maps giving the direction and speed of wind) for each week with weather observations from historical ship logs.

Modern Weather Map Modern weather maps, covering wind patterns from 1979 to 2010, are published by the *National Centers for Environmental Prediction* (NCEP)[1] for four times every day. Consistent with CLIWOC, we use observations from 12 noon each day. These maps

[1] https://rda.ucar.edu/datasets/ds093.0

Figure A.2: Lascelles Family Tree



Note: Figure shows a portion of the Lascelles family tree, annotated to highlight the members of the male line who were slaveholders (blue), slave traders and holders (orange) and beneficiaries of the slave compensation act (green). MP indicates members who were Northallerton MPs.

encompass a latitude range of -10 to 60 and a longitude range of -80 to 10, with a precision of 0.5 degrees. The data provided is at a height of 10 meters above sea level. Each 0.5 degree grid on the maps is represented by two values: the *U vector*, indicating the wind speed in the east-west direction, where a positive U vector signifies a west-to-east wind flow; and the *V vector*, indicating the wind speed in the south-north direction, where a positive V vector indicates a south-to-north wind flow. To summarize the modern wind maps, we calculate the weekly average values for U and V in each 0.5 degree grid cell and, in addition, 53 baseline weekly averages across all observations within a specific week.

CLIWOC Data During the period of 1750 to 1807, the CLIWOC dataset contains a total of 139,222 distinct records capturing wind measurements. We are interested in observations from the North Atlantic Ocean and therefore restrict the dataset to include only records within the longitude range of -80 to 10 and the latitude range of -10 to 60. After applying these constraints, there are 87,644 unique wind records.

We process the CLIWOC data in the same way as the modern weather maps. The U and V wind vector information within each 0.5 degree grid cell is aggregated for every week. To compare CLIWOC observations with modern weather maps, we apply the following procedure. For a given week in CLIWOC, say the fifth week of 1790, we compute the absolute differences between the V and U vectors of the weekly CLIWOC data and the corresponding modern weather maps for every fifth week for the years 1979 to 2010. Next, we identify the modern year with the minimum difference as the closest representation of the historical weather conditions for that specific week in 1790. For any CLIWOC week where we observe less than four observations, we use the weekly average for that week of the year instead.

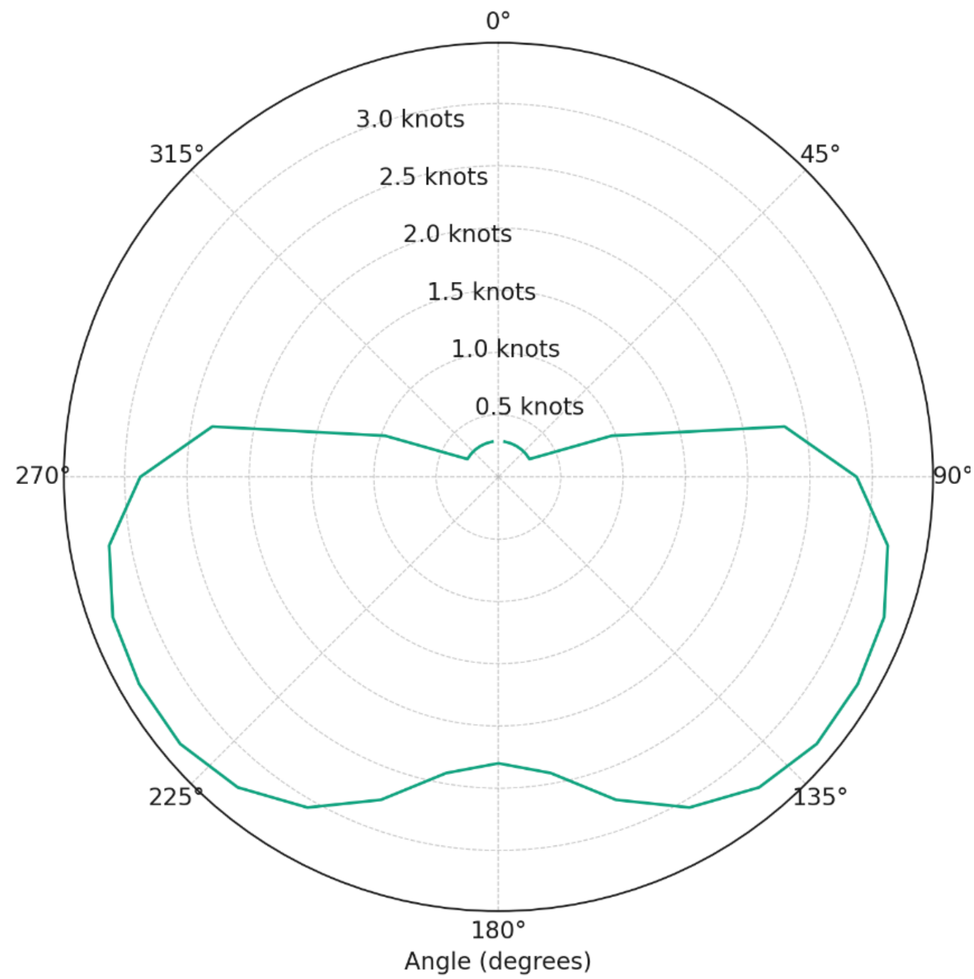
The rationale behind this procedure is based on the fact that weather patterns in the Northern Atlantic Ocean reflect atmospheric pressure fields that revolve around a low-pressure area near Iceland and a high-pressure area around the Azores. These pressure systems exhibit regular patterns, leading to a high degree of spatial autocorrelation (Visbeck et al. 2003). This autocorrelation allows us to use spatial interpolation techniques to estimate weather patterns in areas without direct observations.

In our approach, we consider ship log observations as a representative sample drawn from the population of weather observations in a given week and we leverage modern weather maps to interpolate the weather patterns between these historical sample points. This procedure provides us a time-varying representation of the weather conditions in the Northern Atlantic Ocean. These, in turn, provide the foundation for our voyage-length simulations.

Simulation To use our predicted, weekly historical weather maps to simulate historical sailing times, we have to calculate a cost surface. We follow Pascali (2017) and assume that the costs of sailing only depend on the wind pattern of each grid cell and the sailing characteristics of the ship. These characteristics can be summarized by a polar diagram, which describes how wind speed and direction mapped into sailing speed.[2] Next, we use the Dijkstra algorithm to determine the shortest path for every middle passage voyage where we observe a start and end date. To incorporate variation in weather patterns, we update the weather maps every week. For a given trip from origin O to destination D, this procedure calculates the ship's progress over a week given the observed weekly weather maps and updates the origin location to O' while holding the destination fixed. We repeat this procedure for every subsequent week until the ship has reached destination D. Intuitively, variation in sailing time results from differences in the weather conditions which we infer from *other* ships in the North Atlantic ocean during this time.

[2]No polar diagram for slave ships exists. We derive a polar diagram for 18C ships from the records of sailing of and wind conditions in the CLIWOC database diagram. In the UK slave voyages dataset, there are 618 routes that have the full records of the departure time from Africa, the landing time on New World, and the location of the ports. We then adjusted the polar diagram for 19C sailing vessels as used by Pascali (2017) to match actual sailing times for this full-information subset of the data. The best-fit adjustment suggests a reduction in sailing speeds by a factor of 0.5. Figure A.3 shows the polar diagram we use, for 12 knots of wind.

Figure A.3: Polar Diagram - Sailing Speed as a Function of Wind Angle



Note: The figure shows the speed of an 18C sailing vessel at wind speed of 12 knots, as a function of the ships direction relative to the direction of the wind. It reflects the difficulty of square-rigged ships sailing against the direction of the wind.

Predicted Mortality The least cost path algorithm gives us a measure of voyage length. To compute a corresponding measure of voyage mortality, we regress the voyage mortality on the measure of simulated voyage length, condition on the ship's tonnage, and predict mortality. This procedure allows us to fill in missing mortality information for voyages where we observe departure dates while mortality is missing.

A.1.3 Middle Passage Mortality and Involvement in the Slave Trade

In Subsection 7.1 of the paper, we provide empirical evidence on the role of middle-passage mortality in shaping voyagers' continuing involvement in the slave trade. In Table A.1 we show that – for both UK slave voyages and slave voyages of all other slave trading nations –

voyage 'success' was inversely correlated with the duration of the middle passage.

In Figure A.4, we further probe this relationship by showing linear fits of the probability that a slave trader exits after a single voyage against middle-passage mortality (left panel) and voyage duration (right panel). We use the sample of 10,495 slave voyages operating from British ports. We find strong and approximately linear relationships between the probability of exit after a single voyage and both middle-passage mortality and voyage duration.

Table A.1: Voyage Failure and Middle Passage Duration

	UK		all other	
quintile	share of failed voyages (in %)	middle passage duration (in days)	share of failed voyage voyage (in %)	middle passage duration duration (in days)
lowest	0.00	28.19	0.01	27.24
2	0.00	35.46	0.00	36.38
3	0.01	46.31	0.01	45.74
4	0.09	60.14	0.01	59.30
highest	0.11	92.85	0.04	97.98

Note: Success of voyages, by nationality of ship owners. Classification according to the Slave Voyages Database (variable FATE4). We focus on "original goal thwarted (natural causes)" as the indicator of failure.

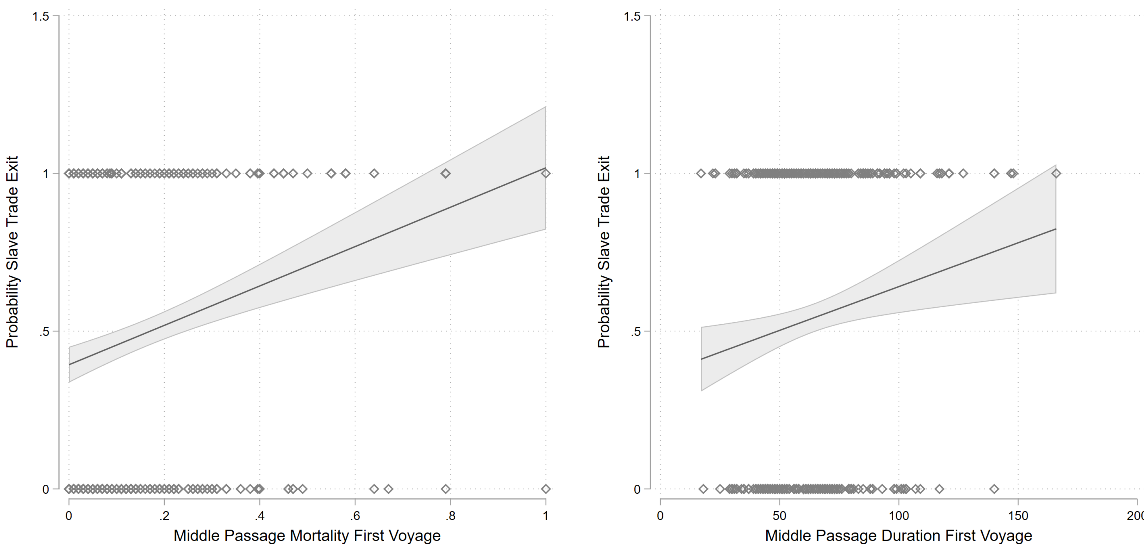
In Table A.2 we show the results of Cox regressions that assess the effect of middle-passage mortality on exit from the slave trade. Experiencing a high mortality during the voyage has a large, positive effect on the likelihood of exiting the slave trade. This result holds even after controlling for the tonnage of the vessel, number of enslaved persons carried and fixed effects for decade and port of departure from Africa. This pattern of results is again consistent with selection on profitability in the slave trade. Many first-time slave traders had relatively small levels of wealth. Those who were unlucky with weather conditions, and experienced high middle-passage mortality, saw their initial wealth levels fall, which could preclude further participation in the slave trade.

Taken together, this additional evidence corroborates the findings in Subsection 7.1 of the paper and further strengthens the argument that the role of mortality, driven by wind conditions, in the shaping the dynastic fortunes of slave traders was large.

A.1.4 Robustness of Main IV Results

In this section of the Online Appendix, we report further details and robustness tests for our main IV specification, as discussed in Section 7.3 of the paper. First, we probe the robustness of our instrument to alternative specifications of the exposure weighted voyage success instrument using either mortality or voyage length as a voyage success measure. Second, we

Figure A.4: Determinants of Exit from the Slave Trade, First Voyage



Note: Horizontal axis shows middle passage mortality during the first slave voyage of a ship owner; vertical axis shows probability of exiting the slave trade after this first slave voyage; grey area represents a 95% confidence interval around the linear fit.

Table A.2: Exit from the Slave Trade and Slave Mortality

	(1)	(2)	(3)	(4)	(5)
MP Mortality	2.66***	2.80***	2.57***	4.04***	4.29***
	(5.07)	(5.04)	(3.03)	(4.79)	(4.29)
Tonnage		1.00*	1.00	1.00	1.00
		(1.70)	(1.01)	(1.63)	(-0.22)
# Enslaved Embarked				1.00	1.00
				(-1.09)	(-0.09)
Decade FE	No	No	Yes	Yes	Yes
African Port FE	No	No	No	No	Yes
Observations	3,194	3,094	3,092	2,716	2,716
Cluster	Voyage	Voyage	Voyage	Voyage	Voyage

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Cox regressions - exponentiated coefficients; t statistics in parentheses. We use survival analysis where a trader operating from a British port exiting the slave trading business is coded as "failure". Standard errors are clustered at the level of the individual slave voyage. African port fixed effects control for the port of departure on the middle passage crossing.

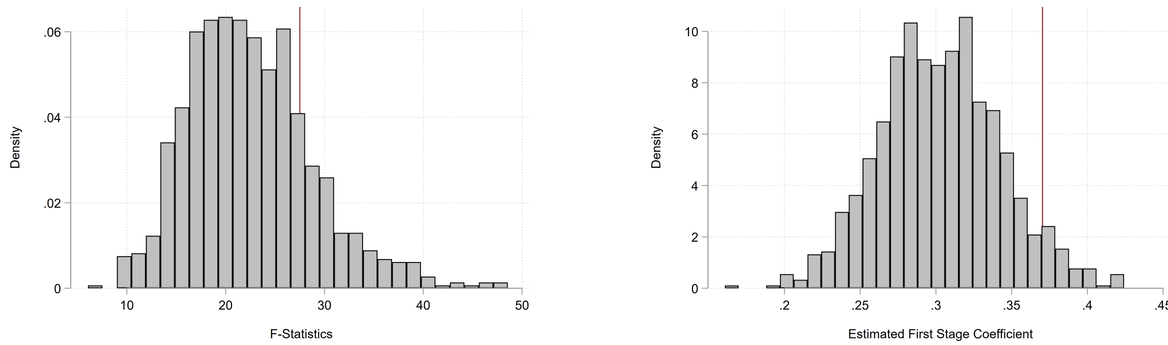
present results of a placebo exercise. Third, we show an alternative instrument that exploits variation in slave voyager surnames from the 1851 full count census to determine regional exposure weights. Fourth, we report additional estimation results for our baseline specification and demonstrate the robustness of our findings across different variants of this baseline specification. Fifth, we assess the potential relevance of spatial autocorrelation. Sixth, we report a robustness test in which we assign parishes to our hexagonal regions using area weights instead of centroids. Seventh, we report a robustness test, in which we exclude regions close to the main slave-trading ports. Eighth, we demonstrate the robustness of our results to the use of alternative levels of spatial aggregation. Finally, we report further results for the specification check using never-takers discussed in Section 7.2 of the paper.

Mortality and Instrument Versions using Mortality or Voyage Length In our baseline version of the instrument, we calculate voyage success as inverse mortality where we condition voyage mortality on route and decade fixed effects. We will now consider alternative versions where we (i) only remove decade fixed effects; (ii) remove decade and route fixed effects (the baseline); (iii) remove captain fixed effects; (iv) we predict mortality using weather conditions (as in the main text). Lastly, we present the same four specifications but we use voyage length instead of voyage mortality, to address the concern that in specifications without captain fixed effects, the mortality rate conditional on a given voyage duration could be affected by captains.

Table A.3 shows the results of these robustness checks. It is reassuring to see that our results are robust to all these modifications; they neither change qualitatively nor quantitatively. We draw two conclusions from this exercise. First, it does not look like captain quality affected the relationship between voyage length and mortality significantly. This is in line with our argument that variation in voyage length is primarily driven by unpredictable and therefore quasi-random weather shocks.

Permutation test This section of the robustness checks shows the result of 1,000 permutations where we randomly reshuffle the voyage success measure across local exposure shares derived form the spatial distribution of voyager ancestors and re-estimate the first stage (Equation (16)). Figure A.5a compares the distribution of 1,000 first-stage F-statistics from the permutation exercise to the actual baseline outcome indicated by the red line. Figure A.5b shows the same comparison between the baseline first stage coefficient on the instrument and permutations. Visibly, our estimated effects are at the fringe of the distribution which underlines our claim that the observed distribution of ancestors is a meaningful predictor the unobserved family network that accumulated slavery wealth. The relationship is unlikely to be driven by spurious correlation.

Figure A.5: Permutation Test



(a) First Stage F-Statistics

(b) Estimated First-Stage Coefficient

Note: *Left panel:* The figure shows results of 1,000 placebo regressions of Equation (16) where we randomly reshuffle our voyage success measure across ancestor exposure shares. The *left panel* shows the distribution of first stage F-statistics and the *right panel* shows the estimated first stage coefficient on the instrument. The red line contrasts the actual baseline result with the distribution of this permutation test.

Alternative exposure weights using surnames Our main instrument uses direct genealogical connections from family trees to measure slave traders' familial locations. A potential concern about this approach is that family trees on *Ancestry.com* are not available for all slave traders. This selection could be non-random: Slave-trading families could be either more or less likely to have detailed family records. To address this potential concern, we also use the national distribution of all *surnames* (from the 1851 population census) to measure slave traders' familial locations. This strategy exploits the persistent geographical concentration of surnames in Britain (Cheshire and Longley 2011) and assumes that concentrations of slave voyager surnames in 1851 are informative about their familial locations. While less precise than the family-tree instrument, this strategy is exhaustive, and hence provides a useful cross-validation of our family-tree instrument.

The 1851 census contains a total of $N = 17,474,083$ individuals with $S = 330,329$ distinct surnames. The surname distribution is heavily skewed (Fox and Lasker 1983, Güell et al. 2014). The two most common surnames, Smith and Jones, account for about 1.4 percent of all individuals, while 37 percent of names occur only once. Of the 2,259 distinct voyager surnames, we can match 90 percent (2,040) to at least one individual in the 1851 census. Comparing the voyager and non-voyager surnames, we find that voyager surnames are slightly more common than non-voyager surnames.

We use the voyager surnames observed in the 1851 census to infer the spatial distribution of voyagers' familial locations. Each individual in the 1851 census has a recorded name and parish. We match all slave voyagers v (unique in first name and surname) to individuals in the 1851 census using their surname s. Since multiple individuals may have the same surname, this is a one-to-many match. For example, we observe 21 slave voyagers with the surname *Smith*. We match each of these 21 voyager observations with the 240,117 individuals named *Smith* in the 1851 census. As with the ancestor instrument, we exploit the exogenous variation in each voyager's average voyage success (VS_v) defined in equation (13) above and compute the surname-based average success instrument as exposure weighted voyage success across all regions i:

$$VSI_i^{sname} = \sum_{i=1}^{S_i} s_{is(v)} VS_{s(v)}, \tag{A.1}$$

where the exposure weights $s_{is(a)}$ are location i's share of surnames that we could match to a slave voyager v and the notation $s(v)$ makes explicit that surname s is matched with voyager v. In our regressions, we will control for the local surname share, S_i/S with S being restricted to the total of surnames that match with at least one ancestor, so as to focus on the plausibly exogenous variation in voyage success across regions.

Table A.4 gives the results. We find broadly similar patterns, with areas more exposed to successful slave traders having more slave-wealth in 1833 – and the part of the variation in slave wealth driven by genealogical links and exogenous voyage success predicting structural change as well as relative property wealth and the location of textile factories.

Specification Variants This section reports additional estimation results for our baseline specification and demonstrates the robustness of our findings across different variants of this baseline specification. Table A.5 reports the estimated coefficients on all the control variables from our baseline specification, as reported in Table 2 in the paper. Table A.6 reports a robustness test in which we exclude the control variables from our baseline specification. Table A.7 reports a further robustness test, in which we use the log transformation instead of the inverse hyperbolic sine transformation. We find that our baseline estimation results are robust across each of these different specification checks.

Spatial Auto-correlation of Regression Residuals Our baseline specification uses robust standard errors, because our 849 regions are relatively large, which helps to alleviate potential concerns about spatially correlated errors. Nonetheless, in principle, there still could be spatial autocorrelation (SAC) across these hexagons. We now provide evidence on the potential relevance of this concern using the procedure in Colella et al. (2019). To assess this, we first seek to understand the extent of SAC in the residuals of our main IV specification (as reported in Table 2). Table Table A.8 reports Moran's I statistics (the spatial analogue to the Durbin—Watson d statistic), measuring SAC at a range of different distance bandwidths. The interpretation of the Moran's I statistics displayed in the Table A.8 is the following. We are testing the null hypothesis that the data is randomly disbursed. A rejection of this null hypothesis implies that the data are more spatially clustered than one would expect under a random distribution. Moran's I lies in the interval $[-1, 1]$ with positive (negative) values indicating positive (negative) spatial auto-correlation. We find some evidence of positive spatial auto-correlation up to about 200 km. After that, this starts to peter out with very small and mostly negative values. Across all the distances reported in Table A.8, the values of Moran's I are small in magnitude and close to zero.

Table A.3: Variations of Slave Mortality Calculations

	PropTax1815	%Agric1831	%Manuf1831	CottonMill-1788	CottonMill-1839
IV-Mort, Time	0.87***	-0.80***	0.92***	0.56***	0.97***
	(0.163)	(0.152)	(0.215)	(0.204)	(0.224)
N Voyagers	213	213	213	213	213
KPW F-stat	27	27	27	27	27
AR p-value	0.0	0.0	0.0	0.0	0.0
IV-Mort, Time, Route	0.84***	-0.75***	0.90***	0.62***	0.83***
	(0.161)	(0.167)	(0.219)	(0.216)	(0.211)
N Voyagers	169	169	169	169	169
KPW F-stat	27	27	27	27	27
AR p-value	0.0	0.0	0.0	0.0	0.0
IV-Mort, Captain	1.07***	-1.03***	1.33***	1.02***	1.16***
	(0.227)	(0.230)	(0.352)	(0.350)	(0.296)
N Voyagers	128	128	128	128	128
KPW F-stat	22	22	22	22	22
AR p-value	0.0	0.0	0.0	0.0	0.0
IV-Mort, Predicted	1.13***	-0.88***	0.91***	0.37	0.91***
	(0.270)	(0.238)	(0.288)	(0.230)	(0.275)
N Voyagers	389	389	389	389	389
KPW F-stat	15	15	15	15	15
AR p-value	0.0	0.0	0.0	0.1	0.0
IV-Voy, Time	1.07***	-1.04***	1.31***	0.90***	1.19***
	(0.254)	(0.240)	(0.341)	(0.314)	(0.317)
N Voyagers	211	211	211	211	211
KPW F-stat	17	17	17	17	17
AR p-value	0.0	0.0	0.0	0.0	0.0
IV-Voy, Time, Route	1.09***	-0.96***	1.25***	0.95***	1.19***
	(0.248)	(0.222)	(0.326)	(0.313)	(0.291)
N Voyagers	179	179	179	179	179
KPW F-stat	19	19	19	19	19
AR p-value	0.0	0.0	0.0	0.0	0.0
IV-Voy, Captain	1.10***	-1.02***	1.32***	1.00***	1.25***
	(0.250)	(0.227)	(0.341)	(0.345)	(0.328)
N Voyagers	119	119	119	119	119
KPW F-stat	19	19	19	19	19
AR p-value	0.0	0.0	0.0	0.0	0.0
IV-Voy, Predicted	1.13***	-0.80***	0.79***	0.34	0.82***
	(0.272)	(0.228)	(0.274)	(0.225)	(0.268)
N Voyagers	389	389	389	389	389
KPW F-stat	15	15	15	15	15
AR p-value	0.0	0.0	0.0	0.1	0.0

Note: *** p<0.01, ** p<0.05, * p<0.10. Standardized coefficients with robust standard errors in parenthesis. Slave claims and the outcomes in columns 1, 5 and 6 are IHS-transformed. The Voyage success instrument (VSI) allocates slave-traders to their familial locations using family trees. Controls are population in 1500, latitude, longitude, distance to the coast, and the local ancestor share A_i/A.

Table A.4: Main IV Estimates Using Surnames

	(1) First Stage	(2) PropTax1815	(3) %Agric1831	(4) %Manuf1831	(5) CottonMill-1788	(6) CottonMill-1839
Panel A: OLS – Base						
Slave Claims		0.183***	-0.250***	0.210***	0.0855**	0.206***
		(0.032)	(0.032)	(0.033)	(0.036)	(0.036)
Panel B: IV – Base						
VSI	0.258***					
	(0.034)					
Slave Claims		0.947***	-1.375***	1.679***	1.118***	1.487***
		(0.155)	(0.236)	(0.354)	(0.340)	(0.283)
Observations	847	847	847	847	847	847
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Elasticity	0.59	0.20	-0.30	0.34	1.26	1.12
N Voyagers	2040	2040	2040	2040	2040	2040
KPW F-stat		58.52	58.52	58.52	58.52	58.52
AR p-value		0.00	0.00	0.00	0.00	0.00
tF adjusted CI		[0.62,1.27]	[-1.87,-0.88]	[0.94,2.42]	[0.41,1.83]	[0.90,2.08]

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Standardized beta coefficients with robust standard errors in parenthesis. Panel A shows OLS regressions and Panel B IV regressions where the instrument is the grid cell share of voyager surnames scaled by voyage success (Panel B). Controls are population in 1500, latitude, longitude, distance to the coast, and the local surname share $A_i/A.$.

Table A.5: Main IV Estimates Showing Full Controls

	(1) SlaveClaims	(2) PropTax1815	(3) %Agric1831	(4) %Manuf1831	(5) CottonMill-1788	(6) CottonMill-1839
VSI	0.370***					
	(0.07)					
Slave Claims		0.839***	-0.748***	0.901***	0.620***	0.825***
		(0.16)	(0.17)	(0.22)	(0.22)	(0.21)
Latitude	-0.144***	0.095**	-0.189***	0.180***	0.279***	0.251***
	(0.02)	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)
Longitude	0.070***	0.171***	0.118***	-0.064**	-0.104***	-0.065**
	(0.02)	(0.02)	(0.03)	(0.03)	(0.02)	(0.03)
Population (1500)	0.135***	0.165*	-0.129***	0.071	0.035	0.079
	(0.04)	(0.09)	(0.04)	(0.04)	(0.05)	(0.06)
Dist Coast	-0.047*	0.006	0.067**	0.128***	0.094***	0.153***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Coal field indicator	0.059	0.322*	-1.158***	0.927***	0.219	0.808***
	(0.14)	(0.18)	(0.16)	(0.23)	(0.21)	(0.25)
Share Control	-0.472**	-0.082	-0.030	0.081	-0.040	-0.009
	(0.23)	(0.16)	(0.15)	(0.19)	(0.19)	(0.18)
Constant	6.457***	-6.503***	11.329***	-10.863***	-15.575***	-14.737***
	(1.44)	(2.46)	(1.89)	(2.15)	(2.31)	(2.18)
N Voyagers	169	169	169	169	169	169
KPW F-stat		26.74	26.74	26.74	26.74	26.74
AR p-value		0.00	0.00	0.00	0.00	0.00

Note: *** p<0.01, ** p<0.05, * p<0.10. Standardized beta coefficients with robust standard errors in parenthesis. Instrument is the grid cell share of voyager ancestors, scaled by voyage success. All control variables except latitude and longitude are inverse hyperbolic sine transformed.

Table A.6: Main IV Estimates Without Controls

	(1) First Stage	(2) PropTax1815	(3) %Agric1831	(4) %Manuf1831	(5) CottonMill-1788	(6) CottonMill-1839
Panel A: OLS – Base						
Slave Claims		0.278***	-0.248***	0.221***	0.0432	0.193***
		(0.036)	(0.033)	(0.033)	(0.036)	(0.039)
VSI	0.270***					
	(0.040)					
Slave Claims		0.950***	-0.855***	1.167***	0.699***	1.039***
		(0.147)	(0.151)	(0.209)	(0.190)	(0.200)
Observations	851	850	850	850	851	851
Controls	No	No	No	No	No	No
N Voyagers	169	169	169	169	169	169
KPW F-stat		45.42	45.42	45.42	45.53	45.53
AR p-value		0.00	0.00	0.00	0.00	0.00

Note: *** p<0.01, ** p<0.05, * p<0.10. Standardized beta coefficients with robust standard errors in parenthesis. Instrument is the grid cell share of voyager ancestors, scaled by voyage success.

Table A.7: Main IV Estimates with Log Transformations

	(1) First Stage	(2) PropTax1815	(3) %Agric1831	(4) %Manuf1831	(5) CottonMill-1788	(6) CottonMill-1839
Slave Claims		0.180***	-0.243***	0.190***	0.0741**	0.192***
		(0.034)	(0.033)	(0.033)	(0.035)	(0.036)
VSI	0.365***					
	(0.073)					
Slave Claims		0.805***	-0.716***	0.860***	0.584***	0.790***
		(0.154)	(0.163)	(0.212)	(0.209)	(0.210)
Observations	849	849	849	849	849	849
Controls	Yes	Yes	Yes	Yes	Yes	Yes
N Voyagers	169	169	169	169	169	169
KPW F-stat		25.09	25.09	25.09	25.09	25.09
AR p-value		0.00	0.00	0.00	0.00	0.00

Note: *** p<0.01, ** p<0.05, * p<0.10. Standardized beta coefficients with robust standard errors in parenthesis. Variables are transformed using $\log(1+x)$ instead of IHS. Instrument is the grid cell share of voyager ancestors, scaled by voyage success.

Table A.8: Moran's I

Bandwidth	PropTax1815	%Agric1831	%Manuf1831	CottonMill-1788	CottonMill-1839
50km	.219***	.067***	.138***	.224***	.179***
100km	.103***	.014***	.046***	.070***	.057***
150km	.043***	.004**	.017***	.016***	.009***
200km	.014***	-.00	.004**	-.00*	-.00
250km	-.00	-.00*	-.00*	-.00***	-.00***
300km	-.00***	-.00	-.00***	-.00***	-.00*
400km	-.00	-.00	-.00***	-.00***	-.00***
500km	-.00	-.00	-.00	0***	-.00
600km	-.00***	-.00**	-.00	-.00***	-.00***
700km	-.00	-.00	-.00	-.00	-.00
750km	-.00	-.00	-.00	-.00	-.00

To ensure that the presence of SAC within these bandwidths is not unduly biasing our standard errors, we apply the procedure described in Colella et al. (2019) that computes standard errors corrected for cluster correlation in spatial settings. Table A.9 presents these standard errors for the main IV results. At the bandwidth distance of even 750km, we are reassured to find that our main results remain statistically significant at conventional levels.

Area weighting In our baseline specification, we assign parishes to hexagons based on their parish centroids, as discussed further in Section S.2.3.2 of this data appendix. The main alternative approach is to use area weights to redistribute parish data across all hexagons that intersect the boundary of the parish, in proportion to the share of the parish area that each intersection represents. We use centroids assignment as our baseline specification to avoid introducing the spatial autocorrelation between neighboring units that apportioning the data with weights necessitates. To show that our results are not sensitive to the choice of one mapping procedure over the other, we present a comparison of the estimates for the share of agriculture and manufacturing in 1831. We would expect these shares to be most sensitive to the assignment choice and it is reassuring to see in Table A.10 that using area weights rather centroid assignment has close to no effect on our results. We also confirmed in unreported regressions that switching to area weights does not materially affect any of our other specifications.

Exclusion of Major Slave-Trading Ports Given the geographic concentration of slave-holding around the three major slave-trading ports of Bristol, Liverpool and London in Figure 2a in the paper, it is reasonable to explore the extent to which our results are driven by

Table A.9: Main Voyage Success IV Estimates with Conley Standard Errors

	(1) PropTax1815	(2) %Agric1831	(3) %Manuf1831	(4) CottonMill-1788	(5) CottonMill-1839
50km	0.839***	-0.748***	0.901***	0.620**	0.825***
	(0.192)	(0.184)	(0.306)	(0.283)	(0.262)
250km	0.839***	-0.748***	0.901**	0.620**	0.825***
	(0.158)	(0.165)	(0.397)	(0.311)	(0.184)
500km	0.839***	-0.748***	0.901***	0.620***	0.825***
	(0.099)	(0.120)	(0.310)	(0.236)	(0.147)
750km	0.839***	-0.748***	0.901***	0.620***	0.825***
	(0.082)	(0.098)	(0.253)	(0.193)	(0.120)
Observations	849	849	849	849	849

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Standardized beta coefficients with Conley standard errors in parenthesis. Instrument is voyage-success-scaled ancestor share. We vary the bandwidth of the estimator from 50 to 300km. Kernel is Bartlett throughout.

these locations. In each panel of Table A.11, we exclude from the estimation sample any regions located within 30km of the noted slave-trading port. We find that the magnitude and significance of the coefficients are relatively stable across each of these specifications. Coefficients also remain in line with our baseline estimation results for the full sample, and even tend to get slightly further from zero when dropping Liverpool. Bristol, the smallest of the three major ports, has indeed the smallest impact on the results. When excluding either London or Liverpool, the significance of the first stage remains above conventional levels. We conclude that our findings are not driven by the major slave-trading ports alone - compliers with the slavery treatment can be found across England and Wales.

Effect of Spatial Aggregation on Results Our main specification uses spatial units that are regular hexagons of area 200 square kilometres covering England and Wales (see Subsection S.2.3.2 of this Online Appendix). It is reasonable to compare the performance of our main IV across alternative choices of spatial units. We show these results in Table A.12. First, using parishes, the smallest unit of local government in England and Wales, we see that our main findings hold. Second, using registration districts, we maintain a compelling first stage, but lose some coefficient significance in the second stage. It is plausible to expect results using this spatial unit to be less strong, since registration districts were not created until the Births and Deaths Registration Act (1836), and hence arguably were not cohesive political and economic units before that time. Finally, we construct a tessellation of England and Wales into a grid of

Table A.10: Voyage Success IV: Data Generation using Area Weights

	Centroid Mapping		Area Weights	
	%Agric1831	%Manu1831	%Agric1831	%Manu1831
Slave Claims	-0.75***	0.90***	-0.81***	0.91***
	(0.17)	(0.22)	(0.16)	(0.21)
Observations	849	849	849	849
Controls	Yes	Yes	Yes	Yes
N Voyagers	169	169	169	169
KPW F-stat	26.74	26.74	26.74	26.74
AR p-value	0.00	0.00	0.00	0.00

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Standardized coefficients with robust standard errors in parenthesis. Instrument is the grid cell share of voyager ancestors, scaled by voyage success. Outcomes from the 1831 parish census are constructed in two ways. Centroid mapping, our preferred specification, assigns parish data to the grid cell that contains the parish centroid. The first two columns thus repeat the results from Table 2. Area weights distribute data by intersecting parish polygons with our hexagon grid and proportionally assigning values using area weights.

squares with side length 0.2°, or roughly 20km. Here, the performance of the main IV is again highly comparable to that in our baseline specification with hexagonal spatial units.

Never-takers In Section 7.2 of the paper, we report a specification check for our IV-strategy in the spirit of Bound and Jaeger (2000) and D'Haultfœuille et al. (2022) that looks at never-takers–regions where ancestors of slave traders lived, but where we find no descendants making claims for slavery compensation in 1833. If our argument is correct, regions that merely had exposure to the slave trade–without slave-holding later– should **not** show any statistically significant differences in economic performance. As a specification check, we therefore estimate reduced-form regressions of our economic outcomes on our instruments for the sample of regions with no slaveholding in 1833. In Figure 8 in the paper, we plot the estimated coefficients on our instruments and the 95 percent confidence intervals. Table A.13 below reports the full estimation results using our family-tree voyage success instrument. These empirical results support the mechanism in our model, where familial connections to the slave trade affect local economic development through slaveholding and slavery wealth. In locations where we observe no slaveholding and no slavery wealth in 1833, we find little relationship between familial connections to the slave trade and local economic development.

A.1.5 Evidence on Local Investments

In this section of the Online Appendix, we provide empirical evidence in support of our assumption in the model that investment disproportionately occurs locally. We use data on rail-

Table A.11: Main Voyage Success IV Estimates with Slave Port Exclusions

	(1) PropTax1815	(2) %Agric1831	(3) %Manuf1831	(4) CottonMill-1788	(5) CottonMill-1839
Excl. Liverpool	0.84***	-0.80***	0.89***	0.70***	0.94***
	(0.17)	(0.19)	(0.24)	(0.25)	(0.25)
Observations	837	837	837	837	837
KPW F-stat	21.7	21.7	21.7	21.7	21.7
Anderson-Rubin	0.00	0.00	0.00	0.00	0.00
Excl. Bristol	0.92***	-0.84***	1.08***	0.75***	0.96***
	(0.21)	(0.21)	(0.28)	(0.28)	(0.27)
Observations	837	837	837	837	837
KPW F-stat	19.7	19.7	19.7	19.7	19.7
Anderson-Rubin	0.00	0.00	0.00	0.00	0.00
Excl. London	0.85***	-0.79***	1.10***	0.76**	0.87***
	(0.21)	(0.22)	(0.31)	(0.30)	(0.28)
Observations	837	837	837	837	837
KPW F-stat	18.7	18.7	18.7	18.7	18.7
Anderson-Rubin	0.00	0.00	0.00	0.00	0.00

Note: *** p<0.01, ** p<0.05, * p<0.10. Standardized beta coefficients with robust standard errors in parenthesis. Instrument is voyage-success-scaled ancestor share. We drop grid cells within 30km of the three largest British slave trading ports - Liverpool, Bristol and London - from the estimation sample.

way investments by individual slaveholders from the UCL Legacies of Slavery database (436 investments). We measure the distance between a slaveholder's residential address in England and Wales and a railway in which they invested.

We construct these distances as follows. First, we compute the latitude and longitude of the slaveholder's residential address. Second, we compute the latitude and longitude of the railway's terminus. Third, we compute the latitude and longitude of stations in major cities along the railway's route. Fourth, we calculate the minimum of the straight-line (Euclidean) distances from the slaveholder's address to the railway's terminus and major cities. Note that at the time at which most of these investments were made, railway companies were frequently local (e.g., London and Greenwich railway opened in 1836) before the gradual process of mergers that ultimately led to the formation of the main British railway groupings (e.g., Southern Railway formed in 1923).

In Figure A.6, we display the share of the total value of investment across distance grids ranging from 0-50, 50-100, 100-200 and >200 km. Consistent with our assumption that most investment occurs locally, we find that more than one half of all investment takes place within 100km. Although for brevity, we focus on the share of investment value, we find a similar

Table A.12: Main Voyage-Success IV Estimates with Various Spatial Units

	(1) PropTax1815	(2) %Agric1831	(3) %Manuf1831	(4) CottonMill-1788	(5) CottonMill-1839
Parishes	0.72***	-0.63***	0.65***	0.29	0.64***
	(0.14)	(0.13)	(0.16)	(0.23)	(0.22)
Observations	12,655	12,099	12,099	12,655	12,655
KPW F-stat	22.7	22.7	22.7	22.7	22.7
RD	0.75***	-0.58***	0.63***	0.34**	0.83***
	(0.16)	(0.13)	(0.17)	(0.17)	(0.23)
Observations	624	623	623	624	624
KPW F-stat	32.2	32.3	32.3	32.2	32.2
0.2° grids	0.53***	-0.98***	1.07***	0.46*	1.13***
	(0.13)	(0.22)	(0.27)	(0.24)	(0.31)
Observations	567	567	567	567	567
KPW F-stat	19.5	19.5	19.5	19.5	19.5

Note: *** $p<0.01$, ** $p<0.05$, * $p<0.10$. Standardized beta coefficients with robust standard errors in parenthesis. Instrument is voyage-success-scaled ancestor share, as shown in Table 2. Each panel aggregates the data in a different spatial unit. Parishes takes the 1851 definition of English and Welsh parishes from Kain and Oliver (2018). RD are registration districts, a political unit consisting of, on average, 20 parishes. The last panel uses a square tessellation of England and Wales with side length of 0.2°.

pattern of results for share of the number of investments.

A.2 Calibration Appendix

In this section of the Online Appendix, we discuss the calibration of the model's parameters. We use central values for the model's parameters from the existing empirical literature and our historical time period. We calibrate the share of land in agricultural production costs (α^A) using data on farm incomes. From Table 23 of Feinstein (1972), the share of rent for farm land and buildings in total farm incomes in the United Kingdom in 1855 (the first year for which data are reported) was 31 percent. We therefore set $\alpha^A = 0.31$.

Given this assumed value of α^A, we calibrate the share of capital in manufacturing production costs (α^M) to ensure that the model's predictions are consistent with observed data on the aggregate share of labor in national income and the share of agriculture in national income. In our model, there are two domestic production sectors: agriculture and manufacturing. Agriculture uses labor and land. Manufacturing uses labor and capital. The aggregate

Table A.13: Never-takers Analysis of Voyage Success Instrument using Ancestors

	(1) PropTax1815	(2) %Agric1831	(3) %Manuf1831	(4) CottonMill-1788	(5) CottonMill-1839
VSI	0.23***	-0.27***	0.45***	0.34***	0.26**
	(0.08)	(0.08)	(0.11)	(0.11)	(0.10)
Latitude	-0.03	-0.14***	0.05**	0.16***	0.10***
	(0.04)	(0.03)	(0.03)	(0.03)	(0.03)
Longitude	0.28***	0.09***	-0.01	-0.06***	0.00
	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Population (1500)	0.19**	-0.18***	0.17***	0.08**	0.10**
	(0.09)	(0.03)	(0.03)	(0.04)	(0.04)
Dist Coast	-0.01	0.05	0.12***	0.06**	0.10***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)
Coal field indicator	0.49***	-1.22***	0.95***	0.30	0.82***
	(0.16)	(0.16)	(0.22)	(0.21)	(0.25)
Voyager ancestors as a share of all ancestors	-0.28	0.44*	-0.72**	-0.66**	-0.44
	(0.24)	(0.26)	(0.31)	(0.29)	(0.28)
N	567	567	567	567	567
F-stat	30.8	25.8	16.7	6.9	11.7

Note: *** p<0.01, ** p<0.05, * p<0.10. Standardized beta coefficients with robust standard errors in parenthesis. Reduced-form regression of economic outcomes on our voyage success instrument based on family trees, only in grid cells where there is no slaveholding.

share of labor in national income $(1-\alpha)$ is:

$$(1-\alpha) = \frac{wL}{Y} = \frac{wL^A}{Y} + \frac{wL^M}{Y} = \frac{Y^A}{Y}\frac{wL^A}{Y^A} + \frac{Y^M}{Y}\frac{wL^M}{Y^M},$$

which can be written as:

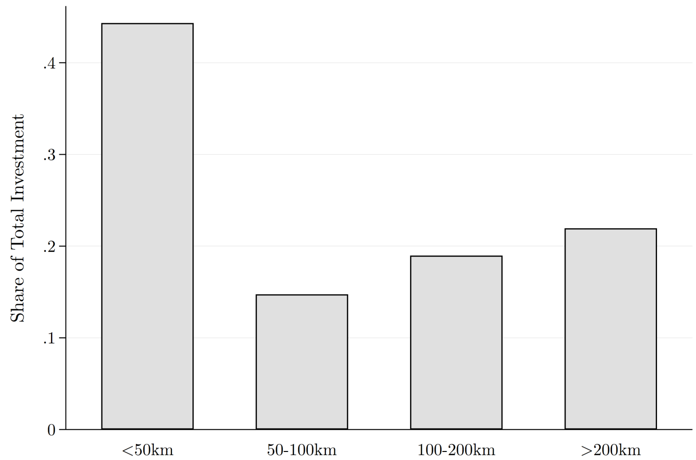
$$(1-\alpha) = \frac{Y^A}{Y}\left(1-\alpha^A\right) + \left(1-\frac{Y^A}{Y}\right)\left(1-\alpha^M\right).$$

Rearranging this relationship, we have:

$$\left(1-\alpha^M\right) = \frac{(1-\alpha) - \frac{Y^A}{Y}\left(1-\alpha^A\right)}{\left(1-\frac{Y^A}{Y}\right)}. \tag{A.2}$$

Recall that we set the share of land in agriculture production costs as $\alpha^A = 0.31$. From Table 3 in Crafts (2022), the share of labor in national income for the nearby year of 1850 is $(1-\alpha) = 0.65$. From Table 37 in Deane and Cole (1967), the share of agriculture, forestry and fishery in national income for the nearby year of 1851 is $Y^A/Y = 0.20$. Substituting these values into equation (A.2) above, the implied value for the share of labor in manufacturing production costs is $\left(1-\alpha^M\right) = 0.64$, which implies a value for the share of capital in manufacturing production costs of $\alpha^M = 0.36$.

Figure A.6: Gravity of Slaveholder Railway Investments



Note: We measure the distance between a slaveholder's residential address and a railway in which they invested ($N = 436$). Railway investments are from UCL Legacies of Slavery, see https://www.ucl.ac.uk/lbs/commercial/. Railways are located by their terminus cities and/or major stations along the route. The investment values (£) are divided into four distance bins.

We calibrate the migration elasticity ($1/\kappa$) using structural estimates from the spatial economics literature. Using data for U.S. states and Indonesia regions, Bryan and Morten (2019) estimate migration elasticities from $1/\kappa = 2.7 - 3.2$. Using data for U.S. commuting zones, Galle et al. (2020) estimate migration elasticities from $1/\kappa = 1.42 - 2.79$. Surveying existing estimates, Fajgelbaum et al. (2019) report migration elasticities ranging from $1/\kappa = 1.16 - 2.49$ in Appendix Table A.17. Based on these findings, we choose a central value for the migration elasticity of $1/\kappa = 2$.

We calibrate the elasticity of substitution between slavery and domestic investments (θ) using estimates from the recent literature on asset demand systems following Koijen and Yogo (2019). The smaller this elasticity, the greater the increase in the rate of return to investment from the expansion in the set of investment opportunities. Using data on international stocks and bonds, Koijen and Yogo (2020) estimates elasticities of substitution of 1.9 and 4.2, respectively. Based on these estimates, we assume a conservative (i.e., relatively high) value of $\theta = 4$ in our baseline specification.

We assume a value for the rate of return for consumption bonds of $\rho = 0.0399$, which is the average of the values reported for 3 percent British Consols from 1750-1799 in Table 2 from Antràs and Voth (2003), based on data from Mitchell (1971).

A.3 Robustness to Alternative Parameter Values

In our baseline specification in Section 7.4 of the paper, we assume central values for the model's parameters from the existing empirical literature and our historical time period. In this section of the Online Appendix, we demonstrate the robustness of our quantitative conclusions to the assumption of alternative parameter values.

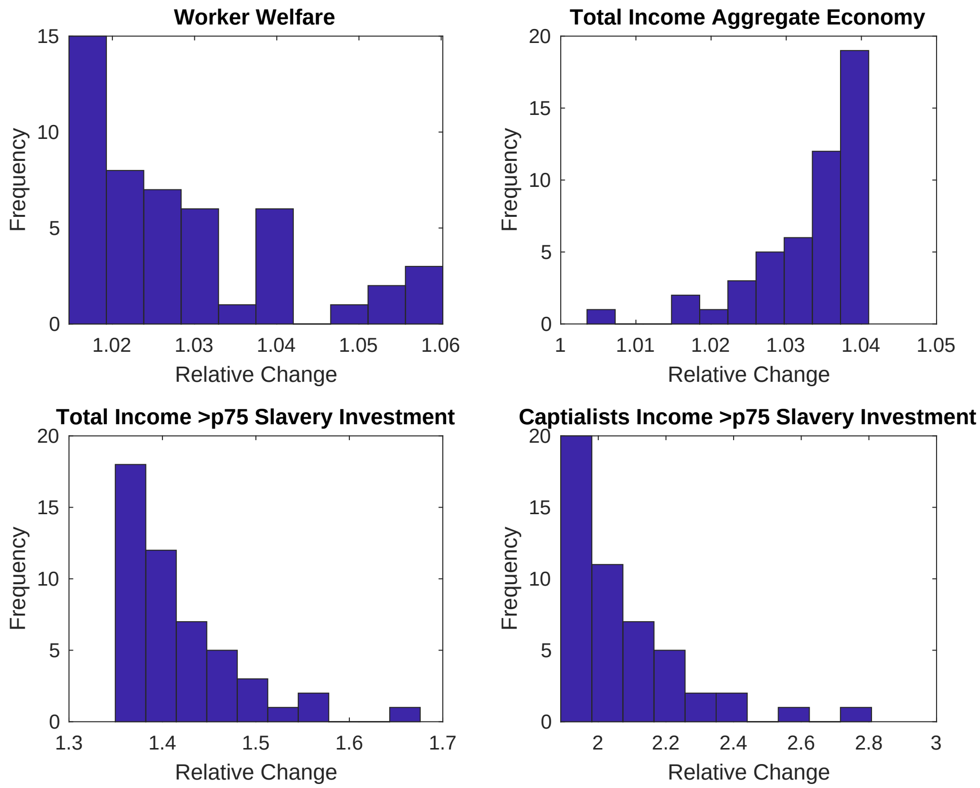
In particular, we demonstrate robustness to the use of alternative values for the migration elasticity ($1/\kappa$) and the elasticity of substitution between domestic and slavery investments (θ). We hold all other parameters constant at their values in our baseline specification. Therefore, we set the share of land in agricultural costs as $\alpha^A = 0.31$, based on the share of land and buildings in farm income in Feinstein (1972). Given this parameter, we set the share of capital in manufacturing costs as $\alpha^M = 0.36$, which ensures that the model is consistent with both the 20% share of agriculture in national income in 1851 in Deane and Cole (1967), and the 65% share of labor in national income in 1850 in Crafts (2022).

Given these values for the other model parameters, we consider a grid of seven alternative values of the migration elasticity ($1/\kappa$) and the elasticity of substitution between domestic and slavery investments (θ), which yields $7 \times 7 = 49$ parameter combinations. We vary the migration elasticity ($1/\kappa$) from 1.25 to 5, which compares with a central value of $1/\kappa = 2$ in existing empirical studies (Bryan and Morten 2019, Galle et al. 2020). We vary the elasticity of substitution between domestic and slavery investments (θ) from 2 to 8, which compares with the empirical estimates of 1.9 and 4.2 in Kiojen and Yogo (2020).

For each parameter combination on this grid, we undertake our counterfactual for prohibitive colonial financial frictions ($\phi_{n\mathbb{N}} \to \infty$). The lower the migration elasticity ($1/\kappa$), the more difficult it is to reallocate labor away from slaveholding locations in the counterfactual for prohibitive colonial financial frictions ($\phi_{n\mathbb{N}} \to \infty$). The lower the elasticity of substitution between domestic and slavery investments (θ), the more difficult it is to reallocate capital domestically in this counterfactual for prohibitive colonial financial frictions ($\phi_{n\mathbb{N}} \to \infty$).

We compute relative changes from the counterfactual equilibrium with prohibitive colonial financial frictions to the observed equilibrium in 1833 for (i) Worker welfare as measured by expected utility; (i) Total income for the aggregate economy as a whole; (iii) Total income for locations with slavery investment shares above the 75th percentile for locations with positive slavery investment shares; (iv) Total capitalist income for locations with slavery investment shares above the 75th percentile for locations with positive slavery investment shares. The relative change in worker welfare is a weighted average of the relative change in worker real income in each location, where the weights are population shares. Total income is the sum of the income of capitalists (from both slavery and domestic manufacturing capital), landowners and workers.

Figure A.7: Proportional Changes in Worker Welfare, Total Income for the Aggregate Economy, and both Total Income and Capitalist Income for Locations With Slavery Investment Shares Above the 75th Percentile



Note: Histograms of relative changes (x/x') from the counterfactual equilibrium with prohibitive financial frictions ($\phi_{n\mathbb{N}} \to \infty$) to the observed equilibrium in 1833 across a grid of parameter values for the migration elasticity ($1/\kappa$) from 1.25-5 and the elasticity of substitution between domestic and slavery investments (θ) from 2 to 8. Total income equals the sum of the income of capitalists (from both slavery and domestic manufacturing capital), landowners and workers. Bottom two panels show aggregate values for locations with slavery investment shares above the 75th percentile for locations with positive slavery investment shares.

In Figure A.7, we display histograms of the relative changes in each variable across the entire parameter grid. As shown in the top-left panel, the welfare gains from access to slavery investments range from around 2 to 6 percent. As shown in the top-right panel, the increase in total income for the aggregate economy as a whole varies from around 1-4 percent. As shown in the bottom-left panel, the increase in total income for locations with the greatest participation in slavery investments ranges from 35-65 percent. Finally, as shown in the bottom-right panel, the increase in capitalists income for these locations with the greatest participation in slavery investments varies from 100-180 percent.

Therefore, across this entire grid of parameter values, we find that access to slavery investments has sizeable aggregate economic effects and a substantial impact on the geography of the Industrial Revolution.

References

Antrás, Pol and Hans-Joachim Voth (2003) “Factor Prices and Productivity Growth During the British Industrial Revolution,” *Explorations in Economic History*, 40, 52-77.

Bound, J. and D. A. Jaeger (2000) “Do Compulsory School Attendance Laws Alone Explain the Association between Quarter of Birth and Earnings?” in *Research in labor economics*, Emerald Group Publishing Limited, vol. 19, 83–108.

Bryan, G. and M. Morten (2019) “The Aggregate Productivity Effects of Internal Migration: Evidence from Indonesia,” *Journal of Political Economy*, 127, 2229–2268.

Cheshire, J. and P. Longley (2011) “Spatial concentrations of surnames in Great Britain,” *Procedia - Social and Behavioral Sciences*, 21, 279–286, international Conference: Spatial Thinking and Geographic Information Sciences 2011.

Colella, F., R. Lalive, S. O. Sakalli and M. Thoenig (2019) “Inference with Arbitrary Clustering,” *IZA Discussion Paper*, 12584.

Crafts, N. (2022) “Slow Wage Growth During the Industrial Revolution: Productivity Paradox or Pro-rich Growth?” *Oxford Economic Papers*, 74, 1–13.

Deane, P. and W. A. Cole (1967) *British Economic Growth 1688-1959: Trends and Structure*, Cambridge: Cambridge University Press.

Fajgelbaum, Pablo, Eduardo Morales, Juan-Carlos Suárez-Serrato and Owen Zidar (2019) “State Taxes and Spatial Misallocation,” *Review of Economic Studies*, 86, 333-376.

Feinstein, C. H. (1972) *National Income, Expenditure and Output of the United Kingdom 1855-1965*, Cambridge: Cambridge University Press.

Fox,W. R. and G.W. Lasker (1983) “The Distribution of Surname Frequencies,” *International Statistical Review / Revue Internationale de Statistique*, 51, 81–87.

Galle, S., M. Yi, and A. Rodriguez-Clare (2020) “Slicing the Pie: Quantifying the Aggregate and Distributional Consequences of Trade,” University of California, Berkeley, mimeograph.

D’Haultf÷uille, X., S. Hoderlein, and Y. Sasaki (2022) “Testing and Relaxing the Exclusion Restriction in the Control Function Approach,” *Journal of Econometrics*, forthcoming.

Fox, W. R. and G.W. Lasker (1983) “The Distribution of Surname Frequencies,” *International Statistical Review / Revue Internationale de Statistique*, 51, 81–87.

Guell, M., J. V. Rodriguez Mora, and C. I. Telmer (2014) “The Informational Content of Surnames, the Evolution of Intergenerational Mobility, and Assortative Mating,” *The Review of Economic Studies*, 82, 693–735.

Kain, R.J.P., and R. R. Oliver (2018) *Historic parishes of England and Wales*, Cambridge University, Cambridge UK.

Koijen, R. S. and M. Yogo (2019) 11A Demand System Approach to Asset Pricing,” *Journal of Political Economy*, 127, 1475-1515.

Koijen, R. S. and M. Yogo (2020) “Exchange Rates and Asset Prices in a Global Demand System,” *NBER Working Paper*, 27342.

Mitchell, B. R. (1971) *Abstract of British Historical Statistics*, Cambridge: Cambridge University Press.

Pascali, L. (2017) “The Wind of Change: Maritime Technology, Trade, and Economic Development,” *American Economic Review*, 107, 2821–54.