Taking Credit
Online Supplementary Materials

1 A Formal Model of Consumption, Inequality, and Taxation

In this section we develop a political-economic model of inequality, redistribution, and consumption/savings. Our model emphasizes one demand-side mechanism–positional externalities in consumption– albeit to the neglect of an explicit model of the financial system or other plausible mechanisms, such as industry lobbying and regulatory capture. We do not intend our model to be read as implying that the policy supply side is irrelevant. Rather, our intention is to identify a set of assumptions sufficient to generate consumer behavior that would lead to a trade-off between redistribution and credit-fueled consumption. Moreover, we want to attract the attention of political economists to questions of positional externalities (Frank, 2005; Frank and Cook, 1996), a concept we believe has been neglected, despite its clear relationship to redistribution and consumer behavior.

Our model takes the Frank, Levine and Dijk (2005) (FLD) model of positional consumption and then layers on a model of the tax-and-transfer system. We derive optimal private consumption choices of citizens, given fixed tax policies and the income of the rich. We then turn to tax policy and define optimal tax preferences of each group of citizens, noting that left-wing parties are generally representative of poorer citizens.

We begin by considering private consumption choices in the presence of both positional consumption effects (as in FLD) and redistributive taxation. We consider a continuum of agents of mass one. Each agent lives for two periods and, as in FLD, agents have Cobb-Douglas utility functions composed of current and future consumption where future consumption depends on how much of current income is saved (α represents the relative future preference of citizens).

We follow Iversen and Soskice (2006) and Persson and Tabellini (1999), and examine an economy with three equally-sized groups $j \in \{H, M, L\}$, each with group-specific exogenous period-1 incomes, y_j, where $y_H > y_M > y_L$. Agents within each group are identical and decide what proportion of their incomes, net of taxes, to consume today, denoted c_j. We assume a linear flat income tax rate, t, used to fund a lump sum transfer, g, received by all citizens. The government budget constraint implies that $g = t\bar{y}$, where $\bar{y} = \int_0^1 y_i di$, or average income. To simplify presentation let $\nu = (1 - t)$. Utility to members of group j is given by

$$u_j = \left[(1-t)c_j y_j + g - \pi(1-t)(\hat{c}_H y_H - c_j y_j)\right]^{(1-\alpha)} \left[(1-t)(1-c_j)y_j + f_j\right]^{\alpha}$$
$$= \left[\nu c_j y_j + (1-\nu)\bar{y} - \pi\nu(\hat{c}_H y_H - c_j y_j)\right]^{(1-\alpha)} \left[\nu(1-c_j)y_j + f_j\right]^{\alpha} \quad (1)$$

To capture positional consumption we allow agents to care about consumption relative to their peers. There are several plausible ways to model the peer or reference group.[1] Here we assume that agents compare their consumption to the expected consumption of the rich $\hat{c}_H y_H$, in line with the findings in Bertrand and Morse (2013).[2] This comparison could be purely 'aspirational', capturing 'keeping up with the Jones' motivations, or it could reflect the increased cost - relative to a group's fixed income - of positional goods such as housing and education as the incomes of the richest group rise. We use the parameter π to capture the importance of positional consumption. In order to make borrowing possible ($c_j > 1$) we assume that individuals have group-specific expected future earnings, f_j, unrelated to net savings $\nu(1-c_j)y_j$.

Equation 1 reflects three important simplifying assumptions. First, we assume that government transfers must be consumed entirely in the current period, perhaps because it is given in kind. Second we assume that positional concerns are only relevant in the current period.[3] This could be motivated by the observation that relative consumption in positional goods like housing and education matter early on but become increasingly irrelevant later in life.[4] Third, we assume that future income is unrelated to current savings and is untaxed.

Holding tax rates fixed and maximizing this equation with respect to c_j for $j \in \{L, M\}$ yields the following first order condition:[5]

$$(1-\alpha)\nu(1+\pi)y_J(\nu(1-c_J)y_J + f_J) = \alpha\nu y_J\Big(\nu y_J(1+\pi)c_J - \pi\nu(\hat{c}_H y_H) + (1-\nu)\bar{y}\Big) \quad (2)$$

From this equation we can solve for the optimal level of consumption for group members c_j^*, noting that $\bar{y} \propto y_H + y_M + y_L$, and replacing ν with $(1-t)$:

$$c_J^* = (1-\alpha)\left(1 + \frac{f_J}{(1-t)y_J}\right) + \alpha\left[\pi(1-t)\hat{c}_H y_H - \left(\frac{t}{1-t}\right)\left(\frac{y_H + y_M + y_L}{y_J}\right)\right] \quad (3)$$

[1] Note that all agents within an income tier make the same consumption choice.

[2] Similar results follow if we instead set mean consumption as the reference point or if each group refers to the next-highest income group in setting consumption aspirations.

[3] Our interest focuses on borrowing and saving today. To analyze future choices explicitly, the model would need to be extended to include a stream of expected future consumption decisions for times $t = 2$ through $t = T$: that is, c_{j2} through c_{jT}. This adds considerable complexity to the model without providing new insights for our purposes.

[4] To our knowledge no one has studied possible life cycle effects in positional or aspirational consumption. We also ignore bequest motivations.

[5] Since the positional consumption component drops out for members of $j = H$, their consumption preferences are shaped solely by tax rates.

This expression is revealing. Firstly, in the absence of future earnings (i.e. $f_J = 0$), optimal consumption is clearly likely to vary from the case without either positional consumption motivations or taxation, where $c_J^* = (1 - \alpha)$. However, the direction of this variation is not obvious. In the FLD model the positional consumption effect (coming through $\pi(1-t)\hat{c}_H y_H$) always increases optimal individual consumption, producing systematically higher present consumption. However, introducing taxation produces countervailing effects. This occurs because redistribution provides a way to reduce the relative incomes of the rich and increase one's own relative income, thereby reducing post-tax inequality in consumption. Finally, with positive future earnings, citizens can sustain higher levels of consumption than their current income would otherwise be able to produce - that is we can have $c_J^* > 1$.[6] We can thus think of higher levels of preferred consumption as implying higher willingness to borrow in the population.

Of particular interest to us is how inequality affects consumption and hence borrowing decisions. We model this through changing in the income of the rich, holding constant the incomes of the other two groups. We now take the derivative of optimal consumption for group $J \in \{L, M\}$ with respect to y_H:

$$\frac{\partial c_J^*}{\partial y_H} = \alpha \left[\pi(1-t)\hat{c}_H - \frac{t}{1-t}\frac{1}{y_J} \right] \lesseqgtr 0 \tag{4}$$

Rising inequality - driven by the rich becoming wealthier - can increase or decrease optimal consumption. Whether it does so depends on whether the positional consumption effect outweighs the taxation effect. As the expected consumption rate of the rich $\hat{c}_H$ rises, it is more likely that rising inequality produces higher individual consumption (through the positional consumption effect).[7] On the other hand, rising incomes of the rich also increase the size of the redistributive transfer received by other groups (for a fixed rate of taxation). This in turn provides higher current income and thus reduces the incentive to consume private income rather than save.

We can examine these divergent effects directly by examining the cross-derivatives of y_H and (a) aspirational consumption π, and (b) taxation t.

$$\frac{\partial^2 c_J^*}{\partial y_H \partial \pi} = \alpha(1-t)\hat{c}_H > 0 \tag{5}$$

We find that the cross-derivative of y_H and positional consumption π is positive. This suggests that factors that raise either the motivation or capacity to engage in positional consumption will amplify the impact of growing inequality on consumption. What about the effect of taxation? Here we take the cross-derivative of the effect of y_H on consumption,

[6] This will be true provided that $\frac{(1-\alpha)}{\alpha}\frac{f_J}{(1-t)y_J} + \left[\pi(1-t)\hat{c}_H y_H - \left(\frac{t}{1-t}\right)\left(\frac{y_H+y_M+y_L}{y_J}\right)\right] > 1$: that is, if the present is valued highly relative to the future, if expected future earnings are high relative to net current earnings, or if aspirational consumption effects are substantially larger than tax effects.

[7] This is unaffected by future expected earnings since individuals only care about comparing their relative *current* consumption–future earnings simply provide a means to borrow and consume now.

with respect to taxation:

$$\frac{\partial^2 c_J^*}{\partial y_H \partial t} = -\alpha \left[\pi \hat{c}_H + \frac{1}{y_J} \frac{1}{(1-t)^2} \right] < 0 \tag{6}$$

Here we see a negative cross-derivative. The implication of this key result is that higher levels of taxation reduce the impact of growing income among the wealthy on the consumption of other groups. This occurs through two mechanisms: firstly, rising taxes lead to larger redistributive transfers that therefore increase income in the first period, reducing the incentive to consume private income in that period. Second, higher taxes also reduce the net income of the rich, and therefore the absolute level of net consumption by the rich. Accordingly, higher taxes compress the difference in consumption between the rich and the rest and thereby reduce the positional consumption effect. Starting from a position where positional consumption effects dominate and inequality increases consumption, a rise in taxation could reduce this effect to zero or indeed could, given high enough rates of taxation, reverse the effect entirely. Where redistribution is higher, we should be less likely to see demands for higher consumption and hence less demand for credit in response to growing inequality.

We conclude by examining citizens' preferences over taxation, fixing consumption at $c_J = \tilde{c}_J$.[8] We use as our baseline utility function, Equation 1, and take its derivative with respect to taxes $t = 1 - \nu$. As with Iversen & Soskice we presume that the richest group wants zero taxes, since their income is by definition above the mean and hence their benefit from a lump sum transfer is always lower than the absolute cost of taxation with a linear tax schedule. Accordingly, we restrict our analysis to the preferred tax rate for voters in each group $J \in \{L, M\}$.

$$t_J^* = 1 + (1-\alpha)\frac{f_J}{(1-\hat{c}_J)y_J} - \frac{\alpha \bar{y}}{\bar{y} + \pi c_H y_H - (1+\pi)\hat{c}_J y_J} \tag{7}$$

The derivative of this expression with respect to group income is:

$$\frac{\partial t_J^*}{\partial y_J} = -\left(\frac{(1-\alpha) f_J}{(1-\hat{c}_J) y_J^2} \right) - \alpha \left(\frac{\pi c_H y_H + (1+\pi)\hat{c}_J(\bar{y} - y_J)}{(\bar{y} + \pi c_H y_H - (1+\pi)\hat{c}_J y_J))^2} \right) \leq 0 \tag{8}$$

Mirroring standard results from the political economy of public finance we see that the preferred tax rate declines with income. In particular this implies that the middle income group want lower taxes than the poor group, since $y_M > y_L$ and $\partial t_J^* / \partial y_J < 0$, (with the rich group preferring zero taxes by assumption). This allows us to rank-order the tax preferences of each group: $t_L^* \geq t_M^* \geq t_H^*$, permitting us to argue that political parties representing poorer citizens will demand higher taxes in this model.

[8] In other words, we assume policies are fixed for the medium term when citizens make consumption choices but that consumption choices are fixed when it comes time to express policy preferences. It is not possible to solve this model simultaneously for consumption and tax preferences.

2 Empirical Appendices for reviewers

These printed results are presented for reviewer inspection. We will publicly post all data and replication code upon publication.

Correlation between different indicators of electoral institutions

Table 1: Correlation matrix for 18 OECD countries, 1980-2010. “Left gov’t” is an indicator for whether a country had a Left government in that year as defined in *Comparative Political Data Set I 1960-2010* (2012). “Avg. Left gov’t“ is the average government partisanship score from 1960 to t, taken from *Comparative Political Data Set I 1960-2010* (2012), with 1 as hegemonic right government and 5 as hegemonic left government.

	Left gov’t	Cumulative Left	Avg. Left gov’t	ENPP	Gahallager	majoritarian
Left gov’t	1.00	0.42	0.40	0.05	-0.06	-0.12
Cumulative Left	0.42	1.00	0.98	0.36	-0.25	-0.34
Avg. Left gov’t	0.40	0.98	1.00	0.39	-0.23	-0.32
ENPP	0.05	0.36	0.39	1.00	-0.55	-0.60
Gahallager	-0.06	-0.25	-0.23	-0.55	1.00	0.69
majoritarian	-0.12	-0.34	-0.32	-0.60	0.69	1.00

BUGS code for base model

```
model{
  for(i in 1:n.obs){  #likelihood
      d.credit[i] ~ dnorm(mu[i], tau.y[i])
      mu[i] <- a.unit[country[i]] + b.l.credit[country[i]]*lag.credit[i] + XB[i]
      XB[i] <- b.l.top1*lag.ineq[i] + b.d.top1*d.ineq[i]+
        b.cl*cum.left[i] + b.l.top1cl*lag.ineq[i]*cum.left[i] + b.d.top1cl*d.ineq[i]*cum.left[i
        b.l.unemp*lag.unemp[i] + b.d.unemp*d.unemp[i] +
        b.l.pop*lag.pop[i] + b.d.pop*d.pop[i] +
        b.l.gdp*lag.gdp[i] + b.d.gdp*d.gdp[i] + #b.d.growth*d.growth[i] +
        b.l.k*lag.gfcf[i] + b.d.k*d.gfcf[i] +
        b.l.cab*lag.cab[i] + b.d.cab*d.cab[i] +
        b.l.budg*lag.budg[i] + b.d.budg*d.budg[i] +
        b.l.world.save*lag.world.save[i] + b.d.world.save*d.world.save[i] +
        b.l.bm*lag.bm.growth[i] + b.d.bm*d.bm.growth[i] +
        b.l.old*lag.old[i] + b.d.old*d.old[i]
    lag.credit[i] ~ dnorm(mu.l.credit, tau.l.credit)#imputation models for missing covariates
    lag.ineq[i] ~ dnorm(mu.l.top1, tau.l.top1)
    d.ineq[i] ~ dnorm(mu.d.top1, tau.d.top1)
    lag.budg[i] ~ dnorm(mu.l.budg, tau.l.budg)
    d.budg[i] ~ dnorm(mu.d.budg, tau.d.budg)
```

```
    lag.unemp[i] ~ dnorm(mu.l.unemp, tau.l.unemp)
    d.unemp[i] ~ dnorm(mu.d.unemp, tau.d.unemp)
    lag.bm.growth[i] ~ dnorm(mu.l.bm.growth, tau.l.bm.growth)
    d.bm.growth[i] ~ dnorm(mu.d.bm.growth, tau.d.bm.growth)
    logsigma2.y[i] <- g.unit[country[i]] + g.year[years.d[i]] + g.euro*eurozone[i] #model for 
    tau.y[i] <- 1/exp(logsigma2.y[i])
    res[i]<-d.credit[i] - mu[i] #residuals
    y.pred[i] ~ dnorm(mu[i], tau.y[i]) #repredicting y
  }

  for(j in 1:(n.countries)){#country RE in model for variance
    g.unit[j] ~ dnorm(0, tau.vc)
    a.unit[j] ~ dnorm(mu.c, tau.country) #country RE
    b.l.credit[j] <- -1*temp[j]
    temp[j] ~ dbeta(1,1)
  }
  for(j in 1:n.years){#country RE in model for variance
    g.year[j] ~ dnorm(0, tau.vy)
  }

# priors
  mu.c ~ dnorm(0,0.00001) #country RE
  ##imputation means
  mu.l.credit ~ dnorm(0,0.00001)
  mu.l.top1 ~ dnorm(0,0.00001)
  mu.d.top1 ~ dnorm(0,0.00001)
  mu.l.budg ~ dnorm(0,0.00001)
  mu.d.budg ~ dnorm(0,0.00001)
  mu.l.unemp ~ dnorm(0,0.00001)
  mu.d.unemp ~ dnorm(0,0.00001)
  mu.l.bm.growth ~ dnorm(0,0.00001)
  mu.d.bm.growth ~ dnorm(0,0.00001)
  ## regression parameters
  b.l.top1~ dnorm(0,0.0001)
  b.d.top1~ dnorm(0,0.0001)
  b.cl~ dnorm(0,0.0001)
  b.l.top1cl~ dnorm(0,0.0001)
  b.d.top1cl~ dnorm(0,0.0001)
  b.l.unemp~ dnorm(0,0.0001)
  b.d.unemp~ dnorm(0,0.0001)
  b.l.pop~ dnorm(0,0.0001)
  b.d.pop~ dnorm(0,0.0001)
  b.l.gdp~ dnorm(0,0.0001)
  b.d.gdp~ dnorm(0,0.0001)
  b.l.k~ dnorm(0,0.0001)
```

```
  b.d.k~ dnorm(0,0.0001)
  b.l.cab~ dnorm(0,0.0001)
  b.d.cab~ dnorm(0,0.0001)
  b.l.budg~ dnorm(0,0.0001)
  b.d.budg~ dnorm(0,0.0001)
  b.l.world.save~ dnorm(0,0.0001)
  b.d.world.save~ dnorm(0,0.0001)
  b.l.bm~ dnorm(0,0.0001)
  b.d.bm~ dnorm(0,0.0001)
  b.l.old~ dnorm(0,0.0001)
  b.d.old~ dnorm(0,0.0001)
  g.euro ~dnorm(0,0.0001)
  ## variances/precisions
  sigma.country ~ dunif(0,50)
  tau.country <- pow(sigma.country,-2)
  sigma.vc ~ dunif(0,10) #variance for country RE in variance term
  sigma.vy ~ dunif(0,10) #variance for year RE in variance term
  sigma.l.credit ~ dunif(0,50)
  tau.l.credit<- pow(sigma.l.credit,-2)
  sigma.l.top1 ~ dunif(0,50)
  sigma.d.top1~ dunif(0,50)
  sigma.l.budg~ dunif(0,50)
  sigma.d.budg~ dunif(0,50)
  sigma.l.unemp~ dunif(0,50)
  sigma.d.unemp~ dunif(0,50)
  sigma.l.bm.growth~ dunif(0,50)
  sigma.d.bm.growth~ dunif(0,50)
  tau.vc <- pow(sigma.vc, -2)
  tau.vy <- pow(sigma.vy, -2)
  tau.l.top1 <- pow(sigma.l.top1,-2)
  tau.d.top1<- pow(sigma.d.top1,-2)
  tau.l.budg<- pow(sigma.l.budg,-2)
  tau.d.budg<- pow(sigma.d.budg,-2)
  tau.l.unemp<- pow(sigma.l.unemp,-2)
  tau.d.unemp<- pow(sigma.d.unemp,-2)
  tau.l.bm.growth<- pow(sigma.l.bm.growth,-2)
  tau.d.bm.growth<- pow(sigma.d.bm.growth,-2)
}
```

MCMC convergence

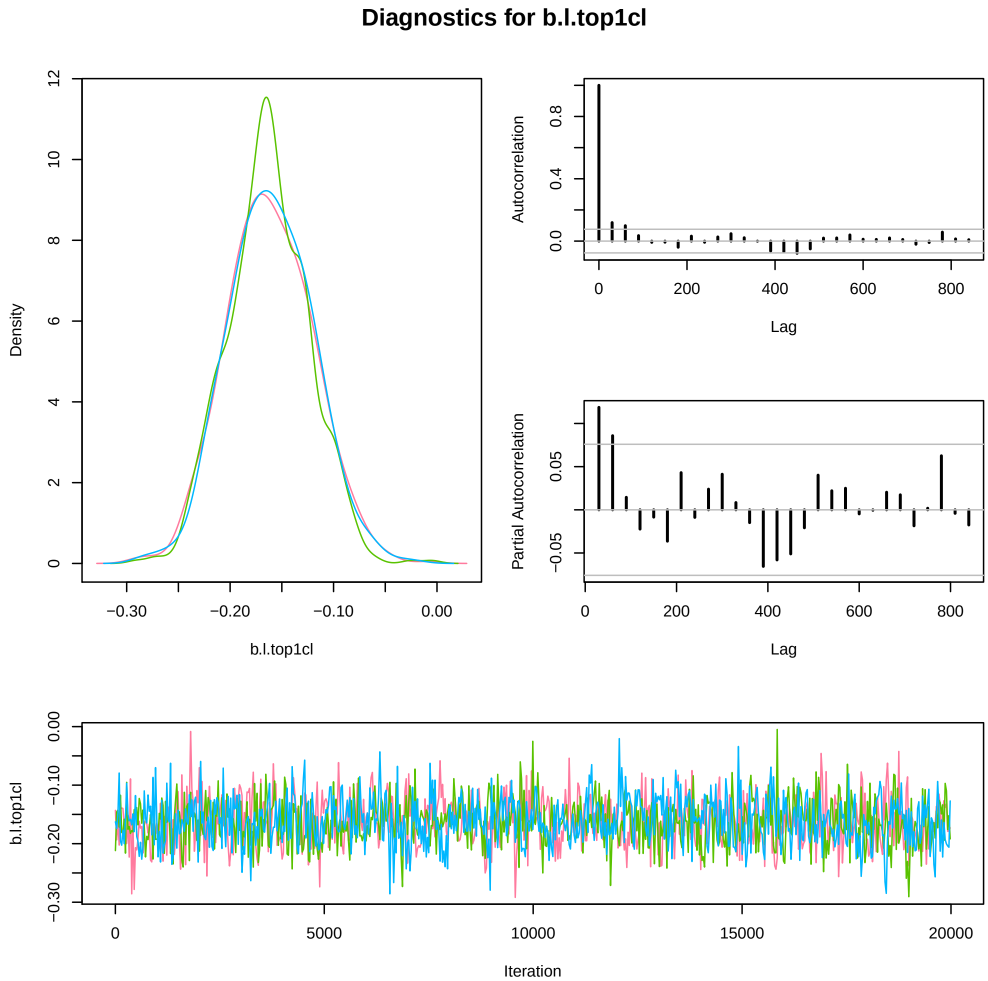

Figure 1: Illustrative MCMC Convergence Diagnostics

Alternative model specifications

Top 1% excluding capital gains

Using top 1% income share excluding capital gains does not alter inference in any way (fig. 2. The base model in the main text has slightly lower DIC/higher R^2.

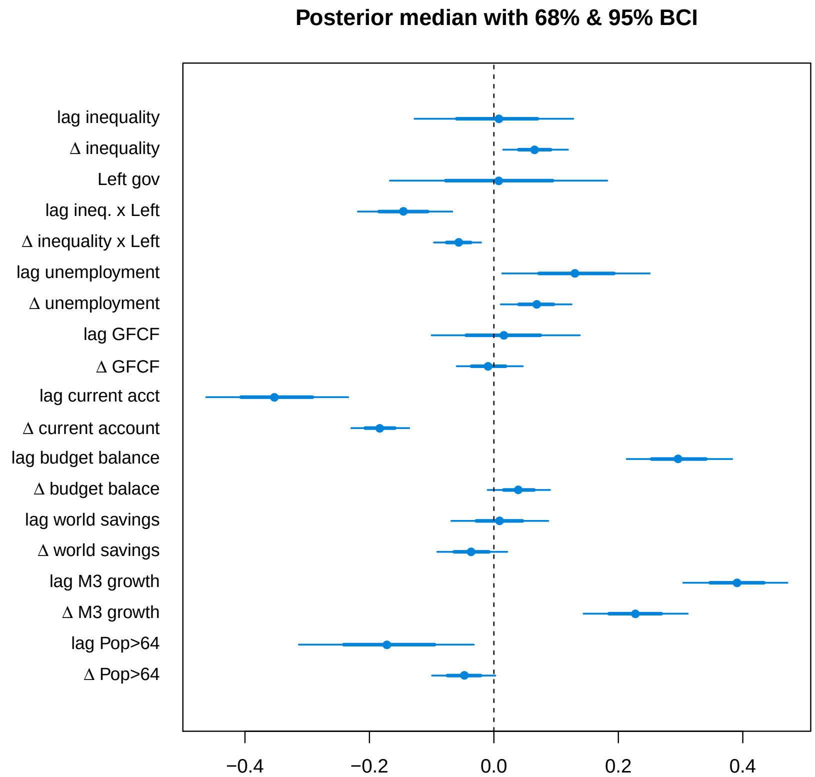

Figure 2: *Alternate measure of inequality*: posterior medians and 95% Bayesian credible intervals for regression slope parameters using top 1% income share excluding capital gains. $N = 558$, number of countries = 18, DIC = 14190.

Including labor compensation in FIRE sector as percent of total labor compensation

It may be argued that greater financialization of the economy will result in more credit in the economy, especially if the financial sector is better able to win policy favors due to its size. We refit the base model including including the lag and first difference of compensation costs in the Finance, Insurance, and Real Estate (FIRE) sector as percent to total employment compensation (fig 3). Results are qualitatively similar to those reported in the main text with the base model, although the magnitude of the relationship between inequality and credit, conditional on electoral institutions is somewhat smaller. In the main text we stick with the base model because including FIRE requires us to drop Switzerland from the analysis and because the size of the financial sector may itself be a function of inequality (Kumhof and Ranciere, 2010).

Longer time series

The key variables in the analysis are available back to 1962 for some countries, though many of the covariates only become available much later, usually around 1980. If we fit a simple version of

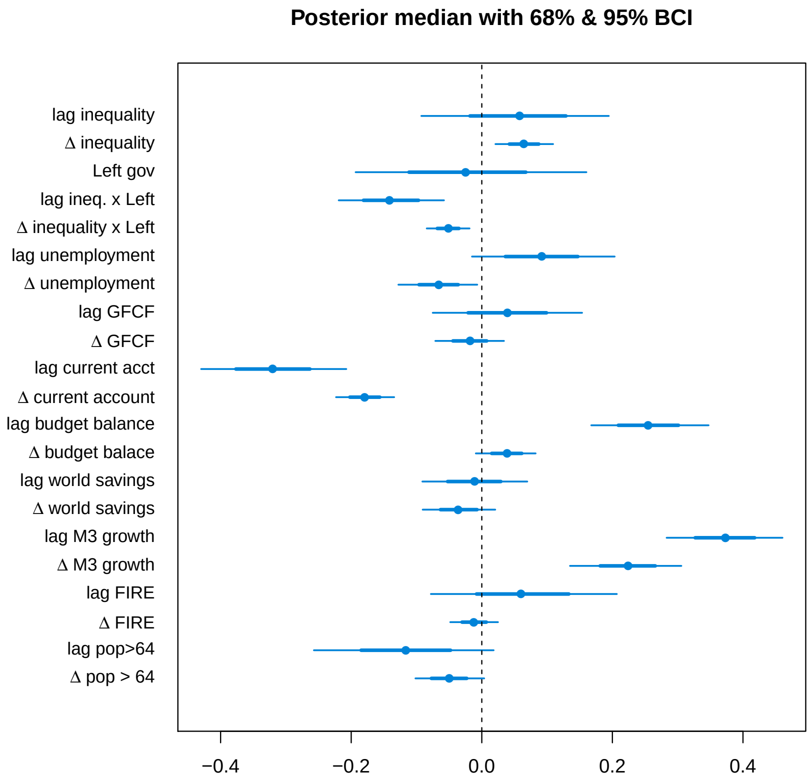

Figure 3: *Adding FIRE:* posterior medians with 68% and 95% Bayesian credible intervals for regression slope parameters from a model $N = 510$, number of countries = 17.

the base model in which lagged GDP (log), GDP growth, lagged population (log) and population growth are the only covariates model beyond top income shares and electoral institutions we get the results displayed in figure 4. Note that we use the majoritarian dummy variable[9] here since the cumulative Left government variable is dated from 1960 and is therefore very volatile in the early part of the series (it stabilizes dramatically by 1980). Even using this weaker predictor we find a large and strongly significant long term effect of inequality on credit. The figure omits the parameter estimates for the population and GDP variables for scale reasons.

[9] which was not a good predictor in the 1980-2010 period (Fig. **??**)

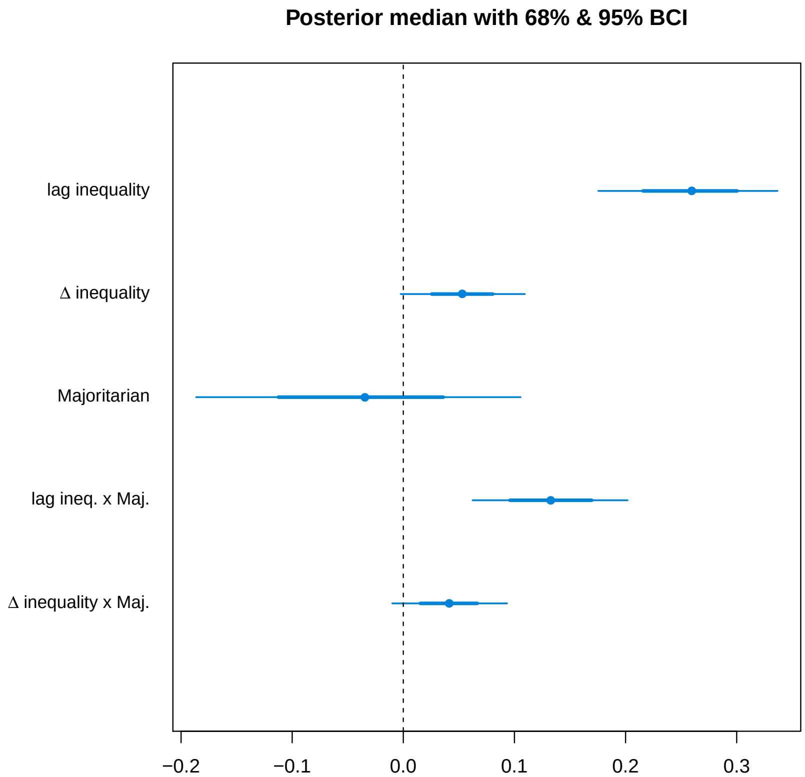

Figure 4: *Simpler model, longer series*: posterior medians with 68% and 95% Bayesian credible intervals for regression slope parameters for a simpler model fit to a longer unbalanced time series (1962-2010). There are no missing values imputed here, save interpolated top income shares. Even using a weaker predictor (majoritarian dummy variable) we find that the link between credit and inequality is strongly conditioned by electoral institutions. $N = 717$, number of countries = 18, DIC = 1401.

No imputation

We refit the base model without imputing missing values, i.e., using listwise deletion (fig. 5 This causes us to lose 132 country-years of data, or about 24% of our sample. In this case the results are substantively consistent with what we reported based on the analysis of imputed data.

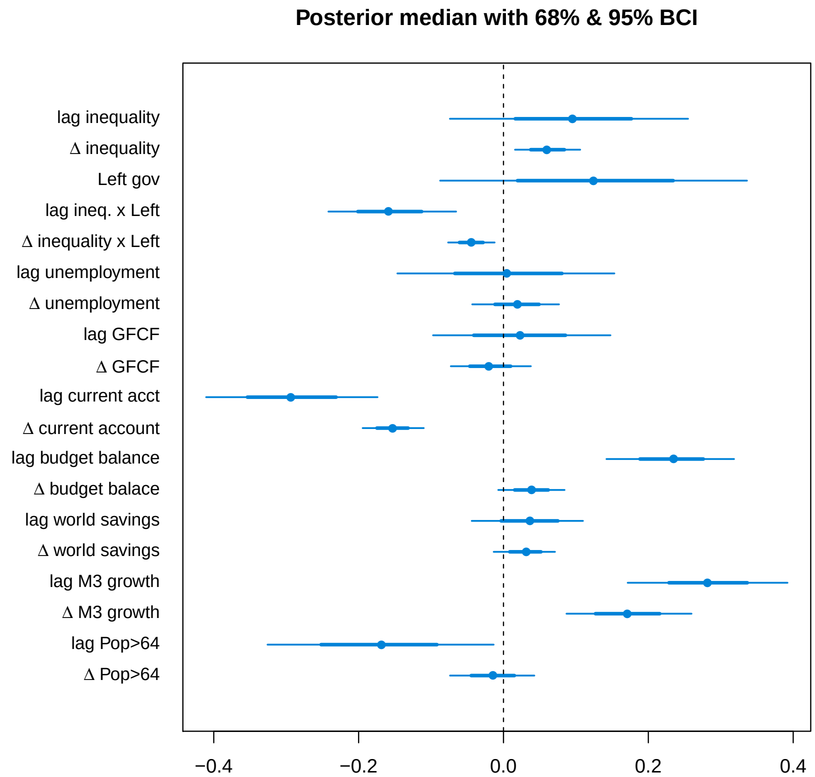

Figure 5: *No imputation*: posterior medians with 68% and 95% Bayesian credible intervals for regression slope parameters for the base model fit without imputing missing values, save interpolated top income shares. $N = 426$, number of countries = 18, DIC = 587.

Modeling household savings

As mentioned in the main text we also consider models of household savings as percent of net disposable income and taken from the OECD (2014). The savings variable, while close to our theoretical model, has far inferior coverage, especially longitudinally, making any inference using this variable even more time-period dependent than is already the case with our analysis of credit. Nevertheless, for completeness, we present two models here that analyze savings. Results are broadly consistent with our augments and findings in the main text that use the credit variable.

For the sake of comparability, we use the same ECM hierarchical structure that we used in the main text, including the models for variances. As above we examine top income shares and its interaction with institutional covariates. As covariates we include the

- proportion of the population older than 65, under the hypothesis that older people will spend down savings.
- real GDP per capita (log) and growth in per capita GDP, both from the Penn World Tables.
- The long term real interest rate, taken from the OECD (2014)

We present two models, one using the cumulative Left government variable and the other using the majoritarian dummy variable. We do no imputation here and we fit the model using all available country years. The earliest year is available is 1971. There are 18 countries in the sample but there is no year in which all 18 are reporting data. The sample has highly restricted cross-sectional coverage (fewer than eight countries) until 1991. For brevity we report only regression parameter estimates and ignore further discussion of higher order parameters, etc.

Using Cumulative Left government

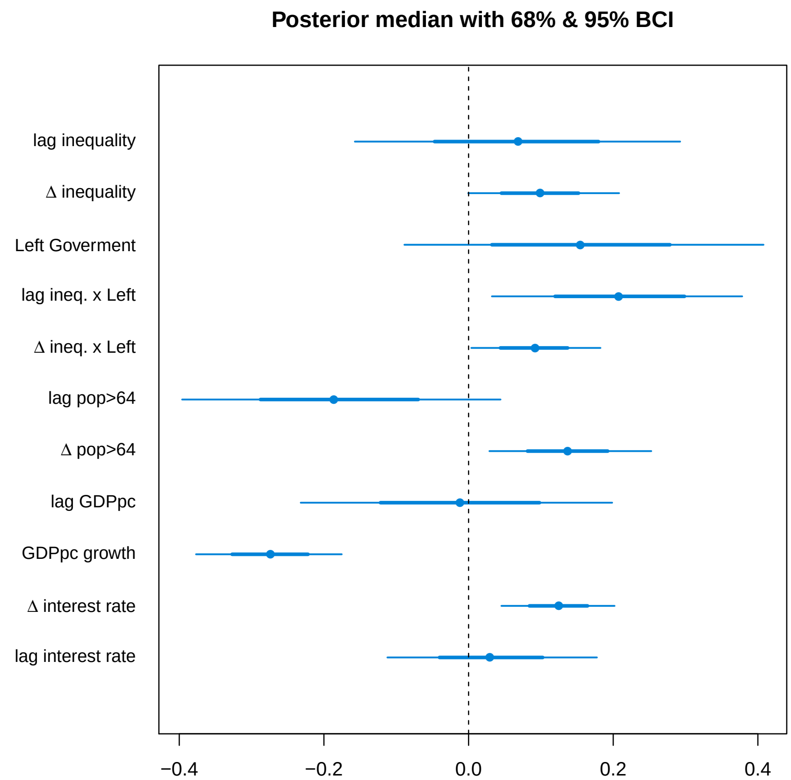

Figure 6: *Household savings*: posterior medians with 68% and 95% Bayesian credible intervals for regression slope parameters for the a hierarchical ECM regression on household savings as percent of net disposable income $N = 448$, number of countries = 18, $R^2 = 0.27$, DIC = 917.

In the model using cumulative Leftist participation in government, displayed in figure 6 we again see parameter estimates following a similar pattern to those reported in the main text: Relative to countries with frequent left government, household savings is negatively affected by inequality in countries with less levels participation by Leftist political parties in government. The 95% BCI for both the short and long-run terms do not contain 0.

Using the Majoritarian indicator

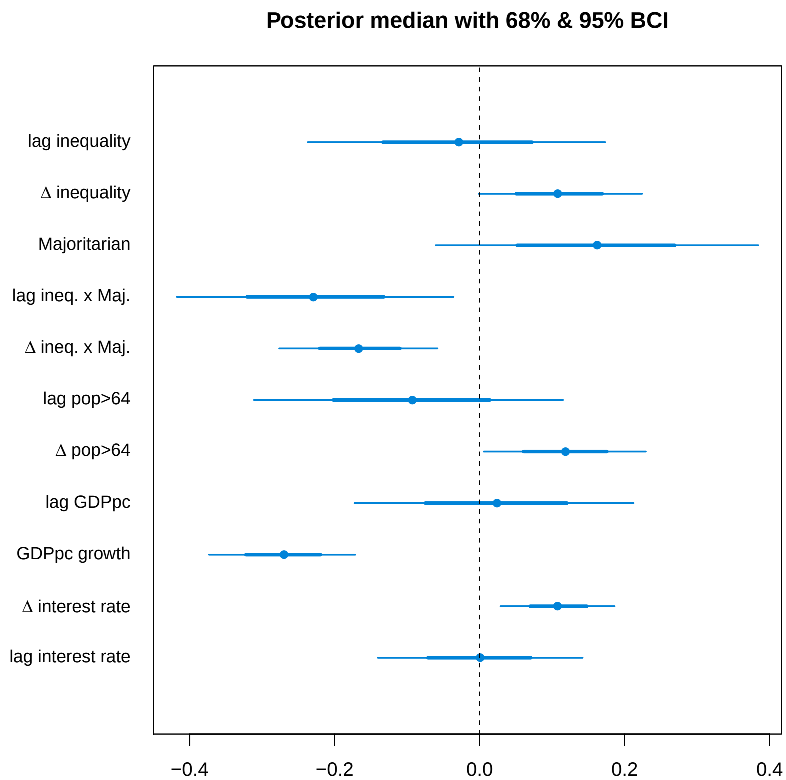

Figure 7: *Household savings*: posterior medians with 68% and 95% Bayesian credible intervals for regression slope parameters for the a hierarchical ECM regression on household savings as percent of net disposable income $N = 348$, number of countries = 18, $R^2 = 0.32$, DIC = 904.

When we use the majoritarian indicator variable, as seen in figure 7, the results are again consistent with what we found in the main text. Long run household savings is significantly lower as inequality rises, but only in majoritarian countries. The model using the majoritarian indicator instead of the leftist government variable fits the data better based on both R^2 and DIC heuristics.

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