EIGHT CENTURIES OF GLOBAL REAL RATES AND THE ‘SUPRASECULAR DECLINE’, 1311-2018*

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PAUL SCHMELZING

ABSTRACT

This article presents a novel dataset for benchmark global real rates on an annual basis going back to the 14th century, for both the international safe asset provider, and advanced economies as a whole. Drawing on new primary and secondary data, and covering more than 70% of advanced economy GDP over time, the data allows for the first time to trace precisely the evolution of global financial real returns. I demonstrate that – contrary to prevailing accounts – real rates and their standard deviation have followed a long-term downward path for more than 500 years, and that numerous previous “real rate depressions” have occurred. If historical trends are not radically upended, real rates will continue to decline between 0.9 and 1.2 basis points per annum, and reach permanently negative territory in coming years. The new data has key implications for various recent debates, including propositions of a “secular stagnation” environment, and future trends in excess capital returns and social inequality. This paper argues that in the 20th century, the years between 1955 and 1980 represent an “outlier episode” and that since then, real rates are merely converging back to historical trends. Excess capital returns over growth rates have meanwhile steadily declined for centuries. Finally, long-term drivers of the trend fall are explored – with both growth and demographic variables being rejected.

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Affiliations and contact:

HARVARD UNIVERSITY, Robinson Hall, 35 Quincy Street, Cambridge (MA), 02138: schmelzing@fas.harvard.edu, Phone: +1 760 5121858

HOOVER INSTITUTION, STANFORD UNIVERSITY, 580 Serra Mall, LHH, Office 231, Stanford (CA), 94305-6003: schmelz@stanford.edu

BANK OF ENGLAND, Threadneedle Street, London, EC2R 8AH, United Kingdom: paul.schmelzing@bankofengland.co.uk

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I. INTRODUCTION

The evolution of long-term real interest rates has in recent years attracted significant academic interest, not least in the broader context of the “secular stagnation” debate (Summers 2014; 2015; 2016). While there is no final agreement on the precise contribution of factors such as productivity, demographics, debt deleveraging, or excess savings, no one disputes the observation of an unusually low real rate environment in past years.

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

Equally, historical real capital returns play a central role in the vocal debate on long-term inequality trends, culminating in the widely-discussed contribution of Piketty (2014). The latter contended – on the basis of positing a “virtual stability of the pure return of capital over the very long-run” – that excess real capital returns over real growth rates would perpetuate an “endless inequalitarian spiral” (ibid, 206, 572).

However, this article documents for the first time the precise evolution of both global and “safe asset provider” long-term real rates over a span of 707 years. Relying on new archival data and widely dispersed published data ranging from 14th century North Italian bond yields, over Imperial Spanish, Dutch, and German municipal accounts, this paper aggregates for the first time nominal long-term yields and numerous separately published inflation accounts into a homogenous dataset covering over 70% of advanced economy GDP over time.

On that basis, the paper will posit substantial qualifications to the prevailing narratives concerning real financial returns over time. A key finding advanced here is there is no evidence of a “virtual stability” of real capital returns over the very long run. In contrast to prevalent theories, global real rates are not mean-reverting within a certain corridor (Hamilton et al. 2016), and will not reach a steady-state value in the medium-term, even if that value is negative (Eggertsson, Mehrotra, and Robbins 2017, esp. 41). Rather, global real rates have shown a persistent downward trend over at least five centuries, falling between 0.9 (safe asset provider
basis) and 1.2 basis points (global basis) per annum. In this sense, a wide body of recent literature preoccupied with real interest rate trends has “missed the forest for the trees”: the decline of real returns since the 1980s in my dataset represents merely a return to long-term historical trends; an actual unusual aberration can be detected between the mid-1950s and the early 1980s instead. All of this suggests that the “secular stagnation” narrative, to the extent that it posits a highly unusual current real rate environment, appears quite misleading.

Against the new data, suggestions that real rates may “stabilize” at low levels or remain by necessity positive for the foreseeable future equally seem unwarranted. The data presented here demonstrates that the “historically implied” safe asset provider real rate stands at 1.56% for the year 2018, which suggests that against the backdrop of inflation targets at 2%, nominal advanced economy rates may not rise substantially above 3.5% anymore. If long-term historical trends are not reversed, negative real rates will indeed soon constitute a “new normal” – but 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: for the safe asset provider, the all-time annual fluctuation stands at 166 basis points – but the figure has in recent years dropped to the lowest-ever standard deviation, at just over 30 basis points. The same trend discernible in the global real rate sample. This would suggest that policy responses designed to raise real interest rates from the effective lower bound (ELB) during cyclical upswings could become increasingly hard to make effective.

Though more nuanced approaches may modify the exact numbers, I construct matching long-term safe asset provider and global series on population and GDP growth, showing that correlations with real rates are in fact negative over time – thus contradicting prevalent explanations that have identified fundamental growth or demographic factors as key drivers of the trend fall in recent decades. This finding also has key consequences for the much-debated “r>g” thesis prominently advanced by Piketty (2014): I show that as nominal rates were already consistently declining before the Industrial Revolution accelerated global growth rates, the difference between r and g in fact declined for seven centuries – suggesting, if anything,
inequality trends in the opposite direction to those advanced by Piketty. Tentatively, the paper closes with more plausible explanations for the trend decline over the long run. I suggest that diminishing returns to capital as global capital accumulation accelerated, and liquidity factors appear to represent more promising variables for the “suprasecular” trend over the past seven centuries – though more robust data aggregations are desirable.

This paper proceeds as follows: part I discusses existing literature and methodology, as well as comparability aspects, part II discusses the construction of the safe asset provider, and the global datasets, part III focuses on robustness, followed by an analysis of trends and interpretation, including growth and demographic variables (including a long-term survey of “r>g”), while part IV concludes.

I. METHODOLOGY AND LITERATURE

I.A EXISTING REAL RATE 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, respectively, 1985, 1800, 1985, 1870, 1980 and 1870. Eggertsson, Mehrotra, and Robbins (2017) in their model-approach, or Williams (2015; 2016), and Kiley and Roberts (2017) from the policy perspective equally take the 1970s and 1980s as their point of departure. Notable additions pre-dating the most recent policy debates have been provided by Barro and Martin (1990), who begin observations in 1959, Gagnon and Unferth (1995), Chadha and Dimsdale (1999), as well as Reinhart 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) includes a general discussion of early modern European interest rates. Ferguson (2006) has compiled in detail leading bond issuer prices on a weekly basis for the great powers in the 19th and early 20th century. Both geographically and
methodologically, however, these studies remain restricted, not least by failing to provide any high-frequency aggregation of their datapoints. Clark (2005) in an unpublished study discussed long-term real return trends since 1170, but used farmland returns and rent charges, rather than bond data, and focused on England only.¹

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 2014). 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; Atkeson and Ohanian 2001; Bean et al. 2014; Mertens 2016). We 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 – as well as Reinhart and Sbrancia (2015), who record three-year moving average ex post real short-term rates based on Treasury bills and deposit rates between 1946 and 2012, Jorda et al. (2017, 9-10, 14-5), who use realized real decadal moving averages, as well as more confined approaches by Gagnon and Unferth (1995), and Ford and Laxton (1999).

A few attempts to “splice” together historical nominal bond data do exist: Homer and Sylla (2005, 560) have 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. 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 1857.² 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

¹ Some excerpts from Clark’s paper are published in Clark (2007, 167-75), as well as in Clark (2010).
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).

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, while Cipolla (1952) and Homer and Sylla (2005) have equally suggested that nominal interest rates have trended downwards for selected periods: “[T]he tendency of [nominal] long-term interest rates [is] to decline…the half-century trend of the minimum rates has been downward or flat for seven centuries” (ibid., 559). Similarly, Epstein (2000, 61f.) notes that “the Black Death saw a major change of trend in European interest rates which set in motion a gradual decline in the real cost of capital that lasted up to the eighteenth century…the fall in the expected rates of return and cost of capital for individuals was nearly as impressive”. Epstein (ibid., 27) argues that the “remarkable similarity and long-term decline of interest rates among the major Continental states indicates that the rulers’ autocratic and predatory impulses were kept in check by military competition”.

The existing literature, however, is marked by major methodological drawbacks. All existing accounts featuring a meaningful share of global GDP are confined to rather short time frames. Those featuring longer timeframes are exclusively confined to nominal data, and only feature individual countries. Even the most comprehensive effort to collect interest rate data – Homer and Sylla (2005) – suffers from an exclusive focus on nominal yields, and from major data gaps which restrict long-term comparability: early modern data for Germany, Spain, and Italy ex-Venice are excluded, for instance.3 No previous study aggregates dispersed country-level observations into a long-term dataset encompassing a robust share of global GDP over time. No previous literature has systematically related such real rate data to related macro variables, including global population growth and real GDP growth over the very long term. All of the existing literature pre-dates the current “secular stagnation” episode, and so has not commented on the causes of the alleged trend fall in recent decades.

3 See also my discussion of the new German data below.
I.B COMPARABILITY, AND SAFE ASSET STATUS

Does it matter that my dataset encompasses institutional and political entities spanning a range from 15th century city-republics, to (constitutional) monarchies, to modern democracies? Certainly, the institutional, political, and monetary regime changes over half a millennium of data should be a matter for close scrutiny (Gorton 2017).

First, however, note that the only key institutional and monetary regime change in fact concerns the “relatively recent” switches from bullion monetary regimes, to the intermediate gold-exchange standard regime during the interwar and Bretton Woods periods, followed by the modern floating fiat money system (Obstfeld and Taylor 2004, 33-41). In contrast, the period from the 14th to the early 20th century exhibits a highly consistent adherence to either pure silver or gold, or mixed gold-silver standard regimes (Eichengreen and Sussman 2000; Redish 2000; Velde and Weber 2000). The switch from bullion-standard to fiat money regimes has not led to any serious comparability concerns about real rate studies covering this transition (Hamilton et al. 2016; Jorda et al. 2017) – nor should it. It is obvious that hypothetical inflationary biases (confirmed in absolute amounts and in volatility terms in Figure II) do not impact conclusions drawn for real rates, given the transmission of higher inflation expectations onto nominal yields, in line with the classic Fisher equation (Fisher 1930). At least since the time of Henry Thornton (1811), it has been understood that

“…in countries in which the currency was in a rapid course of depreciation, supposing that there were no usury laws, the current rate of interest was often…proportionately augmented. Thus, for example, at Petersburgh, at this time, the current interest was 20 or 25 per cent, which he conceived to be partly compensation for an expected increase of the depreciation of the currency”. 4

Later, these insights were theoretically formalized and refined (Wicksell 1936; Fisher 1930). The preferred inflationary monetary tools in early modern economies – debasement operations –

4 Cit. in Schwartz (1987, 153).
are documented across early modern and modern regimes alike, and include the UK in the 19th century (Rolnick and Weber 1997; Reinhart and Rogoff 2009, 174-179).

More important, hence, is the confirmation of credible commitment mechanisms that have assured the appropriate feed-through. I therefore pre-select assets to focus exclusively on issuers where the existence of credible commitment mechanisms is documented and consensual – with the effect that none of my chosen assets featured a principal default event throughout the entire timeframe, and all my chosen markets attracted strong participation by international investors.

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).5

For Spain, Drelichman and Voth (2014, 7) have shown that there existed a “first-rate system of public finances”, where “revenues, expenditures, and debt issuance were managed at least as responsibly as in Britain, France, and the United Provinces at the height of their powers, if not more so”. Fratianni and Spinelli (2006, 259f.) represent a common view in arguing that “the North-Weingast commitment mechanism was just as present in the United Provinces of Habsburg Netherlands as it was in the England of the Glorious Revolution: legitimate governments that can tax credibly can commit to pay their debts”.6 The commitment mechanism for England from the 17th century itself is equally undisputed, with some authors even arguing that “secure property rights existed in England at least as early as 1600, and probably much earlier. As far as private investors were concerned, nothing special happened in 1688, or, for that matter in any period between 1600 and 1688” (Epstein 2000, 18).

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5 I discuss commitment mechanisms also in Part II below. For further evidence of the robustness of the Italian republics’ commitment mechanism, see equally Fratianni and Spinelli (2006), De Lara (2008), and Stasavage (2011).
6 A view shared by Tracy (1985), Neal (1990), and more recently Zuijderduijn (2009).
II. HISTORICAL DATA

II.A THE SAFE ASSET PROVIDER SERIES

Figure I displays my overall spliced nominal bond series for the historical “safe asset provider”. 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. 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 1171-2. 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 1343-5. Henceforth, it was known as the Monte Comune. The instruments of these city-republics could be pledged as collateral for bank loans, lent to third parties, used in lieu of money to pay private obligations, and 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 to be allowed 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”. 7 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” (Sievking 1909, 32).

Italian urban debt thus constituted the proverbial risk-free, marketable asset of the day. 8 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 real rate 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 (2001) 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. 9

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7 Cit. in Luzzatto (1929, CCXLV–VI N.1); also cf. Mueller (1997, 563).
8 For Florence, see also Molho (1971).
9 The methodology is the same across the 20 cities covered by Allen (2001). Some cultural differences are reflected in the consumption baskets, i.e. the English basket features butter and beer, while the North Italian features olive oil and wine.
Figure I: Global nominal long-term rates, safe asset provider, 1311-2018.

Allen’s bullion basis provides a check against debasement operations, which are documented frequently for low-denomination coins across Europe (Cipolla 1956, 27-37). Bond coupon and principal payments in the period up to 1700 are typically transacted on the bullion basis, which represented the only internationally accepted standard: florins, ducats, and gulden (ibid.; Fryde and Fryde 1963; Rothmann 1998, 426). These practices can also be confirmed by numerous archival contracts. 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).\textsuperscript{10} I thus strip out all national money accounting, and ensure comparability while checking against debasements. Allen’s data has been used in the academic literature in various other contexts.\textsuperscript{11}

Figure II: Inflation for the safe asset provider, year-on-year, seven-year centered average.

It is apparent from Figure II that inflation volatility reached elevated levels in the early modern period, until the early 16\textsuperscript{th} century, to levels subsequently only experienced again during the 20\textsuperscript{th} 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 basic

\textsuperscript{10} Geheimes Staatsarchiv Preussischer Kulturbesitz (GStAPK), I. HA Rep. 78, Nr. 10, 96-131.
\textsuperscript{11} Among them Lindert and Williamson (2003), Clark (2008), Turchin (2009), Reinhart and Rogoff (2009).
pattern is, however, confirmed by a range of alternative accounts and country-basis studies. 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 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 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.12

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,

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12 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.
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”. 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 (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”. By the 16th century, Spain was equipped with a “first-rate system of public finances” and “Spanish revenues, expenditures, and debt issuance were managed at least as responsibly as in Britain, France, and the United Provinces at the height of their powers, if not more so” (ibid., 7). Alonso Garcia (2008) and Stasavage (2011) equally agree on the maturity and liquidity of the Castilian long-term debt market: in the 16th century, “everybody with credit and reputation had bonds in Castile” (Alonso Garcia 2008, 40). Alvarez Nogal (2008, 82) has separately argued that “the Spanish monarchy, despite being an absolutist government, did not need help from any other institution to provide credible commitments to its bankers and obtain access to important amounts of credit for more than 150 years”.

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

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13 Drelichman and Voth (2014, 243). See also Ehrenberg (1928) on the Crown’s relationship with the Fuggers.
14 Ibid., 24, and cf. footnote [55] there.
Long-term loan rates to the Spanish Crown are reported in Homer and Sylla (2005, 113), as well as in Ucendo and Garcia (via European State Fiscal Database, cf. Bonney 2007), and Drelichman and Voth (2014, 114). I take the low-end of the ranges reported in Homer and Sylla, 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, in line with the methodology in Drelichman and Voth. The average long-term yield for the Spanish phase thus calculated – 7.6% on long-term debt – is thus 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).\(^\text{15}\) I use Allen’s (2001) data for Spanish CPI in Valencia to obtain real rates.

Soon after Philip II’s death in 1598, Spanish decline set in with equal swiftness: “the Empire on which the sun never set had become a target on which the sun never set” (Parker 2000, 283). Economic primacy passed to the Dutch financial centers. Between 1599 and 1702, I rely on long-term bond yields from the Dutch Province of Holland, then home to the “financial capital of the world” (T’Hart, Jonker, and Van Zanden 1997, 48), and the “payments centre for the seventeenth-century European economy” (Michie 2006, 9): Amsterdam. The 17th century is widely regarded as the “Golden Age of Dutch finance”, with the Dutch national debt being put on a permanent basis in 1596, and more than 65,000 individual investors based in the Netherlands by 1620 (ibid., 26). Already, “by the earlier 16th century, the fame of Amsterdam’s wealth, backed up by a powerful market position, had radiated far beyond Dutch borders. After 1609, with the establishment of the Bank of Amsterdam, the power of its financial market was even acknowledged world-wide” (van der Burg, and t’Hart 2003, 197). I rely on nominal *renten* data provided by Weeveringh (1852), Dormans (1991), and Homer and Sylla (2005), and adjust with Allen’s (2001) Antwerp year-on-year CPI to reach real yields.

From 1703, I switch to British 3% 1726 consol yields, as recorded in the Bank of England archive.\(^\text{16}\) In my geographic shift, I follow standard accounts such as Neal (1990), Ferguson (2002), and Broadberry and Fouquet (2015), which treat British public sector assets beginning with the inception of the central bank in 1694 as the leading “safe asset” instrument, concurrent with the transition of dominant financial market activity from Amsterdam to London.

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

Between 1908 and 1913, I rely on the German Imperial 3% benchmark bond as recorded by NBER *Macrohistory database*, and between 1962 until 1980 we rely on German 10-year

\(^{15}\) The 7.2% spread refers to a positive spread of Asientos over Juros, since the Spanish yield curve was inverted.

\(^{16}\) Bank of England Archive (BoEA), 10A 270/1. I average monthly figures reported there.
government bonds. In 1908, Germany overtook the United Kingdom in total GDP and entered a stronger growth trajectory than the United Kingdom, only interrupted by World War One. In 1961, after the revaluation of the deutschmark, the rise of the Eurodollar market in London as an alternative financing pool, and consistently lower inflation rates, German rates started being considered as prime advanced economy assets (Cohen 2015). I return to US assets concurrent with Paul Volcker’s first success in his “war on inflation” in 1981, and conclude with the latest monthly U.S. 10-year bond yield for August 2018, and the corresponding August year-on-year all-item consumer price inflation figure as recorded by the Bureau of Labor Statistics (BLS).

II.B THE GLOBAL SERIES

The global series is obtained by fully weighing all available advanced economy long-term debt yields, by GDP shares based on Maddison (2007). Early modern data outside of Holland and Spain primarily consists of municipal long-term annuities (rentes), through which sovereigns frequently channelled their borrowing. In the case of France before 1522, and England prior to 1694, it should be noted that I choose unfunded, personal long-term loan rates as reported in Sinclair (1785, 34-59), Fryde (1955), and Fryde and Fryde (1963, 451-472) for England, and Fryde and Fryde’s (Ibid., 472-92) for France. While a majority of the literature interprets these as voluntary loans, and assignability is equally confirmed, attention should still be paid to the evolution of contractual details in the instruments forming this series.\footnote{Detailed discussions on assignability, negotiability, and other legal aspects can be found in Kuske (1904, 54-90), Usher (1943, chapters 2 and 5), and Munro (2003a). On the voluntary nature, as Fryde and Fryde (Ibid., 482) stress, “a certain amount of pressure was undoubtedly applied at times…but it would be misleading to lay too much stress on the compulsory nature of such loans. Wealthy townsmen and other prominent persons had much to gain from earning and maintaining the king’s good will towards them by contributing”. In the same spirit, see Ehrenberg (1928, book 2, chapter 2); for England, see Sinclair (1785, 34-38) documenting the blocking of Henry IV’s attempts to raise loans, and the important role of Parliament from 1382.} One could alternatively rely on municipal data, too, such as the rentes rates paid by the cities of Douai, which began issuances in the year 1270, and Reims (Douai data in Espinas 1902; Tracy 2003, 16-20), but the nominal rates differed only marginally. For geographies where it frequently tapped long-term debt markets, therefore, the rates for the central political authority are preferable.
GERMAN 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

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18 Basis for real GDP weights: Maddison (2007), linearly interpolated figures; for share of advanced economy real GDP covered, I divide countries covered by the sum of Maddison’s (2007) real GDP aggregates for “Total 30 Western Europe”, plus “Western Offshoots”.

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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), as courts and tax offices accepted it in lieu of cash payments.19 The fragmented political character of Germany in the early modern, and late medieval times – the Holy Roman Empire never issued central government debt – may partly explain Homer and Sylla’s limited coverage. Given that Germany accounts for more than 20% of European GDP since the 15th century, however, the issue needs to be addressed.

Notable works on early German municipal finance next to Kuske (1904) remain Neumann (1865), and case studies such as Haug (1899) or Reincke (1953). Notable recent works include Rothmann’s (1998) study of the Frankfurt fairs, and Mihm and Mihm (2007) for the city of Duisburg. Neumann (ibid., 266-273) appears still to be the only systematic compilation of nominal rates for German-speaking municipal annuities, covering the years 1215 until 1620. Kuske (1904, 62) claims some of these figures represent private rates, but we are able to corroborate Neumann’s files and expand his coverage both spatially and temporally.

For Germany, I therefore construct a long-term interest rate time series from archival sources, and weigh the available nominal municipal and state numbers arithmetically, to yield a proxy for the country as a whole. For late medieval and early modern data, I rely first on data recorded at the Frankfurt trade fairs and by the Frankfurt municipal “Rechneiamt” (accounting office) as early as 1485.20 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). 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 1451.21 Hamburg data is calculated on the basis of Reincke (1953, 500). All data refers to benchmark life or perpetual annuities. For data from the 18th and 19th centuries, we rely on archival official data reported by the City of Frankfurt, the city of Nuremberg, the city of Münster, and on archival stock market reports by the “Syndikat der Wechsel-Sensale” and

19 See also Schmidt-Lorenzen (1979) for an empirical case study for the debt turnover in primary and secondary markets for Hamburg between 1470-1570; he documents a ca. 15-25% share for “Altrentenkaeufe” (secondary markets) of total turnover for the time.
20 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.
21 Münster data in StdAMs, A IX, 725 a and b, 721-724. Nuremberg data in NStA B17/II 140, 144, and 147.
“Berlyn’s Cours-Blatt”. Inflation data is obtained by averaging Allen’s (2001) CPI data for Leipzig, Augsburg, Vienna, and Munich.

Figure V: German nominal rate data for 24 cities and states, and Austria, 1310-1810, real rate trend.

Figure VI aggregates all 1376 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 German-speaking 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.

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22 Stock market report copies in ISG, Handel Ugb-Akten 374.
23 Data via ISG, Prozessdruckschriften (15 BL./S.); Rechnet 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; and Neumann (1904).
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 average.

In the global series, I exclude the hyperinflation years in Germany (1919-23). Both if nominal data is GDP-weighted 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. The key idiosyncrasy concerns sharper yield spikes during the Napoleonic Wars, during the Crimean War, and during the interwar period of the 1920s. Nominal bond yields were equally elevated during the 14th and 15th centuries, though on average they remained clearly below the peaks of the Italian city-states during the time of the bullion famine, and in contrast to the Italian city-state basis rose between the 14th and 15th centuries.

Inflation levels on the global basis are 20-30 basis points higher on average compared to the safe asset provider basis, but exhibit similar general features in most other aspects: there were frequent “deflationary dips” until the early 18th century: 138 out of the 415 annual observations between 1311 and 1725 record global deflation; over a 200-year horizon (1818-2018), global inflation averaged 2.75%.

The resulting all-time GDP-weighted real rate, at 5.07%, comes extremely close to the single-issuer, safe asset benchmark rate of 4.78%. Key differences include an earlier all-time peak, about one century prior to the single-issuer peak, in 1379, at a lower level (18.7% versus 21.7%). The all-time low was once again during World War One, though at a slightly more depressed absolute level (-13.8% versus -11.8%).

Figures VII and VIII decompose the real rate set in Figure IX, by adding the bond data available at respective stages from all other advanced economies, to the individual series specified in Appendix Table A.2.
Figure VI: Nominal bond yields, GDP- and arithmetically-weighted, 1311-2017.
Figure VII: “Global” inflation, GDP- and arithmetically-weighted, 1311-2017.
III. ROBUSTNESS

My key results – continuously falling real rates since the late 1400s, and the real rate standard deviation – are confirmed if alternative asset choices are applied for robustness purposes, and generally would point to an even more pronounced trend. I could focus solely on Venice as the issuer with the most credible relative commitment mechanism (Fratianni, and Spinelli 2006, 262-269) – but in light of the strong correlation of yields across city-republics, the step would increase average annual spreads over the weighted sample by 30 basis points, and in addition point towards an even sharper spike in real yields in the late 15th century. I could follow Epstein’s (2000, 17f.) argument in assuming a strong commitment mechanism already in 17th century England, replacing Dutch yields during the period with English quotations – but even
short-term loans in London showed a meaningful positive spread over Amsterdam *renten* throughout the episode (Ibid., 19).

In the next step, I vary price indices to test robustness. I construct five alternative time series on the “global” basis, each with a different inflation basis, displayed in Figure X. The series have the following properties:

- **V0**: original, “preferred” global series.
- **V1**: original series, German inflation between 1495-1797 replaced with the average of Wuerzburg inflation in Elsas (1936), and Nuremberg rye inflation in Bauernfeind (1993).
- **V2**: original series, Italian inflation between 1311-1800 replaced with Malanima’s (2011) price index.
- **V3**: original series, U.K. inflation between 1311-1815 replaced with Phelps Brown and Hopkins’ (1956) price index.
- **V4**: original series, Holland inflation between 1450-1800 replaced with Western Netherlands price index in van Zanden (2017).
- **V5**: original series, France inflation between 1432-1788 replaced with Paris wheat prices in Baulant (1968).

Each alternative series displays a downward trend, but each of them differs slightly in its slope, with V1 falling by 1.6 basis points per annum, compared to the 1.41 basis points in the “preferred” V0 series. V2 displays the flattest slope, with a 1.34 basis point fall per year. Particularly V5 displays a higher overall volatility, which would be expected in view of its comparatively narrow price base.

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24 Wuerzburg inflation is obtained by arithmetically weighing Elsas (1936, 634-646) price series for rye, oat, straw, butter, and meat (Rindfleisch).
Next, I present all eight individual country series, which also confirms the common downward interest rate trend across geographies. Each country exhibits a trend fall over time ranging from 0.3 basis points per annum (Spain) to 4.08 basis points (U.K.) p.a. Germany (0.7 basis points p.a.) and Italy (1.4 basis points p.a.) represent the median long-term sovereigns. The decomposition illustrates that rearrangements for the “safe asset provider” (e.g. substituting Holland for U.K. during the 1600s) would influence the slope of our trend fall for certain subperiods – but would have no effect on the overall tendency of the dataset.
Figure X: Real rates: country decomposition and trend fall, 1317-2018.25

III.A TRENDS AND INTERPRETATION

Figures V, IX and XII display “suprasecular” trends for the spliced real rate dataset. Our data reveals a number of illuminating general features over the 707-year span: the average real rate since 1311 was at 4.78% for the safe asset provider; the average real rate in the last 200 years was at 2.58%. On both measures, therefore, current real rates (at 0.30% as of August 2018) are historically severely depressed. In fact, the year-end 2017 real rate (0.81% moving average) was just within the 90th-percentile threshold for the lowest real rates across the dataset.26

The average real rate has declined relatively steadily since the “bullion famine” in the late 1400s. This decline holds true for the 100-year moving average, for the respective “century

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25 Y-axis maximum and minimum adjusted for presentational purposes.
26 In 66 years since 1311, I record lower annual real rates than at year-end 2017, equivalent to 9.4% of observations. As with all following figures, I take the 7-year centered average basis.
average”, and for a more granular seven-year moving average (Figure V). The century-average peaked in the 15th century at 9.1%, and declined to 6.1% in the 16th century, followed by 4.6% in the 17th, 3.5% in the 18th century, and 1.4% (thus far) for the 21st century.

The highest real rate on the single-issuer basis is observed in 1472, at 21.9%. During the late 1400s, the Italian city-states were faced with rising war expenditure, given the intensifying wars both between the republics themselves, and against the Ottoman Empire. More decisively, the Ottoman conquests of the Balkans cut off large mining areas, while escalating trade deficits drained bullion supplies. “The Great Bullion Famine” was already discussed by Keynes (1924, 162f.).27 In the controversy about a late medieval general credit shortage, our data thus supports the narrative advanced by Day (1978), and contradicts the opposing more recent view of Epstein (2000, esp. 61-68).

The lowest real rate ever was in 1917 (-11.3%), in the mature phase of World War I. This was associated with the sharp inflationary shock of British war time finance and government repression of consol yields (Ferguson 2007, 442-453). World War II lows, at -5.0% in 1945 were not as low as the steep decline caused by the monetary growth that ended the “bullion famine” in the 1490s. In the 1940s, the post-war low preceded the de facto introduction of the 2.5% long-term yield cap, first enforced in November 1947 (Chaurushiya and Kuttner 2003).

Furthermore, the frequency of negative real rate episodes has been increasing over time. I record a total of 52 annual instances of a negative real rate since 1311. 22 instances 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 four instances, the 16th century only one, the 15th century eight, and the remainder occurred prior to that.

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 (Figure III). 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

27 For more see also Day (1978).
the longer run”. Current inflation targets of close to 2% are in fact below 100-year averages, but above all-time or 200-year averages.

Figure XI: Real rate trends, safe asset provider, 1317-2018.\textsuperscript{28}

\begin{center}
\begin{tabular}{|c|c|c|c|c|c|c|c|c|}
\hline
% & 1300s & 1400s & 1500s & 1600s & 1700s & 1800s & 1900s & 2000s \\
\hline
Nominal rate & 7.3 & 11.2 & 7.8 & 5.4 & 4.1 & 3.5 & 5.0 & 3.5 \\
\hline
Inflation & 2.2 & 2.1 & 1.7 & 0.8 & 0.6 & 0.0 & 3.1 & 2.2 \\
\hline
Real rate & 5.1 & 9.1 & 6.1 & 4.6 & 3.5 & 3.4 & 2.0 & 1.3 \\
\hline
\end{tabular}
\end{center}

\textsuperscript{28} Centennial average table subject to rounding.
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 XIII). From the peak in 1472, the average annual fall in real rates has been 3.9 basis points. On a 500-year horizon, the average fall has been 1.5 basis points per annum. On the 200-year horizon, it has been 2.1 basis points per annum. The respective all-time annual fall for the “global” real rate stands at a higher 1.23 basis points (Figure IX).

Figure XII focuses particularly on the period before and during the alleged “secular stagnation” episode, 1955-2018. It shows the actual evolution of safe asset provider, and global real rates – versus the historically-implied trendline, derived from my new dataset.

The key observation apparent in the figure is that in the mid-1950s, both safe asset and global real rates were both de facto at trend. Subsequently, a divergence began to unfold: the safe asset provider (here: the U.S. and Germany) accumulated a spread of up to 4.60% over historically-implied rates by 1985, with a temporary correction during 1968-74. Global real rates at first follow the implied trajectory more closely, before plunging during the oil shock episode. From the early 1980s, the divergence was as stark as for the safe asset provider, with the global real rate rising to a record of 5.1% by 1984. Since the mid-1980s, a gradual correction for both series back to the historical trend set in. In other words, the “secular stagnation” episode so often invoked to describe an unusual low-rate environment merely constitutes a multi decade mean-reversion. The really striking divergence from trend took place prior to the mid-1980s, when real rates drifted sharply upwards.

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

Appendix figure A.1 extrapolates the historically-implied trend further, into the second half of this century. Obviously, it represents an illustrative exercise fraught with qualifications – but on its basis, we can observe that if multi-century trends are fully conformed to, short-term real rates
will have reached permanently negative levels by the late-2020s already, implying serious challenges for policy rate setting in the years ahead. Long-term real global rates will have reached negative levels by the final quarter of this century.

Figure XII: Historically-implied real rate trends, versus actual, 1955-2018.29

In addition, Figure IX displays the evolution of the spread between the global series, and the safe asset provider series. It is clear that this spread captures some of the “default risk” component of sovereign bond prices over time, given that the key difference of the two measures remains the absence of any default event in the latter series. Apart from notably higher rates in the 15th century for the safe asset provider (Northern Italy), the spread is positive throughout, and

29 Trend equations used: see Figures IX, and XIII.
tends to decline (as the global sample convergences towards “safety” status). The all-time, 707-year spread stands at just over 21 basis points.

It does not follow therefore 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, an extrapolation of the 700-year trend from today would not yield a real rate average of 1% until the year 2079. However, the novel insight suggested by my data is that there is historically little ground 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.

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 XIII, 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 by 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. We 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 (prior to the “Great Bullion Famine” referred to above, but following the population plunge associated with the Black Death) – saw the onset of the “Depression of the Renaissance” (Lopez and Miskimin 1962), with 1405-10 seeing a temporary recovery in trade and industrial activity, before a renewed European-wide five-decade relapse into contraction that lasted five decades. Trade hubs such as Genoa and Marseille experienced declines in trade volumes widely exceeding population losses – and reacted with severe currency debasements (ibid., 424). [2] – the second half of the sixteenth century is commonly associated with the sharp surge in silver imports from the New World, and a resulting inflation pickup across the entire Continent (Hamilton 1934; Munro 2003b). [3] – my third episode, 1669-99, 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 and market depth (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, 111-8). 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, and poor productivity performance across advanced economies (Fels 1949).

Figure XIII: 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 in safe asset provider real
rates stands at 3.77% (30-year centred average basis); over a 200-year horizon (1818-2018) it is 4.38%; while the all-time is 10.2%.

I plot the standard deviation of the long-term real rate in Figure XIV to illustrate this finding. It can be seen that not only real rates in absolute terms, but also real rate volatility has exhibited a long downward trend since the early 1500s. Notable temporary spikes occurred during the Napoleonic War years in the early 1800s, as well as in the early 1900s, when real rate volatility began an ascent over a 30-year period, having reached new all-time lows in 1906. Since the Great Depression peak in 1934, the trend once more turned towards a reduction in volatility. It is clear that the “secular” changes in real rate volatility – paralleling the trend in absolute performance – long preceded the 1980s “inflection point” often cited. In fact, every century since 1500 recorded a lower standard deviation. On average safe asset provider real rates’ standard deviation has fallen by 2.7 basis points per annum.

Figure XIV also plots the standard deviation for the global GDP-weighted real rate. We detect the same basic pattern of steadily declining real rate volatility (falling on average by a smaller 1.5 basis points per annum) – again with notable spikes during the Napoleonic period, and the 20th century interwar periods. Here, the all-time standard deviation average stands at 7.5%, while for the 1918-2018 period it is 4.5%. For the broad sample, however, we see that the annual variation is almost one third lower than the “safe asset provider” basis, reflecting contrasting volatility during the 1300s-1600s. The period since 2008 has been the first one since the Napoleonic Wars in which global rate volatility has performed below safe asset provider volatility.

Overall, my observations for the standard deviation during the 20th century are somewhat lower than those suggested in Kiley and Roberts (2017, 319ff.), who report a steady-state nominal interest rate standard deviation between 1960-2017 of 325 basis points.
Figure XIV: Real rate standard deviation, global and safe asset provider basis, 30-year centered average (%).

Fall p.a., global STD, %: -0.0146
Fall p.a., safe asset provider STD, %: -0.0273
IV. LONG-TERM CORRELATIONS

IV.I DEMOGRAPHICS, AND GROWTH CORRELATIONS

Numerous authors have explained the trend fall in real interest rates since the 1980s with reference to demographic or growth factors. Gordon (2015) – who takes a historical perspective extending back to the 19th century – is most commonly associated with the thesis that secular productivity trends explain recent real rate developments. Similarly, even though Rachel and Smith (2017) are generally dismissive of a major role for growth factors, they attribute a quarter of the fall in real rates since the 1980s to weaker global growth prospects (ibid., 14).

Studies including Hansen (1938), Baker, DeLong, and Krugman (2005), and Gagnon, Johanssen, and Lopez-Salido (2016), have suggested a meaningful role for population growth factors in the determination of real interest rates, as slower population growth reduces the marginal product of capital and labor (assuming both are complements), thus reducing capital returns, and real rates.

Against the background of these arguments, I proceed in this section by investigating the (very) long-term correlation between growth and real rates, and between demographic change and real rates, respectively. I test correlation for both pairs on the single-issuer, “safe asset provider” basis, and for the global sample of advanced economies on three-, seven-, and 13-year centred averages. I also lag growth and real rate figures on two and four years, and test for the first derivative correlations. Appendix tables A.5 and A.6 report all results. In all but three possible combinations, we find a negative correlation between real rates and either demographic change or real GDP growth over the very long term. The general trend of relatively muted real GDP growth rates until the mid-18th century, followed by a subsequent acceleration is well documented – even though most (very) long-term studies continue to be either restricted to individual countries, or omit high frequency year-on-year data (Maddison 2007; Clark 2008; Malanima 2011; Alvarez-Nogonal and Escosura 2012; Broadberry et al. 2015). Broadberry and Fouquet (2015) have offered a recent long-term aggregate growth overview far more nuanced than previous studies, in which they reject the simplistic narrative of a “stagnant” millennium prior to the take-off associated with the Industrial Revolution.
I use the same overlapping country-sets for the single-issuer and advanced economies correlations, already introduced in the real rate data selections (cf. Appendix tables A.1, A.2). Figures XV-XVIII display long-run trends on the simple seven-year centered average basis. On this basis (Figure XV), the all-time correlation between seven-year centered average real rates, and seven-year centered average year-on-year real GDP growth is de facto non-existent (-0.06). On the full advanced economies basis (Figure XVI), the correlation is more clearly negative (-0.37), exhibiting a more pronounced rise of real GDP particularly from the 18th century, against an accelerating real rate trend decline. The same negative correlation is obtained by using 3- or 13-year centred averages, or if either series is lagged 2 or 4 years (Appendix tables A.5 and A.6).

Figure XV: Correlation real rate – real GDP growth, single-issuer basis.

Figure XVI: Correlation real rate – real GDP growth, advanced economies basis.

Turning to demographic drivers, we see a similar pattern: a slightly negative all-time annual correlation on the “safe asset provider” basis (-0.18, Figure XVII), and a more pronounced negative correlation on the full advanced economies sample (-0.356, Figure XVIII). As Appendix table A.6 shows, demographic drivers are negatively correlated for all possible
variations in lags, the first derivative, and for various centred averages. The global sample is more negatively correlated throughout than the safe asset provider, rising to up to -0.49 for the 13-year centred average.

Figure XVII: Correlation real rate – population growth, single-issuer basis.

The results are robust against alternative real GDP and population data (which by and large do not differ substantially from more recent estimates): comparing our nominal rate data with Maddison’s (2007) or Clark’s (2008) long-run world GDP nominal growth evidence yields negative correlations for several centuries: while Maddison records an average GDP growth per annum of 0.14% between the year 1000-1500 for the “Western 30” advanced economies, the growth performance picks up to 0.3% per annum between 1500-1600 in parallel to the fall in
yields; afterwards he records 0.11% per annum between 1600-1700, followed by steady accelerations, to 0.52% per annum in 1700-1820, 1.3% for 1820-1900, and finally 2.94% per annum in global nominal growth for 1900-2000. Over the very long run, a rise in nominal and real global GDP growth – except for a drop between the 16th and 17th century – is thus associated with a drop in nominal benchmark real rates, once again suggesting that fundamental factors were not key drivers of interest rate changes in the very long run.

Global population, after recording an average growth rate of 0.13% between 1000-1500, generally accelerated its expansion, with average growth rates of 0.27% between 1500-1600, with a fall back to 0.09% for 1600-1700, followed by a renewed increase to 0.61% per annum for 1700-1820, 0.63% for 1820-1900, and finally 2.9% per annum for 1900-2000. The negative relationship is also confirmed on the city-level by the two classic long-term population surveys of de Vries (1984) and Bairoch et al. (1988): the only cases of population stagnation or decline are the Italian city-states between the early 14th and 16th century: Bairoch et al. (ibid., 43,49) put the decline for Venice in this timeframe at 9.1%, for both Florence and Genoa it is 42%. In contrast, Spain and Castile showed strong population growth in the 16th century (Ruiz Almansa 1948), as did the population of Holland, which grew by more than 30% over the 17th century (Lourens and Lucassen 1997).

Against the background of the widely-debated contentions in Piketty (2014), alleging that a secular divergence between capital returns (r) and growth (g) underlies changes in societal income equality trends, it is here also possible to calculate – for the first time, to the best of the author’s knowledge – the very-long term relationship between both variables on an annual basis. Piketty (ibid., 353-358) himself simply assumes – without anywhere justifying the numbers – that real capital returns between 1000-1500, and between 1500-1700 average 4.5%, citing Homer and Sylla (1996). However, they nowhere suggest a stable real return around 4.5%. Such an assumption, as I have documented, underestimates capital returns by a significant amount, and when Piketty (ibid, 354, figure 10.9) displays a general rising trend in real capital returns

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31 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”. Nowhere is such a statement to be found in the History of Interest Rates. Even ignoring this, it is still not explained why Piketty then opts for 4.5%, rather than at least choosing a figure between 6-8%.

between 1500-1700 and 1950-2012, such a contention is thus fully at odds with the evidence presented here and also contradicts the only interest rate source Piketty explicitly refers to, Homer and Sylla (ibid, cf. 560). Figure XIX displays the difference between real capital returns (r) and real growth rates (g) on an annual basis, on both the global and the single issuer basis.

Figure XIX: “r minus g”, difference real rate to real GDP growth, 7-year centered average, single issuer and advanced economies basis, 1317-2018.

This resulting series does not necessarily disprove Piketty’s contention of some causal relationship between excess capital returns and inequality trends; given that real rates measured in this paper refer to financial asset real returns, a sharp contrast between total wealth returns
(including land and rental real returns) and real growth over time may produce somewhat different long-term slopes. A stable general real wealth return, however, is against the evidence of a close correlation between financial and non-financial assets over time not be expected.32 The data thus suggests that excess capital returns have continuously decreased over time, and, if historical trends are extrapolated, are bound to fall into negative territory – rather than stay comfortably above real growth rates. These observations here thus have implications for social income equality trends that are the direct opposite of those that Piketty posits, and rather support the scepticism expressed by Rognlie (2014), who argues from a theoretical perspective.

Overall, then, the widely posited growth and demographic drivers that have been offered as explanations for the evolution of global real rates are clearly rejected here.

IV.II EXPLAINING THE TREND FALL – TENTATIVE SUGGESTION

What, then, best explains the trend fall? No conclusive, final answers are posited in the following. However, given the evidence on diminishing returns to capital referred to above, arguments putting capital accumulation and liquidity factors at the centre appear to be a promising area, in the general direction of Rogoff and Lo (2016), or Del Negro et al. (2017), as does the “safe asset” literature including Caballero, Farhi, and Gourinchas (2017).

Regarding the latter, while not representing conclusive evidence, I can show that the slope of the real rate trend for individual country episodes at least appears closely aligned with safe asset supply and demand dynamics. Figure XX constructs a long-run demonstration for the U.K., compiling the volume of historical publicly-held sovereign debt outstanding (the safe asset “supply” variable), and equivalent money demand (the safe asset demand variable), measured as the M3/M4 stock – here Krishnamurthy and Vissing Jorgensen (2012) have most recently posited that the Treasury debt demand function closely parallels a money demand function.

Schularick and Taylor (2012) meanwhile have quantified the growth in asset and broad money stocks to GDP for a sample of 14 countries since 1870, finding a relatively close growth performance of both broad money and assets prior to World War Two. The asset-money ratio on their basis grows by 0.43% per annum prior to 1939, and 1.82% post-1947. Though obviously only suggestive, I therefore also display in Figure XIX an implied asset stock growth path for the

U.K. since the first aggregate marketable debt figures for the U.K. in 1471 are recorded by Sinclair (1785).\textsuperscript{33}

We can see that prior to the establishment of the Bank of England safe asset demand clearly outstrips U.K. public debt supply, and that the period is associated with the steepest annual real rate decline (7.4 basis points per annum). The slope sharply moderates with the founding of the Bank of England and the increase in debt supply during the period that Dickson (1967) famously termed the “financial revolution”, to just 2.55 basis points per annum. Following the Napoleonic Wars and the associated deleveraging, the supply discrepancy once again widens, and the real rate decline once more accelerates, to 3.23 basis points per annum. Appendix chart A.2 displays a similar exercise for Holland between 1610-1770, also finding a positive correlation between real rates and safe asset dynamics.

These correlations do not yet prove causation – nor do they illuminate how much of the general trend fall may be associated with safe asset dynamics. But in contrast to demographic and growth variables, the correlation here is at least clearly positive – indicating that more country-level data may indeed deliver a sufficient degree of robustness.

\textsuperscript{33} Schularick and Taylor (2012) define assets as total bank assets only. Gorton, Lewellen, and Metrick (2012) use a broader asset definition, encompassing series for total assets, and all financial sector assets. The asset-money growth rate would with a high degree of probability be meaningfully larger on the latter definition, thus increasing the robustness of our suggestions here.
Meanwhile, Piketty (2014) and others are acknowledging a secular rise in the capital-income ratio (K/Y). None other than Karl Marx famously posited a secular trend fall in the rate of profit in his *Kapital*. More general avenues relating the concept of diminishing capital returns to the trend fall therefore, appear equally promising (cf. also Rognlie ibid., for recent theoretical comments on diminishing returns). Country-level evidence does suggest that throughout

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45 “Broad money” on the basis of M3/M4 money supply via Palma (2018) and Thomas and Dimsdale (2017). Implied asset stock is obtained by adjusting the broad money growth rate with the annual growth rate of the asset-money ratio given in Schularick and Taylor (2012, 1034), 0.43% pre-1938, and 1.82% post-1947. Publicly-held debt stock uses debt figures in Sinclair (1785), and Thomas and Dimsdale (2017, tab A.29), subtracting government assets held by the Bank of England (“government debt” + “other government securities”), as recorded in Thomas and Dimsdale (Ibid., tab A.23). Broad money stock, implied asset stock, and publicly-held debt stock indexed to 1471=100. For a general discussion of the U.K.’s debt and interest rate path between 1700-1914, see also Barro (1987).
advanced economies, capital-income ratios (or its inverse, income velocity, respectively) have sharply turned around during the 16th and 17th centuries. Mayhew (1995) and Palma (2018) have accumulated the respective data for England, while Riley and McCusker (1983), and Glassman and Redish (1985) cover the crucial period for France; for Germany, Sprenger (1984) and Roessner (2014) provide evidence on increasing long-term capital-income ratio trends. For the U.S., Warburton (1949) still represents the most encompassing data, beginning in 1790. While involving a range of qualifications, a combination of these studies could yield much more robust results on the exact interaction between real rate trends and general capital accumulation. The anecdotal evidence, too, points towards this line of reasoning: among other authors, Neumann (1865, 260) attributes the fall in Prussian interest rates during the 16th century to “steigende[m] Kapitalverkehr” (rising money circulation).

V. CONCLUSION

This article has introduced the first multi-century, high-frequency real rate dataset for both the global “safe asset provider”, and advanced economies on aggregate. It has demonstrated that a long-term reconstruction of real rate developments leads to key revisions concerning at least two major current debates directly based on – or deriving from – the narrative about long-term capital returns. Crucially, my new dataset showed that real rates over the (very) long run are by no means “virtually stable”, as posited by various standard accounts (e.g. Piketty 2014, 206): in fact, real rates have been falling for over five centuries for a broad sample of different geographies and regression measures. The first implication shown is that the “secular stagnation” debate, to the extent that it posits a unique episode of declining capital returns “for the better part of a generation” (Summers 2015, 12) appears fundamentally misleading. The previous three decades do not constitute an anomaly in the context of (very) long-term economic history. Instead, the significant trend departure of real rates between the mid-1950s and the anti-inflation policy measures such as Paul Volcker’s “war on inflation” in the early 1980s, stand out as the true recent aberrations. The second implication concerns future trends: if the past performance of long-term real rates is extrapolated, one can expect a continued fall in annual safe asset provider real rates of just below 1 basis points, and for “global” real rates, this figure rises to 1.2 basis
points.; there is no reason, therefore, to expect rates to “plateau”, to posit that “the global neutral rate may settle at around 1% over the medium to long run”, or to proclaim that “forecasts that the real rate will remain stuck at or below zero appear unwarranted” as some have suggested (Hamilton et al. 2016, 663; Rachel and Smith 2017, 37). With regards to policy, the zero lower bound can be expected to become a more frequent monetary policy problem – but my evidence is still rejecting studies that have proposed a “new normal” steady state for real rates in the negative territory, which is subsequently supposed to gradually reverse (Eggertsson, Mehrotra, and Robbins 2017, 41, who suggest a “nadir” in global real rates in the 2020s): the long-term historical data just lends no support to expect that the the trend decline should suddenly come to a halt within the next decade.

Thirdly, the 500-year decline in real rates has key implications for the lively debate on past and future social inequality trends. Most prominently, Piketty (2014, 572) has underpinned his prediction of an “endless inegalitarian spiral” on a broadly static historical evolution of real capital returns. With recourse to a much broader and higher-frequency dataset than employed by Piketty (ibid.), it has been shown here that the long-term gap between real capital returns and real growth is declining; extrapolating these multi-century trends do not suggest a continuously rising capital share – rather the reverse, if Piketty’s remaining framework is upheld.

Finally, this article has argued that two of the most commonly identified fundamental factors underpinning the trend decline in real rates – demographic drivers and growth – in fact do not show a direct correlation over the very long term with interest rate developments. It remains a topic for further research which factors represent a better explanation for this long-term decline: long-run safe asset variables, and particularly a reconstruction of matching global capital accumulation data, appear as worthwhile avenues.

Harvard University, Bank of England, and Hoover Institution, Stanford University.

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**APPENDIX**

Appendix table A.1: OVERVIEW OF NOMINAL BOND DATA AND INFLATION DATA CHOSEN SINCE 1311, SINGLE ISSUER BASIS.
<table>
<thead>
<tr>
<th>PERIOD</th>
<th>NOMINAL YIELD SOURCE</th>
<th>INFLATION DATA</th>
<th>ASSET USED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1703-1907</td>
<td>BoEA, 10A 270/1; Thomas and Dimsdale (2017), Tab A31, Column P.</td>
<td>Thomas and Dimsdale (2017): “Preferred headline CPI”, Tab A47, Column AW.</td>
<td>British consol long-term yields.</td>
</tr>
<tr>
<td>1908-1913</td>
<td>NBER Macrohistory database, series m13028a, December yield.</td>
<td>Bundesbank (1968, 19).</td>
<td>German Imperial 3% bond yields.</td>
</tr>
</tbody>
</table>
--- | --- | --- | ---

Note: 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, we take the last annual month recorded.

Appendix table A.2: OVERVIEW OF NOMINAL BOND DATA AND INFLATION DATA, GLOBAL BASIS.

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>NOMINAL YIELD BASIS</th>
<th>INFLATION BASIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1400-1431</td>
<td>As above, plus: Conti 1984 (Italy); NL (Homer and Sylla 2005; Epstein 2000).</td>
<td>Northern Italy CPI (Allen 2001), England (Thomas and Dimsdale 2017), Antwerp (Allen 2001).</td>
</tr>
<tr>
<td>Period</td>
<td>Details</td>
<td>Sources</td>
</tr>
<tr>
<td>--------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>1432-1499</td>
<td>As above, plus France (Homer and Sylla 2005; Epstein 2000; Fryde and Fryde 1963), and Germany (ISG, Rechneiamt vor 1816; NStA B17/II, 140-7; GSta PK; Neumann 1865).</td>
<td>Northern Italy CPI (Allen 2001), England (Thomas and Dimsdale 2017), Antwerp (Allen 2001), Paris (Allen 2001), Germany: average of Leipzig, Augsburg, Munich, Vienna (Allen 2001).</td>
</tr>
</tbody>
</table>
Jacks and Lindert 2006, 1885-1926; League of Nations 1927-44; Japan Bureau of Statistics 1946-).  

Note: individual missing years are linearly interpolated. Spain is excluded from 1600-99. For Däbritz (1906, 83) I use the 3% “Landwirtschaftliche Obligationen” of 1763.

Appendix table A.3: Real GDP

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>COUNTRY</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1311-1508</td>
<td>Northern Italy</td>
<td>Malanima (2011, 205-17, series 3, in 1420-40 prices), Maddison (2007).</td>
</tr>
<tr>
<td>1509-1599</td>
<td>Spain</td>
<td>Alvarez Nogal and Escusura (2013, p.33): interpolated decadal real GDP.</td>
</tr>
<tr>
<td>1908-1913</td>
<td>Germany</td>
<td>Hoffmann (1965, 14, interpolated).</td>
</tr>
<tr>
<td>PERIOD</td>
<td>COUNTRY</td>
<td>SOURCE</td>
</tr>
<tr>
<td>-----------</td>
<td>----------------</td>
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</tr>
</tbody>
</table>

Appendix table A.4: Population

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>COUNTRY</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1311-1508</td>
<td>Northern Italy</td>
<td>Malanima (2011, 205-17, series 6 over series 3).</td>
</tr>
<tr>
<td>1600-1699</td>
<td>Holland</td>
<td>Fritschy (2017).</td>
</tr>
<tr>
<td>1908-1913</td>
<td>Germany</td>
<td>Hoffmann (1965, 174).</td>
</tr>
<tr>
<td>1919-1960</td>
<td>United States</td>
<td>Bureau of the Census (2018), selected historical population and census counts; FRED (2017), series B230RC0A052NBEA.</td>
</tr>
</tbody>
</table>
Appendix figure A.1: Extrapolating the historical trend fall, safe asset provider, global, and short-term real rates, 1970-2080.\(^{35}\)

\(^{35}\) To extrapolate global short-term real rates, historical average annual spreads between a short-term real rate sample and global long-term rates between 1950-2017 are used: the spread is 52 basis points.
### Appendix table A.5: Real rate and real GDP growth correlation

<table>
<thead>
<tr>
<th></th>
<th>Safe asset provider</th>
<th>Global sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-Y centered average</td>
<td>0.2020</td>
<td>-0.0842</td>
</tr>
<tr>
<td>7-Y centered average</td>
<td>-0.0581</td>
<td>-0.3676</td>
</tr>
<tr>
<td>13-Y centered average</td>
<td>-0.2791</td>
<td>-0.5577</td>
</tr>
<tr>
<td>Real rate lagged 2 years</td>
<td>-0.1902</td>
<td>-0.4195</td>
</tr>
<tr>
<td>Real rate lagged 4 years</td>
<td>-0.2559</td>
<td>-0.4302</td>
</tr>
<tr>
<td>Growth lagged 2 years</td>
<td>-0.1742</td>
<td>-0.3910</td>
</tr>
<tr>
<td>Growth lagged 4 years</td>
<td>-0.1965</td>
<td>-0.3681</td>
</tr>
<tr>
<td>Change in real rate, growth</td>
<td>0.0883</td>
<td>0.0352</td>
</tr>
</tbody>
</table>

### Appendix table A.6: Real rate and population growth correlation

<table>
<thead>
<tr>
<th></th>
<th>Safe asset provider</th>
<th>Global sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-Y centered average</td>
<td>-0.0966</td>
<td>-0.2168</td>
</tr>
<tr>
<td>7-Y centered average</td>
<td>-0.1792</td>
<td>-0.3560</td>
</tr>
<tr>
<td>13-Y centered average</td>
<td>-0.2595</td>
<td>-0.4901</td>
</tr>
<tr>
<td>Real rate lagged 2 years</td>
<td>-0.1724</td>
<td>-0.3519</td>
</tr>
<tr>
<td>Real rate lagged 4 years</td>
<td>-0.1829</td>
<td>-0.3729</td>
</tr>
<tr>
<td>Pop growth lagged 2 years</td>
<td>-0.1854</td>
<td>-0.3770</td>
</tr>
<tr>
<td>Pop growth lagged 4 years</td>
<td>-0.2049</td>
<td>-0.4251</td>
</tr>
<tr>
<td>Change in real rate, change in pop.</td>
<td>-0.0045</td>
<td>-0.0128</td>
</tr>
</tbody>
</table>
Appendix figure A.2: Holland long-term debt stock, money stock, and implied asset stock, and real rates, 1610-1770.³⁶

³⁶ Debt data: Dormans (1991) via Fitschy (2017). Broad money stock is taken as Bank of Amsterdam total balances recorded in van Dillen (1934, 117-121), implied asset stock calculated based on asset-money stock ratio growth of 0.43%. All stock data indexed in 1610=100.