Wealth distribution and interest rates: empirical evidence for the US

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Abstract Capital market theory predicts that the wealth distribution should affect interest rates. This paper empirically analyzes the relationship between the wealth distribution and interest rates in the US. We use data on wealth inequality from various sources. Measures of wealth inequality are linked positively to the real commercial paper rate and to the real rate on government securities. This result is consistent with predictions from capital market equilibrium models with moral hazard. Accordingly, rich individuals can only commit credibly to providing effort if the rate of return is not too high. When the rich are poorer, the rate of return has to be lower in order to guarantee entrepreneurial effort. Capital demand will therefore fall as inequality is reduced. The capital market is in equilibrium at a lower rate of return.

Keywords: Wealth distribution, interest rates.

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1 Introduction

There is a considerable amount of theoretical research that analyzes the macroeconomic role of the wealth distribution. This research focuses on the role of capital market imperfections. With imperfect capital markets wealth is an important instrument that helps individuals to gain access to credit. Risky investment projects can be started more easily by individuals who can contribute their own funds. The wealth distribution should therefore affect aggregate credit supply and demand. It should play a major role in shaping macroeconomic outcomes. In particular, theory predicts links between wealth inequality, interest rates and economic growth.

This paper empirically analyzes the relationship between the wealth distribution and interest rates. We use two data sets on the distribution of wealth in the United States. We also use a time series on income inequality as a proxy for wealth inequality.

Our results are roughly consistent with predictions from capital market models with moral hazard. According to these theories rich entrepreneurs can only credibly commit to providing effort if the riskless rate of return on the market is not too high. Less wealth inequality is associated with lower wealth of the rich. Capital demand is reduced and the riskless rate of return has to be lower in order to equate capital supply and demand. The reason for this is that rich individuals can only commit credibly to providing effort if the rate of return is not too high. When the rich are poorer, the rate of return has to be lower in order to guarantee entrepreneurial effort. Capital demand will therefore fall as inequality is reduced. A lower rate of return obtains in equilibrium.

This paper is related to a recent theoretical literature that studies general equilibrium effects of the wealth distribution when credit markets are imperfect. The papers by Aghion and Bolton (1997) and Piketty (1997) study the capital market equilibrium when individuals decide whether to start a risky entrepreneurial project or become

an investor. In Aghion and Bolton's model only sufficiently rich individuals become entrepreneurs because there is entrepreneurial moral hazard. The theoretical predictions about the relationship between inequality and interest rates that can be derived from such models are ambiguous. In a simple moral hazard setting one can show that the interest rate is lowered when there is less inequality (c.f. Grüner and Schils, 1996). The opposite relation between inequality and interest rates can be derived from a very similar model where individuals differ in their abilities. Consider e.g. a setting with observable abilities. In such a setting wealth and ability both facilitate access to credit. More inequality may lead to a situation where the average ability of entrepreneurs is lower. Less inequality instead may lead to the selection of more able entrepreneurs and to higher returns for investors. Similar results obtain in more complex setting where both ability and effort are unobservable (Grüner, 2000).

Hence, while theory predicts an effect of the wealth distribution on interest rates, the sign of the effect is ambiguous. Most of the evidence in this paper is in favor of theories that link inequality with higher rates of return. However, some of our results indicate that at least locally equality may lead to lower rates.

The paper is related to a recent empirical literature that links measures of inequality with macroeconomic variables. Most of this literature focuses on the role of inequality in the process of economic growth (e.g. Persson and Tabellini ,1994. See also Perotti ,1996, for a survey of evidence). Part of this literature such as Besley and Burgess (2000) and Deininger and Olinto (2000) studies the role of the distribution of land or of assets. Besley and Burgess (2000) study the role of land reform for economic growth. They find that land redistribution reduces poverty and increases wages of the landless. Deininger and Olinto (2000) find a negative relationship between an unequal asset distribution and growth. The present analysis instead attempts to study how capital markets are affected by the distribution of wealth.

2 A theoretical argument

In this section we briefly explain the interest rate effects of redistribution that can be derived from capital market equilibrium models with moral hazard. in a simplified version of Aghion and Bolton (1997)[1].

2.1 Inequality increases the rate of return

Consider an economy populated with a continuum of potential entrepreneurs of mass 1. An agent's wealth endowment is w. The cumulative distribution of wealth is denoted $\Phi(w)$, average wealth is $\bar{w}$. Each agent may start an investment project which a fixed capital outlay $I > w$. An agent who does not start a project lends money to other agents. An entrepreneur with wealth $w < I$ needs credit $I - w$. A project yields a positive return Y with probability p (q) if the agent does (does not) provide effort. Effort costs B monetary units and is unobservable. All agents are risk neutral.

Consider a credit contract that yields a risk free return of R per unit lended. Under such a contract an entrepreneur must pay $R/p(I-w)$ if he succeeds. This contract induces effort if shirking does not pay. An agent provides effort if

$$p\left(Y - \frac{R}{p}(I-w)\right) - B \geq q\left(Y - \frac{R}{p}(I-w)\right). \tag{1}$$

Solving this condition for the agent's wealth yields:

$$w \geq \omega(R) := \frac{p}{R}\left(Y - \frac{B}{p-q}\right). \tag{2}$$

Accordingly, entrepreneurs can commit to providing effort if they are sufficiently wealthy. If the rate of return R satisfies

[1]See Gruener and Schils, (1996), for a detailed formal analysis of the interest rate effect in such a model.

$$\Phi\left(\omega\left(R\right)\right) = 1 - \frac{\bar{w}}{I}, \tag{3}$$

then the wealth constraint holds exactly for a fraction $\frac{\bar{w}}{I}$ of individuals and the capital market clears. Suppose now that only agents with wealth above average are entrepreneurs. Then a more equal society is associated with poorer entrepreneurs. In equilibrium, condition (2) must hold at a lower wealth level and therefore also at a lower rate of return. Entrepreneurs can only commit to providing effort if R is sufficiently low. This explains why equality may be linked negatively to the rate of return R.

2.2 A negative link

The opposite effect of inequality on interests rates can be derived from a setting where agents differ in their ability. Consider the case where ability, measured by the probability of success p is observable and differs among agents. In this case wealth can be used as a substitute for ability. This follows if one solves the incentive constraint (1) for the interest rate R:

$$R \leq \rho(w, p) = \frac{p}{I - w}\left(Y - \frac{B}{p - q}\right). \tag{4}$$

According to this inequality an agent can commit to providing effort if the rate of return is not too large. Since $dr/dp > 0$ and $dr/dw > 0$, a more able entrepreneur needs less wealth in order to obtain credit. An unequal wealth distribution may then be associated with low-ability rich agents who crowd out poor agents with higher ability on the capital market. The ensuing rate of return for investors may be lower than under a more equal wealth distribution where better entrepreneurs get credit for their projects.

To see why consider the example of an economy with two wealth classes $w_1 = \bar{w}+a$ and $w_2 = \bar{w} - a$. Half of the population are in the upper class and a measures inequality. There are two ability levels p_h and $p_l < p_h$. Each class has the same fraction of high- and low-ability individuals. Consider the case where there is enough capital to endow 40 percent of the population with an entrepreneurial project, i.e. $\bar{w} = 0.4 \cdot I$. With a sufficient amount of inequality we have that low ability rich individuals can commit to providing effort at a rate which is slightly higher than the one for high-ability poor agents, i.e

$$\rho(w + a, p_l) = \rho(w - a, p_h) + \varepsilon. \tag{5}$$

In such a situation the equilibrium rate if return is $R = \rho(w+a, p_l)$. Only rich agents become entrepreneurs. Now consider a reduction in inequality to $a\prime < a$ such that

$$\rho(w + a', p_l) < \rho(w - a', p_h). \tag{6}$$

The increase of the wealth of poor agents has enabled the high-ability poor to get credit at interest rates where the low ability rich would not get credit. In this situation the wealth constraint is binding for poor high ability agents and the equilibrium rate if return is $R = \rho(w - a', p_h)$. For ε small enough the equilibrium rate of return is higher than $\rho(w + a, p_l)$ since $\rho'_w > 0$.[2].

[2]See Gruener (2000) for a model with unobserved entrepreneurial abilities. In this model redistribution of wealth may lead to the selection of better entrepreneurs and to a higher rate of return.

3 Data

3.1 Measures of wealth inequality

We used various sources for our measures of wealth inequality. Our first source is data on the estimated share of total wealth held by the top 1 percent of households, published by the Joint Economic Committee. The variable is labeled wealthtop1. Table 1. The data ranges from 1911-1983 with a total of 16 observations.

Our second source for wealth inequality data is Lindert (2000). He provides measures for the percentage share of net worth or assets held by the top 1 percent of households. We call the variables nettop1 and tottop1. nettop1 describes the percentage share of net worth held by the top 1 percent of households. tottop1 refers to total assets held. The variable nettop ranges from 1890-1989 with a total of 18 observations, the variable tottop from 1860-1983 with a total of 14 observations.

In a third set of regressions we used data on income inequality as a proxy for wealth inequality. The data is taken from the World Bank. We use the Gini-coefficient (giniinc) and the income share of the different quintiles (incq1-4) as measures of inequality. The data is annual and ranges from 1947 to 1991.

3.2 Data on interest rates

The dependent variable "interest" is derived from data on the 3 to 6 month US commercial paper rate. This data is available from 1831-1997. The source for data from 1831-1899 is Macaulay (1938). The 20th century data is from various publications of the Federal Reserve Board.

We used data on inflation rates available from 1666-2000 to derive our measure for a real interest rate (interest). The numbers since 1913 use the CPI from the United States' Bureau of Labor Statistics. This data is taken from www.eh.net. The Data

before 1913 is also available from this source.

The second measure of rates of return that we used is "govsec". This is the real interest rate of US-government securities (treasury bills). It is based on one year auctions highs, annualized using a 360 day year. The time series ranges from 1959-2000. The data is available at www.publicdebt.treas.gov/of/ofrespr.htm.

3.3 Other explanatory variables

We included a number of other explanatory variables in our regressions. First, some governments may be more prone to spending and debt financing than others. Their behavior is likely to affect the rate of return. It may therefore be useful to introduce measures of government spending and government indebtedness into the regression.

Our measure for government expenditure per GDP (exptgdp) is derived from data by the Bureau of Economic Analysis (BEA). The outstanding debt per GDP ratio is derived from data by the Bureau of the Public Debt and GDP data by BEA.

Additionally we introduced a dummy in some regressions that accounted for periods in which the US was involved in a military conflict. This variable (wardum) takes the value 1 in the following periods: 1861-1865 (civil war), 1917-18, 1941-45, 1950-53 (Korea war), 1965-73 (Vietnam war), 1991 (desert storm).

4 Results

In a first attempt to analyze the link between measures of inequality and interest rates we postulated the following relationship:

$$y = (x, y')\,\beta + u. \tag{7}$$

The variable x is a measure for wealth inequality and y' refers to the vector of

other explanatory variables. Finally, u is an error term. The vector of coefficients β was estimated with OLS.

Table 1 reports regression results using the data from the Joint Economic Committee. Table 2 contains regression results based on measures of inequality that were taken from Lindert (2000). Inequality measures tend to be related positively both with the commercial paper rate and with the rate of return for government securities. Whenever significant at the 10, 5 or 1 percent level, the coefficient of the variable that measures inequality is positive.

Tables 3 and 4 report results based on the income inequality data from the World Bank. Results from these regressions are mixed. The Gini-coefficient of the income distribution enters positively in the regressions. This holds both for the regressions that use commercial paper rates and for those that use government securities. In another set of regressions we used the income shares of the various quintiles as measures of inequality. In some regressions we only used the share of the top quintile, in others we used the shares of quintiles 1-4. In these regressions the share of the top quintile enters with a negative sign and highly significant.

Rather large gaps lie between the different observations in the data by Lindert (2000) and by JEC. The World Bank instead provides annual data. Hence, it is likely that there is a strong autocorrelation in most explanatory variables and in the real interest rates. This is why we also estimated regressions with this data using first differences. Table 5 reports results from these regressions. The dependent variable used in the regressions is the first difference of the commercial paper rate. The first difference of the Gini-coefficient turns out to enter positively again. It is significant at the one percent level. In regression 2 we introduced an error correction term, "diff", that measures the residual in the corresponding levels regression. This term enters positively and highly significant. A similar regression (regressions 3 and 4) with income quintiles yields results that are consistent with the ones in the levels

regression. The change in the income of the top quintile enters negatively in both regressions and significantly in regression 3.

The results concerning the other explanatory variables are mixed. One would expect that the two measures expenditure per GDP (expgdp) and debt per GDP (debtgdp) should enter with a positive sign. However, this only holds for the expenditure variable in the estimates based on Lindert's data in table 2. A reason for the negative signs reported in table 4 might be that debt and expenditure may be procyclical while interest rates are anticyclic.

Similarly the war-dummy could be expected to enter with a negative sign when a war raises the governments credit demand. At the same time however private investment may be more reluctant and monetary policy eased which may explain the negative sign in the regressions from Table 2. Note however that the war dummy enters significantly and with a positive sign in two regressions in table 3.

Table 1

Dependent variable: interest

	regression 1	regression 2	regression 3
wealthtop1	−0.106	−0.08	0.329*
	(−0.482)	(−0.391)	(1, 923)
exptgdp			1.688
			(0.128)
debtgdp			−3.118
			(−1.274)
wardum		−2.947	−0.769
		(−1.624)	(−.726)
constant	3.947	4.47	−3.808
	(.741)	(.885)	(−0.549)
R^2	0.16	0.183	0.511

t-values in brackets.

*, **, *** = significant at 10, 5, and 1 percent level.

Table 2

Dependent variable: interest

dependent variable	interest	interest	interest	interest	interest
nettop1	0.248**		0.02	0.255**	
	(2.174)		(.07)	(2.518)	
tottop		0.508***	0.426		0.432**
		(3.182)	(1.092)		(2.723)
expgdp					
debtgdp					
wardum				−2.972**	−2.563
				(−2.284)	(−1.553)
constant	−4.189	−8.114*	−7.359	−3.601	−5.404
	(−1.173)	(−2.102)	(−1.624)	(−1.13)	(−1.335)
R^2	0.228	0.458	0.423	0.427	0.555

*, **, *** = significant at 10, 5, and 1 percent level.

Table 2 contd.

dependent variable	interest	interest	govsec	govsec
nettop1	0.293**		0.589**	
	(2.906)		(2.937)	
tottop		0.336**		0.327**
		(3.404)		(19.760)
expgdp	9.166	4.388	11.28	24.055
	(1.114)	(0.702)	(0.518)	(4.554)
debtgdp	−2.264	−2.137	−22.592	5.248
	(−1.194)	(−1.468)	(−1.408)	(1.682)
wardum	−1.785*	−1.013	−2.653	−0.099
	(−1.847)	(−1.304)	(−1.404)	(−0.397)
constant	−6.973	−4.718	−8.25	−13.902
	(−1.370)	(−1.322)	(−.955)	(−5.305)
R^2	0.624	0.815	0.795	0.99

Table 3

Dependent variable: interest

regression	1	2	3	4	5
giniinc	1.135***		2.767***		
	(2.959)		(6.821)		
					−894.855***
					(−3.317)
					265.462
incq1-4		−104.275		−904.29***	(1.221)
		(−.748)		(−7.822)	−351.696**
					(−2.454)
					156.118
					(1.211)
exptgdp			−90.942***	−37.164***	−47.179*
			(−5.077)	(−3.173)	(−1.887)
debtgdp			−25.345***	−28.577***	−24.447***
			(−6.986)	(−8.039)	(−6.06)
wardum	0.748	0.147	0.889	1.68 ∗ ∗	1.551*
	(0.709)	(0.127)	(1.255)	(2.461)	(1.874)
constant	−39.033***	6.397	−57.762***	71.172***	56.847
	(−2.862)	(0.978)	(−5.696)	(7.551)	(1.493)
R^2	.173	0.15	0.647		0.755

*, **, *** = significant at 10, 5, and 1 percent level.

Figure 1: Interest-rates and Gini-coefficient of the income distribution

Figure 2: Interest rates and the Gini-coefficient of the income distribution: 1947-1991

Table 4

Dependent variable: govsec

regression	1	2
giniinc	1.433**	
	(2.420)	
incq1-4		−1096.164**
		(− − 2.429)
		893.488
		(1.497)
		−627.840
		(−1.508)
		130.427
		(0.887)
exptgdp	−39.97*	−21.435
	(−1.786)	(−0.742)
debtgdp	−8.036	−17.077*
	(−0.94)	(−1.818)
wardum	0.777	1.081
	(1.033)	(1.067)
constant	−33.914**	59.719
	(−2.684)	(1.118)
R^2	0.307	0.446

Table 5: Regressions with first differences

independent variable interest, first difference

regression	1	2	3	4
giniinc, first diff	2.21^{***}	2.43^{***}		
	(2.864)	(3.684)		
incq1-4, first diff				-392.95
				(-1.364)
				-334.325
			-549.915^{***}	(-1.254)
			(-3.734)	-168.721
				(-1.07)
				169.019
				(1.585)
exptgdp, first diff	-73.925^{*}	-82.658^{**}	-43.072	-38.691
	(-1.938)	(-2.538)	(-1.225)	(-1.408)
debtgdp, first diff	-13.987	-25.107^{**}	-6.863	-32.009^{***}
	(-1.293)	(-2.608)	(-0.698)	(-3.335)
wardum	0.294	0.331	-0.09	
	(0.357)	(0.472)	(-0.116)	
diff		0.673^{***}		0.943^{***}
		(3.917)		(5.555)
constant		0.178	0.37	-0.03
		(0.456)	(0.873)	(-0.103)
R^2	0.227	0.454	0.311	0.667

*, **, *** = significant at 10, 5, and 1 percent level.

5 Discussion

The regression results show that there may be a positive relationship between inequality and real rates of return in the US. This indicates that moral hazard models of capital markets may have some explanatory power. According to these models, rich entrepreneurs can only credibly commit to providing effort if the risk-free interest rate is not too high. A high interest rate is associated with huge repayments to creditors and therefore with little incentives for entrepreneurs. If the interest rate is too high, credit demand falls and the risk free rate has to adjust.

The present empirical analysis gives some support to politico-economic theories that explain limits to redistribution via an interest-rate effect on the credit market (Grüner and Schils, 1996). This interest rate effect of equality may explain why some middle class individuals oppose political redistribution of wealth despite the fact that they may gain wealth. Middle class individuals have incentives to oppose redistribution when the interest rate effect of redistribution dominates the wealth effect[3].

Some of our regression results link the share of the top quintile negatively with the rate of return. This is the case for the regressions that use the World Bank's income inequality data. One possible explanation for this is that the rate of return is higher when better entrepreneurs get credit. A lower share of the top quintile may be associated with more and better qualified entrepreneurs in lower quintiles.

Alternative explanations for the link between inequality and rates of return can be given. One may for example argue that some fixed costs are involved with exporting capital. Only rich individuals can afford to pay this cost. More inequality may be associated with more capital being exported and therefore with a higher rate of return.

[3]See Benabou (2000), Corneo and Gruener, (2000 a,b), Romer (2000) and Piketty (1995), for other recent theoretical explanations for limits to redistribution in presence of inequalities.

The analysis of individual or household data might help to shed light on this issue.

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