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

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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 both new primary and secondary data, and representing 71% of advanced economy GDP over time, I show that real rates in absolute terms, and its standard deviation are not static, but in fact have followed a long-term downward path for more than 500 years. I show that numerous previous “real rate depressions” have occurred, and that in fact the period of 1955-80 – rather than the past thirty years – represents an “outlier episode”. Since then, global real rates have started to converge back to their long-term historical trend: historically-implied real rates now stand at 0.7%, and are set to continue falling by 1.2 basis points per annum – if past trends are sustained, negative and “stickier” real rates will thus become an increasingly frequent occurrence for the global economy. In the second part, this paper investigates “suprasecular” correlations with growth and demographic factors, and posits that liquidity variables, rather than fundamental ones, appear to be a better explanatory framework for the trend fall over time.

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, most notably 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, the observation of an unusually low real rate environment in past years is universally shared.

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 second half of the 1900s at first appears decisive.

However, I will argue in this article that the narrative about the evolution and trends in both “safe asset provider” real rates, and global real rates, needs to be substantially qualified once long-term economic history is taken into account. Relying on both 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 coherent 707-year global real rate dataset.

A key insight from a very long-term investigation of real rates trends consists in the fact that real rates are not static over the long run. Instead, global real rates have shown a persistent downward trend over at least five centuries, falling between 0.9 (safe asset provider) and 1.2 basis points (global real rates) per annum. In this sense, real interest rates over the past decades have merely once more reverted back to their entrenched trend – the outlier in recent history in fact appears to be the post-war rise in real interest rates until Paul Volcker’s “war on inflation” in the early 1980s. This suggests that the “secular stagnation” narrative, to the extent that it posits a unique and unusual current real rate environment, is misleading.

Similarly, suggestions that real rates may “stabilize” at low levels appear to be equally misleading. 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 historical trends are not
radically upended, negative real rates will indeed soon constitute a “new normal”, and by the second half of this century, global real rates will have fallen constantly below 1%.

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 is shown for 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 harder to engineer.

Though more nuanced approaches may modify the exact numbers, I also show that both population and GDP growth dynamics are in fact negatively correlated with real rates for both the safe asset provider and the global real rates, 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 since nominal rates already consistently decline before the industrial revolution accelerates global growth rates, the difference between r and g in fact declined for seven centuries – putting doubt on its explanatory power related to inequality variables. Tentatively, I suggest that liquidity factors could represent promising explanatory variables that explain the “suprasecular” trend fall in real rates.

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), or Gourinchas and Rey (2018) are among recent examples offering a “long-
term” view on global real rate developments. However, these studies begin their observations in 1985, 1800, 1985, 1870, 1980 and 1870, respectively. Eggertsson, Mehrotra, and Robbins (2017) in their model-approach, or Williams (2015; 2016), and Kiley and Roberts (2017) from the policy perspective equally take the 1970s and 1980s as their reference 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 7-year moving average ex post real rates, methodologically closest to Eichengreen (2015) – who uses a 7-year moving average of ex-post CPI to determine long-term real rates – as well as Reinhart and Sbrancia (2015), who record 3-year moving average ex post real short-term

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1 Some excerpts from Clark’s paper are published in Clark (2007, 167-75).
rates based on Treasury bill assets and deposit rates between 1946-2012, 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

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: “the 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 is excluded, for instance.\textsuperscript{3} None 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 has not commented on the context of the alleged trend fall in recent decades.

\textbf{I.B. COMPARABILITY, AND SAFE ASSET STATUS}

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

First, I note, however, that the only key institutional and monetary regime change in fact concerns the “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 14\textsuperscript{th} – early 20\textsuperscript{th} century exhibits a highly consistent adherence to either pure silver or gold, or mixed gold-silver standard regimes (Eichengreen and Sussman 2000; Velde and Weber 2000). The switch from bullion-standard to fiat money regimes has not lead to any serious comparability concerns lingering over longer-term real rate studies covering this transition (Jorda et al. 2017; Hamilton et al. 2016) – nor should it. In empirical and theoretical terms, is obvious that hypothetical inflationary biases (confirmed in absolute amounts and in volatility terms in Figure II) are not impacting conclusions drawn for real rate developments, 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, the insight entered the academic debate, exemplified by his observation in 1811 that

\textsuperscript{3} See also my discussion of the new German data below.
“…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”.

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

More important, hence, is the confirmation of credible commitment mechanisms that have assured the appropriate feed-through. I therefore pre-select assets to focus exclusively on issuers where the existence of credible commitment mechanisms is documented and consensual – with the effect that none of our assets features a principal default event throughout the entire timeframe, and all markets featured 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 its “public debt derived its success from the fact that the main lenders were also members of the elite…as the low interest rates on offer reveal, the system worked because it aligned the creditors’ and debtors’ incentives. Lenders and borrowers had a joint stake in ensuring repayment and, more broadly, in ensuring the borrowing city’s political and financial stability”. The same overlap between debtor and creditor incentives ensured that “early modern Genoa was a true paradise for savers” (Pezzolo 2003, 154).

For Spain, Drelichman and Voth (2014, 7) have shown that there existed a “first-rate system of public finances”, where “revenues, expenditures, and debt issuance were managed at least as responsibly as in Britain, France, and the United Provinces at the height of their powers, if not more so”. Fratianni and Spinelli (2006, 259f.) represent a common view in arguing that “the

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4 Cit. in Schwartz (1987, 153).
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).
North-Weingast commitment mechanism was just as present in the United Provinces of Habsburg Netherlands as it was in the England of the Glorious Revolution: legitimate governments that can tax credibly can commit to pay their debts”. The commitment mechanism for England from the 17th century itself is equally undisputed, with some authors even arguing that “secure property rights existed in England at least as early as 1600, and probably much earlier. As far as private investors were concerned, nothing special happened in 1688, or, for that matter in any period between 1600 and 1688” (Epstein 2000, 18).

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”. 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 ever since” (Mueller 1997, 516), and almost uninterrupted market prices are from then onwards recorded in Luzzatto (1929). Following Venice, Genoa consolidated its various long-term loans into a single fund, the Compere, in 1340. Florence equally consolidated debts in 1343-5, henceforth known as the Monte Comune. The

6 A view shared by Tracy (1985), and Neal (1990).
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”. 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 1909, 32).

Italian urban debt thus constituted the proverbial risk-free, marketable asset of the day. Venice is conventionally treated as the most advanced sovereign debt market, while Florence, home of the Medici Bank, is frequently considered the leader in private, commercial markets (Tracy 2003; Pezzolo 2013).

The “bottleneck” in my 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, hence, marks the first to allow the calculation of real rates. Allen (2001) constructs his “Northern Italy” index with data from the largest Italian city-states, including Venice, Milan, and Florence. His CPI basket

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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).
includes the key food items, energy prices, linen, soap, and candles, and is based on institutional, urban price data, expressed in silver unit equivalents.\(^9\)

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). These practices can also be confirmed by numerous archival contracts.

\(^9\) 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.
Exemplary, I can point to the debt letters recorded by Friedrich II., Markgrave of Brandenburg, which in the 1460s 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, 7-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 during the

\textsuperscript{10} GSPK, I. HA Rep. 78, Nr. 10, 96-131.
\textsuperscript{11} Among them Reinhart and Rogoff (2009), Turchin (2009), Clark (2008), Lindert and Williamson (2003).
20th century World Wars again. The apparent 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 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 more related to a 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 (Michie 2006, chapter 1; Malanima 2011; Pezzolo 2013, 255). I choose the year 1509 for the transition – the date of the decisive Venetian defeat in the famous Battle of

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.
Agnadello against the League of Cambrai. Niccolo Machiavelli – referring to the event in *The Prince* – claimed that Venice at this occasion 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”.13 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 in the second half of the 16th century – the *Asientos* – , 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”.14 By the 16th century, Spain was thence 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 Lyon’s Bourse, where the French monarch also preferably floated 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.
Figure III: Real long-term rates for the safe asset provider, 7-year centered average.

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). We take the low-end of the ranges reported in Homer and Sylla (Idib.), thus introducing a further conservative bias for the subsequent interpretations, and use the 22 datapoints reported by Ucendo and Garcia (Ibid.). All other Spanish annual nominal Juros yield datapoints are linearly interpolated, in line with the methodology in Drelichman and Voth (Ibid.). The average long-term yield for the Spanish phase thus reached – 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). 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), Amsterdam, and the “payments centre for the seventeenth-century European economy” (Michie 2006, 9). 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 Netherland 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 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. In our geographic shift, we 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 (Neal 1990, 51).

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 overtake 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

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15 The 7.2% spread refers to a positive spread of Asientos over Juros, since the Spanish yield curve was inverted.
16 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). We 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) 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 given, attention should still be paid to the evolution of contractual details in the instruments forming this series. 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 therefore preferable.

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17 Detailed discussions on assignability, negotiability, and other legal aspects can be found in Munro (2003a), Usher (1943, chapters 2 and 5) and Kuske (1904, 54-90). 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, 34-8) documenting the blocking of Henry IV’s attempts to raise loans, and the important role of Parliament from 1382.
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

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”.

GERMAN DATA

Figure IV: GDP weights, and share of total advanced economy real GDP covered, “global series”.18
6.95% yield at offering – a very unsatisfactory empirical situation, as German state and municipal finance has been proven to stretch back into the 14th century and to have been comparatively advanced. German municipal debt has been shown to be 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 them 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 to reach a high degree of subsequent real rate robustness.

Notable works on early German municipal finance next to Kuske (1904) remain Neumann (1865), and case studies such as Haug (1899) or Reincke (1953). 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, hence, I 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 data recorded by the Frankfurt municipal “Rechneiamt” (accounting office) as early as 1485.20 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 We also add archival data for Saxony from the Sächsisches Staatsarchiv Dresden, and from the Geheimes Staatsarchiv Preussischer Kulturbesitz (GSPK) to supplement Neumann’s (Ibid.) rather sparse Mecklenburg and Saxony state data.22 Hamburg data is calculated on the basis of Reincke (1953, 500). All data refers to benchmark life or perpetual annuities. For data

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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.

22 Here particularly GSPK, 1.HA Rep. 78, No. 8, 10, for 15th century datapoints.
from the 18th and 19th centuries, we rely on archival official data reported by the City of Frankfurt, the city of Nuremberg, the city of Münster, and on archival stock market reports by the “Syndikat der Wechsel-Sensale” and “Berlyn’s Cours-Blatt”. Inflation data is obtained by averaging Allen’s (2001) CPI data for Leipzig, Augsburg, Vienna, and Munich.

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

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23 Stock market report copies in ISG, Handel Ugb-Akten 374.
24 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; and Neumann (1904).
in German-speaking Europe aligns well with the “safe asset” and global trend posited: the average annual real rate between 1428 and 1499 stands at 5.6%, and exhibits 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 compared to global averages.

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 are equally elevated during the 14th and 15th centuries, though on average they remain clearly below the peaks of the Italian city-states during the time of the Bullion famine, and do in contrast to the Italian city-state basis exhibit a rise 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: we record 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, global inflation performance stands at 2.75%.

The resulting all-time GDP-weighted real rate, at 5.02%, 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%). Our all-time low continues to be observed 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, obtained by adding the bond data available at respective stages from all other advanced economies, with 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 Venetian assets 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, and replace 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.
  - 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).

It is visible that each alternative series displays a downward trend, but V1-5 differ slightly in their 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 ex ante given its comparatively narrow price base.

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25 Wuerzburg inflation is obtained by arithmetically weighing Elsas (1936, 634-46) price series for rye, oat, straw, butter, and meat (Rindfleisch).
Figure IX: Global real rates: “preferred” inflation basis, and alternative inflation series, 1317-1800.

Next, I exhibit 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 (Spain) to 4.08 basis points (U.K.) per annum. 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 have no effect on the overall tendency of the dataset.
3.1 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 its 707-year span: the average real rate since 1311 stands at 4.78% for the safe asset provider; the average real rate in the last 200 years stands 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) is just within the 90th-percentile threshold for the lowest real rates across the dataset.27

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26 Y-axis maximum and minimum adjusted for presentational purposes.
27 In 66 years since 1311, we 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.
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 average”, and for a more granular 7-year moving average (Figure V). The century-average peaked in the 15\textsuperscript{th} century at 9.1\%, and declined to 6.1\% in the 16\textsuperscript{th} century, followed by 4.6\% in the 17\textsuperscript{th}, 3.5\% in the 18\textsuperscript{th} century, and 1.4\% (thus far) for the 21\textsuperscript{st} 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 among the Republics themselves, and against the Ottoman Empire. More decisively, the Ottoman conquests on 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.). 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 is recorded in 1917, at -11.3\%, in the mature phase of World War One – associated with a sharp inflationary shock of British war time finance and government repression of U.K. consol yields (Ferguson 2007, 442-453). World War Two lows, at -5.0\% in 1945 are surpassed by the steep decline caused by monetary growth that ended the “Bullion famine” in the 1490s, with the post-war low preceding 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 rates is increasing over time. We record a total of 52 annual instances of a negative real rate since 1311. 22 instances have occurred in the 20\textsuperscript{th} century – a significant increase above the four instances in the 19\textsuperscript{th} century, and over the 7 instances in the 18\textsuperscript{th} century. The 17\textsuperscript{th} century count stands at four instances, that of the 16\textsuperscript{th} century at one, eight in the 15\textsuperscript{th} century, 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\%. Particularly the disappearance of deflationary tendencies – until the year 1800 almost half of all years (229 in total) recorded price declines – has led to a pronounced return of inflation in the most recent phase of our timeline (Figure III). We observe, therefore, that in the very long context, inflation performance is in fact increasingly contributing to the trend fall in real rates – which contrasts with recent observations

\[^{28}\text{For more see also Day (1978).}\]
including Kiley and Roberts (2017, 318), who assert that “the potential decline in the equilibrium real interest rate has been accompanied by a decline in the level of inflation expected to prevail over the longer run”. Current inflation targets of close to 2% are in fact below 100-year averages, but above all-time or 200-year averages.

Figure XI: Real rate trends, safe asset provider, 1317-2018.29

<table>
<thead>
<tr>
<th>Centennial averages</th>
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<tbody>
<tr>
<td>%</td>
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<tr>
<td>Nominal rate</td>
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<tr>
<td>Inflation</td>
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<tr>
<td>Real rate</td>
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29 Centennial average table subject to rounding.
The all-time trend fall in real rates for the safe asset issuer since 1317 stands at 0.92 basis points per annum (Figure XIII). From the all-time peak in 1472, the average annual fall in real rates stands at 3.9 basis points. On a 500-year horizon, the average fall stands at 1.5 basis points per annum. On the 200-year horizon, the fall stands at 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, displaying 1955-2018. It shows 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 trend-implied trajectory more closely, before plunging during the oil shock episode. From the early 1980s, the divergence is equally stark as for the safe asset provider, 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 is merely constitutes a multi decade mean-reversal. The actual notable divergence in the interest rate space took place prior to the mid-1980s, when real rates drifted sharply upwards.

By 2018, the historically-implied safe asset provider real rate stands at 1.57%. For the global sample, the historically-implied rate is 0.68%. The latter – recording an actual value of 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 on my basis 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 to expect nominal rates to reach more than 3.6% when inflation is “at target”. Global real rates, meanwhile, have normalized far more already than usually acknowledged.
In addition, Figure IX displays the evolution of the spread between the global series, and the safe asset provider. Apart from notable higher rates in the 15th century for the safe asset provider (Northern Italy), the spread is positive throughout, and tends to decline (as the global sample convergences towards “safety” status). The all-time spread stands at just over 21 basis points.

On my basis, 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, extrapolating the 700-year trend from today would yield a real rate average of 1% only by 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, a positing of which appears not justified.

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30 Trend equations used: see Figures IX, and XIII.
Next, however, a closer look at past “real rate depressions” may yield some insights into the alleged present “secular stagnation” since the 1980s. Are we living through unprecedented decades? Is the acceleration of the trend fall noted above the distinguishing feature over 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 concerns 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 dawn of the 20th century saw a comparatively small trend fall.

What is the historical context around these intervals? The periodization can be underpinned qualitatively, though I will only provide snapshots here. [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 experiencing a temporary recovery in trade and industrial activity, before a renewed European-wide five-decade relapse into contraction. 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] – our third episode, 1669-99, follows 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 for the safe asset provider, the United Kingdom, is one characterized by political and price stability, 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 across advanced economies, and poor productivity performance (Fels 1949).

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

Interestingly, both the real rate, and inflation rates, have become less volatile over time. On the recent 100-year timeframe, the average standard deviation in safe asset provider real rates stands at 3.77% basis points (30-year centred average basis); on a 200-year horizon (1818-2018) the average change stands at 4.38% basis points; while the all-time average stands at 10.2% basis points.

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 are apparent during the
Napoleonic War years in the early 1800s, and in the early 1900s, when real rate volatility began an ascent over a 30-year period, after reaching 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. Per annum, on average safe asset provider real rates’ standard deviation has fallen by 2.7 basis points.

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

Overall, my observations during the 20th century for the standard deviation 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; my observations are higher on any longer time horizons.
Figure XIV: Real rate standard deviation, global and safe asset provider basis, 30-year centered average (%).

Fall p.a., global STD, %: -0.0145
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 demographic or growth factors. Gordon (2015) – who takes a historical perspective extending back to the 19th century – is most commonly associated with the thesis of secular productivity trends underpinning 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 evidence 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 3-, 7-, and 13-year centred averages. I also lag growth and real rate figures on 2 and 4 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 demographics 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-Nogal and Escosura 2012; Broadberry et al. 2015). Particularly 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 7-year centered average basis. On this basis (Figure XV), the all-time correlation between 7-year centered average real rates, and 7-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.

Turning to demographic drivers, we detect 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.\textsuperscript{31} Over the very long run, a rise in nominal and real global GDP growth – except for a drop between the 16\textsuperscript{th} and 17\textsuperscript{th} century – is thus associated with a drop in nominal benchmark real rates, once again suggesting that fundamental factors were not a key driver of changes in the very long run.

Global population, after recording an average growth rate of .13% between 1000-1500, generally accelerated its expansion, with average growth rates of .27% between 1500-1600, with a fall back to .09% for 1600-1700, followed by a renewed increase to .61% per annum for 1700-1820, .63% for 1820-1900, and finally 2.9% per annum for 1900-2000. The negative relationship is also confirmed on the city-level by the two classic long-term population surveys of de Vries (1984) and Bairoch et al. (1988): the only subperiod showing population stagnation or decline are the Italian city-states between the early 14\textsuperscript{th} and 16\textsuperscript{th} 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 equally showed strong population growth in the 16\textsuperscript{th} century (Ruiz Almansa 1948), as did the population of Holland, which grew by more than 30% over the 17\textsuperscript{th} 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%, referring to evidence allegedly asserted in Homer and Sylla (1996). The latter source, however, nowhere suggests a stable real return around 4.5%.\textsuperscript{32} 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 between 1500-1700 and 1950-2012, such a

\textsuperscript{31} Maddison (2007) calculates World GDP on the basis of 1990 International Geary-Khamis US Dollars. Our observation holds for both nominal and real GDP growth, using the century inflation rates reported in Appendix Exhibit 2.

\textsuperscript{32} 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%.
contention is thus fully at odds with the evidence presented here – and explicitly 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 the annual basis over time, both on the global and the single issuer basis.

Figure XIX: “r minus g”, difference real rate to real GDP growth, 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. 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 the exact opposite implications for social income equality trends to those that Piketty posits, and rather support the scepticism expressed by Rognlie (2014), who argues from a theoretical perspective.

Overall, therefore, the widely posited growth and demographic drivers allegedly explaining the evolution of global real rates – at least for the very long term – are clearly rejected here.

IV.II EXPLAINING THE TREND FALL – TENTATIVE SUGGESTIONS

What, then, best explains the trend fall? Capital and liquidity factors remain a promising area, as ventured by Rogoff and Lo (2016) and Del Negro et al. (2017) – and more generally 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).34

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.1 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.

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34 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, the trend in profit rates has been at the centre of the discussion sparked by Piketty (2014), and his contention that the rate of profit (r) would exceed the rate of growth (g) over the long run (see above). 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 – which would need to explain the particular timing, however, and its dissonance

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35 “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).
from the population and growth trends outlined – therefore, appear equally promising (cf. also Rognlie 2014, for recent theoretical comments on diminishing returns).

V. CONCLUSION

This article has argued that the trend fall in real rates since the 1980s – or since the late 1990s as Bean et al. (2015, 3) report – does not constitute an anomaly in the context of (very) long-term economic history. In fact, the natural condition of real interest rates, thus, is not static, but trends downwards: if past trends are broadly sustained, one can expect a continued fall in annual safe asset provider real rates of just below 1 basis point; for “global” real rates, this figure rises to 1.2 basis points.; there is no reason, therefore, to expect rates to “plateau” or to posit that “the global neutral rate may settle at around 1% over the medium to long run” as some have suggested (Rachel and Smith 2017, 37).

Against the background of this evidence, the “secular stagnation” period that according to Summers (2014; 2015; 2016) has been with developed countries for “the better part of a generation”, represents a misleading concept to the extent that it posits an isolated decline in real interest rates over the last decades. Instead, the significant trend departure of real rates since the mid-1950s until explicit anti-inflation policy measures such as Paul Volcker’s “war on inflation” in the early 1980s, stand out as the true aberrations. Negative real rates, therefore, are to become more frequent, and the zero lower bound can be expected to become a more frequent monetary policy problem – my evidence is thus underpinning theory studies that have proposed a “new normal” in negative or significantly depressed real rates for the future (Eggertsson, Mehrotra, and Robbins 2017).

Further, 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 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: liquidity variables, and particularly long-run safe asset dynamics, appear as worthwhile avenues.

36 Summers (2015, 12).
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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>Period</td>
<td>Sources</td>
<td>CPI Data</td>
<td>European Interest Rates</td>
</tr>
<tr>
<td>-----------------</td>
<td>------------------------------------------------------------------------</td>
<td>----------</td>
<td>---------------------------------------------------------------</td>
</tr>
<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><em>As above</em>, 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>Description</td>
<td>Notes</td>
</tr>
<tr>
<td>-------------</td>
<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
</tbody>
</table>

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
### Appendix table A.4: Population

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>COUNTRY</th>
<th>SOURCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>Country</td>
<td>Source</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<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 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 A6: 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 Chart A.1: Holland long-term debt stock, money stock, and implied asset stock, and real rates, 1610-1770.  

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.