A Review of "The Three Horsemen of Riches: Plague, War, and Urbanization in Early Modern Europe" by Voigtländer and Voth (2013)

Reviewer 2

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> I am wiser than this person; for it is likely that neither of us knows anything fine and good, but he thinks he knows something when he does not know it, whereas I, just as I do not know, do not think I know, either. I seem, then, to be wiser than him in this small way, at least: that what I do not know, I do not think I know, either.
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> Plato, *The Apology of Socrates*, 21d

> To err is human. All human knowledge is fallible and therefore uncertain. It follows that we must distinguish sharply between truth and certainty. That to err is human means not only that we must constantly struggle against error, but also that, even when we have taken the greatest care, we cannot be completely certain that we have not made a mistake.
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> Karl Popper, 'Knowledge and the Shaping of Reality'

Overview

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Abstract Summary: The paper uses a two-sector Malthusian model to explain how European per capita incomes and urbanization rates rose permanently between 1350 and 1700, arguing that the Black Death triggered a transition to a high-income steady state.

Key Methodology: Two-sector Malthusian model with multiple steady states, incorporating Stone-Geary preferences, endogenous mortality (Horsemen effect), and calibration using historical European and Chinese data (1300–1800).

Research Question: How did Europe escape the "Iron Law of Wages" and achieve permanently higher per capita incomes and urbanization rates during the early modern period (1350–1700)?

Summary

Is It Credible?

The article presents a theoretically ingenious and historically sweeping argument that flips the standard Malthusian narrative on its head. By proposing that Europe's "Horsemen"—plague, war, and urbanization—acted as agents of economic growth rather than destruction, the authors offer a compelling mechanism for the "First Divergence." The theoretical framework, which relies on multiple steady states driven by an upward-sloping death schedule, is logically sound and offers a fascinating explanation for how a one-time shock like the Black Death could lead to permanently higher incomes. However, the credibility of the article's quantitative execution does not match the elegance of its theory. While the qualitative narrative is persuasive, the calibration of the model—the bridge between the theory and historical reality—is marred by significant technical errors and reliance on exogenous forcing that weakens the study's central claims.

The most concerning issue lies in the calibration of the warfare mechanism, which is the largest contributor to the "Horsemen effect." In attempting to estimate the fixed costs of warfare, the authors regress the number of battles on tax revenues. They then interpret the regression intercept—which represents a quantity of battles—as a monetary fixed cost. This is a dimensional error; one cannot subtract a number of battles from a monetary value of tax revenue. Furthermore, a positive intercept in this regression implies warfare occurs at zero revenue, which contradicts the model's structural assumption that war only begins once a fixed cost threshold is passed. This is not merely a semantic quibble; it suggests that the parameter governing the most powerful "Horseman" is derived through a mathematically inconsistent procedure. Similarly, the derivation of tax revenues contains an algebraic oversight regarding the distinction between output and consumption taxation, introducing a potential factor-of-two error in the revenue calculations. These unforced technical errors cast doubt on the precision of the quantitative results.

The comparative analysis between Europe and China, while central to the article's contribution, also rests on somewhat shaky foundations. The divergence is largely driven by the

"belligerence" parameter, which dictates the frequency of war. The authors calibrate Europe's belligerence to match history but set China's belligerence to a fraction of Europe's based on an exogenous choice (p. 797). While they justify this as a reflection of "starting conditions," it effectively means the model assumes the divergence (via political fragmentation) to explain the divergence. The model shows *how* political fragmentation interacts with the plague, but because the fragmentation itself is an exogenous input, the result feels partially circular. The robustness checks provided are helpful, but they do not fully escape the critique that the primary driver of the difference is "baked in" rather than endogenous.

Finally, the article engages in some narrative shaping regarding the European Marriage Pattern (EMP). The authors relegate the discussion of fertility restrictions to the online appendix, where they concede that EMP was "equally important" to the "Horsemen effect" for explaining England's rise. By focusing the main article almost exclusively on the mortality mechanism, the authors present a cleaner, more novel story, but one that perhaps overstates the primacy of their specific mechanism relative to well-established fertility-based explanations. Ultimately, the article succeeds as a theoretical proof-of-concept: it demonstrates that under specific conditions, mortality shocks can create high-income steady states. However, due to the calibration flaws and the handling of competing mechanisms, it does not definitively establish that this specific mechanism was the primary quantitative driver of Europe's rise to riches.

The Bottom Line

Voigtländer and Voth provide a fascinating and logically coherent theory arguing that Europe's deadly environment—characterized by war, disease, and unsanitary cities—paradoxically sustained higher incomes after the Black Death. However, the quantitative evidence supporting this "Horsemen effect" is compromised by basic mathematical errors in calibration and a reliance on modern proxies for historical data. While the theoretical contribution regarding multiple steady states is valuable, the specific numerical results should be viewed with significant caution (p. 805).

Specific Issues

Dimensional and theoretical errors in fixed cost calibration: The calibration of the fixed cost of warfare contains a significant dimensional inconsistency. The authors regress the number of battles on tax revenues and interpret the intercept (measured in battles) as the monetary fixed cost of warfare. This is dimensionally impossible, as one cannot subtract battles from currency. Furthermore, a positive intercept in this regression implies that warfare occurs even when tax revenue is zero, which directly contradicts the model's structural equation where warfare is zero until taxes exceed a fixed cost threshold. This error undermines the calibration of the warfare mechanism, which is the model's largest driver of mortality (p. 789; Online Appendix, p. A-3).

Algebraic error in tax revenue derivation: There appears to be a derivation error in the equation used to calculate total tax revenue. The model defines the tax rate τ as a levy on manufacturing output, but the calibration equation applies this rate directly to consumption without the necessary adjustment term $1/(1-\tau)$. Given the calibrated tax rate of 0.52, this omission introduces a substantial error, potentially halving the calculated tax burden relative to the model's definition. This creates an inconsistency between the theoretical definition of the tax rate and its empirical application (pp. 789, 793; Online Appendix, p. A-2).

Exogenous calibration of the core comparative mechanism: The explanation for the divergence between Europe and China relies heavily on the "belligerence" parameter (A_W). While Europe's parameter is calibrated to match outcomes, China's is set exogenously to 25 percent of Europe's level. This effectively assumes the political difference (fragmentation vs. unity) as a starting condition rather than generating it endogenously. While the authors argue this is a conservative estimate given that battle data suggests a ratio as low as 0.02, it means the model describes the consequences of the divergence in political organization rather than the origin of it (pp. 797–798).

Narrative relegation of the European Marriage Pattern (EMP): The article attributes the "First Divergence" primarily to the mortality-based "Horsemen effect," yet the analysis in the online appendix reveals that the fertility-based EMP was "equally important" for England's

rise. By confining this finding to the appendix and the conclusion, the authors streamline their narrative around their novel mechanism, potentially obscuring the fact that their model relies on fertility restrictions to explain nearly half of the observed phenomenon in the most successful economy of the period (p. 804; Online Appendix, p. A-7).

Reliance on modern analogies for historical quantification: The calibration of trade-related mortality relies on elasticities derived from modern gravity models and HIV transmission data from Africa. While the authors acknowledge this as a "best guess" due to the absence of historical data, applying modern epidemiological parameters to 17th-century trade flows introduces significant uncertainty. This is particularly relevant given that trade contributes 0.25 percent to the mortality effect, a non-negligible portion of the mechanism (p. 796).

Issues regarding parameter sensitivity and data consistency: There are several smaller issues regarding calibration and data handling. The "Horsemen effect" relies on the aggregate impact of war, trade, and urbanization; however, city mortality alone (0.15 percent) is insufficient to drive the result, making the model highly sensitive to the warfare calibration. The maximum war mortality effect is determined by a linear functional form assumption rather than data. Additionally, the authors use inconsistent urbanization cutoffs (10,000 vs. 5,000 inhabitants) across different parts of the analysis, though they argue this is a conservative choice. Finally, the assumption that urban population recovers immediately after the Black Death simplifies the transition dynamics but may not reflect the friction of migration and reconstruction (pp. 788, 795, 797, 799).

Future Research

Correction of calibration methodologies: Future work must rigorously recalibrate the model to address the dimensional and algebraic errors identified. Specifically, the fixed cost of warfare should be estimated using a structural approach that respects the threshold nature of the model (e.g., a Tobit model or similar method appropriate for censored data) rather than a simple linear regression that yields dimensionally inconsistent intercepts. Similarly, the tax revenue equations must be harmonized to ensure the tax rate parameter is applied consistently to either output or consumption as defined by the theory.

Endogenizing political fragmentation: To move beyond assuming the difference between Europe and China, future research should attempt to endogenize the "belligerence" parameter. A dynamic model that links geography, the cost of state capacity, or the technology of warfare to the likelihood of unification versus fragmentation would provide a more complete explanation of the "First Divergence." This would allow the difference in war frequency to be an outcome of the model rather than an exogenous starting condition.

Integration of fertility and mortality mechanisms: Given the acknowledged importance of the European Marriage Pattern, future models should integrate fertility restrictions into the core framework rather than treating them as a supplementary or residual explanation. A unified model that allows for the interaction between the "Horsemen" (mortality) and the EMP (fertility) would provide a more holistic quantitative accounting of Europe's escape from the Malthusian trap, allowing researchers to decompose the relative contributions of preventative and positive checks within a single consistent system.