Essays on Long-Term Real Rate and Safe Asset Trends, 1311-2018

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ESSAYS ON LONG-TERM REAL RATE AND SAFE ASSET TRENDS, 1311-2018

A dissertation presented
by
Paul Ferdinand Schmelzing
to
The Department of History
in partial fulfillment of the requirements
for the degree of
Doctor of Philosophy
in the subject of
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Harvard University
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ABSTRACT

With recourse to archival, printed primary, and secondary sources, the first article of this dissertation constructs global real interest rate series on an annual basis going back to the 14th century, covering 78% of advanced economy GDP. I show that throughout monetary and fiscal regimes, and across fixed income assets, real interest rates have not been “stable”, and that since the major monetary upheavals of the late Middle Ages, a trend fall of 0.6-1.8bps p.a. has prevailed, despite temporary reversals such as the 17th Century Crisis. Currently depressed sovereign real rates are in fact “at historical trend” – a trend that makes narratives about a “secular stagnation” environment misleading, and suggests real rates could enter permanently negative territory in the coming years. I posit that the data here reflects a substantial share of “nonhuman wealth” over time: the resulting “R-G” series derived from this data exhibit a downward trend over the same timeframe: suggestions about the “virtual stability” of capital returns are thus equally unsubstantiated by the historical record.

With recourse to both archival and published data, the second paper constructs a 546-year survey of “safe asset” dynamics in advanced economies. I document performance for historical “safe asset providers”, and identify nine major “safe asset shortage periods”. These have on average seen net reductions in safe asset supply of over 40% within 20 years, and are now secularly becoming more intense. In contrast to recent propositions, sub-par inflation has not been overcome by a boost in net safe asset supply.

The third paper posits that it is entirely plausible that early modern economies exhibited “modern” net investment ratios, and that historical capital depreciation rates of 3% and more appear unlikely. But why were capital stocks relatively low at the beginning of the industrial age? I construct long-term “war-induced capital destruction series” to show empirically that the changing nature and capital destruction
intensity of wars over time likely constitute a key influence on the capital accumulation process. I link these geopolitical dynamics to present interest rate discussions – and seek to provide new replies to Simon Kuznets’ early modern capital accumulation model.
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For excellent support and many valuable discussions, I particularly thank my advisor Niall Ferguson, and for their insights and long support my dissertation committee members Barry Eichengreen, Charles Maier, and Kenneth Rogoff. For further useful discussions I thank Michael Bordo, Steve Broadberry, Pierre-Olivier Gourinchas, Andy Haldane, Andrew Metrick, John Lewis, Ryland Thomas, and Gertjan Vlieghe, as well as participants at the Joint Seventh CEPR Economic History Symposium-Fifth Banco de Espana Economic History seminar, the UC Berkeley economic history seminar, the Bank of England research seminar, the CEPR-BoE monetary policy roundtable, the Applied History Meeting at Harvard Kennedy School, the Reinventing Bretton Woods Conference Hamburg and discussants at Yale SOM. I thank Simon Neal for assistance with the transcription of early modern archival sources. I thank the Hoover Institution, Stanford, for financial research support during 2017-2019, and the Bank of England for the hospitality given to me as a visiting researcher since 2016.

I particularly thank my parents, siblings, and grandparents for continued support and encouragement.

Mountain View, September 7, 2019.

I. INTRODUCTION

The evolution of long-term real interest rates has in recent years attracted significant academic interest. Partly in the context of the “secular stagnation” debate and related contributions, which in different variants have advanced theories on the drivers behind a low rate environment, supposedly originating in the second half of the 20th century. Partly in the context of “inequality” and “wealth” debates, particularly accelerated by the contributions of Piketty (2014), and its peculiar view of long-term asset and wealth returns in their relation to broader income growth. Despite regular recourse to “history” from the proponents of such theories, it will be posited in this essay that both debates advance a misrepresentative view of long-run interest rate and wealth return trends – and only partly because they overwhelmingly omit archival and other historical factual evidence.

The discussion of longer-term trends in real rates is typically confined to the second half of the 20th century, identifying the high inflation period of the 1970s and early 1980s as an inflection point triggering a multi-decade fall in real rates. And indeed, for most economists’ eyes, considering interest rate dynamics over the 20th century horizon – or even over the last 150 years – the reversal during the last quarter of the 1900s at first appears decisive.

Equally, the historical relation between real wealth returns (R) and broader real growth (G) has assumed a central role in the current debates on long-term inequality trends, culminating in the widely-discussed contribution of Piketty (2014). The latter contended – on the basis of positing a “virtual stability of the pure return of capital over the very long-run” – that excess real capital returns over real growth rates would perpetuate an “endless inegalitarian spiral” (ibid, 206, 572).

From what are, at their core, return and capital cost debates, have sprung various related policy and academic contributions. For instance, more recently the spread between “Safe R” (the real capital cost for...
the “safe” sovereign debt issuer) and “G” (its respective real income growth rate) since 1950 has been documented, and highlighted as a key variable to assess public debt sustainability (Blanchard 2019).

This essay approaches these subjects from a historical perspective, arguing that the recourse to archives, printed primary sources, published secondary works, and assessed written evidence from the past, qualifies many of the assumptions underpinning such present debates. In what follows, I attempt to document for the first time the particular evolution of both GDP-weighted global and “safe asset provider” long-term sovereign real rates over a span of 707 years, relying on a collection of evidence from 14th century European registers to current Federal Reserve data.

First, the approach here modifies various of the empirical findings by what is perhaps the most comprehensive existing investigation on interest rate trends, the work of Homer and Sylla (1996, 2005). The latter do not take into account primary sources, and even the secondary source material is limited, once assessed in detail. Neither do they discuss real rate dynamics, or attempt to build “GDP-weighted”, global series. In consequence, the timing and evolution of interest rate trends is partly inappropriate, partly inapplicable for current debates both in the historical and the economic literature.

A key empirical finding advanced here is there is no evidence of a “virtual stability” of real capital returns over the very long run. Rather, – despite temporary reversals such as the period between 1550-1640 – global real rates have shown a persistent downward trend over the past five centuries, falling between 0.9 (safe asset provider basis) and 1.75 basis points (global basis) per annum, with the former displaying a continuous decline since the deep monetary crises of the late medieval “bullion famine”. This downward trend has persisted across monetary regimes, is visible across various asset classes, and long preceded the emergence of modern central banks. It is not directly relatable to growth or demographic drivers, though capital accumulation trends, first visible in 14th century Northern Italy and the merchant towns of the Holy Roman Empire, may go some way in explaining the phenomenon.

Together, I posit that these assets go some way in enabling the reconstruction of total “nonhuman” wealth returns since the 14th century. Prior to the recording of robust public statistics, wills and tax assessments suggest that around one-third of private wealth is tied to public and private debt assets, with
another third in real estate – in an environment where wealth-income ratios may plausibly have reached 150-250% of GDP. Aggregating such evidence, and constructing plausible long-run R-G series over the last 700 years, firmly suggests that real nonhuman wealth returns over time are downward trending. They are by no means “virtually stable”, a cornerstone of Piketty’s (2014) framework. In fact, if historical trends continue, R-G will soon reach permanently negative territory – a first since at least medieval times. If one wanted to draw inferences to “inequality” debates, it may be more justified to conclude that it is capital-holders who are “losing out”.

With regards to “secular stagnation” debates, I argue that in contrast to prevalent theories, global real rates are not mean-reverting within a certain corridor (Hamilton et al. 2016), and history does not suggest that they reach a steady-state value in the medium-term, even if that value is negative (Eggertsson, Mehrotra, and Robbins 2017, esp. 41). The “real safe rate” is not “normally fluctuating around the levels we see today” (Jorda et al. 2017, 4). In this sense, the decline of real returns across a variety of different asset classes since the 1980s represents merely a return to long-term historical trends. All of this suggests that the “secular stagnation” narrative (Summers 2014; 2015; 2016; Rachel and Summers 2019), to the extent that it posits an aberration of longer-term dynamics over recent decades, appears fully misleading.

The data here demonstrates that the “historically implied” safe asset provider long-term real rate stands at 1.56% for the year 2018, which suggests that against the backdrop of inflation targets at 2%, nominal advanced economy rates may not rise substantially above 3.5% anymore. Whatever the precise eventual driver – simply extrapolating such long-term historical trends suggests that negative real rates will not just soon constitute a “new normal” – they will continue to fall constantly. By the late 2020s, global short-term real rates will have reached permanently negative territory. By the second half of this century, global long-term real rates will have followed.

The standard deviation of the real rate – its “volatility” – meanwhile, has shown similar properties over the last 500 years: fluctuations in benchmark real rates are steadily declining, implying that rate levels are set to become both lower, and stickier. This would suggest that policy responses designed to raise real
interest rates from the effective lower bound (ELB) during cyclical upswings could become increasingly hard to make effective.

Finally, this paper is not naïve about the limitations of the very long-term historical evidence. Even the robustness checks below cannot deflect from the fact that late medieval and early modern data of course can never be established with the same granularity as modern high-frequency statistics. One has to rely on interpolations, deal with the peculiarities of early modern finance, and acknowledge that the permanency of wars, disasters, and destitution since the times of medieval Condottieri and Landsknechte have irrecoverably destroyed not an insignificant share of the evidence we would ideally desire. But I still suggest that whoever invokes “history” in the present policy and academic debates needs to proceed against the backdrop of these limitations.

II. GLOBAL AND SAFE ASSET PROVIDER SERIES, ARCHIVAL DATA

II.A THE GLOBAL SERIES

The global series is obtained by fully weighing all available advanced economy long-term debt yields, by GDP shares based on Maddison (2010). For the preferred series, I follow an “average observed” approach on the country level, which means giving equal weights to municipal and personal sovereign loan datapoints. It is shown below that weighing rates on the basis of country-level wealth shares could yield more nuanced results, but that there are no meaningful changes to any of the underlying dynamics (see discussion pp. 58-63 below). I only include yields which are not contracted short-term, which are not paid in-kind, which are not clearly of an involuntary nature, which are not intra-governmental, and which are made to executive political bodies. These qualifications are particularly relevant for the early modern period: financial arrangements back then feature a variety of oddities by modern standards, which need to be adjusted for. Back then, we can encounter cash lending against annual payments in “chicken”, or
against leases for offices, against jewellery, land or other real estate with no known equivalent cash value (all these are excluded). I do include personally contracted long-term cash loans, municipal cash *rentes* and annuities, and loans contracted against explicitly given payment streams. Overwhelmingly, all these arrangements were contracted on a secured basis, and they have been selected indiscriminately regarding loan size.

![Figure I](image)

**Figure I**: GDP weights, and share of total advanced economy real GDP covered, “global series”.¹

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¹ Basis for real GDP weights: Maddison (2010), linearly interpolated figures; for share of advanced economy real GDP covered, I divide countries covered by the sum of Maddison’s (2010) real GDP aggregates for “Total 30 Western Europe”, plus “Western Offshoots”.
Figure I displays the GDP weights over time, and the share of advanced economy GDP covered by the series. Spanish data begins with Aragon’s debt operations (“prestechs”) in 1418 (Kuechler 1983, chapter V); French with the Crown’s loans from 1415 (Fryde and Fryde 1963, 483), and registry data from Amiens and Gascony (Maugis ed. 1898; Samaran ed. 1966); English with William de la Pole and Simon van Halen’s loans to Edward III (Fryde 1967, 1988); Italian with the well-known municipal debt in Genoa, Venice, and Florence in the 1310s, as well as occasional loan operations, the first being Cardinal Luca de Fieschi’s loan to Genoa in 1327 (Sieveking 1898, 99); German begins with registry data on loans to King Lewis (Reg EB Mainz) and archival data on municipal debt of the Reichsstaedte (see below); Dutch (Flanders) operations with registry data in Utrecht (van der Sprenkel ed., 1937); later U.S. data is incorporated beginning with French “revolutionary loans” and some by the Dutch banking house Hope & Co. (House of Representatives 1876; StAAm – Archief 735); finally, from 1871 Japanese data is added.

The average advanced economy GDP covered by my global R series over time stands at 78%, and for the past 600 years it has never been less than 52%. Overall, the global R sample provided here thus represents the most comprehensive available over such a horizon.

GERMAN ARCHIVAL DATA

For the global series, German yields are required, for which printed sources remain very scarce. German fixed income data prior to the founding of the German Reich in 1871 remains widely dispersed and notably less integrated than other geographies. Homer and Sylla (2005, 201) record as the first German entry a Prussian Sterling-denominated 5% bond in 1818, with a 6.95% yield at offering – a very unsatisfactory empirical situation, as German state and municipal finance has been shown to stretch back

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2 During the 14th century, the GDP share is in the 44-48% range, but throughout a significantly higher share of “advanced economy financial market activity” is of course covered. Maddison (2010) also uses a modern-day geographical basis for “Germany” – I subsume data from wide parts of the Holy Roman Empire and neighbouring regions under this heading, however (the de facto share of GDP therefore is somewhat higher, and includes Austria, parts of modern Switzerland, Poland, the Czech Republic, Slovenia, and Luxemburg).
into the 14th century and to have been comparatively advanced. German municipal debt has been shown to have been actively traded as early as the mid-15th century on both primary and secondary markets (Kuske 1904, 85-90), often with courts and tax offices accepting them in lieu of cash payments.3 The fragmented political character of Germany in the early modern, and late medieval times – the Holy Roman Empire never issued central government debt – may partly explain Homer and Sylla’s limited coverage. Given that Germany accounts for more than 20% of European GDP since the 15th century, however, the issue needs to be addressed.4

Notable works on early German municipal finance next to Kuske (1904) remain Neumann (1865), and case studies such as Haug (1899) or Reincke (1953). More recent discussions include Rothmann’s (1998) study of the Frankfurt fairs, Mihm and Mihm (2007) for the city of Duisburg, and Chilosi, Schulze and Volckart (2018), who ignore Neumann (ibid., 266-273), whose compilation appears still to be the first and most systematic nominal rates for German-speaking municipalities, covering the years 1215 until 1620.

For Germany, I therefore construct a long-term interest rate time series from archival sources, and printed primary sources such as the Imperial Regesta Imperii, and weigh the available nominal municipal and state numbers arithmetically, to yield a proxy for the country as a whole. Since for European annuities, secondary yields and primary yields at issue are almost fully identical, I mostly rely on the latter measure, for which data availability is more satisfactory.5 On the municipal level, I rely first on data recorded at the Frankfurt trade fairs and by the Frankfurt municipal “Rechneiamt” (accounting office) as early as 1485.6 Frankfurt yields arguably serve as the benchmark rates for the entire Holy Roman Empire,

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3 See also Schmidt-Lorenzen (1979) for an empirical case study for the debt turnover in primary and secondary markets for Hamburg between 1470-1570; he documents a ca. 15-25% share for “Altrentenkaeufe” (secondary markets) of total turnover for the time.

4 Notwithstanding the fact that some Emperors borrowed in related capacities – i.e. Ferdinand I., in his role as Archduke of Austria, faced effective interest rates of 6.3% in 1564, but was unable to raise centralized German debt (the practice is not covered by Homer and Sylla either, but included here where applicable, cf. Kohler 2003, 182).

5 Chilosi (2014, 890-892) calculates that for Northern Italy, the absolute difference between yearly means of average primary yields at issue divided by secondary market rates is less than one percent; Chilosi, Schulze and Volckart (2018, 642) similarly find that for German annuities, the average difference is a mere 0.28%. Case studies on the municipal level such as Rothmann’s (1998, 473) data for Erfurt secondary market transactions concur.

6 Archival files held in Institut fuer Stadtgeschichte (ISG), Frankfurt, Prozessdruckschriften (15 BL./S.); Handel, Ugb-Akten: Nr. 374; Rechnei vor 1816: Nr. 282, 882, 1,853.
the city being the ”clearing centre” and reserve currency of the German lands (Rothmann 1998, 225).

Next to Frankfurt, I rely on Hessian (HHStAM and HHStaW) and Cologne (HStAK) data: Cologne served as a key hub of the Continental financial system, with the city being the capital of the Rhenian coin association from 1386, and the minting centre for the underlying Rhenian Gulden, the de facto accounting basis for merchant transactions. Additional archival data comes from the Nuremberg “Zinsmeisteramt” (literally “interest rate master office”, NStA), containing yields since 1427, and from the archives of the Imperial city of Münster’s fiscal offices (StdAMs), recording municipal debt yields since 1451. Hamburg data is calculated on the basis of Reincke (1953, 500). All data refers to benchmark life or perpetual annuities. For data from the 18th and 19th centuries, we rely on archival official data reported by the City of Frankfurt, the city of Nuremberg, the city of Münster, and on archival stock market reports by the “Syndikat der Wechsel-Sensale” and “Berlyn’s Cours-Blatt”. Inflation data is obtained by averaging Allen’s (2001) CPI data for Leipzig, Augsburg, Vienna, and Munich.

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7 Archival basis for Cologne: HStAK, U1/1181; U1/1198; U1/1225; U2/19; U2/8; U2/1148. Cf. also the reference section. On the Rhenian coin association and context, see Sprenger (2002, chapter 6).
8 Münster data in StdAMs, A IX, 725 a and b, 721-724. Nuremberg data in NStA B17/II 140, 144, and 147.
9 Stock market report copies in ISG, Handel Ugb-Akten 374.
Figure II: “Carolingian Europe” nominal rate data, 1310-1810, and real rate trend.\textsuperscript{10}

Figure II aggregates all 1391 municipal and state datapoints between 1310-1810 and shows the resulting real rate trend line (inflation data is not separately shown). I observe that the trend in “Carolingian Europe” aligns well with the “safe asset” and global trend posited: the average annual real rate between 1428 and 1499 was 5.6\%, and exhibited a clear downward trend into the 19\textsuperscript{th} century. The average in 1700-1810 stands at 3.6\%, implying a trend fall of 200bps over 250 years, or 0.8bps per annum – a slightly more moderate rate of decline than the global average.

It could theoretically be the case that surviving archival data exhibits a bias towards higher-yielding \textit{Leibrenten}, as opposed to lower-yielding \textit{Erb-} or \textit{Ewigrenten} (or vice versa). Perhaps a far higher share of \textit{Leibrenten} accounts has been lost, though we do not have suggestions for any such bias. An alternative

\textsuperscript{10} Data via ISG, Prozessdruckschriften (15 BL./S.); Rechnei vor 1816: Nr. 282, 882, 1.853; and files of the Nuremberg “Zinsmeisteramt”, NStA B17/II 140, 144, and 147; StdAMs A IX, 721-4, 725 a-b; HStAK (ibid.), HHStaW 130II/258, 260, and 6/95; and Neumann (1865, 266-273). Douai/Lille and Saint-Omer in Nieuwenhuysen (1984, 353-355); Haarlem/Leyde in Bos-Rops (2004, 33, 39).
approach is therefore to infer effective rates by constructing a weighted average cost of capital figure, by using the weights of *Leibrenten* and *Erb- or Ewigrenten* in the total issuance volumes, for those municipalities where such a breakdown is available. In the 15th century, we generally see shares of 66-70% for *Leibrenten* (Kostanecki 1889, 53, for Braunschweig; Sander 1902, 414, for Nuremberg; for a contrasting case see Gilomen 2018, 73, for Schaffhausen).

Outside of the urban financial centers of Northern and Central Europe in late medieval and early modern times, prior to the consolidation of debt on the national level, we frequently encounter sovereigns resorting to personal loans from “court bankers” (figures like William de la Pole in England, Konrad von Weinsberg in the Holy Roman Empire, or Jacques Coeur in France), or from wealthy merchants. Especially in war episodes and in the context of weak central bureaucracies, such practices supplanted more institutionalized methods of public finance until well into the 17th century (Fryde and Fryde 1963). Given that there is considerably more room to distort market prices of capital in these circumstances, it is worth isolating rates on “personal” – or more generally “non-marketable” – loans over time and compare the evolution to the aggregate picture. Figure III compiles data on 447 non-marketable sovereign loans since the year 1314, on the basis of archival, printed primary, and secondary material for a broad sample of advanced economies. For figure IX, I exclude all intra-governmental loans, loans featuring in-kind payments, forced loans and those which are de facto expropriations (such as the “loans” from Jewish communities in medieval times, often raised against the threat of expulsion). I exclude loans which were opened to public subscription, which are increasingly prevalent from the late 18th century. This excludes for instance the vast majority of loans recorded in Winkler (1933), the late ancient regime loans in Velde and Weir (1992, 20), or those in van der Wee (1963, I, appendix 45). Included, mainly relevant during the 14th and 15th centuries, are the typical “pledge loans”, to the extent that repayment – which is often assigned to revenue streams in tolls, taxes, or other income streams from towns, castles, or offices – is
cash-based; included are also loans from municipalities to the central authorities, since these merchant communities and city governments typically enjoyed a considerable degree of independence, and such loans were usually free of coercion. While there are various mixed forms, the basic properties of these contracts place them firmly into the “obligation” category, including the fact that, as in renten, the contract duration introduces a chance element, and thus the probability of interest rate profits. Easier legal recourse and outward adherence to moral usury standards explain their popularity (Kostanecki 1889, 11-25, 56-87; more generally: Munro 2003a).

The loans included fall firmly into the “long-term” spectrum, with an average maturity of all loans estimated at between ten and twelve years. Pledge loans during the 14th and 15th century are typically perpetual, redeemable loans, for which no precise maturity date is agreed upon – similar to the situation with Leibrenten. But on aggregate they can be safely put into the “long-term” category. Exemplary, in one representative (but non-exhaustive) document collection, if one averages instances where explicit maturities are stated, typical maturities around five years are suggested. At times, the boundaries between short- and long-term debt has been blurry. The English Crown during the 15th and 16th centuries, for instance, engages in frequent “short-term” loan operations in Amsterdam and in the London market – only to continuously roll over these arrangements, with little or no changes to the underlying terms (Ashton 1960; Outhwaite 1966). Similar practices are documented in France (Doucet 1937, 45). In cases where such prolongations have repeatedly occurred on the same interest rate terms, I have here chosen to regard these underlying yields as “long-term” interest rates and include them in the sample. It should in

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11 Not all such “pledge loans” had an underlying credit basis, but they remained by various accounts the most important revenue source during the 14th and 15th centuries. For an in-depth discussion, see Landwehr (1967, esp. 234-257). Data in Isenmann (1980/1, 17).

12 Weighing all personal loans extended by Frankfurt bankers across Europe between the 14th and 19th centuries with explicit maturities in Dietz (1925, IV/II, appendix 2) yields 12.53 years average maturity. If one excludes the outliers such as the notoriously unreliable Counts of Hesse-Darmstadt, and one 100-year Jewish loan to the Count of Schönburg-Waldenburg (ibid., 773), we reach 9.9 years.

13 Averaging instances in Reg Pfalz (Ruprecht I, 3737, 3913; Ruprecht III, 331, 442, 543, 2704, 2940, 3626) yields 5.5 years, for instance. I leave out all instances of “life pledges” which would raise the average maturity further.
any case be mentioned, however, that there is considerable evidence that the term structure for the 14\textsuperscript{th}-17\textsuperscript{th} centuries de facto is entirely flat.

Such non-marketable sovereign loans have gone out of fashion over the past two centuries. A “benchmark” non-marketable instrument today is likely represented by U.S. savings bonds, which are non-transferable, long-term, and redeemable after 12 months. Their history originates in U.S. (inter-, and post-) war financing under Henry Morgenthau Jr. in 1935 (Linehan 1991).

As Figure III and data reveal, current non-marketable long-term debt, at 0.51\% real at the end of 2018, in fact shows elevated yields compared to historically-implied real rates, which have already fallen close to negative territory (2018: 0.19\%). The non-consolidated/personal loan sample once more shows an all-time downward trend close to the 1-2bps p.a. slope exhibited by the global aggregate group, at -1.96bps p.a.\textsuperscript{14}

Table 1: Selection of personal/non-marketable sovereign loans, 1338-1803.

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<th>Details</th>
<th>Amount and Rate</th>
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<tr>
<td>1401</td>
<td>Amadi/Rommel loan to King Sigismund, 1,200 ducats</td>
<td>18% (1.5% per month)</td>
<td>RTA, Vol. 5, no. 37 (note 1)</td>
</tr>
<tr>
<td>1440</td>
<td>Paumgartner loans to Lewis of Bavaria, 4 years</td>
<td>1800fl at 24%</td>
<td>Krag (1914, 11)</td>
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<tr>
<td>1459</td>
<td>Medici bank loans to Sforza, Duke of Milan</td>
<td>218,072 Milanese pounds at 15.4%</td>
<td>De Roover (1963, 264-269)</td>
</tr>
<tr>
<td>1502</td>
<td>Melchior, Bishop of Brixen to Maximilian I (Raitkammer)</td>
<td>30,000fl at 5%</td>
<td>Regesta Imperii, XIV Vol. 4, no. 16970</td>
</tr>
<tr>
<td>1570</td>
<td>Loan to Maximilian II from Hans Bernhard von Wallprun</td>
<td>20,000fl at 5%</td>
<td>OeStA, FHKA SUS RA 75.6</td>
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\textsuperscript{14} Cf. additional notes in appendix, appendix table A.3 and sources to Figure III.
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<th>Amount</th>
<th>Interest Rate</th>
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<td>1622</td>
<td>Loan from Philip Burlamachi for upkeep of forces in the Palatinate</td>
<td>6,000l at 10%</td>
<td>Calendar of State Papers Domestic, James I, Vol. 3, entry no. VOL. CXXXIII., [57a]</td>
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<tr>
<td>1642</td>
<td>Loans to Queen Henrietta Maria in Holland</td>
<td>2x 150,000 livres tournois at 7.5%</td>
<td>National Archives (TNA), SP 84/157, fols. 227, 231</td>
<td></td>
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<tr>
<td>1645</td>
<td>80,000l loan from merchants group including John Wollaston</td>
<td>80,000l at 8%</td>
<td>Calendar of State Papers Domestic, Vol. 20, p.377, entry no. VOL. DVI., 84</td>
<td></td>
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<td>1706</td>
<td>Loan to the German Emperor to support Prince Eugen's campaign in Italy</td>
<td>250,000l at 8%</td>
<td>Calendar of State Papers Domestic, Anne I, Vol. 4, entry no. text 474</td>
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<td>1778</td>
<td>French Revolutionary War loan to United States</td>
<td>18m Livres at 5%</td>
<td>House of Representatives (1876, 24)</td>
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<td>1803</td>
<td>Loan Bethmann Bank to Emperor Franz II</td>
<td>2m Gulden at 5%</td>
<td>ISG Frankfurt, 1.117</td>
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</table>

See the full list of sources in “Notes to figure III”, appendix section.

Page 14: Figure III: 447 personal/non-marketable loans to sovereigns, 1310-1946, and U.S. savings bonds – plus resulting real rate trend.¹⁵

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¹⁵ For full list of sources, see appendix table A.3 and “Notes to figure III”. Loans are included at global headline level prior to establishment of consolidated debt at national levels. Excluded are intragovernmental loans from central/public banks, from de facto public agencies (such as Venice’s Grain Office or the East India Company), bank loans opened up to public subscription, loans to political figures below the ducal level, Annualized cash-only rates recorded. Interest on U.S. savings bonds adjusted bi-annually since 1995: average of two bi-annual “long-term” rates taken. Nominal loan sample deflated with arithmetic global inflation.
In the global series, I exclude the hyperinflation years in Germany (1919-1923). Both if nominal data is GDP-weighted (preferred) and – for robustness purposes – arithmetically-weighted, the downward trend in rates over time is confirmed, as is the identification of all-time nominal lows in most recent years. We frequently encounter highly elevated nominal yields in the 14th and 15th centuries even though, to reiterate, these rates represent secured interest rates throughout, with collateral in early modern Europe typically including jewels, mortgages or land assets (Fryde and Fryde 1963; Bell, Brooks, and Moore 2009).

Inflation levels on the global basis are 20-30 basis points higher on average compared to the safe asset provider basis, but exhibit similar general features in most other aspects: there were frequent “deflationary dips” until the early 18th century: 138 out of the 415 annual observations between 1311 and 1725 record global deflation; over a 200-year horizon (1818-2018), global inflation averaged 2.75%.
The resulting all-time GDP-weighted real rate, at 6.46% (Figure IV), is expectedly higher than the safe asset provider benchmark rate of 4.68%. Key differences include an earlier all-time peak, about one century prior to the single-issuer peak, in 1379, at a slightly lower level (18.4% versus Safe R at 21.1% in 1478). The all-time low for global R occurs during World War Two, in 1945 at -10.4%.

Interestingly, it can be seen that the various plausible long-term rate trendlines all suggest that currently “depressed” real rates are fully “at historical trend”. Next to the all-time trendline – displaying a -1.75 basis point decline per annum – I add three further key historical slopes.

- First, the “post-Bullion famine” slope, beginning in 1494 after the second monetary contraction identified by John Day (1978), and the resumption of Balkan mining output.

- Secondly, the “North-Weingast” slope, in reference to the well-known arguments by the authors (North and Weingast 1989), who posited a key institutional revolution in late seventeenth century Britain which enabled the emergence of credible debt mechanisms. In fact, since 1694, this slope displays a trend decline of -1.24 bps per annum – actually the flattest of our slopes, suggesting a meaningful moderation from late medieval trends. This suggests some problems for the institutionalist view.

- Thirdly, the “post-Napoleonic slope”, beginning in 1820, after the Congress of Vienna and the founding of the modern international state system. Since then, it appears the downward slope has converged again to the all-time trajectory, displaying a -1.78bps fall.

Figures IV and V decompose the real rate set in Figure IV, by adding the sovereign yields available at respective stages from all advanced economies to the individual series specified in Appendix Table A.2.
All-time annual average, GDP-weighted: 1.60%.
All-time annual average, equal weighted: 1.74%.
II.B THE SAFE ASSET PROVIDER SERIES

Figure VII displays my overall long-term real series for the historical “safe asset provider” (an earlier version is found in Schmelzing 2018, 19). Its central feature consists in the fact that it remained entirely default-free over its 707-year span, and that it can with recourse to historical documents be shown to have represented the preferred “safe” investment asset over time. The only “stress events” in the series concern interest payment delays, particularly during the 14th century, but the phenomenon affected most sovereign annuities issuers during this time. While it would be tempting to assume that municipal long-term debt (i.e. Figure II) in general represents the “safe asset” in the early modern period given its low nominal yields in absolute terms, municipalities frequently encountered default events: relying on Dietz (1925, IV/II, appendix 2) and Gilomen (1994) alone yields at least 17 “default events” narrowly defined between 1300-1700 among “Carolingian” cities: one should not assume, therefore, that a lower yield per se signals safety, a criticism that equally applies to Flandreau et al.’s (2009) choice of commercial bills.16 To establish the inception point for a long-term series of long-term sovereign bond yields, I follow a vast literature of financial history which has identified the Italian city-states of Venice, Florence, Siena, and Genoa as the earliest issuers of marketable long-term sovereign debt during the Renaissance (Kindleberger 1984; Epstein 2000; Tracy 2003; Pezzolo 2005; Michie 2006; Fratianni and Spinelli 2006; Goldthwaite 2009).

According to the classic account of Luzzatto (1929, 7), as well as Epstein (2000) and Homer and Sylla (2005, 90), the earliest funded debt of Italian city states can be traced back to a forced loan by Venice on its wealthy citizens in 1171-1172. No interest was paid on this loan for more than three decades, and the rates did not reflect market prices of risk.

16 Note also how Italian long-term debt presently (March 2019) yields below 10-year USTs: are we to regard the former as “safer”? Regarding early modern municipal debt, one often observes that cities had to offer higher-yielding Leibrenten when faced with adverse funding conditions; but in many cases, cities restricted their credit market activity altogether, and found it more advantageous to resort to raising direct taxes among citizens in such situations.
We have to wait until 1262 for secondary markets in Venetian long-term debt to be established, by a decree of the Venetian Grand Council, the *ligatio pecuniae*, which also fixed annual coupons at 5% (Tracy 2003, 21). This date marked the start of “continual speculation on the open market in government obligations” (Mueller 1997, 516), and almost uninterrupted market prices are recorded from then onwards in Luzzatto (1929). Following Venice, Genoa consolidated its various long-term loans into a single fund, the *Compere*, in 1340. Florence equally consolidated its debts in 1343-1345. Henceforth, it was known as the *Monte Comune*. The instruments of these city-republics could be pledged as collateral for bank loans, lent to third parties, used in lieu of money to pay private obligations and taxes, and the “vivacious” turnover gave rise to the establishment of both private broker houses and public debt agencies in charge of issuance and liquidity management (Mueller 1997, 453ff.; Pezzolo 2003). The participation of international investors – ranging from foreign rulers such as the Portuguese King, to religious orders such as the Knights Hospitallers in Jerusalem (typical “institutional investors” of the day), and private German merchants – has been extensively documented. All of them were attracted by Italian debt “because they had no similar investment opportunity in their own capital cities and because they sought to put a safe distance between internecine struggles in their own courts and the hoards that could guarantee survival to themselves or their heirs in case of a change of political fortune” (Mueller 1997, 545). German merchants in the 15th century petitioned the Venetian city council for trading concessions in the *Monte Vecchio* market, “when no one could have imagined to secure for himself a modest but safe income by buying Venetian government credits”.17 Similarly, foreigners had to pay the Genoese administration for the privilege to invest in its *Monte*; merchants, rulers, and institutional investors from across the Continent still yearned for the chance given the Compere’s reputation as “precipua columna et lumen istius urbis”, a “particularly safe investment” (Sieveking 1898, 32). Despite real rates north of 20% during the second half of the 15th century, Italian debt remained preferable to alternatives, at a time when even the wealthy towns of Flanders were in arrears, and short-term sovereign rates reached up to 74% even in Burgundy.18

17 Cit. in Luzzatto (1929, CCXLV-VI N.1); also cf. Mueller (1997, 563).
18 Also cf. below, pp. 45-46. Van der Wee (1963, II, 105-110).
In relative terms, Italian urban debt thus constituted the proverbial risk-free, marketable asset of the day. Venice is conventionally treated as the most advanced sovereign debt market, while Florence, home of the Medici Bank, is frequently considered the leader in private, commercial markets (Tracy 2003; Pezzolo 2013).

The “bottleneck” in my safe asset data is set by the European price data provided by Allen (2001), which represents my “preferred” inflation basis, among various alternatives, and which in the case of the Italian city states commences in the year 1311. This year is therefore the first for which the calculation of real rates is possible. Allen (ibid.) constructs his “Northern Italy” index with data from the largest Italian city-states, including Venice, Milan, and Florence. His CPI basket includes the key food items, energy prices, linen, soap, and candles, and is based on institutional, urban price data, expressed in silver unit equivalents.

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19 For Florence, see also Molho (1971).
20 The methodology is the same across the 20 cities covered by Allen (2001). Some cultural differences are reflected in the consumption baskets, i.e. the English basket features butter and beer, while the North Italian features olive oil and wine.
Figure VII: Real long-term “safe asset” rates and composition by century, 1311-2018.\textsuperscript{21}

Allen’s bullion basis provides a check against debasement operations, which are documented frequently for low-denomination coins across Europe (Cipolla 1956, 27-37). Interest and principal payments in the period up to 1700 are typically transacted on a bullion basis, with gold coins of a specified weight the preferred internationally accepted standard: florins, ducats, and gulden (ibid.; Fryde

\textsuperscript{21} Compare Schmelzing (2018, 19) for an earlier version.
and Fryde 1963; Rothmann 1998, 426); on the local and private level one finds a higher share of silver accounting in the arrangements. These practices can also be confirmed by numerous archival contracts. The debtors of Emperor Maximilian I. frequently incorporated clauses into loan agreements to be repaid in “gutem reinischen golde” (good Rhenian gold coin). The debt letters recorded in the 1460s by Friedrich II., Margrave of Brandenburg never omit the provision to pay back the “Schult” (debt) in “gut gulden und gewicht” (proper gold coin and weight). My series thus are not prone to debasement problems, though one could speculate if creditors ignored silver-price inflation at times when the gold-silver ratio also moved, for instance during 1618-1625. Allen’s data has been used in the academic literature in various other contexts.

It is apparent that inflation volatility reached elevated levels in the early modern period, until the early 16th century, to levels subsequently only experienced again during the 20th century World Wars. The reason must be sought in the fluctuation of agricultural prices, particularly wheat, which make up a considerable share of the early price indices. The well-known early Phelps Brown and Hopkins price index shows equally strong fluctuations, with the authors observing that “the index of prices has two periods each of about 130 years, 1380-1510, and 1630-1760, throughout which there is constancy in the general level, and this surprising stability, as it seems to us, was maintained through fluctuations of two to three years’ span, due no doubt mostly to the harvest, whose violence seems no less extraordinary” (Phelps Brown, and Hopkins 1956, 305). As Hamilton (1936, 58) observes, “economists have long recognized that wheat is one of the most reliable single measures of long-run value, but that throughout

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22 For instance: Reg. Imperii XIV, 4/1, no. 18941. July 4, 1504. The phrase frequently encountered in international contracts is “boni auri et iusti ponderis”, see for instance Maximilian’s December 1507 loan in London: TNA E 30/1736, fol. 1d.

23 Geheimes Staatsarchiv Preussischer Kulturbesitz (GStAPK), I. HA Rep. 78, Nr. 10, 96-131. Gilomen (2018, 68f.) agrees. Conversely, see an illuminating court case by Adolph von Oppenfeld, a real estate investor in Cologne, who sues the Abbey Altenberg in a lengthy proceeding between 1598-1612 alleging his interest instalments are paid in “schlecht geldt” – the claimant’s success shows at the same time that debasement was still an issue by the early 17th century – but that creditors had working institutional means to tackle these risks. See Cologne Archive (HStAK, A 71 – “Klaeger: Adolph von Oppenfeld, Koeln, 1418-1618”). Many similar printed court cases are to be found in the “Reichskammergericht” registers, such as those published via BayHStA, see Gebhardt and Hoerner (eds., 1994). 

24 Soetbeer (1879, 123) records an increase in the German silver-gold ratio from 11.74 in 1622 to 15.1 in 1634. Apart from a notable weakening of gold during 1339-1359, the ratio on a “global” basis is generally rather stable. See also Watson (1967, 24f.).
history the short-period fluctuations have been notoriously violent”. As recent studies have confirmed the generally high level of wheat price volatility even beyond the 15\textsuperscript{th} century (Bateman 2011), the decline in general price volatility is best explained by the declining share of wheat in the general consumption basket.

To match the nature of Allen’s price data most closely, for the years 1311 to 1508, I construct a synthetic “Northern Italy” nominal bond series, which incorporates 242 specific annual datapoints from Venetian long-term \textit{Monte Vecchio} and \textit{Monte Nuovo} bonds (104 datapoints), Florentine \textit{Comune} bond yields (52 datapoints), and for Genoa \textit{Comperre} bonds and San Giorgi \textit{luoghi} rates (96 datapoints). For datapoints not explicitly documented, I rely on linear interpolations – however, there are only 18 annual instances for which none of the three city-republics has a confirmed explicit bond yield datapoint. Appendix table A.1 lists all specific spliced country sources. I weigh the three city-states according to population data and taxable wealth data, giving a 55\% share to Venice, 25\% to Genoa, and 20\% to Florence.\textsuperscript{25}

There is broad consensus among economic historians that the late 15\textsuperscript{th} century marks the beginning of the long secular decline in economic pre-eminence of the Italian city states, with the Portuguese discoveries in India in 1498, and the conquest of Egypt by the Ottoman Empire in 1517 often singled out as turning points (Michie 2006, chapter 1; Malanima 2011; Pezzolo 2013, 255). I choose for the transition the year 1509 – the date of the decisive Venetian defeat in the famous Battle of Agnadello against the League of Cambrai. Referring to the event in \textit{The Prince}, Niccolo Machiavelli claimed that Venice had lost “in one day what took them eight hundred years exertion to conquer” (Machiavelli 2003, 77).

At this point we enter the Spanish phase of financial dominance. During the 16\textsuperscript{th} century, “no other power controlled...armed forces as powerful or financial resources as vast as Habsburg Spain”.\textsuperscript{26} Spain

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\textsuperscript{25} Mueller (1997, 479, 491) uses a basis for Venice population in 1379 of 70,000, of which 2,100 households had net taxable wealth, and 37,000 for Florence. He also suggests a population figure of 50\% of Venice’s level for Genoa – while Bairoch et al (1988, 49) would suggest a higher population figure for Genoa, Kedar (1976, 43) in turn suggests a lower basis of taxable households on the basis of custompayers.

\textsuperscript{26} Drelichman and Voth (2014, 243). See generally Ehrenberg (1928) on the Crown’s relationship with the Fuggers.
was the leader among territorial states (as opposed to “city-states”) in developing public finance, and during the 1500s its public debt market assumed “unprecedented” proportions (Stasavage 2011, 31). While Habsburg Spain was infamous for defaulting on its short-term debt – the Asientos – in the second half of the 16th century, it continuously serviced the long-term debt, the Juros, which constitute our bond asset (Grafe 2011, 12-19; Drelichman and Voth 2014, 22). From the late 15th century, “Juros…assumed all the characteristics of sovereign debt: they were sold for cash, a seniority system was established, and they were allowed to trade in a secondary market”. 27 By the 16th century, Spain was equipped with a “first-rate system of public finances” and “Spanish revenues, expenditures, and debt issuance were managed at least as responsibly as in Britain, France, and the United Provinces at the height of their powers, if not more so” (ibid., 7). Alonso Garcia (2008) and Stasavage (2011) equally agree on the maturity and liquidity of the Castilian long-term debt market: in the 16th century, “everybody with credit and reputation had bonds in Castile” (Alonso Garcia 2008, 40). Alvarez Nogal (2008, 82) has separately argued that “the Spanish monarchy, despite being an absolutist government, did not need help from any other institution to provide credible commitments to its bankers and obtain access to important amounts of credit for more than 150 years”.

Next to Amsterdam and Antwerp, European-wide highly liquid secondary markets for Spanish assets centred on the Lyons and, towards the end of the century, Besancon Bourses, where the French monarch also preferred to float his “King’s Bonds” to a highly internationalized financial base, including Ottoman investors (Ehrenberg 1928, 281-306; Pezzolo and Tattara 2008).

Long-term lending rates to the Crowns of Aragon and Spain during the 15-16th centuries are reported in Kuechler (1983, chapter V), Alvarez Nogal (2010, 61-63, 76), as well as in Ucendo and Garcia (via European State Fiscal Database, cf. Bonney 2007), and Drelichman and Voth (2014, 114). I add individual long-term datapoints such as the yield implied by Christoforo Riba’s 1571 report in Ehrenberg (1922, 321). I further take the low-end of the ranges reported in Homer and Sylla (2005, 113), thus

27 Drelichman and Voth (ibid., 24, footnote [55]).
introducing a further conservative bias, and use the 22 datapoints reported by Ucendo and Garcia (ibid.). All other Spanish annual nominal Juros yield data are linearly interpolated. The average long-term yield for the Spanish phase thus calculated – 7.6% on long-term debt – is thus broadly in line with the general 7.2% spread to short-term Asientos yields suggested by Drelichman and Voth (ibid., 206), who by default use a 7.14% rate on Juros (ibid., 177). I use Allen’s (2001) data for Spanish CPI in Valencia to obtain real rates.

Soon after Philip II’s death in 1598, Spanish decline set in with equal swiftness: “the Empire on which the sun never set had become a target on which the sun never set” (Parker 2000, 283). Economic primacy passed to the Dutch financial centers. Between 1599 and 1702, I rely on long-term bond yields from the Dutch Province of Holland, then home to the “financial capital of the world” (T’Hart, Jonker, and Van Zanden 1997, 48), and the “payments centre for the seventeenth-century European economy” (Michie 2006, 9): Amsterdam. The 17th century is widely regarded as the “Golden Age of Dutch finance”, with the Dutch national debt being put on a permanent basis in 1596, and more than 65,000 individual investors based in the Netherlands by 1620 (ibid., 26). Already, “by the earlier 16th century, the fame of Amsterdam’s wealth, backed up by a powerful market position, had radiated far beyond Dutch borders. After 1609, with the establishment of the Bank of Amsterdam, the power of its financial market was even acknowledged world-wide” (van der Burg, and t’Hart 2003, 197). I rely on nominal renten and obligations data provided by Weeveringh (1852, 50f.), Dormans (1991), and Zuijderduijn (2009, 283-285), and adjust with Allen’s (2001) Antwerp year-on-year CPI to reach real yields.

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28 The 7.2% spread refers to a positive spread of Asientos over Juros, since the Spanish yield curve was inverted. One could consider using Calabria’s (1991, appendix 1) series for Naples as an additional proxy, which issued Juros under Spanish auspices. The 1520s-1580s period shows a flatter downward slope here.

29 The timing and extent of the Spanish decline has perhaps attracted more discussion over the years than any of the other transition points. For the debates within the historical profession, see Weisser (1973), Israel (1981), and Stradling (1981). In geopolitical terms, a strong case could also be made to view Spain’s disaster against the French Crown at Rocroi in 1643 as the decisive turning point.
From 1703, I switch to British consol yields, as recorded in the Bank of England archive. In my geographic shift, I follow standard accounts such as Neal (1990), Ferguson (2002), and Broadberry and Fouquet (2015), which treat British public sector assets beginning with the inception of the central bank in 1694 as the leading “safe asset” instrument, concurrent with the transition of dominant financial market activity from Amsterdam to London.

From 1919 until 1961, and from 1981 to the present, I use long-term U.S. Treasury bonds, as recorded by the Federal Reserve Board (1943; 1971), and FRED (2017). The United States first overtook the United Kingdom in per capita GDP in 1901, but subsequently fall back again in 1904 and 1914. From 1919, however, the lead is continuous, and the United States assumed a dominant creditor position in the international financial system (Obstfeld and Taylor 2004).

Between 1908 and 1913, I rely on the German Imperial 3% benchmark bond as recorded by NBER Macrohistory database, and between 1962 until 1980 I rely on German 10-year government bonds. In 1908, Germany overtook the United Kingdom in total GDP and entered a stronger growth trajectory than the United Kingdom, only interrupted by World War One. In 1961, after the revaluation of the deutschmark, the rise of the Eurodollar market in London as an alternative financing pool, and consistently lower inflation rates, German rates started being considered as prime advanced economy assets (Cohen 2015). I return to US assets concurrent with Paul Volcker’s first success in his “war on inflation” in 1981, and conclude with the final annual U.S. 10-year bond yield for 2018, and the corresponding year-on-year all-item consumer price inflation figure as recorded by the Bureau of Labor Statistics (BLS).

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30 From 1733, see: Bank of England Archive (BoEA), 10A 270/1. I average monthly figures reported there. An almost identical series is obtained when one averages the monthly consol prices from 1730 in Sinclair (1790, Appendix No. III, 49-66); For pre-1733: BoE stock in Castaing, via EFSDB, Series “COE1700S DATA”.
II.C EVIDENCE FROM “PRIVATE R”

After focusing on different parts of public, sovereign rates (marketable and non-marketable), a logical next step is the investigation of non-sovereign interest rates. Private debt assets over time have been a key component of aggregate “nonhuman” wealth. If similar trends can be observed between “public R” and “private R”, this would strengthen the argument that more general trends underpin the long-term rates evolution, and that the causes of the trend decline are not primarily to be sought in the decline of sovereign default risk premia, or the strengthening of specific public commitment mechanisms. While there remains a margin of error in estimating the share of individual components, the exact weights are for now a secondary concern – and for total private wealth returns in Piketty’s (2014) sense, we obviously have to look beyond fixed income assets – as long as we can establish more precision on the evolution and long-term slope of component returns.

An attempt is presented in this section, by focusing on the private, secured mortgage market over the 700 years. I compile data for “Carolingian Europe” in Figure VIII partly from printed primary sources (e.g. Maugis 1914, for Amiens; van der Sprenkel 1937, for Utrecht), secondary sources (e.g. Gobbers 1883; Voye 1902; Liebeherr 1971), and partly from municipal archival data; for modern equivalent assets – in their most basic form these medieval assets are still in existence –, Bundesbank (2019) data is integrated. The yields refer to privately negotiated Erbleihen, Leibrenten, Gülten, and private rentes, all of which having grown out of the Carolingian census contracts (Arnold 1861; Munro 2003a, 518f). They all involve the debtor as a private party who pays the recorded interest rate, which is tied to the value of a real estate asset itself, or where the collateral involved consists of a real estate asset. The creditor counterparties involve abbeys, municipalities, or other private individuals. Note that the contract length is

31 It is worth noting that the archival evidence of “private defaults” or re-structurings appears to me comparatively limited, though when they took place, they remain disproportionately well-documented since court registers survived well. For instance, see Sturm (2009) for Hannover 1550-1750, and more generally Smail (2016).

32 Obviously, the main other financial asset would be business investments (modern: equity). See the appendix for a discussion of early modern evidence.
often not specified, but since the typical instruments were at least for “one life”, they are firmly in the long-term category. Real estate-secured *Leibrenten* or *Erbleihen* morphed into standardized *Pfandbriefe* issued by specialized lenders from the 19th century, on which basis they continue to exist today. There is no known historical bias in the collected loan size, and regions in all parts of the former Carolingian legal realm are covered. 894 historical nominal datapoints are obtained (in addition to 65 modern annual *Pfandbrief* datapoints by the Bundesbank), and Allen’s (2001) German-averaged data is used from 1428 to deflate nominal rates. Between 1326 and 1427, I rely on averaging baskets of grain silver prices from Mainz and Hannover, based on primary sources, on the one hand, and Abel’s (1978, 308f.) grain price index on the other.\textsuperscript{33}

The trend fall in “Private R” between 1428 and 2019 stands at 0.55 basis points per annum, with a unique plunge during the Kipper- and Wipper inflation crisis in 1621-1622 just after the outbreak of the Thirty Year’s War.\textsuperscript{34} Without delving into the debate too deeply, the lower volatility and absolute levels of private R in the early modern period stands out (sharp spreads to public R during the 1300s-late 1400s are notable); this is consistent with Strieder’s (1904, 59-83) observations – contra Sombart – that interest rate increases in private debt contracts were very difficult for the creditors to re-negotiate in times of distress, with many of them being in continued existence for 200-300 years by the late medieval ages.

\textsuperscript{33} I take averages of recorded grain prices in the Mainz registers, and the Hannover rye price series reported by Unger (1752), held via OeStA HHStA MEA Muenzsachen 8, interpolating missing years.

\textsuperscript{34} For context on the inflation surge, see Paas (2012) or the Frankfurt case study by Schneider (1990). On Allen’s (2001) German-averaged basis, inflation peaks at 95.6% year-on-year in 1621. Pfister’s (2017) data records notably lower peaks: see also the inclusion in the robustness section below.
Figure VIII: Private R, and R-G trends, “Carolingian Europe”, 1250-2019.35

Similarly, a long-term trend is derived for “Private R-G”, with growth data based on Maddison (2010, interpolated). Between 1500 and 2019, I observe a trend fall in R-G of -1.01 basis points on average. The fall accelerates particularly following the Napoleonic Wars: if only the period of 1500-1850 is observed,

35 For a full list of sources, see Appendix “Notes to Figure VIII”. Sources include: Stadtarchiv Bamberg (StABb): A 21, D 3001, D 4017; Frankfurter ISG: Hausurkunden; Stadtarchiv Mainz (StAMz); Historisches Archiv der Stadt Koeln (HStAK): files including A73, A1401, A2213, A2221, A2242, U1/214, U1/17139, U2/4, U2/7, U2/587, U3/1652 and files in Nachlaesse R, Raitz von Frentz – for full list, see references section; Stadtarchiv Worms (StAWs): 001AI/0149; Arnold (1861, 235, 245-246); Kahn (1884, 236-240 [average of Karlsruhe, Muenchen, Berlin, Hamburg, Dresden, and Kempten]); Gobbers (1883, 204); Voye (1902, 24, 29f., 35f., 90ff. [tables 12, 13, 18]); Liebeherr (1971). “Hessen” aggregates datapoints from municipalities in today’s Hessen state region, via funds in the Hessian Central State Archives (HHStaW and HHStaM). Pfandbrief yields 1955-2019 in Bundesbank (2019); one French datapoint in Longnon (1878, no. LX) and others in Maugis (1908, XLII, no.16; 1914, V [Supplement a l’Article XIII, pp. 433ff.], No.5; XXI, no. 4); Utrecht in van der Sprengel (1937, nos. 618, 657, 698, 859, 984, 1189, 1192, 1244).
the fall moderates to -0.34 basis points per annum; if Pfister’s (2011, 25) growth data is interpolated for the same time period, the R-G fall reaches -0.44 basis points p.a.

The trend-implied 2019 private real rate, in contrast to public rates, stands at a higher level than sovereign historically-implied rates: the “normalized” level for German Pfandbriefe on my basis is 2.97% in real terms, versus an actual value of -0.91%. While private rates, unlike public ones, are not “at historical trend”, there is similarly no particular trend break in the early 1980s that can be observed, and the trend fall is steady enough to see policy-independent factors at work driving the trend decline, which – like the dynamics for public assets – remains consistent across various financial regimes.

An additional step would now involve weighing private and public R according to their shares in national balance sheets over time, but this is not formally undertaken in this paper. However, one can anecdotaly see that such a weighting – if combined with business returns resulting in the non-human wealth return measure that Piketty (2014) appears to have ultimately in mind – would just as well confirm the downward trend, with a slope slightly tilted towards the flatter “private R”. To name just a few datapoints, we can infer from Oldland (2010, 1074) that in early Tudor England, merchants held 29.5% of assets in land, and 48.4% in debts (private and public); one and a half centuries later, one of the wealthiest British financiers held 22.5% of his investment portfolio in “public R”, with 42% in private loans and annuities; and the remainder in real estate assets (Clay 1978, 191). For Venetian bank balance sheets of the 15th century, the “public R” share could approximately be derived at 22-25% based on Lane (1937), with up to 54% in real estate, and the remainder in “private R”. These shares are not qualitatively different to the shares Piketty (2014, table S10.4) finds in 1872 Parisian portfolios (Real estate: 42%; sovereign bonds 13%; aggregate financial assets 56%). But while the downward slope can at this stage of the argument be increasingly be taken as given, certainly more datapoints are desirable to trace shorter term and cyclical fluctuations in the private wealth composition.

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36 Also cf. Appendix chart A.4, p.117, and Figure X, with respective sources there.
III. RISK PREMIA, WARS, AND VERY LONG-RUN “R-G”

Does the decline in sovereign nominal rates merely reflect declining risk premia over time? Previous studies have certainly shown a decline in the premium over the long-term in the sovereign bond space, tracing the spread between higher risk long-term sovereign yields and the safe long-term assets (i.e. Tomz 2007, 56, using Brazilian bonds over U.K. consols). This approach is applied in Figure IX, “Trend 1”. Another avenue to approximate the long-run risk premium is to trace the spread over time of long-term sovereign bond yields to fully risk-free economic investments, often considered to constitute land returns (Clark 2010, 69f.; Stasavage 2011, 41, figure 2.4). Indeed, as early as the 17th century, British economic thinkers such as William Petty posited that “at the base of the pyramid of [capital] assets lay land – the most secure investment…further up the scale money loans and the money rate of interest. Assuming that the risk premium between the two was constant, the problem of ‘interest’ was reduced to the…value of land” (Low 1954, 116).

Figure IX displays both these approximations, charting real land returns on a “G5” basis (Italy, U.K., Flanders, France, U.S.), on the basis of Ward (1960), Featherstone and Baker (1987), and Clark (1988; 2010, table 7). Trend 2 approximates the risk premium via the difference between the long-term real bond yields less real land returns of the same country sample.

Contrary to Petty’s assumption in 1682, the bond-land risk premium is not a constant. And consistent with the implied land return slopes in country-level studies, (e.g. Clark 2010, 69), I reach aggregate slopes flatter than those for the real rate fall – which means that falling risk premia do not sufficiently explain the general trend fall in real rates. The trend fall for the first approximation – global real yields minus safe asset provider R – on average records a 0.88bps decline per annum; the second proxy – safe R less “safe asset provider” returns minus real land returns – yields a somewhat flatter 0.52bps per annum. It may seem peculiar that during the 14th century, land returns seemed structurally more “risky” than safe financial assets – but the negative spread echoes evidence documented for instance by Sieveking (1898, 174), who reports that indeed in 14th century Genoa, “the investment in government debt was preferred to
the investment in housing”. Similarly, the Venetian chronicler Girolamo Priuli recounts in his diary that “[many citizens and nobles] were anxious not to turn their sons into country bumpkins…they were reluctant to buy land and wanted their heirs to apply themselves to commerce…they preferred to invest their money in the Monte Nuovo rather than in estates” (Chambers and Pullan eds. 2001, 161). The Hundred Years War saw constant land dispossession on the Continent, and many cash-rich nobles saw their property investments turn sour, as speculators such as the commander Sir John Fastolf found out to their detriment (McFarlane 1981, 188).37

Though the share of interpolated data for early modern land returns remains rather high at this point, Clark’s (1988; 2010, table 7) resulting values are consistent with alternative reports for individual property portfolios.38 Set against the overall R trend fall between 0.92bps (Safe R) and 1.75bps (global R), overall we can venture that, in both cases risk premium factors as measured here may play a meaningful role, but that even with a generous definition as to its influence as employed here, roughly half of the trend fall over time remains unexplained.

37 Stasavage’s (2011, 41) compilation for 1250-1750 spreads groups city-states versus territorial states and appears to imply a rise in risk premia for city states between 1350-1650. The difference seems to be partly related to his omission of the high Venetian rates in the late 15th century (ibid., 39, cf. Figure 2.2). The average bond-land spread equally seems to be negative for 1350-1550 on his basis, however.
38 McFarlane (1981, 191) for instance reports a nominal return of John Fastolf’s property portfolio in the 1440s of 5.6%. This compares to values of 5.6% (Clark 1988) and 5.0% (Clark 2010) for interpolated values.
Figure IX: Two approximations of the risk premium over time, 1317-1984.\textsuperscript{39}

Against the background of the widely-debated contentions in Piketty (2014), alleging that a secular divergence between real nonhuman (productive) wealth returns (r) and growth (g) underlies changes in societal income equality trends, it is here also possible to outline the very-long term relationship between these variables, with r here defined as real long-term public debt returns.

As Lindert (2014, 5) points out, this may capture only a subset of the intended definition of Piketty’s “r”, and in a following step, a proper weighting of financial asset, land and business investment components would be desirable.

However, it appears underappreciated to what extent long-term debt assets on their own have historically constituted the key component of elite non-human wealth. Herlihy and Klapisch-Zuber (1985, 102ff.) showed that the most important wealth component of Florence’s top households were public debt assets by 1427; tax return data in various German cities throughout the 14th-16th centuries consistently confirm the dominant role of public and private renten wealth; even in smaller Dutch towns, already 27% of households report exposure to annuity investments by 1462, a share that more than doubles over the following century (Zuijderduijn and De Moor 2013, table 4).

Figure X compiles 45 datapoints for “public and private debt as percentage of total wealth” prior to 1688, when Goldsmith (1985) initiates his more detailed national balance sheets. These are meant to be suggestive – not comprehensive – in their current form and exhibit a German-Italian geographical bias. But they are to demonstrate the significance of such assets for aggregate balance sheets, and it is not implausible on this basis to assume as a working hypothesis around a one-third share of public and private long-term debt in private wealth aggregates for top European households pre-1688 – a lower bound that is likely to be substantially higher for the 15th-16th centuries.

From the asset evidence above and Figure X below, however, it should already be apparent that a full “balance sheet weighting” of all components for nonhuman wealth – also including real estate, cash, private loans, and business investment – will likely yield trend properties over time very close to those displayed here. Real estate plus public debt components on their own cover above 50% of total private wealth until well into the 18th century. True: if it could be shown that private debt levels were significantly higher than implied here, the overall nonhuman wealth return tend fall could potentially be meaningfully more moderate, perhaps below 1bps p.a.
A second justification to focus on long-term public debt returns comes from Piketty (ibid., 353-358) himself, who simply assumes – without anywhere justifying the numbers – that real capital returns between 1000-1500, and between 1500-1700 average 4.5%, citing Homer and Sylla (1996). However, the latter do not to my knowledge suggest a stable real return around 4.5%, which would be demonstrably wrong.

Such an assumption, as documented here, underestimates capital returns by a significant amount, and when

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40 Florence data in Goldthwaite (1968, 45, 60, 115, 125, 143, 177, 192) and Herlihy and Klapisch-Zuber (1985, 102ff.); North Germany data from Richter (1918, 87) and Reincke (1951, 203-213, taking breakdowns where reported for “Oberschicht” cases). Konstanz via Nuglisch (1906, 371, taking “fahrende Habe”). British – taking Sir Stephen Fox’s portfolio in 1686 via Clay (1978, 191). Nuglisch’s numbers likely overestimate the share a little, given that he includes some sovereign loans in the “movable” definition; on the other hand, Richter and Herlihy and Klapisch-Zuber are underestimating the total share since they are reporting real estate-linked private debt, and public debt, respectively, only.

41 In a footnote, Piketty (2014, 354) refers to Homer and Sylla (1996), contending that the reference would show that “for interest on loans, we often find rates above 5% in earlier periods, typically on the order of 6-8 percent, even for loans with real estate collateral”. I have been unable to find such a statement in the History of Interest Rates. Even ignoring this, it still remains unexplained why Piketty then opts for 4.5%, rather than at least choosing a figure between 6-8%.
Piketty (ibid, 354, figure 10.9) displays a general rising trend in real capital returns between 1500-1700 and 1950-2012, this contention is thus fully at odds with the available evidence, here and elsewhere.

The “R-G” spread has been the focus in a separate recent treatment by Blanchard (2019), who posited that a negative value (an excess growth figure over real rates) would indicate a high public debt tolerance.

Neither Piketty’s nor Blanchard’s arguments will be investigated in-depth here. But the new data on “R” (and the aggregations of “G” figures discussed below, see Figures XXII and XXIII) do allow – for the first time, to the author’s knowledge – a very long-term time series for “R-G”, allowing both an approximation of Blanchard’s “Safe R” concept over time, as well as the key components of Piketty’s rate of return on “nonhuman wealth”.

Figure XI displays the resulting R-G spread over time, with all R relating to pre-tax returns: the most important takeaway here is the observation that the spread has narrowed rather continuously over a 700-year horizon across all three different approaches., with the global R-G sample displaying the steepest fall (-2.28bps per annum). Previous studies (Mehrotra 2017; Blanchard 2019) have noted that a negative R-G condition has not been unusual in recent decades, but have not identified an increasingly negative R-G trend over time. The slower decline in real land returns results – unsurprisingly – in a somewhat flatter fall in its respective R-G trajectory, here by 1.37bps p.a. There are several ways to apply this result to present debates – one presumably favoured by Blanchard (2019) would be to see a continuously improving debt sustainability in advanced economies over the very long-term at play. But if one follows Blanchard (2019), it can be observed, in any case, that the “excess G condition” supporting debt capacities is in fact of recent origin in the historical context: developed markets have not experienced protracted episodes of “excess G” prior to the 20th century and even short-term “excess G” is only observed during a handful of geopolitical stress events (the Kipper- and Wipper inflation; the Napoleonic Wars). In contrast to shorter-term evidence, over the very long-term, financial repression clearly is not a key factor in the decline (contrast: Drelichman and Voth 2008; Escolano, Shabunina, and Woo 2017). 42 A simple extrapolation of the R-G trend into the

42 The evolution of financial repression trends certainly warrants a longer discussion. But to posit a multi-century trend towards higher financial repression in advanced economies – the only narrative consistent with the R-G trends
coming decades may point to an increasingly better ability to absorb and self-finance public debt levels for advanced economies, at the expense of capital providers. Should the public not expect a secularly improved debt sustainability of public finances, and in turn the absence of any upcoming tax levying to finance deficits? If so, we may expect “crowding out” effects for private debt to be small.

The implications for Piketty’s version of “R-G” appear more ambiguous: a general trend decline of capital returns across asset classes – it was shown that real private loan rates display a very similar trajectory – would require a disproportional increase in the capital stock to generate rising absolute returns to capital owners. Capital volumes have clearly increased for the major economies, but relative proportions remain unclear, thus putting sufficient doubt on Piketty. I highlight the period between the 1550s-1630s, which marks a meaningful temporary reversal in the R-G decline. I note that Hoffman et al. (2002) in their work on social inflation differentials in the U.K., Holland, and France, have identified the years of 1500-1640 period as the first “inegalitarian phase” in early European history, with a second following between approximately 1740-1815, when my series also shows some temporary moderation. Given the different methodologies, one should not expect a clear overlap, but the similarities suggest that though Piketty’s general trend and policy identifications appear substantially misguided, some general validity to examine R-G differentials over time as a guide for inequality trends is retained. The period prior to 1850 equally deserves more attention: beyond the Napoleonic Wars, R-G levels stay comparatively elevated, together with R, and accompanied by unprecedented divergence between real and nominal rate standard deviations (see appendix chart A.8). Might this be a consequence of the “institutional meltdown” of the pre-1850 political fabric (Maier 2014, 15)?

We occasionally encounter arguments that the increasing absence of wars or general geopolitical risk, an alleged secular rise of enlightened diplomacy, is related to the course of interest rates. Certainly, with

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in Figure XI – appears clearly to contradict both circumstantial evidence (see the sorry fate of the famous financier Jacques Coeur or the Knight’s Templars at the hands of the French crown, or that of the impoverished Konrad von Weinsberg in in early modern Germany), and the general narratives of market commitment mechanisms. Not least the prevalence of “in-kind” debt is evidence of stronger creditor protection by the 16th century (see discussion below, and appendix, pp. 203-204).
most of state spending linked to military pastimes prior to the rise of social welfare states, the channel could be relevant on the secular level (i.e. Conway and Sanchez 2011). In 1717 the Earl of Bath, William Poulteney (1729, 68) declares that the interest rate reduction implemented in the Finance Act by the British government this year would be “so natural a consequence of quiet and peaceful Times”. Richard Cantillon regularly invoked political causes in his interest rate theories (Low 1954, 121). Barro (1987) found positive effects on U.K. long-term real interest rates between 1700-1918 when temporary wartime spending was increased – which suggests that secular reductions in war intensity should work in the opposite direction on a more general level. And in his sweeping political analysis, Tilly (1992, 74f.) argued that “from the late seventeenth century onwards budgets, debts, and taxes arose to the rhythm of war…as a by-product of preparations for war, rulers willy-nilly started activities and organizations that eventually took on lives of their own: courts, treasuries, systems of taxation, regional administrations, public assemblies, and much more”.

There are various possibilities to test the secular impact of political conflict on real rates. Many of them will be more sophisticated than Figure XII, which relates both in a rudimentary way: it calculates the annual “war intensity” in European history between 1495-2018 on the basis of Levy’s (1983, table 4.1) data. Battle deaths per million European population is aggregated here for the countries covered in the real rate sample, and distinguished between “safe asset provider” leading involvement, or global type. We in fact observe a marked rise in war deaths from the frequent but low-intensity warring of the Italian city states towards the “devastations of biblical proportions” (De Vries 2009, 170) during the Thirty-Years War, and the subsequent large scale campaigns of a Louis XIV or, eventually, Napoleon. Ferguson (2006, XXXV) has similarly shown the significant rise in battle death as a % of world population.

Of course, there are indications that measuring human capital destruction (battle deaths) may not be the indicator that matters. There are good reasons to argue that trends in physical capital destruction should be

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43 Cf. also Dickson (1967, 475f.).
44 Note that Levy’s (ibid.) table is mis-labelled in its original form: the “severity” column in fact counts absolute battle deaths. His “intensity” column in fact counts battle deaths/million European population.
the actual relevant factor to relate real rates to capital accumulation trends. It appears as a promising further line of future investigation, given the historical finding on the changing nature of (economic warfare). For instance, Caferro (2008, 174) argued in his analysis of the seigneurial Condottieri raiding that “Fourteenth- and fifteenth-century Italian warfare was fundamentally economic in its aims…the operative strategy was to wear down an opponent economically by doing as much damage to physical structures as possible, short of risking manpower”.

Page 41: Figure XI: Three variations of “R” minus “G”, 1317-2018.45

followed by

Page 42: Figure XII: Global nominal interest rates and war frequency, 1495-2018.46

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46 War frequency calculated by total battle deaths per million European population in given year, based on tables in Levy (1983, table 4.1) – “intensity” figure (cf footnote 43 above). “Safe asset provider battle deaths (leading role)” are recorded if respective safe asset provider assumes leading participatory role in multi-party conflicts – deaths then ascribed fully to safe asset provider unless more specific breakdown exists. Eighty-Years war death toll data has been added on the basis of Clodfelter (1992). Also cf Levy and Thompson’s (2011, 7-9) charts.
Global R-G trend fall: -2.28bps p.a.
Safe R-G trend fall: -1.38bps p.a.
Land R-G trend fall: -1.37bps p.a.
Certainly, while individual geopolitical escalations reverse existing trends in the shorter- and medium term, and while we have indications that shorter-term maturities often showed much more pronounced reactions to such stress events (for instance, see the collapse of French billets during the War of the Spanish Succession; Luethy 1998, chapter 2), it can be seen that the early modern era did not witness a steady march towards increased safety or geopolitical uncertainty – yet the general interest rate trend fell proceeds. 47 Wars of shorter duration (Tilly 1990) did not necessarily mean that they were less disruptive in terms of human or capital losses.

IV. TRENDS, METHODOLOGY, AND LITERATURE

IV.A EXISTING REAL AND NOMINAL DATA

King and Low (2014), Eichengreen (2015), Bean et al. (2015), Hamilton et al. (2016), Rachel and Smith (2017), and Gourinchas and Rey (2018) are among recent authors offering a “long-term” view on global real rate developments. However, these studies begin their observations in 1985, 1800, 1985, 1870, 1980 and 1870, respectively. Eggertsson, Mehrotra, and Robbins (2017) in their model-approach, or Williams (2015; 2016), and Kiley and Roberts (2017) from the policy perspective equally take the 1970s and 1980s as their point of departure. Notable additions pre-dating the most recent policy debates have been provided by Barro and Martin (1990), who begin observations in 1959, Gagnon and Unferth (1995), Chadha and Dimsdale (1999), as well as Reinhart, Reinhart, and Rogoff (2012), in the context of real advanced economy debt overhang episodes since 1800, and Reinhart and Sbrancia (2015), who studied short-term real interest rates between 1946-2012 in the context of the “financial repression” literature. A

47 Global war frequency similarly increases during 1870-2001. Harrison and Wolf (2012) argue that states are increasingly capable to wage wars: propped up by globalization and trade specialization, formerly poor and dependent states “can engage in risky behavior at smaller cost”.
separate body of literature has investigated historical real interest rates in the context of Wicksellian theory, but typically relied on UK data from the 1700s at the earliest (Shiller and Siegel 1977).

Nominal overviews of historical interest rate developments were most notably provided by Macaulay (1938), as well as by Kaufman (1986) and Homer and Sylla (2005). A key early study is provided by Billeter (1898). Epstein (2000) includes a general discussion of early modern European interest rates. Ferguson (2006) has compiled in detail leading bond issuer prices on a weekly basis for the great powers in the 19th and early 20th century. Both geographically and methodologically, however, these studies remain restricted, not least by failing to provide any high-frequency aggregation of their datapoints. Clark (2005) in an unpublished study discussed long-term real return trends since 1170, but used farmland returns and rent charges, rather than bond data, and focused on England only.  

Methodologies to establish real rates have differed. Naturally, studies restricting their data to the past few decades have offered the most nuanced approaches, and often opt for ex ante measures of inflation, typically incorporating inflation expectations such as those embedded in “inflation-protected” bonds (including King and Low ibid). To determine the “equilibrium” real rate, estimates of potential output are added, as in Laubach and Williams (2003). For longer time frames, and particularly for long-term bond yields, past realized inflation has typically served as a strong indicator of future inflation expectations, both empirically and theoretically (Shiller and Siegel 1977; Schwartz 1987; Bean et al. 2014; Mertens 2016). I focus here on seven-year moving average ex post real rates, an approach that is methodologically closest to Eichengreen (2015) – who uses a seven-year moving average of ex-post CPI to determine long-term real rates, Jorda et al. (2017, 9-10, 14-15), who use realized real decadal moving averages, as well as more confined approaches by Gagnon and Unferth (ibid), and Ford and Laxton (1999).

Flandreau et al. (2009) have argued that following 1688, short-term commercial bills of exchange constituted the “safe” market instrument and traded at lower interest rates than sovereign debt. Their arguments are noted here, but there is no evidence that their approach can be extended temporally and

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48 Some excerpts from Clark’s paper are published in Clark (2007, 167-175), as well as in Clark (2010).
spatially. Short-term debt remained unconsolidated in North Italy, and the yield curve was regularly inverted, signalling the higher risk and poorer commitment mechanisms. I note further than even today, the lowest-yielding asset is not necessarily synonymous with the “risk-free” instrument. My series is strictly not registering the “lowest yielding” fixed instrument available at any point in time, as for instance also Haldane (2015) chooses to do: the focus is on long-term asset homogeneity, and on sovereign “safe” issuers.

A few attempts to “splice” together historical nominal bond data do exist: in their classic, Homer and Sylla (ibid, 560) have also reported trends in “suprasecular” yield movements by splicing together data for the respective lowest-yielding asset from the 13th century. The resulting long-term chart remains very crude, however, relying on a total of 16 half-century datapoints. The authors never use primary or printed primary sources, and even the secondary source treatment remains in many ways very superficial, leading to various inaccuracies in the timing of interest rate trends. A real rate discussion is relegated to just four pages (1991, 429-432).

Haldane (2015) for his nominal chart equally uses the lowest-yielding asset, directly relying on Homer and Sylla’s (ibid.) data, splicing assets from the 16th century. Hamilton et al. (2016) present real data for 17 developed economies, but methodologically splice together individual country series, such as for the U.S. since 1857. They have posited a nonstationary process of global real interest rates since the 19th century with no discernible overall trend – but also find that “although apparently nonstationary, the real interest rate does exhibit a form of mean reversion in that episodes with real interest rates above 5 per cent or below -5 per cent proved to be temporary” (ibid., 690) – a statement that does not hold over the long term.

Various early authors have noted a declining tendency of nominal rates for their respective areas of specialization, and subperiods. Winter (1896) noted a trend fall in German municipal coupon payments

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49 As above, note for instance that Italian 10-year bond yields traded below U.S. counterparts for most of 2014-2018.
between 1200-1550; Pressnell (1960) noted a similar trend for English money market rates during the 18th century; Costa, Rocha, and Brito (2018) have found declining nominal rates in 18th century Portugal. Cipolla (1952) and Homer and Sylla (2005) have equally suggested that nominal interest rates have trended downwards for selected periods: “[T]he tendency of [nominal] long-term interest rates [is] to decline…the half-century trend of the minimum rates has been downward or flat for seven centuries” (ibid., 559). Similarly, Epstein (2000, 61f.) notes that “the Black Death saw a major change of trend in European interest rates which set in motion a gradual decline in the real cost of capital that lasted up to the eighteenth century…the fall in the expected rates of return and cost of capital for individuals was nearly as impressive”. Epstein (ibid., 27) argues that the “remarkable similarity and long-term decline of interest rates among the major Continental states indicates that the rulers’ autocratic and predatory impulses were kept in check by military competition”.

The existing literature, however, is marked by major methodological drawbacks. All existing accounts featuring a meaningful share of global GDP are confined to rather short time frames. Those featuring longer timeframes are exclusively confined to nominal data, and only feature individual countries. Even the most comprehensive effort to collect interest rate data – Homer and Sylla (2005) – suffers from an exclusive focus on nominal yields, and from major data gaps which restrict long-term comparability, and misstate long-term trends and timing: early modern data for Germany, Spain, and Italy ex-Venice are fully excluded, for instance.51 No previous study aggregates dispersed country-level observations into a long-term dataset encompassing a robust share of global GDP over time. No previous literature has systematically related such real rate data to related macro variables, including global population growth and real GDP growth over the very long term. All of the existing long-term data literature pre-dates the current “secular stagnation” episode.

My data disagrees with previously suggested general trends, most prominently Homer and Sylla (1991, 554, 557) at various crucial junctions, and also suggests different absolute figures: Homer and

51 See also my discussion of the German data above.
Sylla (ibid.) suggest stable nominal rates between the first half of the 15th century and the late 16th century; the most dramatic fall in nominal rates on their basis occurs between the second and the fourth quarter of the 17th century; they also suggest a flat trajectory between the early eighteenth and late 20th century on the basis of minimum rates. In contrast, my global data shows a significant fall in nominal rates in the 15th and 16th centuries (a reduction from 15% averages to 8%); from the late 16th century until the middle of the 17th century, a reversal is detectable, but the subsequent fall until the end of the 17th century is not dramatic; my average “safe rates” stands at 6.3% between 1311-2018: Homer and Sylla (ibid.) suggest average rates between 4-5% over time, just 4% over ca.1415-ca.1575, and rates consistently below 3% since the mid-17th century. We will see below that other evidence – for instance from wealth accumulation evidence between the mid-15th to mid-16th century – matches the series presented here far better than Homer and Sylla’s trajectory.

IV.B TRENDS AND INTERPRETATION

Figures IV, VII, and XV display “suprasecular” trends for the spliced real rate dataset. My data reveals a number of illuminating general features over the 707-year span: the average real rate since 1311 was at 4.78% for the safe asset provider; the average real rate in the last 200 years was at 2.58%. On both measures, therefore, current real rates (at 0.30% as of end-July 2019) are historically severely depressed, but in fact “in line” with historical trends (the mean historical 0.55%). The year-end 2017 real rate (0.81% moving average) was just within the 90th-percentile threshold for the lowest real rates across the dataset. 52

The average real rate has declined relatively steadily since the “bullion famine” in the late 1400s. In the early 14th century, double-digit nominal rates north of 15% are the norm across advanced economies, though England, where King Henry III’s interest rate ceiling of 45% remains enforced, stands out with

52 In 66 years since 1311, I record lower annual real rates than at year-end 2017, equivalent to 9.4% of observations. As with all following figures, I take the 7-year centered average basis.
higher averages (Bond 1840, 225f). The measured decline here holds true for the 100-year moving average, for the respective “century average”, and for a more granular seven-year moving average (Figure VII). The century-average peaked in the 15th century at 9.1%, and declined to 6.1% in the 16th century, followed by 4.6% in the 17th, 3.5% in the 18th century, and 1.4% (thus far) for the 21st century.

Despite the general downward trend, the tendency is not continuous. The long-term data allows us to put temporary reversals, such as that beginning in the mid-16th century into proper context for the first time: at various instances, the years following the 1557 defaults have been invoked as triggering a shift to considerable money tightness (Outhwaite 1966; Braudel 1972, 480ff.): here we may argue – witnessing the sharper reaction in “R-G” than “R” itself – that the “tightness” was driven more by the growth slide, rather than directly by rising credit costs. Aside, prior to the 20th century World Wars, the inflation shock of the 1620s – the Kipper- and Wipper crash in Germany – stands out for pushing real interest rates to their lowest value ever witnessed – but only until being surpassed by the War of the Spanish Succession.

The highest real rate on the single-issuer basis is observed in 1472, at 21.9%. During the late 1400s, the Italian city-states were faced with rising war expenditure, given the intensifying wars both between the republics themselves, and against the Ottoman Empire. More decisively, the Ottoman conquests of the Balkans cut off large mining areas, while escalating trade deficits drained bullion supplies. Unsecured private loan rates in England reached up to 100% during that time, and short-term sovereign rates reached up to 74% p.a.\(^{53}\) “The Great Bullion Famine” was already discussed by Keynes (1924, 162f.). In the controversy about a late medieval general credit shortage, my data generally supports the narrative advanced by Day (1978) and Nightingale (1997), and contradicts the opposing more recent view of Epstein (2000, esp. 61-68).

The lowest real rate ever was in 1917 (-11.3%), in the mature phase of World War I. This was associated with the sharp inflationary shock of British war time finance and government repression of

\(^{53}\) For commercial rates, see Nightingale (1997, 639). The corporate-sovereign spreads were obviously tighter, reported for the example of the London Grocer’s Company in the range of 10.4-15% (Ibid., 637). Bennett (1989, 249, table 40) found triple digit annualized commercial loan rates in London prior to 1420. The 74% refers to Maximilian’s refinancing as de facto Duke of Burgundy in 1490-1491, see van der Wee (1963, II, 110).
consol yields (Ferguson 2007, 442-453). World War II lows, at -5.0% in 1945 were not as low as the steep decline caused by the monetary growth that ended the “bullion famine” in the 1490s. In the 1940s, the post-war low preceded the de facto introduction of the 2.5% long-term yield cap, first enforced in November 1947 (Chaurushiya and Kuttner 2003).

Furthermore, the frequency of negative real rate episodes has been increasing over time. I record a total of 46 annual instances of a negative real rate since 1311. 29 instances, or no less than 63% of all negative real rate observations, have occurred in the 20th century – a significant increase compared with the four instances in the 19th century, and over the seven instances in the 18th century. The 17th century saw six instances, and not a single instance occurred on the global level prior to this (basis 7-Y centered average rates).

All-time year-on-year inflation rates for the safe asset issuer stand at 1.45%, with the 200-year average at 1.6%, and the 100-year average at 2.71%. Until the year 1800 almost half of all years (229 in total) recorded price declines; thereafter there was a pronounced return of inflation in the most recent period. In the very long run, inflation performance is in fact contributing significantly to the trend fall in real rates – which contrasts with the recent observation of Kiley and Roberts (2017, 318) that “the potential decline in the equilibrium real interest rate has been accompanied by a decline in the level of inflation expected to prevail over the longer run”. Current inflation targets of close to 2% are in fact below 100-year averages, but above all-time or 200-year averages.

The all-time trend decline in real rates for the safe asset issuer from 1317 to 2018 has been 0.92 basis points per annum (Figure VII). From its peak in 1472, the average annual fall in real rates has been 3.9 basis points. On a 500-year horizon, the average fall has been 1.5 basis points per annum. On the 200-year horizon, it has been 2.1 basis points per annum. The respective all-time annual fall for the “global” real rate stands at a higher 1.75 basis points (Figure IV).

Figures XIII and XIV display several historically plausible slopes for global R, safe R, and Safe R-G, which are extrapolated until 2080. The three trend slopes introduced in section II above are displayed, including the “North-Weingast” and “Post-Napoleonic” slopes.
One observation apparent in the figures is that in the mid-1950s, both safe asset and global real rates were both de facto at trend. Subsequently, a divergence began to unfold: the safe asset provider (here: the U.S. and Germany) accumulated a spread of up to 4.60% over historically-implied rates by 1985, with a temporary correction during 1968-74. Global real rates at first follow the implied trajectory more closely, before plunging during the oil shock episode. From the early 1980s, the divergence was as stark as for the safe asset provider, with the global real rate rising to a record of 5.1% by 1984. Since the mid-1980s, a gradual correction for both series back to the historical trend set in. In other words, the “secular stagnation” episode so often invoked to describe an unusual low-rate environment merely constitutes a multi decade mean-reversion. The really striking divergence from trend took place prior to the mid-1980s, when real rates drifted sharply upwards.

In 2019, the time of writing, the historically-implied safe asset provider real rate is 1.57%. For the global sample, the historically-implied rate is 0.70%. The actual value of the latter is 0.40% in 2019 – now only marginally below expected values. The historically-implied safe asset issuer rate is higher, therefore, than recent estimates, for instance in Roberts (2018), who posits a long-term “neutral” rate of 0.74% for 4Q-2017. While it therefore follows that U.S. real yields have around 80 basis points of upside potential to reach normalized levels, it follows equally that there is now no fundamental basis for expecting nominal rates to rise above 3.6% when inflation is “at target”. Global real rates, meanwhile, have normalized far more already than is usually acknowledged.

Crucially, on the basis of Figure XII we can observe that actual end-2018 global real rates are almost exactly in line with the mean estimate of historically-implied slopes (0.39% versus 0.55%). The actual clear deviations of global GDP-weighted real rates from historical trends over the past seven decades are visible during the 1960s, and especially during the 1980s and 1990s. Since the late 1980s, global real rates are slowly normalizing back to their historical trend-decline range.

From these extrapolations, it clearly does not follow that “the global equilibrium real rate may settle at or slightly below 1% over the medium to long term” (Rachel and Smith 2017, 37). In fact, within a generation, historically-implied global long-term real rates will have reached negative territory (starting in
2038): one key suggestion from my real rate series therefore is that on historical grounds there is little reason to expect real rates to “settle” at all: any plateauing of the global real rate at a predetermined level would imply a sharp break from past tendencies. And the historical record does not imply that any conventional policy action can generate a trend break.

Chart XIV goes on to display “Safe R” trends, as well as the resulting R-G series: in a sharp break from traditional historical relationships, we observe that all historical slopes now imply a sustained excess growth environment over real rates in the years ahead. Current “Safe R-G” as of 2018 has somewhat overshot, but was almost exactly “at trend” in 1974, 2005, and 2015. The financial repression dynamics accounting for the unusually negative R-G values during the 1950s are visible here as well. In this sense, advanced economies are in the coming years showing more and more “R-G” attributes usually associated with emerging economies (Escolano, Shabunina, and Woo 2017).

Generally speaking, these trends may suggest that since the long-term R-G trend decline is neither driven by financial repression, nor by unconventional monetary policy, as ELB episodes are becoming more frequent, the fiscal space to counteract such periods could rise in parallel.

Page 52: Figure XIII: Extrapolating historical global real rate (global R) slopes, 1950-2080.

followed by

Page 53: Figure XIV: Extrapolating historically-implied Safe R-G slopes, 1950-2080.
<table>
<thead>
<tr>
<th>Global R values (%)</th>
<th>End 2018</th>
<th>By 2025</th>
<th>By 2035</th>
<th>Turning negative by</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-time R slope (1317-)</td>
<td>0.349</td>
<td>0.227</td>
<td>0.053</td>
<td>Dec-2038</td>
</tr>
<tr>
<td>“North-Weingast” R slope (1694-)</td>
<td>0.816</td>
<td>0.729</td>
<td>0.605</td>
<td>Aug-2084</td>
</tr>
<tr>
<td>“Post-Napoleonic R slope” (1820-)</td>
<td>0.472</td>
<td>0.347</td>
<td>0.169</td>
<td>Jun-2045</td>
</tr>
<tr>
<td>Mean global slope</td>
<td>0.55</td>
<td>0.434</td>
<td>0.275</td>
<td>Apr-2053</td>
</tr>
</tbody>
</table>

Dec-2018: actual global R: 0.398%
Mean historically implied global R: 0.55%
Upper bound: “North-Weingast” R slope (1694-)
Mean global historical slope
Lower bound: All-time R slope (1317-)
### Table: Safe R-G values (%)

<table>
<thead>
<tr>
<th>Description</th>
<th>2018</th>
<th>By 2025</th>
<th>By 2035</th>
<th>Slope: fall bps p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-time R-G slope (1317-+)</td>
<td>-1.074</td>
<td>-1.171</td>
<td>-1.301</td>
<td>1.38bps</td>
</tr>
<tr>
<td>&quot;North-Weingast&quot; R-G slope (1694-+)</td>
<td>-1.210</td>
<td>-1.302</td>
<td>-1.432</td>
<td>1.30bps</td>
</tr>
<tr>
<td>&quot;Post-Napoleonic R-G slope&quot; (1820-)</td>
<td>-1.322</td>
<td>-1.422</td>
<td>-1.565</td>
<td>1.43bps</td>
</tr>
<tr>
<td>Safe R, implied (1317-)</td>
<td>1.573</td>
<td>1.509</td>
<td>1.417</td>
<td>0.92bps</td>
</tr>
</tbody>
</table>

---

**Actual 2018 Safe R-G: -1.8%**

**Historically-implied mean Safe R-G: -1.2%**

- "Safe R", implied trend (1317-)
- Post-Napoleonic "Safe R"-G slope (1820-)
- North-Weingast "Safe R"-G slope (1694-)
- All-time R-G slope, safe asset provider
- Safe R-G, actual
Are we living through an unprecedented period? Is the acceleration of the trend fall noted above the distinguishing feature of the past 30 years? In fact, I can identify at least five additional episodes since 1317 which exhibited a comparable acceleration of real rate contractions: in Figure XV, I show periods of at least 30 years length, which saw a compression of at least an average of 10 basis points per annum in safe asset provider real rates (an acceleration of the trend fall of at least 12x). These periods on average lasted for 38 years, and saw a total peak-to-trough real rate compression of 10.7%.

The most extreme precedent was the period 1379-1417, which witnessed a 58 basis point decline per annum, followed by the second half of the 17th century (27 basis points), the middle of the 16th century (23 basis points), and the four decades subsequent to the Congress of Vienna. I note that the “Long Depression” episode at the end of the 19th century saw a comparatively small trend fall.

What is the historical context of these episodes?

[1] – The late 14th century economy is still reconfiguring from the Black Death shock, but recurrent plagues and the scorched earth policies of the Hundred Years War continue into the 15th century; Abel (1953) in particular has analysed the late 14th century crisis phase, identifying a sustained fall in agricultural prices, but rising intermediate goods prices. Indeed, on my basis, average global inflation between 1360-1460 stands at just 0.65% p.a., compared to 1.58% in 1311-1359. However, the combination of high and rising real wages with falling real rates suggests a situation where, subsequent to the severe depopulation, capital per capita is highly abundant, and aggregate demand remains comparatively robust. Fixed investment trends, for instance proxied by the number of mills in England, confirm this picture (Langdon 2004, 21-31). The narrative here about lower borrowing costs in real terms contrasts with some of the literature, including Munro (2003c, esp. 229). Certainly, there is no dominant identifiable “precautionary savings” motive among contemporaries; and generally, charting long-term plague frequency against global real rates reveals various inconsistencies, not least considering the sharp rise in the late 16th century

[2] – the second half of the sixteenth century is commonly associated with

the sharp surge in silver imports from the New World, a relative decline of the importance of gold, a boom in debt activity, and the acceleration of inflation dynamics famously known as the “price revolution” across the entire Continent (Hamilton 1934; Spooner 1972, chapter 1; Munro 2003b). [3] – my third episode, 1669-1699, followed the Peace of Münster between Spain and the United Provinces, which prompted a trade and financial resurgence in the financial centres of Holland, and propelled Amsterdam and Antwerp to the forefront of international financial market activity (Dehing and T’Hart 1997). [4] The period following the Napoleonic Wars and the Congress of Vienna was characterized by political and price stability for the safe asset provider, the United Kingdom, as well as debt deleveraging (Hargreaves 1930; Hilton 1977; Ferguson 1998, 111-118). Finally, [5] covers the period of the “Long Depression”, initiated by sharp stock market sell-offs in the 1870s, and followed by a period of sustained deflation, with poor productivity performance across advanced economies (Fels 1949).

Figure XV: Real rate trend, safe asset provider, and the six real rate depressions, 1317-2018.
Interestingly, both the real rate, and the inflation rate have become less volatile over time. In the most recent 100-year timeframe, the average standard deviation for safe asset provider real rates stands at 3.77% (30-year centred average basis); over a 200-year horizon (1818-2018) it is 4.38%; while the all-time level is 10.2%.

I plot the standard deviation of the long-term real rate in Figure XVI to illustrate this finding. It can be seen that not only real rates in absolute terms, but also real rate volatility has exhibited a long downward trend since the early 1500s. Notable temporary spikes occurred during the Napoleonic War years in the early 1800s, as well as in the early 1900s, when real rate volatility began an ascent over a 30-year period, having reached new all-time lows in 1906. Since the Great Depression peak in 1934, the trend once more turned towards a reduction in volatility. It is clear that the “secular” changes in real rate volatility – paralleling the trend in absolute performance – long preceded the 1980s “inflection point” often cited. In fact, every century since 1500 recorded a lower standard deviation, irrespective of particular monetary regimes. On average safe asset provider real rates’ standard deviation has fallen by 2.7 basis points per annum, the global one by a more moderate 1.2bps. Overall, my observations for the standard deviation during the 20th century are lower than those suggested in Kiley and Roberts (2017, 319ff.), who report a steady-state nominal interest rate standard deviation between 1960-2017 of 325 basis points (my nominal global STDev 1960-2017: 2.92%).
V. GENERAL REMARKS, ROBUSTNESS, LIMITATIONS

Various factors should be kept in mind when considering very-long term interest rate aggregations, many of them related to the nature of early modern public finance, some related to my choice of data. Here I discuss some of the most relevant of them.

For one, while this paper is concerned with cash interest rates, in early modern states public finance depended not just on bilateral cash transactions, but on in-kind transactions which saw advances being repaid in “chicken”, “fruit” or grains, in offices, in income streams from customs duties, and in the entitlement to other privileges. These forms are particularly important for the regional level, and – to the extent that one is rather interested in “total financing costs” – could bias the country-level aggregations in
case implied interest rates on these transactions differed sharply from cash interest rates. Krueger (1980, 230), for instance, has made an attempt to calculate implied interest rates on “fruit” credits in Hesse, reaching yields meaningfully above cash rates (11.3-27%). At the same time, however, he shows that the share of such transactions in the overall debt in Hesse by the mid-16th century stands at 12.5% (ibid., 478). Another 16.2% of debts are registered as “pawned offices”. 71% of debt outstanding was recorded as being on a cash basis. Such evidence suggests that when considering “total financing costs”, early modern financing terms are likely biased somewhat to the downside in my sample for the 14th and 15th centuries for non-municipal inputs. Therefore, a “total financing cost” slope taking into account such transactions would in all likelihood generate a steeper overall downward R fall.

Secondly, in case Allen’s (2001) inflation basis contains significant biases, the long-term real trends could potentially be sharply different. How likely is it that fundamental biases exist? In Figure XVII, I vary price indices to test robustness. I construct six alternative time series on the “global” basis, each with a different inflation basis. The series have the following properties:

- V0: original, “preferred” series: German inflation between 1326-1750 as average of rye price index averaging Abel’s (1978, 308-309) decadal data, Wuerzburg prices in Elsas (1936), Nuremberg rye inflation in Bauernfeind (1993), and, between 1326-1600, Hannover rye prices in Unger (1752, via OeStA HHStA MEA Muenzsachen Box 8).55
- V1: original series, German inflation from 1500 replaced by German price inflation in Pfister (2017).
- V2: original series, German inflation from 1428 replaced by average of German-speaking Allen (2001).
- V3: original series, Italian inflation between 1311-1800 replaced with Malanima (2011) price index y-o-y.

55 Note that Allen (2001) relies partly on Elsas (ibid.) for his values, but not on Wuerzburg. The Unger (1752) rye prices in gold Gulden are transformed into silver prices via Soetbeer’s (1879, 118, 123) and Watson’s (1967, 24f.) gold-silver ratios for Germany, and using the gold content of the Rheinflorin over time in OeStA FHKA Beeriana 01/3a-1. The Unger (1752) and Abel (1978) series are linearly interpolated.

• V5: original series, Holland inflation between 1450-1800 replaced with Western Netherlands price index y-o-y in van Zanden (2017).

• V6: original series, France inflation between 1432-1788 replaced with Paris wheat price index y-o-y in Baulant (1968).

Figure XVII: Global real rates: “preferred” inflation basis (V0), and alternative inflation series, 1317-1800.

Each alternative series between 1317 and 1800 displays a downward trend relatively close to the “preferred” headline series, falling between 1.82bps – 1.95bps p.a. Particularly Baulant’s (V6) series exhibits higher volatility and half a dozen additional negative rate incidents (the late 17th century French
grain price shock stands out), but otherwise we can conclude that price index variations have little effect on the aggregate trends identified.

Thirdly, one may speculate that particular countries drive the downward trend, and that changes in the composition or weights may qualify the results. To explore this, I decompose the aggregate series into all eight individual countries, charted in Figure XVIII. It is observed that the downward interest rate trend holds across geographies. Each country exhibits a trend fall over time, ranging from 1.16 basis points per annum (Germany) to 4.56 basis points (U.K.) p.a. The United States (2.1 basis points p.a.) and Japan (2.3 basis points p.a.) represent the median long-term sovereigns. The decomposition illustrates that rearrangements for the sovereign “safe asset provider” (e.g. substituting the U.K. for Holland during the 1600s) would influence the slope of our trend fall for certain subperiods – but would have no fundamental effects on the overall tendency of the dataset.

Some country-specific comments are in order: England exhibits notably elevated real rates over the entire early modern period. One factor for England’s “insularity” is the absence of annuity contracts (or any “census”-based variants) there until the 17th century, and the country’s preference for “obligation” agreements, in contrast to all other countries (Postan 1930; Tracy 1985, 7-8). But the high de facto rates for Edward III and his successors are confirmed by a number of different authors, and do not appear to be a consequence of source bias or interpolations. Hansen (1910, 402) reports that North German merchants lent to the Crown at 25% and even 65% in 1339 and 1347, respectively, but that the Bardi and Peruzzi between 1308 and 1337 achieved average returns on capital lent of 20%. Fryde and Fryde (1963) reported rates of 26%, but based on the criticism of Bell, Brooks, and Moore (2009, 418f.) the figure should be adjusted to an annualized 41.4%. These are higher rates than those we find on the Continent, where personal nominal loan rates above 20% are rarer. If one wanted to treat the U.K. as an outlier though and fully exclude the country until the year 1500, it would be observed that the all-time trend fall for the “global” real rate sample would moderate to 1.44bps p.a. – clearly a decisive variation. But the justification to exclude the U.K. seems nevertheless weak: the Crown was very well integrated into the pan-European personal loan business through the early medieval age, and the country remained a key hub
for global trade and financial exchange from these days, despite its relatively small real GDP share in the full sample of 9.7% for 1317-1500.

Figure XVIII: Real rates: country decomposition and trend fall, 1317-2018.\(^{56}\)

A further robustness check entails querying the plausibility of the new data against the background of other existing narratives. To some extent this is done above, assessing previous “real rate depressions” in the historical context. Figure XIX represents another case study: here I overlay global real rates with a series of English debt volumes contracted in the 14th and 16th centuries, compiled by Nightingale (via TNA 2004). If the real rate series is to stand scrutiny, it needs to correspond plausibly to such related quantitative testimony. Fortunately, in this case, this seems to work relatively well: without exploring further the possible channels of causation, one notes for instance the strong symmetry around 1379-1380 when a sharp rise in global real rates coincides with a sudden reversal in debt volumes contracted in

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\(^{56}\) Y-axis maximum and minimum adjusted for presentational purposes.
England; approximately 100 years later, a pronounced multi-decade fall in global real rates corresponds with a strong recovery in debt activity in England, to levels – in both cases – last seen in the century prior.

**Figure XIX:** English credit volumes versus global real rates, 1314-1530.\(^{57}\)

WEIGHING MUNICIPAL AND TOP-LEVEL RATES: RELATIVE IMPORTANCE

Here I test variations of the municipal-toplevel shares, to assess if and how an “average observed” approach (followed in the preferred series prior to 1618 except for Germany) differs from wealth-weighted approaches. Obviously, we are dealing with a dual mode of public finance in the early modern period, characterized by relatively regular, structured, and harmonized municipal financial operations.

\(^{57}\) English credit volume: annual debt volumes calculated on basis of Pamela Nightingale/TNA Study 4997 (2004), Class C 131. For discussions of the credit data see (Nightingale 2004; Goddard 2016, chapter 3).
based on Ewig- or Leibrenten – a consolidated debt “stream” – and secondly, by an ad hoc practice of
borrowing from merchants, bankers, or contacts in extended personal or professional networks, mainly
resorted to by political figures in the princely realm, rural nobles, by the Emperor himself, and by
ecclesiastical executives – an unconsolidated debt “stream”. Though in practice, of course, such a
delineation remains a simplification, a number of authors have fallen back on the distinction between
“princely” and “municipal” finance as a key characteristic of the early modern financial system (i.e.
Kostaneki 1889; Ehrenberg 1922, 18ff.). Indeed, regional dukes and bishoprics clearly do engage in
Guelten and other census contracts. But it is not a dominant form of capital raising, as more detailed
breakdowns of regional and princely finances document (Droege 1966; Zmora 1996). It is equally clear
from the wide body of municipal evidence that Carolingian cities engaged in few ad hoc loan operations
prior to the Thirty Years War, typically only resorted to during major emergencies. From 1618 onwards,
the devastations of war distort the character of municipal finance: across the country, cities scramble for
funds to pay retributions, or restore military damage, while their traditional tax base erodes; bankruptcies
such as the well-traced case of Noerdlingen – up to that date a net creditor to princes and regional rulers –
abound in all parts of the Empire (Kaphahn 1912; Friedrichs 1979, chapter 5). Hence, from this date I
return to an “observed average” of interest rate datapoints for all countries without centralized
consolidated debt.

When a sensible weighting of fixed renten and personal loans – of consolidated and unconsolidated
interest rates, in other words – is undertaken, in order to try to arrive at a “toplevel” weighted interest rate
for the period – it is posited here that treating municipalities as the “fixed renten” share of the public debt
market, and the remainder as the personal loan share, represents the best approximation. How might one

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58 Absent aggregate compilations in the literature for different forms of credit activities grouped by cities and
territorial rulers, one has to fall back to case studies. See Winder (2012) for the loan surge in Austria 1521-1612; for
France, see Bonney (1978, appendix II); for Saxony Schirmer (2006, 196f.); Rankl’s (1976, 65) data shows that by
1514 interest-bearing loans equally dominate for the Bavarian princes. For Holland, rural, noble, small village and
cloister rent issuance combined accounts for less than 8% of total rent issuance by the mid-16th century. Some
Flanders/Brabant/Burgundy towns struggle well into the 16th century to establish a deep annuities market. See van
arrive at plausible relative financial market weights for both, though? A recourse to urbanization rates is a useful first approximation, but should be amended with wealth evidence, since not only indebtedness and financial assets per person are significantly higher in urban areas than at the regional level, but also movable wealth as a percentage of total wealth is higher in urban areas (i.e. among various examples Herlihy and Klapisch-Zuber 1985, chapter 4; Gilomen 2018, 64).

The solution to plausible aggregate shares thus lies in early modern tax registers. Beyond limited annual contributions from Jews, free and imperial cities (“Freie und Reichsstädte”) and shares in customs duties (to the extent they were not pawned), the Holy Roman Emperor lacked any regular tax income during the 14th to 16th centuries (Isenmann 1980). To remedy shortfalls, at multiple occasions the imperial executive – after tedious negotiations with the other municipal, ecclesiastical, and lay stakeholders – resorted to one-time collections, known as the “Common Penny”, or special aid levies to raise mercenary forces against Turkish or Hussite advances (Schmid 1989; Lanzinner 2012). These taxes were directly assessed on the basis of interest and Guelten income; if resorted to a wealth assessment, renten and Guelten formed the key taxable item: “immovable wealth” such as real estate was equally assessed on the basis of its interest or Guelten yields (Schmid ibid., 37f.; Lanzinner ibid., 270f.), a method that allows some general approximation of total assets to income: total financial assets of all census-based variants (Guelten, Erbleihen, Leibrenten etc.) in Germany by 1500 could have been between 136-242% of GDP. This would be a significant size when one considers that the U.S. only reached a comparable

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59 Other important sources of income were fines and the assignment and renewal of privileges – these did not however assume any regular or predictable character (Isenmann 1980/1, 18-69).

60 Isenmann (1980/2, 166) provides some valuable details for the 1471 tax assessment: at the Reichstag in Regensburg, a total yield of 4m Gulden was anticipated. Based on the 10% stipulated tax on renten and Guelten income, Isenmann (ibid.) suggests an annual Empire-wide renten and Guelten income of 40m Gulden, and a wealth stock of 800m Gulden at a 5% capitalization. If we take a per capita GDP of 24.5-42.9 Gulden for 1500 – a level 11% below the Mediterranean average of Braudel (1972, 460; the 11% figure being the difference of Maddison’s average for Spain, Italy, France, and Turkey on the one hand, and Germany on the other, for 1500, taking 1 Ducat=1.376 Gulden) and a German population of 12m (Maddison ibid.), we reach the asset/GDP range. Such calculations obviously involve various simplifications: the 4m sum likely includes “Kopfsteuer” (poll taxes) from paupers and artisans, as well as the taxes on corporate profits (which capitalized profits at a 4% rate), and have an upward bias, therefore. Cash assets, for one, were not assessed (ibid., 164f.). But the GDP per capita level is a generous assumption biasing the total asset ratio downwards somewhat. My data here of course suggests that a simplistic 5% capitalization is inappropriate, which in turn would bias the total financial asset level downwards (my German nominal rate for the 1470s stands at 9.04%, which implies a capitalized asset stock of 426m Gulden).
financial asset/GDP ratio by the 1970s. Wealt was self-assessed on the personal level, with priests and other local authorities in some regions being asked to confirm the general validity. Against that background, the taxes sourced from the different Reich classes likely represent the best approximation of respective shares in aggregate financial assets, though some general underreporting would occur if one was interested in tracing absolute wealth amounts.

Four datapoints from the “Common Penny” and levies in 1495, 1521, 1545, and 1571 exist. In 1495, after tense negotiations, the municipalities agreed to a 24.5% share in the overall 100,000fl emergency levy to counter the French invasion into Italy (Schmid ibid., 115). In 1521, the municipalities were assessed with a 23.9% share (30,300fl out of 127,000fl monthly total); in 1545, the share was 23.6% (22,150fl out of 94,000 monthly total); in 1571 the share was 21.5% (Lanzinner ibid., 283). For pre-1495, I have taken the average of Gilomen’s (ibid) Swiss datapoint and the German 24.5% share for 1495, resulting in a 33% municipal wealth share; the remainder of the German weight (i.e. 67% for pre-1495) is then formed by the personal sovereign loan series.

In general, the German rates should come close to a weighted “global” average based on relative urbanization rates (Allen 2000, 8f.). Though some regions within Northern Italy record even more elevated levels (Herlihy and Klapisch-Zuber 1985, 94), on the sovereign level Holland should give an idea of the “upper bound” municipal share: Terdenge (1925, 96f.) reports wealth tax shares in Holland which imply a municipal share of 40% in 1426-1427, and 45.2% in 1462. The municipal share then appears to peak north of 60% around the mid-16th century. Tracy (1985, 202f.) reports that in 1631, the city of Amsterdam accounted for 39.4% of Holland’s wealth, based on a similar tax scheme to finance the wars with Spain. By 1671, Amsterdam’s share had fallen to 32.9%.

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61 According to the Fed Board’s Z.1 statement, total financial assets/GDP of the U.S. crossed the midpoint of the above estimate for 1500 in late 1971.
62 The basis being the “shildtalen” tax. For municipal share in 1462, I add “Dordrecht and South Holland” (6100), plus the other large cities (18700 pound), out of a 54,900 pound total.
63 Van Zanden (1995, 651) shows a multiple of 4.1 of municipal versus countryside rental values in 1561, his proxy for overall inequality and wealth; the Amsterdam-countryside ratio in particular is 7.5. Assuming a 16% population share of Amsterdam (cf Tracy 1985, 203), this would even imply a wealth share of 60%.
Figure XX displays individual nominal rate series, focusing only on the German variations. It can be observed that municipal rates exhibit significantly lower volatility than personal loans over time. Risk events, such as the Peasant Wars in the 1520s, leave traces mostly in the personal loan series, but are almost completely undetectable in urban rates. This behaviour of municipal rates matches other evidence and is explained by the fact that municipalities could resort to the levying of taxes among their citizenry during times of distress – rather than having to pay steep penalty rates (Friedrichs 1979, chapter 5; Isenmann 2018). Such resort was not possible for the Emperor – who, as we have seen, had to bargain for funds in tedious negotiations – and many of the regional dukes and prices. The German situation is echoed in many other parts of Europe, including Holland (Terdenge 1925, 123-134).

Figure XX: Country-level weighting: municipal and personal sovereign loans, German nominal rates, 1320-1618.
We see that the downward slope for personal loans is almost double the municipal trend fall (-1.36 bps p.a.) during the period, but that switching to an “average observed” basis for the pre-1618 period – while flattening the nominal trend fall by 0.07bps p.a. between 1326-1618 – would not change any of the basic characteristics of our series.

Finally, the German region of Hesse between 1500-1567 represents a suitable case study to highlight secondary aspects, mainly to illustrate how future refinements of aggregate global series could be undertaken. Krueger (1980) has collected price data which can be used to create an “Allen-equivalent” CPI basket. I use Allen’s (2001) weights in Figure XXI to deflate the regional archival interest rates, and to compare the German “toplevel” private R data with evidence from the regional level.\(^{64}\) We see that across interest rate and inflation bases, a good degree of homogeneity remains, though the 1% difference over the period suggests limits to the market integration between regions and municipalities, and though one would like to draw on further case studies before generalizing.

Of interest should be the calculation of implied interest rates in mixed or exclusively “in-kind” transactions, also displayed in Figure XXI – the first time to the knowledge of the author.\(^{65}\) It is quite wrong to assume, as for instance Chilosi, Schulze, and Volckart (2018, 643) do, that early modern investors had no concept of real interest rates; that “when deciding where and at what interest to invest their capital, pre-modern investors had little choice but to use nominal rather than real rates”.\(^{66}\) Mixed cash-commodity debt is a prime example to put doubt on such claims. We have plenty of related evidence that points towards a proper understanding of real versus nominal dynamics: merchants and artisans guilds in Nuremberg and Augsburg, for instance, complained regularly in the 15\(^{th}\) century that rising

\(^{64}\) The only key basket difference relates to Allen’s “fuel”, “candles”, and “oil” components, which I have subsumed under the “wax” price series in Krueger (1980, 390) with a 14.6% basket weight. For the “bread” component, I average Krueger’s (ibid.) prices for rye, oat, wheat, and barley.

\(^{65}\) I am only aware of Heimpel’s (1966) in-kind calculations for Biberach hospital contracts as the closest attempt. See also discussion in Dirlmeier (1978, chapter VI.3). Heimpel finds even higher premia for in-kind implied rates than I do here, rising up to 25%. Beyond, there are occasional ad hoc references: Outhwaite (1966, 302) refers to an estimate via Richardson (1953) regarding an English Crown loan in Antwerp featuring commodity payments that yielded 18%, compared to a 12-14% cash rate. It is not clear that these loans were frequent for the English Crown, but the spread suggested is plausible in light of the figures presented here.

\(^{66}\) See also the appendix, pp.201-202, for relevant points in the context of Fisher’s (1930) arguments.
prices eroded their fixed-contract nominal income, and offered price discounts when transactions were
paid in gold gulden (Dirlmeier 1978, 222).

Below I have collected transactions in Hessian archives which feature at least in parts annual interest
payments in commodities (here mostly in wheat, rye, and chicken). The closest contemporary instruments
are inflation-protected bonds such as TIPS. Recall that Krueger (ibid., 478) suggests that around one-
eighth of public debt outstanding in Hesse by the 16th century is contracted on such an in-kind basis;
estimates for other regions find shares of 25% and higher.67 The view of widespread money scarcity
during this period remains entrenched – however, compared to the 15th century, during the “Century of
the Fugger”, the European coin and bullion shortage had notably eased, and it is marked by a transition
from gold towards high-velocity silver transactions from the 1550s (Spooner 1972, chapter 1) – it is quite
plausible therefore that the popularity of in-kind contracts genuinely represents a desire to target real
returns, rather than being necessarily a consequence of money shortage. One finds mixed cash-in-kind
loans on the imperial level at least until 1498, too, for which some implied rates have also been
calculated.68

67 Andermann (1991) records significantly higher in-kind shares for some rural properties in the German South-West
as late as the 1590s, though the trend is equally in favor of cash here. He does not provide implied interest rates.
Sicken’s (1982) figures are closer to Krueger, showing less than 25% in in-kind income for two Bavarian regions in
the mid 16-th century, versus two-thirds in cash.
68 See Reg Imperii, XIV, 2, no. 5896, for a loan from the Bishop of Augsburg to Maximilian I, featuring annual
payments in salt (100 Fuder), next to 1000fl cash interest. I have valued the salt payments at 44.94fl p.a., implying a
total rate of 4.75% p.a. For salt prices, cf. Pribram (1938, 454). Another example is Reg Pfalz (Ruprecht III, 4506),
which would translate into a total 12.7%p.a. rate, if one takes wine and corn prices in Reg Pfalz (Ruprecht III,
3199).
I find a number of double-digit effective “in-kind” real rates over the period. It appears that on average these levels are slightly higher than pure cash rates (for Hesse 1501-1568: in kind average private R: 5.75%; cash average private R: 4.55%). This suggests that if one were to calculate “total effective real interest rate trends” – a series outside of the scope of this paper – a somewhat steeper trend fall should emerge prior to the late 16th century, but that this effect may be partly offset by fully including (and ideally GDP-weighting) regional-level markets. In a similar spirit, implied interest rates from tariff income streams are a fully ignored aspect thus far. Mainly relevant for the 14th and 15th centuries, combining registers with the tariff revenue data in Troe (1937) does at least permit some general observations, though certainly no high-frequency series.

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69 Hesse inflation rates constructed on the basis of Krueger’s (ibid., 362-392) tables, applying Allen’s (2001) basket weights. Hesse interest rates on the basis of HHStaW and HHStAM, including in-kind payment cases recorded in HStAM: Fonds Urk. 49 No 3289, Fonds Urk. 37 No 3440, Fonds Urk. 49 No 3289, Fonds Urk. 15 No 484, Fonds Urk. 56 No 1398; HHStaW Fonds 352 No U 37; UniA Marburg Fonds Urk. 91 No 240 (‘Henne Fischer’ entry).

70 One can derive, for instance, a nominal interest rate of 8.82% p.a. from a transaction between the Archbishop of Trier and a group of Jewish lenders in 1345, to whom the Koblenz tariff revenues were pledged for three years. See Troe (1937, 145, taking the midpoint of the 900-1000 pound heller annual revenues).
Finally, an important robustness aspect deserving more detailed discussion than given here is the phenomenon that in times of financial market distress, we repeatedly encounter reports that potential creditors, rather than adjusting lending rates to reflect higher default risks from their counterparties, simply refuse to participate in lending per se. Outhwaite (1966, 302f.) describes Thomas Gresham’s difficulties to borrow at any terms from 1561 onwards: “For that here ys no mony to be hade apon Interest at no prys”, even though previous transactions suggest the Crown was flexible to offer unconventionally high rates, for instance via commodity supplements. Outhwaite (ibid.) correctly observes that “we have the interesting situation in which the rate of interest on royal loans fluctuated less than the merchants’ willingness to lend at a given rate”. Generally, such observations are far too infrequent, however, to validate Temin and Voth’s (2005) conjecture from British 18th century observations, that adjustment from the credit supply side dominated under binding interest rate restrictions. My observations in the context of “financial repression” factors are relevant to such posited market distortions.71

VI.B COMPARABILITY, AND SAFE ASSET STATUS

Does it matter that my dataset encompasses institutional and political entities spanning a range from 15th century city-republics, to (constitutional) monarchies, to modern democracies? Certainly, the institutional, political, and monetary regime changes over half a millennium of data should be a matter for close scrutiny (Eichengreen and Sussman 2000).

First, however, note that the only key institutional and monetary regime change in fact concerns the “relatively recent” switches from bullion monetary regimes, to the intermediate gold-exchange standard regime during the interwar and Bretton Woods periods, followed by the modern floating fiat money system (Obstfeld and Taylor 2004, 33-41). In contrast, the period from the 14th to the early 20th century exhibits a highly consistent adherence to either pure silver or gold, or mixed gold-silver standard regimes

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71 See the appendix discussion, pp.203-204.
(Eichengreen and Sussman 2000; Redish 2000). The switch from bullion-standard to fiat money regimes has not led to any serious comparability concerns about real rate studies covering this transition (Hamilton et al. 2016; Jorda et al. 2017) – nor should it. It is obvious that hypothetical inflationary biases (confirmed in absolute amounts and in volatility terms in Figures VI and XVI) do not impact conclusions drawn for real rates, given the transmission of higher inflation expectations onto nominal yields, in line with the classic Fisher equation (Fisher 1930). At least since the time of Henry Thornton (1811), it has been understood that

“…in countries in which the currency was in a rapid course of depreciation, supposing that there were no usury laws, the current rate of interest was often…proportionately augmented. Thus, for example, at Petersburgh, at this time, the current interest was 20 or 25 per cent, which he conceived to be partly compensation for an expected increase of the depreciation of the currency”.73

Later, these insights were theoretically formalized and refined (Fisher 1930; Wicksell 1936). The preferred inflationary monetary tools in early modern economies – debasement operations – are documented across early modern and modern regimes alike, and include the UK in the 19th century (Rolnick and Weber 1997; Reinhart and Rogoff 2009, 174-179).

More important, hence, is the confirmation of credible commitment mechanisms that have assured the appropriate feed-through. I therefore pre-select assets to focus exclusively on issuers where the existence of credible commitment mechanisms is documented and consensual – with the effect that none of my chosen “safe assets” featured a principal default event throughout the entire timeframe, and all my chosen markets attracted strong participation by international investors. The global series, meanwhile, features a handful of default events, therefore enabling an approximation of the sovereign “risk premium” over

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72 For long-run data on early modern currency composition, see Spufford (1988, appendix III), and Munro (2003b).
73 Cit. in Schwartz (1987, 153).
time. Furthermore, all assets chosen – for both the safe asset provider and the global series – consist exclusively of long-term secured instruments.

For the Italian city-states – which represent the inception point for the dataset in the 14th century – economic historians are today clearly postulating reliable institutional commitment mechanisms. As Epstein (2000, 26) argues, the city-republics enjoyed the lowest yields in Europe and their “public debt derived its success from the fact that the main lenders were also members of the elite…as the low interest rates on offer reveal, the system worked because it aligned the creditors’ and debtors’ incentives. Lenders and borrowers had a joint stake in ensuring repayment and, more broadly, in ensuring the borrowing city’s political and financial stability”. The same overlap between debtor and creditor incentives ensured that “early modern Genoa was a true paradise for savers” (Pezzolo 2003, 154).

For Spain, Drelichman and Voth (2014, 7) have shown that there existed a “first-rate system of public finances”, where “revenues, expenditures, and debt issuance were managed at least as responsibly as in Britain, France, and the United Provinces at the height of their powers, if not more so”. Fratianni and Spinelli (2006, 259f.) represent a common view in arguing that “the North-Weingast commitment mechanism was just as present in the United Provinces of Habsburg Netherlands as it was in the England of the Glorious Revolution: legitimate governments that can tax credibly can commit to pay their debts”. The commitment mechanism for England from the 17th century itself is equally undisputed, with some authors even arguing that “secure property rights existed in England at least as early as 1600, and probably much earlier. As far as private investors were concerned, nothing special happened in 1688, or, for that matter in any period between 1600 and 1688” (Epstein 2000, 18).

74 The relevant “default” events on long-term assets concern primarily the French defaults in the 16th century, the French Revolution, and the British Restriction period. The interwar hyperinflation period for Germany and Japan is excluded as discussed in detail below. For France, see Bonney (1999), who counts six restructuring events during 1591-1797. Some German restructurings in the aftermath of the Thirty Years War documented in Kaphahn (1912).
75 I discuss commitment mechanisms primarily in Part IV. For evidence of the robustness of the Italian republics’ commitment mechanism, see equally Fratianni and Spinelli (2006), De Lara (2008), and Stasavage (2011).
76 A view shared by Tracy (1985), Neal (1990), and more recently Zuijderduijn (2009).
VI. LONG-TERM GROWTH AND DEMOGRAPHIC RELATIONS – TOPOLEVEL EVIDENCE

Numerous authors have explained the trend fall in real interest rates since the 1980s with reference to demographic or growth factors. As Baker, DeLong, and Krugman (2005, 315) sought to demonstrate, “over the long run, rates of return on assets are correlated and causally connected with rates of economic growth...only in stock market bubbles can capital gains diverge widely from economic growth, and then only for a little while”. Gordon (2016) – who takes a historical perspective extending back to the 19th century – is most commonly associated with the thesis that secular productivity trends explain recent real rate developments. Similarly, even though Rachel and Smith (2017) are generally dismissive of a major role for growth factors, they attribute a quarter of the fall in real rates since the 1980s to weaker global growth prospects (ibid., 14).

Studies including Hansen (1938) and Gagnon, Johanssen, and Lopez-Salido (2016), have suggested a meaningful role for population growth factors in the determination of real interest rates, as slower population growth reduces the marginal product of capital and labor (assuming both are complements), thus reducing capital returns, and real rates.

Against the background of these arguments, I proceed in this section by investigating the (very) long-term correlation between growth and real rates, and between demographic change and real rates, respectively. I test correlations for both pairs on the single-issuer, “safe asset provider” basis, and for the global sample of advanced economies, employing various lags and moving averages. In all but three possible combinations, I find a negative correlation between real rates and either demographic change or real GDP growth over the very long term.

Surely there are more sophisticated ways to statistically test underlying correlations, but the general observation here is that a simplistic high-level parallel evolution of growth rates and real rates is not detectable. Trend breaks in growth rates do not overlap well with those in interest rates, and this is equally...
true for country-level observations. The general trend of relatively muted real GDP growth rates until the mid-18th century, followed by a subsequent acceleration is well documented – even though most (very) long-term studies continue to be either restricted to individual countries, or omit high frequency year-on-year data (Clark 2008; Maddison 2010; Malanima 2011; Alvarez-Nogal and Escosura 2012; Broadberry et al. 2015). Broadberry and Fouquet (2015) have offered a recent long-term aggregate growth overview more nuanced than previous studies, in which they reject the simplistic narrative of a “stagnant millennium” prior to the take-off associated with the Industrial Revolution.

![Graph showing correlation between real rate and real GDP growth](image)


Figure XXII: Correlation real rate – real GDP growth, safe asset provider basis.

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77 In reduced form the problem is already apparent when one compares Homer and Sylla’s “best credit” rates (1991, 554) by half-century with underlying growth rates. Spain, for instance, is considered the “best credit” issuer in the 15th century – at a time when the economy records among the lowest per capita GDP in Western Europe and is stagnant trend-wise (Broadberry and Fouquet 2015, 230).
I use the same overlapping country-sets for the single-issuer and advanced economies correlations, already introduced in the real rate data selections. Figures XXII, XXIII, XXVI and XXVII display long-run trends on the simple seven-year centered average basis. On this basis (Figure XXII), the all-time correlation between seven-year centered average real rates, and seven-year centered average year-on-year real GDP growth is de facto non-existent (between -0.058 and -0.064), testing Maddison’s (2010) real GDP data against some of the more recent country level series.


Figure XXIII: Correlation real rate – real GDP growth, global basis, 1317-2018.
On the full global basis (Figure XXIII), the correlation is more clearly negative (-0.37), exhibiting a more pronounced rise of real GDP particularly from the 18th century, against an accelerating real rate trend decline. The same negative correlation is obtained by using 3- or 13-year centred averages, or if either series is lagged 2 or 4 years. I also test against alternative “global” series composed on non-Maddison data (“Individual G”), obtaining a similar negative correlation (-0.45).

This may at first be a surprising result. Even when we allow for merely an indirect channel from real GDP growth to interest rate developments, in particular via capital accumulation, we should probably expect a bigger effect. There may be several reasons why the general growth series present in the literature do not suit our purposes here – issues which may also point towards problematic assumptions present in such early modern growth accounting.

Capital accumulation factors must certainly assume a key role in the explanation. This is not the place to address comprehensively the paucity of in-depth studies on early modern capital accumulation trends. Several previous authors have drawn direct links between falling interest rates during particular periods and capital volumes – but usually in the most general terms, and without the evidence of any empirical exercises. For instance, Neumann (1865, 260) attributes the fall in Prussian interest rates during the 16th century to “steigende[m] Kapitalverkehr” (rising money circulation). Strieder (1904) is a notable exception for his rigorous micro-study of the evolution of German merchant fortunes, which documented how patrician families began accumulating significant volumes of trade profits by the late 15th century.

Common laborers and small artisans according to some anecdotal evidence did by all means save a portion of their income; and supplementary in-kind income sometimes allowed substantial savings rates. Dirlmeier (1978, 92-94) reports some savings rates for municipal household servants between 46-75% in the early 16th century. Only in four out of 15 cases, servants accumulated no savings or accumulated net debts.

Yet it is doubtful that low-skilled workers in general, particularly in non-urban areas, were able to save in such proportions, and were able to drive aggregate debt demand. Various German banks, for instance, only accepted minimum deposits of 10fl, equivalent to 3-4 monthly gross salaries of middle class artisans
(Maschke 1967, 36; Dirlmeier 1978, 176ff); Sturm (2009, 82) finds that between 1550-1750 in Hannover, 77.7% of creditors in private debt were upper class citizens, particularly merchants, with a further 22.3% belonging to the middle class. But we have examples of meaningful middle class creditor activities, including from the city of Speyer (Maschke 1967). GDP series that typically base general output estimates on combinations of agricultural goods consumption and artisan wage rates (i.e. Allen 2000; Malanima 2011; Alvarez Nogal and Escosura 2013, appendix 1) therefore must lead to a misleading picture of actual capital accumulation trends, since increments around subsistence or even (lower) middle class levels – just like increases in “in-kind income”, which could reach 40-70% of total income for lower-classes (Elsas 1936, 60-63, 707-776) – had no proportionate effect on financial asset demand; though still imperfect, a better correlation should be obtained when collecting time series on aggregate merchant profits, or on urban wealth levels, as a proxy of asset demand.

And indeed, the case of Augsburg, for which tax records allow a relatively detailed tracing of wealth levels between 1467 and the 1700s, suggests a strong plausibility of this channel. Figure XXIV displays the evolution of per capita real wealth in Augsburg – one of the leading merchant hubs on the Continent, and not least home to the Fugger, Rehlinger, and Welser merchant empires. Splicing together the tax return data in Hartung (1898, 1283), Strieder (1904, 28), and Mayr (1931, 12ff.), and deflating with the aggregate German CPI series allows the comparison for some of the most crucial subperiods. The fact that the Emperor repeatedly tapped the city of Augsburg directly for funds, and that Augsburg financiers were most frequently appointed to run the Imperial Treasury itself, illustrates its key role as a liquidity centre (Ehrenberg 1922, 88f., 151, 190) – though of course we should still not expect a full overlap with global real rate dynamics given the geographical disparities. We observe that during the steep global real rate fall during ca. 1475-1515, Augsburg real per capita wealth exhibits a 4.3x increase. Per capita real wealth levels peak at 867fl in 1467 prices by 1525, not by coincidence marking the death of Jakob Fugger. Afterwards, the city’s relative decline is increasingly apparent, with a meaningful contraction following the 1557 Spanish and French defaults, which hurt the German merchant community particularly
hard. A recent similar chart by Scheidel (2017, 337) is not inflation-adjusted and therefore displays misleading trends: wealth per capita certainly did not peak in 1618 in real terms.

Figure XXIV: Global real rates and real wealth per taxpayer in Augsburg, range and midpoint, 1467-1715.  

In this sense, one can regard savings accumulation as assuming a key role at a key inflection period for long-term sovereign interest rates. But can we speak of a “precautionary savings” motive, as Summers and Rachel (2019, 16ff.) have invoked as a potential channel, and as Zuijderduijn and De Moor (2013) posit for the early 16th century? The long-term evidence appears relatively weak. Zuijderduijn and De Moor (ibid.) focus on households that do not belong to the broader elite, and whose role in general asset

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78 Wealth data splices Hartung (1898, 1283), Strieder (1904, 28), and Mayr (1931, 13). The total tax basis widens from 1558 since Strieder (ibid.) does not cover wealth below 2,400fl between 1467-1498, and not that below 3,600fl between 1498-1540. I estimate that an adjustment of the tax base would increase per capita wealth levels upwards by a maximum of 21% during 1467-1558, given the wealth brackets <20fl in Hartung (ibid., 1279, 1283). It is unlikely that this group represents a relevant source of aggregate savings, however. I deflate with the aggregate German CPI.
demand, though growing in importance, remains limited. There is no evidence that war frequency, natural disasters, or “societal hardship” on top income earners in Augsburg rose markedly in the late 15th century, which could rationalize a sharp incentivization to save precautionarily. Neither do the alimony or the primitive social security systems indicate relevant breaks (Van Bavel and Rijpma 2016).

The contemporary statements by top strata households speak a different language, emphasizing abundant liquidity. The Venetian chronicler Girolamo Priuli reports in 1509 that

“the nobles, citizens, and people of Venice were so flush with money that they did not know what to do with it, and so they purchased these bonds, because they collected their payments every six months in good money and they cared about nothing else” (Chambers and Pullan eds. 2001, 160).

Where did this sudden liquidity originate? We have little indication that the rate of profit suddenly surged in the late 15th century. Instead, one should consider the possibility that in fact “forced savings” assume a key role behind one of the most notable all-time turnarounds in real and nominal interest rates. We should consider the wave in sumptuary laws across all of Europe during the late 14th and throughout the 15th century as a powerful – maybe even the dominating – force behind the rapid capital accumulation visible during these years. Of course, this wave was a reaction to the time associated with the consumerist decadence of “the evolution from the state as a business affair to the state as a work of art”. Such legislation, if properly enforced, should be associated with a notable drop in the consumption-wealth ratio, which has recently been inferred as a useful predictor for subsequent real (short-term) interest rate trajectories (Gourinchas and Rey 2017).

Previous literature has identified a sharp acceleration in sumptuary legislation – restricting “luxury” spending on clothing, feasts, alcohol and food consumption, gift-giving – both north and south of the Alps from the late 14th century, with a peak in the second half of the 15th century, with Bulst (1988) documenting the spread throughout Germany until the late 16th century, and Killerby (2002) doing the same for Italy. The former (ibid., 35) counts 140 new clothing regulations between 1450-1499 alone, and another 120 between 1500-1549, compared to a total of 125 in the 14th century, and 19 during the 13th
century. Killerby (ibid., 26, table 2.1) counts a total of 46 new sumptuary laws in Florence, Genoa, and Venice combined between 1450-1499, representing 38% of all such laws enacted in the three cities between 1157-1500. The Black Death created not just the means for wider parts of the population for excessive consumption – but the traumatizing experience of sudden decimation in the earthly life also triggered the impetus to enjoy it to the fullest, while still able to. Prominent narratives have established what amounts to evidence of a sharp rise of the consumption-wealth ratio between 1350-ca.1450. Some claim it may have been the necessary precondition for the Renaissance as such (Goldthwaite 1993). In the words of the Florentine chronicler Matteo Villani, the disaster did not make men more pious. Rather,

“the opposite happened. Men gave themselves over to the most disordered and sordid behaviour…As they wallowed in idleness, their dissolution led them into the sin of gluttony, into banquets, taverns, delicate foods and gambling. They rushed headlong into lust”.

Consumerism abounded. “Statesmen who had tried to build up their power and prestige by enlarging their estates now vied with one another to gather works of art” (Lopez 1953, 30). “No epoch ever witnessed such extravagance of fashion as that extending from 1350 to 1480”, according to Huizinga (1924, 228). Figure XXV illustrates how such narratives fit with our interest rate and related evidence. It displays two “gross (aggregate) savings rates” scenarios for the Piedmont region, following an early modern economy model discussed by Kuznets (1968). Kuznets (ibid.) tried to argue that the early modern economy had a substantial gross savings potential – which did not translate into high net capital formation because of high levels of depreciation and unproductive use of capital. He argued that aggregate savings rates between 5-13% of income would be entirely plausible, assuming that (a) the top 5% commanded 25% of total income, and constituted the only relevant source of aggregate savings; (b) the top 5% consumed 3-5x the average expenditure of the bottom 95%.

79 Translated from Bulst (ibid., 39). See also further sources there from France and Germany.
80 In Kuznets’ (ibid., 48) words, “at the danger of exaggeration, one may ask whether there was any fixed, durable capital formation, except for the ‘monuments’ in pre-modern times, whether there was any significant accumulation of capital goods with a long physical life that did not require current maintenance (or replacement) amounting to a high proportion of the original full value”.

80
From various sources, we know that the 5x expenditure multiple is not implausible as a lower bound in early modern times, though as an average it appears slightly too low – certainly, it showed meaningful variation.\textsuperscript{81} However, it seems relatively clear that the 25\% income share of the top 5\% of households for early modern Europe is too low. If we assume that the wealth share broadly corresponds to the income share, levels of 30-50\% are more realistic.\textsuperscript{82} Below I use Alfani’s (2015) top 5\% wealth shares for the Italian Piedmont region over time, and employ two expenditure multiple scenarios to derive plausible gross savings rates. First, I use a constant 6x consumption expenditure multiple over time; secondly, I construct a “conspicuous consumption boom scenario”, which assumes that the sumptuary law frequency indicates corresponding increases in the expenditure multiple: here, the latter peaks at 8x in 1450 and 1500, and falls to 4x by 1750, in a gradual process where, once more, the collective view prevailed that “good management warned against immobilizing too many resources in humanistic culture” (Lopez ibid., 31). Only four centuries later a similar mindset seems to have returned. Following Sombart (1967 [1922], 89ff.), the late 18\textsuperscript{th} century is once more beset by a return to a “boundless luxury”, and the scenario reflects such arguments by assuming a spike back to a 6.75x expenditure multiple.

\textsuperscript{81} For instance, see Dirlmeier’s (1978, chapters 4-7) datapoints for expenditures and incomes. Rent expenditure multiples are meaningfully higher (ibid., 244-252), while total household budgets such as Burkhard Zink’s in the 1400s fit well with a 5x multiple (ibid., 455ff.).

\textsuperscript{82} Perhaps suggesting such a broad equivalence between wealth and income shares grossly simplifies the situation: but the more rigorous comparisons in the early modern period equally point to much higher income shares. I stick with the wealth data because it is better documented empirically. For instance, Soltow (1989, 80) records details from the 1585 Amsterdam income tax, and implies an income share above 40\% for the top 5\% if midpoints for the full sample (7,500 taxpayers) are taken throughout.
Figure XXV: Implied gross savings rates scenarios in Piedmont, and Italian real rates, 1300-1800.

We note that Kuznets’ 13% gross figure could potentially be too low by a factor of 2-3x, though particularly post-1618, Kuznets’ assumptions are weakening.\textsuperscript{83} But more important is the broad timing of dis-savings and the relationship to real rates. While the “conspicuous consumption boom” scenario is the historically more realistic one, the bottoming of savings rates in the mid-15\textsuperscript{th} century does not depend on the variation in the expenditure multiple. The series are consistent at least with the following narrative: the Black Death leads to an excessive consumption boom during the late 14\textsuperscript{th} and early 15\textsuperscript{th} centuries, which diverts large funds away from debt markets, with authorities (under pressure no doubt from religious moralists) subsequently trying to rein in the decadence with a wave of sumptuary legislation. At

\textsuperscript{83} By then, the “bottom 95%” has become a more relevant source of asset demand. Meanwhile, Kuznets works his way back from Dean and Cole’s (1962) capital-output ratio estimates for Britain in 1688: but for the “global” sample here, the evolution involves several “resets” that are not affecting Britain, such as the Thirty Years War, and would therefore be compatible with higher underlying long-term savings rates.
the turn of the century, then, the suasion efforts finally bite, and in the search for alternative employment, the growing trade and financial profits are directed into debt markets again – sharply lowering rates there. These final speculations are not underpinned by more rigorous archival and empirical evidence at this point – particularly micro evidence on the evolution of savings rates would of course be desirable. But they suggest a scenario at least consistent with the narrative accounts, and with the related evidence from longer-term wealth evolution.

Turning to demographic drivers, we see a similarly inconsistent pattern: some demographic shocks, such as the Black Death 1348-1349 are visible in a sharp drop in real rates – but on a general level population growth accelerations are at times associated with interest rate increases (the 20th century interwar- and post-war episode), at times with static or slightly falling levels (the second half of the 18th century); simply correlating real rates with year-on-year global or “safe asset provider” real rates yields negative values, which remains true if various lags are applied (Figures XXVI, XXVII).

Might life expectancy (or a combination of population and life expectancy levels) be a better measure to consider? I have not systematically undertaken a direct comparison. But I note that data for instance for England (Wrigley and Schofield 1981 via Voigtlaender and Voth 2013, 779) does not suggest a close match: life expectancy on their basis shows a downward trend over 1550-1750 – when we should expect dis-savings –, and jumps in the 1560s and the 1740s, which has left no traces in the English real rate series. Overall, one should likely be hesitant to attribute at least a dominant role to demographic factors in (very) long run real rate dynamics.
Global population (Figure XXVII), after recording an average growth rate of .13% between 1000-1500, generally accelerated its expansion, with average growth rates of .27% between 1500-1600, with a fall back to .09% for the crisis-ridden 17th century (Parker 1997), followed by a renewed increase to .61% per annum for 1700-1820, .63% for 1820-1900, and finally 2.9% per annum for 1900-2000. The negative relationship is also confirmed on the city-level by the two classic long-term population surveys of de Vries (1984) and Bairoch et al. (1988): the only cases of population stagnation or decline are the Italian
city-states between the early 14th and 16th century: Bairoch et al. (ibid., 43,49) put the decline for Venice in this timeframe at 9.1%, for both Florence and Genoa it is 42%. In contrast, Spain and Castile showed strong population growth in the 16th century (Ruiz Almansa 1948), as did the population of Holland, which grew by more than 30% over the 17th century (Lourens and Lucassen 1997).


Figure XXVII: Correlation real rate – population growth, global basis.
VII. CONCLUSION

This concludes the long-term survey. First, this paper has argued that – partly given their methodological shortcomings (such as the sole focus on secondary source, nominal, country-level, “lowest-issuer”, scattered rate evidence) – relying on existing interest rate narratives obscures and mis-times the long-run evolution of interest rate dynamics: for one, it was not the Black Death that triggered a lasting historical interest rate reversal (Epstein 2000, 61ff.), or the 13th and late 17th centuries, as Homer and Sylla (1991, 556f.) suggest. The far more plausible turning point occurs in the late 15th century – which coincides with a sharp surge in capital accumulation trends, and a jump in plausible savings rates – an inflection which also clearly precedes institutional “revolutions” such as those proposed by North and Weingast (1989). From my data, it appears that the wave in sumptuary legislation across Europe in the late middle ages could have been far more decisive for the arrival of modern financial markets than late 17th century British commitment mechanisms, given that it forced large-scale capital accumulation.

But the value of constructing the first multi-century, high-frequency GDP-weighted real rate dataset for both the global “safe asset provider”, and advanced economies on aggregate goes beyond purely empirical qualifications. In its applied dimension, I sought to suggest that a long-term reconstruction of real rate developments points towards key revisions concerning at least two major current debates directly based on – or deriving from – the narrative about long-term capital returns. First, my new data showed that long-term real rates – be it in the form of private debt, non-marketable loans, or the global sovereign “safe asset” – should have been expected to hit “zero bounds” around the time of the late 20th and early 21st century, if put into long-term historical context. There is little unusual about the current low rate environment which the “secular stagnation” narrative attempts to display as an unusual aberration, linked to equally unusual trend-breaks in savings or productivity measures. To extent that such literature posits a unique episode of declining capital returns “for the better part of a generation” (Summers 2015, 12), it is found to be fully misleading.
Secondly, sovereign long-term real rates have been placed into context to other key components of “nonhuman wealth returns” over the (very) long run, including private debt, and real land returns, together with a suggestion that fixed income-linked wealth has historically assumed a meaningful share of private wealth. There is a very high probability, therefore, to suggest that “non-human wealth” returns have by no means been “virtually stable”, as posited by recent popular accounts (e.g. Piketty 2014, 206): only if business investments have both shown an extreme increase in real returns, and an extreme increase in their total wealth share, could the framework be saved.\textsuperscript{84} If compared to real income growth dynamics over the same timespan, R-G, we equally detect a downward trend across all assets covered in the above discussion. General incomes, not wealth returns, have increasingly gained the “upper hand” over the very long term.

There is no reason, therefore, to expect rates to “plateau”, to posit that “the global neutral rate may settle at around 1% over the medium to long run”, or to proclaim that “forecasts that the real rate will remain stuck at or below zero appear unwarranted” as some have suggested (Hamilton et al. 2016, 663; Rachel and Smith 2017, 37). With regards to policy, the zero lower bound can be expected to become a permanent and protracted monetary policy problem – but my evidence still does not support those that see an eventual return to “normalized” levels however defined (for instance Eggertsson, Mehrotra, and Robbins 2017, 41, who suggest a “nadir” in global real rates in the 2020s): the long-term historical data suggests that, whatever the ultimate driver, or combination of drivers, these forces have been indifferent to monetary or political regimes; they have kept exercising their pull on interest rate levels irrespective of the existence of central banks, (de jure) usury laws, or global capital controls. They persisted in what amounted to early modern patrician plutocracies, as well as in modern democratic environments.

This article has then related the real rate trend fall over time to key measures regularly advanced as potential drivers, including a decline in risk premia, a decline in war frequency, and growth and demographic developments. Though the sophistication of statistical tests will always leave some wanting,\textsuperscript{84} I argue in the appendix below (pp.197-200) that there are few indications that this can be the case.
on an aggregate level there appears little to suggest that any single factor among them could explain the dynamics outlined over multiple centuries: clearly, few of the respective “inflection points” overlap with each other at the crucial junctures.

In the end, then, it was the contemporaries of Jacques Coeur and Konrad von Weinsberg – not those in the financial centres of the 21st century – who had every reason to sound dire predictions about an “endless inegalitarian spiral”. And it was the Welser in early 16th century Nuremberg, or the Strozzi of Florence in the same period, who could have filled their business diaries with reports on the unprecedented “secular stagnation” environment of their days. That they did not do so does not prove their lack of economic-theoretical acumen: it should rather put doubt on the meaningfulness of today’s concepts.
INTRODUCTION

In the context of an observed trend fall in real interest rates over the past decades in advanced economies, an alleged shortage of investable, “safe assets” has been repeatedly identified as a key driver. The August 2018 Federal Reserve Board minutes, for instance, contain the statement that “many participants commented... on the secular decline in neutral real interest rates. That decline was viewed as likely driven by various factors, including slower trend growth of the labor force and productivity as well as increased demand for safe assets”. Such policy considerations follow an increasingly well-established academic literature on the issue. Prominently, Caballero, Farhi, and Gourinchas (2017, 30) write that “For the last few decades, with minor cyclical interruptions, the supply of safe assets has not kept up with global demand. The reason is straightforward: the collective growth rate of the advanced economies that produce safe assets has been lower than the world’s growth rate, which has been driven disproportionately by the high growth rate of high-saving emerging economies such as China. If demand for safe assets is proportional to global output, this shortage of safe assets is here to stay”.

Such propositions are tied to specific macroeconomic recommendations for above-mentioned and fiscal policymakers, often endorsing a higher provision of “safe assets” to alleviate undesirable growth and output dynamics associated with zero lower bound episodes. In representative fashion, the authors (ibid., 37) observe that

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“In a safety trap, issuing additional public debt increases the supply of safe assets and stimulates the economy… The macroeconomic desirability of an expansion in public debt during a time of safe asset shortage is distinct from (and complementary with) the more conventional advocacy for (cheaply funded) fiscal expansion during liquidity traps and/or secular stagnation situations. The mechanism operates through a swap of risky for riskless assets in private sector portfolios. In this sense, policies that increase the gross supply of safe assets…stimulate aggregate demand and output.”.

Unfortunately, the safe asset literature remains unusually devoid of longer-term empirical investigations – “historical” additions have come in highly stylized fashions such as Gorton (2017), lacking any empirical ambition. For all its historical simplifications, I posit here that a long-term reconstruction of “safe asset” dynamics can illuminate the present discussion, and in the following proceed to construct a long-run dataset for 5 leading “safe asset providers” over the last 546 years, adjusted for demographic and price changes. I suggest the following results:

- Even though over the very long-term, safe asset supply growth has outstripped demand growth, and even though the 19th century remains unsurpassed in safe asset scarcity, safe asset shortage periods have become more frequent, now affecting on average 15-20% of real developed market GDP at any time.
- I identify nine major historical “safe asset shortage periods”. These episodes have taken on average 18 years, during which real per capita net safe asset supply fell by 40.2%. These episodes are associated with sub-par growth, and sub-par inflation. However, while a rebound in safe asset supply historically spurred real GDP growth, the effect on inflation remained muted over the 13-post trough years in these episodes.
- I identify numerous subperiods for which an increased demand for safe assets is correlated with falling real rates; but on aggregate, the real rate correlation over time with “safe asset gaps” appears weak across a variety of measures. There are two possibilities:
• Over the long-run, safe asset dynamics may only with significant qualifications causally relate to the trend fall in real rates. This is a relevant result in itself.

• Money demand may not be a suitable proxy for measuring safe asset demand, even though sovereign debt and money share many “safe” attributes. This could be due to the “safe asset share” fluctuating widely over time. This paper can in this case trace the evolution of the safe asset share over time in an unprecedented fashion.

• If – the case which I set out here – money demand serves as a relevant proxy for safe asset demand – or if savings represent a relatively constant share of money demand –, I finally show that the income elasticity of money demand is secularly increasing in advanced economies; to the extent that such an exponential development is not matched by increased asset supply, therefore, the frequency and severity of safe asset shortages could further accelerate meaningfully on the basis of existing historical trends.

MEASURING HISTORICAL SAFE ASSET SUPPLY AND DEMAND

The five countries covered – the United Kingdom, Germany (The Holy Roman Empire), Spain (Spanish Empire), Holland, and France – accounted for 63-67% of advanced economy real GDP between the 15th and 19th century. A number of studies (Kindleberger 1996; Broadberry and Fouquet 2015) have identified these sovereigns successively as leading, frontrunner economies. Among the universe of investable debt assets over time, it was – despite crisis periods such as the second half of the 16th century – among these sovereign issuers where investors sought “safe investments”.

For most of early modern history, the economies concerned followed bimetallic commodity standards (Eichengreen and Sussman 2000). So why would one not regard gold or silver coin (i.e. the aggregate

86 Basis: Maddison’s (2007) real GDP data; five country real GDP as percentage of “Western Europe” plus “Western offshoots” (Canada, US, Australia).
87 See the discussion in section “Global real rate, R-G, and the ‘suprasecular’ decline’, 1311-2018”, sub-section “Safe asset status”.

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money supply) itself as a “safe asset”? For one, coins were notoriously subject to debasements across all five countries concerned; minting activity was subject to continuous political interference; and clipping, subtle changes in weight, and widespread counterfeiting introduced severe uncertainties regarding the future value of currency in circulation (Spufford 1988; Rolnick, Velde, and Weber 1996). Various instances are recorded when European rulers decided ad hoc to ban or to impose draconian tariffs on particular circulating vintages; at times they even engaged in counterfeiting themselves, such as Peter IV of Aragon, who attempted to undermine trust in the rival Castilian coin (Hamilton 1938, 86). The unit of account and the medium of exchange were separate: in Glassman and Redish’s (1988, 75) words, a major source weighing on capital and trade flows was the fact that “no specie metal had the properties of durability and portability required in a perfect medium of exchange”. As Roessner (2018, 158) argued, “coin money could be debated, negotiated and fought over quite frequently. It accordingly did not always fulfil the criteria of acting as a safe store of value”.

In today’s parlance, historically coins did not constitute an “asset…whose real value is insulated from shocks, including the declines in GDP due to the rare disasters” (Barro et al. 2015, 1), nor did it “provide insurance against possible bad events in which agents need liquidity instruments”, nor was it particularly equipped to “transfer wealth across periods (Holmstroem and Tirole 1998, 2013).”

Public debt contracts, for that part of the population with accumulated savings or trading relationships – in effect provided both much-needed elasticity and safety compared to the volatile situation of the circulating currency. Though also far from being that “perfect medium of exchange” – for those with accumulated capital still constituted a preferred storage and saving destination: whether consolidated (as in most early modern municipalities) or unconsolidated (France until 1522, England until 1694), the contracts crucially were denominated in the international reserve currency, the Florentine florin and the Venetian ducat (Cipolla 1963; Stahl 2012). Safe sovereign debt typically featured clauses that denominated payments in specific weights of the de facto international reserve currencies: the Florentine florin.

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88 Cit. via Gorton (2015, 10).
florin or Venetian ducats. As merchant republics, these two cities early on understood the value of being regarded as the issuer of the “the most stable coin in Europe” (Hamilton 1936, 23f.; Cipolla 1963; Goldthwaite 2009, 222-224). Another he contracts allowed “pledgeability” and showed the collateral attributes emphasized by (ibid.) and Gorton (2010) – they could be used to meet tax demands, or to acquire real estate (Mueller 1997, 458). Major advances in cross-border circulation of urban debt, and a harmonization of contract clauses took place as early as the 14th century (Kostanecki 1889, chapters 3 and 6).

Subsequently, I therefore regard long-term, both redeemable and non-redeemable, consolidated government debt issued by the five prime advanced economies as the relevant historical “safe asset” for financial markets; various authors have included short-term sovereign assets, and temporarily also government-sponsored entity (GSE) debt (Barclays 2012) among the realm of “safe” instruments; others also include all assets eligible for common repo transactions such as interbank loans (Gorton et al. 2012, 102). Historically, short-term government debt has attracted a meaningfully higher risk premium, leading to inverted yield curves as a typical phenomenon such as 16th century Spanish markets. I will below however provide robustness checks which include short-term assets, and which underpin the underlying conclusions suggested here. On the status of long-term government bonds, however, there exists broader (though not unanimous) consent, even though the higher price risk has been pointed out given interest rate sensitivity.

How to measure safe asset demand? in the current literature, various proxies have been used to estimate safe asset demand: Caballero, Farhi, and Gourinchas (2017, 30f.) suggest that safe asset demand should be proportional to global output or global wealth. The Securities and Exchange Commission (2014, 2) also focuses on growth measures, positing that “rapid economic growth of emerging economies has encouraged ….”

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89 Among the many examples that could be given, the debt letters recorded by Friedrich II., Markgrave of Brandenburg, in the 1460s never omit the provision to pay back the “Schult” (debt) in “gut gulden und gewicht” (proper gold coin and weight). See GStAPK, HA Rep. 78, Nr. 10, 96-131.
90 Drelichman and Voth (2014, 177) demonstrate this for Spain, where the Juro yield at 7.14% is consistently below short-term debt during the 16th century.
91 See Krishnamurthy and Vissing-Jorgensen (2012, 239f.), who posit distinct “long term safety attribute[s]”.

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markets…has triggered demand for safe assets, including those ‘produced’ in the United States”. As can be shown for individual countries, however, money growth has diverged from real per capita GDP growth in advanced economies, particularly since the 1960s, after centuries of a relatively close correlation between real per capita broad money endowments, and real per capita GDP growth (i.e. Exhibit 16 for the case of England).

In this paper, it is advanced that real broad money per capita balances provide a close proxy for safe asset demand, given that this measure more closely aligns with overall per capita asset growth. Furthermore, Gorton et al. (2012, 101) have found a historically very stable demand in U.S. household portfolios for safe assets over the past 60 years, positing that “the stability of the safe asset share implies that the demand for information-insensitive debt has been relatively constant as a fraction of total assets in the economy”; most explicitly, Krishnamurty and Vissing-Jorgensen (2012, 234) have recently linked money demand directly to safe asset demand, as both converge in their rates of return given shared safety attributes in the eyes of investors.

Constructing per capita and real values provide relevant checks against demographic and inflation variables. The fact that default events did of course occur in 15th and 16th century Europe among more or less all leading economies does not further concern our analysis here, and merely raises semantic issues about our use of the “safe asset” nomenclature: “safe assets” do not refer to default-free instruments – which in all likelihood did not exist anywhere in the early modern economy – but describes a relative risk assessment; what matters in a discussion of asset supply trends is the question if rising money demand could have reasonably been met by these instruments. Historically it is quite apt, therefore, to posit as Caballero, Farhi, and Gourinchas (2017, 29) do, that “safety is an elusive concept, because nothing is ever safe. Investors will always view the safety of an asset through the prism of their own perceptions, needs, and concerns, in relation to other assets, and in relation to the perceptions of other investors”.

French rentes – just like Spanish juros – were widely subscribed to by an international investor base seeking interest-carrying outlets for surplus funds, who rationally factored in meaningful default probabilities – and still returned voluntarily to each new subscription after cessations of interest
payments, or principal payment stops. For France the frequent and voluntary subscription of investors ranging from the Welsers, merchants from Lucca, the investor families of the Behaims and Imhoffs of Nuremberg is widely documented, particularly for the bourses of Lyon and Besancon (Eisenhart 1881; Ehrenberg 1928, 281-306; Pezzolo and Tattara 2008).92 Exemplary for German municipal debt, I can equally draw on archival funds detailing shares of “exterritorial” creditors, suggesting averages of 31% in the 17th century.93 I discuss data and data limitations further in section III below.

I. SAFE ASSET SUPPLY AND DEMAND

In the attempt to explain the secular fall in global real rates over the last three decades, a variety of authors have advanced arguments that see a primary role for a “safe asset shortage”, starting with Bernanke’s (2005) “savings glut” proposition, and more recently Caballero and Farhi (2014), Farhi and Gourinchas (2016), Gourinchas ans Rey (2016), and Del Negro et al. (2017). High savings ratios in emerging market economies, and a low level of domestic long-term bond assets in this view have led to a sharp increase of demand for U.S. Treasury assets, against rising but inadequate U.S. government bond supply, especially in the years immediately preceding the 2008 financial crisis. The “demand overhang” hence leads to a rise in U.S. bond prices, and consequently a fall in their respective yields. The Bank for International Settlements already in 2001 declared that

“With growth of collateral use so rapid, concern has been expressed that it could outstrip the growth of the effective supply of these preferred assets . . . The increase in collateralized transactions has occurred while the supply of collateral with inherently low credit and liquidity risks has not kept pace. Securities markets continue to grow, but many major government bond

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92 For Spain: Drelichman and Voth (2014).
93 StdAMs, A IX, 717.
markets are expanding only slowly or even contracting. The latter phenomenon was particularly evident in the United States in the second half of the 1990s."94

In the following, I now test these propositions for several historical periods, constructing indices for leading European government debt providers which are components of our “GDP-weighted” global real rate data series (see above).

FRANCE

Vuehrer (1886, 4) quoting on ordonnance of 28 August 1316, argues that the French Tresoriers by the early 14th century already managed stocks both of perpetual and life-time public debt, but unfortunately the figures remain sparse until the late 15th century.95 Figure XXVIII displays an indexed (1493=100) series of real per capita French government debt, on the basis of Vuehrer’s (ibid., 11-501) and Hamilton’s (1947) data between 1493-1788 as a measure of “safe asset supply”;96 set against it is the series of real per capita money endowment (k) as the measure for safe asset demand over the same horizon, based on data in Guery (1978, tableau II), Riley and McCusker (1983), and Glassman and Redish (1985) and, later, Banque de France balance sheet data in Courtois (1875, 16, 145-147, 182).97 Both series are deflated with Allen’s (2001) Paris/Strassburg averaged CPI basket. While I note a slight outperformance of safe asset demand over the first two decades of the series, afterwards the picture is one of a clear and unanimous outperformance of supply, with a particularly sharp divergence in the second half of the 16th century; in 1522, Charles I inaugurated the famous series of bond subscriptions of the rentes sur l’Hotel de Ville to finance the wars against Charles V, laying the ground for a quick ballooning of rentes issuance continued

94 BIS (2001, 2), see also Gorton (2013, 1).
95 The original appears in Ordonnances T1, (De Lauriere ed., 626).
96 Vuehrer (ibid., 11) begins explicit datapoints with Charles VII’s debt operation in 1437 for 60,000 livres, which is assumed to be the stock outstanding by the time we can start the aggregate series from the inception of Allen’s (2001) inflation data. The major French debt operations began with Charles VIII’s invasion of Italy in 1494 (Bonney 1999, 138-140). I always take the broadest money circulation series reported, i.e. for Courtois’ (ibid., 145) column 4.
97 Missing datapoints for French debt are linearly interpolated: between 1600-1715, I assume that the year-on-year change in debt outstanding is equivalent to Guery’s (1978, tableau II, 236-237) annual royal total deficits.
by his successor Francis I (Hamilton 1947, 119; Bonney 2012). Spooner (1972) discusses in detail the monetary and minting backdrop, but does not focus on any developments on the debt side.

Figure XXVIII: Real per capita safe asset supply versus demand, and long-term real rates, France 1493-1788.

The picture for England reveals crucial idiosyncrasies. I calculate time series for real per capita money demand and real per capita safe asset supply in Figures XXIX and XXX below, the former displaying the period up until the founding of the Bank of England in the 1690s, the latter from this inception until the present. Real per capita safe asset supply is defined as national debt including term annuities per capita, as recorded from 1691 in Bank of England archival documents, and prior to this supplement this with the datapoints provided by 16th century British National Archive (TNA) files which contain aggregate
borrowing figures in the Antwerp money market, and which are not covered by the published accounts of Sinclair (1790), Ehrenberg (1928), or Outhwaite (1966). Thomas Gresham, for instance, reports that in Antwerp a total of 279,565 florins (fl) of debt is outstanding by May 1560 (TNA SP 70/147, fol. 101-102); by August 1571, the debt load has been reduced to 38,618fl (ibid., fol. 410). Many of these loan operations are for less than one year, which are excluded. In addition, I rely on the accounts of Dietz (1920), and Sinclair (ibid., part 2, chapter 3, 34-47). Population and inflation figures are recorded as per Broadberry et al. (2015), reprinted in Thomas and Dimsdale (2017, tab A.21).

While Sinclair (ibid., part II, 35) begins his sovereign debt recordings in the year 1232, with “the unfortunate Henry III [as] the first monarch of England whose debts are recorded in history”, Figure XXIX below begins with the first precise long-term debt stock recorded by Sinclair (ibid.), the 372,000 GBP outstanding by the time of the death of Henry VI in 1471. The crucial observation in Figure XXIX is that it fully conforms to modern-day models of safe asset dynamics: for the 217 years in question, real per capita safe asset demand (real money demand k) outstrips real per capita safe asset supply, and as predicted by simple arithmetic, real long-term yields in the British Kingdom fall considerably during the same timeframe, from peaks above 25% during the European wide “Bullion famine” (Day 1978), to close to 5% by the time of the Glorious Revolution.

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98 BoEA, 14A 156/1, “Funded Debt – Issues for Terminable Annuities – Great Britain – 1693-1836”; TNA SP 70/147, fols. 101-102 and 410, for various Antwerp operations and reports on debt stocks outstanding not reported in Ehrenberg (1928) or Outhwaite (1966). I exclude the short-term loans (<12m) reported there.

99 Some intermittent debt figures are in Ormrod (1999, 37f.), including Edward III’s 300,000 pound debt load.
Figure XXIX: Real per capita safe asset supply versus demand, and long-term real rates, England, 1471-1688.
The situation in Germany is complicated by its fragmented political structure for most of the late medieval and early modern period, since the Holy Roman Emperor lacked the authority to centralize either minting or debt matters; rather, the wealthier municipalities ("Reichsstadt"), and price-elects retained coinage rights following an Emperor’s bull of 1356. More than two dozens of municipalities, however, already engaged in issuing perpetual annuities in the 14th century, putting them institutionally – though not in terms of market depth – at a level of financial development comparable to Italian city states (Kuske 1904). Some recent investigations into longer-term, aggregate German trends are Sprenger (1991), and Schremmer and Streb (1999) – however, both offer no empirical series; the latter is erroneous.
and useless for our purposes by building its conclusion of a falling per capita silver endowment on the assumption of a constant long-term money velocity.\(^{100}\) Roessner (2014, 326) offers a broad trend estimate of German velocity based on coin hoards between 1400-1599, but admits to the high level of uncertainty involved. His positing of a trend velocity rise (falling money demand) between 1500-99, however, aligns with our alternative debt-based estimates below – as do Sprenger’s (1984, 142-144) scenarios for the 16\(^{th}\) century, which are equally not based on concrete money demand figures.

One can follow Soetbeer (1879) and Nef (1941) to construct long-term money supply figures in Germany as a function of silver mining volumes, as various authors have done for country-level subperiods.\(^{101}\) I will in the following attempt to supplement the broader trends by reconstructing municipal series. Lamprecht (1885, 375, note 1) provides some scattered data for the 15\(^{th}\) century: the Rhenian coin association minted an aggregate maximum 2,022 metric pounds of silver coin per annum in the 15\(^{th}\) century based on the coin contract of 1425; Frankfurt minted 3,800 marks within a year in 1418-1419. Harster (1882, 47) reports figures for Speyer – one of the oldest mints in the German Empire and the third largest municipality in the late middle ages in the HRE.\(^{102}\) According to his calculation, in 1502, 19,264 domestic silver coin equivalents circulated in Speyer (or 14,448 Albus coins), and the ratio of foreign coins to domestically-minted coins stood at 1.89x, implying a total silver coin equivalent circulation of some 55,701 coins; these sums imply 78,957 Albus coins in circulation, which consisted of 1.83 grams of pure silver each (Wuerdtwein 1789; Wagner 2001). Using Bairoch et al.’s (1988, 8) population figure for 1500 of 13,000 people, I arrive at a per capita endowment of 6.07 grams of pure silver. In comparison, British pure silver endowment per capita in 1500 stands at 8.87 grams according to

\(^{100}\) The authors stick to their assumption apparently despite better knowledge about non-constant money velocity (ibid., 466f., and footnote 17 there).

\(^{101}\) Wherever Nef (ibid.) disagreed with the Soetbeer figures, I have given preference to the latter, as most of the literature has done. See, for instance, recently TePaske and Brown (2010).

\(^{102}\) My municipal German sample according to the population data by Bairoch et al. (1988, 4-9) covers four of the largest six German cities by 1400, 1500, and 1600.
our calculations.\footnote{I use Allen’s (2001) silver content per pence of 0.7192 grams for 1502. Our calculations for real money endowment per head implies 0.0514 GBP per capita in 1502 (see discussion above); 240 pence constitute one GBP.} Given the more intense minting activity in London, the higher endowment in such a dimension appears plausible.

I obtain historical municipal debt statistics from archival sources of the “Zinsmeisteramt” (“interest rate master office”) in Nuremberg, and for Münster on the basis of the archival files recorded by its “Stadtkämmerer” and “Grutshaus” (the two municipal fiscal offices), which compiled full debt inventories in 1669, 1732, 1802, and 1804-1805, and which contain interest rate and debt volume information for perpetual issuance stretching back to 1442 at the earliest.\footnote{Files used: StdAMs, Ratsarchiv (vor 1802), A IX, 714-726. See references for additional details.} German municipal debt overwhelmingly consists of long-term life and perpetual annuities, callable at the earliest after “one life” (the death of the first generation subscriber, the asset being known as \textit{Leibrente}). Hamburg data is calculated on the basis of Reincke (1953, 498-503).\footnote{Nuremberg archival data via NStA, B 17/II, 140-147, Zinsmeisteramt files. I take 20-year centered averages of annual real gross debt issuance, weighing Hamburg, Münster, and Nuremberg equally.} I deflate with an average of Allen’s (2001) German data for Augsburg, Munich, and Leipzig.
Figure XXXI: Real per capita safe asset supply versus demand, and long-term real rates, Germany, 1428-1800.

Figure XXXI displays the equivalent metrics for Germany. Once more, I observe a faster growth of safe asset supply than safe asset demand over most of the 372-year period, coupled with a trend fall in German long-term real rates. Of all samples, our German data is most subject to revisions, given its comparatively narrow base for safe asset supply (real per capita debt for Hamburg, Münster, and Nuremberg, equally weighted). The fact that its general trends fall in line with all my previous observations, however, should be encouraging. The sharp fall in safe asset supply in the early phase of the Thirty Year’s War (1620-1621) stands out in the sample, and coincides with a sharp fall in real interest rates. The behavior is a consequence of a notable jump in Allen’s CPI figure for all German cities covered in the early 1620s, during the debasement crisis of the “Kipper- und Wipperzeit”. Alternative sources register a price surge of similar proportions – Bauernfeind (1993, 436) for instance records a 170% rise in Nuremberg rye prices between 1619-1622. The inflation itself does not impact my underlying measures.
on a real per capita basis – the depressed state of German safe asset supply for the remainder of the 17th century, on the other hand is notable, but explicable. Case studies such as Schneider (1990) for Frankfurt, and Denzel (2012) for Nuremberg suggest that the episode left some enduring scars on municipal finance independent of the Thirty Years War effects, and only gradually reversed after fundamental currency and banking reforms in the 1690s.\textsuperscript{106}

In the German case, it is notable that a variation of the indexation leads to a more nuanced record: the pre-Thirty Years War period is characterized by safe asset supply outstripping safe asset demand; after 1620, the relationship shifts into reverse – safe asset demand is clearly outstripping supply, thus constituting an episode of falling real rates consistent with the “safe asset shortage” framework.

SPAIN

For Spain, I combine data from Hamilton’s (1934, 124-128; 1936, 207-213) coinage figures for the Valencian mint to construct money demand series for Castile in 1493-1650. To calculate per capita money endowments, I follow previous approaches that have used a 30-year rolling sum of mint output as a proxy for circulating coin supply in the economy (Braudel and Spooner 1967; Spooner 1972). For real GDP figures, I use Alvarez-Nogal and Escosura (2013), while for “safe asset supply”, I use real per capita long-term perpetual juros volumes outstanding as reported in Ruiz-Martin (1975), Garcia (2008; 2015), and Drelichman and Voth (2010, 823).\textsuperscript{107} Since Castilian crown revenues and juros debt outstanding is tightly correlated – given that juros could only be issued against ordinary revenues (Drelichman and Voth 2011, 1203, 1208) – I index outstanding debt back to 1493 via Comin and Yun-Casallila’s (2012, 237)

\begin{thebibliography}{10}
\bibitem{106} As Denzel (2012, chapter 3) shows for Nuremberg, the city’s proud Banco Publico, modelled on the famous Genoese S. Georgi Bank, collapsed in the 1630s amid a loss of depositor confidence and the Swedish occupation; the city spent the rest of the century in tedious reform efforts, which only saw a breakthrough with the 1695 reform. For the purely war-induced problems for German public finance, particularly in the 1650s-1660s, see Kaphahn (1912).
\bibitem{107} Cit. in Van der Wee (1977, 374). I disregard short-term asientos debt outstanding given the practice to convert such volumes into juros debt; juros never defaulted, despite the default events in the 16th century on asientos. We assume that bank lending in 1600-42 adds to the outstanding long-term debt stock in a 1:0.86 ratio, based on the fact that 86% of asientos issuance was collateralized with juros, and in light of the conversion practices mentioned above (Drelichman and Voth 2011, 1209).
\end{thebibliography}
revenue index. I deflate throughout with Allen’s (2001) averaged price index for Valencia and Madrid. Exhibit 5 is indexed to the trough in Spanish money demand, the year 1590.

![Graph](image)

**Figure XXXII:** Real per capita safe asset supply versus demand, and long-term real rates, Spain, 1491-1650.

The resulting series shows the trend decline in Spanish real *juros* interest rates, and divergent safe asset dynamics pre- and post-1590: a clear outperformance of safe asset demand following 1590 conforms to theoretical expectations on the interest rate behavior; prior to the inflection point, however, opposite dynamics prevail – a steady acceleration of safe asset supply between 1493-1590, coupled with a trend fall in safe asset demand, which steepens particularly after 1550. On balance, Spain exhibits the strongest
correlation between safe asset “gaps” and real rate trends: we record a correlation of 0.556 on a 7-year centered average basis, and 0.67 on a 15-year averaged basis.¹⁰⁸

**HOLLAND**

![Graph showing real per capita safe asset supply versus demand, and long-term real rates, Holland, 1599-1795.](image)

**Figure XXXIII**: Real per capita safe asset supply versus demand, and long-term real rates, Holland, 1599-1795.

I obtain annual long-term debt and population figures for Holland in 1599-1790 from Fritschy (2017), who follows Dormans (1991, 65-66, 80-81, 100-111), and inflation data via Allen’s (2001) Amsterdam series; I focus entirely on long-term Holland debt, the sum of Fritschy’s (ibid.) life annuities, other

¹⁰⁸ Throughout, I refer to a “safe asset gap” as the difference between annual growth in real per capita safe asset supply and safe asset demand, cf. particularly Figure XXXV and discussion thereof.
annuities, and lottery loan volumes. Broad money supply figures are reported in de Vries and van der Woude (1997, 90), which I linearly interpolate. In Figure XXXIII, I observe that Holland displays a weak but positive correlation between the safe asset gap and country-level real rates, on a somewhat stronger basis for shorter intervals (0.349 for 7-year centered average) than for longer intervals (0.271 for 15-year centered average).

AGGREGATES: THE NINE SAFE ASSET SHORTAGE CRISSES

Henry VI’s debt stock recorded for 1471 serves as my point of departure for the construction of a European-wide, GDP-weighted safe asset series (i.e. I index at 1471=100), displayed in Figure XXXIV. Real GDP weights are obtained with reference to Maddison’s (2007) figures. German, Spanish, Dutch, and French data are added at their respective inception points with the running GDP weights. I note that safe asset supply on aggregate sharply outgrows safe asset demand over the 329-year horizon, rising in real per capita terms by a factor of 78; real per capita safe asset demand, though accelerating throughout the 17th century, only rises by a factor of just over four. In Figure XXXIV, I also identify the first six periods of sustained safe asset shortages, during which underlying safe asset demand meaningfully outstrips safe asset provision. I define a “safe asset shortage period” as a cumulative excess growth of safe asset demand over safe asset supply of at least 20% in a period between 10-30 years. In a subsequent step, we analyze the macroeconomic properties associated with these episodes (real GDP growth, inflation, real rates).

109 Dorman’s Holland data is also compiled in http://resources.huygens.knaw.nl/gewestelijkefinancien, accessed August 8, 2018.
110 German and French data added from 1494; Spanish data added 1497; Dutch data added 1599. The Maddison (2007) datapoints between 1500-1600, 1600-1700, and 1700-1820 are linearly interpolated; for 1471-1500, I apply the real per capita growth rates for European countries in Broadberry and Fouquet (2015).
Figure XXX: Aggregate, GDP-weighted safe asset supply and demand, 1471-1800.

Figure XXXV displays the annual “gap” between safe asset supply growth, and safe asset demand growth for the full data covered, between 1471-2016 (7/11-year centered average basis), together with the matching long-term real rate series for the same sample. The all-time gap stands at 1.46% - in other words, average year-on-year safe asset supply change outstripped year-on-year safe asset demand by 1.46% (since 1923: 2.1%; all-time excluding 1914-1922: 1.06%). If safe asset dynamics should have played a strong role in real interest rate trends, one should expect a higher “gap” (i.e. “safe asset supply shock”) to be associated with a corresponding fall in real long-term interest rates. I test this hypothesis on the basis of various lags, but the best result in favor of the safe asset hypothesis only yields a long-term
correlation of 0.09 (3-year centered average basis); other lags (7-year, 15-year) in fact yield slightly negative correlations (-0.04 for 7-year centered averages; -0.09 for 15-year centered averages).

Figure XXXV: Safe asset supply less safe asset demand, annual, 7-Y centered avg; long-term real rates, 1471-2016.

Safe asset supply and demand fluctuate in a tighter corridor following the Napoleonic Wars, with overall ranges within 65% of starting values in real per capita terms. However, as Figure XXXVI displays, the 19th century witnessed two long-lasting safe asset shortage periods, of 20 and 19 years in length, and the former more severe than average episodes experienced over the previous 350 years. The general trend is one of deleveraging after the significant war debts incurred during the Napoleonic Wars –
culminating in the late 1840s, when both real asset supply per head and real asset demand per head are close to 60% below their inception values.

Figure XXXVI: Real per capita safe asset supply and safe asset demand, indexed, 1820-2016.

A key question to investigate over the long-term is whether safe asset shortage periods are becoming more frequent, as some recent literature ventured (Caballero, Farhi, and Gourinchas 2017). I distinguish several supply and demand definitions in Figure XXXVII to seek out longer-term trends: we can observe that “global” safe asset shortage frequency started out tepidly in the 15th and 16th centuries (recording 6.9%, and 9.5% frequencies, respectively), irrespective of demand or supply definitional variations. The 17th century witnesses the first notable acceleration in shortage frequency: we record a rise to 23.3% on
the long-term debt basis; the 18th century witnesses a moderate decline, to 14.5%, before during the 19th century almost half (48.9%) of advanced economy real GDP on average experiences safe asset shortage conditions.

Figure XXXVII: Safe asset shortage frequency: affected countries as % of advanced economy real GDP, 1471-2016.111

The 20th century – during which Germany is excluded between 1914-1963 – records an average of 20.9% of real GDP affected; the figure rises to 29.7% on the total debt basis, confirming that long-term

111 The years 1799-1819 are excluded from coverage.
debt in fact recorded a faster growth than overall debt volumes, an observation also highlighted for emerging markets during the century in Reinhart and Rogoff (2009, 105f).

In short, I do detect a secular rise in safe asset shortage periods, with a tripling of frequencies over the between the 15th and 19th centuries; but the record during the 19th century – a century marked by the severe deleveraging efforts during following the Napoleonic Wars – does remain in a class of its own thus far. The 21st century is not yet showing unusually elevated properties over the very long term.

QUALITATIVE EVIDENCE, AND ROBUSTNESS

My results are confirmed if checked against alternative methodological and definitional approaches. Equally important, however, are qualitative checks to confirm notable statistical movements. I begin by the latter, then decompose series by country, and vary safe asset supply and demand, as well as weighting inputs to demonstrate robustness.

My dataset suggests a sharp acceleration of safe asset supply during the second half of the 16th century. Between 1475-1525, in fact safe asset demand moderately outstrips safe asset supply growth on average by 0.57% per annum; between 1530-85 on the other hand, safe asset supply growth is outstripping safe asset demand by no less than 6.5% on average per annum, the most marked divergence within half a century over the 329-year early modern period. Why would such a divergence have taken place? My series is driven in particular by French fiscal activity in the 1540s and 1550s, when the national debt increases from a mere 725,000 Livres Tournois, to 42m Livres Tournois by 1560 (Vuehrer 1886, 18-26). The background is set by France’s involvement in the costly Italian Wars, and its geopolitical attempts to escape the Habsburg encirclement following Charles V’s election as Holy Roman Emperor. Annual war expenditures almost quintupled by the 1540s compared to the average of 1480-1530, and then doubled again by 1553-1554, at the “climax of Emperor Charles V’s…efforts against the Valois” (Lot 1962; Spooner 1972, chapter 3; Bonney 1999, 139f.).
Vuehrer documents that these loans continued to be “freely agreed” (“librement consentis”) upon in the Hotel de Ville, and carried punitive interest rates with them, up to 14.3% in 1553 (ibid., 24f.). In 1555, at the Easter fair of Lyons, Henri II contracted “Le Grand Parti”, the largest loan raised by the French Crown in the 16th century, at a 16% annual rate, with a maturity of 41 fairs, or 10.25 years (Ehrenberg 1928, 300-306; Doucet 1933). Again, investors all across Europe flocked to the subscription, for which a new special office administering the sinking fund, the Receveur du don Gratuit, was established.

“God knows how greed for these excessive gains, disguised by designation of a ‘free gift’ (don gratuit) lured men on. Every one ran to invest his money in ‘Le grand parti’, the very servants brought their savings. Women sold their ornaments, and widows their annuities in order to take shares in ‘Le grand parti’. In short, people ran for it as if to see a fire”.112

There is no evidence, therefore, that financial repression was applied – rather, creditors were in full control and able to walk away with generous terms; the final burden was carried by rising tax requirements of the countryside, many of which did not yield to the new Treasury demands “sans resistance” (Vuehrer ibid.). As a result, I regard the sharp rise in safe asset supply for 1530-1560 evident in Figure XXXIV as qualitatively well underpinned.

Next, if I index my series in 1585 – the most “sanguine” point of departure if we were out to defend an excess safe asset demand performance – safe asset demand marginally outstrips safe asset supply over the next 215 years (the GDP-weighted index stands at 1798=91.3); however, as Figure XXXVIII reveals, the performance is again disproportionately driven by France, which exhibits a marked cutback in safe asset supply in the century prior to the fiscal watershed of 1783.113 A European GDP-weighted index excluding France ends the period with a cumulative excess safe asset supply (dotted red line; value in 1798=171).

112 Rubys (1604), via Ehrenberg (1928, 303).
113 The lack of French safe asset availability is only partly related to the periodic rescheduling of the outstanding long-term debt, which retired portions of debt outstanding, i.e. in 1648; during the 18th century, France successfully reigned in expenditure and kept military spending in check, so that by 1783, its debt/GDP was significantly below the British (Bonney 1999, 148); bond market investors in any case were long accustomed to the volatility, and did not lose their faith in the “unimpeachable” crown debt – partly, no doubt, for a lack of alternatives (Ehrenberg 1928, 325).
The same is true if arithmetic weights are applied to the entire sample (dotted black line; value in 1798=199). But I also note a cutback in German safe asset supply following the Thirty Year’s War; given the bleeding in resources, financial and physical, such a trend does not ex ante surprise; Donaubauer (1893, 76-82) has analyzed Nuremberg’s situation during the Thirty Year’s War, documenting the city council’s desperation to find new financial sources: it resorted not just to annuities issuance, but instituted new war, income, wealth, and even horse taxes to meet the contributions demanded by the Swedish King Gustav Adolf.

Secondly, I test robustness by varying “safe asset supply” definitions. Having relied on a subset of “total debt” in advanced economies – long-term funded debt –, one would expect total debt measures to
show an even more pronounced divergence from safe asset demand proxies in history. Figure XXXIX displays respective “safe asset supply” measures for those economies relying on a broader funding mix, GDP-weighted, with alternative measures for (a) “total debt” (thus including short-term securities, *asientos* in the case of Spain, unfunded debt in the case of the U.K., “obligations” in the case of Holland), and (b) long-term funded debt plus terminable annuities (callable long-term debt, issued for the U.K. and Holland, but not Spain).\textsuperscript{114} The evidence reveals that in fact, the discrepancy to safe asset demand decreases with alternative measures (a variation of the index reveals equal results): since in the U.K.’s and Holland’s case the share of long-term funded debt as a share of total debt increases significantly over the time period covered, we note a flatter trajectory for the two alternative indices.\textsuperscript{115} However, the measures continue to sharply outgrow the safe asset demand growth over the same timeframe, which in consequence underscores our rejection of safe asset shortage dynamics in advanced economy economic history.

\textsuperscript{114} In the case of Germany and France, total debt already equals funded debt. Asientos volumes are recorded in Alvarez-Nogal (2008, 91f.) and Drelichman and Voth (2010); asientos had an average maturity of 18 months according to the latter. Holland terminable annuities and obligations in Fritschy (2017). U.K. terminable annuities and funded debt data in BoEA 14A 156/1.

\textsuperscript{115} In the U.K.’s case, long-term funded debt as a share of total consolidated debt increases from an average of 25.4% in 1694-1714, to 84.9% in 1780-1800. See also Dickson (1967) for the country’s underlying financing strategy. The increase is more moderate in Holland’s case: from 14.6% in 1599-1619, to 24.5% in 1776-1796.
Secondly, can we historically detect a “stimulation of aggregate demand and output” following increased safe asset supply, as Caballero, Farhi, and Gourinchas (2017, 37) and others posit? Figure XL displays an indexed average of all nine major “safe asset shortage episodes”, in a 31-year window around the safe asset trough (t=0), together with the average course of the global price level for the same episodes. We note that the average safe asset shortage period between 1471-1800 saw the opening of a 40.2% “safe asset gap”, with a range between 22% (1582-1597) and 47.2% (1720-1726).\textsuperscript{116} From the trough, safe asset gaps reverse by 39.1% in the subsequent 13 years on average. I detect an acceleration of

\textsuperscript{116} “Safe asset shortage episode” refers to peak to trough change in cumulative change in safe asset supply minus safe asset demand. Episodes with at least a 20% cumulative gap over 20 years are included.
real annual GDP growth, post-trough at 0.7% p.a., versus pre-trough at 0.3% - but would caution that five of the nine cycles rely on interpolated Maddison (2007) figures; the growth acceleration is driven by the post-1820 cycles.

However, the correlation with price level dynamics is at least as revealing, and is robust given Allen’s (2001) high-frequency price data; most importantly, I note that historically, inflation dynamics have not just failed to accelerate, but in fact declined, from 1.3% p.a. in the pre-trough period, to just 1.13% in the post-trough period. The entire 31-year windows on aggregate thus qualify as low inflation periods, witnessing an acceleration of real growth figures, from low levels. A basic identity between posited secular stagnation attributes (low growth, low inflation) is thus undeniable – but the reversal has only made itself felt in the growth figures.

Figure XL: Nine safe asset shortage episodes (averaged), indexed; respective price level, real GDP evolution, 1471-2016.
II. SECULAR MONEY DEMAND AND VELOCITY

In the above, I have used money demand as a historical proxy for safe asset demand, given the arguments advanced in Krishnamurthy and Vissing-Jorgensen (2012) and others, who use money demand as a close proxy for Treasury debt demand; they find that money has equal seigniorage to Treasury debt and shares the same liquidity and safety attributes with our safe asset supply measure, long-term government debt. Both are equal “convenience assets” (ibid., 233-237).

I focus in this section, hence, on a long-run focus on money demand, and its conceptual twin – money velocity. As I show below, historically money demand is neither stable, nor is the income elasticity of money demand stable over time. The long-term “Ascent of Money” (Ferguson 2008) brought with it a deeper and deeper penetration of an original barter society, first by commodity, then fiat money, as wealth increments were increasingly identical to money increments. As Van der Wee (1977, 290) similarly observed, “in the later Middle Ages…the money economy had everywhere become more pervasive. An essential feature of urban growth, it had also penetrated vigorously the economy of the countryside, disturbing age-old customary routines as it did so…everywhere money was on the march”. Britnell (1993) has undertaken a valuable long-term study in this context for England.

Much more so than in many other areas, an investigation of money demand and velocity trends is confronted by definitional questions. In broad terms, the main fault line continues to run between the Cambridge School – focusing on income velocity, the ratio of GDP over the money stock (V=Y/M) – and Fisher, associated with the transactions approach (V= PT/M).117 Like Selden (1956) in what still constitutes one of the most careful examinations for modern U.S. data, we subsequently focus on income velocity, given that measuring transaction volumes involves significant difficulties, particularly for historical data. Even focusing on income velocity, however, we confront a wide array of definitional idiosyncrasies: Selden (ibid., 184f.) has identified at least 38 individual approaches in the literature

117 Here: V=velocity; PT (Y)=nominal output; P=price level; T=total transactions; M=money supply. The two approaches exemplified by Marshall (1923), and Fisher (1911). Also cf. Selden (1956, 180f.).
between 1933-1951 alone. What unites these approaches is that they overwhelmingly focus on U.S. data, and secondly, that none of them traced data back further than Warburton (1949), who begins his series in 1799. Some modern approaches (Bordo and Jonung 1990) broadened the geographical coverage, and others (Mayhew 1995) extended the temporal coverage, but focused on a limited geography. A long-term synthesis, a link to interest rates, and a link to the supply side – “safe asset supply” – is still lacking.

Selden (ibid., 198f.) agrees with Warburton (1940) and Wald (1946) that long-term bond yields constitute the best approximation for the cost of holding money, but actually uses corporate long-term bond yields, rather than sovereign bond yields – a choice that remains unexplained.118

By the mid-20th century, controversy still surrounded the question of the secular trend in (U.S.) velocity: Warburton posited a secular fall in trend velocity since the 18th century; Hansen (1949) and Selden (1956) agreed, though with some reservations about the slope of the decline; James Angell (1941) and Albert Hart (1948) posited a constant income velocity prior to 1929. Tobin (1965, 473) still opined that “velocity did not begin its decline until after 1880…no trend is apparent from 1914 to 1929”.

During the 1950s and 60s, monetarists begun detailed investigations into secular money demand and elasticity trends, but typically involving data over 50-60 year timespans, usually beginning in the second half of the 19th century.119 The literature mostly posited a positive but stable income elasticity of money demand. These discussions, however, long preceded “safe asset” debates. This proposition can be stated as its inverse, as in Warburton (ibid.), positing a secular fall in U.S. income velocity. In Friedman’s (1959, 327) words: “in countries experiencing a secular rise in real income per capita, the stock of money generally rises over long periods at a decidedly higher rate than does money income. Income velocity – the ratio of money income to the stock of money – therefore declines secularly as real income rises”.

Famously, Friedman (ibid., 329) considered money a “luxury in the terminology of consumption theory”. Portfolio allocation and opportunity costs considerations have in this regard been clearly posited: as Meltzer (1963, 226) states, “for a given increase in real wealth, the community has chosen to increase its

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118 Wald (1940) equally opts for corporate yields; Warburton on the other hand uses U.S. government bond yields.
119 This section draws heavily on the statistics and papers compiled and annotated in MFP, Boxes 46, 51, 92, and 96.
time deposits by a greater percentage than its demand deposits and currency. In short, the public has chosen to hold a larger proportion of its wealth in the form of income-yielding assets”. While the link between real income and money balances has been proven for limited periods in the U.S., the interest rate variable is more contentious. Friedman (ibid.) in his experiments notes that “the yield on corporate bonds is correlated with the real stock of money and velocity in the expected direction: a rise in the bond yield tends to reduce the real stock of money demanded for a given real income – that is, to raise velocity – and conversely. [Long-term] bond yields, however, play nothing like so important a role in accounting for changes in velocity as does real income”. On the other hand, Latane (1954; 1960) posited a strong correlation for U.S. high grade long-term nominal interest rates and income velocity, surveying data between 1909-1958: “the [data] taken together point to a rather close and continuing relationship between V and r. This is not surprising. For many purposes bonds are excellent substitutes for money…when interest rates are high, wealth-holders economize on their cash balances thus leading to increases in the turnover of money” (Latane 1960, 446).

Country-specific historical investigations of money demand have traditionally been undertaken in connection with the “price revolution” literature, with most of them using the monetarist interpretation of Hamilton (1936) as a point of departure (Riley and McCusker 1983; Goldstone 1991).

To my knowledge no accounts, however, aggregate the widely dispersed data, and link long-term historical insights to the contemporary secular stagnation, and safe asset discussion; crucially, virtually all existing accounts lack the inclusion of interest rate aspects, both nominal and real; not even proximate data – for instance on rents – are compiled for long periods: not much has changed since 1929, hence, when Hamilton (1929, 350) simply declared that “precise data concerning the course of rents…are lacking”. In any case, the monetarist position was rejected by later studies. Erroneously, contributions such as Hoffman and Rasche (1991, 673) continue to posit the existence of a “stationary linear

120 Friedman (1959) uses Macaulay’s (1938) long-term railroad bond data up to 1900, and Bureau of Census data (“Basic Yields of Corporate Bonds to 50 years maturity”) from 1900. He also uses a GNP basis for real per capita income, relying on Kuznet’s series.
combination of cash balances and real income…income elasticities are not significantly different from 1 in all specifications”.

I examine the (very) long-term behavior of real money demand, beginning with English annual data between 1311-2016. Conceptually, I follow closely the approach in Friedman (1959) in calculating real money balances and income on a per capita basis, rather than in absolute terms. His preference for per capita basis is not explained in Friedman (ibid.). Latane (ibid.) and Friedman (ibid.) also differ in their definition of money, with the latter including time deposits in his variable. Latane focuses on currency in circulation plus demand deposits only. I construct an index displaying real English per capita money balances in narrow and broad form, to test different approaches. The index is normalized to the year 1598, which represents the all-time trough in real broad money per capita balances in England.

I highlight several insights from a construction along these lines: in the very long-run, English real money demand expressed on the per capita basis exhibits a “U-shaped” trend, first showing a strong downward trajectory between the early 14th and late 16th century, against only marginally rising or stagnant real per capita income; after bottoming out in the final years of the 16th century, real money demand growth is outstripping real income growth until the second half of the 18th century, both in the narrow money definition, and in its broad form, when both converge. Between the late 18th and early 20th century, real broad money demand and real income are rising in parallel, and a clear outperformance of real money demand in lieu of accelerating real income growth cannot be detected. Our narrow money basis, encompassing all currency in circulation, sharply departs from the two parallel trends in the late 18th century.

121 Here on the basis of narrow money, M1.
122 Our narrow money definition between 1311-1695 includes only coin in circulation, as in Palma (2017), via Thomas and Dimsdale (2017), and from 1696 coin in circulation plus Bank of England notes in circulation; broad money is here defined as “Composite broad money measure based on M3/M4” in Thomas and Dimsdale (2017), sheet A.24, column BA. Real money balances are obtained by deflating by the consumer price inflation index in Thomas and Dimsdale (2017). Population data is sourced from Broadberry et al. (2015).
Turning to other geographies, I apply the same per capita concept to France during 1493-1680, constructing a series partly on the basis of Glassman and Redish’s (1985) money supply data, expressed in silver terms applying Allen (2001) conversions, displayed in Figure XLII. Being based on coin circulation, the index represents technically a narrow money index, but covers a time period where both narrow and broad money concepts are closely aligned. The index is again normalized to the trough in real per capita money balances, the starting year 1493. I note some differences to Figure XXVIII: the

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123 A fact that is also visible from the English data, where narrow and broad money indices only diverge with the arrival of what Temin and Voth (2013, chapter 6) recently termed the “boring banking” era, with sizable balance sheet growth, coupled with highly elevated levels of internal cash balances – a trend that would drive M1 – M3/4 divergence.

124 I take Glassman and Redish’s (1985, 43f.) “Series A” for money supply in Livres Tournois, converted to silver gram equivalents via Allen’s (2001) conversions for Paris to yield real levels.
trough in real money endowments precedes the English bottom by over a century; afterwards, real income and real money supply tend to be closely aligned until the fourth quarter of the 16th century, when the latter begins to dominate the real income trajectory. A meaningful acceleration in real money endowments per capita can be detected from the 1640s. Income velocity in absolute terms, meanwhile, displays an equivalent break to the downside in the late 16th century, and again by the 1640s, confirming that the trend towards “moneyness” is independent of the population variable.

Figure XLII: French real per capita GDP, real narrow money balances per capita, income velocity (PY/M) 1493-1680 (Log scale).

For U.S. data during the period of 1870-1954, Friedman (1959, 328f.) claims a real income elasticity of money demand of 1.8 to real income per capita: “a 1 per cent increase in real income per capita has therefore been, on the average, associated with a 1.8 per cent increase in real money balances per capita and hence with a 0.8 per cent decrease in income velocity”.
Can these relationships be found in the very-long run, and ex-U.S., context? I construct elasticity series in Figure XLIII. The left axis displays 11-year centered averages in real money per capita elasticity to 1% real per capita income changes for the two English categories, and for French performance. The horizontal lines (RHS) display period averages for both pre- and post-troughs in real money per capita balances (the year 1598 for England; 1493 for France).

**Figure XLIII**: Real per capita money balances, elasticities to real per capita income, 1320-2016 (11-Y centered avg).

The picture revealed in Figure XLIII quantifies precisely the implicit observation from Figures XLI and XLII – the turnaround in elasticities from the trough in real per capita money balances in 1598. Both English narrow and broad real money endowment elasticities prior to 1598 are clearly negative, -0.88 for the narrow basis, and -1.25 for the broad basis. The French elasticity between 1493-1680 is most obviously positive: in the 190 years covered, a 1% increase in French real per capita GDP lead to an
average of 5.02% in real per capita money balances – representing a far more apt period, hence, to posit the emergence of money as a “luxury good” along Friedman’s lines. Both English real broad and narrow money elasticities after 1598 stand above 1: at an average of 2.10 for broad money in 1598-2016, and 1.16 for narrow money (Table 1).

Table 1: Real per capita income elasticity of money demand, by period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Real Broad Money</th>
<th>Real Narrow Money</th>
</tr>
</thead>
<tbody>
<tr>
<td>1319-1597</td>
<td>-1.248</td>
<td>0.878</td>
</tr>
<tr>
<td>1598-2016</td>
<td>2.103</td>
<td>1.159</td>
</tr>
</tbody>
</table>

England, real broad money p.c., per 1% real capita GDP

England, real narrow money p.c., per 1% real capita GDP

1493-1680

France, real money p.c., per 1% real capita GDP 5.204

I can show in my data, then, that the increasing “moneyness”, the sharp increase in money demand defined either along Friedman’s (1959) or Meltzer’s (1963) lines, is a phenomenon stretching back far further than previous authors have considered. Elasticities are not stable, but have accelerated meaningfully (Figure XLIV). Since the late 16th century in England’s case, and since the late 15th century in France’s case, money per capita endowments across Europe have grown faster than output growth. In the case of broad money growth – the category closest to Friedman’s money definition – this growth has also been faster than posited hitherto.
III. DATA AND DATA LIMITATIONS

On the data side, a long-term historical aggregation of income and money statistics faces various limitations regarding coherence and granularity compared to the modern, short-term, single-country investigations in the literature. However, it should be re-emphasized that this paper is not concerned with cyclical trends, and even in the secular space uses a considerably longer horizon than employed by the longest U.S. study by Warburton (1949).

*Income data:* most studies with the typical modern U.S. focus employ either personal income, national income, or gross national product data, often excluding non-monetary income. Selden (1956, 238) recommends a definition of net national income (NNI) less all non-monetary elements, but including

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*Figure XLIV:* UK real per capita income elasticity of money demand, 1759-2014 (50-year centered average).
government sector income. My data instead focuses on real gross domestic product data, thus including both non-monetary income, and net international income payments. Maddison (2010) merged a variety of income approaches to arrive at his long-term series, ranging from value-added measures (i.e. Germany 1850-1938), to GNP by industry of origin (i.e. Canada 1851-1870) and expenditure approaches. The resulting GDP series is today widely accepted though. How large is then the potential bias from using GDP instead of GNP or NNI? Bureau of Economic Analysis (BEA) expenditure approach annual data puts U.S. GNP at 0.7% above GDP on average since 1929 (Chained 2012 Dollar basis); the largest divergence is recorded for 2011 at 1.5%.125

Among the velocity literature, my income series most closely resembles Currie’s (1933) approach; Wernette (1945), who switches between national income and personal income, and Warburton (1949), who uses personal income data, both posit a U.S. velocity trend fall; Hart (1933) uses gross national product and agrees with a trend fall if the denominator includes a broad definition of money (here including time deposits); though it is hard to quantify, there is thus no conceptual or empirical evidence why adjustments for net foreign income, depreciation, or indirect taxes should weigh on our long-term data construction.

**Money data:** it has been shown that U.S. income velocity exhibits divergent – sometimes contradictory – trends depending on granular variations in the denominator. Following the majority of studies in Selden’s (1956, 244) overview shows that perhaps only currency in circulation and demand deposits are uncontroversial elements in the monetary aggregate; disagreements concern the role of (a) government balances in cash, including Treasury cash and cash at Federal reserve banks; (b) bank time deposits; and (c) bank reserves and vault cash.

The method used in this paper – averaging volumes of coins minted – represents a broad money measure, and it rests on assumptions including constancy in hoarding behavior; it assumes changes in the share of other “illiquid” forms of money (such as time deposits, according to a subset of scholars) are

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125 The respective BEA account codes used are A001RX (GNP), and A191RX (GDP).
relatively negligible over time: “for any society or economy during the Middle Ages, coins represented the major part of the total money supply” (Roessner 2018, 161), even though one should emphasize – contrary to the position in Wicksell (1923) who asserts that (time) deposit banking represents a modern phenomenon, and dismisses its relevance for pre-19th century velocity trends – that the evidence for existing time depository banking today is relatively strong.126 In fact, case studies such as De Roover (1963, 98) put the share of time deposits at the Medici Bank in 1427 at 12.5% of total liabilities; the same author has argued for the existence of de facto time deposits in 14th century Bruges banks (De Roover 1942, chapter 13; Goldthwaite 2009, for Florence), and Mueller (1997, 366) has documented time deposits which required 6-months advance notice for the Grain Office, the public bank, in Venice by the 1300s. In the U.S., by 1892 time deposits only comprise 7.4% of total commercial bank deposits.127 Such funds, which necessarily derive from coins in circulation, are a source of overstatement in the denominator in the series presented here – if one believes they should be excluded. But it should be re-emphasized that 17 of the 38 definitional approaches in Selden (1956, 184f.) do not distinguish between time and demand deposits, and include both – an approach equally followed by Friedman (1963; 1959).

For sub-periods and countries where I use underlying mint and silver statistics (Germany, Castile), the well-known issues of circulating foreign coins, and balance of payment effects on coin circulation arise; to the extent that the share of foreign coins is not broadly constant, and to the extent that these geographies may have exhibited sharp fluctuations in trade balances, total legal circulating currency volumes may have fluctuated more than our statistics reveal.128 Our check against these potential biases is to average out money supply figures by 30-years, in line with previous approaches, and treat this timeframe as sufficient to smooth out underlying volatility. The problem is equally minimized once we

126 Wicksell (1923, 74f.) mistakenly states that “the large banks which arose in the middle ages in Italy and in Northern Europe at the beginning of the seventeenth century (in Venice, Genoa, Amsterdam, and Hamburg) had, initially at any rate, quite different functions from those of modern banks. Their chief task was to provide for a full-weight currency of guaranteed metallic content, or in other words a medium of exchange…[their] operations did not lead to any economy in the use of hard cash”.
127 See: Board of Governors (1943, 34, Table 9).
aggregate country-basis data, as German coin circulating in France now cancel out French coin circulating in Germany. Only the external balance of payments deficit of Europe then matters.

I currently do not cover one of the prime “safe asset providers” of Early Modern Europe, the Italian city states; the Florentine currency was regarded as the West’s reserve currency until well into the 16th century and the Venetian, Florentine, and Genoese long-term annuities so desirable that merchants and “institutional investors” (monasteries, knight’s orders) actually paid steep prices for the privilege to invest in these markets. For Florence and Genoa data has been assembled, however, and is set to be merged into the existing dataset. It is unlikely that this addition changes any of the conclusions of this paper.

However, an important limitation of this approach concerns “foreign” demand for safe assets, which would not show up in the money supply figures we have used. To the extent that meaningful imbalances with the ex-European world in the early modern economy drove accumulation, we are not capturing these factors. How significant could such neglect be? There is detailed evidence of meaningful trade deficits of the West with the Levant in early modern times: Ashtor (1971) posited that 75% of European trade deficits vis-à-vis the Middle East were accumulated by Venice, and Day (1973, 6-12) states that between 1300-50, circa 25% of annual silver mining was lost through the payments deficit; he provides no subsequent figures. This does not imply, however, that anywhere near these proportions found their way back into European rentes markets. I have found little archival evidence in account books and ledgers of such dynamics; neither do published sources who have collected investor registers revealed these domiciles as key sources of demand (StdAMs A IX; NStA B17/II; Mueller 1997, 314-317, for Venetian exchange with the Levant). Mueller (ibid., 317) for one concludes on the basis of Venetian exchange ledgers that “the exchange activity of Venetians with the Levant was not particularly significant…in comparison with the known examples of exchange and rechange with the West”.

Grierson’s (1961) investigation of Mediterranean financial networks broadly agrees with these

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129 For real GDP and population: Malanima (2011); for debt outstanding we can use debt data supplied by the public debt offices (S. Giorgi Bank in Genoa; Monte Comune fund in Florence) in Sieveking (1934); for mint output/money supply see Bernocchi (1974) or Spufford (1988, Appendix III, 415).

130 For a general introduction, see particularly Lopez (1973).
observations. Munro (2006) agrees, and considers the balance of payments deficit problem arising through during the 17th and 18th centuries from the East Indies trade as a more severe phenomenon.

POLICY IMPLICATIONS

This paper has argued that safe asset shortage periods are becoming more frequent in advanced economies over the long-term, and now affect 15-20% of real GDP at any time; it has sought to quantify – and qualify – major past safe asset shortage periods in historical context, and made the case that fiscal stimuli have in the past been effective at raising real GDP levels, but ineffective at lifting inflation.

To the extent that both income velocity and safe asset dynamics show relatively consistent tendencies over the past centuries in the fashion shown here, the results have important practical implications in the context of current debates about “safe asset shortages” and the conduct of monetary policy. Recent literature – for instance Caballero and Farhi (2018, 241) – suggest that in their “safety trap”, two “effective stimulative policies work by influencing the value of safe assets S (public debt issuance and QE…and r (increasing the inflation target)”. To the extent that the authors have the medium and longer impact on aggregate demand and real rates in mind, the historical record outlined above would suggest that such posited palliatives may not in fact be that “effective”: over the last 546 years, real rates, like inflation are on balance poorly correlated to safe asset dynamics for the prime asset providers during “safe asset gap” periods.

This paper has lastly made a case by drawing inferences from the long-run behavior of money demand. As the income elasticity of money demand accelerates in advanced economies, it suggested indeed that from this perspective, too, safe asset gap periods are set to become a more regular, and more intense phenomenon, if deeper historical trends continue. Policy responses should in this sense rather seek to better understand and address the accelerating dynamics on the demand side, which – if left unchecked – may on their own drag down safe asset values, along with nominal rates continuously further.
ADDENDUM: USURY AND FINANCIAL REPRESSION?

One may speculate that the lack of interest rate response from asset supply variation reflects various entrenched forms of financial repression, sovereign pressure, or other market failures. Most importantly, usury regulations have historically placed de jure ceilings on nominal interest rates – or, originally, even blanket banks on any explicit return on the loan principal – until well into the modern era, including 18th century Britain (Ashton 1960; Dickson 1967, esp. chapter 19). But we equally have enough examples of sovereign debtors simply throwing their lenders into jail or kidnapping them when they demanded repayment. Philip IV’s regular kidnappings and extortions of Flemish burghers, and Italian merchant-lenders are among the more notorious examples (Fryde and Fryde 1963, 479-494). In this sense, a section on financial repression and usury, questioning how responsive real rates could in fact have been to supply dynamics appears crucial.

The debate among economic historian on the practical relevance of usury laws has certainly been lively, and opinions differed sharply over time. Certainly, agreement exists that even de jure, usury laws were widely abolished following the Reformation (Glaeser and Scheinkman 1998, 25f.). Despite the very real examples encountered, on balance the weight of the evidence has confirmed that usury laws were highly ineffective in practice, and openly flouted, or interest payments more or less thinly disguised in currency arbitrage or “gift giving”, and that such practices were grudgingly tolerated or outright ignored by the Church early on. In the words of Charles Kindleberger, usury “belongs less to economic history than to the history of ideas”.\textsuperscript{131} Certainly, in the Italian city states first consolidating their public debt during the 13 century, including Florence, Genoa, and Venice, the payment of interest on the Monte Vecchio or Comune funds went ahead smoothly: theologians there justified the taking of explicit and predetermined interest here with the principle of \textit{damnum emergens} or \textit{interesse} given that the proceeds were used to defend its citizens (Munro 2003, 515f.). The higher effective interest rates obtained by

\textsuperscript{131} Cit. via Munro (2003, 506).
speculation in secondary markets was typically not seen as direct lending to the state, thus not being subject to usury laws (ibid., 516).

The emergence of rentes as a financial instrument, meanwhile, is directly linked to the circumvention of usury laws. The Carolingian census contract, from which it originated, allowed in-kind or cash deliveries for the use of land or property (ibid. 518). In its original sense it was therefore always strictly a compensation for real asset use. Neumann (1865, chapter 5.3) traces how gradually the Renten decoupled from any underlying real asset transactions, and the property morphed into serving as a collateral, a security for the creditor. Hotly debated among theologians during the first half of the 13th century, Pope Innocent IV in 1251 put an end to the controversies by declaring rentes not to be “usurius”, and all trading in the instruments legitimate (Munro 2003, 522). In 1416 the council of Constance ruled not only reaffirmed the legal nature of interest on renten, but also approved that already practiced habit of municipal rentes redemption (at the instigation of the debtor).

In short, there is no evidence that any of my country series incorporating rentes (Germany, Holland) should be subject to the problems raised by usury problems. Is the same true for sovereign loans and bonds? Certainly, the drastic increase in supply by the French Crown during the 16th century, and that of its Habsburg rivals in Spain merits closer investigation.

Doucet (1933) finds little evidence that the French Crown was able to exercise coercion in the 1550s. While he contends at one instance that it was generally regarded “unreasonable” and “against civil and canon law” (“deraisonnable et prohibe par le droit naturel, divine et civile”) in the Swiss Cantons – a preferred traditional investor base for the French Crown’s loan raising activities – to charge 16% annual interest, it was exactly this rate that the terms in the grand parti stipulated; we find short-term loans, raised in 1557 for the Italian wars, which carried an effective interest rate of 22.3% (ibid., 5). Regular charges that the Cantons turned a blind eye towards “extorque de tells usures” were brought forward, but evidently with little practical consequences for the financiers. Pezzolo (1999, 252) equally confirms that the legal interest rate ceiling of 8.33% neither applied to royal, nor to private rentes markets during the 16th century. Ehrenberg (1928, 324f.) equally contends that the Lyon interest rate setting was autonomous.
The Curia itself did not hesitate to enter into punitive loan arrangements as early as the 13th century, as Gottlob (1899, 675) documents: during the time of the same Innocent IV, no less than 150,000 gold ducats of principal debts were outstanding, with the same sum as interest charges. His predecessor Gregory IX was already heavily indebted to Roman and English merchants by the 1240s, with the subscriptions often disguised as “money collections”.


INTRODUCTION AND PROBLEM

Half a century ago, Simon Kuznets at the Third International Economic History Conference presented his rough outline of the capital accumulation process in the early modern economy between 1500-1750. Kuznets (1968) himself stressed the speculative nature of his considerations – but it is the thesis of this essay that the problems he raised remain highly relevant. It is worth re-stating his thought process: based solely on the high levels of early modern inequality, and allowing for multiples in consumption expenditures above subsistence levels of 3-5x for the top income shares, Kuznets (ibid., 32f.) believes gross savings rates to GDP of 5-13% could have been plausible levels for the period prior to modern
growth acceleration, thus allowing for substantial potential capital formation. Even taking the lower bound of this range, and allowing for extreme assumptions of the productive role of land, however, he arrives at net capital-output stocks by the year 1750 which strike him as too high (12.5x, assuming 0.4% p.a. GDP growth). Instead, given Deane and Cole’s (1962, chapter VIII) datapoints for 1688, a net capital formation proportion below 3% appears more realistic to him. But then high gross savings rates coupled with low levels of net capital formation could be explained by significant early modern levels of capital depreciation. In Kuznets’ (ibid., 48) words, “at the danger of exaggeration, one may ask whether there was any fixed, durable capital formation, except for the ‘monuments’ in pre-modern times, whether there was any significant accumulation of capital goods with a long physical life that did not require current maintenance (or replacement) amounting to a high proportion of the original full value”.

Much, if not most, in Kuznets’ essay remained conjectural, and the contribution did not rely on any empirical material, save for Dean and Cole’s datapoint above (and Gregory King’s famous 1688 numbers). It is not the purpose of the following to challenge Kuznets on the theoretical and econometric aspects of his propositions, or to reject various related, and misleading advances in the recent work of Scheidel (2017). Rather, it is to try to provide some insights on Kuznets self-assessed weak points: the actual historical data. On that basis, and against the background that a wealth of special country- and regional-level literature has been published since 1968, but few among those that try and make sense of aggregate, longer-term inferences, I will offer some thoughts on the capital accumulation process since the late medieval times.

From the outset, it begs more refined explanations that regional-level and case study evidence throughout the early modern period often find high gross investment levels after the 13th century (Heimpel 1966; Hilton 1973; Langdon 2004). Some studies which distinguish between gross and net rates have claimed net investment rates for English estates of 6.7-11.2% in the early 14th century (Stephenson
Yet on the macroeconomic level, very low net investment ratios, not higher than 3%, are usually posited.\(^{132}\)

Here, I attempt to address this seeming conundrum, and will posit that net investment ratios were meaningfully higher than standard accounts such as Kuznets (1961; 1968) have advanced previously. Germany and other early modern economies were well able to generate net investment ratios even higher than 1688 Britain. But what, then, explains relatively low levels of capital-income stocks at the eve of industrial growth? By creating a new series of “war-induced capital destruction events”, set in relation to battle deaths, I argue that the raiding warfare of the late 17\(^{th}\) century Europe – as destructive as World War One – must be part of the answer.

I will in the following often rely on flashpoints of evidence – in a similar spirit to Kuznets, but with an empirical approach. Towards the end, a more detailed focus on long-term trends in war-induced capital destruction is provided: to my knowledge a fully ignored aspect of the capital accumulation process.\(^{133}\)

The entire venture may ultimately at least lead to a few speculations on present debates: they could bear relevance on (a) the extent to which extreme levels of historical inequality were a net benefit to economies (Schmitt-Hebbel and Serven 2000; Piketty 2014); (b) the consumption-wealth ratio – a direct derivative of absolute levels of savings and savings propensities –, which has attracted some attention in the current policy debates (Gourinchas and Rey 2017): but a hesitancy to delve into historical dynamics has prevented a more robust analysis of its relevance. An empirical investigation can thus contribute to the debate on low real interest rates. And (c) finally, it can square an empirical conundrum that has been implicit for decades in the historical-economic analyses: long before income growth performance accelerated – a process that began sluggishly from the late 16\(^{th}\) and 17\(^{th}\) centuries (Broadberry and

\(^{132}\) Heimpel (ibid., 81) has documented gross investment ratios of 4.3\,-\,21.8% per annum for the Holy Spirit Abbey Biberach in South-West Germany; Langdon (2004, 179ff.) has argued that the fixed capital stock of English mills by 1300 must have stood at 200,000 – 350,000 GBP; Hilton (ibid, table 4, 193) found double digit levels of gross investment to income in Staffordshire, though his late 13\(^{th}\) century Cornwall are in the lower single digits (ibid., table 1, 185). Kitsikopolous (2000, 249) posited levels of up to 29.8% of income in pre-plague England on the basis of peasant budgets.

\(^{133}\) And one in fact entirely empirically absent from the recent Scheidel (2017).
Fouquet 2015) – real interest rate dynamics and capital accumulation trends were “ready” to trigger high growth rates. Sharp falls in interest rates can be identified in the early modern economy (Homer and Sylla 2005; Schmelzing 2019), and are paralleled by evidence of significant levels of capital accumulation. But why did Western European growth not “take off” in the late 15th century? We will investigate for the first time the long-run empirical role of capital depreciation and especially capital destruction in this essay.

CONSPICUOUS CONSUMPTION

At least since Veblen (1899) and Sombart’s (1922) classic works, the role of luxury over the long run, and its potentially key role in the evolution of capitalism has received attention. In more recent years, Lopez (1953) and Goldthwaite (1993) have made the case of a clear shift towards the acquisition of taste, and the neglect of previous business acumen in the Italy of the 15th century: Lorenzo Medici composes lyrics and is proud of his artistic patronage, while his family’s bank is sliding into bankruptcy under his watch (Lopez ibid., 32). Of course, extreme levels of luxury spending should already manifest themselves in lower gross savings rates – but since I am in the following deriving savings rates through the proxy of wealth shares over time, this section explores how much of an influence conspicuous consumption could plausibly have been: if it is found to be a major factor, it could have been the case that very high and rising levels of income inequality – as we observe during the first half of the 16th century, for instance – could have co-existed with low or falling gross savings rates.

Fortunately, we have some datapoints to illustrate the broader dimensions at issue: Francois I of France in 1542, personifying the peak of courtly extravagance in Sombart’s narrative, records total annual expenditures of 5.8m livres for himself personally. Sombart (ibid., 96-97) classifies 2.99m livres of these expenditures as “luxury items”. In 2018, inflation-adjusted terms, this would be equivalent to EUR 3.9bn annual “luxury” expenditure for the King personally (of which EUR 500m are spent on “presents”, and close to EUR 80m annually on falconry). 134

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134 Taking Sombart’s conversion of a 1542 livre into 3.34 contemporary Francs for 1912. Afterwards I deflate with French headline CPI, and assume 1 EUR=6.56 French francs.
In Germany, middle-class lifestyles also bear similar marks of the times. Extraordinarily lavish feasts and meals have been shown to be parts of socially accepted – and socially rewarded – acts of “demonstrative wastefulness” in the late middle ages (Fouquet 2012, 83). And such feasts took place more often during the year: on average, every fourth day of the year constituted a public holiday in Southern Germany of the 15th century: the total spend on social events, therefore, constituted a certain multiple in real per capita terms compared to the 19th century, when industrial workers on average logged 35-65 more working days per annum compared to late medieval typical equivalent professions (Dirlmeier 2012 [1983], 111). Similarly, Miskimin (1964, 486ff.) has argued that the increase in money endowments per head following the Black Death left two options for survivors: hoarding or spending. In his view, “spending…held the field”, with imported wine real expenditures per head and those for other luxury items doubling between the periods of 1261-1350 and 1351-1400, while quantities stayed almost fixed.

And yet, these reports from the late 15th century fade from the time the wave of sumptuary legislation both north and south of the Alps comes into effect. Killerby (2002, 26ff.) counts the enactment of 41 new sumptuary laws in Venice between 1306 and 1499; in Florence, 58 are passed between 1307 and 1497. Genoa – the first Italian city to pass a sumptuary law in 1157 – still counts 18 new additions during the 15th century alone. Increasingly, evidence from wills and household budgets indicate a decline in luxury spending. In fact, wills and wealth inventories drawn up at the time of marriages or inheritance occasions are often very detailed, and remain a valuable, but underexploited source today as well as 40 years ago: their utilization in the cultural and legal fields continues to far outstrip their inclusion into economic discussions, though the numbers of intact individual archival funds across Europe dating from the 15th century has been estimated in the hundreds of thousands (Von Brandt 1973; Paringer and Richard 2005). Not all wills include wealth inventories detailed enough to be of use. But Figure XLV summarizes a – here already simplified – “best case” inventory list of more than 40 pages drawn up by the Neuhof family of Wiesbaden, a top 5% Hessian household, detailing wealth components at the time of the death of the household head in 1749-1750. Particularly household items and furniture are typically broken down very carefully, and often grouped by the type of commodities (“Holtzwerck” for wood items; “Glaswerck” for
glass items etc.). In the Neuhof case, a total wealth of 6611 fl is recorded, 4307 fl of which (65.1% of the total) are financial assets, primarily private debt assets. We note that conspicuous consumption has apparently played a less dominant role: the two paintings are of miniscule value, and even if we include the large collection of “books” among luxury items, we reach not more than a 10% “conspicuous consumption share” in the mid-18th century. This constitutes a single datapoint, of course, but one that is easily scalable, and that suggests that: first, to assume a decline in the expenditure multiple can be empirically backed (see below); and secondly, that therefore wealth shares can remain a reasonable proxy for long-term gross savings/GDP series. Goldthwaite (2018) has recently highlighted the value of Florentine household accounts for similar exercises, though he refrains from aggregations or a more systematic exploration of longer-term trends.

Figure XLV: Wealth components, Neuhof family of Wiesbaden, 1749-1750.  

135 HHStaW 127/349, “Anteil der Catharina Dorothea Neuhof geb. Stachelroth, Ehefrau des Amtmanns Neuhof zu Höchst a. d. Nidder, am elterlichen Vermögen”. “Baarschaft” denotes cash (share: 0.8%); “Buecher” denotes books (share: 4.8%); “Kleider” denotes clothing (total: 3.5%); “Vieh” denotes cattle (share: 4.1%).
TOP 5% INCOME SHARES AND EXPENDITURE MULTIPLES

The first step in a critical evaluation of the “long-run” savings and capital accumulation evolution is the income and wealth distribution. Kuznets’ (ibid., 33) starting point was to assume a 25% income share for the “top 5%” of households between 1500-1750, which are the only source of aggregate savings. I have argued elsewhere that the assumption of the top 5% as the main origin of savings is increasingly simplistic approaching the 17th and 18th centuries, but a useful working hypothesis. But in light of five decades of intervening research, Kuznets’ first assumption must clearly be revised. In all of the following, I assume that wealth shares remain a relatively good proxy for income shares.

Perhaps Kuznets had Gregory King’s famous income distribution table for 1688 England in mind when he assumed a 25% share for the top 5% in early modern Europe. Indeed, the implied income share in this source comes close, at 24.1%. But we know today that these figures for late 17th century England are far from representative for Europe as a whole between 1500-1750. Herlihy and Klapisch-Zuber (1985, 100) showed that the top 5% of households in 1427 Tuscany owned more than 50% of region’s total wealth. More recently, Alfani (2015, 1084) calculated that the top 5% wealth share in the Italian Piedmont region between 1300-1800 bottoms at 32.6% in 1450. On average, it stands at 39.8% during 1300-1500, never falls below 40% from the mid-1600s, and peaks at no less than 49.9% in 1800. The shares are similar outside of the Italian north: Eulenburg’s (1895, 444ff.) “top 7%” in 15th century Palatia command 40% of wealth, close to the respective levels in Piedmont found by Alfani (2015). In the German city of Noerdlingen, Friedrichs (1979, 122) records for the top 5% a wealth share that never falls below 40% during 1579-1724. In other words, we find more confirmation that Kuznet’s 25% income share for the top 5% is also very likely too low: mid-point ranges of 40% can be assumed for the 15th century, and 45% for the 16th, with the figure plateauing until the outbreak of the Thirty Years War.

136 See Schmelzing (2019, above) on a savings scenario with more detail on the assumptions.
137 King (1802) in his well-known estimate implied a top 5% income multiple in Britain of 6.02x of average income for 1688 (251 GBP vs 41.8 GBP annual income). For the top 5% I take the twelve upper income classes reported by King, comprising a total of 48,586 households, out of the total 1.02m households.
Secondly, to arrive at plausible – at least rudimentary – savings series, a necessary further step is to investigate how realistic the expenditure multiples of 3-5x are which Kuznets invokes. A major item of early modern expenditure baskets remains rent. Dirlmeier (1978, 252) has grouped rent expenditure in early 16th century South German cities according to social classes. Dirlmeier (ibid.) distinguishes between three social income groups and reports annual rent expenditures for the upper third of 5-20fl per annum. The bottom third, in contrast, expends less than 1.5fl p.a. on rent.\footnote{Throughout, “fl” denotes the German “Rheinflorin” currency, not the Florentine florin (Fflorin).} If we focus on top 5% individuals, the implied expenditures in Frankfurt and Nuremberg certainly involve amounts above 75fl. As early as 1368, the house of the merchant-patrician Ulrich Stromeier commands an annual 91fl (ibid., 248). As an upper bound, one might consider the court of the Pope in Basel, reported as carrying a rent of 270fl for 1441-1442 (ibid., 244). Such proportions already suggest substantially higher expenditure multiples than Kuznets allows for. Schoenberg (1879, 137) puts the 5% threshold in Basel in 1429 at 2,000 gulden and above. Household maids and servants make up 20.5-22.3% of taxpayers in 1451, and given that they declare zero wealth, are assessed on their annual income: on average, these are recorded at 3.12 (maids) – 7.0 (servants) fl. p.a. (ibid., 302f.; Dirlmeier 2012 [1983], 102).

Burkhard Zink during the 1440s represents an Augsburg merchant at the at the lower end of the “top 5%” wealth spectrum. Based on his tax return data (Strieder 1904, 198), his wealth can be estimated at around 1,700fl in the 1440s. His annual income amounts to 200fl during the same period, in his position as a partner in a smaller merchant company. Though a single individual case, again, wealth-income ratios higher than the early 18th century are suggested. According to his autobiography, Zink maintains a 7-person household (himself, his wife, five children) on 100fl of expenditures per annum, and can dedicate between 40% and 50% of net income to savings (Dirlmeier 1978, 455f.). The income side, too, therefore suggests a higher expenditure level multiple than Kuznets (1965) assumed. “Habenitze” consistently comprise 40% of the total citizenry in German municipalities between 1498-1712 (Hartung 1898, 1279). It is also fairly safe to assume that the lower taxable wealth brackets were unable to save: we find no
representation of lower and even lower middle class citizens either as creditors or debtors in the detailed aggregations in various cities even for long time-spans.

Ogilvie (2010) has shown that there were significant regional differences opening up in Europe between the 16th and 20th century, both in consumption patterns and overall volumes. She calculated “retail ratios”, which may serve as a proxy for the diffusion of “modern consumption patterns” among the general population, and suggests that the Southern Netherlands or England showed multiples of 7-9x the consumption activity of relatively backward areas such as Württemberg (ibid., 302). Though theoretically the average spending per retailer could of course be substantially higher in Württemberg than in Northern Europe – perhaps given monopoly conditions and high guild entry barriers – related evidence does not suggest that this was the case. In this sense, any detailed reconstruction of expenditure multiples should incorporate a flatter downward slope for backward regions over time. Similarly, the breakdown in consumption between durable and non-durable expenditures should not be neglected; the share of consumption as a percentage of total expenditure (as opposed to rent, interest payments, taxes), however, seems to have been rather stable (De Vries 1993; Shammas 1993, tables 9.5-9.6).

That the general slope is downward, however, is clear from numerous sources. By the mid-19th century, there is evidence that expenditure multiples have decreased, and that they now come closer to Kuznets’ (ibid.) figures: Weatherill (1988, 93-136) suggests expenditure multiples between top 5% households and those in the middle categories of 3.6-4x by the late 17th century. Postel-Vinay and Robin (1992, 498) suggest a minimum-maximum total household expenditure multiple across French arrondissements in 1852 of 4.7x. Prais’ and Houthakker’s (1955) approach, which is in fact methodologically close to Dirlmeier (1978), in their study on British household budgets in the 1930s segmented the population bilaterally into “working class” and “middle class”, each comprising seven sub-

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139 See particularly the various discussions in Brewer and Porter (eds., 1993).
140 See summary table in Weatherill (ibid., 133): Lady Griselle Baillie’s household as “top 5%”, those of Gregory King, and Rachael Pengelly in 1694-1699 as “mean”.

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groups. Taking the “top 5%” sub-sample here (ibid., 184, comprising of the two uppermost “middle class” groups, summing to 213 households), we arrive at a weighted expenditure of 4229.4 GBP versus a “global” weighted expenditure average of 1489.2 GBP. This yields an expenditure multiple of 2.84, though it likely understates the “top 5% to average” multiple somewhat.

Despite that, the evidence still permits to proceed with a general assumption of a declining trend in expenditure multiples over time, certainly from the late 16th century – but such a general trend certainly masks meaningful geographical variation, especially between “backward” areas such as Wuerttemberg, and the vibrant consumer centers of the Protestant European North.

“NATURAL” CAPITAL DEPRECIATION

To make his case for significantly higher depreciation rates in early modern Europe, Kuznets – again entirely relying on conjecture, as he himself admits – states that “if most equipment lasted no more than five or six years, if most land improvements had to be maintained by continuous rebuilding amounting to something like a fifth of the total value per year, and if most buildings were destroyed at a rate cumulating to fairly complete destruction over a period from 25 to 50 years, then there was little that could be classified as durable capital” (ibid., 48). On this basis, Kuznets reaches depreciation rates of between 8.3% (gross product) and 9.6% (net product) during 1500-1750 (ibid., 50).

Do the empirics support his scenarios? In German municipal archives, we find collections on “Hausurkuden” – housing contracts – which document changes in ownership, and damages over the life of the object, and which have been preserved by official notaries, to keep accurate tax registers. The Frankfurt archive (ISG) keeps one of these funds. Going through these documents can give us a sense of the average life of one of the key components of early modern capital stock – residential real estate. To my knowledge, it has been widely neglected in the literature thus far to infer depreciation rate trends from such archival funds.  

141 Note that I exclude all dynamics that may be related to inventories. This could potentially be a source of mis-measurement in all of the below. Inventory investment in early modern times was typically high, given the need to hedge against harvest volatility.
Exemplary, take the case of the house “Zum Sachsenhausen”. In ISG (HU 15), we find the entire lifespan of the residential building documented in detail between the years 1559-1774. After the death of its final occupant, the widow Mrs. Lamoine in 1774, the house was taken over by the Frankfurt municipality itself, after the death of the final owner. Over the course of 215 years, only two major constructions or repairs are registered by the notaries: in April 1619, both the neighboring house and the house itself are damaged by a “broken pipe” through which water invaded the walls (ibid., fols. 4, 7). In April 1705, it is registered that a new horse shed is added to the main building (fol. 13-14). We learn that in February 1693, the annual rent charge was fixed at 90fl (ibid., fols. 12, 15): the value of the house, based on typical capitalization rates, must have ranged between 450–900fl. Elsas (1936, 593-624), on whom Allen (2001) relied for Augsburg prices, reports wood prices in 1612 of 168 denar per Reif, or 0.007 gram silver per liter. A 2% maintenance charge – and maintained the house was, for more than three centuries – would therefore buy 4551 – 9103 litres of wood: enough to build a new wooden roof, together with a new horse stable, every other year.\textsuperscript{142} For the same price, the tenant could have bought between 2,400 – 4,800 roof tiles, according to related prices in Elsas (ibid., 623).\textsuperscript{143} Today, such amounts would cover a roof area of 36-72m\textsuperscript{2}.\textsuperscript{144} Against such evidence, even the lower bound of depreciation charges appear to this author quite high. These are so far scattered archival datapoints. But printed primary sources from other cities tell a similar story: Schaab (1841, 438ff.) included a detailed historical overview of ownership changes, tax charges, and construction measures for a meaningful number of houses in his hometown of Mainz since the 16\textsuperscript{th} century. We learn that several prominent buildings were destroyed by the Swedes in the 1630s “to gain coal” – but these are the standout “destruction” cases in a house-by-house survey beginning in the late 15\textsuperscript{th} century. Most reports detail houses passing through the generations.

\textsuperscript{142} Note that I could not directly locate Allen’s reported “Augsburg firewood” prices in the underlying Elsas (1936, 593-624). He might in fact be referring to Wuerzburg prices.

\textsuperscript{143} I take Elsas’ (ibid., 623) price of 112 denars for 100 tiles for 1614, and convert on the basis of the silver equivalents in (ibid., 122) 100 tiles to 0.366fl.

\textsuperscript{144} Contemporary sources – for instance evidenced by the “Roofstores tiles calculator” online – in fact suggest that this is a conservative estimate, and that a volume of 12 tiles per square meter could suffice.
Now I assume that 20% of the wealth stock is reproducible fixed capital, not an unreasonable assumption against a total non-financial asset wealth share around 70%, and after a period of comparative geopolitical calmness. Taking the midpoint of the German wealth-income ratio for 1480 above (263%) then yields a fixed capital stock of 52.7% of GDP, or an initial gross value of 128m fl. Now one can either opt to choose a fixed depreciation rate, or a fixed net investment rate, as two sides of the same coin. I opt for a 2% depreciation rate (of the capital stock, translating into an initial 1.05% of GDP), on the basis of my Frankfurt housing example and provide two further scenarios with a 1.5% and a 5% depreciation rate of stock. Note that the latter is Kuznets’ most extreme scenario, but he considers it among the range of plausible trajectories. In Figure XLV, however, under my plausible conditions outlined, the 5% depreciation scenario is to be fully rejected, providing an average annual capital stock contraction of 14.2%. The 2% depreciation scenario yield a net investment ratio of 2.8% - which is an interesting figure because it matches Kuznets’ (ibid., 34) and Dean and Cole’s (1962, 278-314) upper bound estimates for Britain in 1688. The basic result here is that departing from all the plausible starting conditions in 1480: depreciation rates, savings rates, real GDP growth, and expenditure multiples, I can show that it is entirely plausible that even in the mid-16th and throughout the 17th centuries, net investment ratios meaningfully above current “upper bound” estimates – at one for a leading economy like Britain in 1688 at that – are reasonable. In fact, any “natural depreciation rates” above 3% (and not assuming extreme conspicuous consumption scenarios) would yield implausible trajectories. It is relatively likely that the capital-output ratio in Germany at the beginning of the 17th century was quite comfortable. One easily finds additional evidence to Mrs. Lamoine’s situation above: Diez (1925, IV/1, 17) for instance reports that the city of Frankfurt during the entire Thirty Years War, when it constantly had to fear an invasion or bombardment, spent a total of 400,000 Florins on construction and fortifications. With a population figure of 12,000 at the time, this translates into just 33fl per citizen – spread over a period of 30 years.145

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145 Per annum, this translates into about one monthly income for a fully propertyless “Habenitz”, who did not have to pay taxes given his destitute situation. See Dirlmeier (1978).
In short, we have to look elsewhere to find a driver that explains high, almost modern net investment ratios in European economies, and at the same time remains consistent with the low capital-output ratios at the beginning of growth “lift-off”. That driver, it is posited, must empirically be found in war or large financial shocks. We turn to the former now.

Figure XLVI: Three scenarios of the German net investment/GDP ratio, under 1.5%, 2%, 5% p.a. depreciation of stock, 1480-1819.

CAPITAL DESTRUCTION

Warfare was at the heart of early modern political existence: 95% of years in the 16th century experienced great power conflict (Tilly 1992, 72). But at the heart of warfare, in turn, lay capital destruction itself. Echoing Caferro (2008), in her study of the 14th century Languedoc, Firnhaber-Baker (2010, 96) recently observed that
“The prevalence of raiding and the relatively low mortality of warfare stemmed from medieval war’s focus on causing economic damage rather than on producing casualties. While modern wars have generally sought to inflict as much death as possible on the opposing army, this emphasis on killing only became usual in the fourteenth and fifteenth centuries after royal and princely armies began employing large numbers of paid recruits rather than relying on knights and feudal dues of service. Prior to what is sometimes called a medieval ‘infantry revolution’, attackers aimed instead to weaken their opponents by destroying or stealing as much of their productive resources (tools, grain, livestock) as possible.”

Certainly, then, in pre-Westphalian European economies, we should expect the rhythm of war to leave strong marks on the wealth-income ratio (an influence on which Piketty [2014] remains quasi silent). Of course, any precise long-term tracing is hampered by the scattered data availability, and one should not harbor unreasonable expectations regarding the granularity that can be offered. I should also emphasize that I leave out for the moment capital destruction caused by fire or natural catastrophes: at least for the former, a downward secular trend would ex ante be expected as well, due to better protection mechanisms over time. To determine more precisely the possible role of capital destruction over the long run, and its role in the capital accumulation process, it is helpful to first begin with an imaginary extreme scenario, for the example of Germany, for which the data is most precise. Figure III shows an “eternal peace” trajectory of the wealth-income ratio since the year 1480, which simply assumes that an initial wealth stock in Germany in the late 15th century rises smoothly with the real rate of return on total wealth. I have in the first part above shown long-term return series for “private R”, “public R”, and for land over time. Together with “non-productive” components (in the archives we typically find the most common ingredients to be cash, cloth, jewelry, household items), these three “productive” components here make up the wealth stock. I have also shown some snapshots of wealth shares among these components, including from aggregate Italian cities, entrepreneurs, tax surveys, and individual wills from Germany and

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146 Private components there include capital depreciation, though we do not know at what level this rate is precisely.
Italy. Prior to 1688, when Goldsmith (1985) begins his balance sheet series for Britain, we currently do not have detailed aggregate breakdowns: until that is the case, reliance on these simplified case studies will be needed. But a plausible distribution consistent with such evidence over time is here taken as: 30% private debt and investments, 20% public debt, 35% land and real estate (immovable wealth), and 15% non-productive assets. The latter yield zero nominal returns over time. The other three assets are imputed here with nominal returns from the above series for Germany, and – for real estate – the “global” sample, respectively. The starting point for average per capita wealth levels is taken from a representative regional study in Eulenburg (1895, 451), who put the figure at 105 fl per taxpayer in the year 1439 for Rhine-Palatine, based on tax assessment data in 61 towns and cities. In line with Hartung’s (1898, 1279) estimates, I put the share of the population without taxable wealth at 40%, thus reaching an average per capita wealth level in the year 1480 of 63 fl. Of course, on its own such data may be quite unrepresentative for Germany as a whole. But importantly, various other urban-level and Empire-wide datapoints point towards very similar values.\(^{147}\) The Empire-wide “Common Penny” tax assessment from 1495 revealed a total financial asset stock (which capitalized real estate, but excluded cash) of 800m fl (Isenmann 1980/2, 166; Schmid 1989), which yields a remarkably close 66.7 fl wealth per capita stock if we take Maddison’s (2010) German population figure of 12m for 1500.\(^{148}\) For the income side, I rely on Dirlmeier’s (1978, 511 ff.) estimates for average annual incomes in South German cities. “Habenitze” – citizens without taxable wealth, and for whom one can assume that income equal expenditure levels – in Freiburg in 1470 may realistically have earned between 5-20 fl p.a. In Groningen in 1448, the range falls between 2.7 – 14.3 fl p.a. (ibid., 513), with dependents covered in both cases. Construction workers constitute the “representative” profession by the late 15\(^{th}\) century in Dirlmeier’s (2012 [1983], 103) view, with income

\(^{147}\) Generally, see Van Zanden (1995) for an early discussion on such inequality trends.

\(^{148}\) Maddison (ibid.) takes present-day geographical boundaries, but note that the Empire-wide tax assessments did not include the autonomous regions in Northern Italy, and present-day Netherlands in any case (Schmid 1989, chapter 3.2; more generally on de facto jurisdiction: Whaley 2011, 19 ff.). But an upwards adjustment should be made for the Austrian Habsburg lands, Bohemia, Reichsstaedte in present-day Switzerland (Basle), and Western Poland (ex-Pomerania). Estimating these at 3m additional population on the basis of Maddison (ibid.) would yield a 53.3 fl per capita wealth in 1495.
levels between 23-24 (Nuremberg) and 45 (Frankfurt) fl pre-tax income per annum. These figures align well with Braudel’s (1972, 460) estimate of a 20-35 ducat per capita GDP for the Mediterranean world during the second half of the 16th century, which translates into a 24.5 – 42.9 fl income range. I thus operate with a lower initial per capita income of 19.1 fl – assuming Nuremberg “representative profession” income for the 60% of taxpaying population – and an upper range value of 32 fl – the Frankfurt “representative profession” income for the 60% of taxpayers – for the year 1480. For the city of Mainz, a bishop- and Imperial-elector seat of considerable influence, we have a wealth assessment from the year 1541. Per taxpayer, it records an average taxable wealth of 200 fl, according to the compilations of Herrmann (1914, 90). Based on our Germany-wide average per capita income for 1541 (at 47.1 fl), adjusting with the prevailing “Habenitze” share, we reach a wealth-income ratio of 255%. This does not suggest dramatic changes from the late 15th century. The city was affected, together with most of the German South-West, and North-East, by the German Peasants War in the 1520s, and, as we will see, by recurring regional power struggles with the Princes of Nassau. Braudel (1972, 455) implies a wealth-income ratio for a smaller Brescia commune in 1555 of 409%, with 46% of wealth in the form of real estate, based on tax assessments, and reported damages to property after a fire. Goldsmith (1987, 148ff.), relying on Herlihy and Klapisch-Zuber (1985) for Florence at the time of the 1427 catasto implies a wealth-income ratio of 339%.

Altogether, creating average ranges for the estimates of German data, an aggregate initial wealth-income ratio range between 197-330% for Germany in 1480 is plausible. Figure XLVII is now meant to illustrate the dynamics that would gain momentum if observed wealth and income gains were left “unchecked” by wars or other shock events. My “nonhuman wealth return” observations for Germany

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149 As opposed to agrarian workers on “daily pay” arrangements, construction workers were in Dirlmeier’s analysis in fact more regularly employed year-round, hence annualizing day rates with 265 working days renders de facto total income (cf. ibid., 93ff.).

150 Assuming 1 Dukat = 1.376 Rheinflorin (fl.) from 1559, and an 11% per capita income gap between the Mediterranean and Germany in 1500 (Braudel 1972, 460; Maddison 2010). See tables in OeStA FHKA Beeriana Nr. 1/3a-1. Consistent also with the proportions implied in Allen (2001).

151 Clericals are excluded from the tax assessment, reports Herrmann (ibid.). But they are excluded in the Empire-wide tax assessments, too (Isenmann 1980/2).
show consistently higher year-on-year growth rates throughout than Pfister’s (2008) or Maddison’s (2010) real per capita income gains. Compounding returns work their power: war, indeed, is in this sense “the great leveler”. Scheidel (2017), however, almost entirely relies on 19th – 21st century evidence, and provides no relevant own early modern data (certainly not on aggregate real wealth return trends), despite purporting to illuminate trends since the “Stone age”.

Figure XLVII: “Eternal peace” wealth-income ratio scenario – no wars or external wealth shocks, 1480-2008, Germany.

We can certainly confirm such practices across Europe, and will try to quantify the effect to the extent possible. Pisa after its brutal defeat at the battle of Cascina in 1364 had to compensate Florence for war

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\[152\] For the real “non-human” wealth return series used in Figure XLVII, I weigh the data introduced in Schmelzing (2019, above) with the following shares: private debt – 30%; public debt – 20%; real estate – 35%; and non-productive goods (with a 0 return) at 15%.

\[153\] For a detailed discussion on town destruction, see particularly the contributions in Batlome, Flueckinger, and Koerner (eds., 2000).

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damages totaling 100,000 Florins. The latter, following its defeat at the War of the Eight Saints 15 years later, was assessed at 250,000 Florins in damages to Pope Gregory XI; Padua had to submit the same sum to Venice in 1373, after the battle of Buonconforto (Caferro 2008, 175). The number of deaths at the former is put at 1,000; that in 1379 at 4,000. The capture of Chioggia by Genoese and Paduan soldiers in 1379 had cost 860 defenders’ lives and was assessed later with an indemnity of 100,000 ducats (Kohl 1998, 209-212). Here in these Italian condottieri wars, we thus regularly reach ranges of 55.5-100 Florin in “assessed damages” per battle death, which are not free from biases, but represent the best approximation of total wealth destruction; when we compare soldiers salaries and allow for some capitalization, it is clear that the indemnities typically included both human and fixed capital compensation. At the “Mainzer Stiftsfehde”, a feud over the prestige and income of the Mainz Diocese between regional counts in 1459-1463, the restitution was fixed at 40,000fl. in a draft agreement from the first phase of the conflict (Menzel 1870, 5). The Chronicles differ in their reports on deaths, ranging from 462-636, and 150 destroyed houses (Sprenger 2005, 110). This would yield approximate values of 62.9 – 86.6fl for every dead. If we value the average house in a German leading city in the mid-15th century at 50fl (see house-by-house values for Mainz in Schaab 1841; for the German South Dirlmeier 1978, 250ff.), we reach a plausible compensation for houses of 7,500fl, which leaves 32,500fl for human losses, and implies a range of 51.1 – 70.3fl per death. Obviously, there are elements of damage not specified in value – for instance on the city walls – and for which we do not know if they were included in such sums, or otherwise compensated for. But we observe that those “seigneurial wars” covered for Italy and Germany typically exhibit capital stock costs of 12,500-19,700 US$ per battle death in 2019 terms.

154 Here referring to Florentine florins, throughout denoted “Fflorins”, as opposed to Rheinflorin/Rheingulden (fl).
155 For instance, see the salaries paid by the Genoese for mercenaries in Kohl (1998, 216). If we assume on the basis of his data that a 27-men detachment earned 150 ducats per month, we would reach a personnel cost of 4778 ducats for the 860 killed soldiers per month. A typical contract saw a three month service agreement.
156 I have here calculated with an August 2019 gold price per gram of 48 US$. Both the Rheingulden and the Florentine Florin weighted 3.54 grams of gold until1386, when the Rheingulden began depreciating. From 1386-1490 to 3.36g, until 1550 to 2.53g, and from 1559 held at 2.5g. See Spufford (1988), and OeStA FHKA, Beeriana Nr. 1/3a-1. One can equally justify using long-run price indices such as those in Allen (2001) to reach PPP equivalents.
Caferro (ibid.) and Firnhaber-Baker (ibid.) characterizations imply major shifts of the strategic focus in European warfare, away from targeting property and the capital stock, towards targeting human capital and the direct physical opponent. Can we find quantitative evidence to support such arguments? Has the shift in feudal battle strategy inadvertently led to a major acceleration in the capital accumulation process by the early 16th century? The military innovations of the 16th century should provide some intuitive hints. As Hale (1985, 216ff.) notes, improvements in mining led themselves conveniently to the new demands of naval and land-based warfare: they enabled the substitution of iron for stone cannon balls. But the shift did not necessarily imply a reduction in capital destruction: we learn that while between 5,500 – 10,000 cannon balls were fired against Padua in 1509, 40,000 were fired against Rhodes in 1522, and no less than 140,000 – 170,000 cannon balls by the Ottomans against Famagusta in 1571 (ibid). Casualty figures for defenders are miniscule, 5,060, and 7,600, respectively (i.e. more than 20 cannon balls per battle death by the mid-16th century).157

During the Thirty Year’s War, the capital stock destruction in Central Europe, particularly in Germany and Austria, rose to extreme levels: when aggregating the various regional reports, it is remarkable how similar the estimates tend to be. Nichols’ (1989, 260) reports indicate that in the war-affected Austrian regions of Krems and Stein, 70% of dwellings were left destroyed. At 64.4%, Miehe (1990, 36) reaches a very similar figure for destroyed dwellings for the bishoprics of Magdeburg and Halberstadt. In Württemberg, dwelling destruction was reported at 50%; in the regions of Brandenburg, Mecklenburg, and Pomerania the range was put at 50-60% by Zeeden (1975, 332). In the city of Augsburg, real wealth per taxpayer plunged by no less than 39% between 1618 and 1648 (Hartung 1898, 1276-1280; Mayr 1931; Schmelzing 2019, above).158 In the city of Noerdlingen, total real wealth fell by no less than 93.5% between 1621 and 1646 (Friedrichs 1979, appendix III-IV).159 Some major towns – Magdeburg, famously – vanished completely in the course of the war.

157 All casualty figures based on Clodfelter (2008).
158 Deflating Hartung’s (ibid.) and Mayr’s (ibid.) data with Allen’s (2001) CPI for Augsburg.
159 Friedrichs (1979, appendix IV) deflates Noerdingen real wealth with Allen’s (2001) Augsburg index, taking a nine-year average y-o-y CPI, which as a result mis-times the Kipper- and Wipper inflation (in Friedrichs’ index, the
Hippel (1978, 442) reports a decline in outstanding Guelten values in Wuerttemberg between 1629 and 1655 of 3.9bn fl, to 1.2bn fl, and direct war-related mobile and immobile capital costs of 58.7m fl. Values of dwellings declined on average by 75% during the same period according to his estimates (ibid., 441) – these figures would suggest that financial and non-financial wealth components were affected in similar proportions, and we should be able to regard all of these damages as directly war-related. Thus, Hippel also implies a rising capital-labor ratio as a result of the war. Taking Hippel’s (ibid., 421, 437) estimate for the total population change in Wuerttemberg of 57% as a benchmark, we would reach a “capital stock cost” of 308 gulden per death over the period of 1629-1655. Levy (1983, table 4.1) reports total battle deaths of 2.07m – the overwhelming majority of which were Germans (mercenaries and in domestic armies).\textsuperscript{160} If we now proceed on his basis and estimate therefore that 28% of total deaths were battle deaths, we would reach a per capita cost figure of 1,101fl per battle death. On aggregate, such datapoints imply a capital stock adjustment for the Holy Roman Empire, including Bohemia, of 1.85bn fl, or 141% of 1629-1655 real GDP in 1610 prices. This should be seen as a midpoint among estimates: population losses closer to 45% of the 1600 total population would suggest a decline in the wealth-income ratio of 154% of 1629-1655 real GDP.\textsuperscript{161} In 2019 prices, we reach a capital stock cost per battle death of 52,335 US$; if we apply the low number of battle deaths, however, we reach a cost of no less than 792,840 US$. These are wide ranges, and the low number of battle deaths remains questionable. But both figures equally suggest that transition from the seigneurial “raiding warfare” did not lead to lower capital destruction: quite the opposite.

The wars of Louis XIV fall into a period of transition. Intent to erect a buffer zone to the Holy Roman Empire, the French King invaded his Eastern neighbor in September 1688, with a record force of 30,000 men. Once occupied, he ordered the destruction of numerous cities in the German Palatine, including the

\textsuperscript{160} Clodfelter (ibid., 34ff.) reports much lower battle deaths of just 350,000 but voices skepticism about this figure himself.

\textsuperscript{161} When reporting such ranges of estimates, I proceed by taking midpoints for the preferred aggregations, unless explicitly mentioned otherwise.
full destruction of Mannheim, Speyer, and Worms: “the French resolve to destroy everything in their paths spelled the end for hovels as well as for fine houses, as French war parties collected tribute and burned their way across the countryside” (Lynn 1999, 198; Lynn 2002). We need to resort to the local level to obtain estimates on the capital cost. The duchy of Baden-Durlach appears to be the only one that systematically tried to quantify the damages from the French devastation: in the local Chronicles, we find an estimate of total damages amounting to “over 9 million Gulden”, against a loss of just 284 citizens (Schreiber 1817, 223), which would suggest a capital stock cost of 31,690 fl, or 3.8m US$ in 2019 terms. This is quite an elevated number, but can be rationalized by the fact that the French commanders were ordered to ensure the population had a chance to leave the cities, and take their possessions with them, prior to setting entire communities ablaze (Lynn ibid., 197ff.): again these figures suggest a further escalation in real capital destruction from the days of the Renaissance.

World War One set back the British capital-output ratio from 257% in 1914 to a trough of 229% in 1917 (Dimsdale and Thomas 2017);162 its net capital stock (reproducible plus non-reproducible) declined by 111m GBP in the four years of 1915-1918 (Feinstein and Pollard 1988, 443), with most of the decline being concentrated in dwellings and other non-residential buildings (-111m GBP), and ships (-35m GBP peak-to-trough, with other categories showing net increases). This would translate into a net capital stock cost of 135,000 GBP per British battle death, or 82,074 US$ in 1990 international terms (Maddison 2010), on a narrower capital stock definition than the other case studies.163 Since the British Isles never fought an international conflict on their own soil after the days of the Norman Conquests,164 its case is unlikely to be representative for the aggregate sample over time: but dwellings and ship components were of course historically key items of relevance for general political conflicts. This warrants a note on naval warfare: ex ante, we should expect it to be a much more capital-intensive form of battle than land-based

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162 Here: dwellings and non-dwellings capital stock (tab A.55) and GDP at market prices (tab A.9, via Mitchell 1988).
163 I take 855,000 British battle deaths, via Statistics of the Military Effort (1922, 352-354).
164 Considering the Irish conflict a domestic one, and excluding engagements on colonial territory, with the Glorious Revolution, the Anglo-Spanish Wars, the Battle of Britain, or the Falklands War never amounting to actual territorial invasions.
ones. It may be useful to see if we detect even sharper patterns over time here. The first British iron warship, the *Warrior*, had cost 377,292 GBP when it was completed in 1861, a ninefold increase over the cost of the *Victorious* completed in 1809 at 41,796 GBP, one of the flagship 74-gunners of the Royal Navy during the Napoleonic Wars (Winfield 2014, 69, 389). In February 1677, British Parliament approved the “First Great Shipbuilding Programme” at a cost of 600,000 GBP for 30 thirty battle ships (Lavery 1983, 42f.). During the Third Anglo-Dutch Wars 1672-1674, we can thus approximate that the engagement between Dutch Admiral De Ruyter and the Dukes of Sandwich and York in May 1672, which resulted in the loss of four British battle ships as well as 750 battle deaths (Clodfelter 2008, I, 20; Barry 2018), translating to a capital cost of just 314 US$ per battle death in 2018 terms. James I launched the ship of the line *Prince Royal* in 1610 at a cost of 20,000 GBP (Lavery ibid., 12): the Cadiz Expedition in 1625, which sunk 62 British vessels and cost 7,000 seamen’s lives, must therefore have come at a cost of around 531 US$ in 2018 terms as an upper bound – which, again, suggest low figures compared to the destruction wrought across the European land theatres. Henry VII in 1486 ordered the construction of two battleships for 1,000 GBP, in what amounted to the largest shipbuilding venture in Europe; Henry VIII launches the *Henri Grace a Dieu* – the largest European warship of the 1520s – for a total cost of 8,708 GBP (Konstam 2008, 35, 105). These naval figures are mentioned here since future refinements of the capital cost series should aim to incorporate the changing role of “global” warfare by attempting to weigh land- versus naval-based engagements: the present material suggests that the latter may show a directly opposite trend of secularly rising real capital costs per battle death from the late 17th centuries.

The Battle of Britain stands out among capital destruction events during the 20th century: Clodfelter (1992, II, 799) reports a total 1,400,245 destroyed or damaged British buildings over the course of the German aerial campaign, against human losses of 43,000 non-combatants, and 1,494 RAF combat deaths. Based on Holman’s (via Dimsdale and Thomas 2017, tab A.32) data on historical housing values, and assuming a damage level of 50-75%, we would reach a capital stock impact of 677-1,015m USD in 2018.

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165 For contemporary data and more technical accounts, see NWS (1918).
terms, or no less than 453,000 – 679,000 USD per RAF battle death.\textsuperscript{166} For Nazi Germany, Kuznets (ibid., 34, footnote 3) estimated the decline of the capital-output ratio during World War Two at just under one-third, a figure closely in line with Piketty’s (via WID 2017) data suggesting a drop in net terms from 317% in 1940, to 195% in 1945.\textsuperscript{167} In terms of the aggregate wealth-income destruction, we note that the Thirty Years War remains slightly more destructive than World War Two for Germany. Even in bombed-out Berlin itself, estimates put the share of destroyed buildings by the time of the capitulation at below 30\% (Mueller-Mertens 2000, 373f.), a figure below most of the lower bounds reported above for the Thirty Years War. With the number of battle deaths for Nazi Germany today estimated at 5.3m, we would reach a capital cost of 89,284 US$ on the Maddison (2010) basis adjusted to real 2018 terms.

Since the Japanese attack on Pearl Harbor, no war-related fixed capital stock destruction has taken place on the soil of the United States. Since the launch of the final V2 rocket by the German \textit{Luftwaffe} on March 27, 1945, and its impact at Kynaston Road, Orpington, Kent, on the same day, this is equally true for the United Kingdom (Dornberger 1954); and since the German capitulation in May 1945, this has been universally true for Western democratic economies’ home soil. The past 74 years in this sense represent the longest period of absence of war-induced wealth and fixed capital shocks for advanced economies as a group since at least the late middle ages.

We could, however, consider the September 11 attack as a war-induced capital destruction event on the soil of the United States, since with the “Global War on Terrorism”, it was met with a direct military response, and triggered NATO’s article 5 clause. When we follow the Comptroller of New York’s (2002, 2-5) assessment of a total property and physical capital damage of US$ 21.8bn, and set this into relation of a total of 2,819 victims in New York, we reach an unprecedented 7.7m USD per battle death figure (2001 USD), an amount meaningfully above the Nine Years War damage intensity. Of course, spread

\begin{footnotesize}
\begin{itemize}
\item \textsuperscript{166} Here assuming 1 GBP=1.25 USD. 1938 housing prices inflated via Dimsdale and Thomas’ (2017, tab A.47) aggregate CPI, not the house price index.
\item \textsuperscript{167} All German estimates trace their way back to Hoffmann (1965, table 10, and chapter 2.3.1).
\end{itemize}
\end{footnotesize}
across the 74 years of peaceful “home soil” capital preservation, the event does not upend the narrative that capital destruction has become an extremely scarce factor.

Figure XLVIII now aggregates all these figures into an inflation- and population-size adjusted long-term series which, despite all its remaining shortcomings, is able to offer some broader ideas about the long-term capital destruction process. I use Levy’s (1983, table 4.1) calculations of “battle death intensity” of Great Power Wars since 1495 to obtain underlying battle frequency. Levy calculates “intensity” as pure battle deaths (excluding civilians, victims from famine) per million European population, which I divide by conflict length in years. This yields figures between 15 (Venetian-Turkish War of 1499-1503) and 13,793 (World War Two, 1939-1940) battle deaths per million population and year. In the next step, I use our obtained real 2018 USD capital stock cost per battle death number from all discussed case studies and multiply this figure with the war intensity series. I only calculated a handful of underlying costs thus far: but in the aggregation I assume that these cases to some extent are exemplary for the types of warfare typical for their respective age – and therefore that the capital stock costs are for now “representative”. The small-scale battles of Mainz, Padua, and of the Eight Saints, when averaged, are representative of the capital costs per battle death typical of the “seigneurial warfare era”; that of the Nine Years War typical of the wars of Louis XIV; that of the Battle of Britain and the German capital stock destruction typical of World War Two.\footnote{For World War Two, I assign an 80% weight to Nazi Germany’s capital cost destruction intensity, and a 20% weight for the Battle of Britain. The conflict remains the most capital destruction intensive as long as weights are varied within plausible bands.}

Obviously, this series has some potential to be made more granular. In particular, the evidence on naval versus land-based capital costs are intended to serve as a tool to weigh more properly the respective shares of different battle types. If my results of significantly lower capital destruction costs for naval battles are confirmed, we should find that navy-intensive militaries such as the British have historically on an aggregate level sustained far less capital damage. Can this ultimately be related to higher permanent capital stocks for seaborne nations – perhaps even to lower real interest rates, given more abundant capital
supply? However, the series in its present form already suggests that relative to actual battle deaths across Europe, the devastations caused during the 17th and early 18th centuries were the most capital-destructive of the pre-modern age. Only World War Two surpassed any other conflict in five centuries of warfare: it likely is to be regarded as the most “capital destruction intensive” major conflict in human history. And the period since 1945 can already be regarded as the 73 year period with the lowest war-induced average capital destruction intensity since at least 1495 (and likely far beyond, given the interruptions by the Hundred Years War – a highly capital destructive event presently outside the scope of the series).

Though tempting, it is not clear that in its present form the war-related capital destruction process can directly be related to developments in capital markets, and the long decline in real rates. While the period since 1945 invites some speculation about a direct causation, one wonders why the 16th century has not seen a sharper trend fall in real interest rates: the notable decline on the “global basis” occurs between 1450-1550, and a reversal in capital costs is detectable after the French and Spanish defaults of 1557 – a time when capital destruction intensity first shows signs of accelerating from the very low prevailing levels.

Page 160: Figure XLVIII: Estimate of war-induced “capital destruction intensity” p.a. (LHS), and capital cost per battle death (RHS) in 2018 US$ m, 1495-2018.169

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CONCLUSION

This essay has highlighted various aspects that are needed to reach a comprehensive updated capital accumulation model of the very long run, with a particular view on Kuznets’ (1968) suggestions of the long-run capital accumulation process since 1500. It does not claim to yet reach final conclusions given the suggestive empirical underpinning. But it is advancing that the following results are already relevant for a variety present discussions

- Between 1500-1850, we should generally work with higher expenditure multiples between the “top 5%” and the national average, and with higher income shares of the “top 5%” households than those assumed by Kuznets.
- It follows that – if we stick with the assumption that the “top 5%” were indeed the relevant source of aggregate savings – we can posit a meaningfully higher savings potential than the 5-13% of income range across the period that Kuznets’ (ibid.) suggested.
- This, in turn, implies that either capital depreciation rates must have been even higher than the high single-digit figures Kuznets suggested. But for this, at least on the basis of residential real estate sources, there is limited archival and other historical evidence.
- Or: that – the answer advanced here – net investment rates were in fact meaningfully higher than 2-3% of GDP in the 16th century already. Perhaps even higher than 5%. From the capital side, early modern economies were “ready” for lift-off modern growth. But what led to periodic shocks to the capital-income stock were the high levels of “war-induced destruction intensity” emanating from early modern warfare. In particular the shocks of the 16-17th centuries stand out – which generate capital losses comparable to World War One, right at the time high capital stocks had been accumulated.

Of course, many of the quantitative suggestions on the role of capital destruction remain conjectural for the moment: it is desirable to obtain (a) higher frequency evidence for (non-residential) net investments and depreciation, (b) to refine the savings trajectory, and incorporate the “bottom 95%” more
precisely, at least from the 17th century, (c) to investigate the war events in the 15-16th and 18th centuries more closely: both constitute key transition periods, and exhibit relevant parallel dynamics (sharply falling real interest rates). Fortunately, for all three areas the archival and printed primary material seems to allow ultimately to build robust, high-frequency series.

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### APPENDIX

**Appendix table A.1: OVERVIEW OF NOMINAL BOND DATA AND INFLATION DATA CHOSEN SINCE 1311, “SAFE ASSET PROVIDER”**

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>NOMINAL YIELD SOURCE</th>
<th>INFLATION DATA</th>
<th>ASSET USED</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Genoa (25%):</em></td>
<td><em>As above</em></td>
<td><em>Compere</em> long term yields, San Giorgi Bank <em>Luoghi</em> deposit yield.</td>
</tr>
<tr>
<td></td>
<td><em>Florence (20%):</em></td>
<td><em>As above</em></td>
<td><em>Monte Comune</em> long-term bond yields.</td>
</tr>
<tr>
<td></td>
<td>Conti (1984, 34).</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>British consol long-term yields.</td>
<td>Amsterdam CPI, 1599-1702.</td>
<td></td>
</tr>
<tr>
<td>Year Range</td>
<td>Source</td>
<td>Source</td>
<td>Source</td>
</tr>
<tr>
<td>------------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>1908-1913</td>
<td>NBER Macrohistory database, series m13028a, December yield.</td>
<td>Bundesbank (1968, 19).</td>
<td>German Imperial 3% bond yields.</td>
</tr>
</tbody>
</table>

Note: Missing years are linearly interpolated. Luzzatto (1929) provides secondary market prices (% of par). Venetian yields are obtained with reference to official gross interest: between 1262 and 1381, a gross rate of interest of 5% per annum was paid; in 1382, the rate was reduced to 4% (Mueller 1997, 471). Where multiple Venetian prices are provided for individual years, I average datapoints recorded.

**Appendix table A.2**: GLOBAL SERIES: CONSOLIDATED ASSET COMPONENTS (50%) AND OVERALL INFLATION BASIS.

Global series weighs arithmetically assets specified in Appendix table A.2 and all long-term data points used in Figure III (cf. Appendix table A.3 below). From 1310-1618 interpolated unconsolidated series used; thereafter no interpolation used (added with equal weights as it occurs, 1618-1914).
<table>
<thead>
<tr>
<th>PERIOD</th>
<th>NOMINAL YIELD BASIS</th>
<th>INFLATION BASIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1314-1399</td>
<td>Italy (Luzzatto 1929; Heers 1961; Day 1963; Kedar 1976; Mueller 1997 – all per above), England (Fryde and Fryde 1963; Bell, Brooks, and Moore 2009 – per above); France (from 1387; Espinas 1902, 319f, 326f.); Germany (from 1326; HStaK; ISG Rechneiamt vor 1816; NStA B17/II, 140-147; StdAMs; Neumann 1865, 267-273).</td>
<td>Northern Italy (Allen 2001), England (Thomas and Dimsdale 2017), Strassburg (Allen 2001, 1387-1432), Germany: until 1426 average of Unger (1752, interpolated, via OeStA HHStA MEA Muensachen 8) and Abel (1978, 308-309, decadal interpolated).</td>
</tr>
<tr>
<td>--------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1700-1785</td>
<td><strong>As above, plus Germany (Däbritz 1906, Saxony basis); Holland (Weeveringh 1852, 50f.)</strong></td>
<td><strong>Northern Italy CPI (Allen 2001), England (Thomas and Dimsdale 2017), Antwerp CPI (Allen 2001), Germany: avg. of Leipzig, Augsburg, Munich, and Vienna (Allen 2001), Strassburg CPI (Allen 2001), Madrid CPI (Allen 2001).</strong></td>
</tr>
<tr>
<td>1786-1799</td>
<td><strong>As above, plus United States (Sylla, Wilson and Wright 2005, New York basis).</strong></td>
<td><strong>Northern Italy CPI (Allen 2001), England CPI (Thomas and Dimsdale 2017), Antwerp CPI (Allen 2001), Strassburg CPI (Allen 2001), Germany WPI (Mitchell 1975), United States CPI (David and Solar 1977), Madrid CPI (Allen 2001).</strong></td>
</tr>
<tr>
<td>1820-2018</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** Spain is excluded between 1688-1785. Individual missing years are linearly interpolated. Midpoints are taken when ranges are reported. Where multiple annual rates are reported, rates are always arithmetically weighted, except on the sub-national level where issuance volumes are fully documented, as in the case of Tracy (1985, 89, 94). Spain is excluded from 1600-99. For Däbritz (1906, 83), I use the 3% “Landwirtschaftliche Obligationen” of 1763.
Milan is included in Italian nominal rates between 1543-1694. I use De Luca (2007, 127), and also include the Zecca rates (Ibid., 130, averaging the two) between 1537-1540, and for 1570-1616, as Zecca volumes between 1540-1570 are very low.


Municipalities are assigned their present-day national affiliation. Dijon and Douai, for instance, are treated as a French – not Dutch – component. Utrecht as a Dutch one. This is in line with Maddison’s GDP accounting.

Appendix table A.3: GLOBAL SERIES: NON-CONSOLIDATED ASSET COMPONENTS:

England/U.K.: Calendar of State Papers (all references above); Calendar of Treasury Books and Papers (all references above); Sinclair (1790, part II, chapter III); House of Commons (1869); TNA (E 30/1186/3; SP 36/107/1/45; SP 84/157, fols. 227, 231; T 29/627, fols. 5-57); Hansen (1910, 386, 401, 402); Ehrenberg (1922, Vol. 1, 147, 150, 256), Grose (1929, 178); Hauser (1930, 249); Ashton (1960, 119f.); Fryde (1983, IV, 209-210; VII, 1190, 1199); Bell, Brooks, and Moore (2009, 419); France:
Ehrenberg (1922, 304f.); Doucet (1937, 24, 45); Luethy (1959); Fryde and Fryde (1963, 483, 488); Bonney (1981, 318); Tewes (2011, 46); Rowlands (2012, 73, 80; 2015, 104, 121); Holland/States general/Flanders/Brabant: StAAm (735, 1518, fol. 5-6; ); Ehrenberg (1922, Vol. 1, 258ff., 312); Mollet (1958, 316, 318); Van der Wee (1963, II, 57); Emperor/Habsburg/German princes, and Austrian:
Mueller (1900, 276); Dietz (1925, Vol. 4/2, appendix 2, 753ff.); Puff (1911, 175ff.); Schrohe (1933, 39, 45f., 114); Stromer (1970, 260f., 285ff., 428f.); Krueger (1980, 225-245); Bittmann (1991, 137, 139, 141, 153, 161); Kohler (2003, 182); Schirmer (2006, 88); Fuhrmann (2010, 114); Deutsche Reichstagsakten (Aeltere Reihe, Vol. 5, 37 [note 1]); GStAPK (VII. HA Maerkische Urkunden Salzwedel Nr. 77; VII. HA, Nichtmaerkische Urkunden, Polen Nr. 28); ISG (1.117); OeStA (FHKA SUS RA 75.6, 238.44, SUS NL Beer 02/79; HHStA Kolowrat 9, 595 and 613); Regesta Imperii (all above); NStA (Herrschaft Schwarzenberg Urkunden 1440); Quellen und Regesten zu den Augsburger…(1996 and 2004, nos. 131, 162, 168, 184, 216, 234, 245, 258, 277, 330); Reg Pfalz (Ruprecht III, nos. 2124, 3134, 3199, 4244, 4256, 4409, 5164); Papal States: Schulte (1904, 24, 167); Bullard (1980, 115); Partner (1980, 26, short-term vacabili); Bruscoli (2007, 84, 86, 122); Felisini (2016, 120); Spain: TNA (SP 78/223, fols. 40-42); OeStA (HHStA, UR NUK 523); Ehrenberg (1922, Vol.1, 165, 177, 182); Boyajian (1978, 188f.; table III, 137); Kuechler (1983, 251, 253); Tracy (2002, 178); United States: House of Representatives (1876, 24ff.);
Flournoy (1892, 508f.); for U.S. Savings Bonds data: TreasuryDirect.gov. Genoa/Florence/Milan: Bullard (1980, 65); Denmark: GStAPK (VII. Haussachen der Landesherren Nr.76); Other: OeStA (HHStA House Este, Box 14, letter 10 June 1698, letter 28 July 1698, letters in years 1701 (no fols.) [Loans to Duke of Lorraine]).

Notes to Figure III:

I disregard all intra-governmental loans, such as the South Sea Company’s 1731 GBP 20m loan to the British Treasury (see Calendar of Treasury books and papers vol. 2, 173), or loans by the Venetian grain office to the city (Mueller 1997, chapter 9). Loans by municipalities are generally included, however.

In several cases, the effective interest rate is calculated on the basis of related recorded data. For instance, the Duke of Milan’s 218,072 Milanese Pound loan from the Medici outstanding in 1459 is imputed here at 15.4%. De Roover (1963, 269) states that the interest rate recorded in the Medici balance sheet represents the net return after expenses on deposits are paid out. These are imputed at 10.5%, the midpoint between the data for borrowing “from friends” and via time deposits stated by Roover (Ibid., 268-269).

The 1401 Amadi/Rommel loan appears to have been originally conceived as a short-term loan, but an actual repayment in the short-term is not recorded. In RTA (Older series, Vol. 5, No. 173, Nov. 6, 1401) we only learn that the Imperial chamber forwards the 1,200 ducats to Nikolaus Wispriger as a salary.

Stromer (1970, 286) suggests that Duke Albrecht inherited debt contracts in the 10-16.67% range from his father Friedrich. After some digging, one arrives at the original reference in Hoefler (1849, 124f.) who reports that after Albrecht’s marriage with Margaret of Baden in 1446, but before the Bavarian Wars starting in 1459, he attempted a renegotiation of the existing debt – only partially successful. I have here assumed the mid-point of the range for 1446-1450.

Van der Wee (1963, I, appendix 45) does not specify which maturities he considers “short-term”. It appears that he treats at least some multi-year loans as short-term, such as the 1425 loan for the voyage of Duke Philip to Hainaut (ibid., II, 57), which must refer to a war loan for the 1425-1428 campaign against Jacqueline of Bavaria. Apart from this instance, I still exclude the data for the series.

Mollat (1958) does not provide maturities for the Burgundian loans during the capture of John sans Peur at Nicopolis in 1396-1397. I have treated them as long-term loans here, since it is unlikely repayment was conceived within a short timeframe given the state of finances (ibid., 316). For the 1430s-1450s, I have
only included the “long-term” 15-month loan priced at 13.2% p.a., here taken for the year 1434 (ibid., 318).

For Spanish data 1626-1647, I sum the “official” interest rate and the “adehala” interest rate component charged by the Portuguese bankers recorded in Boyajian (1978, table III, 137). While classical asientos were marketable to a degree, the contracts debated here were all separately negotiated with the Crown and in years did not change hands (cf. constant liabilities in books, Ibid., table IV, 145).

For British datapoints during 1692-1700, average reported rates in TNA T 29/627, 5-57. are used. The reported extra “gratuity” rates are always added to the basic interest rates. For Ashton (1960), I include rolled-over loans (the 1610 and 1617 loans; ibid., 118ff.) and exclude the loans actually repaid in the short-term (such as the 1626 Alderman loan; ibid., 130).

The Virginia war loans between 1813-1815 included here were partly extended by the Bank of Virginia. One-third of the latter’s stock was owned by the state government (Gruchy 1937, 167f.). The loans are included here since this does not represent a majority stake and the loan terms show no evidence of financial repression features, but it may be seen as a borderline case.

Notes to Figure VIII:

Sources used in addition to those specified in footnote 32: Institut fuer Stadtgeschichte Frankfurt (ISG Hausurkunden [chronologically]: HU 449, HU 210, HU 213, HU 226, HU 254, HU 335, HU 254, HU 208, HU 481, HU 476, HU 482, HU 527, HU 69, HU 348, HU 528, HU 486, HU 303, HU 318, HU 254, HU 372, HU 352, HU 429, HU 70, HU 340, HU 307, HU 167, HU 375, HU 108, HU 425, HU 310, HU 443); Stadtarchiv Mainz (StdAMz: U 1393/Dezember 9, U 1407/November 20, U 1412/Januar 14, U 1420/Maerz 24, U 1421/September 22, U 1545/April 21, U 1559/Maerz 15, U 1587/Dezember 2, U 1590/Mai 23, U 1608/Maerz 3, U 1609/Mai 18, U 1612/September 8, U 1615/Juni 24, U 1705/Maerz 26, U 1720/Maerz 6; VOA – 7/44, fol. 5-8); Regesten der Erzbischhoefe von Mainz [Reg EB Mainz]: Vol. I/1, nos. 426, 440, 489, 507, 598, 655, 700, 702, 706, 746, 758, 762, 810, 837, 873, 2464, 2612, 2761, 2827, 2835, 2846, 2895; Vol. I/2, nos. 3002, 5105, 3081, 3261, 3267, 3384, 3387, 3423, 3502, 3564, 3572, 4354, 4515, 4636, 4638, 4787, 4794, 4942, 4958-4960, 5091, 5133, 5144, 5258, 5407; Vol. 2/1, nos. 70, 197, 220, 325, 326, 366, 367, 546, 594, 735, 1351, 1533, 1548, 1703, 1747, 2159, 2271, 2292, 2390); also Mainz: Liebeherr (1971, 70, 80, 97, 100, 113, 116, 122, 133, 138, 140, 165, 200); Stadtarchiv Cologne (HStAK: Best. 1037 – Raitz von Frentz, Haus Schlenderhan, Kasten 11, 14, 16, 32, 37; Best 1037 – Raitz von Frentz, Listringhausen/Badinghagen Kasten 23, 63, 72); Bayrisches Hauptstaatsarchiv (BayHStA, Kloster Altomuenster Urkunden, Benediktinerinnen 1256-1760, nos. 106, 111, 119, 137, 194
For modern datapoints, Bundesbank series “Umlaufsrenditen inl. Inhaberschuldverschreibungen/Hypothekenpfandbriefe/Mittlere Restlaufzeit von ueber 7 Jahren, zusammen, Monatswerte” (Code: BBK01.WX4257, accessed May 2019); Voye (1902, 24, 29-30, 35-36, 45, 90-91, 94) data takes the 3.5% “Pfandbriefe” datapoints for all Prussian regions covered (Ostpreussische, Westpreussische, Pommernsche, Posensche, Kur- und neumaerkische, schlesische).

As with all public debt datapoints, I average multiple annual observations on the municipal level.

**Appendix table A.4: Real GDP**

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>COUNTRY</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1311-1508</td>
<td>Northern Italy</td>
<td>Malanima (2011, 205-217, series 3, in 1420-1440 prices), Maddison (2010).</td>
</tr>
<tr>
<td>1908-1913</td>
<td>Germany</td>
<td>Hoffmann (1965, 14, interpolated).</td>
</tr>
<tr>
<td>PERIOD</td>
<td>COUNTRY</td>
<td>SOURCE</td>
</tr>
<tr>
<td>----------</td>
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<td>------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

**Appendix table A.5: Population**

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>COUNTRY</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1311-1508</td>
<td>Northern Italy</td>
<td>Malanima (2011, 205-217, series 6 over series 3).</td>
</tr>
<tr>
<td>1600-1699</td>
<td>Holland</td>
<td>Fritschy (2017).</td>
</tr>
<tr>
<td>1908-1913</td>
<td>Germany</td>
<td>Hoffmann (1965, 174).</td>
</tr>
<tr>
<td>1919-1960</td>
<td>United States</td>
<td>Bureau of the Census (2018), selected historical population and census counts; FRED (2017), series B230RC0A052NBEA.</td>
</tr>
</tbody>
</table>
Measuring returns on a fixed income asset – Erbleihen and Pfandbriefe tied to real estate – my series on “Private R” obviously omits a key component of actual “private R”: business investment returns, that is equity returns in the modern context. Given that business loans and investments are to be found in almost every will or tax register from the 14th century, some discussion is required regarding its role, particularly since the equity risk premium has been rather high in recent years. Can corporate returns over time be the “balancing item” that leads to a more even – perhaps even a positive – slope of overall real wealth returns? Even a relatively small upward slope – if coupled with significant increases in the volume of outstanding corporate investments – could obviously lead to meaningful revisions for the overall series.

Let us ignore for a moment the argument that such rates should not diverge over the long term unless there are significant market imperfections or barriers to entry for investors to take advantage of these hypothetically more attractive returns.
Appendix chart A.1: Selected merchant and investor asset compositions, 1425-1686.\textsuperscript{170}

More important here is the historical-empirical situation. Corporate profits are perhaps the most understudied of all the relevant individual series. We know that the most advanced and internationalized corporations (besides religious orders such as the Templars) are to be found among the banking houses of the Italian North, with their pan-European (and pan-Asian) personal networks, and their role in the administration of Papal income – perhaps the most significant single financial agent until the 16\textsuperscript{th} century.

While I have not undertaken a more systematic compilation of corporate profit trends here, and taking into account the meaningful spreads to land returns displayed in Figure VIII in the second half of the 15\textsuperscript{th} century, one should note that there is sufficient evidence of equally elevated profit margins for early modern times, even if we discount some of the more lofty outliers, such as the Hochstetter’s alleged 500-600\% margins in the 1510s (Ehrenberg 1922, 213): Rothmann (1998, 537f.) records average margins of 20.6\% for German merchants at the fairs in Regensburg and Vienna in the early 1400s; averaging Samsonowicz’ (1969, 64-70) profit rates for Danzig merchants in the late 15\textsuperscript{th} century yields levels of 13\% p.a. gross, with ranges from -16\% to 32\%; De Roover (1963, 117-120) compiled profit rates in FX money markets in Venice, Bruges, and London between 1438-1465, averaging 15.1\%, a figure close to the 14.1\% average Venetian trade credit rates in 1383-1405 (Mueller 1997, 635). Ehrenberg (1922, 388ff.) reports average profit rates for successful German merchant houses in the late 15\textsuperscript{th} – mid-16\textsuperscript{th} centuries of 18-24\% p.a.; in their prime, the Fuggers during the years 1511-1527 commanded no less than 54.5\% (ibid., 196). In early modern tax collections in the Holy Roman Empire, an annual gross profit rate of 4\% for corporates was generally assumed (Isenmann 1980/2, 166). In the Dutch tax assessments during the 16\textsuperscript{th} century, a 6\% gross profit rate was assumed (Tracy 1985, 83). Grassby (1969, 724ff.) reports

typical nominal rates of gross profit of 8-10% in 15th century London among grocers and merchants; the same source (ibid., 725) reports subsequent rates of profit for the Indian voyages in the 17th century that are highly volatile, but typically range between 22.3-46.9% during 1613-1617, with a decline to 9-13% between 1617-1628.

Comparing these – certainly still anecdotal – levels with modern corporate returns – even if we allow for early modern peculiarities regarding tax regimes, depreciation, and regulation – reveals clearly that over the very long term, business returns (real and nominal) cannot have shown a rising trend, and could thus not have produced a general upward slope for “nonhuman wealth” returns. Hudson (1986) and Harley (2010) find nominal returns on British business capital ranging between 9-20% between the late 18th century and the 1850s in leading, capital-intensive industries. For the 20th century, Fama and French (1999, 1995) report nominal internal rates of return on capital for U.S. nonfinancial publicly-listed firms during 1950-1995 of 12.1%, and during 1973-1996 of 14%, before interest and depreciation; these are plausible levels compared with mean nominal USD-denominated equity returns since 1870 of 10.54% p.a. (post-1950: 13.2% p.a.) reported in Jorda et al. (2017, A66, table A.9).

Since the spread between our early modern sample and such modern levels is not ex ante enormous, however, we can enter into a hypothetical thought experiment: to consider an extreme scenario, suppose that in the year 1500, roughly at the peak of public real rates, business investment just comprised 5% of “global nonhuman wealth”; suppose further that today the business investment share has risen to 50%;172

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171 Allen’s (2009, 421) higher values only refer to the fixed capital return. As he notes, Hudson (1986) and Harley (2010) refer to returns on total business capital, around half of which is comprised of trade credit. The lower reported values by the latter two are the relevant ones here, since they represent the broader definition in line with what Fama and French (1999) or Jorda et al. (2017) measure.

172 Certainly an elevated estimate, given that housing wealth still outstrips equity wealth for Jorda et al.’s (2017, A63) global sample.
II. Applications, financial repression

Fisher (1930, 411ff.), was perhaps first to draw attention to the multiple of the real rate standard deviation over the nominal rate standard deviation over time. Finding ratios of 10-13 in the London, Tokyo, and New York markets in the late 19th and early 20th century for short-term private rates, he posited that such high multiples demonstrated that “men are unable or unwilling to adjust at all accurately and promptly the money interest rates to changed price levels. Negative real interest could scarcely occur if contracts were made in a composite commodity standard”.

Appendix chart A.2: Selected merchant and bank gross profit rates on capital invested, 1380-1560.

As was demonstrated above, negative real interest rates have been infrequent under the prevailing commodity standard between the 14th and early 20th centuries, although they do occur. However, Appendix Chart A.3 uses the new long-run evidence to display the multiple of the real rate standard deviation over the nominal rate standard deviation over a 700-year span. For sovereign long-term rates, it shows that the elevated level was not specific to Fisher’s (fiat money) contemporary environment. Over 1311-2018, in fact, the average multiple stands at 10.8 on a 30-year averaged annual basis on the global level with a higher 13.5x multiple for the safe asset provider – an all-time range exactly compatible with Fisher’s 1930s observations. The actual inflection point – Fisher may consider it the “moment of realization”, when investors learnt to fully incorporate inflation dynamics – appears to have taken place following World War Two: since 1953, the multiple has never recorded levels above 5x globally again, and has averaged just 1.42 – unprecedented all-time levels. It is not clear what constitutes the dominant driver of these dynamics. Certainly, some well-known accounts put the “discovery” of real rate dynamics on the policymaking level into the late 1960s and 1970s (Meltzer 2014). While I cannot rule out that data measurement factors could play a role, it is not readily apparent which biases should be responsible. Another peculiarity is the surge in the multiple for Britain after the Restriction Period: the ratio peaks at 55.5x in 1863, levels never measured before or after in developed economies. The rise is driven by a collapse in the nominal rate STDev, from levels of 0.65 in 1818, to a low of just 0.08 in the 1860s, coinciding with the intense deleveraging period which sees British debt/GDP levels being reduced from 214% in 1816, to 75.5% in 1865 (and ongoing thereafter, Thomas and Dimsdale 2017, tab A.29), and half a century of relative political calmness, interrupted only by the outbreak of the Crimean War. Perhaps these travails are connected to the institutional turmoil associated with the birth of the modern state; the normalization of spreads coincides with the political consolidation highlighted for instance by Maier (2014): the precise channel of such interactions warrants more investigation.

174 To the extent that inflation series such as Allen (2001) or Pfister (2017) are interpolating price dynamics over longer time spans, one could speculate that this contrasts with the higher frequency nominal yield data, thus creating a disparity and the measurement of a real rate “lag”. However, the higher multiples hold for country-level subperiods where prices series are of high frequency, such as Northern Italy (average here 1331-1500: 15.4x).
In general, however, Fisher’s interpretation of double-digit standard deviation multiples, and his lamentation of men’s refusal or inability to incorporate price changes into “money” (nominal) rates is misplaced: we note that the commodity standard era had to cope with adjustment difficulties of very similar proportions, though the volatility of the multiple is already reduced from the early 20th century, with the global series showing notably reduced volatility subsequent to around the time of the Mississippi Bubble.

And yet, the possibility that it was in fact men’s “inability” to adjust nominal rates should certainly not be dismissed too lightly. It brings us to some concluding thoughts on the influence of “financial repression” in the following paragraphs.

Financial repression und usury factors are a key potential influence. With the former’s prevalence even apparent during the mid-20th century (Reinhart and Sbrancia 2015), it is only too straightforward to attribute a decisive role to it during times when institutional mechanisms were supposedly fragile, while references to usury and evidence of personal retribution against creditors abound. Temin and Voth (2005) have argued that even for 18th century Britain, merchant banks restricted credit supply in the face of interest rate restrictions. Allen (2009) finds sharply rising real profit rates in the U.K. between 1800-1860 and acknowledges that “even deducting a few percentage points for depreciation, the return to capital in the 19th century exceeded interest rates by a wide margin” – his explanation being that “interest rates...were too heavily regulated to be a reliable indicator of the demand for capital” (ibid., 421).

Certainly, it would be foolish to dismiss repression factors too lightly. The fate of Jacques Coeur, the great French financier who ended in prison on defrauding accusations, or that of the Templars, are two of many high-profile cases. Emperor Ferdinand II, via his financial offices, in 1630 demanded a 50,000 thaler loan from the banker Johann von Bodeck: when the latter resisted, he was threatened with confiscation – and eventually loaned 40,000 thaler secured by claims on future public revenues (Dietz 1921, 262). In 1627, the soldiers of the Duke of Saxony threatened to burn down the properties of two prominent Junkers in Dieburg if the debts of their master were not rolled over (ibid., 1921, 6). In 1554, Henri II of France forced Parisians to subscribe to a 3.1m livre tournois rentes sale, defying the Parlement (Munro 2003a, 537). Around the same time, Holland ex-Amsterdam still occasionally resorted to forced subscriptions (Gelderblom and Jonker 2011, 4).

At the same time, I am not aware of any recent study concerned with longer-term real rate dynamics that, for instance, decided to exclude explicitly the period of the 1960s and 1970s in the U.S. in short-term yields on account on the financial repression practices documented for the period by Reinhart and Sbrancia (2015). Clearly, a significant complication would be introduced for a multi-century trend study of the present sort if it could be demonstrated that an all-encompassing repression system invalidated any reasonable market pricing of desired returns. However, the steep rates registered in Figures III and V above represent a priori evidence that repression cannot have been too effective. Why would a German
Emperor or a French King ever have paid interest rates north of 15%, when he could have reached his aims by financial repression? Why would the English King be forced to pawn his jewels to Cologne creditors in 1431-1434 (Dietz 1921, 209)? For every disgraced Jacques Coeur, we find a Samuel Bernard, a Stephen Vaughan, or a Stephen Fox, rising to the apex of financial fortunes by their savvy exploitation of strained Crown finances (Richards 1953; Clay 1978; Rowlands 2015). Equally, cases where coercive exploits are rebuffed are plenty: Richard II has to bury plans to raise loans in the 14th century, after merchants “refused to supply the King’s wants, unless they received the utmost security, and unless the nobility, clergy, and gentry would furnish him with a considerable sum without interest” (Sinclair 1785, 335). Even at the height of the “Turkish threat”, leading German merchant houses reject further credits to Ferdinand I in 1539 “because we are still owed 100,000fl from various imperial offices” (Hildebrandt ed., 1996, 48).

Especially the rise in cross-border lending highly impedes the options by sovereigns to exercise direct pressure. By 1587, two German creditors, Paulus Brockdorff and Moritz Rantzau, are successfully threatening to arrest the English Crown’s factor in Antwerp, if their GBP 11,000 (Flemish) loan was not immediately repaid: “in these circumstances, the only course left open to the Crown was to go to the considerable trouble and expense of shipping specie from England to the Low Countries” (Outhwaite 1966, 293f.). It would be entirely wrong to perceive of early modern and late medieval financial relations outside of the major financial centers as a basically arbitrary creditor expropriation. For every documented case of actual repression, it is easy to find numerous cases where the executives were either unwilling or unable to suspend market pricing – and these are the cases used in the aggregations here.

Consider the case of Henri II’s “Grand Parti” in 1552, one of the largest individual sovereign loans ever up to that date. Ehrenberg (1928, 303), quoting the chronicler of Lyon, documents how contemporary investors hardly needed inducement to willingly lend at 16%:

“God knows how greed for these excessive gains, disguised by designation as ‘free gift’ (don gratuit), lured men on. Every one ran to invest his money in ‘le grand parti’, the very
servants brought their savings. Women sold their ornaments, and widows their annuities in order to take shares in ‘le Grand Parti’. In short, people ran for it as if to see a fire’.

Other examples are not hard to find. As Mueller (1997, 457f.) puts it,

“Citizens of Venice, Genoa, and Florence were happy to contribute to the functioning of the state as long as the support took the form of interest-bearing loans and as long as the pressure on liquid capital was relatively moderate…when the burden was judged insupportable, there could be active resistance to the fisc, similar to a tax strike as occurred in Venice in 1442…taxpayers would take pains to come up with what was required as long as they got something for their money, some annual return, ‘as had been observed of old in the Republic of Venice’”.

Recent discussions such as Stasavage (2011, 33-34) agree that the rates on such “forced loans” were in fact close to secondary yields and evidence of credible commitments.

Some regional studies have found a “thoroughgoing compliance” with formal interest rate ceilings, at least in the personal loan market (Ogilvie, Kuepker, and Maegraith 2012, 138). But when formal interest rate ceilings are in fact implemented, they more often retain a merely symbolic quality. Emperor Lewis in 1338 capped interest rates to be charged by Jews at 41.7% for domestic subjects, and at 55.5% for foreigners (Dietz 1910, 197). In Edward II’s England of the late 13th century, interest rate ceilings of 45% were enacted (Hansen 1910, 340) – purely circumstantial gestures to please ecclesiastical lobbies, without practical relevance. Both Flanders and the Holy Roman Empire implement interest rate ceilings of 43.3% in the early 14th century (Reg Imperii, VI, 4/2, 393, Henry VII to the Jews of Nuremberg; Haepke 1908, 245) – rates that as far as I can see have not been de facto charged prior to these impositions. The French interest rate legislations in the 16th and 17th centuries explicitly did not apply to royal loans: “the king never intended that these rates of interest should apply to his own financial transactions. Any attempt to do so would make it impossible to obtain the services of financiers and would lead to the abandonment of existing contracts” (Bonney 1981, 19).
APPENDIX MATERIAL FOR “546 YEARS OF SAFE ASSET CYCLES” (pp.90-135).

Appendix figure A.4: GDP weights used, safe asset demand and supply aggregates, 1471-2017.\textsuperscript{175}

Data sources 1471-2017:


2008), Comin and Yun-Cassillia (2012), Drelichman and Voth (2010), Ruiz-Martin (1975), Global
Financial Data (GVDCESPA); real GDP: Alvarez-Nogal and Escosura (2013, to 1850), Maddison (2007,

**U.K.**: money supply: narrow money: Palma (2017) and Capie and Webber (1985) via Thomas and
Dimsdale (2017, tab A.24); broad money: Palma (2017) via Thomas and Dimsdale (2017, tab A.24);
Population: Broadberry et al. (2015) via Thomas and Dimsdale (2017, tab A.18); debt: Dietz (1920),
Sinclair (1790, part II, chapter III), BoEA 14A 156/1, TNA SP 70/147; inflation: Thomas and Dimsdale

**Holland**: population: Maddison (2007); real debt: Fritschy and van der Voort (1997, 69); inflation: Allen
(2001, Amsterdam/Antwerp averaged basis); debt outstanding: Dormans (1991, 65-66, 80-81, 100-111),
Global Financial Data (GVDCNLDA); money supply: de Vries and van der Woode (1997, 90).

**France**: population: Maddison (2007); money supply: Glassman and Redish (1985, 43-44 [loss
rate=0.0025 scenario]), Riley and McCusker (1983, 280 [output at 0.3% scenario]), Courtois (1875, 16,
145-147, 182), Annuaire Statistique (annual vols. 1840-1913); debt outstanding: Hamilton (1947);
Vuehrer (1886, 11-501), Guery (1978, 236-237 for 1600-1715 y-o-y changes); Global Financial Data

**United States**: Board of Governors of the Federal Reserve System, Government Debt outstanding (1971,
887, Table 13.5 D, “Marketable securities by maturities, held by private investors”, June points; 1943,
511, Table No. 147, “Maturities of marketable public direct securities”, June points); money supply:
Friedman (1959, 704-22, Appendix Table A-1, Columns 7 [M1], 8 [M2]); population: 1914-2009:
Maddison (2007), 2010-7: FRED series B230RC0A052NBEA.

[For all real rate data, see the dataset constructed in the first part of this dissertation, and appendix tables
A.2-A.3]

**Notes**: the aggregate M3 money growth rate for the Euro area has been applied to French, German, and
Spanish money supply from 1999 on the basis of FRED Series MYAGM3EZM196N; data breaks occur
1990-1991; French money growth has been linearly interpolated for 1914-1920, and for 1939-1948;
Spanish money growth has been linearly interpolated for 1936-1940; Dutch and Spanish debt outstanding
has been linearly interpolated for 1995-1998. For the German debt series, the DM-Euro conversion rate of
1.95583 was applied to the 1999-2017 figures. German data is fully excluded from the sample for 1914-
1963. From debt outstanding for France, Spain, and Germany, ECB holdings have been subtracted by
applying the capital key to the total reported bond assets in Consolidated Eurosystem balance sheet
(Position A 7.1. “assets held for monetary policy purposes”).