Inequality, Taxation, and Sovereign Default Risk

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Roadmap

1. Introduction
2. Empirical findings / motivating facts
3. Model and mechanism
4. Quantify the effects

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  - Redistributes income
  - But distorts labor supply, affects tax base
  - Moreover, high-income workers may emigrate, affects current and future tax base
- Existing sovereign default models (homogeneous households, lump-sum taxes) are silent on the above discussions.

Empirical evidence calls for new elements in the model

- Income inequality
  - Cross-country sample: Gini index $\uparrow$ 0.1 (e.g. Sweden $\rightarrow$ Portugal), spreads $\uparrow$ 0.5 pp
  - Cross-state sample: Gini index $\uparrow$ 0.1 (e.g. Utah $\rightarrow$ Connecticut), spreads $\uparrow$ 0.8 pp

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- Migration
  - Alessandria, Bai, and Deng (2020): high government spreads accompanied by large labor outflows during European debt crises
  - State-level data: high government spreads are associated with labor outflows

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Redistributive government:

- Chooses tax, issues state-uncontingent debt, but can default
- Faces spreads reflecting default risk
- Internalizes impact of policies on labor supply and migration

Model mechanism

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Facing large inequality, government adopts progressive tax, but suffers high spreads

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- Parametrize to U.S. state-level data
  - Similar magnitude as country-level spreads
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- Parametrize to U.S. state-level data
  - Similar magnitude as country-level spreads
  - Measures are more comparable across the states and consistent over time
- Income inequality and its iteration with migration account for $1/3$ of state government spreads.
- Inequality itself accounts for 23% of the spreads.

Related literature

- Quantitative sovereign default models

  Eaton, Gersovitz (1981), Aguiar, Gopinath (2006), Arellano (2008), Pouzo and Presno (2014), Karantounias (2019), Cuadra, Sanchez, and Sapriza (2010), D'Erasmo and Mendoza (2016, 2020), Tran Xuan (2020)

  New: default on external debt is redistributive, because of endogenous taxation.

- Inequality and sovereign spreads

  Berg, Sachs (1988), Aizenman, Jinjarak (2012), Jeon, Kabukcuoglu (2018), Andreasen, Sandleris, and Van der Ghote (2018)), Dovis, Golosov, and Shourideh (2016), Ferriere (2014)

- Migration and sovereign spreads

  Gordon and Guerron-Quintana (2019), Alessandria, Bai, and Deng (2020)

  New: incorporates and quantifies the role of inequality and its interaction with migration.

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Focus on state-level data

- U.S. states are sovereigns: can formulate and implement tax, issue bonds, can not declare bankruptcy
- States have sovereign immunity just as countries within Eurozone (Ang and Longstaff (2013))
- Arellano, Atkeson, and Wright (2016)
- Data measures are more comparable and consistent over time

Data

- Income inequality & tax progressvity
- Migration
- 5-year credit default swap (CDS) spreads, Bloomberg

Data

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  - high inequality: NY, CT, CA, IL; low inequality: UT, SD, WI
  - Income tax: major source of state government revenue (37%); most progressive; focus on income tax progressivity
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  - Top outbound: IL, CA, and NJ
  - 2012 CA increases marginal income tax rate especially for the high-income, high-income earners increased emigration rate, substantial decrease in taxable income (Rauh and Shyu (2019))
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- Summary statistics for each state ▸ statistics

Data

- Income inequality and government spreads

$$spread_{jt} = \beta_0 + \beta_1 ineq_{j,t-1} + \Gamma' Z_{j,t-1} + \alpha_t + \epsilon_{jt}, \tag{1}$$

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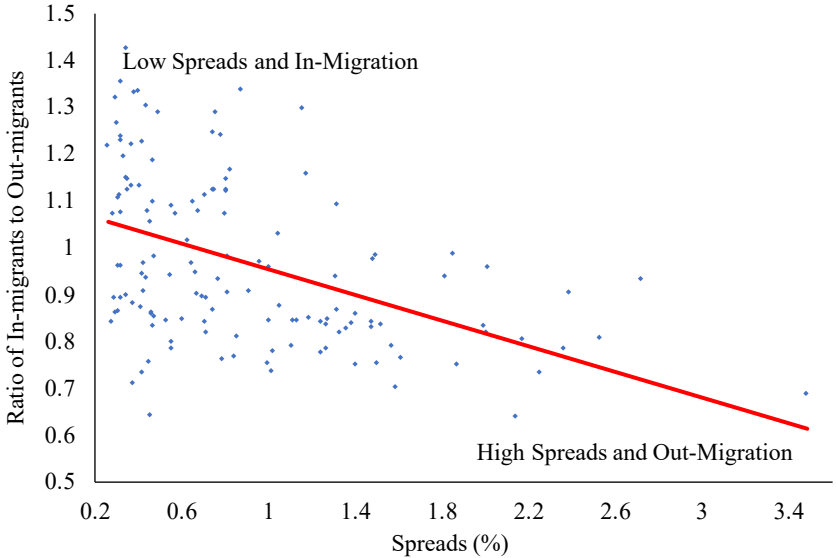
	(1)	(2)	(3)	(4)
Gini	8.08***	8.13***	7.71***	7.96***
	(2.26)	(2.70)	(2.29)	(2.76)
Political (="Split")		0.25		0.29
		(0.18)		(0.19)
Political (="Democratic")		0.46***		0.44***
		(0.13)		(0.13)
Year FE	Yes	Yes	Yes	Yes
Controls		Yes		Yes
N	147	147	147	147
R^2	0.324	0.436	0.418	0.507

- Gini $\uparrow$ 0.1, spreads $\uparrow$ 0.8pp [quite large, average spread is 0.86 pp]

Data

- Migration and government spreads



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Model environment

- Production technology: $Y = AL$
- Heterogeneous workers:
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Model environment

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  - heterogeneous labor productivity z_i
  - preference over c_i, ℓ_i: $u(c_i, \ell_i) = \frac{c_i^{1-\sigma}}{1-\sigma} - \frac{\ell_i^{1+\gamma}}{1+\gamma}$
  - emigrate by paying idiosyncratic migration cost $\delta \sim$ CDF $F(x) = 1 - e^{-\zeta(z)x}$
  - distribution Φ
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  - chooses distortionary income tax/transfer policy, debt B', and whether to default
  - If defaults, productivity loss $A^d \leq A$, financial autarky (aut=1) for a while

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- Denote aggregate state: $S = (B, A, \Phi, aut)$

Tax/Transfer function

- Heathcote-Storesletten-Violante (HSV) tax structure (2014, 2017)
- For worker i with income y_i, tax $T_i(y_i) = y_i - \lambda y_i^{1-\tau}$
- τ determines degree of tax progressivity
  - Ratio of marginal to average tax rates

$$\frac{T'(y)}{T(y)/y} = \frac{1-\lambda(1-\tau)y^{-\tau}}{1-\lambda y^{-\tau}}$$

  - $\tau > 0$: progressive tax
- $y < y^0 = \lambda^{\frac{1}{\tau}}$: receive transfer (negative tax)

Timing

Aggregate state $S = (B, A, \Phi, aut)$, individual state $= (S, z, \delta)$

1. A, z, δ are observed
2. Workers decide whether to emigrate
3. After the migration decision, the distribution of the workers becomes Φ'
4. Government chooses B', and tax/transfer system $\{\lambda, \tau\}$
   - only chooses $\{\lambda, \tau\}$ if in financial autarky
5. Given taxation, the staying workers choose labor supply ℓ and consume c

Recursive formulation

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  - tax system (if in financial autarky)
- Lenders: bond price captures government default risk ▸ Lenders' Problem

Model mechanism

- Simple *one-period* model for analytical solutions
- Exogenous debt B_0, no new borrowing
- Workers
  - two types $z_L = \bar{z} - \sigma_z$, $z_H = \bar{z} + \sigma_z$
  - $u(c, \ell) = \log c - \frac{\ell^{1+\gamma}}{1+\gamma}$

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  - $u(c, \ell) = \log c - \frac{\ell^{1+\gamma}}{1+\gamma}$
  - $\ell_L = (1-\tau)^{\frac{1}{1+\gamma}}, \quad \ell_H = (1-\tau)^{\frac{1}{1+\gamma}}$
  - $c_L = \lambda(wz_L\ell_L)^{1-\tau}, \quad c_H = \lambda(wz_H\ell_H)^{1-\tau}$
- τ discourages labor supply

Simple government problem

- The repayment value:

$$V^c(B_0, A) = \max_{\tau,\lambda}\{0.5u(c_L, \ell_L) + 0.5u(c_H, \ell_H)\}$$

s.t.

$$T_L + T_H = B_0$$

where $T_L = wz_L\ell_L - \lambda(wz_L\ell_L)^{1-\tau}$ and $T_H = wz_H\ell_H - \lambda(wz_H\ell_H)^{1-\tau}$

- The defaulting value:

$$V^d(A) = \max_{\tau^d,\lambda^d}\{0.5u(c_L^d, \ell_L^d) + 0.5u(c_H^d, \ell_H^d)\}$$

s.t.

$$T_L^d + T_H^d = 0$$

Repayment value, rewrite

$$V^c(B_0, A) = \max_{\tau} \Big\{ \underbrace{\log\left(A\bar{z}\ell(\tau) - B_0\right)}_{\text{consumption}} - \underbrace{\frac{1-\tau}{1+\gamma}}_{\text{disutility from working}} + \underbrace{\frac{1}{2}\log[\alpha(1-\alpha)]}_{\text{redistribution}} \Big\}$$

- where $\alpha \equiv (z_L^{1-\tau})/(z_L^{1-\tau} + z_H^{1-\tau})$
- When $\tau = 1$, which implies $\alpha = 1/2$, highest welfare from redistribution
- marginal cost = marginal benefit of increasing $\tau \Rightarrow \tau^*$

Debt and tax progressivity: high B_0 increases marginal cost of $\tau \rightarrow$ low τ

Incentives to default

- Assume for now: if government repays, $A = 1$; if defaults, $A^d \leq 1$

$$V^c(B_0) = \max_{\tau} \left\{ \log\left(\bar{z}\ell(\tau) - B_0\right) - \frac{1-\tau}{1+\gamma} + \frac{1}{2}\log[\alpha(1-\alpha)] \right\}$$

$$V^d = \max_{\tau} \left\{ \log\left(\bar{z}\ell(\tau)\right) - \frac{1-\tau}{1+\gamma} + \frac{1}{2}\log[\alpha(1-\alpha)] \right\} + \log A^d$$

- Marginal cost of high τ on consumption is higher with debt repayment B_0
- Marginal benefits of high τ are the same

When government defaults, it can achieve a higher equilibrium τ

Effect of inequality

- Tradeoff between debt repayment and more redistribution
- Increase inequality σ_z: $z_H - z_L = 2\sigma_z$ increases
- Redistribution benefit $\alpha(1-\alpha)$ increases $\Rightarrow$ higher τ
- However, increase in τ is smaller under repayment B_0

Larger inequality makes government more likely to default

Effect of migration

- Revisit the recursive problem
- Recall government chooses $\{B', \tau, \lambda\}$ to maximize:

$$V^c(B, A, \Phi') = \max_{B', \tau, \lambda} \{ \int u(c_i, \ell_i)\omega_i di + \beta V(B', A', \Phi'')\},$$

s.t. $B = \int_{\Phi'} T_i(y_i)di + q(B', A, \Phi')B'$

- Φ' enters into government's problem:
  1. affects the tax base
  2. affects the government bond price $q(B', A, \Phi')$ by affecting future default risk
- High-income workers' emigration: future repayment capacity $\downarrow$ spreads $\uparrow$

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Parameterization

- Annual
- Aggregate productivity A: $\log(A_t) = \rho \log(A_{t-1}) + \varepsilon_t$
- Productivity losses in default (Chatterjee and Eyigungor, 2012):

$$A_d = A - \max\left\{d_1 A + d_2 A^2, 0\right\}$$

- Two groups of parameters

Parameters

Risk-free rate	r	4%
1/Frisch elasticity	γ	2
Return probability	θ	0.25
Productivity persistence	ρ	0.9
Productivity volatility	σ	0.02
Discount factor	β	0.87
Productivity loss	d_1	-0.4
	d_2	0.475
Labor heterogeneity	$\bar{z}$	0.45
	σ_z	0.414
Migration cost distribution	ζ_L	0.0027
	ζ_H	0.0044

Moments in data and model

	Data	Model
Std. GDP	0.03	0.04
Avg. spread (%)	0.83	0.81
Std. spread (%)	0.40	0.61
Avg. debt-to-GDP	0.18	0.19
Gini index	0.46	0.46
Avg. income tax revenue/GDP (%)	1.8	1.35
Avg. emigration rate of low-income (%)	4.0	4.0
Avg. emigration rate of high-income (%)	2.8	2.8

Note: GDP in the table refers to per capita GDP.

Quantitative effects of inequality and migration

- Inequality increases government spreads
- The magnitude depends on labor distortions
  - *intensive* margin of labor distortion depends on Frisch elasticity
  - *extensive* margin of labor distortion depends on labor mobility

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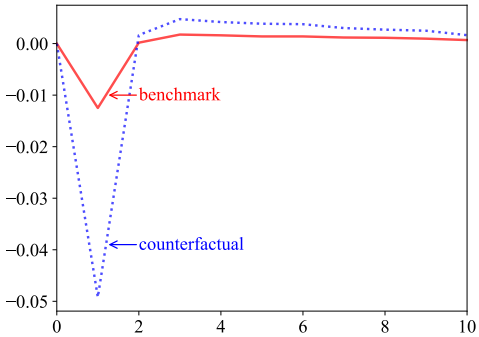
- Inequality increases government spreads
- The magnitude depends on labor distortions
  - *intensive* margin of labor distortion depends on Frisch elasticity
  - *extensive* margin of labor distortion depends on labor mobility
- Benchmark: average spread 0.81 pp
- No-inequality model: average spread 0.62 pp

  - Inequality accounts for 23% ($= \frac{0.81-0.62}{0.81}$) of the government spreads
- No-inequality-no-migration model: average spread 0.54 pp

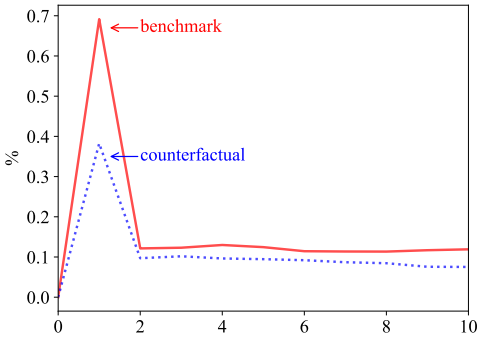
  - Inequality and its interaction with migration account for one-third ($= \frac{0.81-0.54}{0.81}$) of the government spreads

Effects in a recession

- IRFs: benchmark and counterfactual (no-inequality-no-migration)



(a) Tax τ



(b) Spreads

Redistribution preference

- Let the Pareto weights be $\omega_i = z_i^\eta / (\sum_I z_i^\eta)$
  - $\eta = 0$ corresponds to equal weights in the social welfare function
  - Higher η represents a lower redistribution preference

- Experiments with Pareto weights

	τ	labor supply	emig. rate($i = L$)	emig. rate($i = H$)	spread
$\eta = 0$	0.59	0.74	4.0%	2.8%	0.81%
$\eta = 0.4$	0.41	0.83	4.6%	2.4%	0.79%
$\eta = 0.7$	0.18	0.93	5.5%	2.1%	0.62%

- Lower redistribution pref. $\rightarrow$ lower $\tau \rightarrow$ labor supply $\uparrow$, emig. rate of H $\downarrow \rightarrow$ spreads $\downarrow$

Conclusion

- Standard sovereign default literature: homogeneous agents, lump-sum transfers
- Empirical evidence shows importance of income inequality and migration
- This paper develops a framework to study a rich set of government policies (distortionary tax, debt, default) with income inequality and labor mobility
  - Key (new!) tradeoff: redistribution and spreads
  - Income inequality and migration explain $1/3$ of spreads across the states
- Fruitful future research: debt crisis and labor heterogeneity; welfare gain or loss of austerity plan...

Appendix

State	Mean	Std.Dev.	Min	Max
California	1.20	0.85	0.24	3.60
Connecticut	0.99	0.25	0.47	1.67
Delaware	0.41	0.16	0.21	1.05
Florida	0.67	0.43	0.25	1.99
Illinois	2.37	0.77	0.81	4.10
Maryland	0.49	0.25	0.20	1.28
Michigan	0.89	0.59	0.30	2.88
Minnesota	0.45	0.22	0.25	1.09
Nevada	0.83	0.55	0.21	2.33
New Jersey	1.33	0.50	0.45	2.89
New York	0.77	0.61	0.23	2.91
North Carolina	0.42	0.22	0.21	1.08
Ohio	0.75	0.41	0.25	1.78
Rhode Island	0.71	0.40	0.34	1.72
South Carolina	0.35	0.16	0.21	0.94
Texas	0.52	0.22	0.24	1.34
Utah	0.41	0.11	0.20	0.73
Washington	0.49	0.23	0.24	1.11
Wisconsin	0.57	0.34	0.16	1.47

back

Workers

A worker decides whether to stay or emigrate to maximize his value:

$$W(S, z, \delta) = \max\{W^s(S, z), W^m - \delta\}, \tag{2}$$

The staying value $W^s(S, z)$ is:

$$W^s(S, z) = \max_{c,\ell}\{u(H_c(S, z), H_\ell(S, z)) + \beta W(S', z', \delta')\}, \tag{3}$$

$$c \leq \lambda y^{1-\tau}, \tag{4}$$

Let $M(S, z, \delta) = 1$ denotes migration (to other places).
The probability of staying in the original place for a worker is then given by:

$$Pr(\delta \geq W^m - W^s(S, z)) = e^{-\zeta(z)(W^m - W^s(S,z))} \tag{5}$$

back

Government

The government chooses whether to repay or default on its debt:

$$V(B, A, \Phi') = \max\{V^c(B, A, \Phi'), V^d(A, \Phi')\} \tag{6}$$

The repayment value is given by:

$$V^c(B, A, \Phi') = \max_{B', \tau, \lambda} \{ \int u(c_i, \ell_i)\omega_i di + \beta V(B', A', \Phi'')\}, \tag{7}$$

subject to the budget constraint:

$$B = \int_{\Phi'} T_i(y_i)di + q(B', A, \Phi')B' \tag{8}$$

where $\int_{\Phi'} T_i(y_i)di = \int_{\Phi'}(y_i - \lambda y_i^{1-\tau})di$

Government, cont.

The default value is given by:

$$V^d(A, \Phi') = \max_{\tau,\lambda}\{\int u(c_i^d, \ell_i^d)\omega_i di + \beta[\theta V(0, A', \Phi''_{aut=0}) + (1-\theta)V^d(A', \Phi''_{aut=1})]\}, \tag{9}$$

subject to the budget constraint:

$$0 = \int_{\Phi'} T_i(y_i) di \tag{10}$$

back

External lenders

- Risk neutral, competitive
- Break-even condition:

$$q(B', A, \Phi') = \frac{\mathbb{E}[1 - D(B', A', \Phi''(B', A', \Phi'))]}{1 + r}, \tag{11}$$

  - r: risk-free rate
  - $D(B, A, \Phi') = 1$: default

back