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Some International Evidence on Inequality, Demographics, and Long-term Interest Rates

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Some International Evidence on Inequality, Demographics, and Long-term Interest Rates*

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Abstract

Using a cross-country panel spanning the years 1980-2019, we provide empirical evidence on the relationship between inequality, demographics, and declining long-term interest rates in OECD countries. Since the early 1980s, the OECD average long-term nominal interest rate has declined by 11%. We find that rising life expectancy can account for 3.15% of this decline, while rising inequality can account for 1.04%. We construct a real rate measure and find similar conclusions regarding the role of demographics versus inequality. Our evidence suggests that both inequality and demographics are relevant for declining long-term interest rates.

Key words: Inequality; Demographics; Long-term interest rates
JEL classification: E21, E43, J11

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1 Introduction

This paper studies the relationship between long-term interest rates, income inequality, and demographics in an unbalanced panel of 35 OECD countries over the period 1980-2019. Over the last 40 years both nominal and real interest rates have steadily declined to the point where most developed countries have concerns about the frequency with which policy rates will hit the zero lower bound in response to adverse shocks. For example, estimates of the *world* real interest rate from King and Low (2014) and Rachel and Summers (2019) exhibit declines of roughly 3-4% and remain at or below 1%.

Two prominent explanations for the decline in interest rates are rising inequality and demographic changes, often related to the post-WWII baby boom. We provide empirical evidence on the relationship between these factors and the decline in long-term interest rates, and examine if it is consistent with the predictions of those theories. In this context, our results offer the first cross-country evidence on an important topic of contemporary research.

One argument for declining interest rates is the rise in income accruing to the top 1%. This argument is typically made from the standpoint of a loanable funds market: The rich have very different consumption and saving behaviour than the non-rich, and as resources increasingly accrue to those at the top, there is an increase in savings, putting downward pressure on the equilibrium interest rate (Mian, Straub and Sufi 2021b,c). This argument has received significant attention over the previous year due to the theory of *indebted demand* proposed by Mian, Straub and Sufi (2021a). In their theory, changes in inequality can be amplified by debt accumulation. As debt levels of borrowers rise, so do the costs required to service debt. This transfers even more resources to savers and because of differences in marginal propensities to consume, leads to even larger increases in savings and declining long-run equilibrium interest rates.[1] Additionally, they highlight that many stabilization policies (e.g., monetary and fiscal policy) which yield short-run benefits through debt accumulation, can lead to long-run declines in the equilibrium rate.

[1]This argument is described in their Proposition 4 which states: *An increase in income inequality (greater ω^s) unambiguously reduces long-run equilibrium interest rates and raises household debt. In the homothetic model, long-run interest rates and household debt are unaffected by rising income inequality.*

Several alternative arguments put forth are related to demographic factors. One demographic argument for the decline in rates is the slowdown in population growth (Gagnon, Johannsen and López-Salido 2021). However, a slowdown in population growth may have an ambiguous effect on interest rates (Carvalho, Ferrero and Nechio 2016). A slowdown in population growth (eventually) leads to a decline in the growth rate of the labour force and an abundance of capital relative to labour, putting downward pressure on the return to capital and interest rates.[2]

But at the same time a decline in population growth eventually pushes up the fraction of retirees relative to the working-age population. Further, since retirees have lower marginal propensities to save, and an increase in their population share leads to a decline in aggregate savings, putting upward pressure on interest rates. Depending on which of the above effects dominates, a slowdown in population growth could lead to an increase or decrease in interest rates. Auclert, Malmberg, Martenet and Rognlie (2021) study the compositional effect of an aging population on interest rates. Using population forecasts, they predict that low rates will persist throughout the twenty-first century due to aging demographics. To disentangle these effects, we control for both changes in a country's population growth rate and its old-age dependency ratio.

A second demographic argument focuses on the role of life expectancy. From a life cycle standpoint, individuals save for retirement throughout working-age years by accumulating assets. As life expectancy rises, for a fixed retirement age, individuals will need more savings to sustain them for a longer retirement. This results in an increase in saving rates throughout the life cycle, increasing aggregate savings, and putting downward pressure on interest rates.

Our analysis is based on an unbalanced panel of 35 OECD countries for the years 1980-2019. Our dependent variable is long-term nominal interest rates, which corresponds to the yields on 10 year government bonds. Our independent variables, capturing inequality and demographics, are the top 1% income share, population growth, life expectancy, and the old-age dependency ratio.

[2]This is easiest to see if one assumes factor markets are perfectly competitive and the production function is Cobb-Douglas, then the first order condition for capital yields $R_t^k = \alpha(L_t/K_t)^{1-\alpha}$. Let the growth rate of labour be given by $L_t = (1+n)L_{t-1}$. It is straightforward to see that as n falls, the return on capital falls.

We find that the strongest factors associated with declining long-term nominal interest rates in OECD countries are rising life expectancy and income inequality. In our preferred specification, a rise in life expectancy of one year is associated with a 0.41% decline in long-term nominal rates, while an increase of one percent of national income accruing to the top 1% is associated with a 0.31% decline in rates. Based on the OECD cross-sectional average changes in these variables between 1980-1984 and 2015-2019, our results suggest that rising life expectancy can explain 3.15% of the decline in long-term nominal rates, while rising inequality can explain 1.04% of the decline. We construct a measure of long-term real interest rates and find results generally consistent with those using long-term nominal rates, albeit with some caveats.

Our other demographic variables, population growth and old-age dependency ratio, give mixed results. In some specifications they are significant with signs consistent with theory, and in others they take opposite signs, or are not statistically different from zero.

Our results suggest that rising life expectancy and inequality can account for significant shares of the decline in interest rates across OECD countries. Our results also provide some quantitative evidence on the links between interest rates, inequality, and demographics, which are useful for those conducting model-based exercises. Finally, while our focus is on demographics and inequality as explanations for declining rates, a number of other explanations have been proposed in the literature. In terms of structural factors, explanations include the slowdown in productivity (Gordon 2016), global saving glut/safe asset shortage (Bernanke 2005, Caballero, Farhi and Gourinchas 2008, Gourinchas and Rey 2019), and declining investment demand (Rachel and Smith 2017). An emerging literature studies how monetary policy may contribute to declining natural rates of interest. McKay and Wieland (2021) propose a framework where expansionary monetary policy *borrows* aggregate demand from the future, which can depress the natural rate in the future. In Beaudry and Meh (2021), households asset demand is not strictly monotonic with changes in interest rates. Then monetary policy can impact long-run steady state properties of interest rates, even though monetary policy itself is neutral in the long-run. Hillenbrand (2021) shows that almost all of the decline in US 10 year yields has occurred within a short window around FOMC meetings and

proposes an explanation in which market participants learn about the long-run equilibrium rate from the Fed (a so-called long-run Fed information effect). Our empirical findings do not rule out the possibility of these alternative explanations for decline in long-term interest rates in OECD countries.

The layout of the remaining paper is as follows. Section 2 describes the data. Section 3 discusses the results and Section 4 provides some robustness checks. Section 5 concludes.

2 Data

Our unbalanced panel was constructed from a variety of sources. The panel is at an annual frequency and covers the years 1980-2019. We focus on this time period for two reasons. First, this is broadly considered the starting point of the decline in long-term nominal rates in most advanced economies. Second, for most of our sample this is the earliest at which top income share data is available on a consistent basis. Our sample contains 35 OECD countries with a total of 1,142 country-year observations.

Interest rate data was obtained from the OECD iLibrary's MEI Key Short-Term Economic Indicators. We previously used estimates of the natural rate of interest obtained following the Laubach and Williams (2003) and Holston, Laubach and Williams (2017) methodology. However, Buncic (2020) shows that there are several issues with the methodology which make estimates unreliable, particularly those associated with the "other factor" denoted as z_t. For these reasons, we opt for an observable interest rate measure. The reported measure for long-term interest rate refers to the yields on 10 year government bonds. Some countries have limited observations for long-term rates in the OECD database (e.g., Japan), in this case we splice OECD data with long-term government bond yield data from the IMF IFS statistics. For points where our samples overlap, the measures are nearly identical suggesting this splicing is appropriate. Price level data was obtained from the Federal Reserve Bank of St. Louis database (FRED). Our price level measure is the annual consumer price index of all items for each country.

Our measures of top income shares were obtained from the World Inequality Database

(WID). Specifically, our top income share measure is the top 1 percentile (p99p100) of the pre-tax national income for all adults over the age of 20 and split equally among adults (sptinc992j).[3]

Demographic data was obtained from the World Development Indicators. Our demographic variables are the old-age dependency ratio, population growth, and life expectancy. The old-age dependency ratio captures the fraction of population aged 64 and older, relative to the working age population. Our measure of population growth is the growth of the working age population ages 15-64. We opted for this definition of population growth because it directly captures the channel that changes in labour growth could alter the capital-labour ratio. Our measure of life expectancy is the expected life span of a child at birth.

Our baseline measure of interest rates focuses on the long-term nominal interest rate. We focus on this rate for a few reasons. First, the theory relevant interest rate is the steady state equilibrium interest rate. Short term interest rates, however, are subject to a variety of other factors such as the state of the business cycle, meaning they do not necessarily correspond to the rates emphasized by the theory. Long-term interest rates should be much less affected by short-run factors and correspond closer to the interest rate emphasized by the theory. Second, while theory emphasizes the real interest rate, our baseline is nominal due to the challenges of computing accurate country-specific inflation expectations with annual data given our sample period. In Section 4.1, however, we do construct a measure of long-term real interest rates and find similar conclusions.

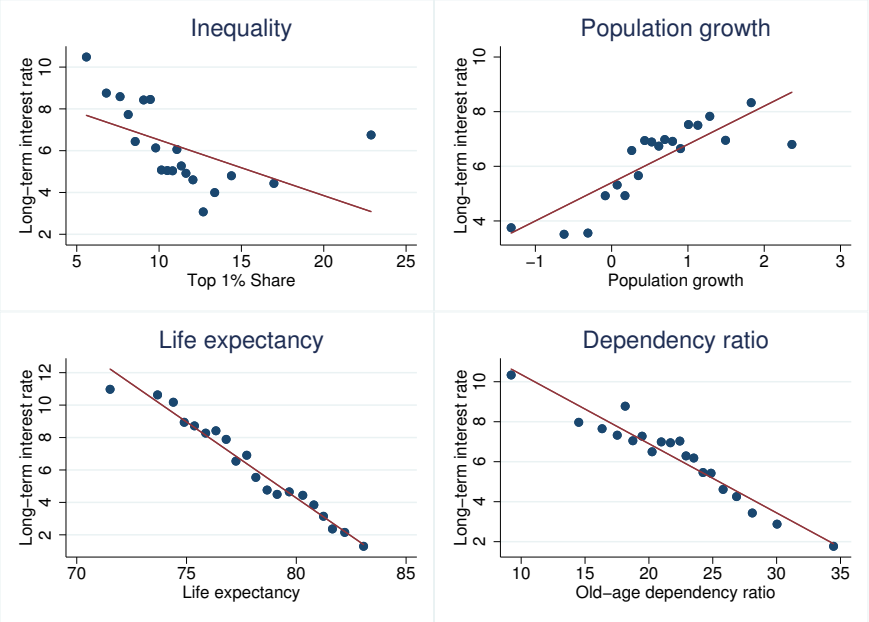
3 Results

To gain some insight into the relationship between interest rates and our independent variables, Figure 1 plots binscatters of our dependent variable and associated independent variables. A binscatter generates equal sized bins by number of observations along the x-axis and takes the mean of data points within each bin, summarizing all data within a bin into a single data point. In each diagram the red line is the unconditional least squares relationship. The

[3]We also explored inequality measured by pre- and post-tax Gini coefficients from Madsen, Islam and Doucouliagos (2018). We thank Jacob Madsen for providing us with the data.

figures show that our independent variables are highly correlated with long-term interest rates. Top income shares, life expectancy, and old-age dependency ratio are negatively correlated with long-term rates, while population growth is positively correlated. However, these plots are unconditional and do not control for any country-specific or time-specific factors.

Figure 1: Binscatter plots of long-term nominal interest rates, top 1% income shares, population growth, life expectancy, and the old-age dependency ratio



To address country-specific and time-specific factors, we estimate the relationship between long-term interest rates, inequality, and demographic factors using a variety of regression specifications. These different specifications include country-specific intercepts and linear time trends. Our baseline regression is given by

$$R_{i,t} = \beta_0 + \beta_1 \text{Top inc. share}_{i,t} + \beta_2 \text{Pop. growth}_{i,t} + \beta_3 \text{Life exp.}_{i,t} + \beta_4 \text{Depend.}_{i,t} + \epsilon_{i,t}, \quad (1)$$

where $R_{i,t}$ is the long-term nominal interest rate in country i at year t, $\text{Top inc. share}_{i,t}$ is the top 1% income share, $\text{Pop. growth}_{i,t}$ is the growth rate of the working-age population, $\text{Life exp.}_{i,t}$ is life expectancy at birth, and $\text{Depend.}_{i,t}$ is the old-age dependency ratio.

The theoretical predictions for the slope coefficients which were discussed in the introduction are as follows: $\beta_1 < 0$ (Top 1% share), $\beta_2 > 0$ (Population growth), $\beta_3 < 0$ (Life expectancy), and $\beta_4 > 0$ (Dependency ratio). Additionally, while the introduction discussed the potential ambiguity of the effects of population growth, here the predicted sign is positive since we are controlling for changes in the old-age dependency ratio.

Table 1 reports our results with varying controls in columns (1)-(3). Column (1) contains pooled estimates. In column (2) we add country-specific intercepts, α_i. In column (3), we include country-specific intercepts and a linear time trend, δ_t, to capture other factors which may be leading to declines in long-term rates across OECD countries, such as declining inflation expectations or risk premia.

Table 1: Panel regressions

	Long-term nominal interest rate		
Independent var.	(1)	(2)	(3)
Top 1% share	−0.277***	−0.400***	−0.313***
	(0.020)	(0.040)	(0.040)
Population growth	1.314***	−0.259*	−0.034
	(0.159)	(0.145)	(0.143)
Life expectancy	−0.829***	−1.117***	−0.411***
	(0.037)	(0.044)	(0.141)
Dependency ratio	−0.047**	−0.062**	0.025
	(0.021)	(0.029)	(0.026)
R^2	0.5812	0.8027	0.8184
Observations	1,142	1,142	1,142
Country FE		✓	✓
Time Trend			✓

Notes: Robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels.

According to estimates in column (1), coefficients mostly take expected signs in accordance with the explanations discussed in the introduction. A one percentage point increase

in the top 1% income share is associated with a decline in long-term nominal interest rates of 0.28%. A fall in population growth of one percent is associated with a decline in long-term rates of 1.31%. An increase of one year in life expectancy is associated with a 0.83% decline in long-term nominal rates. The coefficient for old-age dependency ratio takes a sign opposite to the theory and implies that a one percent increase in the dependency ratio is associated with nearly a 0.05% decline in long-term rates.

With additional country and time controls, our results for top income share and life expectancy align with those reported in column (1), with varying magnitudes. But for population growth and dependency ratio, regressions including country-specific fixed effects and a linear time trend yield estimates with opposite signs to the theory and/or which are not statistically different from zero. We treat estimates in column (3) as our baseline.

In Table 2 we use our regression estimates to provide some quantitative context for the decline in long-term rates. The first two rows report the cross-sectional average of our dependent and independent variables in the 1980-1984 and 2015-2019 periods.[4] In the third row we report the cross-sectional average *changes*. These show that long-term nominal rates and population growth have declined, while the top 1% income share, life expectancy, and the dependency ratio have all risen.

Row four uses the slope parameter estimates in Table 1 column (3) to quantify the relationship between rates and our explanatory variable. In this case only two of the slope coefficients are statistically different from zero. Accordingly, the biggest factor related to the decline in long-term interest rates is the rise in life expectancy, which can account for 3.15% of the total decline. The rise in the top income share can account for 1.04% of the decline. Together these two factors explain about 40% of the overall decline in long-term interest rates (4.19% of the total 10.98%).

The remaining decline of about 6.8% is captured by our linear time trend which is statistically significant with a coefficient of -0.201. From 1984-2015, the linear trend accounts for 6.2% of the decline and likely captures other factors aside from demographic and inequality variables. We do not speculate what these other factors are, but they are likely to include

[4]We use four year averages in an attempt to reduce any impacts associated with year-specific outliers.

some of the alternative explanations discussed in the Introduction.

Table 2: Decomposing the change in OECD long-term nominal interest rates

	OECD countries				
		Inequality		**Demographics**	
Average	Long-term nominal interest rate	Top 1% income share	Population growth	Life expectancy	Dependency ratio
$\overline{1980-1984}$	12.78	9.20	1.19	72.99	17.49
$\overline{2015-2019}$	1.80	12.52	0.22	80.66	26.66
Change	−10.98	3.32	−0.97	7.67	9.17
			According to (3)		
Contribution	−10.98%	−1.04%	—	−3.15%	—

Notes: To compute the contribution to the change in nominal interest rates, we use estimates in column (3) from Table 1. We do not report contributions for population growth and the dependency ratio because the slope coefficients are not statistically significant.

Auclert and Rognlie (2017) consider the consequences of a rise in the top 1% income share in the US from 1980-2017 in a Hugget-Aiyagari framework.[5] They find that the rise in the top 1% income share can plausibly account for between a 0.45% to 0.85% decline in equilibrium real interest rates. Mian, Straub and Sufi (2021a) consider a similar increase in the top 1% income share from 6% to 10%, but find a much larger decline in the equilibrium interest rate, which declines from 8% to about 2.5%. As discussed in the introduction, this is in line with their indebted demand framework which amplifies changes in income inequality.

Rachel and Smith (2017) consider which factors that have led to a decline in global neutral real rates. They find that their measure of a global long-term real interest rate has declined by about 4.5% since the 1980s. Using an accounting framework, they find that higher inequality within countries can plausibly account for about a decline of 0.45%, while a slowdown in global labour supply growth due to demographic forces could account for a decline of about

[5]It is worth noting that Auclert and Rognlie (2017) use a measure of top income share that captures only labour income. The US experiences a rise in this share of 6.4% in 1980 to 11.1% in 2017. The measure in this paper captures both labour and capital income.

1%.

Carvalho, Ferrero and Nechio (2016) study the role of demographics in OECD countries in an overlapping generations model. Their model accounts for a 1.5% decline in equilibrium real rates between 1990 and 2014. In counterfactual simulations they find that almost all of this decline is driven by increases in life expectancy (around 1.2%), while the slowdown in population growth accounts for much less (about 0.3%). Gagnon, Johannsen and López-Salido (2021) also use a calibrated OLG model and find that demographic factors can account for a 1% decline in the equilibrium real rate since 1980, and attribute this decline primarily to changes in population growth. They show that the difference between their results and Carvalho, Ferrero and Nechio (2016) is driven by the assumption that death and retirement probabilities are independent of age.

4 Some additional considerations

4.1 Long-term real interest rates

Our baseline dependent variable is the long-term nominal interest rate. In this section we construct a measure of long-term real interest rates and reexamine these relationships. Constructing a long-term expectation of inflation from annual data for each country is not straightforward. Our measure of expected inflation is simply the one-year ahead actual inflation. This measure would be identical to an ex-post real interest rate if the duration of the asset was one year. Specifically it is given by

$$r_{i,t}^{LR} = R_{i,t}^{LR} - \pi_{t+1}, \tag{2}$$

where π_{t+1} captures the difference between the consumer price index of all items between periods t and $t+1$.

Table 3 reports the relationship between inequality, demographic variables, and long-term real interest rates. Our findings for income inequality hold up well, with a slightly smaller coefficient. However in this case, life expectancy is not statistically different from zero but the dependency ratio is now negative and significant.

Table 3: Panel regressions

	Long-term real interest rate		
Independent var.	(1)	(2)	(3)
Top 1% share	−0.153***	−0.247***	−0.204***
	(0.021)	(0.052)	(0.054)
Population growth	0.141	−1.068***	−0.957***
	(0.161)	(0.212)	(0.210)
Life expectancy	−0.302***	−0.456***	−0.107
	(0.042)	(0.052)	(0.142)
Dependency ratio	−0.108***	−0.161***	−0.117***
	(0.022)	(0.030)	(0.031)
R^2	0.2313	0.4436	0.4508
Observations	1,142	1,142	1,142
Country FE		✓	✓
Time trend			✓

Notes: Robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels.

In OECD countries, the cross-sectional average long-term real interest rate declines from 4.72% in 1980-1984 to 0.34% in 2015-2019. Based on column (3), our estimates would imply that rising inequality can account for about a 0.65% decline in the long-term real rate, while a rising dependency ratio can account for about 1.1% of the decline.

4.2 Post-1990

One challenge associated with interpreting the magnitudes of our coefficients in the baseline is that the decade of the 1980's saw dramatic declines in expected inflation across OECD countries. In Table 4 we rerun our regressions including only post-1990 data where inflation across OECD countries is lower and more stable.

Our estimates from Table 1 hold up generally well. In the specification with country-specific intercepts and a linear time trend, both income inequality and life expectancy are

negative and significant at the 1% level. In this case, population growth is negative and significant. However, this suggests that declining population growth is putting *upward* pressure on long-term nominal interest rates, and thus cannot be an explanation for the decline (see the theory prediction in Table **??**).

Table 4: Panel regressions: Post-1990

	Long-term nominal interest rate		
Independent var.	(1)	(2)	(3)
Top 1% share	−0.163***	−0.256***	−0.213***
	(0.019)	(0.044)	(0.045)
Population growth	0.690***	−0.408***	−0.281*
	(0.144)	(0.152)	(0.152)
Life expectancy	−0.589***	−1.010***	−0.312***
	(0.037)	(0.043)	(0.119)
Dependency ratio	−0.110***	−0.117***	−0.035
	(0.020)	(0.031)	(0.028)
R^2	0.4406	0.7417	0.7574
Observations	922	922	922
Country FE		✓	✓
Time trend			✓

Notes: Robust standard errors are reported in parentheses. ***, **, and * indicate statistical significance at 1%, 5%, and 10% levels.

5 Conclusion

Two prominent explanations for declining interest rates are rising income inequality and demographic factors associated with the post WW-II baby boom. In this paper we examined international evidence for these explanations. We find that both inequality and demographic factors are linked with declining long-term interest rates. Our estimates suggest that rising inequality can plausibly account for a decline of 1.04% in the long-term nominal interest rates, while rising life expectancy can account for a decline of 3.15%.

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