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Abstract

With recourse to archival, printed primary, and secondary sources, this paper reconstructs global real interest rates on an annual basis going back to the 14th century, covering 78% of advanced economy GDP over time. I show that across successive monetary and fiscal regimes, and a variety of asset classes, real interest rates have not been 'stable', and that since the major monetary upheavals of the late middle ages, a trend decline between 0.6–1.6 basis points per annum has prevailed. A gradual increase in real negative-yielding rates in advanced economies over the same horizon is identified, despite important temporary reversals such as the 17th Century Crisis. Against their long-term context, currently depressed sovereign real rates are in fact converging 'back to historical trend' — a trend that makes narratives about a 'secular stagnation' environment entirely misleading, and suggests that — irrespective of particular monetary and fiscal responses — real rates could soon enter permanently negative territory. I also posit that the return data here reflects a substantial share of 'non-human wealth' over time: the resulting R-G series derived from this data show a downward trend over the same timeframe: suggestions about the 'virtual stability' of capital returns, and the policy implications advanced by Piketty (2014) are in consequence equally unsubstantiated by the historical record.

Key words: Real rate history, financial history, historical R-G, 13th–21st centuries.

JEL classification: E40, G12, N10, N20.

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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 stimulated by the contribution 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 often 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, in 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 (ibid.). 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 soon 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, raises deeper problems for such recent 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 municipal and imperial registers, over Habsburg, British, Dutch, crown documents, to (often ignored) earlier secondary sources, and 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 (bar four pages on the U.S. context), or attempt to build "GDP-weighted", global series. In consequence, and for all the merits of their work, the timing and evolution of interest rate trends it suggests is partly inappropriate, partly inapplicable for current debates in both the historical and the economics literature.

One key empirical result analyzed here is that there is no evidence of a "virtual stability" of real capital returns, either expressed in R or "R-G" over the very long run: rather, – despite temporary stabilizations such as the period between 1550-1640, 1820-1850, or in fact 1950-1980 – global real rates have shown a persistent downward trend over the past five centuries, declining within a corridor of between -0.9 (safe asset provider basis) and -1.59 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 throughout the historical gold, silver, mixed bullion, and fiat monetary regimes, is visible across various asset classes, and long preceded the emergence of modern central banks. It appears not directly related to growth or demographic drivers, though capital accumulation trends may go some way in explaining the phenomenon. But whoever posits particular recent savings-investment dislocations in the context of an alleged "secular stagnation" needs to face the likelihood that such "imbalances" may have been a continuous key driver for five centuries.

Similarly, negative long-term real rates have steadily become more frequent since the 14th century, and I show that they affected around 20% of advanced economy GDP over time, a share that has historically risen by 1.2 basis points every year: once more, this suggests that deeply-entrenched trends are at work – the recent years are a mere "catch-up period" in this and a number of related aspects.

Together, I posit that the private and public assets covered in the following also 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, suggests that real returns on nonhuman wealth are equally downward trending over time. They are by no means "virtually stable", a cornerstone of Piketty's (2014) framework. In fact, if historical trends are extrapolated, R-G will soon reach permanently negative territory – a first since at least medieval times.

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 in fact 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 suggests that the "historically implied" safe asset provider long-term real rate stands at 1.56% for the year 2018, which would imply that against the backdrop of inflation targets at 2%, nominal advanced economy rates may no longer rise sustainably above 3.5%. Whatever the precise dominant 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. But downward-trending absolute levels, and declining volatilities have persisted against a backdrop of a secularly growing importance of public and monetary balance sheets. This would suggest that expansionary monetary and fiscal policy responses designed to raise real interest rates from current levels may at best have a cyclical effect in the longer-term context.

Finally, this paper is not naïve about the remaining limitations of the very long-term historical evidence. The robustness checks below cannot deflect from the fact that late medieval and early modern data can of course never be established with the same granularity as modern high-frequency statistics. One still has to rely on interpolations here, 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* has irrecoverably destroyed not an insignificant share of the evidence ideally desired. But I suggest that whoever invokes "history" in the present debates needs to advance against the backdrop of these limitations.

This paper will proceed by first discussing empirical aspects across various assets and geographies, and elaborating on the technicalities of aggregating such evidence, before relating it to other economic and (geo-) political variables, and constructing main derivative series including R-G, the real rate standard deviation, and the long-run negative real rate frequency. This is followed by a discussion of robustness aspects, and, finally, by a closer focus on capital accumulation factors during the late 15th century.

II. "GLOBAL" AND "SAFE ASSET PROVIDER" SERIES, ARCHIVAL DATA

II.A THE GLOBAL SERIES

The global series is obtained by weighting 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 prior to the establishment of consolidated debt on the national level.

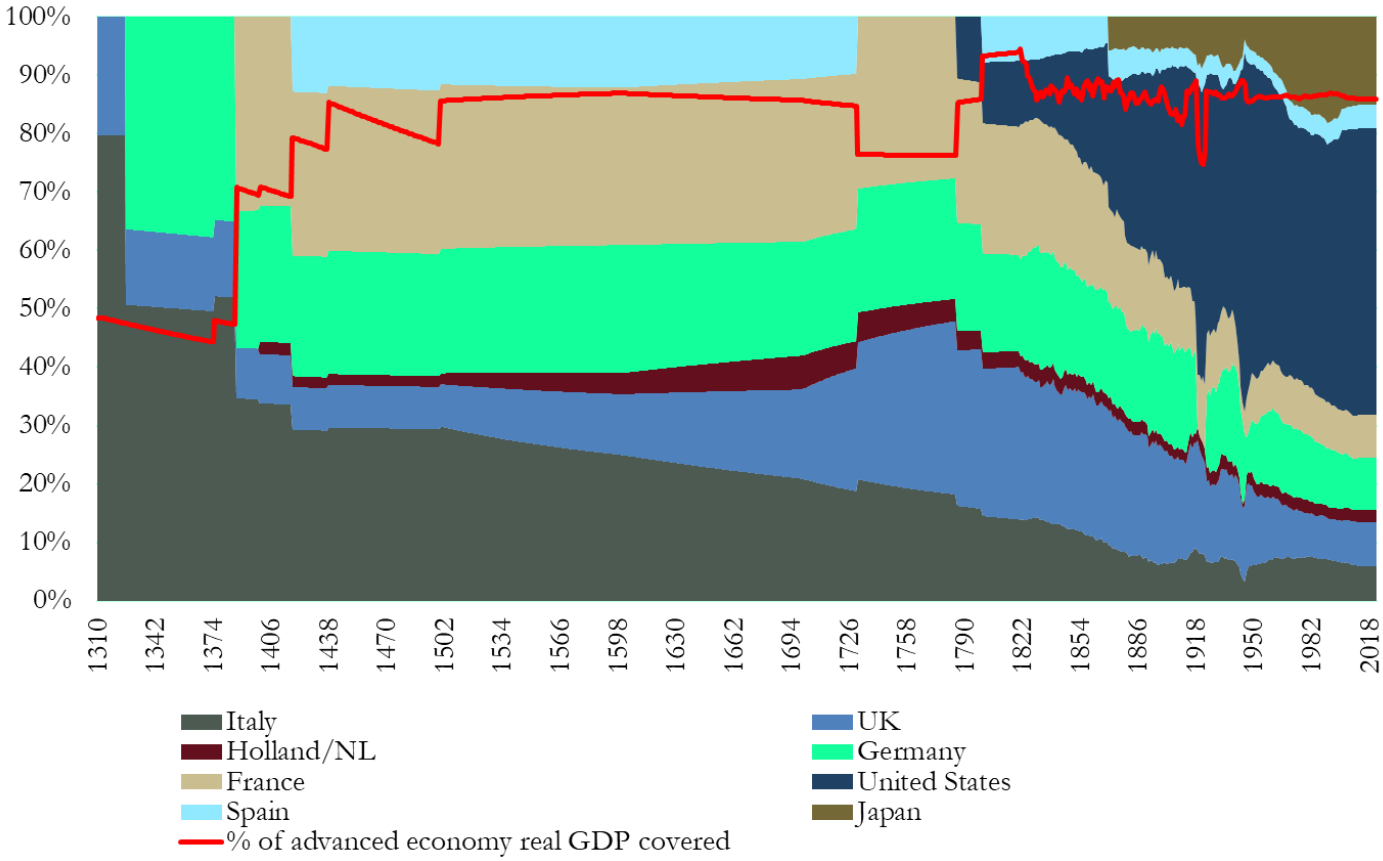

Figure I: GDP weights, and share of total advanced economy real GDP covered, "global series".[1]

It is shown below that weighting 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 pp. 56-

[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".

60 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: we encounter cash lending against annual payments in "chicken" and other commodities, 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, national authorities borrowing cash via municipalities, and loans contracted against explicitly given cash payment streams (details below).

Figure I displays the GDP weights over time, and the share of advanced economy GDP covered by the series. A large number of the various datapoints that follow – in fact the overwhelming share prior to 1800 – are not incorporated into general surveys, particularly Homer and Sylla (1991, 2005), even with regards to the secondary source front. None have been systematically GDP-weighted or traced in terms of aggregated real rate trends over such a timespan. Among others, I incorporate Spanish data featuring Aragon's debt operations ("prestechs") in 1418 (Kuechler 1983, chapter V); French among others include Crown loans from 1415 (Vuehrer 1886; Fryde and Fryde 1963, 483; Shakespeare 1986), and municipal registry data from Amiens and Gascony (Maugis ed. 1898; Samaran ed. 1966); incorporated are the activities of the Burgundian towns and the court at Dijon (i.e. Mollat 1958; Bos-Rops 2004; Lambert 2006); English with William de la Pole and Simon van Halen's loans to Edward III (Fryde 1967, 1988; followed by numerous entries in the Calendar of State Papers [CSP] and some TNA documents); Italian with the well-known municipal debt in Genoa, Venice, and Florence from the 1310s (i.e. Heers 1961; Conti 1984, 34) as well as occasional loan operations, the first being Cardinal Luca de Fieschi's loan to Genoa in 1327 (Sieveking 1898, 99); one of the earliest German ones are registry data on loans to King Lewis in 1315 (Reg EB Mainz, 1744), followed by numerous Habsburg imperial, and ducal transactions (many via the Austrian State Archive [OeStA], ISG, GStA PK, and Reg Imperii, and surveys such as Dietz 1925, Vol. 4/2, appendix 2), and archival data on municipal debt of the *Reichsstaedte* (see below); Dutch (Flanders) operations, among others, feature registry data in Utrecht (van der Sprenkel ed., 1937) and later surveys such as Weeveringh (1852), Kernkamp (1961), or Dormans (1991); I incorporate printed primary sources such as the diaries and account books of the Paler and Rehlinger merchant empires (via Hildebrandt ed. 1998 and 2004) or the Rapondi (Mirot and Lazzareschi 1929), and the activities of individual key sovereign creditors such as the Imperial treasurer Konrad von Weinsberg (via Fuhrmann 2004); later U.S. data is incorporated beginning with French "revolutionary loans" (some via Yale

Beinecke [Yale BL]; House of Representatives 1876) and some by the Dutch banking house Hope & Co. (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 80.1%, and for the past 600 years it has never been less than 52%.[2] Overall, the global R sample provided here thus represents the most comprehensive available over such a horizon.

GLOBAL PERSONAL LOAN AND "CAROLINGIAN" MUNICIPAL 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 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, private individuals, 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 omissions. Given that Germany accounts for about 23% of advanced economy GDP during 1300-1800, 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), whose comprehensive recent compilation nevertheless ignores various previous sources

[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).

[3] A typical registry entry reads that to gain possession of a farm in Cleve in 1500, "the buyer needs to bid with cash or safe rentes in Cleve" (Gorissen ed., 1989, No. 2279). See 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. Brandt (1935, 8f., 40ff.) finds shares of up to 50% for Luebeck during 1320-1350.

[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).

such as Neumann (ibid., 266-273). The latter still appears to be the first and most systematic collection of 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/regional 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, 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.[7] 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.[8] Hamburg data is calculated on the basis of Reincke (1953, 500). All data refers to long-term benchmark life or perpetual annuities. For data from the 18th and 19th centuries, I 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".[9] Inflation data is obtained by averaging Allen's (2001) CPI data for Leipzig, Augsburg, Vienna, and Munich, Abel's (1978, 308-309) rye prices, Bauernfeid's (1993) rye prices for Nuremberg, and archival Hannover rye prices in OeStA HHStA MEA Muenzsachen Box 8 (interpolating series where applicable).

Importantly, annuities, *rentes* and other census-based contracts of the type aggregated here were fully consistent with any of the usury doctrines of the times – whether in fact they were binding, or non-binding in practice for other assets (Munro 2003a, 506-531).

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[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.

[7] Archival basis for Cologne: HStAK, Best. 3 – U1/234, U1/1181, U1/1198, U1/1225, U2/1096, U2/461; Best. 254 (Michael) – U2/8, U2/19, U2/1148. On the Rhenian coin association, 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. I supplement the latter with datapoints in Fuhrmann (2007, 150-153).

[9] Stock market report copies in ISG, Handel Ugb-Akten 374.

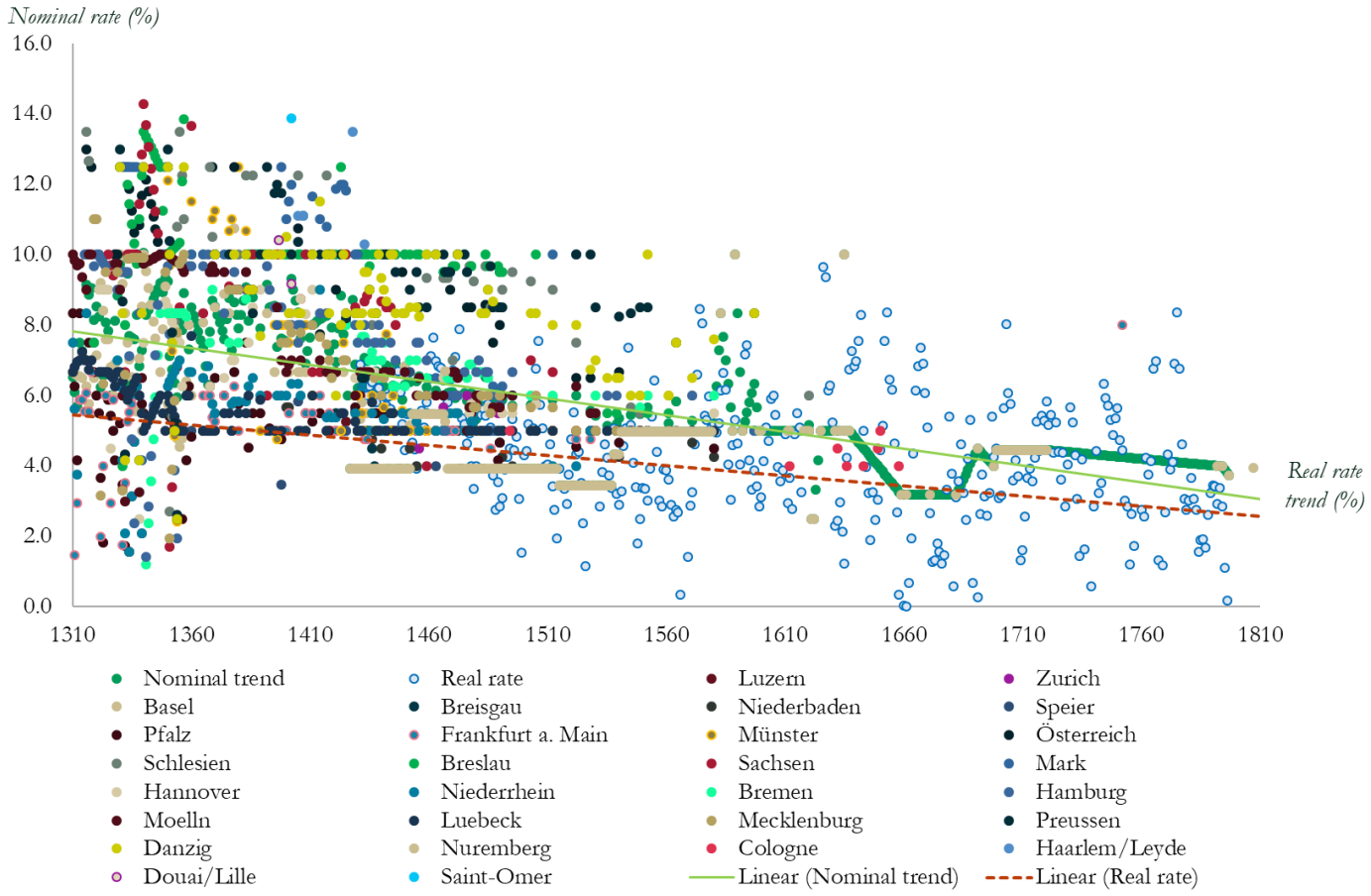


Figure II: "Carolingian Europe" nominal rate data, 1310-1810, and real rate trend.[10]

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 19th 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 GDP-weighted average. The downward

[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, 364-367); Haarlem/Leyde/Schiedam in Kernkamp (ed.1961, 17, 20, 26, 50, 53), Bos-Rops (2004, 33, 39).

trend is apparent here, therefore, irrespectively of any usury legislation from which the assets displayed were fully exempt (Munro ibid.).

It could theoretically be the case that surviving archival data exhibits a bias towards higher-yielding *Leibrenten*, as opposed to lower-yielding *Erb-* or *Ewigrenten* (or vice versa). Perhaps a far higher share of *Leibrenten* accounts has been lost, though we do not have suggestions for any such bias. An alternative 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. Between the 14th-16th centuries, we see a general trend towards a replacement of *Leibrenten*, starting from shares up to 70-80%, with *Erb-* or *Ewigrenten* – the exercise could therefore modify the steepness, but not any principal trends identified here (i.e. Kostanecki 1889, 53, for Braunschweig; Sander 1902, 414, for Nuremberg; Blendinger 1966, for Augsburg; 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 454 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. I exclude all intra-governmental loans, loans featuring in-kind payments, forced loans and those which are de facto expropriations: this thus excludes "loans" from Jewish communities in medieval times, often raised against the threat of expulsion, or – in a transaction typical of many royal capital raisings – Charles VIII's "order" in May 1487 to raise a loan in Normandy at 5% (Vuehrer 1886, 11). 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; [11] Included are also loans from municipalities to the central

[11] Not all such "pledge loans" had an underlying credit basis – sometimes they were rewards for service – but with very few exceptions, the embedded annual income streams are interest rate equivalents – hence repeated efforts by

authorities, since these merchant communities and city governments typically enjoyed a considerable degree of independence, and the towns could not directly market the liabilities of the Crown, even if they concurrently increased their own *rentes* issuance. While there are various mixed forms, the basic properties of all these contracts place them firmly into the "obligation" category, with *renten* – apart from their adherence to usury laws – popular for their redeemability and easy legal recourse, though their compatibility with ecclesiastical doctrines often required a high degree of contractual creativity (Kostanecki 1889, 11-25, 56-87; Neumann ibid., 190f.; Gilomen 1984, chapters II.3-4.; Munro 2003a).[12]

Equally, pledge loans included fall firmly into the "long-term" spectrum, with an average maturity of all loans estimated at between ten and twelve years.[13] 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 *renten*. But in aggregate they can also 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 six years are suggested.[14] This is in contrast to at least one account, which erroneously placed pledge contracts in the short-term category (i.e. Koerner 1995, 513-514). At times, the boundaries between short- and long-term cash loans 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 1960b; Outhwaite 1966). Similar practices are documented in France and Burgundy, with at least one example where short-term bills of exchanges are used to pay out interest instalments from de facto long-term repayment schedules (Doucet 1937, 45; Nieuwenhuysen 1984; Lambert 2006, 118f.). 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 any case be mentioned, however, that there is considerable evidence that a fully-weighted term structure for the 14th-17th centuries would be de facto flat or inverted.

Church authorities to ban the practice. The German version resembles closely the French *bail a rente* and *rente a prix argent*. For in-depth discussions, see Neumann (1865, 180ff.) and Landwehr (1967, esp. 234-257, 328-333), with some context also in Schnapper (1957, 56-60) and Munro (2003a, 519).

[12] For instance, many *rentes* contracts ended up with contradictory clauses that made them both perpetual and redeemable at will by the debtor at the same time: adherence to usury standards required a construct that made redeeming look as an entirely unpredicted "chance event", never intended from the outset (cf. Gilomen 1984, 95).

[13] 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.

[14] 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. Landwehr (ibid., 333) finds a few rare instances with specified pledge loan maturities of 15 and 14 years.

Such non-marketable sovereign loans have gone out of fashion over the past two centuries. A "benchmark" non-marketable instrument today is 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%). And we observe that the properties of the personal loan series are in fact analogous to those of consolidated asset trends – most notable in the fact that the overall trend fall recorded here, at -1.96bps p.a., falls well within the long-run ranges indicated by other assets.[15]

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

Year	Details	Amount and Rate	Source
1397	Filippo Rapondi loans to Duke of Nevers at Bruges, anticipating taxes	18,233 nobles at 23.2%, 18 months	Mirot and Lazzareschi (1929, 170); Bossuat (1950, 368)
1401	Amadi/Rommel loan to King Sigismund, 1,200 ducats	18% (1.5% per month)	RTA, Vol. 5, no. 37 (note 1)
1440	Paumgartner loans to Lewis of Bavaria, 4 years	1800fl at 24%	Krag (1914, 11)
1459	Medici bank loans to Sforza, Duke of Milan	218,072 Milanese pounds at 15.4%	De Roover (1963, 264-269)
1494	Sauli Bank loan to Charles VIII for the invasion of Italy	20,000 ducats at 14%	Dupont (ed., 1840, II, 292); Tewes (2011, 46).
1502	Melchior, Bishop of Brixen to Maximilian I (Raitkammer)	30,000fl at 5%	Regesta Imperii, XIV Vol. 4, no. 16970
1570	Loan to Maximilian II from Hans Bernhard von Wallprun	20,000fl at 5%	OeStA, FHKA SUS RA 75.6

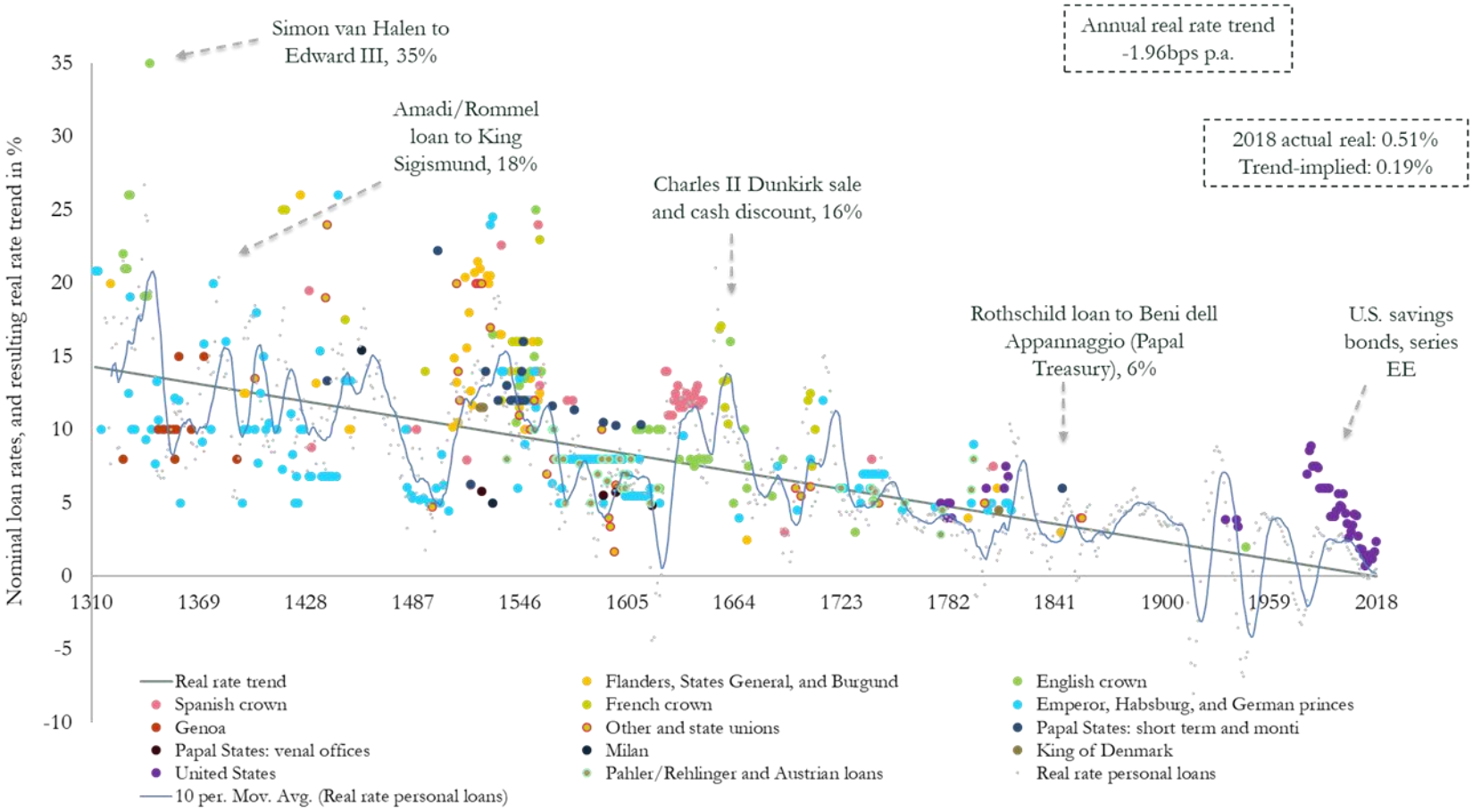
[15] Cf. additional notes in appendix, appendix table A.3 and sources to Figure III.

1578	Loan Counts of Nassau to States General of Holland, to raise troops. 6 years	22,000fl at 4.8%	HHStaW 171/G 717, fols. 119-122.
1622	Loan from Philip Burlamachi for upkeep of forces in the Palatinate	6,000l at 10%	Calendar of State Papers Domestic, James I, Vol. 3, entry no. VOL. CXXXIII., [57a]
1642	Loans to Queen Henrietta Maria in Holland	2x 150,000 livres tournois at 7.5%	National Archives (TNA), SP 84/157, fols. 227, 231
1645	80,000l loan from merchants group including John Wollaston	80,000l at 8%	Calendar of State Papers Domestic, Vol. 20, p.377, entry no. VOL. DVI., 84
1698	Two loans of 8,000fl and 10,000fl to Charles Duke of Lorraine.	18,000fl at 6%	OeStA HHStA, House of Este, Box 14, letters of June 10 and July 28, 1698
1706	Loan to the German Emperor to support Prince Eugen's campaign in Italy	250,000l at 8%	Calendar of State Papers Domestic, Anne I, Vol. 4, entry no. text 474
1778 - 1780	(French) Revolutionary War loans to United States	18m Livres at 5%; 6% continental	Yale BL (GEN MSS 1081, Box 2, fol.57); House of Representatives (1876, 24)
1803	Loan Bethmann Bank to Emperor Franz II	2m Gulden at 5%	ISG Frankfurt, 1.117

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

Page 13: Figure III: 454 personal/non-marketable loans to sovereigns, 1310-1946, and U.S. savings bonds – plus resulting real rate trend.[16]

[16] For full list of sources, see appendix table A.3 and “Notes to figure III”. Loans are arithmetically-weighted at global headline level prior to establishment of consolidated debt at national levels (Germany: prior to 1618). Excluded are intragovernmental loans from central/public banks, from de facto public agencies (such as Venice’s Grain Office or the East India Company), and any bank loans opened up to public subscription. 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.


Simon van Halen to Edward III, 35%
Amadi/Rommel loan to King Sigismund, 18%
Charles II Dunkirk sale and cash discount, 16%
Rothschild loan to Beni dell Appannaggio (Papal Treasury), 6%
U.S. savings bonds, series EE
Annual real rate trend -1.96bps p.a.
2018 actual real: 0.51%
Trend-implied: 0.19%
Nominal loan rates, and resulting real rate trend in %
35
30
25
20
15
10
5
0
-5
-10
1310
1369
1428
1487
1546
1605
1664
1723
1782
1841
1900
1959
2018
Real rate trend
Spanish crown
Genoa
Papal States: venal offices
United States
10 per. Mov. Avg. (Real rate personal loans)
Flanders, States General, and Burgund
French crown
Other and state unions
Milan
Pahler/Rehlinger and Austrian loans
English crown
Emperor, Habsburg, and German princes
Papal States: short term and monti
King of Denmark
Real rate personal loans

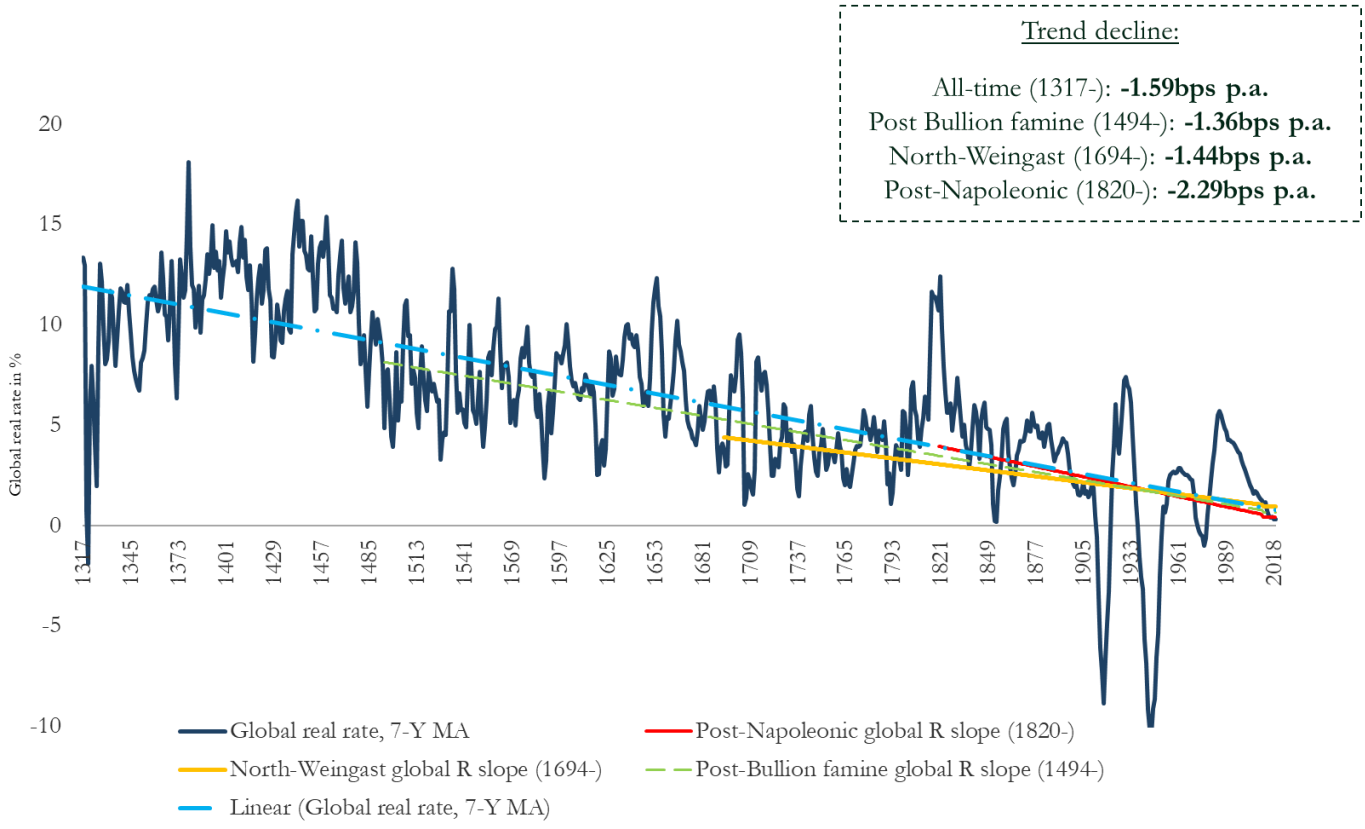


Figure IV: Headline global real rate, GDP-weighted, and trend declines, 1317-2018.

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, with collateral in early modern Europe typically including jewels, mortgages or land assets (Fryde and Fryde 1963; Munro 2003c).

The resulting all-time GDP-weighted real rate, at 6.32% (Figure IV), is expectedly higher than the safe asset provider benchmark rate of 4.60%. Key differences include an earlier all-time peak, about one century prior to the single-issuer peak, in 1379, at a slightly lower level (18.1% 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 -1.59 basis point decline per annum – I add three further key historical slopes.

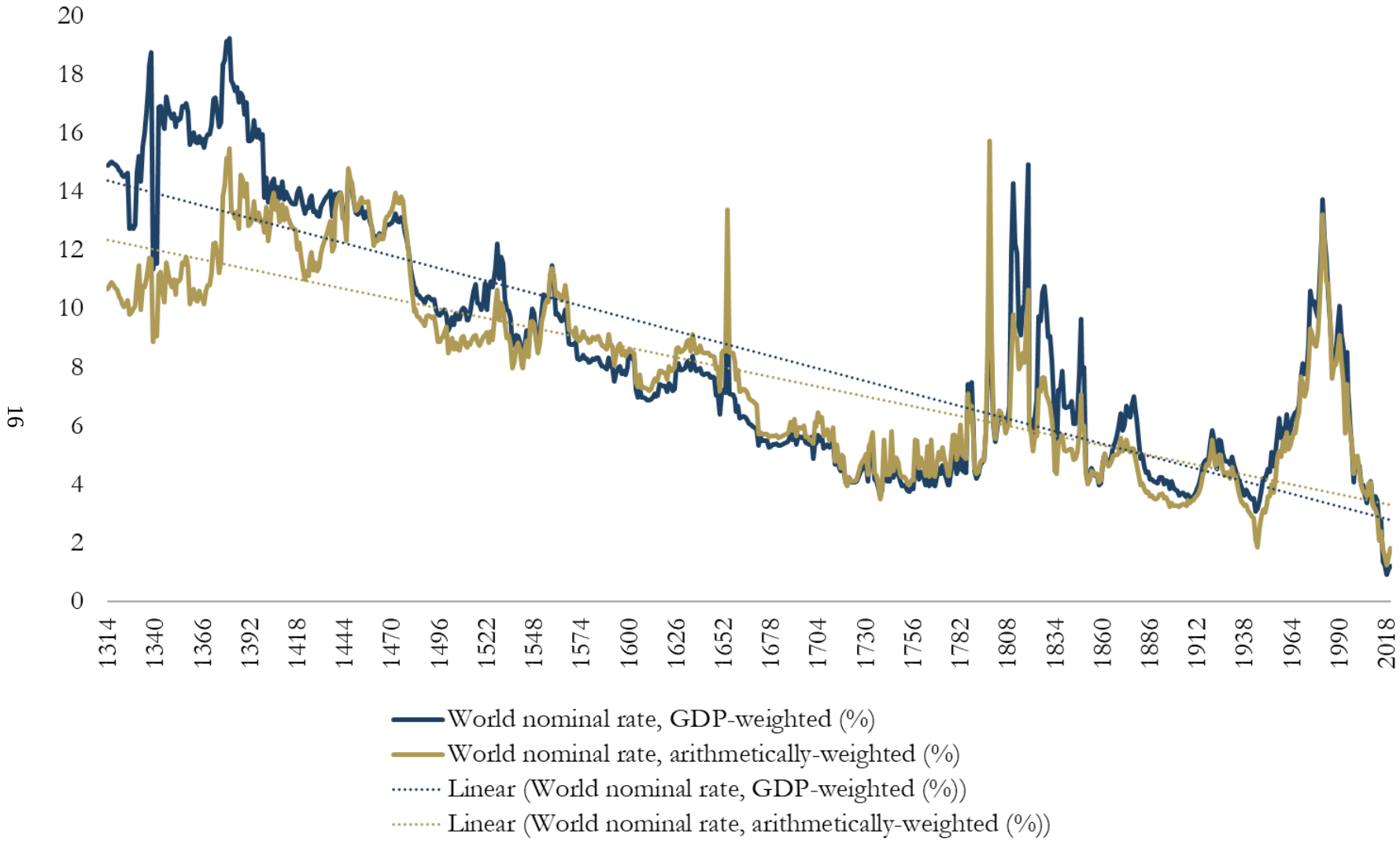
- First, the **"post-Bullion famine" slope**, beginning in 1494 after the second "global" monetary contraction period identified by John Day (1978), and the resumption of Balkan mining output.
- Secondly, **the "North-Weingast" slope**, in reference to the well-known arguments by the authors (North and 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 -1.44 bps per annum – actually the second flattest of our slopes: this suggests some problems for those once more emphasizing the policy inflections in and after 1688 (i.e. Pincus and Robinson 2011).
- Thirdly, **the "post-Napoleonic slope"**, beginning in 1820, after the Congress of Vienna and the founding of the modern international state system. Since the geopolitical inflections then, we record a relatively steep trend decline, displaying a -2.29bps fall.

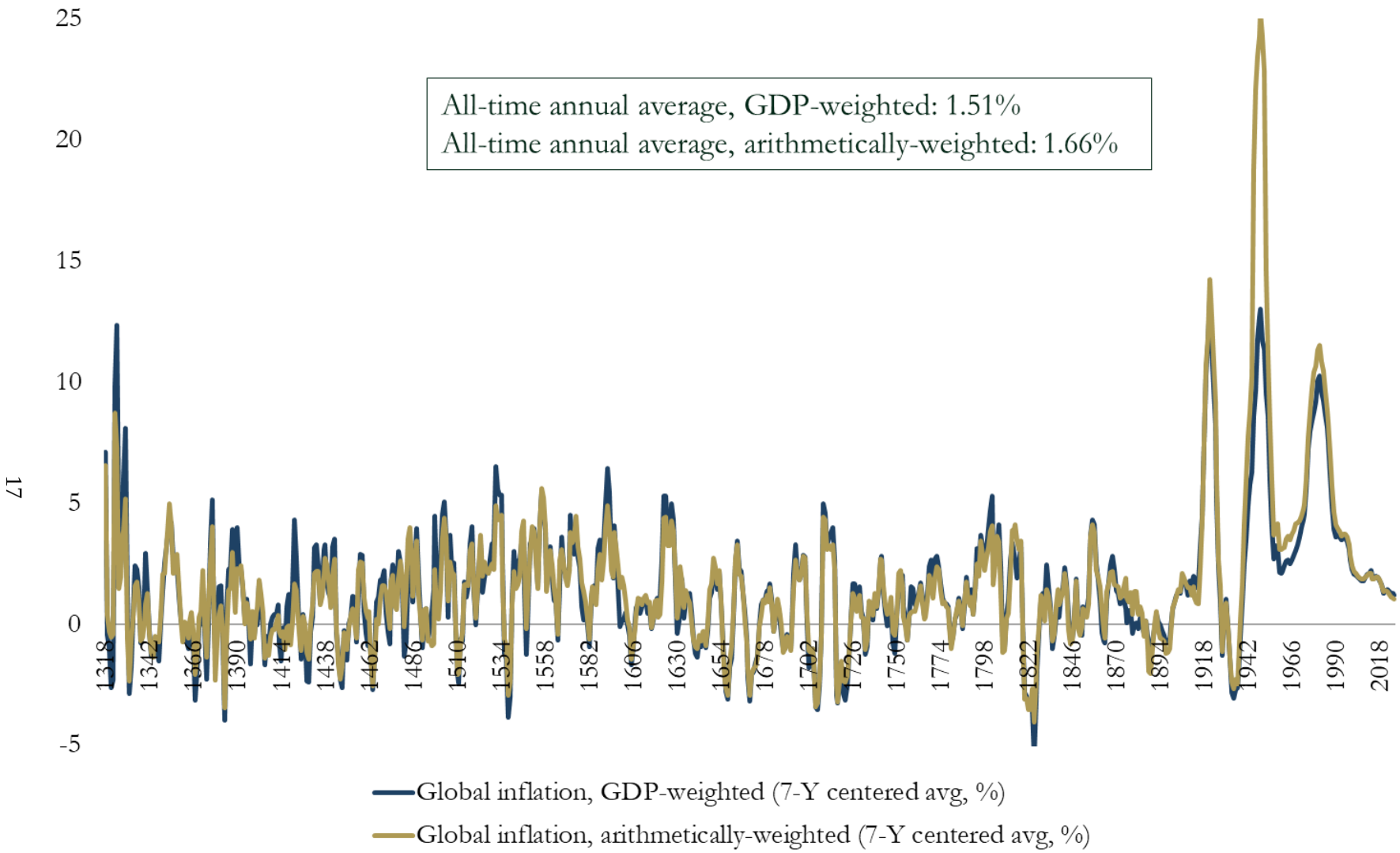
Figures V and VI decompose the real rate set in Figure IV. In particular, figure VI suggests that inflation levels on the global basis exhibit similar general features to that of the safe asset provider: there were frequent "deflationary dips" until the early 18th century: 193 out of the 415 annual observations between 1311 and 1725 record global deflation (on the non-moving-averaged basis); over a 200-year horizon (1818-2018), global inflation averaged 2.43%.

Page 16: Figure V: Nominal bond yields, GDP- and arithmetically-weighted, 1314-2018,

followed by

Page 17: Figure VI: "Global" inflation, GDP- and arithmetically-weighted, 1314-2018.


20
18
16
14
12
10
8
6
4
2
0
1314
1340
1366
1392
1418
1444
1470
1496
1522
1548
1574
1600
1626
1652
1678
1704
1730
1756
1782
1808
1834
1860
1886
1912
1938
1964
1990
2018
World nominal rate, GDP-weighted (%)
World nominal rate, arithmetically-weighted (%)
Linear (World nominal rate, GDP-weighted (%))
Linear (World nominal rate, arithmetically-weighted (%))


All-time annual average, GDP-weighted: 1.51%
All-time annual average, arithmetically-weighted: 1.66%
25
20
15
10
5
0
-5
1318
1342
1366
1390
1414
1438
1462
1486
1510
1534
1558
1582
1606
1630
1654
1678
1702
1726
1750
1774
1798
1822
1846
1870
1894
1918
1942
1966
1990
2018
Global inflation, GDP-weighted (7-Y centered avg, %)
Global inflation, arithmetically-weighted (7-Y centered avg, %)

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 and the late 15th centuries, but the phenomenon affected most sovereign annuities issuers during this time.[17] 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 in fact frequently encountered default events: relying on Dietz (1925, IV/II, appendix 2), Gilomen (1994), and Zuijderduijn (2018, 206-207) alone yields at least 21 "default events" narrowly defined between 1300-1700 among "Carolingian" cities: one should not assume, therefore, that a lower yield per se signals safety.[18] 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.

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,

[17] I focus on long-term debt only; hence this statement is irrespective of short-term defaults such as the 1425 Florentine default on *Dieci* loans (Molho 1971, 165ff.).

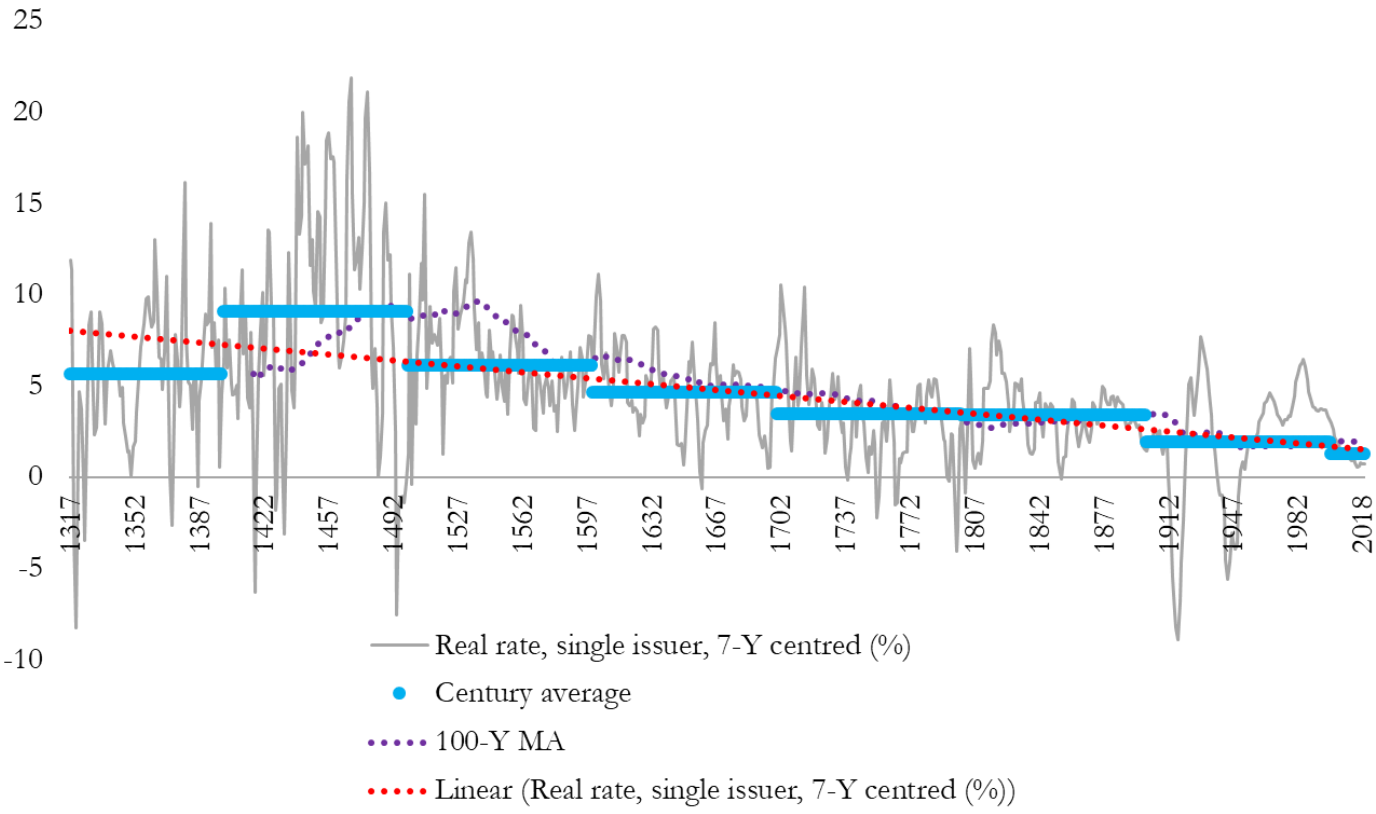
[18] Note also how Italian long-term debt presently (March 2019) yields below 10-year USTs: are we to regard the former as "safer"? Regarding early modern municipal debt, one often observes that cities had to offer higher-yielding *Leibrenten* when faced with adverse funding conditions; but in many cases, cities restricted their credit market activity altogether, and found it more advantageous to resort to raising direct taxes among citizens in such situations. To the extent that such taxes schemes merely represent disguised forced loans, they are excluded here.

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".[19] 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 long-term debt remained preferable to alternative assets, at a time when even the wealthy towns of Flanders were in arrears, and short-term sovereign rates reached up to 74% even at the richest court in Europe, that of the dukes of Burgundy.[20]

In relative terms, Italian urban debt thus constituted the proverbial risk-free, marketable asset of the day.[21] 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.[22]

[19] Cit. in Luzzatto (1929, CCXLV-VI N.1); also cf. Mueller (1997, 563).
[20] Also cf. below, 41, Van der Wee (1963, II, 105-110), Zuijderduijn (2018).
[21] For Florence, see also Molho (1971).
[22] 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.



Centennial averages

%	1300s	1400s	1500s	1600s	1700s	1800s	1900s	2000s
Nominal rate	7.3	11.2	7.8	5.4	4.1	3.5	5.0	3.5
Inflation	2.2	2.1	1.7	0.8	0.6	0.0	3.1	2.2
Real rate	5.1	9.1	6.1	4.6	3.5	3.4	2.0	1.3

Figure VII: Real long-term "safe asset" rates and composition by century, 1311-2018.[23]

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

[23] Compare Schmelzing (2018, 19) for an earlier version. This paper mainly attempted to frame longer-run trends in a "bond market" context on a basis of a limited set of secondary sources.

specified weight the preferred internationally accepted standard: Florentine florins, Venetian ducats, and German gulden[24] (ibid.; Fryde and Fryde 1963; Rothmann 1998, 426); on the local and private level one finds a higher share of silver accounting in the arrangements, and Zujderduijn (2018) has documented some attempts to use silver on the municipal level in the late 15th century (with terrible outcomes for the Dutch cities). These practices can also be confirmed by numerous archival contracts. The debtors of Emperor Maximilian I. incorporated standard clauses into loan agreements to be repaid in "gutem reinischen golde" (good Rhenian gold coin).[25] 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).[26] The financial advisors for the city of Vienna advertised specifically that newly-issued municipal debt should be denominated in gold coin given the fluctuations in pfennig and pfund: "ist unser mainung , daz man soelicher gult jerlich zins nur kaufen und verkaufen, handeln und wandeln sol nach Gulden in guten Ungern und Dukaten…und nicht pfunt, wann die muns der pfennige hie…" (via Gilomen 1984, 107f.).[27] My series thus are not prone to debasement problems, and Allen's aggregations have been used in the academic literature in numerous 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

[24] In all of the following, I denote the German Rheinflorin/Rheingulden as "fl".
[25] 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.
[26] Geheimes Staatsarchiv Preussischer Kulturbesitz (GStA PK), I. HA Rep. 78, Nr. 10, fols. 96-131. Gilomen (2018, 68f.) agrees. Conversely, see an illuminating court case by Adolph von Opperfeld, 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 geldtt" – 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 (HStAK, Best. 310W – A 71: "Klaeger: Adolph von Opperfeld, Koeln, 1418-1618"). Some similar printed court cases are to be found in the "Reichskammergericht" registers, such as those published via BayHStA, see Gebhardt and Hoerner (eds., 1994-).
[27] Gilomen (ibid.) is mistaken of course that the city pressed for such a basis as an *inflation* hedge. Obviously, for a municipal debtor this would have been desirable. The 15th century was generally a period of *deflation*, however: hence the position of the city makes sense in that context.

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 15th 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 *Monte Vecchio* and *Monte Nuovo* bonds (104 datapoints), Florentine *Comune* bond yields (52 datapoints), and for Genoa *Compere* bonds and San Giorgi *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.[28]

There is broad consensus among economic historians that the late 15th 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 *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 16th century, "no other power controlled...armed forces as powerful or financial resources as vast as Habsburg Spain".[29] Spain 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".[30] By the 16th century, Spain was equipped with a

[28] 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.
[29] Drelichman and Voth (2014, 243). See generally Ehrenberg (1928) on the Crown's relationship with the Fugger.
[30] Drelichman and Voth (ibid., 24, footnote [55]).

"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 (Vigne 1903; 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, *juros* issued on Murcia), 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 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).[31] 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).[32] 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",

[31] 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.

[32] 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.

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.

From 1703, I switch to British consol yields as the global "safe asset", as recorded via Castaing and the Bank of England archive.[33] In my geographic shift, I follow standard accounts such as Neal (1990), Ferguson (2002), and Broadberry and Fouqet (2015), which treat Britain as Europe's "most vibrant" economy, concurrent with the transition of dominant financial market activity from Amsterdam to London, and the establishment of the Bank of England in 1694.

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, 468; 1976, 720), 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's 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. 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).

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

[33] 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".

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 evolution of long-term rates, 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.[34] 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[35] – 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 a homogenous series from the private, secured mortgage market over the last 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 (e.g. StAMz, ISG, HStaK); 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 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 multiple German price series are averaged to obtain inflation, including Allen's (2001) German-speaking municipalities, Abel's (1978, 308f., interpolated) and Bauernfeind's (1993) rye prices, and an archival grain silver price series covering 1325-1750 from Hannover (interpolated).[36]

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

[34] 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).
[35] Obviously, the main other financial asset would be business investments (modern: equity). See the online appendix for some anecdotal profit rates which may be broadly indicative of the general levels.
[36] This is the same German inflation series used to adjust German sovereign nominal yields, cf. below.

Thirty Year's War.[37] 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.[38]

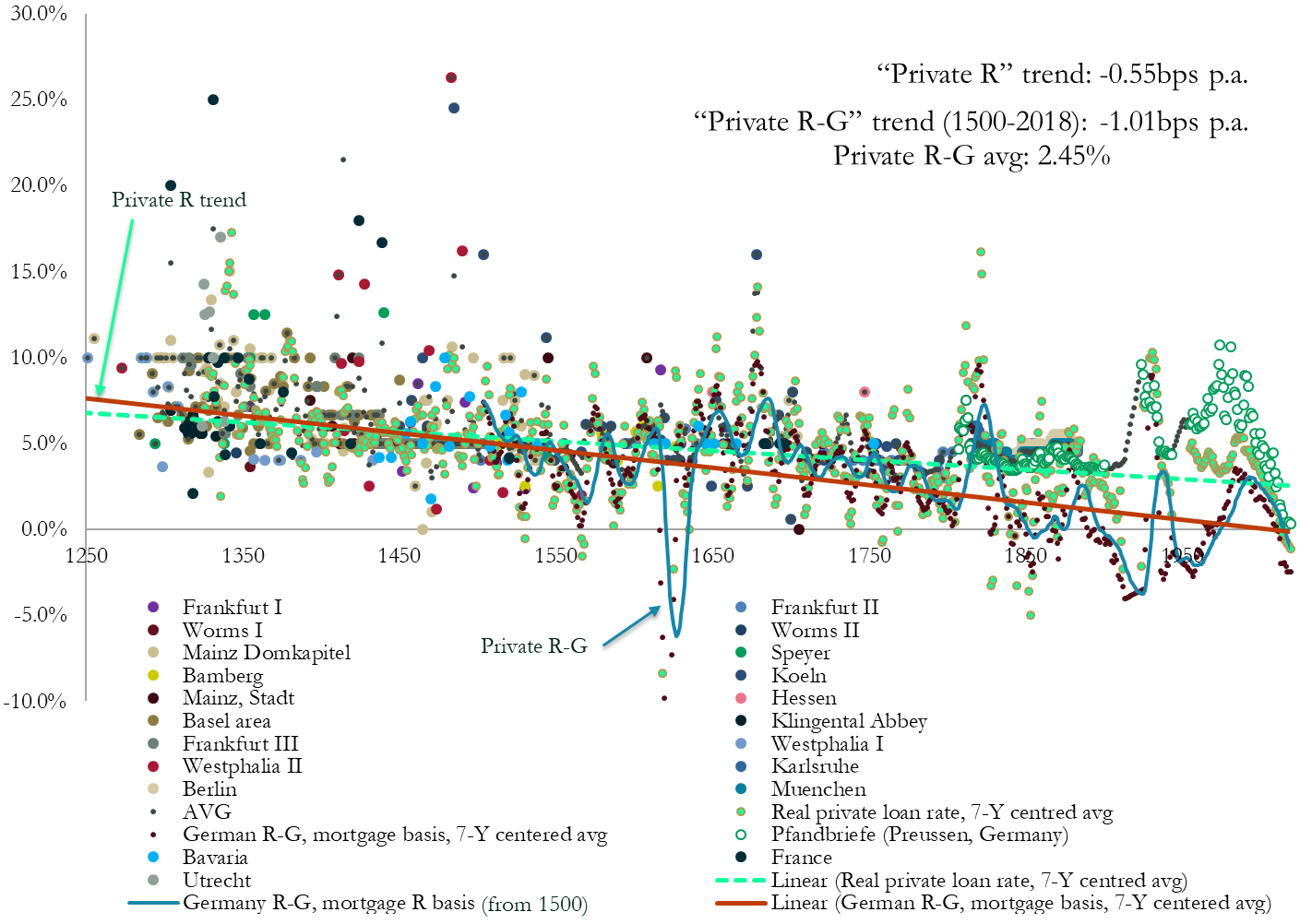


Figure VIII: Private R, and R-G trends, "Carolingian Europe", 1250-2019.[39]

[37] 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.

[38] Kernkamp (1961, 10) found a Dutch municipal rent continuously paid by the city of Schiedam between 1390-1660, but those cases are rarer for "public R".

[39] For a full list of sources, see Appendix "Notes to Figure VIII". Sources include: Stadtarchiv Bamberg (StABb): A 21, D 3001, D 4017; Frankfurt ISG: Hausurkunden; Stadtarchiv Mainz (StAMz); Historisches Archiv der Stadt Koeln (HStAK): files including Best. 1 – A73, U1/17139; Best. 135 – U2/7; Best. 210 – U3/1652; Best. 223 – A

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, the fall moderates to -0.34 basis points per annum; if Pfister's (2008, 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 -1.01%.[40] While private rates, unlike public ones, are not "at historical trend", there is similarly no long-run trend break since 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 equally remains consistent across successive historical 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 anecdotally 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).[41] For Venetian bank balance sheets of the 15th century, the "public R" share may be estimated at 22-25% based on Lane (1937), with up to 54% in real estate, and the remainder in "private R". Despite some lower figures for France in Schnapper (1957, 288f.), 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

1401, A 2213, A 2221, A 2242; Best. 228 – U1/214; Best. 246 – U2/4, and files in Best. 1037 – 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, series BBK01.WU0018); one French datapoint in Longnon (1878, no. LX) and others in Maugis (1908, XLII, no.16; 1914, V [Supplement a l'Article XIII, 433ff.], no.5; XXI, no. 4), Pezzolo (1999, 252); Utrecht in van der Sprenkel (1937, nos. 618, 657, 698, 859, 984, 1189, 1192, 1244).

[40] Taking Bundesbank 2019 nominal 'Pfandbrief' yield of 0.3%, less August 2019 y-o-y CPI of 1.4%.

[41] Also cf. Figure X, with respective sources there.

more datapoints are desirable to trace shorter term and cyclical fluctuations in the private wealth composition.

III. RISK PREMIA, WARS, AND VERY LONG-RUN "R-G"

Does the decline in sovereign nominal rates merely reflect declining credit risk premia over time? Previous studies have certainly shown a compression 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 derive 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 dispossessions 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).[42] We have various indications that the sixteenth century, with its accelerating inflation dynamics, then witnessed a clear switch of investments towards real property, for instance in Venetian portfolios, though the evidence on this does not amount to a robust pan-European picture at this point (Pullan 1971, 132, 173).

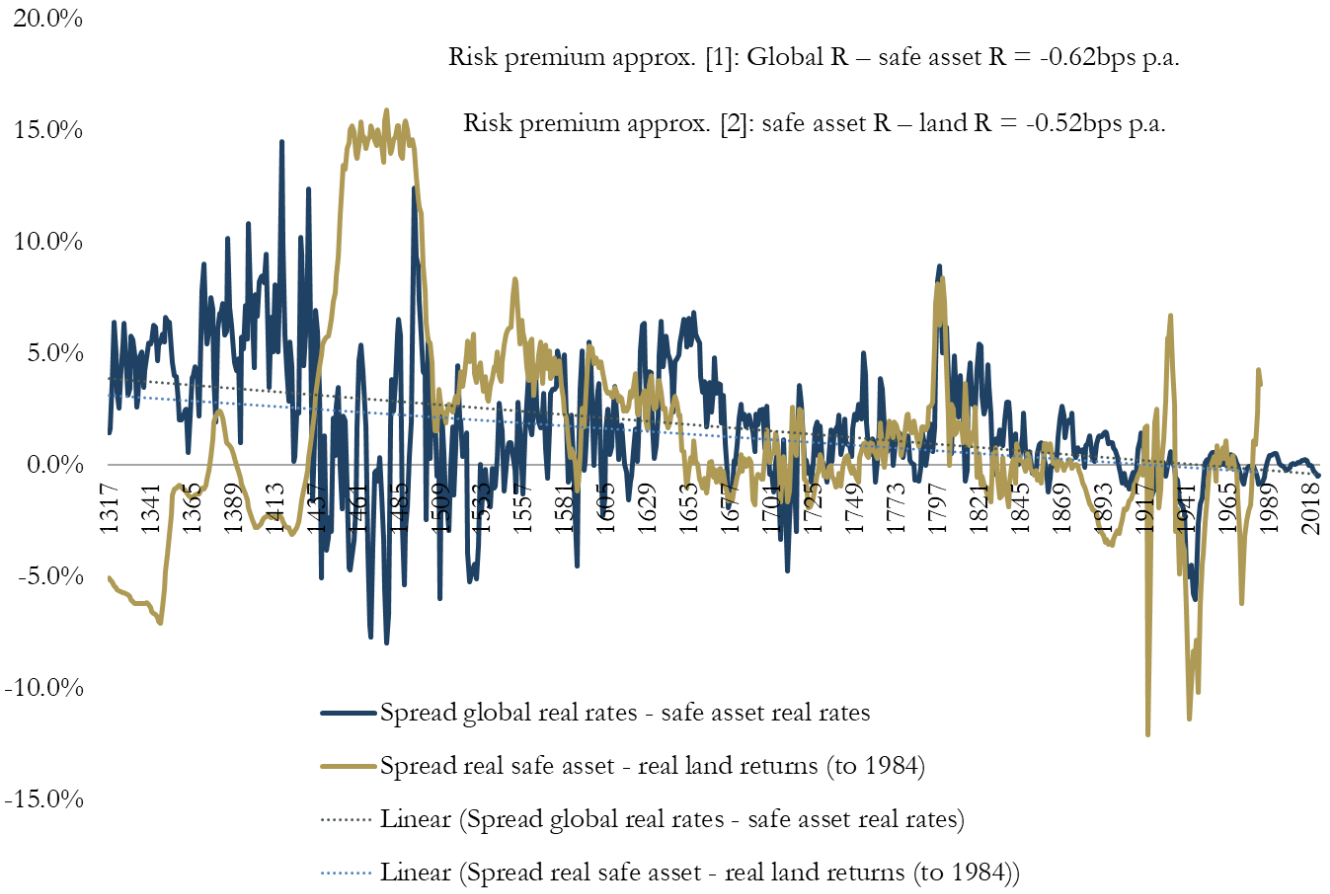


Figure IX: Two approximations of the risk premium over time, 1317-1984.[43]

[42] 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.

[43] The share of interpolated data in the land sample is rather high, and partly based on Clark (1988; 2010, table 7). Note that Clark (2010) derives English "risk-free return on capital" by averaging nominal gross returns on agricultural investments and nominal mortgage rates (which he labels "rent charges"); hence his figures have been

While 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.[44] 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, more than half of the trend fall over time remains unexplained.

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 assets, 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 nonhuman 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

adjusted with English inflation in Thomas and Dimsdale (2017, tab A.47). Modern English land returns via Ward (1960). U.S. land returns via Featherstone and Baker (1987, 545-546).

[44] 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.

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.

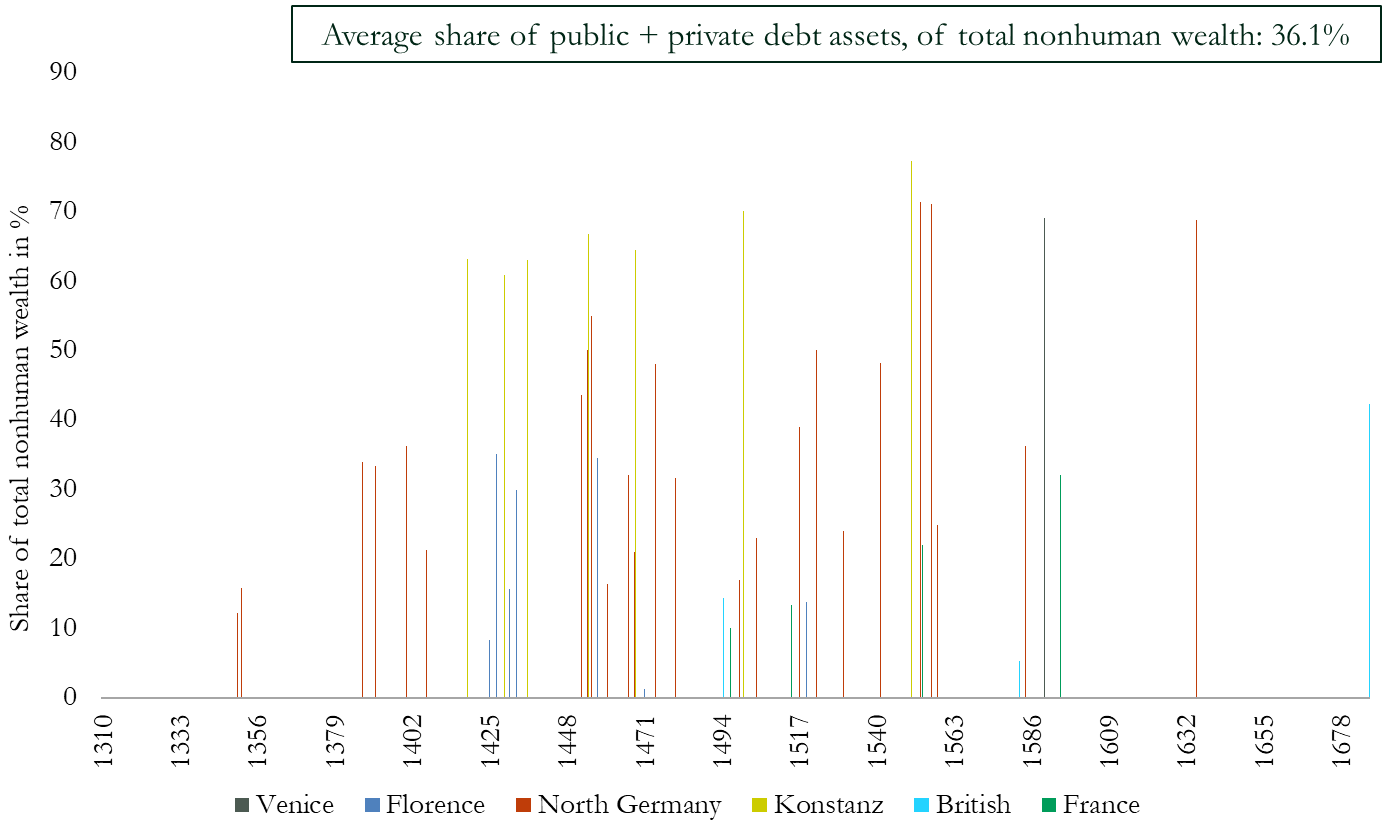


Figure X: Top household public + private debt assets as % of total private nonhuman wealth, 1346-1686.[45]

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

[45] 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). France in Schnapper (1957, 288f.). Venice refers to the Scuola Di San Marco income share in Pullan (1971, 173), who notes that "loans and loan funds" for 1590 refer almost exclusively to government Monti. 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.

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.[46] Such an assumption, as documented here, underestimates capital returns by a significant amount, and when 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" growth series detailed in appendix figures A.3 and A.4) 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 (-2.12bps 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).[47] A simple extrapolation of the R-G trend into the

[46] 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%.

[47] 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 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

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.

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. I highlight the period between ca. 1570-1648, which marks a meaningful temporary reversal in the R-G decline. I note that Hoffman et al. (2002) in their work on income group-specific inflation and expenditure trends in the U.K., Holland, and France, have associated 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, R-G differentials per se could still be indicative of some broader social fault lines. 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 below Figure XXIII). 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 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) declared 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".[48] 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".

the prevalence of "in-kind" debt is evidence of stronger creditor protection by the 16th century (see discussion below, and in the online appendix).
[48] Cf. also Dickson (1967, 475f.).

Many possibilities to test the secular impact of political conflict on real rates 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.[49] 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.

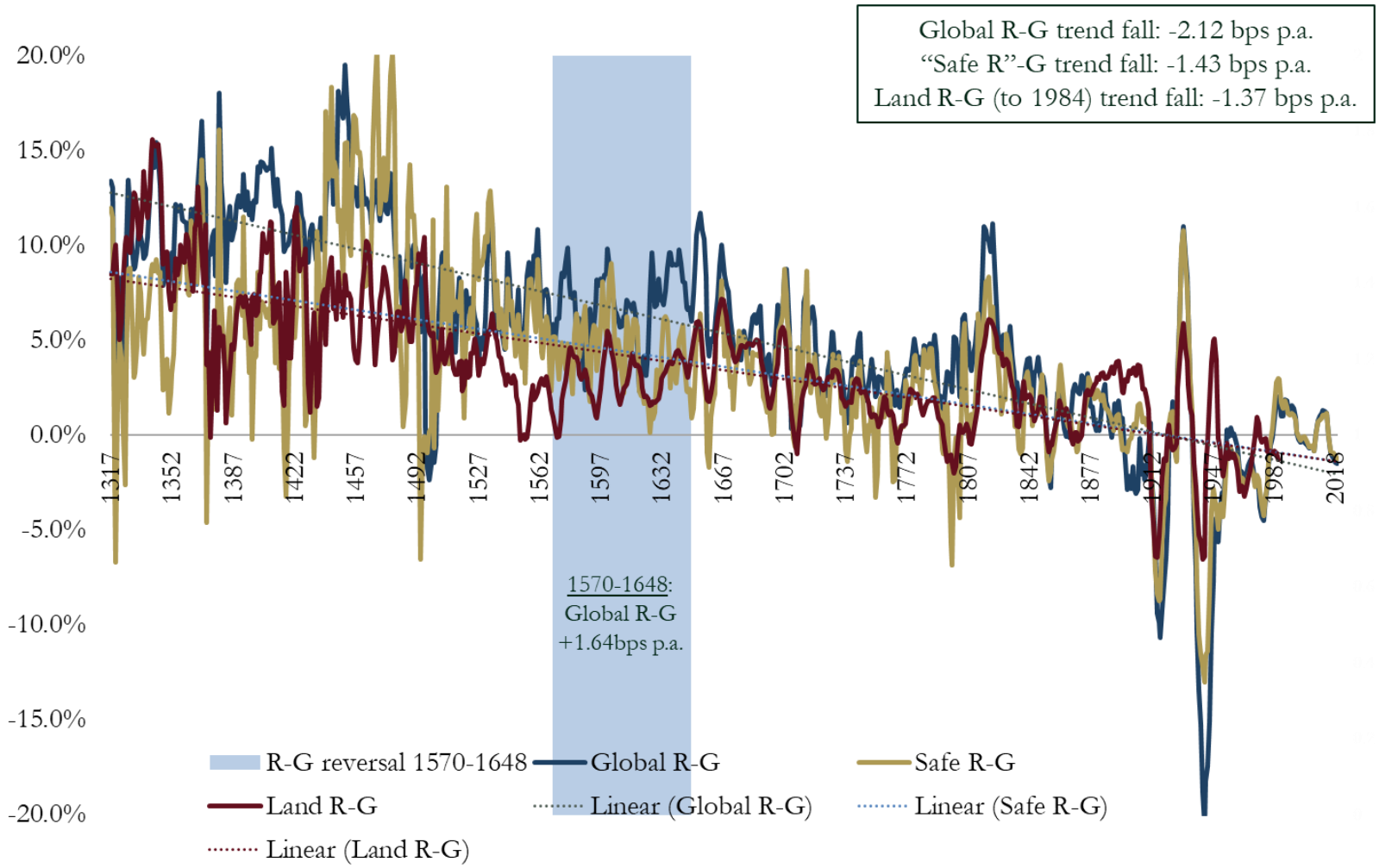
Of course, there are good reasons to argue that trends in physical capital destruction, rather, should be the actual relevant factor to relate real rates to capital accumulation trends. It appears as a promising further line of future investigation, given the historical findings on the changing nature 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". Taylor (1921) famously argued that a major strategic and technological shift, characterized by a new intensity of (more capital stock-destructive) siege warfare and artillery innovation, accompanied Charles VIII's momentous invasion in the fall of 1494.

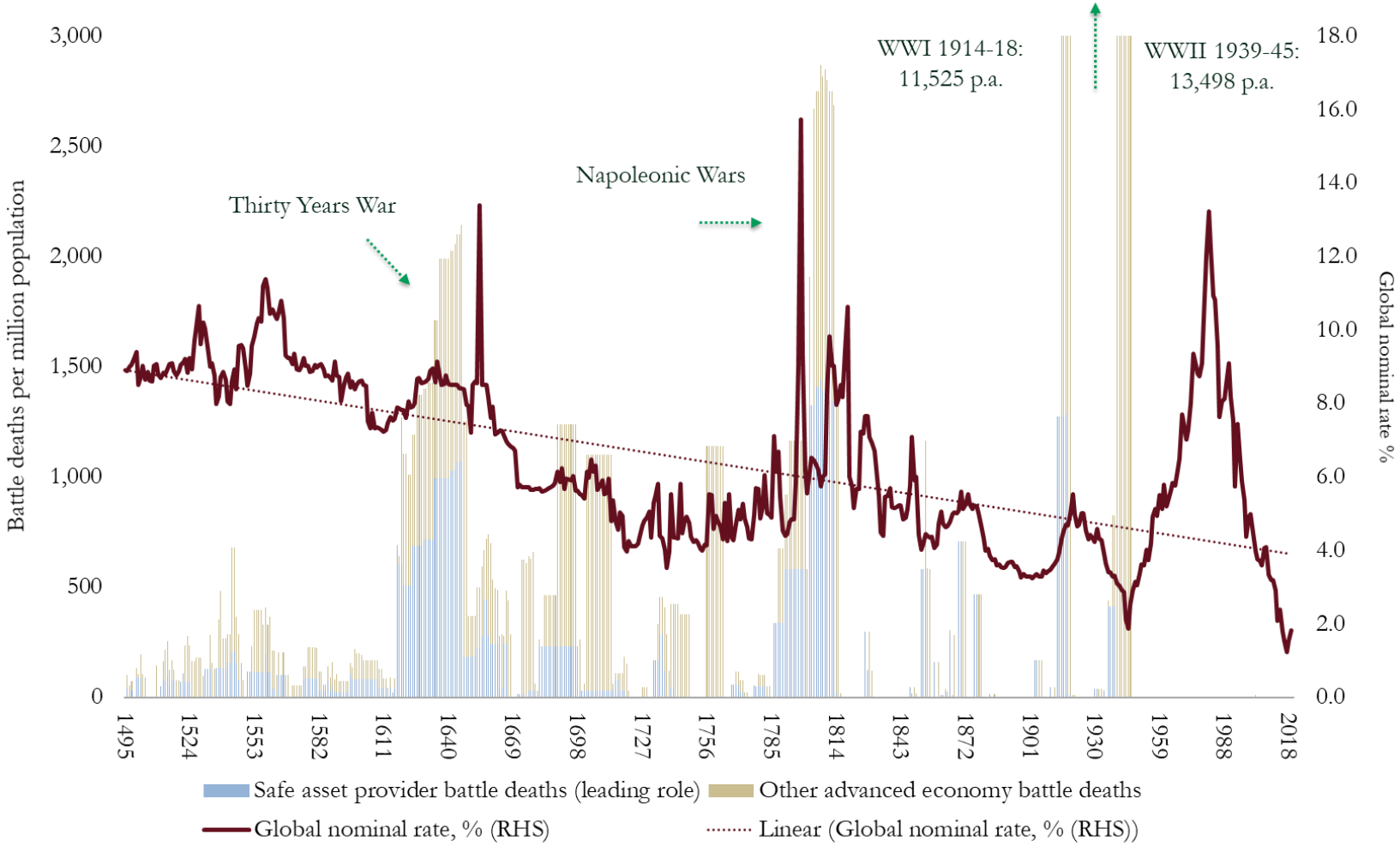
Page 35: Figure XI: Three variations of "R" minus "G", 1317-2018, GDP-weighted.[50]

followed by

Page 36: Figure XII: Global nominal interest rates and war frequency, 1495-2018.[51]

[49] 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.
[50] Growth data based on sources detailed in appendix figures A.3-A.4. "R" and "G" samples always use consistent country groups – "Land R" sample here arithmetic real return averages for Italy (1317-1450), England and France (1451-1516), England, France, and Flanders (1517-1559), England and Flanders (1560-1800), England (1801-1918), U.S. (1919-1984). Inflation data detailed in appendix used to deflate nominal rent returns (primarily Allen 2001).
[51] 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 49 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: -2.12 bps p.a.
"Safe R"-G trend fall: -1.43 bps p.a.
Land R-G (to 1984) trend fall: -1.37 bps p.a.
20.0%
15.0%
10.0%
5.0%
0.0%
-5.0%
-10.0%
-15.0%
-20.0%
1317
1352
1387
1422
1457
1492
1527
1562
1597
1632
1667
1702
1737
1772
1807
1842
1877
1912
1947
1982
2018
1570-1648:
Global R-G
+1.64bps p.a.
R-G reversal 1570-1648
Global R-G
Safe R-G
Land R-G
Linear (Global R-G)
Linear (Safe R-G)
Linear (Land R-G)


Battle deaths per million population
Global nominal rate %
3,000
2,500
2,000
1,500
1,000
500
0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Thirty Years War
Napoleonic Wars
WWI 1914-18:
11,525 p.a.
WWII 1939-45:
13,498 p.a.
1495
1524
1553
1582
1611
1640
1669
1698
1727
1756
1785
1814
1843
1872
1901
1930
1959
1988
2018
Safe asset provider battle deaths (leading role)
Other advanced economy battle deaths
Global nominal rate, % (RHS)
Linear (Global nominal rate, % (RHS))

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 fall proceeds.[52] 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-based 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 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, chapter 2) 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

[52] 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".

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.[53]

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 refined approaches by Gagnon and Unferth (ibid), and Ford and Laxton (1999).

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, and in any case suffers 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.[54] The authors never use primary or printed primary sources, and even the secondary source treatment remains in many ways very superficial, leading in effect to a mis-stating of various key inflection points and general trends. A real rate discussion is relegated to just four pages (1991, 429-432). Not least, Homer and Sylla 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 nominal "safe rate" stands at 6.15% between 1314-2018: Homer and Sylla 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 related variables – for instance those related to wealth accumulation

[53] Some excerpts from Clark's paper are published in Clark (2007, 167-175), as well as in Clark (2010).
[54] See also my discussion of the German data above.

trends between the mid-15th to mid-16th century (below, 68-73) – are in consequence at odds with Homer and Sylla's trajectory, but suggest better coherence with our data here.

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.[55] 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 between 1200-1550; Pressnell (1960) noted a similar trend for English money market rates during the 18th century; Costa, Rocha, and Brito (2018) 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". Both err, however: we have seen that neither the Black Death, nor the 13th century mark particular trend breaks – in fact the period until the mid-15th century remains a tight real rate regime. And the "cost of capital for individuals" shows clear discrepancies (see "private R" above). We will return to further qualifications below.

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 are good reasons not to extend their approach temporally or spatially: short-term debt long remained unconsolidated in early modern Europe, including Northern Italy, and there are strong indications that the yield curve was permanently inverted until the early 17th century.[56] As

[55] For the U.S., the authors splice US commercial paper rates between 1857-1913, Fed discount rates for 1914-1953, and average Fed funds for 1954-2016. See Hamilton et al. (2016, 665).

[56] In the sense that even personal short-term loans were contracted at lower levels than personal long-term sovereign loans, irrespective of personal short-term-municipal long-term spreads. The fact is apparent in many individual case studies, i.e. Mollat (1958, 318) reports that two two-month loans for Charles Téméraire are priced at 20.6-21%, but his 15-month loan at 13.2%. So far, there does not appear to be any systematic investigation into the phenomenon.

per above, I note that even today, the lowest-yielding asset is not necessarily synonymous with the "risk-free" instrument.[57] 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.

In sum, the existing literature is marked by a range of 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. No previous study aggregates dispersed country-level observations into a long-term dataset encompassing a robust share of global GDP over time. No recent literature has systematically related such real rate data to other macro variables (such as "R-G", or global population growth). All of the existing long-term data literature pre-dates the current "secular stagnation" episode.

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 stands at 4.64% for the safe asset provider; the average real rate over the last 200 years stands at 2.30%. 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) fell just shy of the 90th-percentile threshold for the lowest real rates across the dataset.[58]

The average real rate has declined relatively steadily since the "Bullion Famine" of 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% was enforced, stands out with 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 safe real rate 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 1.3% (thus far) for the 21st century.

The highest real rate on the safe-issuer basis is observed in 1472, at 21.9%. During the late 1400s, the Italian city-states were for one faced with rising war expenditure, given the intensifying wars both between the republics themselves, and against the Ottoman Empire. More decisively, the Ottoman

[57] As above, note for instance that Italian 10-year bond yields traded below U.S. counterparts for most of 2014-2018.
[58] In 85 years since 1317, I record lower annual real rates than at year-end 2017, equivalent to 12.1% of observations. As with all following figures, I take the 7-year centered average basis.

conquests of the Balkans cut off large mining areas, while escalating trade deficits drained pan-European bullion supplies. The situation in our three Northern Italian cities still remained favorable in a relative sense: many wealthy merchant towns in Burgundy and Flanders could not secure credit at all; unsecured private loan rates in England reached up to 100% during that time; short-term sovereign rates reached up to 74% p.a. in Burgundy, and Brescia reported rates of 60-80% p.a. (Van der Wee 1963, II, 105-110; Pullan 1971, 445; Zuijderduijn 2018).[59] "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 more revisionist view of Epstein (2000, esp. 61-68).

The lowest real rate ever was in 1917 (-8.5%), 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 consol yields (Ferguson 2007, 442-453). World War II lows, at -5.6% in 1944 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". But 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

[59] 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.

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 1.59 basis points (Figure IV).

But despite the general downward trend, the tendency is clearly 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 results in Figure XIII suggest that the overall trend fall should not obscure some key nuances for various long-lasting episodes: in fact, amid the general downward dynamics, we can distinguish several major sub-periods:

- A late medieval real rate environment which exhibits a trend rise in capital costs between circa 1300 and 1450, from prevailing levels of 10%, to levels close to 15% p.a.
- This is followed by a sharp easing of credit conditions, over a period of about five decades, with global levels being reduced by almost 10% in real terms peak-to-trough. The period in fact represents the most intense easing period on a global level over the entire timeframe.
- Roughly by the time of Charles VIII's momentous decision to invade Italy in 1494, this powerful slide in credit costs comes to a sudden halt: for one and a half centuries thereafter, global real rates in fact show a slight upward bias, visible from the outbreak of the Thirty Years War.
- Approximately beginning with the Peace of Westphalia, global real rates once more resume a notable easing. By the time of the "institutional revolution" of 1694, these trends are already well underway. This period lasts until the outbreak of the French Revolution – when, for the first time, real rates have hit negative values on a global basis. 1789 itself, and the Napoleonic Wars, initiate an unprecedented bounce in levels in a matter of just a few years.
- With the end of the British Restriction period, levels once more normalize, and actually exhibit a slight upward trend, until the end of the Civil War in the U.S., and the founding of the German Reich in 1871.

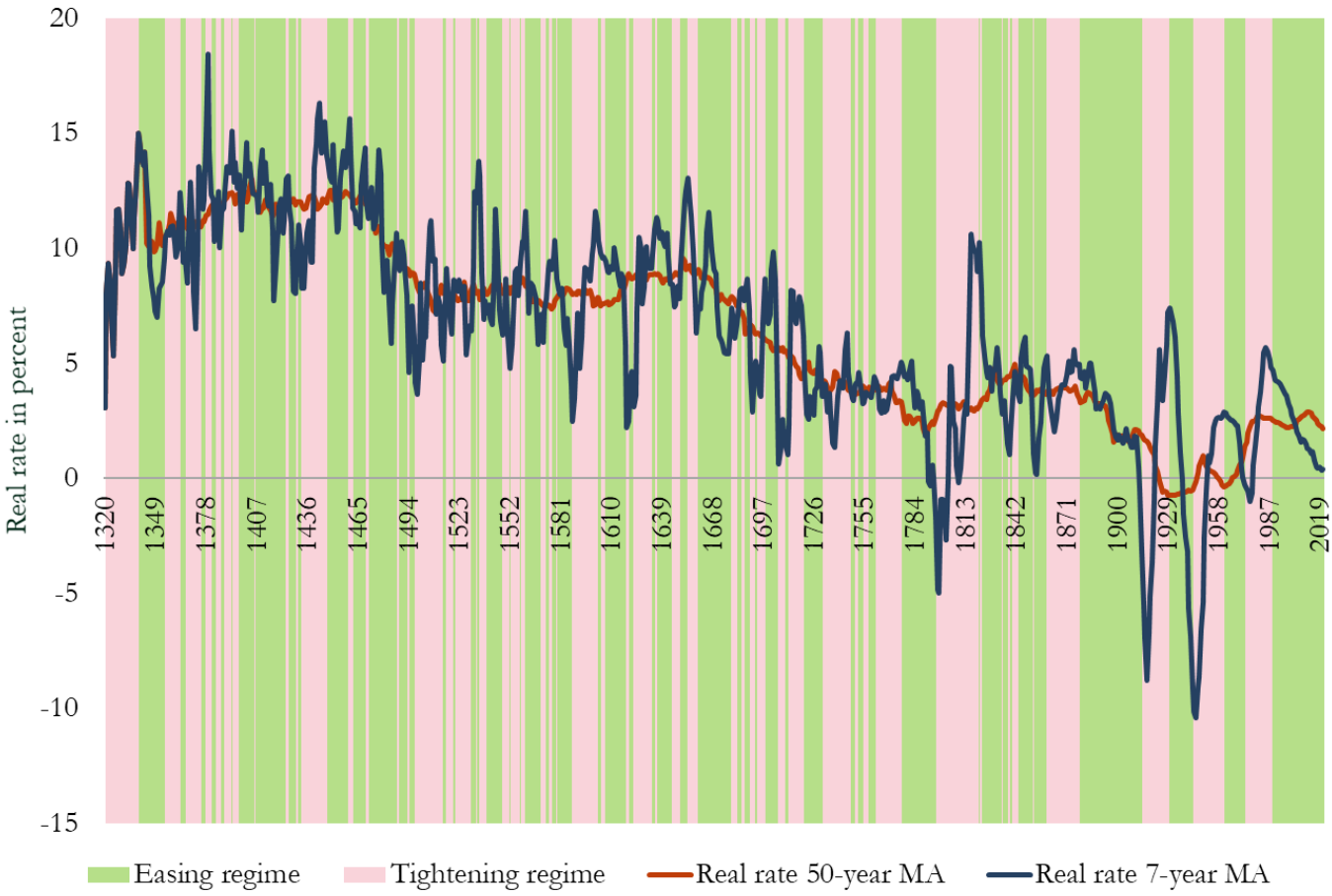


Figure XIII: Easing vs. Tightening public credit episodes in real terms, 1320-2019.

To suggest at least a rudimentary explanatory value, we should expect such an easing/tightening framework displayed (here defined as 7-Y real rates crossing 50-Y averages either upwards [tightening] or downwards [easing]) to be reasonably correlated with default events (or at least not to be entirely contradictory to such events). Is this the case? On the basis in Figure XIII, the 1379-1381 interest payment suspension in Venice falls into a tightening period, as does the 1425 Florentine "bankruptcy" on short-term *Dieci* loans (Molho 1971, 165ff.; Mueller 1997, 467f.); so do the 1557 double Franco-Spanish defaults, and the five French debt reschedulings of 1598, 1661, 1720, 1770, and 1797, just like the Spanish defaults of 1575, 1598, 1627, and 1647 fall into tightening periods on my basis. On the contrary, the French reschedulings in 1634 and 1648 fall into easing periods, as does the Spanish default of 1607, and the 1672 British Exchequer "Stoppage" (Feaveryear 1931, 104-106; Bonney 1999, 162; Reinhart and Rogoff 2009, 87; Drelichman and Voth 2014). The outbreak of the 1619 Kipper- and Wipper shock falls

into a tightening phase (with the inflation surge subsequently easing real credit costs in 1621-1622), as do the travails of the interwar 1920s. On such a provisional basis, the explanatory value of investigations into the dynamics of "real interest rate regimes" appears promising, and if coupled with currency trends may yield a reasonably robust eventual aggregate measure.

The frequency of negative long-term real rates

Since the shift of several advanced economy central banks towards negative (short-term) policy rates, there has been extensive discussion about the negative rates phenomenon. A long-term sketch of trends, however, is missing. We can here try and provide a long-term sketch of "negative rates" frequency, and examine if the phenomenon is in fact new, and if its frequency is in fact rising. The Chart below uses the long-term data and displays the annual % share of advanced economy GDP recording negative real rates at any point in time since 1314, the shares being based on the familiar Maddison composition from Figure I above. Again, I use a 7-year centered average to strip out some short-term volatility.[60]

Over the entire timeframe 1313-2018, I find that 20.3% of advanced economy GDP experience negative long-term real rates on the annual basis. Gradually, the share of DM negative-yielding debt appears to be rising: during 1880-2018, I record a share of 20.8% (compared to a 1313-1750 share of 18.6%). Since 2009, the share stands at 25.9%. A simple linear trend suggests that the share of DM GDP experiencing negative long-term real rates rises on average by 1.2 basis points per annum. And the historical local "peak shares" over time are rising: we find high levels in 1372-1373 (23.4% of DM GDP), then in 1434-1435 (34%), in 1498-1500 (30.9%), 1588-1589 (45.8%), 1723-1726 (38.9%), 1944-1945 (86.4%), and most recently in 1976 (40.8%). However, between 1950-2008, the share stands at an unusually low 11.8%, driven in particular by the period of 1984-2001, which on my 7-year averaged basis recorded an uninterrupted 0% frequency of negative long-term real rates for the sample, here the longest such period on record.

Once more, the general trend towards a rising higher frequency of negative rates appears independent of the establishment of central banks and "active monetary policy"; it is independent of the dominant currency form (gold, silver, mixed gold-silver, or fiat).

[60] The 7-year centred average is used on the aggregate GDP share level: in other words, on the country-level every single negative real rate year is recorded. The country does not have to show a 7-year average negative level to be included.

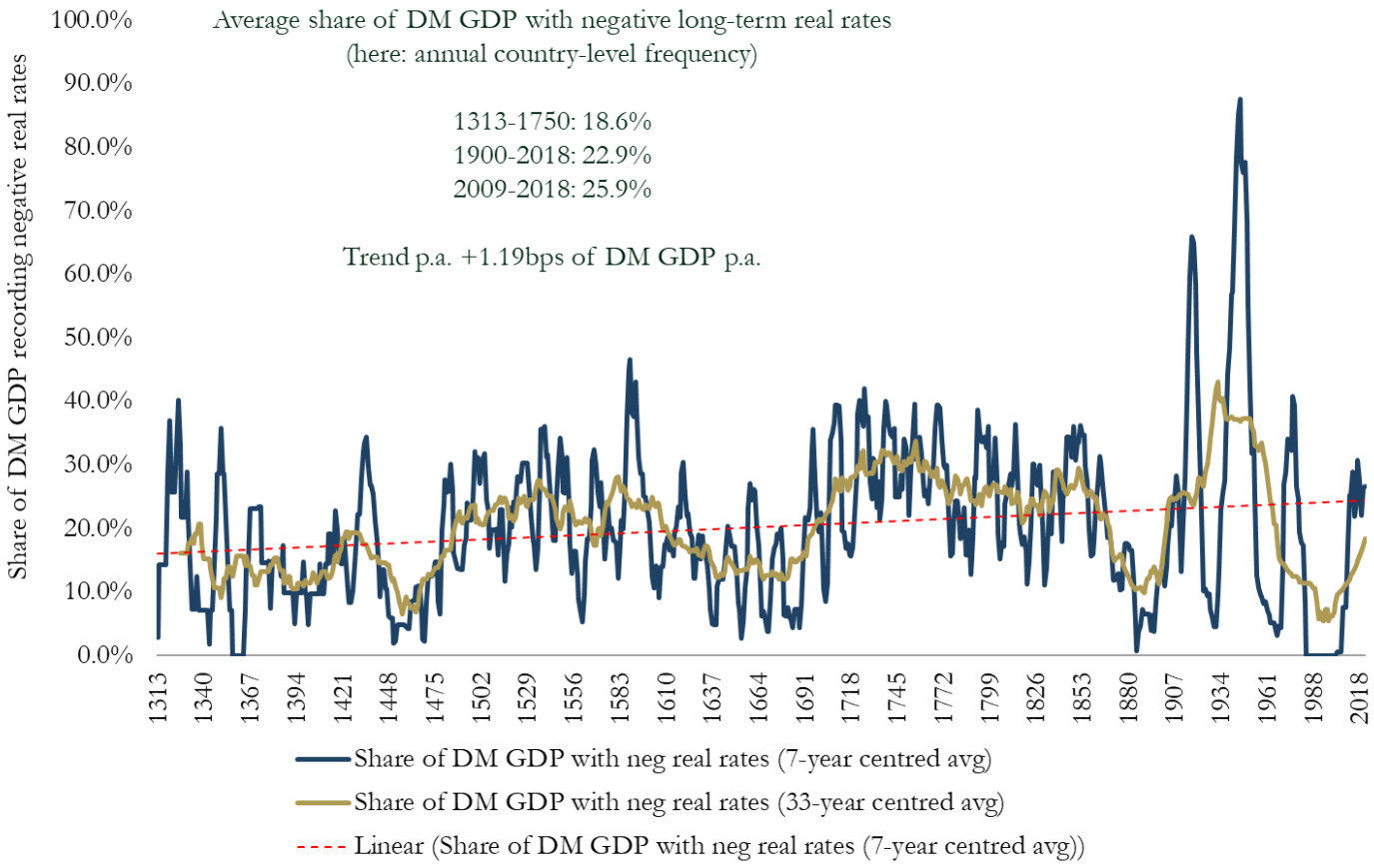


Figure XIV: frequency of negative long-term real interest rates, as % share of DM GDP, 1313-2018.

Figures XV and XVI now display historically-derived trend 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 (or quite close to) 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.

A note in this context on "fiscal regimes": over the periods considered here, total public expenditure levels as a share of GDP have markedly risen. It would certainly be valuable to chart more nuanced separate series in light of some policy proposals in the present discussion – at times suggesting that increases in public spending may be a remedy for present low real rate levels. But there can be little doubt on the general trajectory, accelerating with the establishment of modern welfare states. In the case of the U.K., from an average of 8.3% total expenditures to GDP during 1700-1750, we rise to levels of 35.1% for 1981-2016 (Thomas and Dimsdale 2017, tab A.27).

By late 2018, the historically-implied safe asset provider real rate is 1.57%. For the global sample, the historically-implied rate is 0.78%. The actual value of the latter was 0.40% at the same time – hence it is in fact only marginally below expected values. On that basis, it therefore follows that (a) U.S. real yields would have less than 1% appreciation potential until "historically-normalized" levels are reached; (b) that there would now be no fundamental basis for expecting nominal rates to rise above 3.6% anymore when inflation is "at target"; and that (c), global real rates in particular have normalized far more already than is usually acknowledged.

To illustrate this, on the basis of Figure XV we can observe that actual 2018 global real rates fall fully into our range of historical "trend slopes" – in this sense we are not dealing with an historical aberration of the post-1980s environment. The actual clear deviations of global GDP-weighted real rates 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 at least, it 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.

Current real rate levels should have surprised nobody who had comprehensively charted long-run trends. The 2007-2008 at best plays a minor cyclical role in explanation of low interest rate levels. And the historical record does not imply that any presently-discussed fiscal or monetary policy action can generate any lasting trend break.

Chart XVI 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

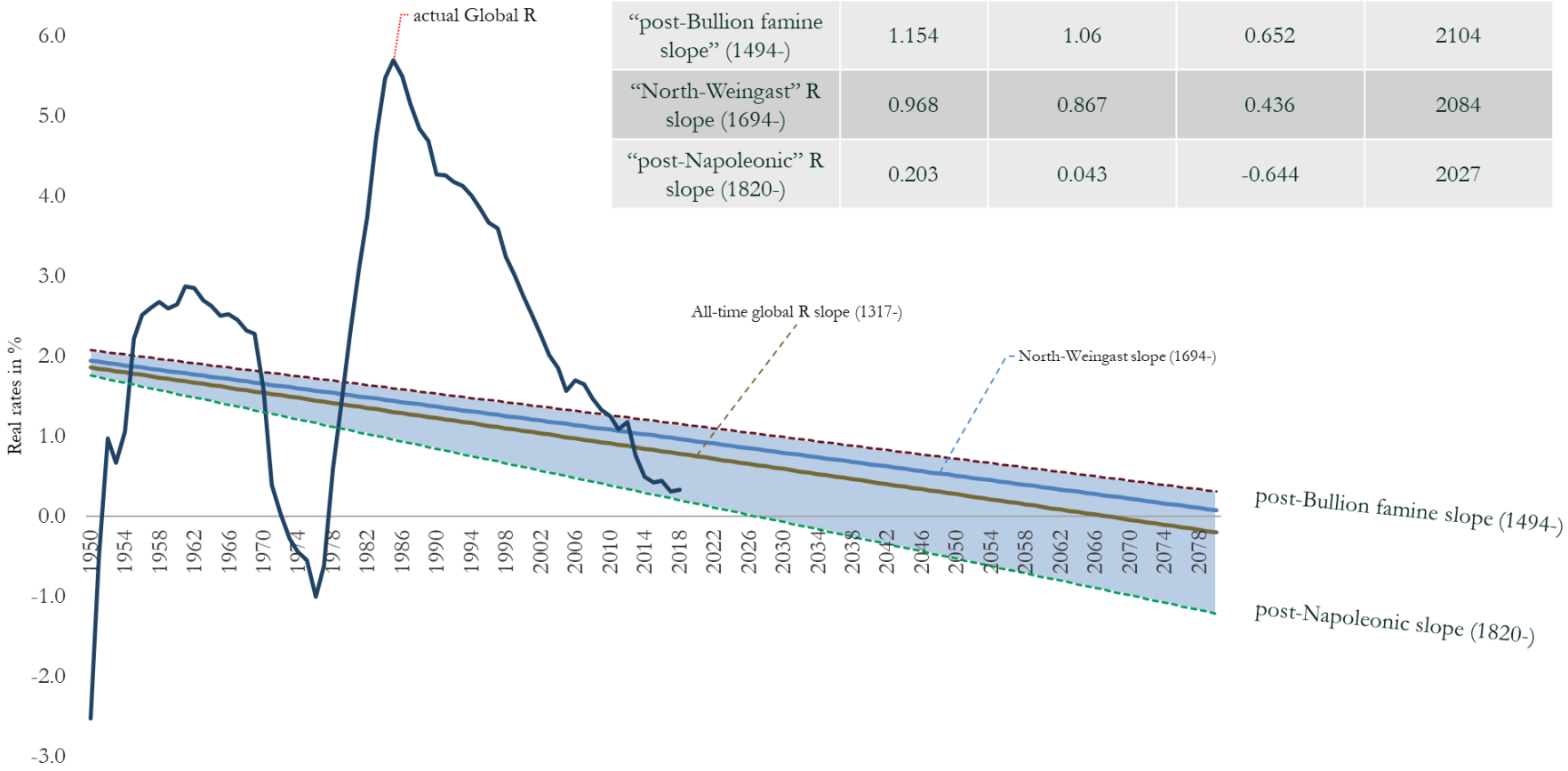
overshot, but was almost exactly “at trend” in 1974, 2005, and 2015. The financial repression dynamics accounting for the unusually negative R-G values during the 1950s are visible here as well. In this sense, advanced economies are in the coming years showing more and more “R-G” attributes usually associated with emerging economies (Escolano, Shabunina, and Woo 2017).

Page 48: Figure XV: Extrapolating historical global real rate (global R) slopes, 1950-2080.

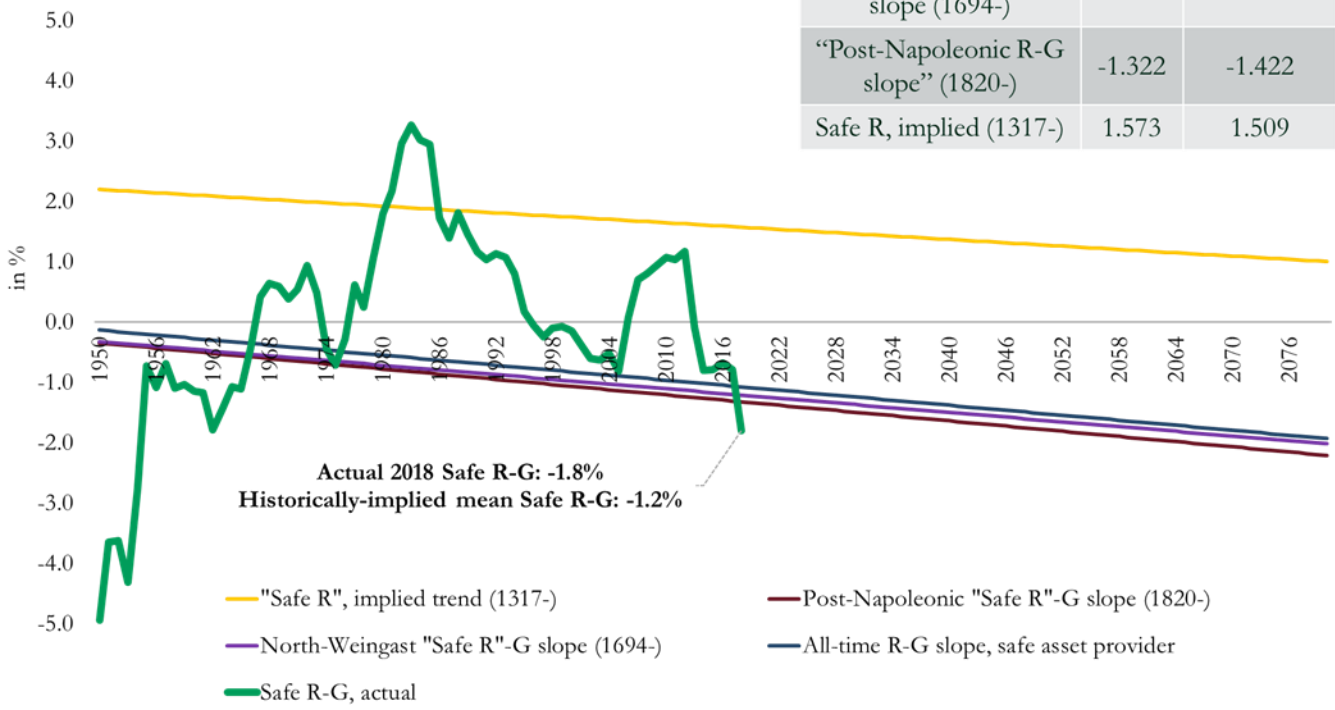
followed by

Page 49: Figure XVI: Extrapolating historically-implied Safe R-G slopes, 1950-2080.

Global R values	End-2018	By 2025	By 2055	Turning negative by
All-time R slope (1317-)	0.783	0.672	0.196	2068
"post-Bullion famine slope" (1494-)	1.154	1.06	0.652	2104
"North-Weingast" R slope (1694-)	0.968	0.867	0.436	2084
"post-Napoleonic" R slope (1820-)	0.203	0.043	-0.644	2027



Safe R-G values (%)	2018	By 2025	By 2035	Slope: fall bps p.a.
All-time R-G slope (1317-)	-1.074	-1.171	-1.301	1.38bps
"North-Weingast" R-G slope (1694-)	-1.210	-1.302	-1.432	1.30bps
"Post-Napoleonic R-G slope" (1820-)	-1.322	-1.422	-1.565	1.43bps
Safe R, implied (1317-)	1.573	1.509	1.417	0.92bps



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 XVII, 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 the potential catalysts for such motives, for instance when plague frequency is considered reveals various inconsistencies.[61] [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).

[61] See for instance the European-wide plague data in Biraben (1975), reprinted in Voigtlaender and Voth (2013, 779).

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).

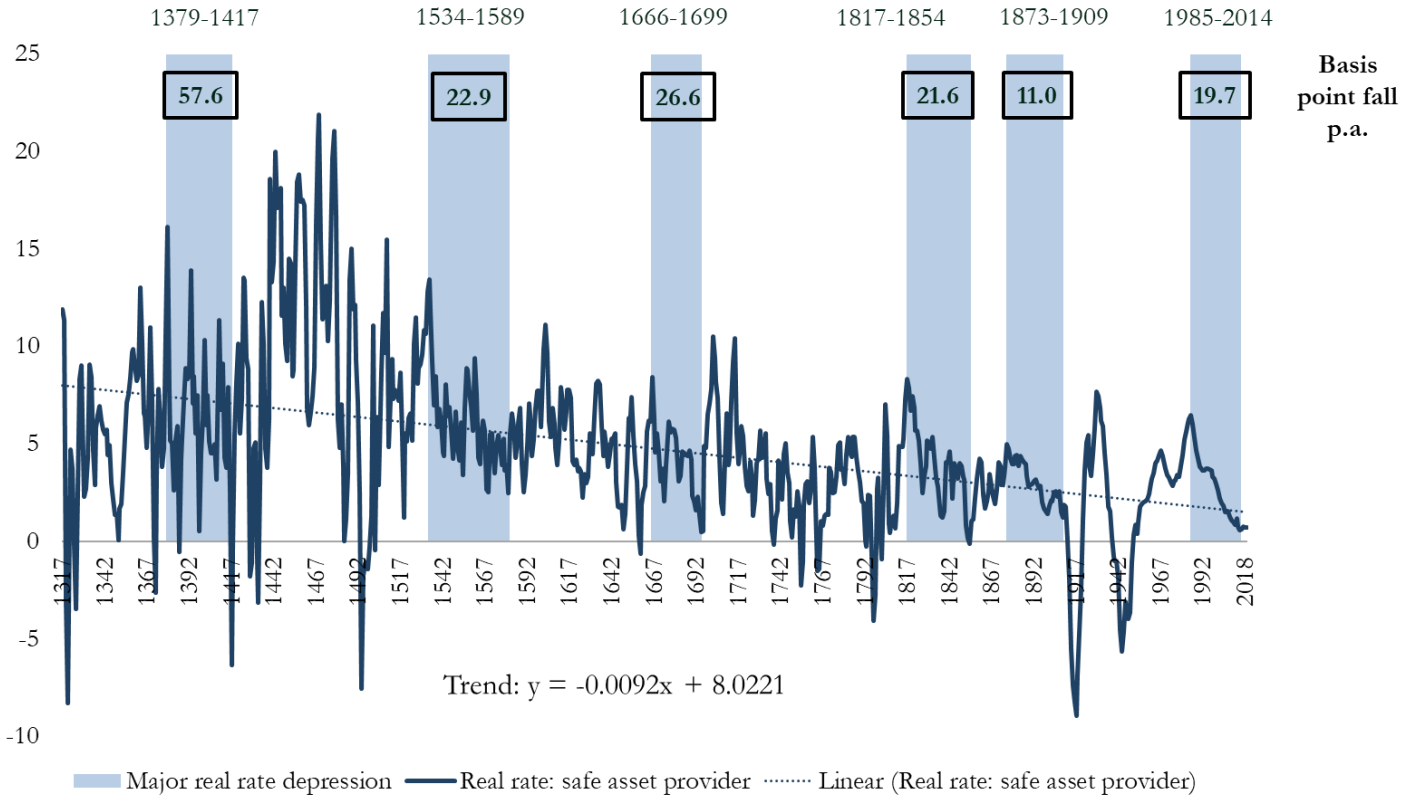


Figure XVII: Real rate trend, safe asset provider, and the six real rate depressions, 1317-2018.

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 3.92% (30-year centred average basis); over a 200-year horizon (1818-2018) it is 4.72%; while the all-time level is 10.4%.

I plot the standard deviation of the long-term real rate in Figure XVIII 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. The very elevated levels for the "safe asset provider" until the end of the "Bullion famine" period certainly stick out, a fact that certainly raises various questions. 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 by 1906. Since the Great Depression peaks during 1931-2, the trend once more turned towards a reduction in volatility. Besides, particularly the decades following the Peace of Westphalia stand out, with a real rate stability only matched again two centuries later. We can generally observe a gradual, but persistent trend towards lower real rate volatility over time: 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 0.7bps p.a.

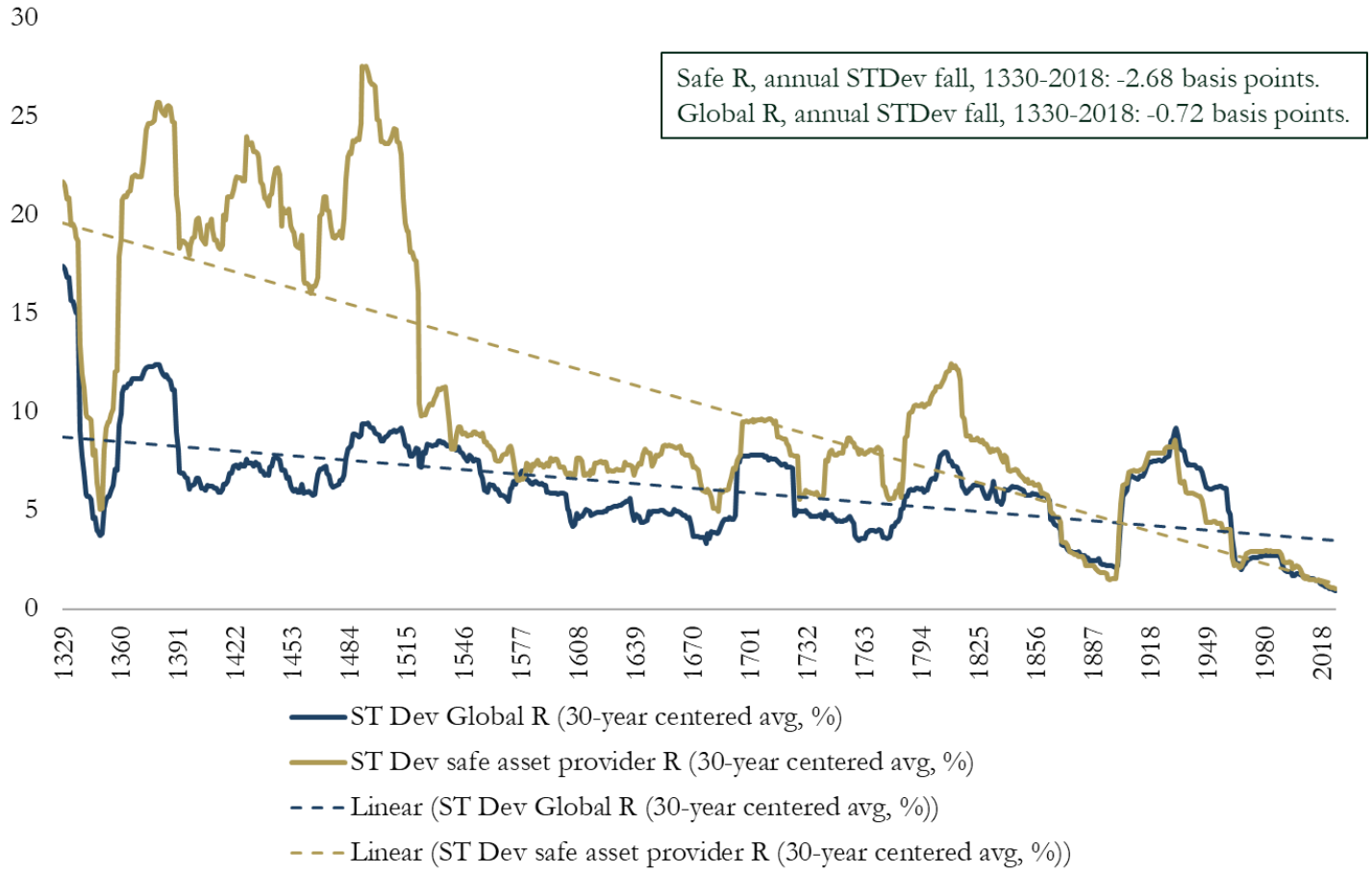


Figure XVIII: Real rate standard deviation, global and safe asset provider basis, 30-year centered average (%), 1330-2018.

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. Schnapper (1957, 81) suggests a lower in-kind share in France after the 1520s, but has not calculated implied rates. 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 XIX, 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 interpolated rye price index of Abel's (1978, 308-309) decadal data, Wuerzburg prices in Elsas (1936, 539ff.), Nuremberg rye inflation between 1428-1671 in Bauernfeind (1993), between 1326-1600 Hannover rye prices in Unger (1752, via OeStA HHStA MEA Muenzsachen Box 8), and the Allen (2001) German-speaking municipalities, added at respective inception.[62]

[62] Note that Allen (2001) relies partly on Elsas (ibid.) for his values, but not on Wuerzburg: I rely on a Wuerzburg basket containing "Roggen", "Hafter", "Weizen", "Stroh", "Butter", and "Fleisch/Rindfleisch", equally-weighted, in silver prices. 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.

- 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) only.
- V3: original series, Italian inflation between 1311-1800 replaced with Malanima (2011) price index y-o-y.
- V4: original series, U.K. inflation between 1311-1800 replaced with Phelps Brown and Hopkins' (1956) price index y-o-y.
- 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).[63]

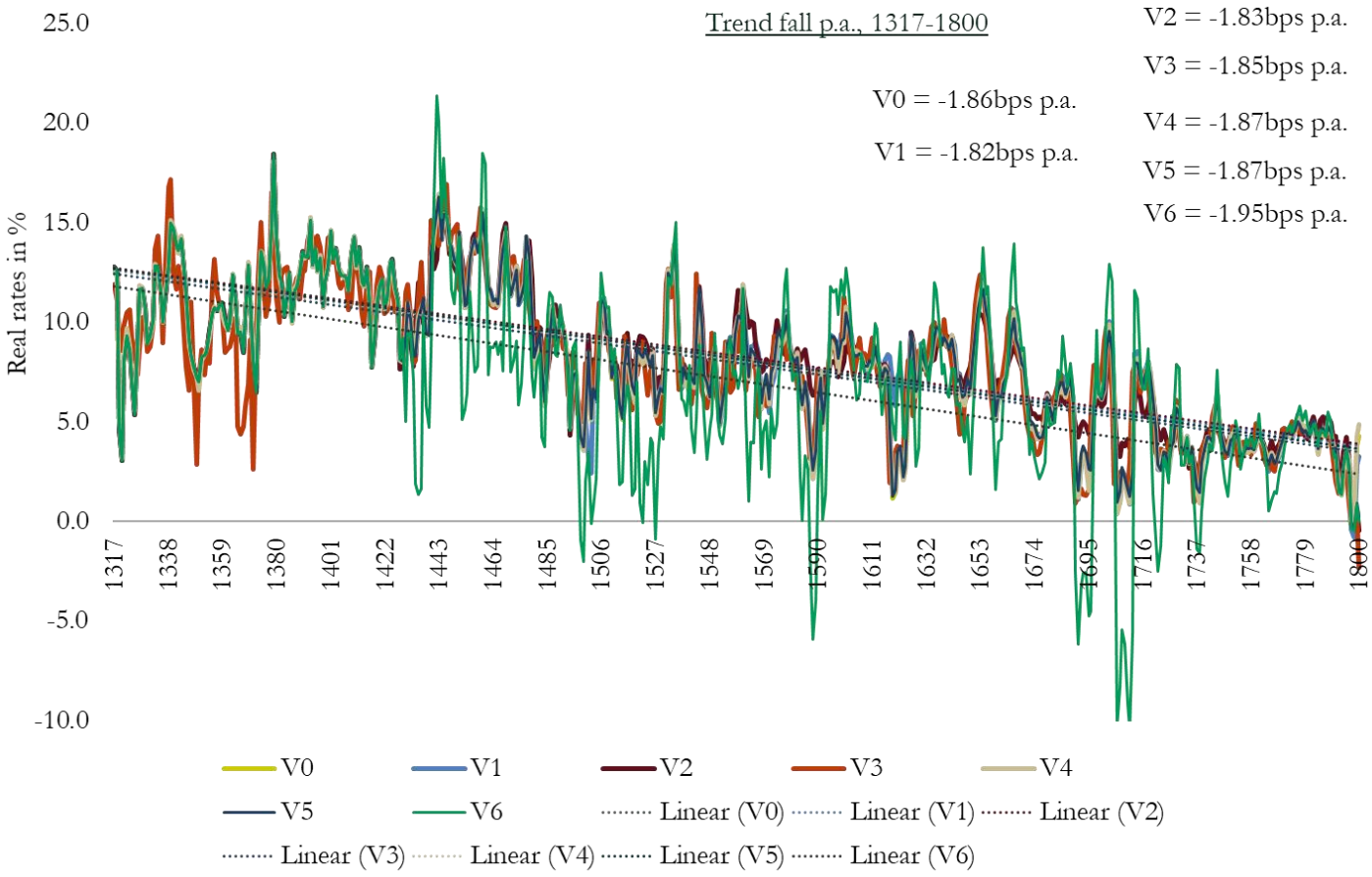


Figure XIX: Global real rates: "preferred" inflation basis (V0), and alternative inflation series, 1317-1800.

[63] Allen (2001, 439) relies on a combination of Baulant (1968) and other sources for his Paris index.

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. However, we need to keep in mind that the typical "bourgeois/upper class" investor in financial assets faces a different inflation basket than ordinary laborers: Hoffman et al (2002, 326-327) suggest the main difference concerns a higher expenditure share for "clothing" for typical creditors over time, compensated for by a lower "food/grain" share compared to the baskets used in the above exercise. It would thus be desirable to run robustness checks on such an adjusted basis, too.

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 XX. It is observed that the downward interest rate trend holds across geographies. Each country exhibits a trend fall over time, ranging from 1.02 basis points per annum (Germany) to 4.56 basis points (U.K.) p.a. Holland (1.57 basis points p.a.) and Spain (2.1 basis points p.a.) represent the median 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 trends described so far.

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 rarity 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; Briggs 2018). 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, 456) 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.[64] 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 1.28bps p.a. – clearly a meaningful impact. But the

[64] Blanchard (1996, 57) claims that "[during the later Middle Ages]…as in the high Middle Ages money remained cheapest in England and in the lands of the Lower Rhine". I have found no evidence for this claim. Blanchard here presents no own data for English 14th or 15th century interest rates.

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. We also observe that Spain in particular is driving much of the "Napoleonic stress" during the early 1800s – perhaps here exaggerating its significance vis-à-vis other geopolitical escalations despite the acknowledged severe strains (Pousada 2015).

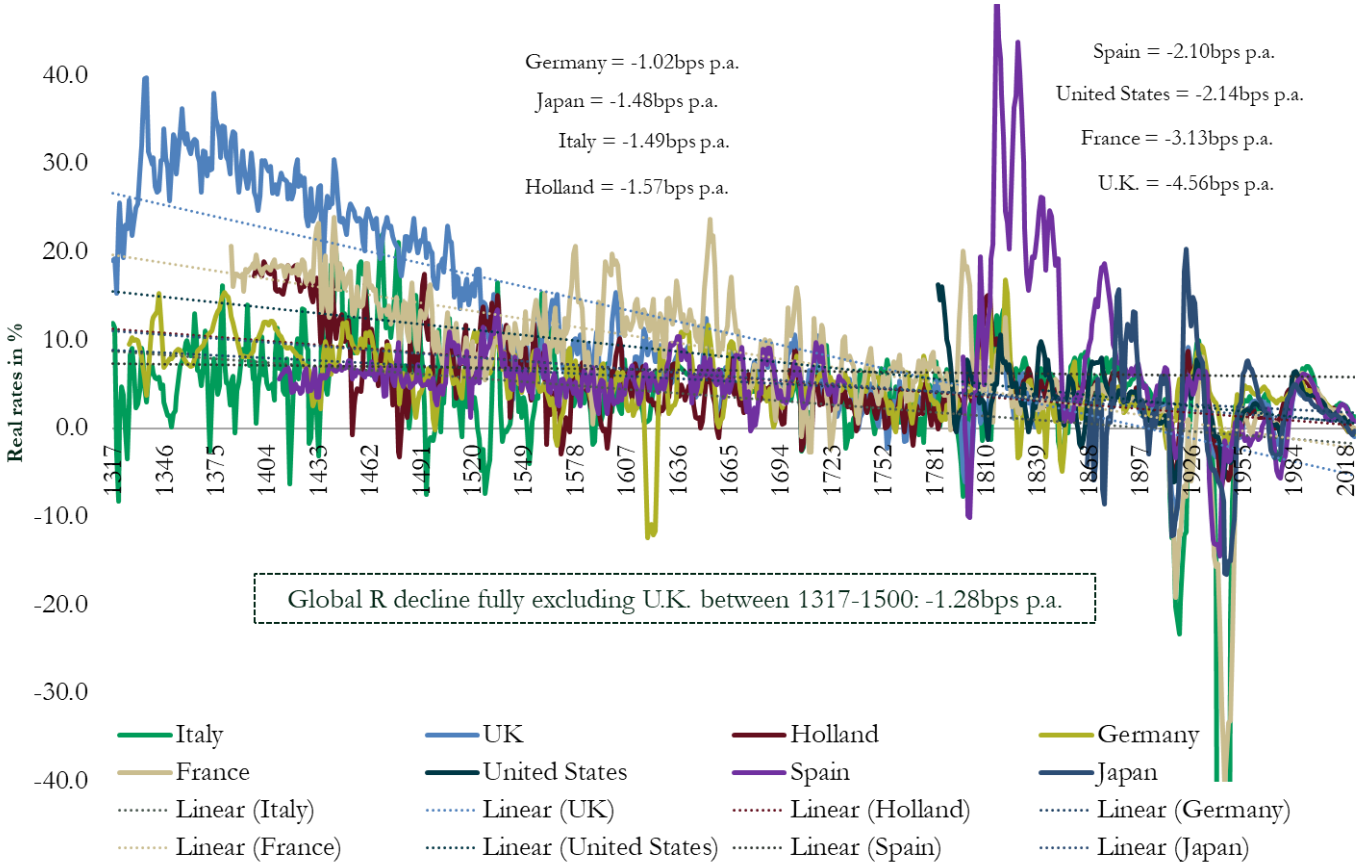


Figure XX: Real rates: country decomposition and trend fall, 1317-2018.[65]

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 XXI represents another case study: here I overlay global real rates with a

[65] Y-axis maximum and minimum adjusted for presentational purposes.

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 England; approximately100 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.

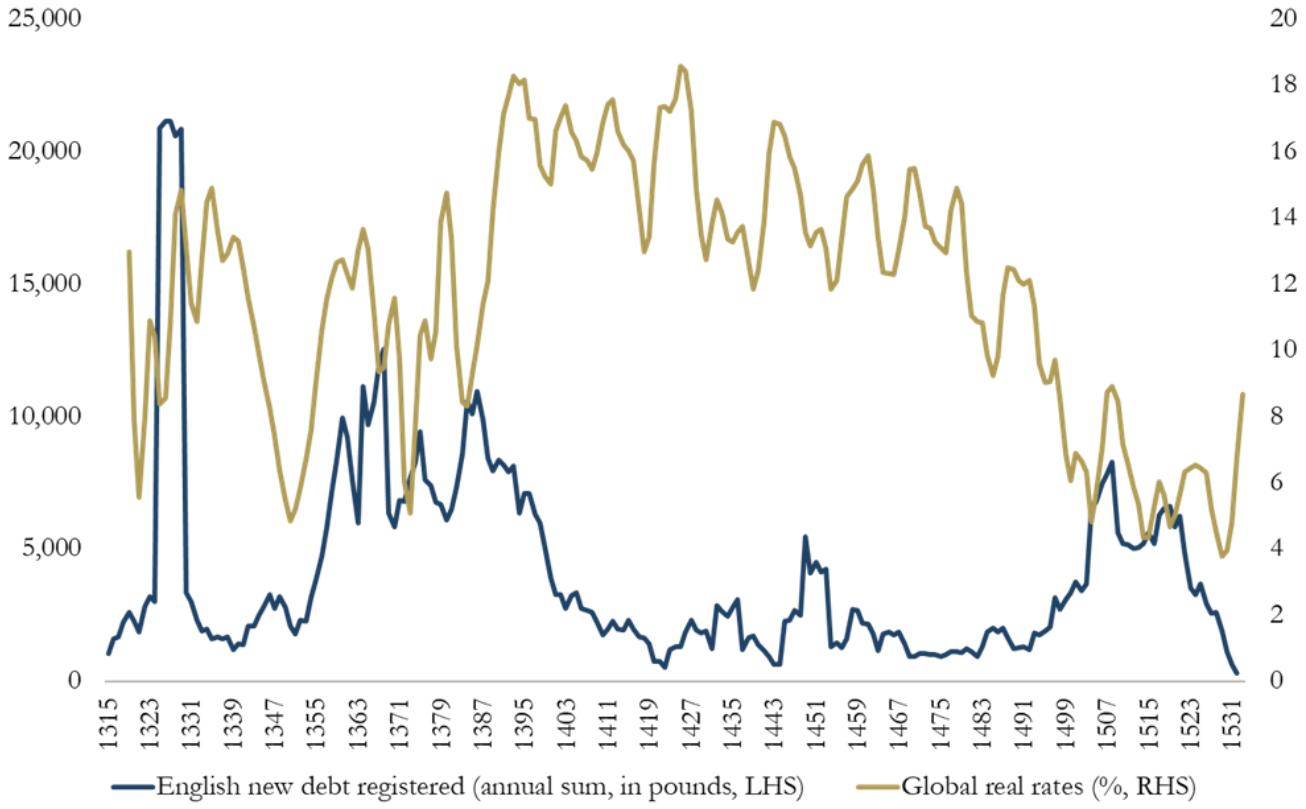


Figure XXI: English credit volumes versus global real rates, 1314-1530.[66]

[66] 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).

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 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. Kostanecki 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).[67] 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 (many archival cases can be added to the survey in Kaphahn 1912, or case studies such as Friedrichs 1979). 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 arrive at plausible relative financial market weights for both, though? A recourse to urbanization rates is a

[67] 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 der Wee (1963, vol. II, 56f., 106ff.), Tracy (1985, 30, 127).

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).[68] 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.[69] This would be a significant size when one considers that the U.S. only reached a comparable financial asset/GDP ratio by the 1970s.[70] Wealth 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.

[68] 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).

[69] 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).

[70] 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.

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.[71] The municipal share then appears to peak north of 60% around the mid-16th century. [72] 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%.

Figure XXII 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 ibid., 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 ibid., 123-134).

[71] 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.
[72] 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%.

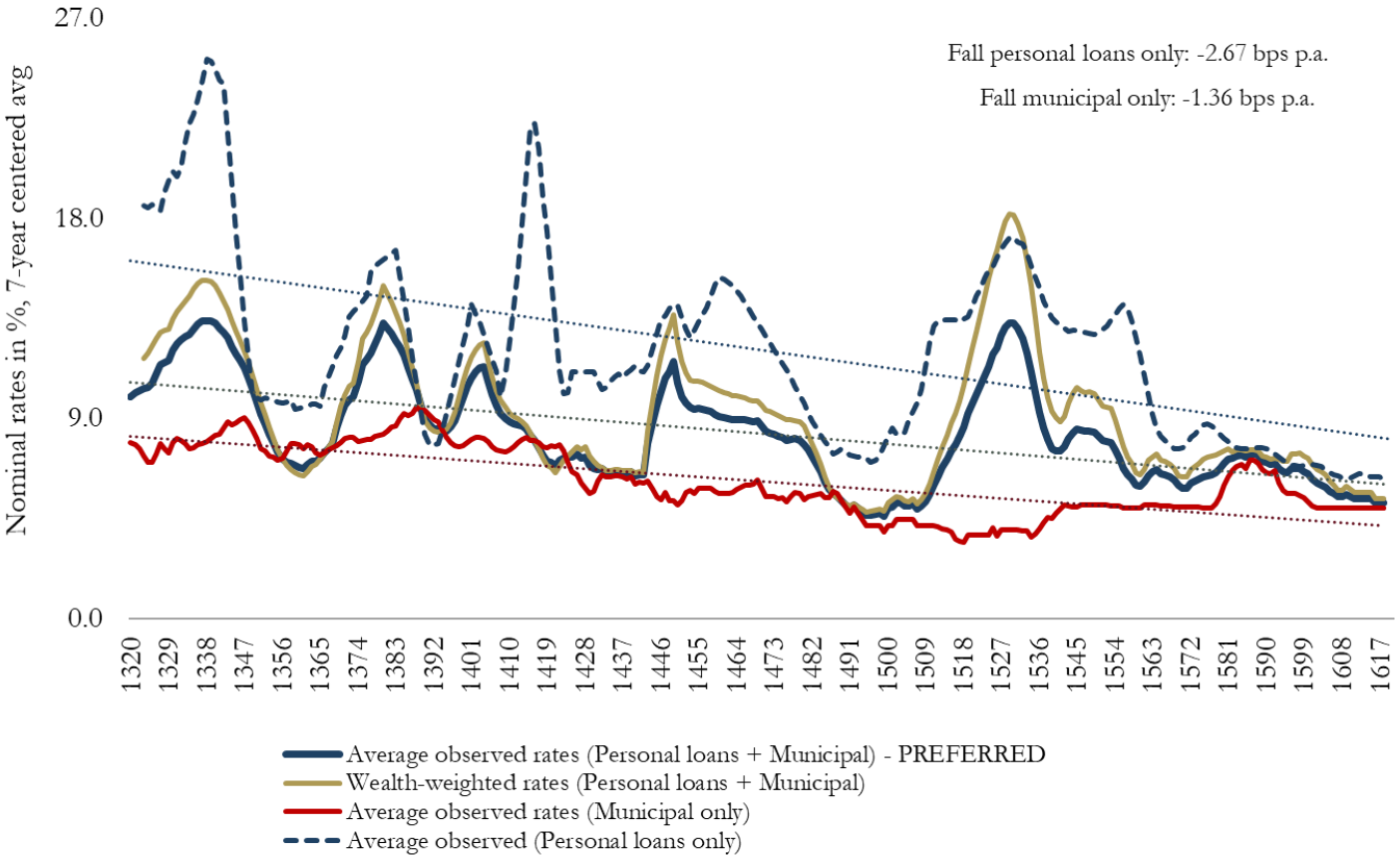


Figure XXII: Country-level weighting: municipal and personal sovereign loans, German nominal rates, 1320-1618.

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 XXIII to deflate the regional archival interest rates, and to compare the German "toplevel" private R data with evidence from the regional level.[73] We see that

[73] 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.

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, which also includes the differences in price dynamics, where a 1.2% premium for the Hessian regional market p.a. over 1501-1568 is suggested over my headline series: the latter, more municipal-oriented version, remains more appropriate however as a general adjustment.

Of interest should be the calculation of implied interest rates in mixed or exclusively "in-kind" transactions, also displayed in Figure XXIII – the first time to the knowledge of the author.[74] 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". 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 15th century that rising prices eroded their fixed-contract nominal income, and offered price discounts when transactions were paid in gold gulden (Dirlmeier 1978, 222). I have referred above to the deliberations of the Viennese city council during the 15th century to opportunistically employ different *renten* coin bases to hedge against inflation.

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, though Schnapper (1957, chapitre III) has found a waning of the phenomenon in France beyond the 1520s.[75] 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-

[74] 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.

[75] 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. Cf. also Gilomen's (1984, 49-54) Swiss data.

kind loans on the imperial level at least until 1498, too, for which some implied rates have also been calculated.[76]

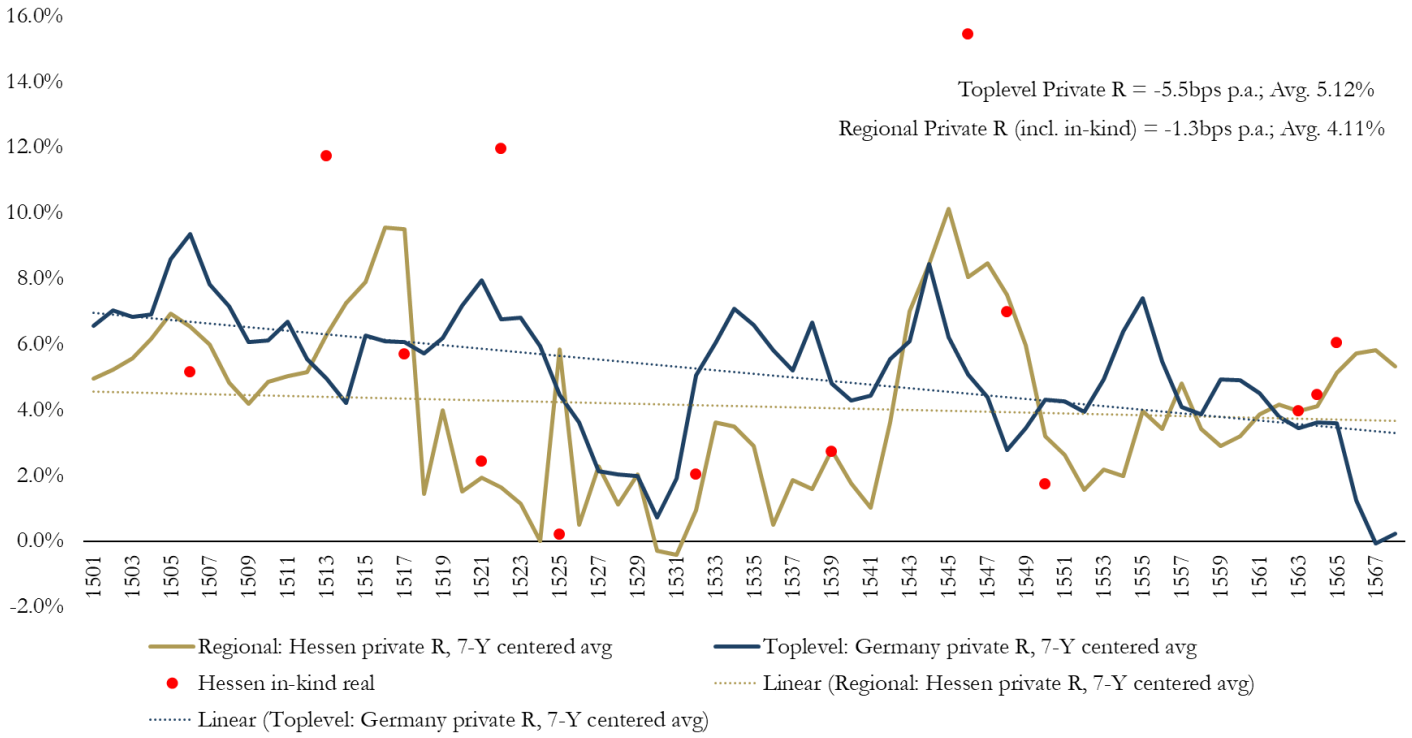


Figure XXIII: Regional vs toplevel real rates, and in-kind real rates: Hesse, 1500-1568.[77]

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 for now – 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

[76] 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).

[77] 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).

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.[78]

VI.B COMPARABILITY, AND SAFE ASSET STATUS

To what extent 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.

The notable feature of our series, however, is the consistency with which (real) rates continue their general trends across monetary (and fiscal) regimes. During the late medieval phase, we are dealing with a predominantly gold-based monetary system, which is gradually replaced by silver from the early 16th century, with silver currency known to have a higher velocity than gold. Gold subsequently enjoys a revival during ca. 1680-1750 (Spooner 1972, chapter 1; Mayhew 1995; Eichengreen and Sussman 2000).[79] There seem to be no clear causal relations between, say, the sliver currency share, and the broader real rate trends, however. Meanwhile, 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 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

[78] 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).

[79] For some long-run data on early modern currency composition, see Spufford (1988, appendix III), and Munro (2003b).

he conceived to be partly compensation for an expected increase of the depreciation of the currency".[80]

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 multiples of 10-13x 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".

As was demonstrated above, negative real interest rates have been less frequent under the prevailing commodity standard between the 14th and early 20th centuries, but they do occur for around 20% of DM GDP even then. However, Figure XXIV 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 unprecedented in Fisher's (fiat money) contemporary environment. Over the entire period of 1329-2018, in fact, the average multiple stands at 8.6x (on a 30-year averaged annual basis) on the global level, with a somewhat higher 13.5x multiple for the safe asset provider – an all-time range quite compatible with Fisher's 1930s observations. The actual inflection point – Fisher may consider it the "moment of realization", when investors learnt (or were enabled) 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 1.42x – unprecedented all-time levels. It is not clear what constitutes the dominant driver of these dynamics. Certainly, various accounts observe that policymakers and academics even by the 1960s and 1970s failed to distinguish properly – both intellectually and in practice – between nominal and real interest rates (Meltzer 2014, 490, 531). While I cannot rule out that data measurement factors could play a role, it is not readily apparent which biases should be responsible.[81] 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 ST Dev, 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,

[80] Cit. in Schwartz (1987, 153).

[81] 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).

Thomas and Dimsdale 2017, tab A.29), and half a century of relative political calmness, interrupted only by the outbreak of the Crimean War.

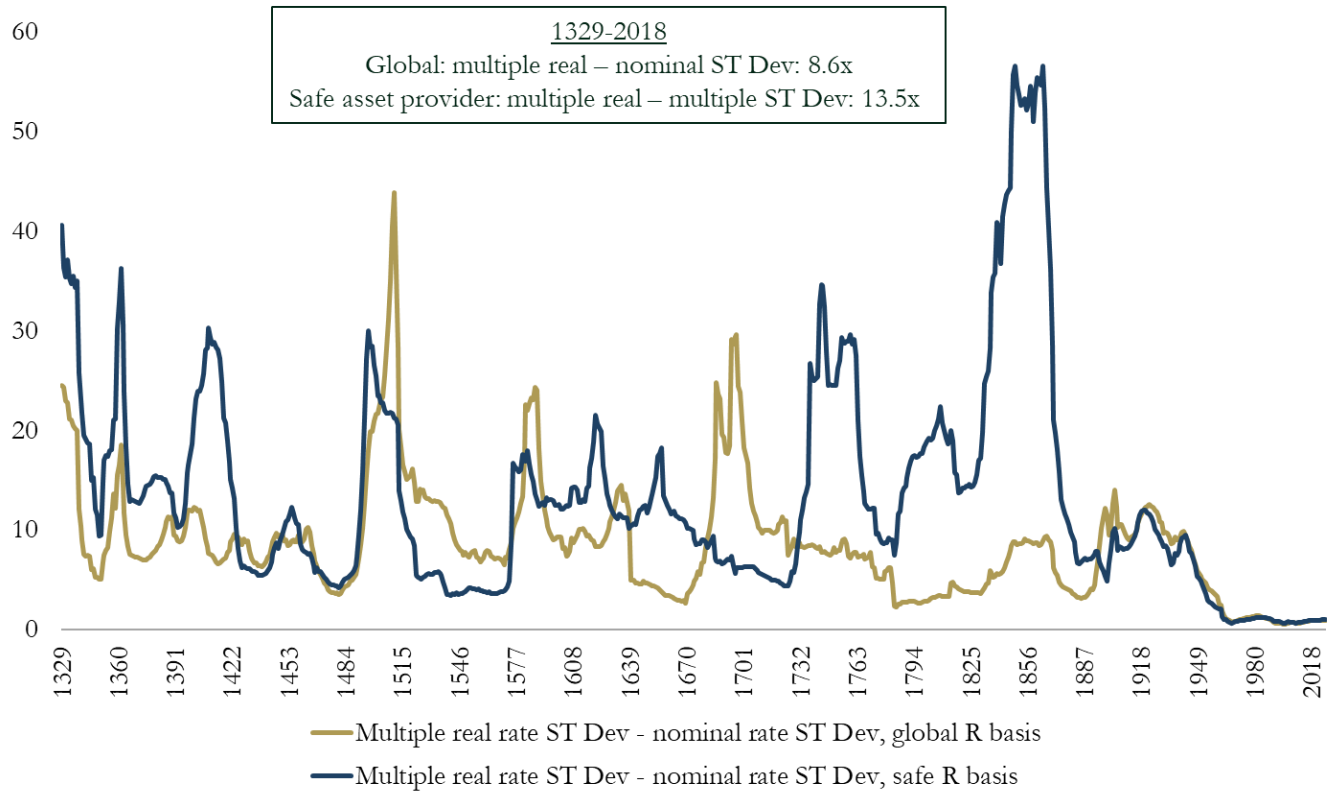


Figure XXIV: Multiple real rate standard deviation – nominal rate standard deviation, 1331-2018.

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. The difference between short-and long-term real-nominal ST Dev multiples appears small: for the U.S. since 1934, on an annual basis the difference between the 3-month maturity and the 10-year

maturity multiple comes to 0.5x.[82] Fisher's statement hence likely misses the context for the entire term structure.

Taking the above measure as one proxy, these multiples hence do not suggest that the commitment mechanisms post-1694 are qualitatively significantly different in their enabling to transmission inflation expectations onto interest rates. Throughout, I pre-select "safe issuer" with an exclusive focus on those 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, on the other hand, features a handful of default and rescheduling events on long-term consolidated assets, therefore enabling an approximation of the sovereign "risk premium" over time.[83]

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).[84]

For Spain, Drelichman and Voth (2014, 7) have posited 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".[85] 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

[82] Basis: taking FRED 3-month bill secondary market rate (series B3MS); 10-year constant maturity rate (GS10); all-item U.S. city CPI index (CPIAUCNS); 11-year ST Dev avg taken. Taking a sample of 6 DM countries' policy rates since 1857 on a quarterly basis points to similar results.

[83] The relevant "default" events on long-term assets concern primarily the French defaults during 1557-1797, the British Exchange "Stoppage" in 1672, as well as various municipal-level debt moratoria and defaults on Guelten/Erb-, Leibrenten assets (Kaphahn 1912; Feaveryear 1931, 104-106, 161ff.; Gilomen 1994; Bonney 1999; Zuijderduijn 2018). The interwar hyperinflation period for Germany and Japan is excluded as discussed below. One can speculate if the Restriction Period during the Napoleonic Wars represents a default event more narrowly defined.

[84] For evidence of the robustness of the Italian republics' commitment mechanism, see also Fratianni and Spinelli (2006), De Lara (2008), and Stasavage (2011).

[85] A view shared by Tracy (1985), Neal (1990), and more recently Zuijderduijn (2009).

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).

VI. WEALTH AND SAVINGS PROXIES – SOME TOPLEVEL EVIDENCE

With both direct growth and demographic drivers failing to convince on the secular level[86], one promising channel in the search for explanations remains general capital accumulation. This is not the place to address comprehensively the paucity of in-depth studies on early modern capital accumulation trends. I note that 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

[86] See the online appendix for a more detailed discussion, and long-term series of aggregate real GDP and population growth for the same weighted samples.

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 XXV 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.

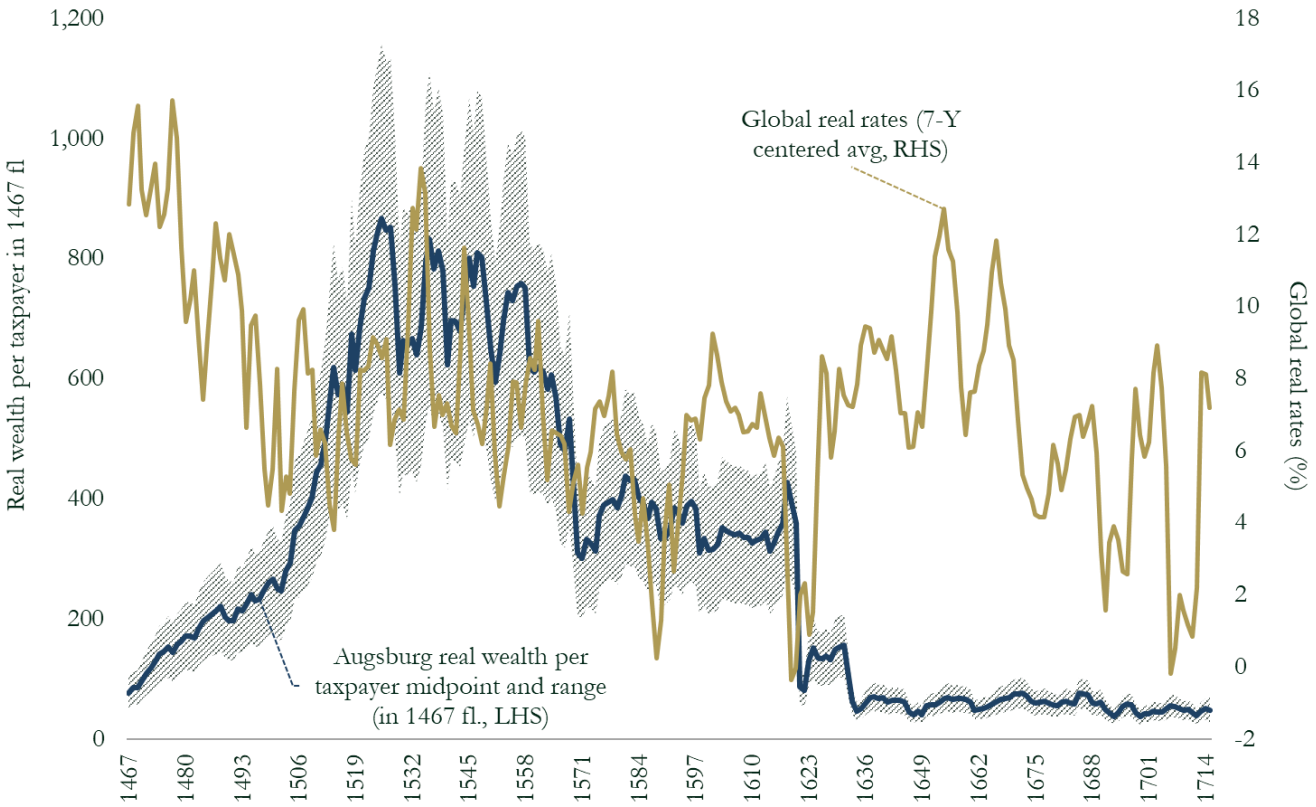


Figure XXV: Global real rates and real wealth per taxpayer in Augsburg, range and midpoint, 1467-1715.[87]

[87] 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.

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.

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 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".[88]

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 XXVI 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.[89] He argued that aggregate savings rates between 5-13% of income would be entirely plausible, assuming that (a) the top 5% commanded

[88] Translated from Bulst (ibid., 39). See also further sources there from France and Germany.
[89] 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".

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%.

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.[90] 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.[91]

Figure XXVI: Proxied gross savings rates scenarios in Piedmont, and Italian real rates, 1300-1800.

[90] 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.).

[91] 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.

In Figure XXVI above, 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 18th 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.

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.[92] 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-15th 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 14th and early 15th 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 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.

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,

[92] 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.

"lowest-issuer", scattered rate evidence) – relying on existing narratives obscures historical interest rate dynamics: for one, there is across a multitude of assets no evidence of a "virtual stability" of real capital returns, and I have argued that with the approach here it is now at least able to approximate quantitatively actual trend falls over (sub-)periods and asset classes. This empirical basis, for one, suggests that it was not the Black Death that stands out as an inflection point (Epstein 2000, 61ff.), or the 13th and late 17th centuries as Homer and Sylla's (1991, 556f.) semi-centennial sketch suggests. A far more relevant turning point – one that initiated a "slope" in real interest rates to which the post-Napoleonic period has once more returned – occurs in the late 15th century. That episode 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).

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 always 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. In fact, a meaningful – and growing – level of long-term real rates should have been expected to record negative levels. 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-investment balances, or productivity measures. To extent that such literature then posits particular policy remedies to address such alleged phenomena, it is found to be fully misleading: the trend fall in real rates has coincided with a steady long-run uptick in public fiscal activity; and it has persisted across a variety of monetary regimes: fiat- and non-fiat, with and without the existence of public monetary institutions.

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.[93] If compared to real income growth dynamics

[93] See a brief discussion in the online appendix below for why there are few indications that this can be the case.

over the same timespan, R-G, we equally detect a downward trend across all assets covered in the above discussion.

There is no reason, therefore, to expect rates to "plateau", to suggest 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, very low real rates 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 contemplate a "nadir" in global real rates in the 2020s): the long-term historical data suggests that, whatever the ultimate driver, or combination of drivers, the forces responsible 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 permanently higher public expenditures. They persisted in what amounted to early modern patrician plutocracies, as well as in modern democratic environments, in periods of low-level feudal Condottieri battles, and in those of professional, mechanized mass warfare.

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 serves not necessarily to illustrate their lack of economic-theoretical acumen: it should rather put doubt on the meaningfulness of some of today's concepts.

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[94] Note that after the collapse of the Cologne municipal archive in 2009, several files are not yet physically available to the public again, including the Raitz von Frentz family collection. The archive's online catalogue contains descriptions with details.

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DATA APPENDIX

Appendix table A.3: GLOBAL SERIES: NON-CONSOLIDATED ASSET COMPONENTS (with interpolated 50% weight France to 1709; Germany to 1618; Holland to 1671. U.K. 100% weight to 1702. Everywhere else integrated "at occurrence", arithmetically weighted with other consolidated datapoints):

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, 376, 385f., 401f.); Ehrenberg (1922, Vol. 1, 147, 150, 256), Grose (1929, 178); Hauser (1930, 249); Ashton (1960b, 119f.); Travers (1975, 641-643); Fryde (1983, IV, 209-210; VII, 1190, 1199); Bell, Brooks, and Moore (2009, 419); **France**: Forbonnais (1758, I, 246); Dupont (1840, II, 292); Vuehrer (1886, 60); Vigne (1903, 175-186); Pelicier (ed., 1905, Vol.5, No., DCCCCXC); Ehrenberg (1922, 304f.); Doucet (1937, 24, 45); Fryde and Fryde (1963, 483, 488); Bonney (1981, 318); Pezzolo (1999, 252); Tewes (2011, 46); Rowlands (2012, 73, 80; 2015, 104, 121); **Holland/States general/Flanders/Burgundy:** StAAm (735,

1518, fol. 5-6); Bigwood (1921, I, 86, 108f.; II, Annexe I, nos. 95, 106, 194-195); Ehrenberg (1922, Vol. 1, 258ff., 312); Mirot and Lazzareschi (1929, 170); Mollat (1958, 316, 318); Van der Wee (1963, II, 57); Lambert (2006, 27f.; 117f.); **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 (2004, 278, 284f.); Deutsche Reichstagsakten (Aeltere Reihe, Vol. 5, 37 [note 1]); GStAPK (VII. HA Maerkische Ortschaften Salzwedel Nr. 77; VII. HA, Nichtmärkische Urkunden, Polen Nr. 28); HHStaW (171/G 717, fols. 119-122); 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, except VI, 4/2, no. 393; XIV, 2, no. 5896); RI Plus Baden, Vol. 1/1, no. 893; 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, 216, 251, 253); Tracy (2002, 178); **United States**: Yale BL (GEN MSS 1081, Box 2, fol. 57); House of Representatives (1876, 24ff.); Flournoy (1892, 508f.); for U.S. Savings Bonds data: TreasuryDirect.gov. **Genoa/Florence/Milan**: Sieveking (1898, 84, 99); 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. Mirot and Lazzareschi (1929, 170) meanwhile imply a loan duration of 10.5-17.5 months, and an interest rate range of 23-38% for Filippo Rapondi's 1397 loans: I have chosen the longest duration consistent with their reporting.

Konrad von Weinsberg's credit activities have only been included to the extent that Fuhrmann (2004) describes them as Reich-related, not for his extensive personal business. For instance, I include

Weinsberg's 4000fl loan on Reich income in Basel in 1435-1436, but exclude his borrowing in 1441-1442 from the city of Heilbronn (ibid., 278, 297).

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. Lambert (2006, 116f.) reports on a fictitious 7% annuity sale by Dino Rapondi for the same purpose. Since these transactions took several years to complete, they are all treated as long-term (with the latter not involving an actual new annuity issuance, hence treated as a loan). For the 1430s-1450s, I have only included Mollat's "long-term" 15-month loan priced at 13.2% p.a., 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 1560-1568, I take Travers' (1975, 641-643) "exchequer debts" for 12m+, averaging all available instances. For 1692-1700, average reported rates in TNA T 29/627, fols. 5-57. are used. The reported extra "gratituity" rates are always added to the basic interest rates. For Ashton (1960b), 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.

"Papal state" and "other" data are currently not included in any of the aggregate global series. They only feature in Figure III.

Notes to Figure VIII:

Sources used in addition to those specified in footnote 37: 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, 146). 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, Kur- und neumaerkische, Schlesische); Laenderrat (ed. 1949, 527, averaging Pfandbriefe – "HAB" and OERK") for 1928-1943. The years 1901-1927 and 1944-1954 are interpolated in the modern period.

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

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

Global series weights arithmetically assets specified in appendix table A.2 below and all long-term data points used in Figure III (cf. appendix table A.3 above). Switch to full consolidated basis for France from 1710; Germany (incl. municipalities) from 1619; Holland from 1672; Britain from 1703 (unconsolidated assets afterwards only integrated "at occurrence").

Prior to the establishment of national consolidated series, sub-national consolidated assets are recorded (for instance Douai for France, HRE municipalities for Germany). However, if the national authority borrows through a municipality (i.e. King Ferdinand of Aragon's borrowing through Valencia and Jativa in May 1413, cf. Kuechler 1983, 216), such transactions are included in the non-consolidated aggregation.

PERIOD	NOMINAL YIELD BASIS	INFLATION BASIS
1314-1399	Italy (Luzzatto 1929, CXXVII-CXXIX; Heers 1961, 630; Day 1963, XXVI; Kedar 1976, 191; Mueller 1997, 472ff.); France (from 1387; Espinas 1902, 319f, 326f.); Germany (from 1326; see details in footnotes 6-10, incl. HHStaW; HHStaM; HStaK; ISG Rechneiamt vor 1816; NStA B17/II, 140-147; StdAMs; Neumann 1865, 267-273; Beyer 1900, 21ff.; Reincke 1953, 500).	Northern Italy (Allen 2001); England (Clark 2010 via Thomas and Dimsdale 2017, Tab A.47, 'CPI - preferred measure' [to 1660]); Strassburg (Allen 2001, 1387-1432); Germany: between 1326-1426 average of Unger (1752, interpolated, via OeStA HHStA MEA Muenzsachen 8 [included 1326-1750]) and Abel (1978, 308-309, decadal interpolated [included 1341-1801]).
1400-1431	*As above*, plus: Italy (Sieveking 1906, 44f.; Conti 1984, 34); Holland (Bigwood 1921, I, 29, 49-52, 86; Kernkamp 1961, 17, 20; Epstein 2000, 20; Bos-Rops 2004, 39; Zuijderduijn 2009, 283-285); France (Maugis ed. 1898, 429; Nieuwenhuysen 1984, 364-367); Spain (Aragon; Kuechler 1983, chapter V).	Northern Italy (Allen 2001); England (Thomas and Dimsdale ibid.); Antwerp (Allen 2001); Germany: until 1427 average of Unger (1752, interpolated, via OeStA HHStA MEA Muensachen 8), and Abel (1978, 308-309, decadal interpolated) from 1428 adding Munich (Allen 2001) and Nuremberg (Bauernfeind 1993 [to 1671]); Valencia (Allen 2001).
1432-1499	*As above*, plus France (Maugis ibid., 434; Schnapper 1957, 50, 111; Humbert 1961, 168); Holland (Kernkamp ibid., 26, 50, 53; Marsilje 1985, 241); Germany (Sander 1902, 409, 411-414; Kuske 1978, 158-179).	Northern Italy (Allen 2001); England (Clark 2010 via Thomas and Dimsdale ibid.); Antwerp (Allen 2001), Paris (Allen 2001); Germany: as above, plus Vienna (Allen 2001 [from 1441]), and Wuerzburg (Elsas 1936, 539ff. [for 1495-1799]).

1500-1599	*As above*, plus Spain (Ucendo and Garcia, in: Bonney 2007; Drelichman and Voth 2014, 114); France (Vuehrer 1886, 16ff., 23ff.; Doucet 1937, 12, 49-51, 66, 100); Holland (Tracy 1985, 89, 94; Dormans 1991, 15, 26); Italy (De Luca 2007, 127, 130; Cipolla 1952, tabella III [A]).	Northern Italy CPI (Allen 2001); England (Clark 2010 via Thomas and Dimsdale ibid.); Antwerp (Allen 2001); Paris CPI (Allen 2001); Germany: as above, plus Augsburg (Allen 2001 [from 1502]) and Leipzig (Allen 2001 [from 1566]); Valencia and Madrid average (Allen 2001).
1600-1699	*As above*, plus Holland (Dormans ibid., 47, 63f., 71; Zuijderduijn ibid.); France (Vuehrer ibid., 56, 60, 72, 99, 117, 123f.; Shakespeare 1986, 52-58); Spain (Alvarez Nogal 2010, 61 [to 1730]).	Northern Italy CPI (Allen 2001); England (Clark 2010 via Thomas and Dimsdale ibid.; Mitchell 1988 via Thomas and Dimsdale ibid. [1661-1749]); Antwerp CPI (Allen 2001); Paris CPI (Allen 2001); Germany: as above; Valencia and Madrid average (Allen 2001).
1700-1785	*As above*, plus England (Castaing via EFSDB [1703-1733]; BoEA 10A 270/1 [1734-1820]); France (Vuehrer ibid., 129, 135, 139, 159, 173, 185ff., 212-280; Shakespeare ibid., 61-103; Velde and Weir 1992, 14, 20 [to 1793]).	Northern Italy CPI (Allen 2001); England (Thomas and Dimsdale 2017); Antwerp CPI (Allen 2001); Paris (Allen 2001); Germany: avg. of Wuerzburg (Elsas, ibid.), Abel (ibid.), Leipzig, Augsburg, Munich [to 1765], Vienna CPI (Allen 2001); Valencia and Madrid average (Allen 2001 [to 1730]).
1786-1819	*As above*, plus Germany (Däbritz 1906, 83, 113, 127 [to 1836]); Holland (Weeveringh 1852, 50f.); France (Loutchitch 1930, 42-45 [to 1929]); United States (Sylla, Wilson, and Wright 2005, New York basis [from 1790]).	Northern Italy CPI (Allen 2001); England (Thomas and Dimsdale ibid.); Antwerp CPI (Allen 2001); Germany: avg. of Wuerzburg (Elsas ibid.), Abel (ibid.), Leipzig [to 1796], Augsburg, and Vienna (Allen 2001); Strassburg CPI (Allen 2001); United States CPI (David and Solar 1977, 16 [to 1820]; Mitchell 1983, 841ff. [from 1821]).
1832-1842	*As above*, United States (Sylla, Wilson and Wright 2005, Pennsylvania 5s basis).	*As above*, United States CPI (Mitchell 1983, 841ff.).

1820-2018	*As above*, France (Annuaire Statistique 1930-1951); Germany (Kahn 1886, 209-213 [to 1883]; Voye 1902, 89 [to 1900]; Bundesbank 1968, 2017; Institut fuer Konjunkturforschung 1923); United States (Homer and Sylla [1991, tables 38+46]; NBER Macrohistory database [from 1919]; Federal Reserve Board 1943, 1976; FRED 2018 [from 1962]), Japan (The Economist 1870-1913; Bank of Japan 1914-1926; Tokyo Chamber of Commerce 1927-36; Japan Statistical Yearbook 1937-46; Japan Industrial and Commercial Semi-Annual Report 1947-1958; Bank of Japan 1959-2018).	(Northern) Italy CPI (Mitchell 1975, 1861-1969; Allen 2001, 1820-1860; IMF IFS, 1970-1987; ECB [all via SDW], 1988-2018), England CPI (Thomas and Dimsdale ibid.), France CPI (Allen ibid., Strassburg, 1820-1840; Annuaire Statistique 1840-1869; Mitchell ibid., 1870-1969; IMF IFS, 1970-1990; ECB, 1991-2018), NL CPI (Mitchell ibid., 1911-1969; Allen ibid., Amsterdam+Antwerp avg, 1820-1910; IMF IFS, 1970-1987; ECB 1988-2018), Germany CPI (Mitchell ibid., 1820-1969; IMF IFS, 1970-1985; ECB, 1986-2018), Spain CPI (Allen ibid., Madrid 1820-1913; Mitchell ibid. 1914-1961; Carreras and Tafunell 2005 eds., 1359-1361 [‘Cuadro 17.16, consume privado’]; ECB, 2000-2018), United States CPI (Mitchell 1983, 841ff. [to 1947], FRED 2018), Japan CPI (Williamson 1998, 1870-1884; Jacks and Lindert 2006, 1888-1925; League of Nations 1926-1944 [for 1926-1930 ‘prices of foodstuff, Tokyo’, afterwards ‘cost of living, Tokyo’]; Japan Bureau of Statistics 1947- [all items less imputed rent, 2010 base]).

Notes: Spain is excluded between 1731-1799. Individual missing years are always linearly interpolated. Midpoints are taken when ranges or multiple emissions for a given year are reported, except where issuance volumes are fully documented, as in the case of Sander (1902, 411-414, for Nuremberg), Schnapper (1957, 111, see below) or Tracy (1985, 89, 94). For Däbritz (1906, 83, 113, 127), I use the 3% “Landschaftliche Obligationen” of 1763 between 1764-1801, and the 5% “Landschaftliche (Reichenbachsche) Obligationen” for 1815-1821, and the 4% emission of 1821 for 1822-1836. For Voye (1902, 89) the 3.5% “konsolidierte Anleihe”.

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.

The Schnapper (1957, 111) reference weighs his six Paris interest rate brackets between 1483-1612: for >10% bracket (“inferieur denier 10”), I have taken 15%; for <6.6% (“au-dela du denier 15”), I have taken 5%. For France 1746-1793, I average rentes, “October loans”, the direct loans in Velde and Weir (1992, 14, 20), as well as Vuehrer’s (1886, 212-290) datapoints. The years 1794-1798 in France are interpolated: from 1798, I take the 5% rentes in Loutchitch (1930, 45), afterwards the 3% rentes (ibid., 42-44). For Holland 1796-1811 in Weeveringh (1852, 50f.) prices of the 3% “Generaliteit Obligationen” are taken, averaging Jan+Jul.

For the U.S., I rely on Sylla, Wilson, and Wright’s (2005) New York prices, beginning with the December 1790 listing in “U.S. 3s” (their code: “US-0010”), to 1832; between 1833-1842 on

Pennsylvania 5s (their code: "S-2240"); between 1843-1853 taking "U.S. loan 6s 1862" (their code "US-0825").

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. I arithmetically average all individual observations in Kuske (1978, 158-179) for Cologne during 1477-1500.

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

PERIOD	NOMINAL YIELD SOURCE	INFLATION DATA	ASSET USED
1311-1508	*Venice (55%):* Luzzatto (1929, CXXVII-CXXIX), Mueller (1997, 472ff.), Pezzolo (2003, 65).	Allen (2001): Florence bread price, 1311-1323; Northern Italy CPI, 1324-1508.	*Monte Vecchio* long term yields (1311-1481), *Monte Nuovo* long-term yields (1482-1508).
	Genoa (25%): Sieveking (1906, 44f), Heers (1961, 630), Day (1963, XXVI), Kedar (1976, 191).	*As above*	*Compere* long term yields, San Giorgi Bank *Luoghi* deposit yield.
	Florence (20%): Conti (1984, 34).	*As above*	*Monte Comune* long-term bond yields.
1509-1598	Ucendo and Garcia in: EFSDB (2018); Alvarez Nogal (2010, 61); Drelichman and Voth (2014, 114).	Allen (2001): Valencia CPI, 1509-1598.	Spain: *Juros* long-term yields.
1599-1702	Dormans (1991, 26, 52,71); Zuijderduijn (2009, 283-285).	Allen (2001): Amsterdam CPI, 1599-1702.	Dutch Province of Holland long-term *Renten* yields.

1703-1907	Castaing (1703-1733) via EFSDB (2018); BoEA 10A 270/1 (1734-1820); Thomas and Dimsdale (2017, Tab A31, Column P).	Thomas and Dimsdale (2017, "Preferred headline CPI", Tab A47, Column AW).	British consol long-term yields.
1908-1913	NBER Macrohistory database, series m13028a, December yield.	Bundesbank (1968, 19).	German Imperial 3% bond yields.
1914-1918	Thomas and Dimsdale (2017, Tab A31, Column P).	Thomas and Dimsdale (2017, "Preferred headline CPI", Tab A47, Column AW).	British consol long-term yields.
1919-1961	Federal Reserve Board (1943, 468), Federal Reserve Board (1976, 720).	FRED (2017), series CPIAUCNS.	U.S. Long-term bonds (11.5-year maturity, 1943-1947), U.S. 10-year bond yields (1948-1961).
1962-1980	FRED (2018), series IRLTLT01DEA156N.	Bundesbank (2017).	German 10-year bond yields.
1981-2018	FRED (2018), series DGS10.	FRED (2018), series CPIAUCSL.	U.S. 10-year bond yields.

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.

Cf. the appendix for the data relating to aggregate GDP, and population series over 1311-2018, as well as further (anecdotal) notes on historical wealth composition, financial repression factors, and profit rates.