Partial Default

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Motivation

- Sovereign defaults are somewhat frequent in developing countries.
- Defaults are commonly thought as discrete events: country either repays or defaults on all its debt.

  (As if they filed for bankruptcy like people.)
- But defaults are very heterogeneous events.
  - Some defaults have costly and lengthy resolutions.
  - Others defaults are minor with fast resolutions.

Existing Theory

- Quantitative models of sovereign default have countries either repaying or defaulting in full.

  (Aguiar and Gopinath 2006, Arellano 2008).

- With countries restructuring all of its debt after default.

  (Yue 2010, Benjamin and Wright 2009, D'Erasmo 2012).

- Default as state contingent assets does not sit well with the evidence that default is costly.

  (Trade costs, Rose 2002; financial crises, Reinhart and Rogoff 2010; lawsuits and sanctions, Hatchondo & Martinez 2013).

- The theory is Non-Markovian. It requires coordination among existing and prospective lenders.

This paper

- We document the properties across heterogeneous sovereign defaults.
  1. Sovereign defaults are partial.
  2. During defaults sovereigns continue to receive foreign credit.
  3. Larger defaults in downturns.

- We develop a Markovian model of partial default.
  - The model promising for explaining the heterogeneity across defaults.
  - The environment requires output loses when debt is in arrears, and partial recovery of those debts.

DATA

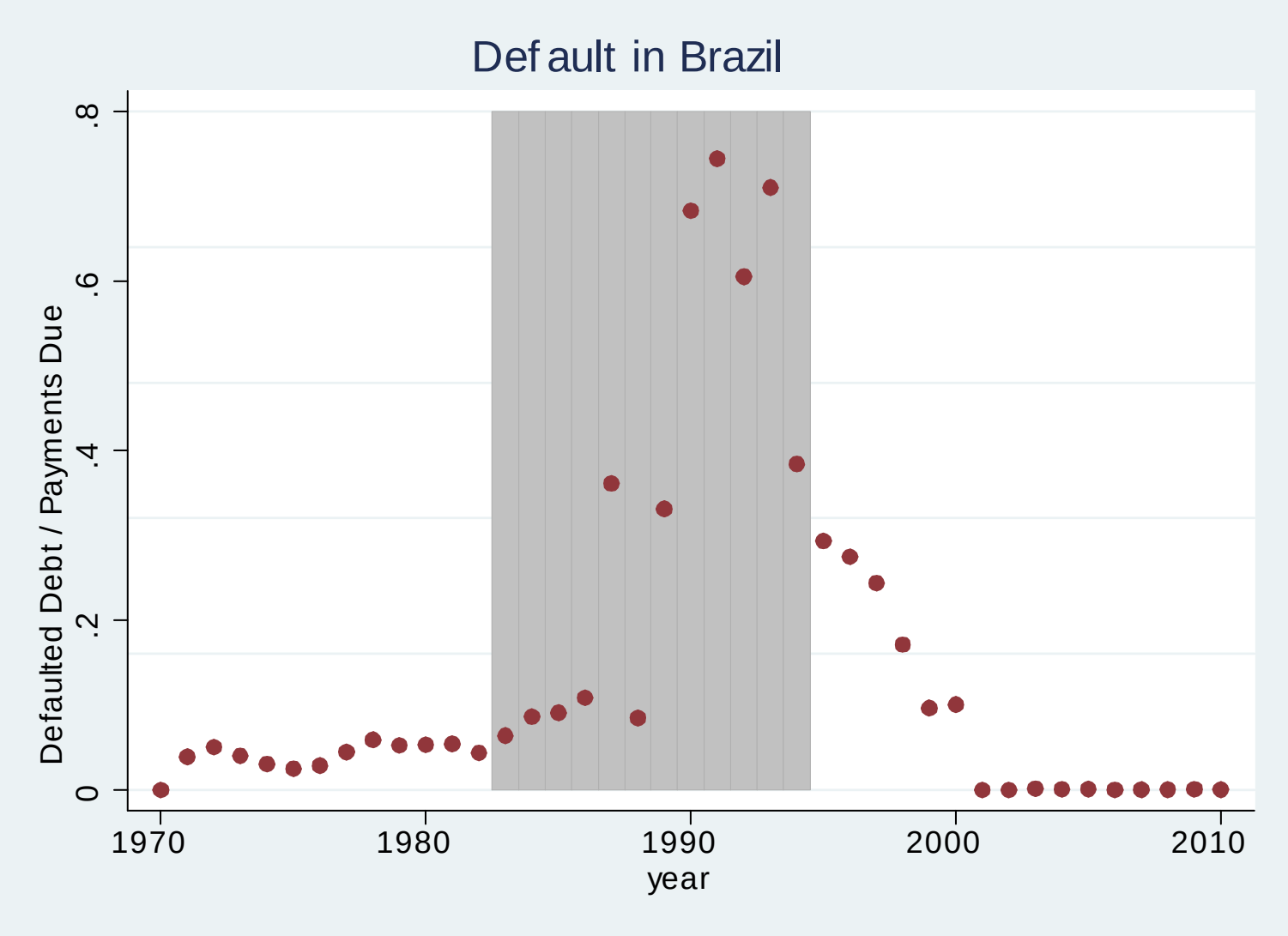
Defaults in the Data

- Panel data for 99 developing countries from 1970-2010.
- Public debt data from World Development Indicators: debt in arrears and new loans.
- Default events from Standard & Poor and Trebesch and Cruces (2012).

$$\text{Partial Default} = \frac{\text{Debt in Arrears}}{\text{Debt Service} + \text{Debt in Arrears}}$$

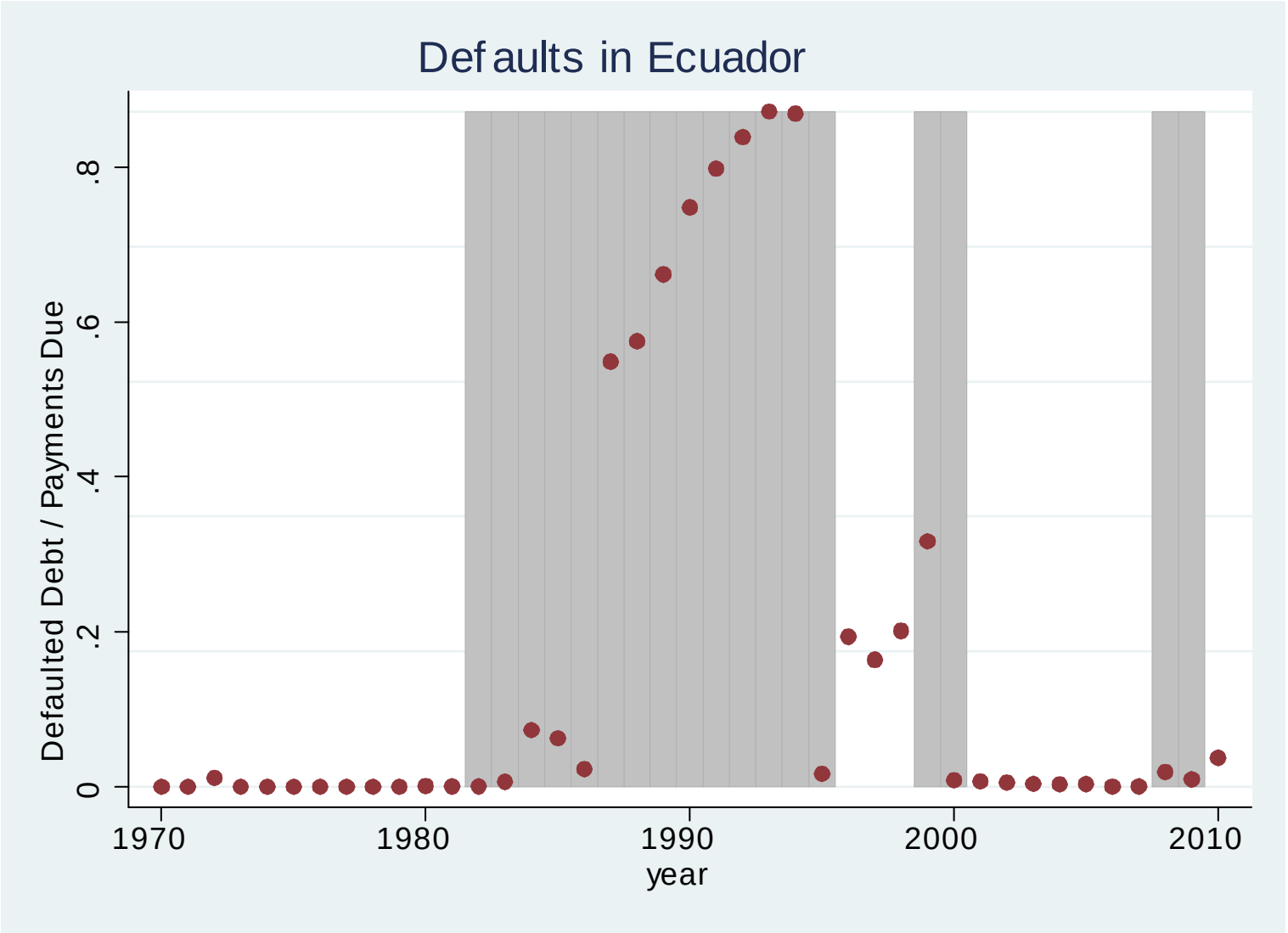
- Debt in Arrears= Interest and principals due this period but in arrears.

Defaults in the Data: 1. Sovereign Default is Partial



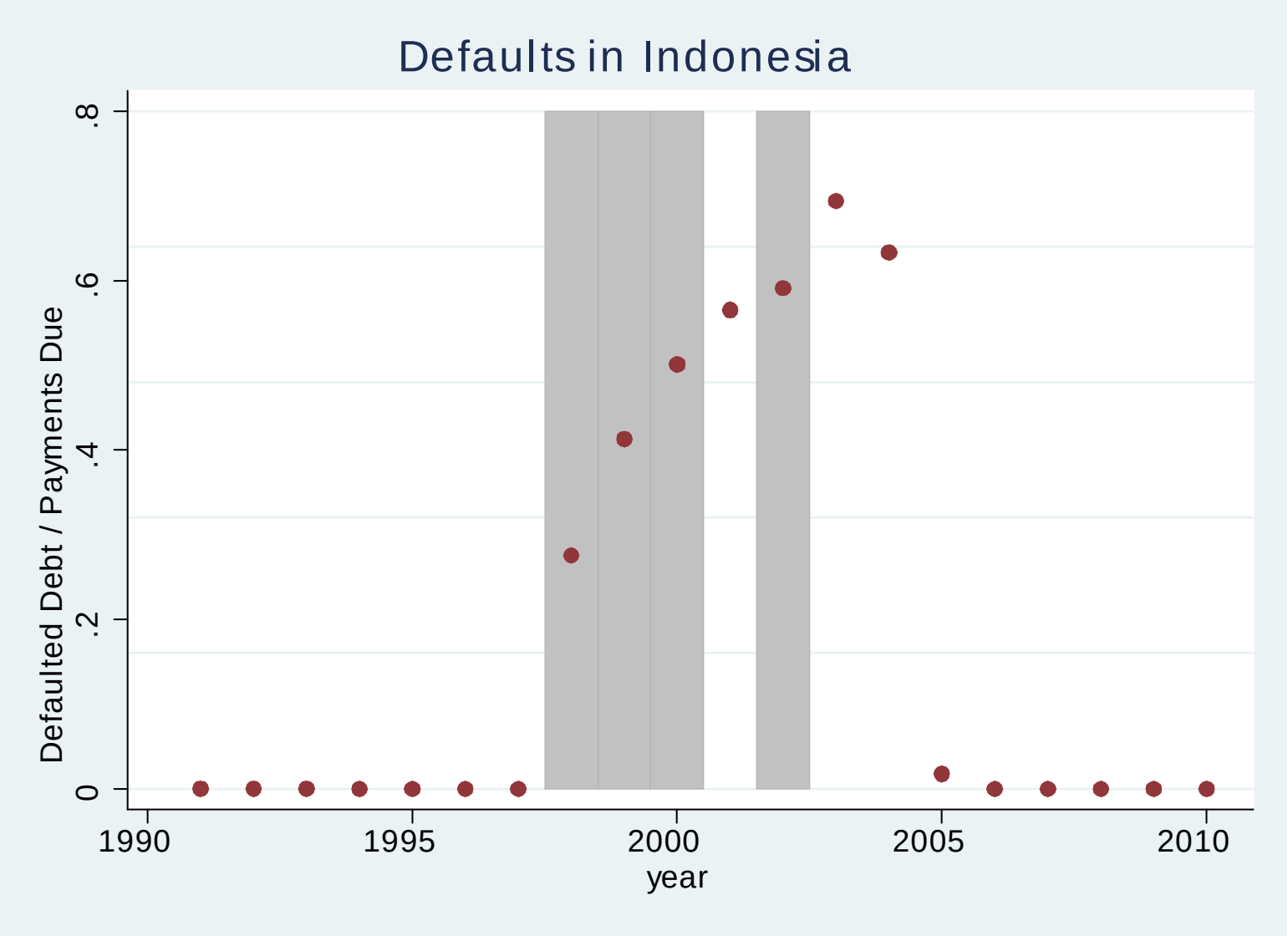
Default events are associated with large arrears but default is partial

Defaults in the Data: 1. Sovereign Default is Partial

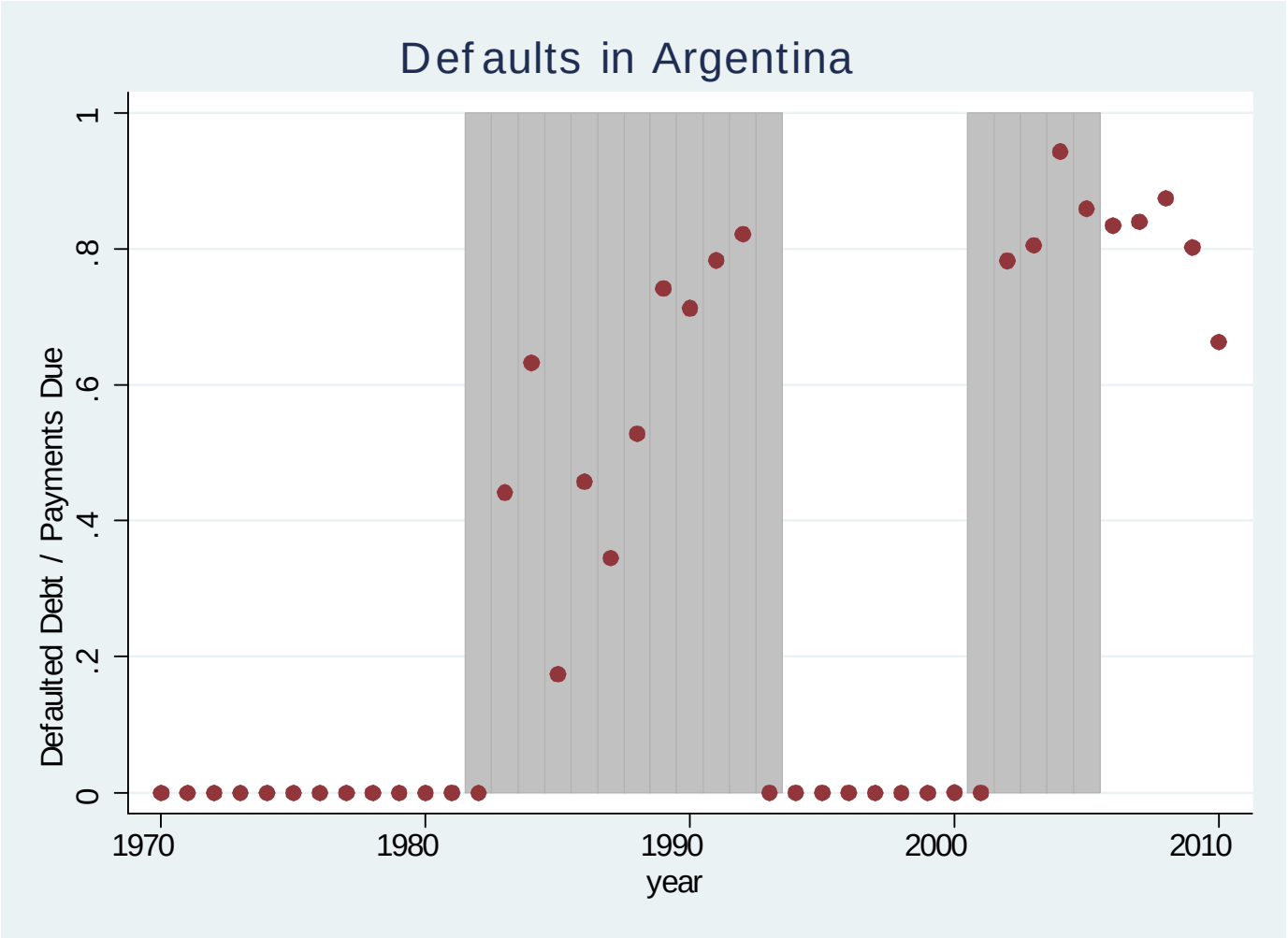


Defaults can be very small as in 2008.

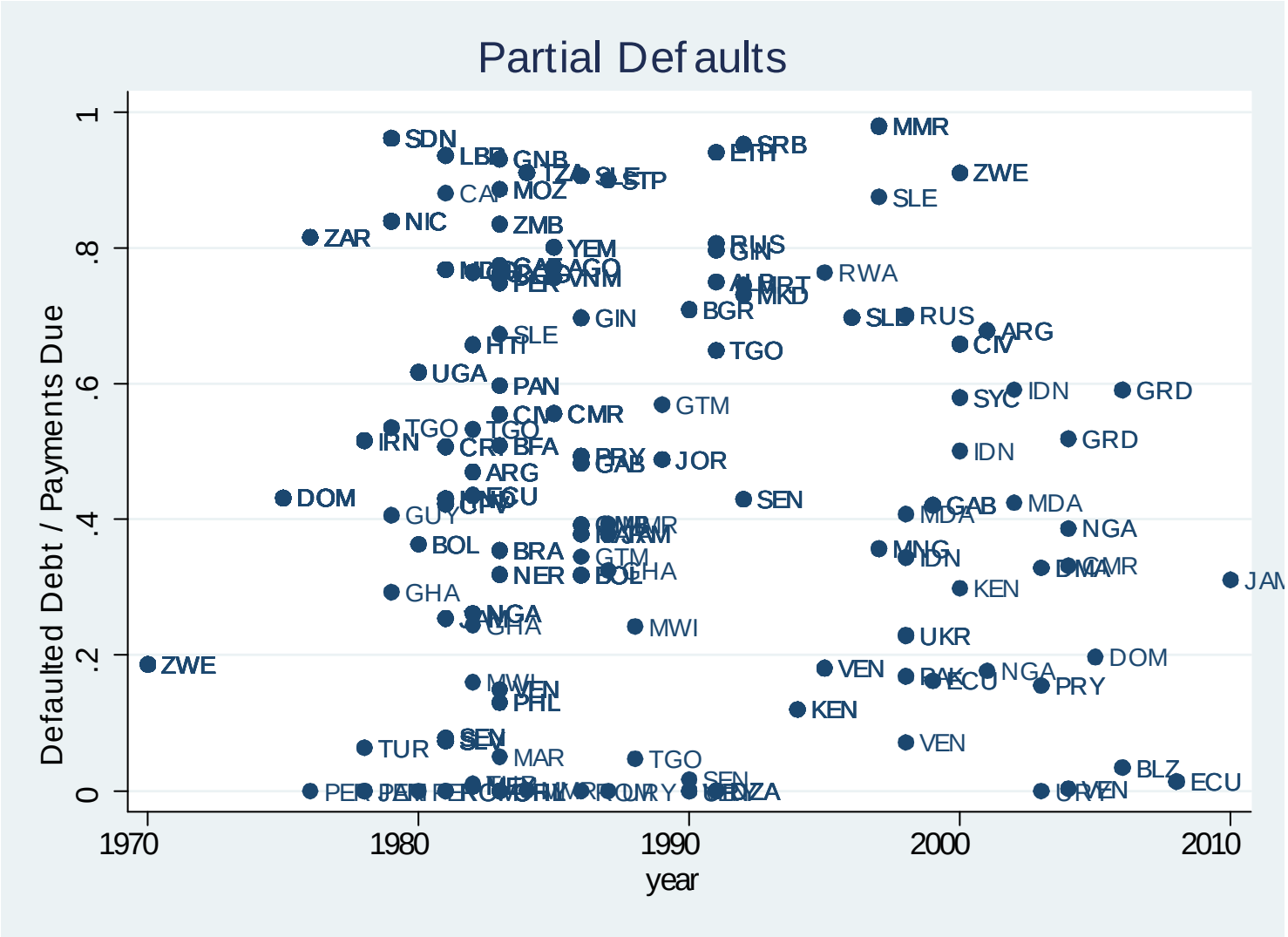
1. Sovereign Default is Partial



Defaults in the Data: 1. Sovereign Default is Partial

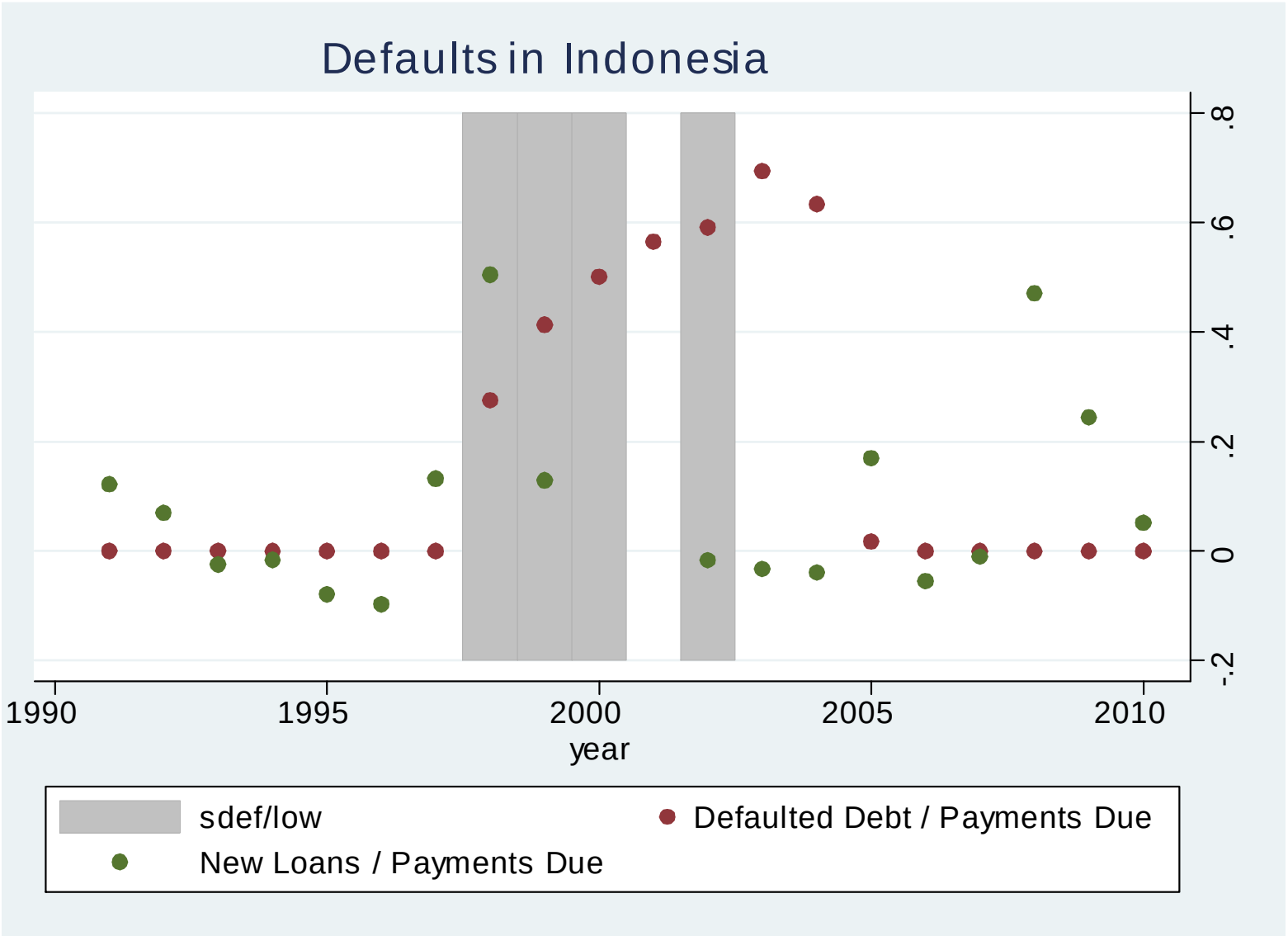


Defaults in the Data: 1. Sovereign Default is Partial



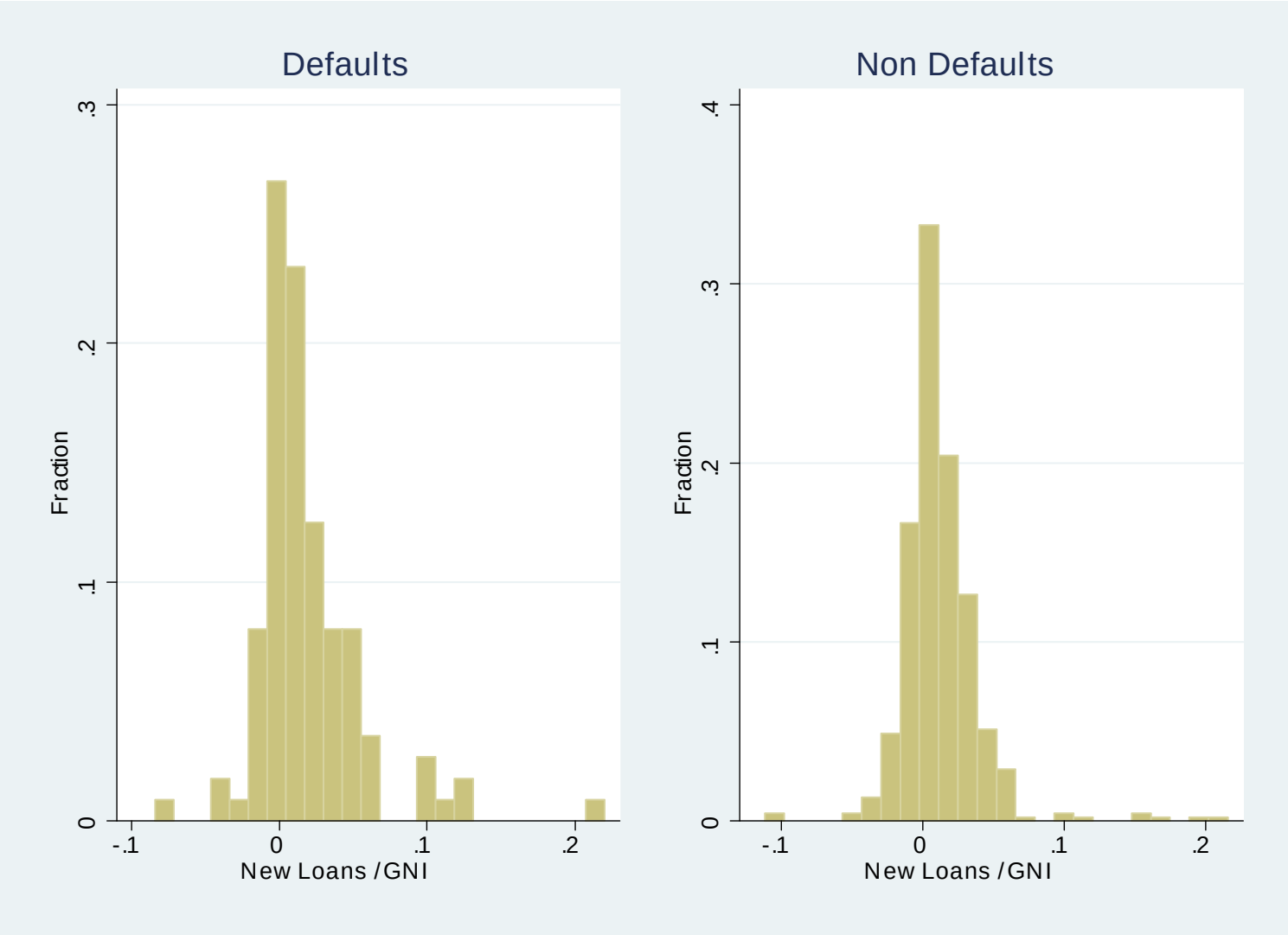
Across all S&P default : countries default on average on 59% of what is due.

Defaults in Data: 2. Borrowing during Sovereign Default



During default countries continue to borrow

Defaults in Data: 2. Borrowing during Sovereign Default

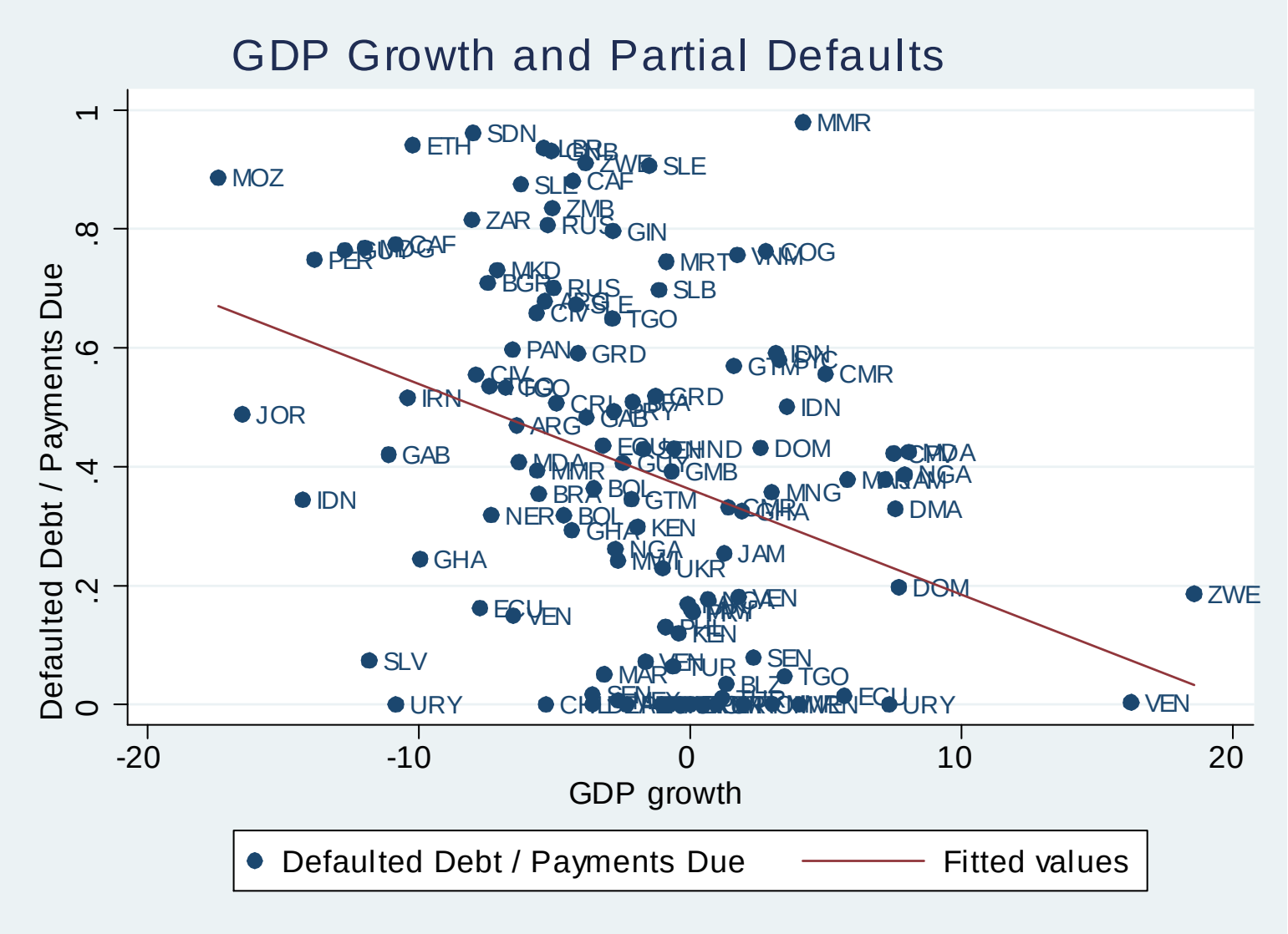


Countries get new loans during defaults almost as much as in normal times,

Caveat: Data on new government loans contains many missing observations.

Defaults in Data: 3. Larger Default in Downturns

Partial Default and GDP Growth



THEORY

Ingredients of our theory

- Limited, but not inexistent, legal system in the world allows for sovereign default. However,
  - Creditors of defaulted debt create some havoc. Costs increasing in the level of defaulted debt.
  - Defaulted Debt does not disappear, it remains in the balance sheet until repayment (like Venezuela 2005) or renegotiated (with a wide range of haircuts- 0-100%). Today a constant fraction of debt in arrears survives.
- Inability of lenders to coordinate to exclude further future lending (free entry in lending markets (Krueger and Uhlig (06)).
- Markov Equilibria (when non multiple equilibria in the static counterpart, it is the limit of equilibria in finite horizon economies).

Model

Dynamic model of borrowing and default

- Small open economy with stochastic endowment z which is Markov with transition $\Gamma_{z,z'}$.
- The small open economy trades bonds with international lenders (often, but not always, borrows, hence borrower) and can default on them.
- Cost of defaulting reduces next period output and is increasing with the level of defaulted debt.
- Lenders are risk neutral.

Borrower

- Trades perpetuity bonds that decay at rate δ.
- Has coupons A, defaults on D, borrows B.

$$\begin{aligned} c &= y - (A - D) + q(z, A', D)\, B \\ D &\leq A \end{aligned}$$

- Total coupon obligations tomorrow.

$$A' = \delta\, A + B + (\, \bar{R} - \delta\,)\, D$$

- D remains as future obligations annuitized at rate $\bar{R}$.
- $D > 0$ has direct costs on endowment with $y' = z'\psi(D)$.
- Price functions $q(z, A', D)$ describe access to credit.

Recursive Problem: Borrower

- State: (z, A, y). Nature, what it owes, what it has.
- Choose consumption, new loans, and default.

$$V(z, A, y) = \max_{c,B,D} u(c) + \beta E\left\{V'(z', A, y')|z\right\}$$

s.t.

$$\begin{aligned} c &= y - (A - D) + q(z, A', D)\, B \\ A' &= \delta\, A + B + \bar{R}\, D \\ y' &= z'\, \psi(D), \qquad 0 \leq D \leq A. \end{aligned}$$

- Resulting policy functions: $B(z, A, y)$, and $D(z, A, y)$.

Recursive Problem: Lenders

- Take as given policy functions and discount at world's interest rate r.
- Value to a claim of one unit.

$$H(z,A,y) = \left(1 - \frac{D(z,A,y)}{A}\right) \qquad \text{Today}$$

$$\text{Tomorrow} \qquad + \frac{1}{1+r}\left(\delta + (\bar{R} - \delta)\frac{D(z,A,y)}{A}\right) E\{H(z',A',y')|z\}.$$

- A' and y' are determined by borrower's functions.

Bond Price and Equilibrium

- Zero profit condition determines price functions

$$q(z, A', D) = \frac{1}{1+r} \; E\{H(z'\psi(D), A', z')|z\}.$$

- Compensates for expected loss in default.
- Partial defaults give price of debt a long-term component.
- Markov equilibrium is the obvious thing. The small country maximizes given prices and the free entry condition given the expected return of loans.

Default as Expensive Debt

- Transfer future resources towards present with B or D.
- Let $w = y - A$ denote cash in hand.
- Standard consumption-savings trade-off:
  - Increase in consumption with B or D

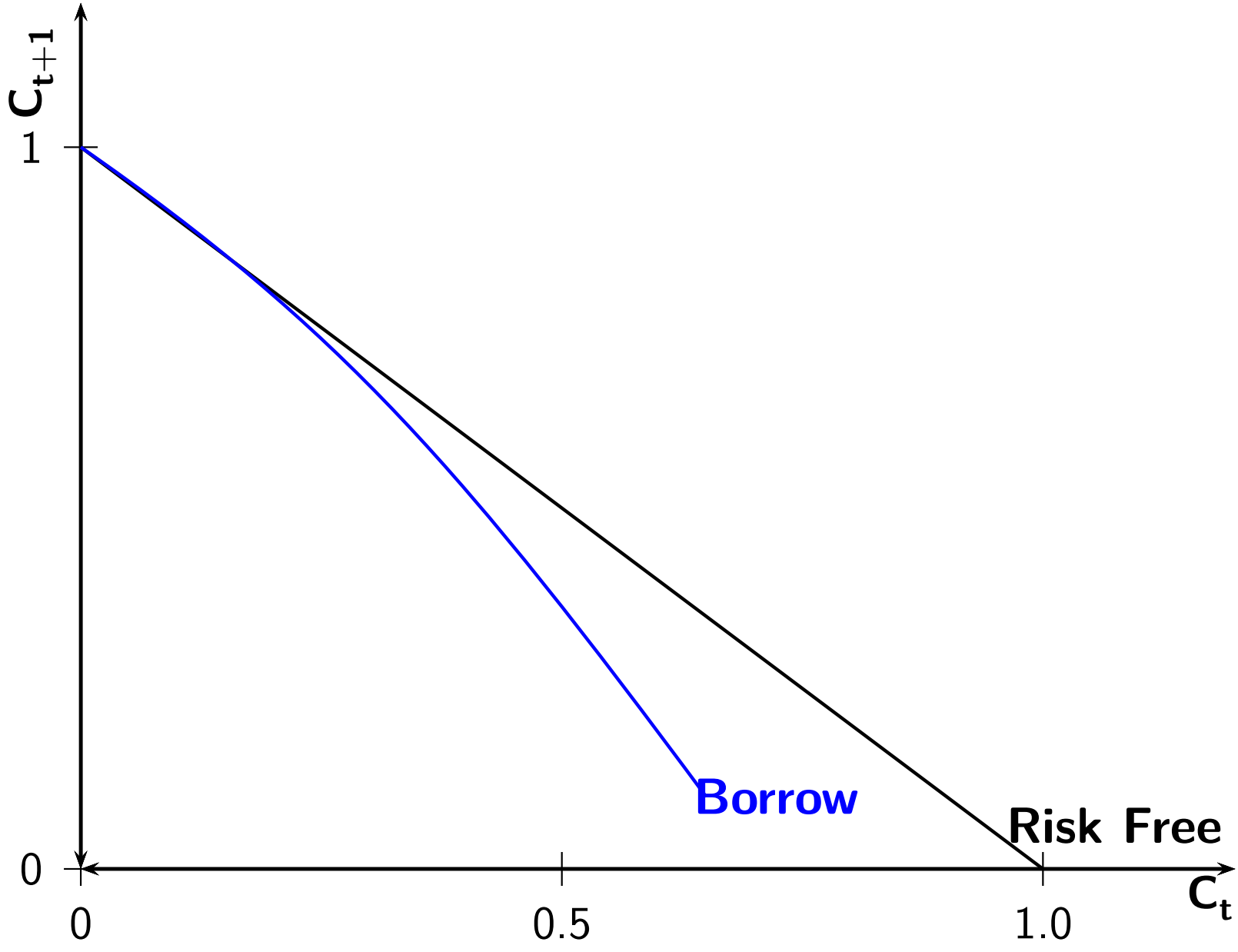
$$c - w = q(A', D, z)B + D$$

  - By reduction in cash on hand tomorrow

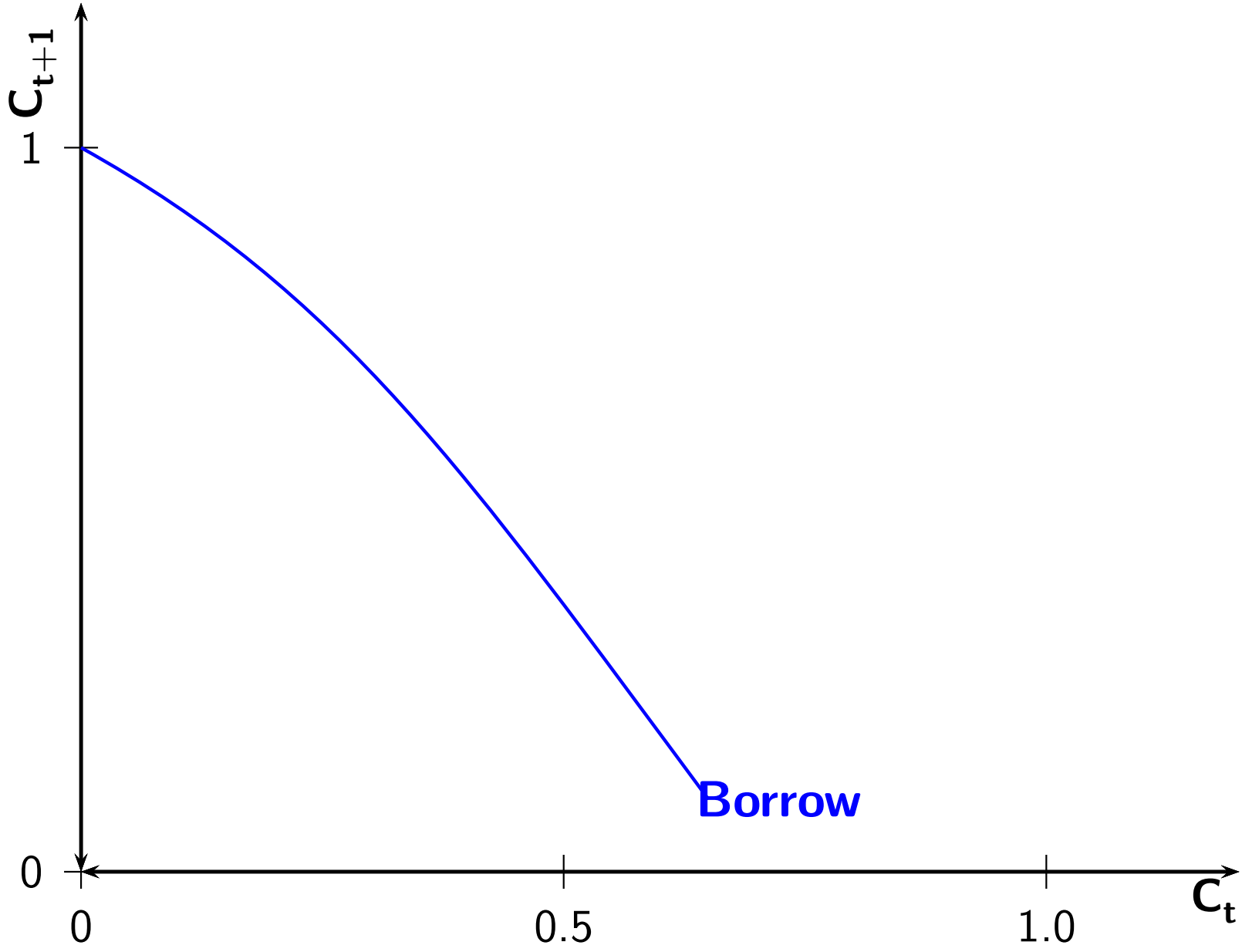
$$\begin{aligned} w' &= z'\psi(D) - A' \\ \text{with} \quad A' &= B - \bar{R}D, \quad D < A \end{aligned}$$

- B is restricted by $q(A', D, z)$.
- D is restricted by A and carries additional cost through $\psi(D)$.

Budget Constraint



Budget Constraint



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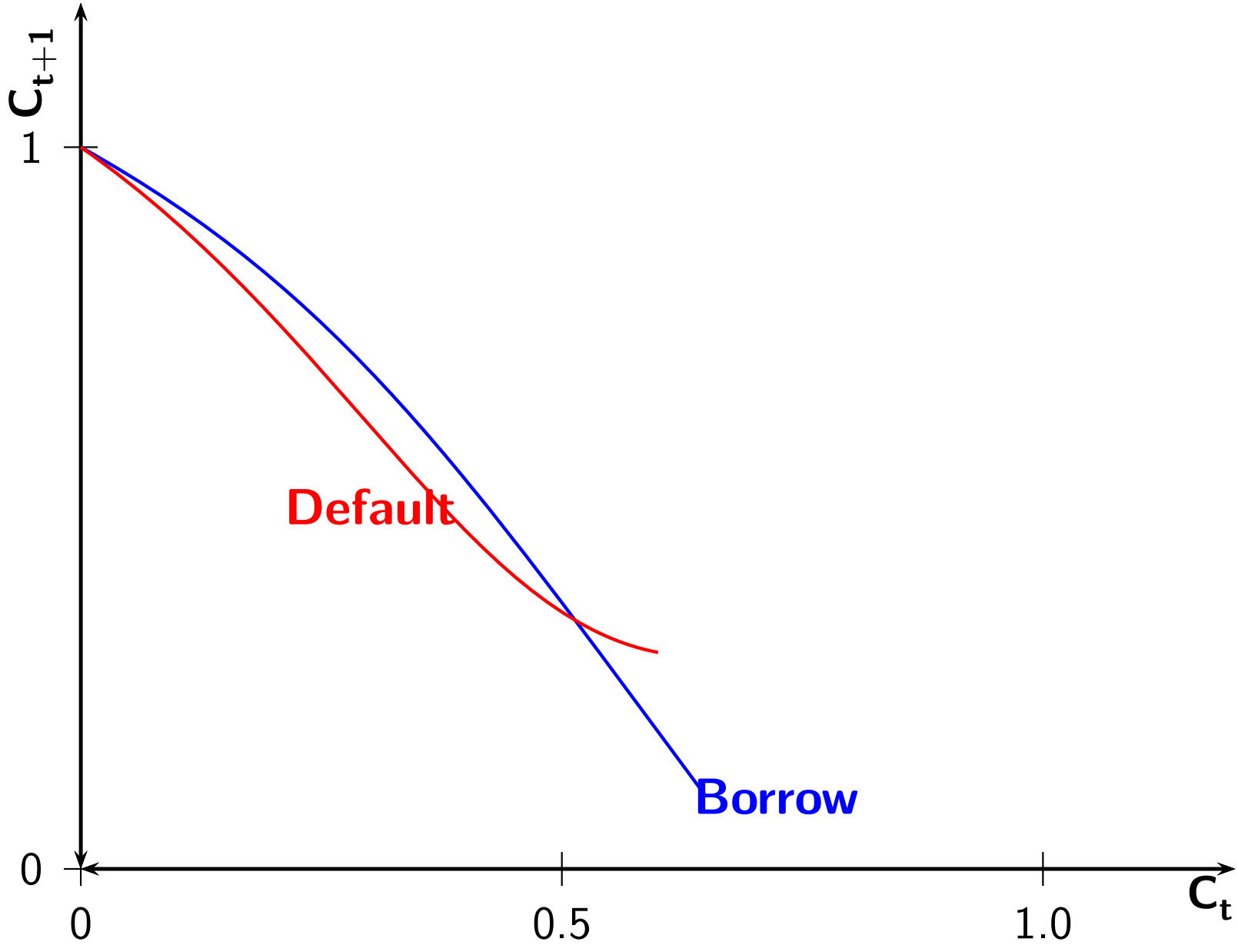
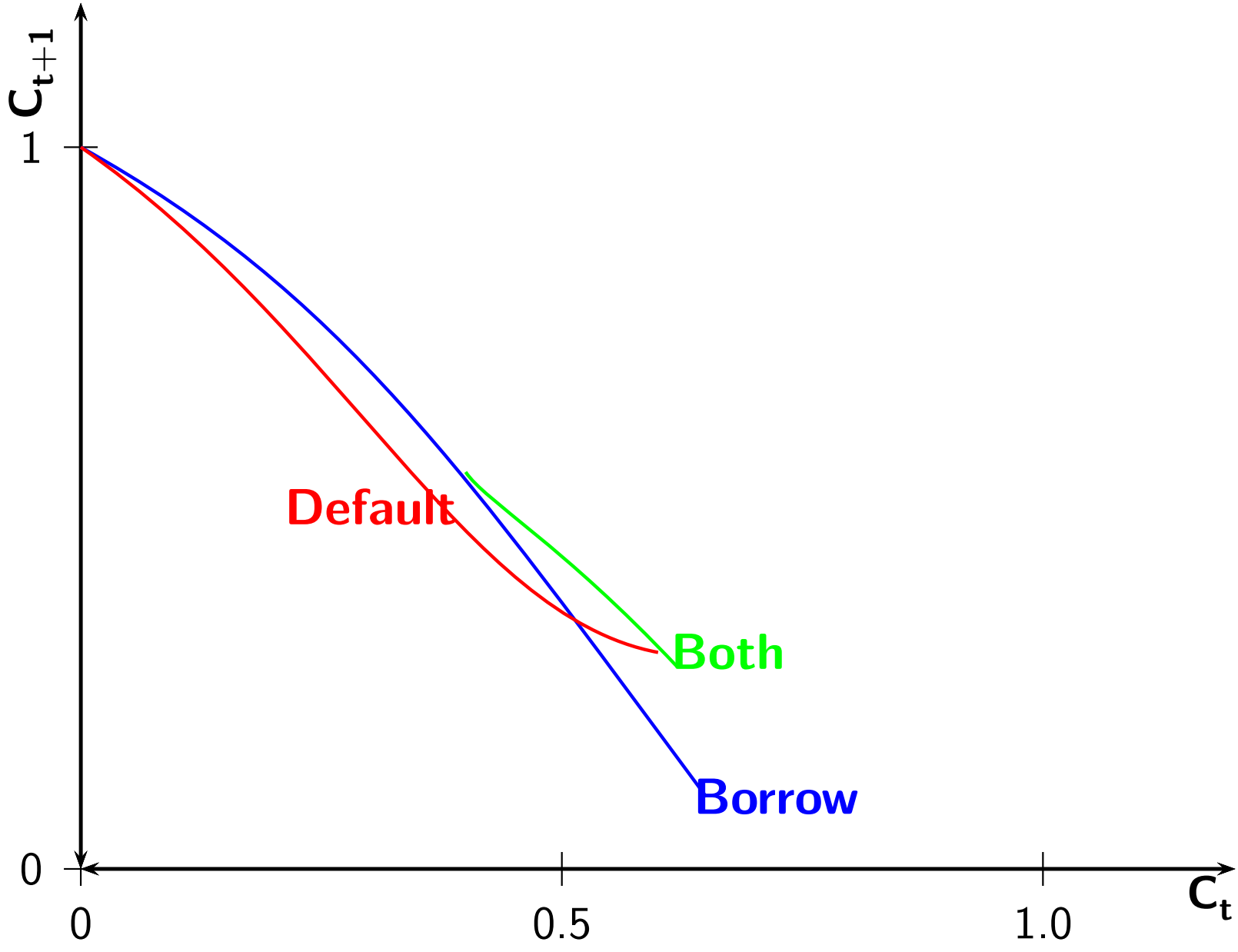


Budget Constraint



Variety of Examples

- Explore the numerical properties of these economies.
- We look for the properties in the data that we documented
  1. Sovereign defaults are partial.
  2. During defaults sovereigns continue to receive foreign credit.
  3. Larger defaults in downturns.
- Designed to resemble developing countries with a year.
  - There is a fixed cost to default.
  - Various economies that differ in the size of debt and persistency of shocks.

Numerical settings

- Default cost $y = z'\psi(D)$ decreasing and concave with lower bound

$$\psi(D) = \psi_0 \max\left\{\frac{(D-\bar{D})^2(\gamma\bar{D}+D)}{(0-\bar{D})^2(\gamma\bar{D}+0)}, \underline{\psi}\right\}$$

- Explore 3 experiments: High debt, low debt, and persistent shocks

- Common parameters: $\sigma = 2$, $r = 1.7\%$, $\delta = 0$, $\bar{R} = 0.80$, $\gamma = 0.5$, $\underline{\psi} = 0.9$.

Description	Parameter	Example 1 High Debt	Example 2 Low Debt	Example 2 Persistent
Shock process	z	iid with σ_H	iid with σ_H	Argentina
Penalty slope	$\bar{D}$	0.5	0.7	0.6
Fixed cost	ψ_0	0.99	0.99	0.995
Discount	β	0.85	0.85	0.94

Average statistics

	Data
Partial default	59%
Frequency of default	51%
Debt /Output	49%
Spread	–
During defaults:	
Debt/GDP	87%
Spreads	–
Arrears/Output	6.2%
New loans/Output	1.07%
Output relt. to Mean	-1.4%

Large frequency of partial defaults

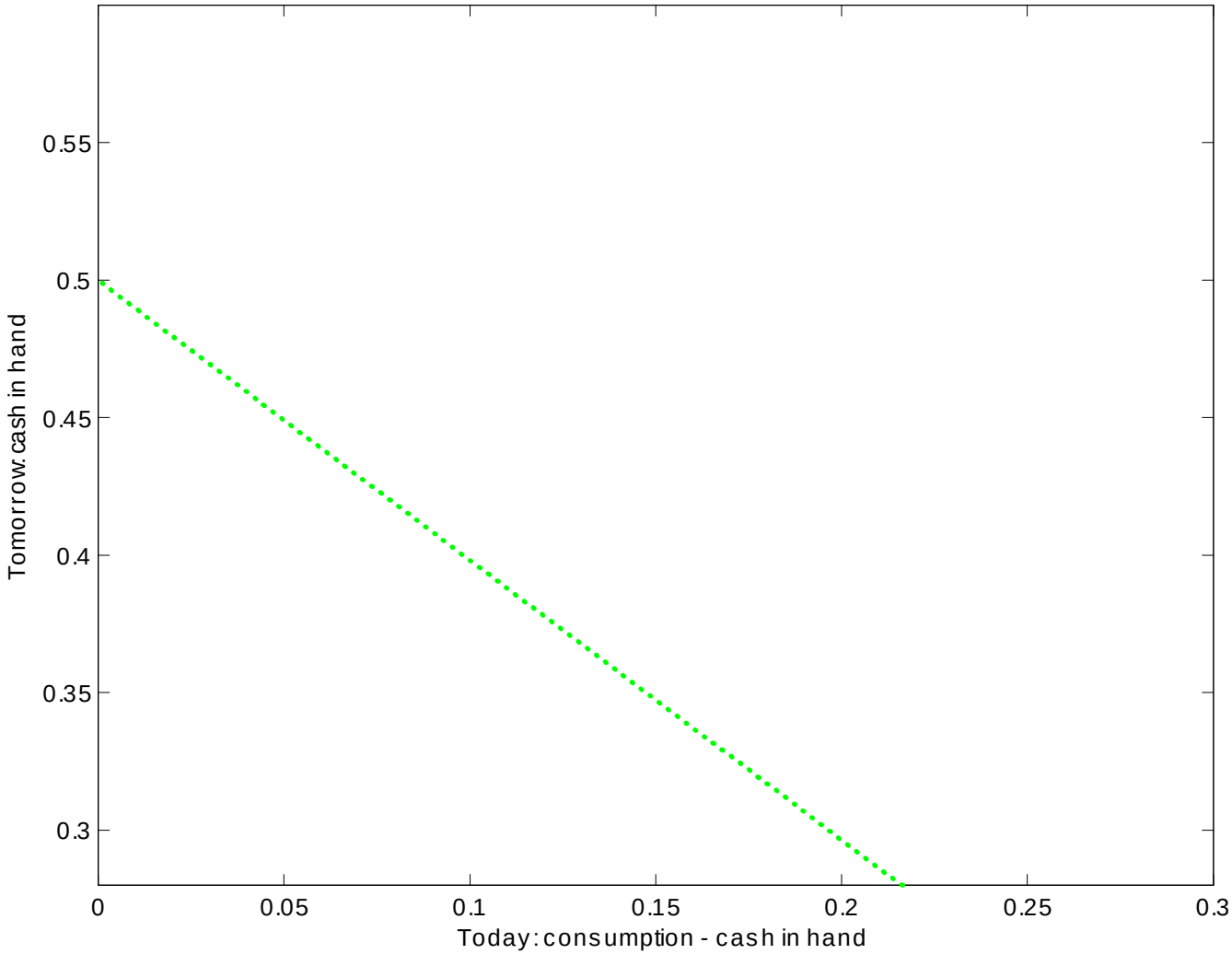
During defaults debt is large, output is low, countries continue to borrow

Average statistics

	Data	Examples		
		High Debt	Low Debt	Persistent
Partial default	59%	18%	100%	76%
Frequency of default	51%	11%	30%	74%
Debt /Output	49%	30%	1%	19%
Spread	–	0.5%	17%	1.5%
During defaults:				
Debt/GDP	87%	41%	5.5%	13%
Spreads	–	1.05%	43%	1.8%
Arrears/Output	6.2%	36%	5.5%	5.3%
New loans/Output	1.07%	7.3%	2%	8.6%
Output relt. to Mean	-1.4%	-15%	-8%	-4%

Examples confirm partial default is alternative credit

Intertemporal frontier: Only B



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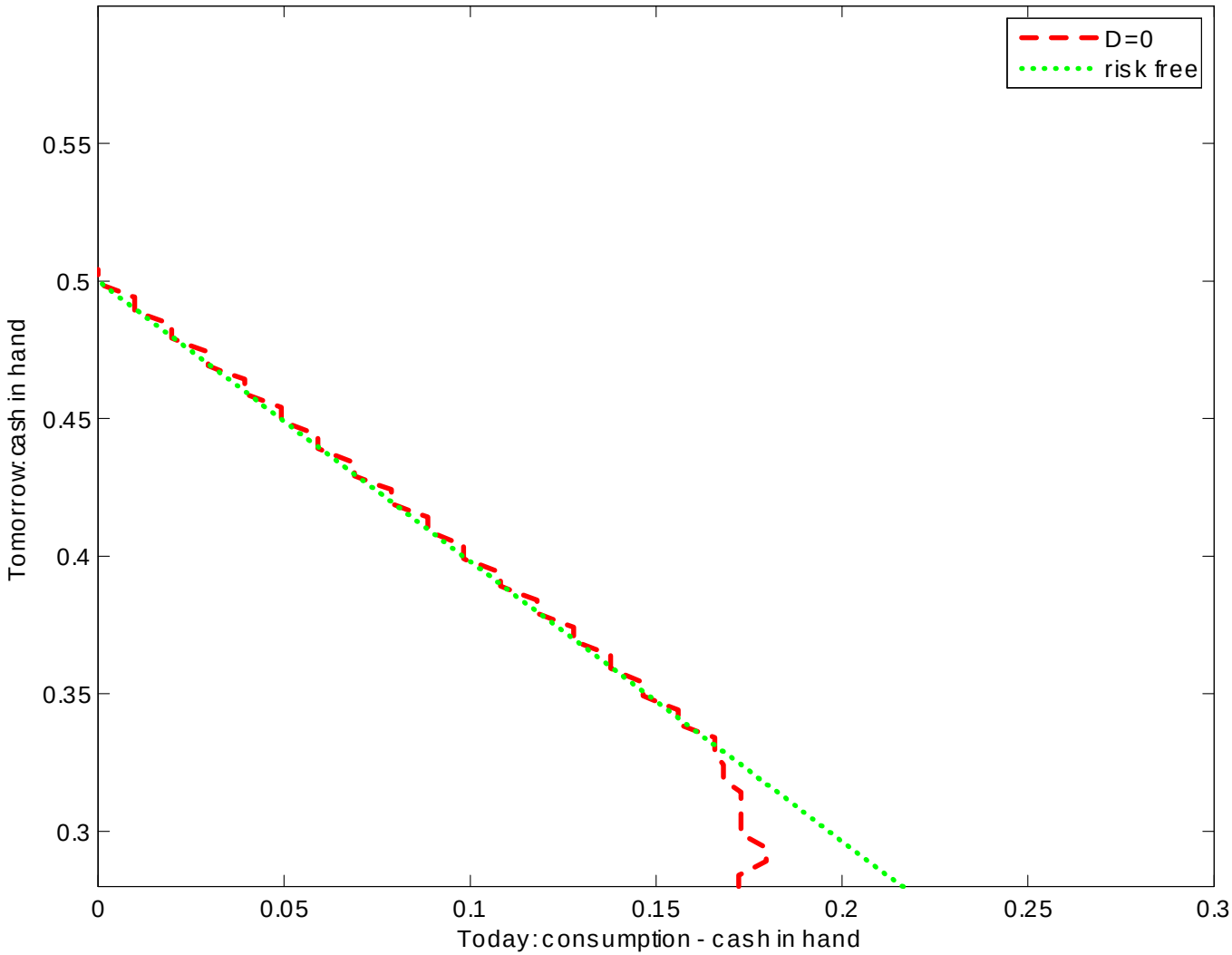
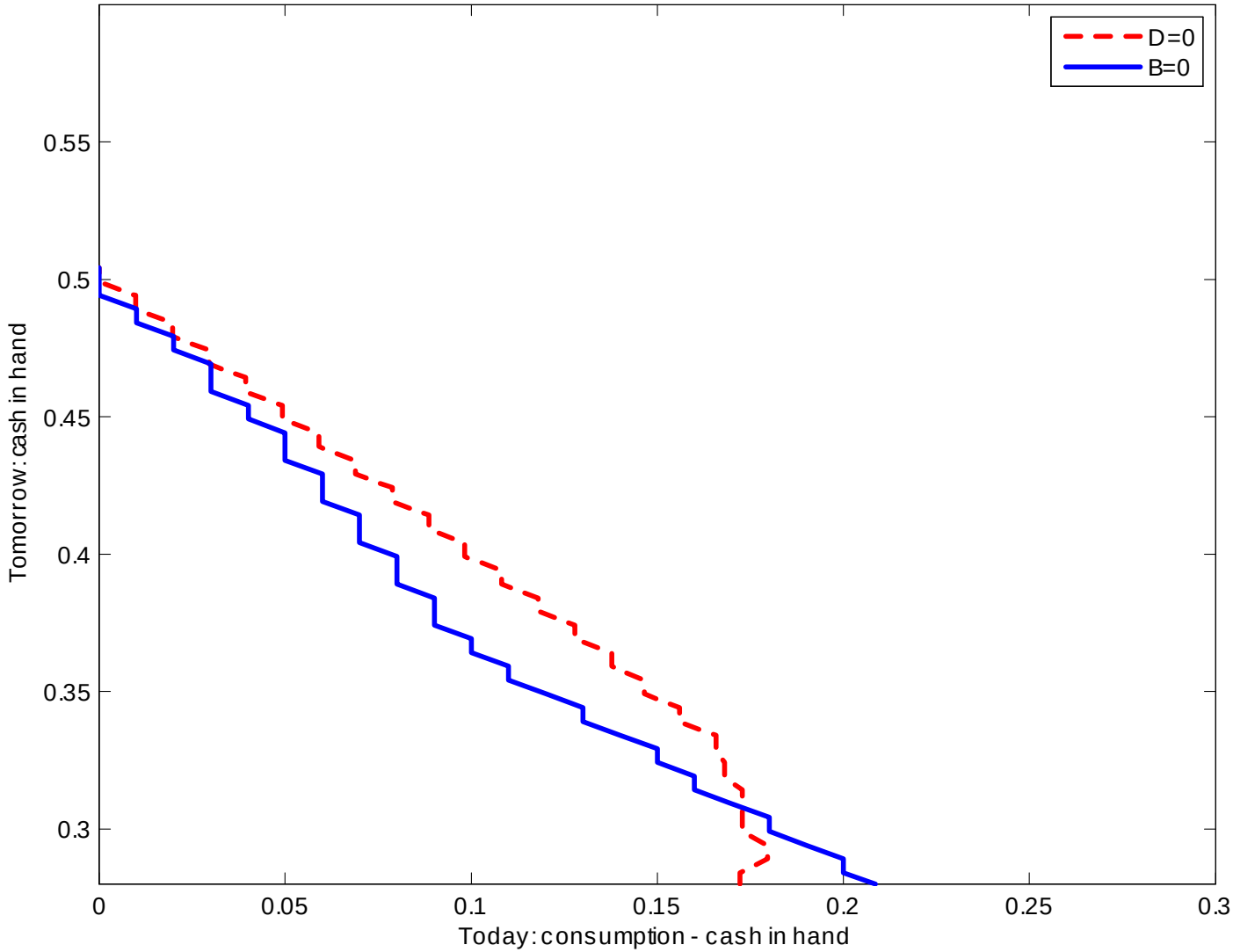


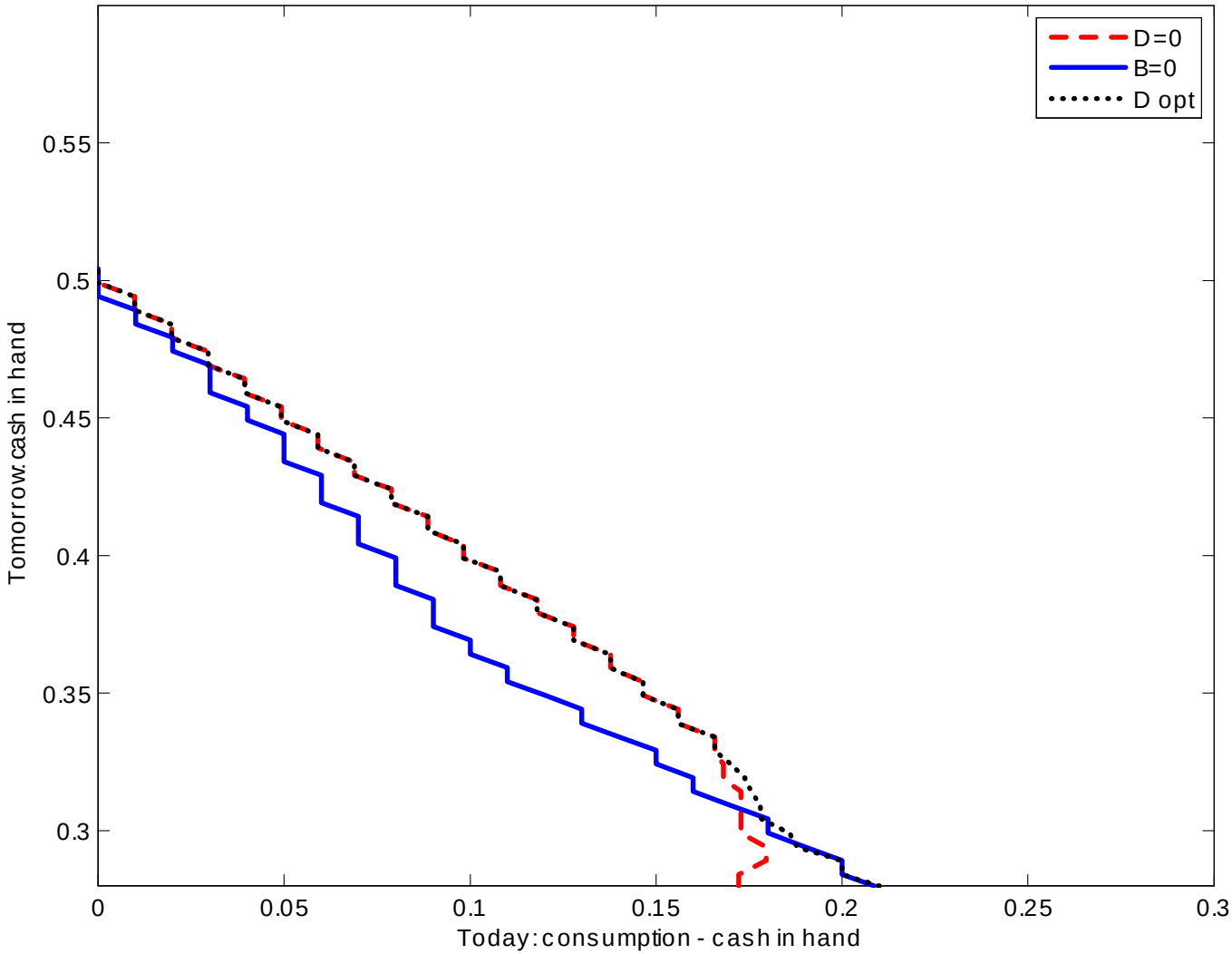
Concave frontier via $q(.)$ due to increasing default risk

Intertemporal frontier: Only D



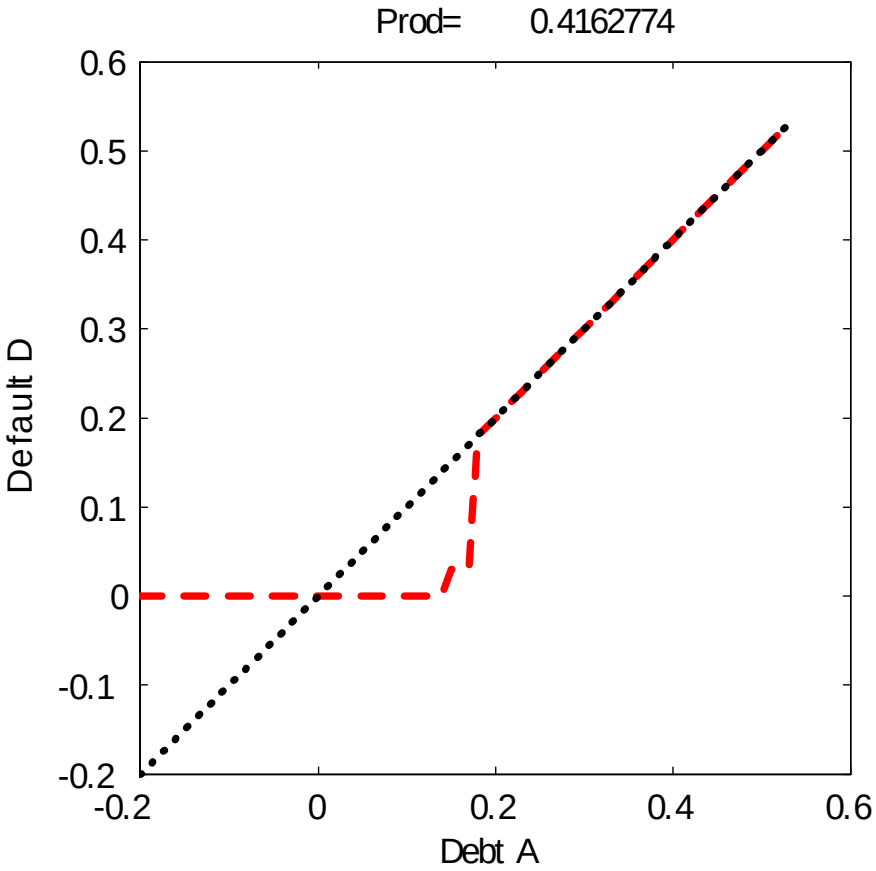
Shape of frontier depends on $\psi(D)$ and $\bar{R}$

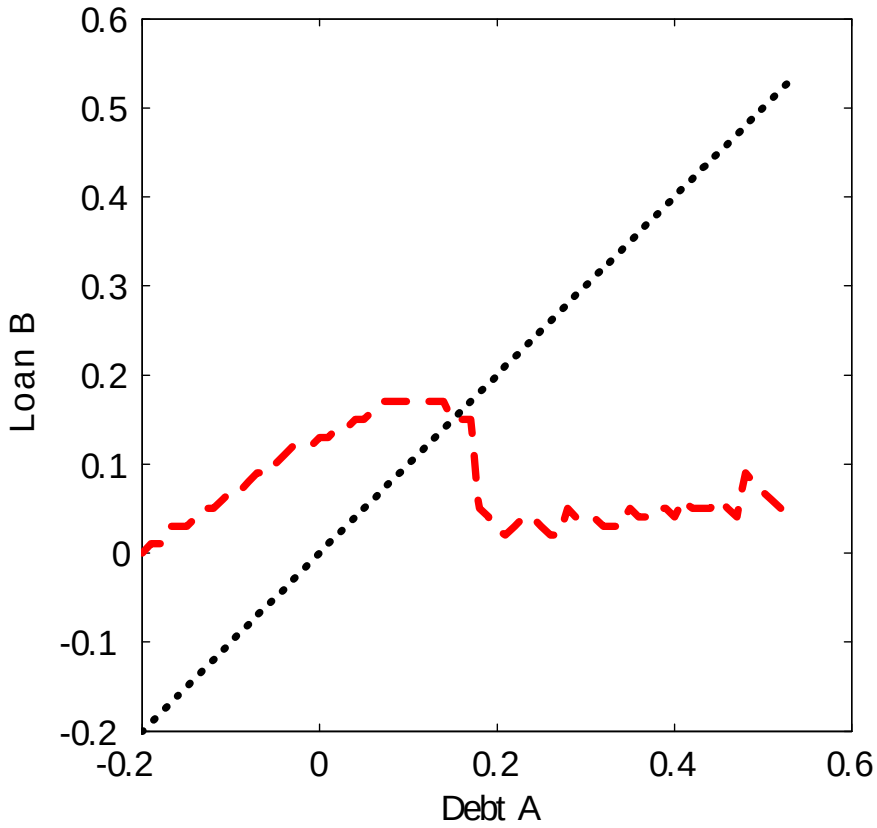
Intertemporal frontier: B and D



Smaller transfers with B, intermediate with $B + D$, large with D

Policy Functions: Borrow and Default

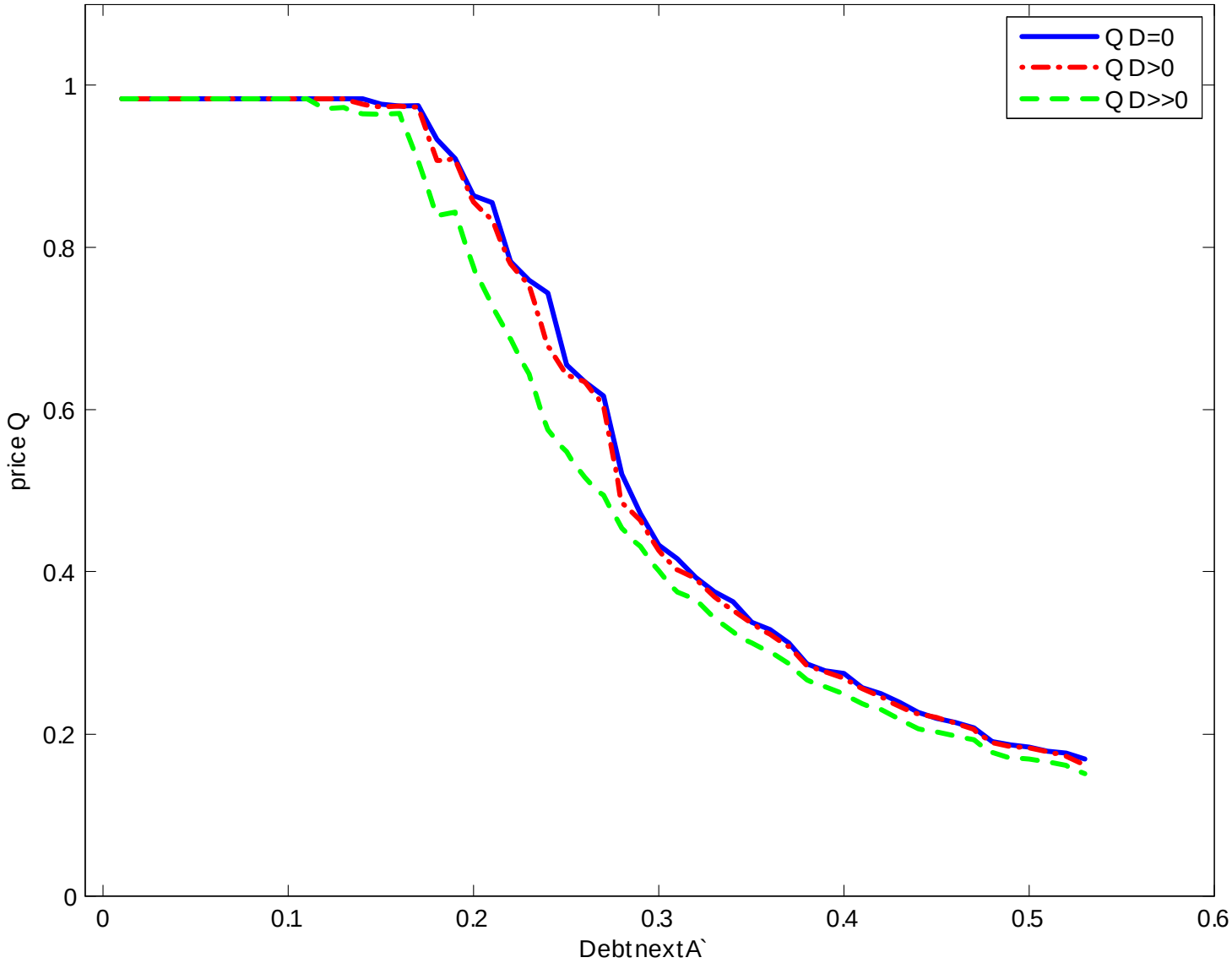




Small debt: $B > 0$, and $D = 0$

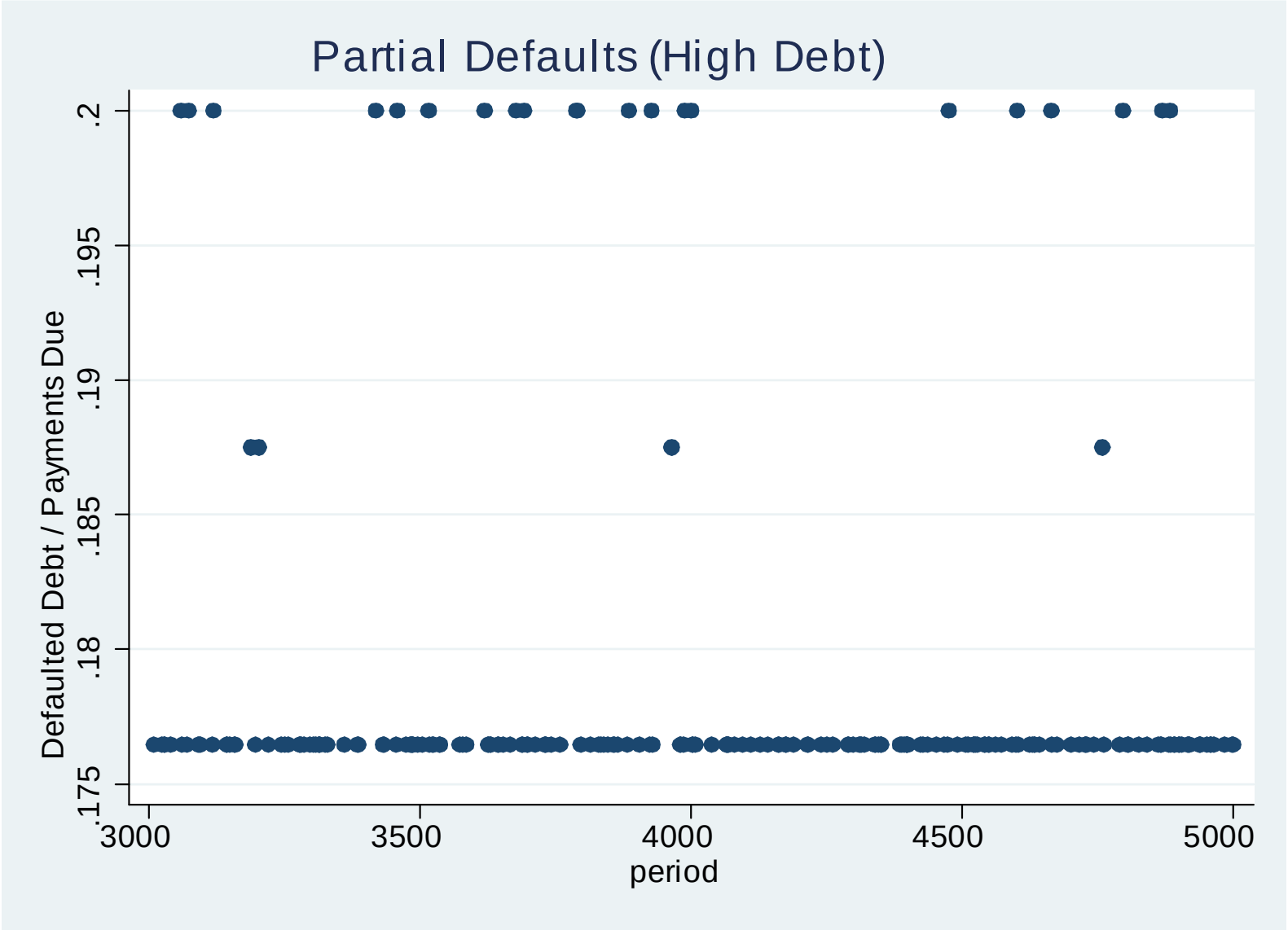
Large debt: $B = 0$, $D = A$. Endogenously borrow less due to bad price.

Policy functions: Prices



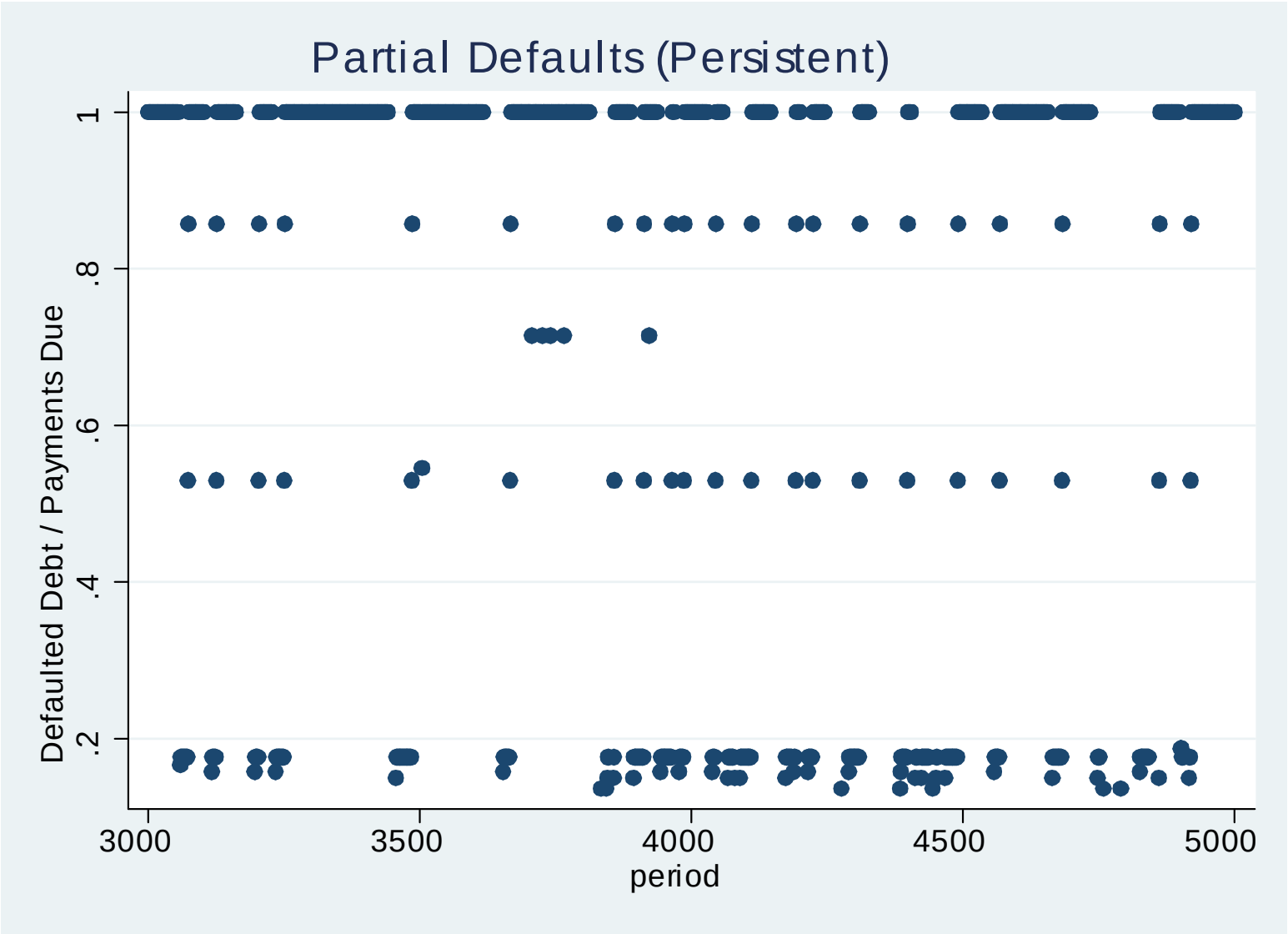
Price decreases with larger debt and is worse when default $D > 0$.

Implication 1: Partial Default



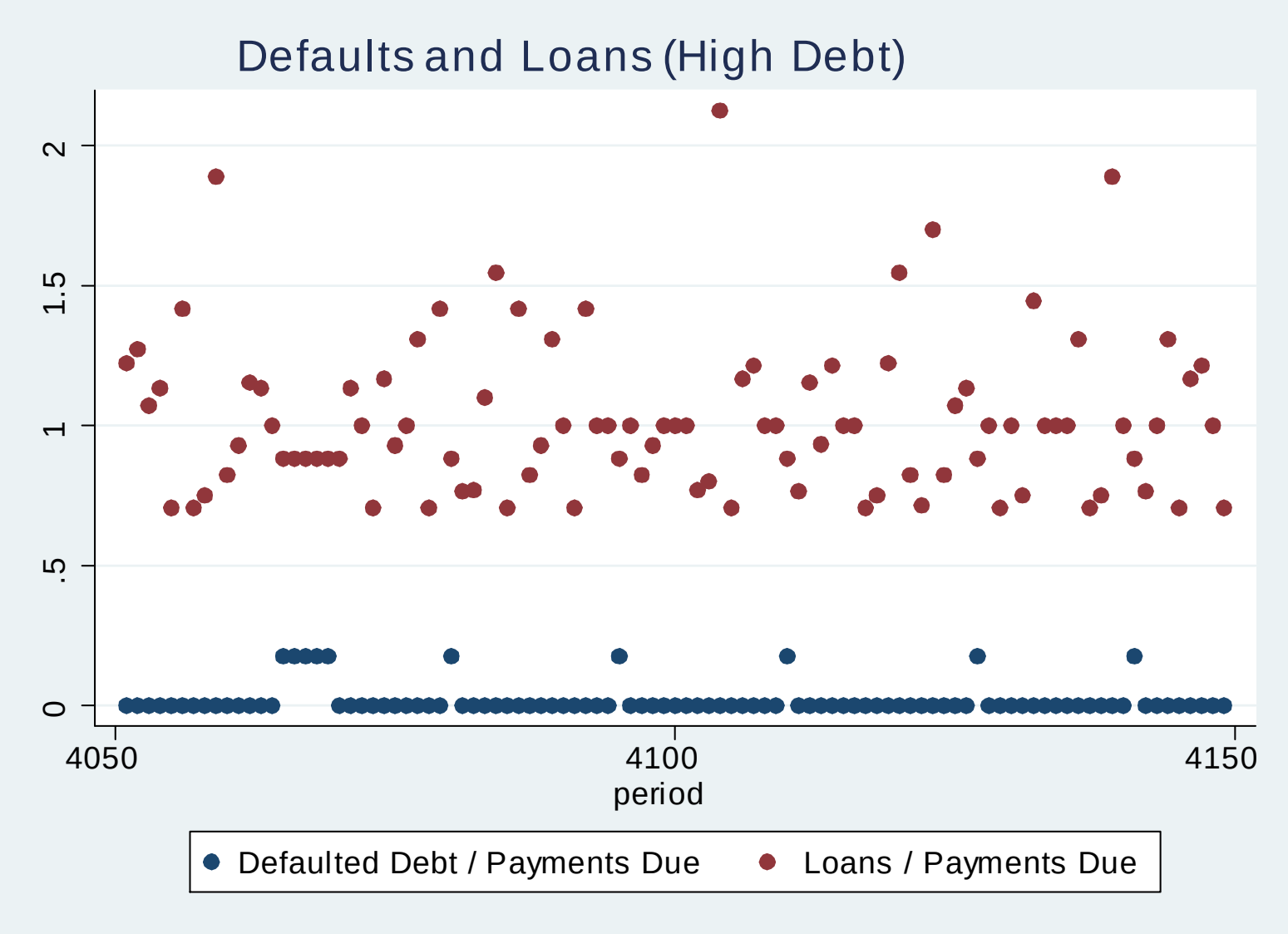
Default is always partial. Narrow range

Implication 1: Partial Default



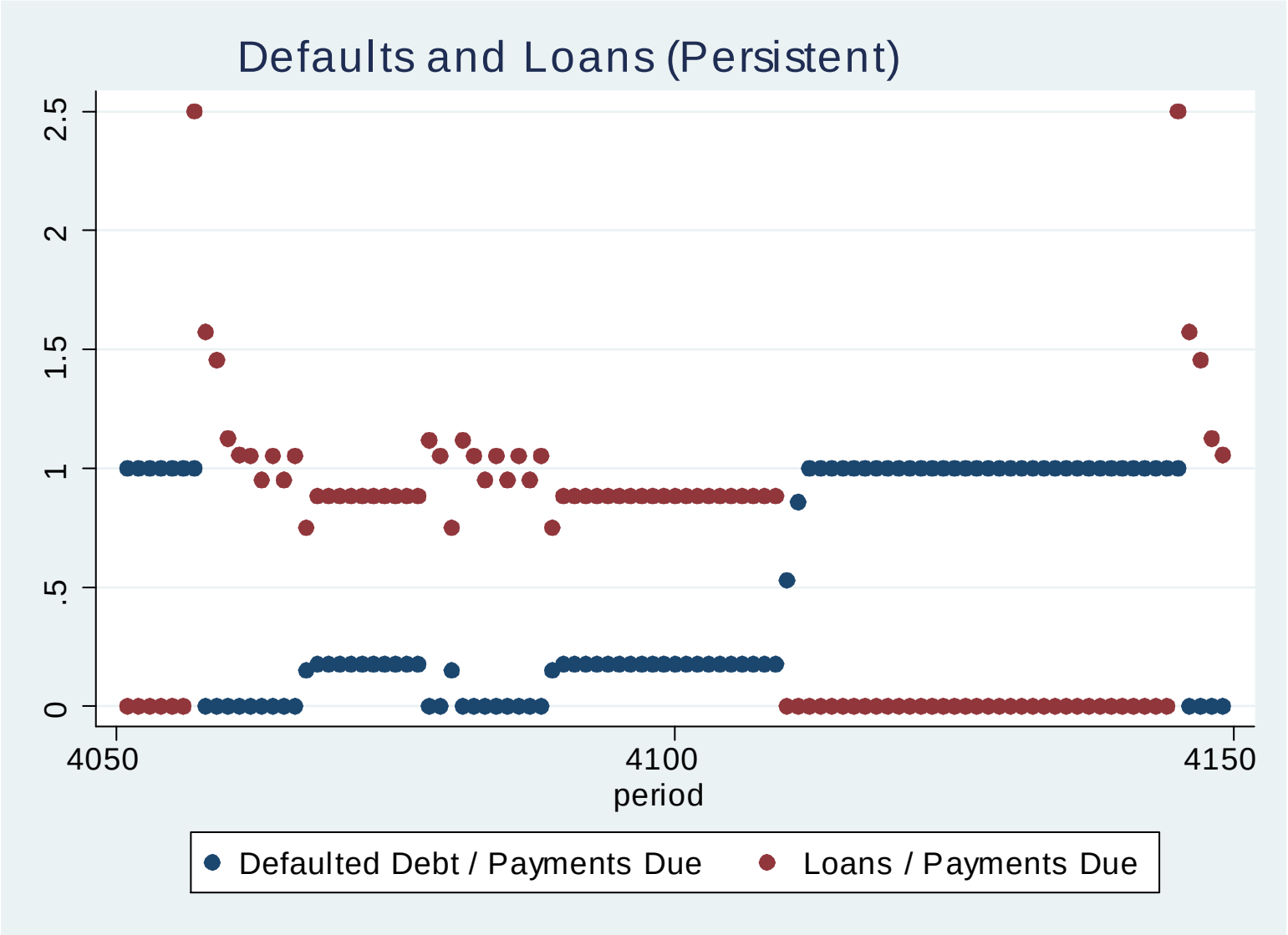
Wide range of partial default

Implication 2. Borrowing during Sovereign Default



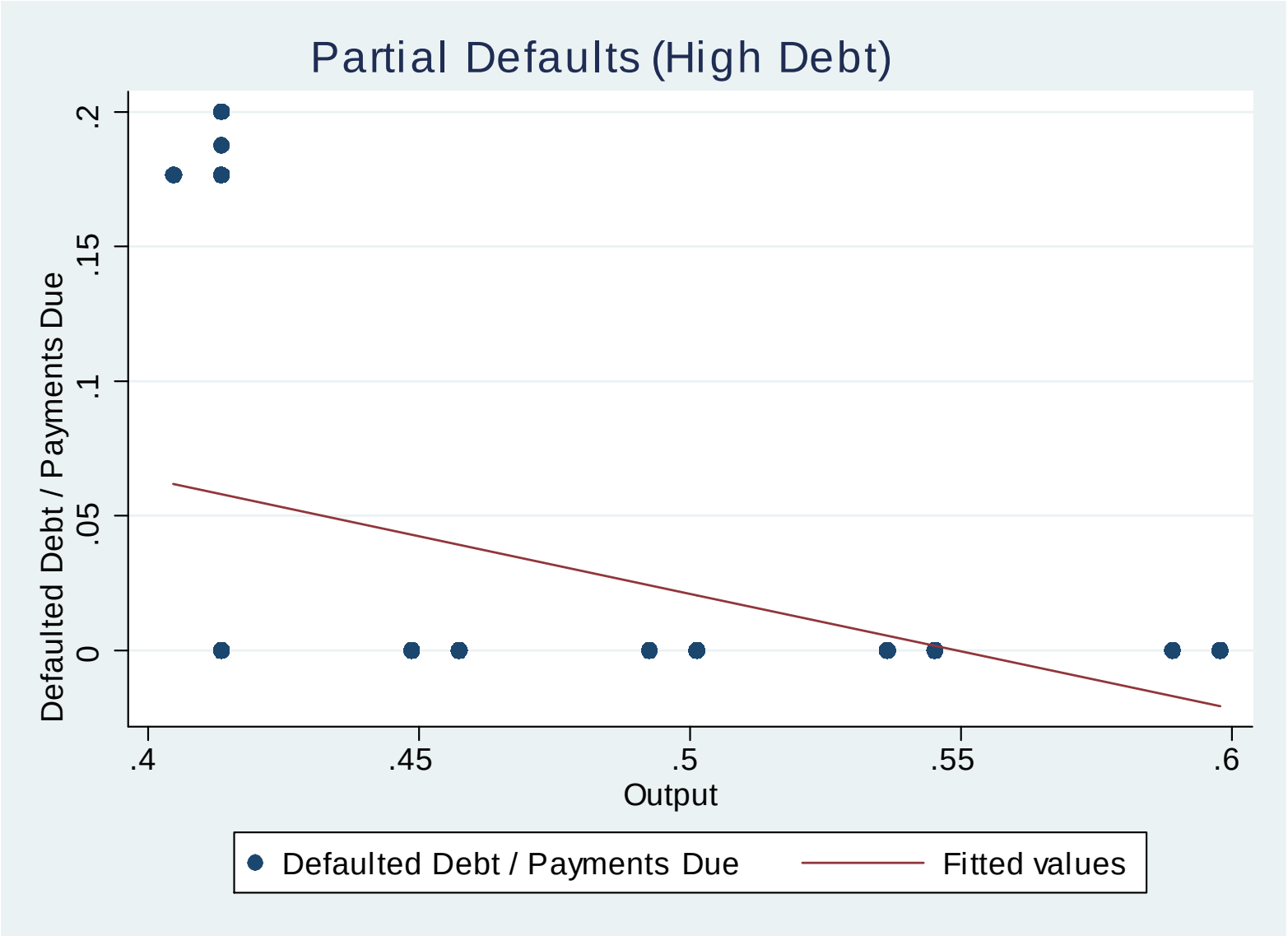
New loans are used much more actively than defaults

Implication 2. Borrowing during Sovereign Default



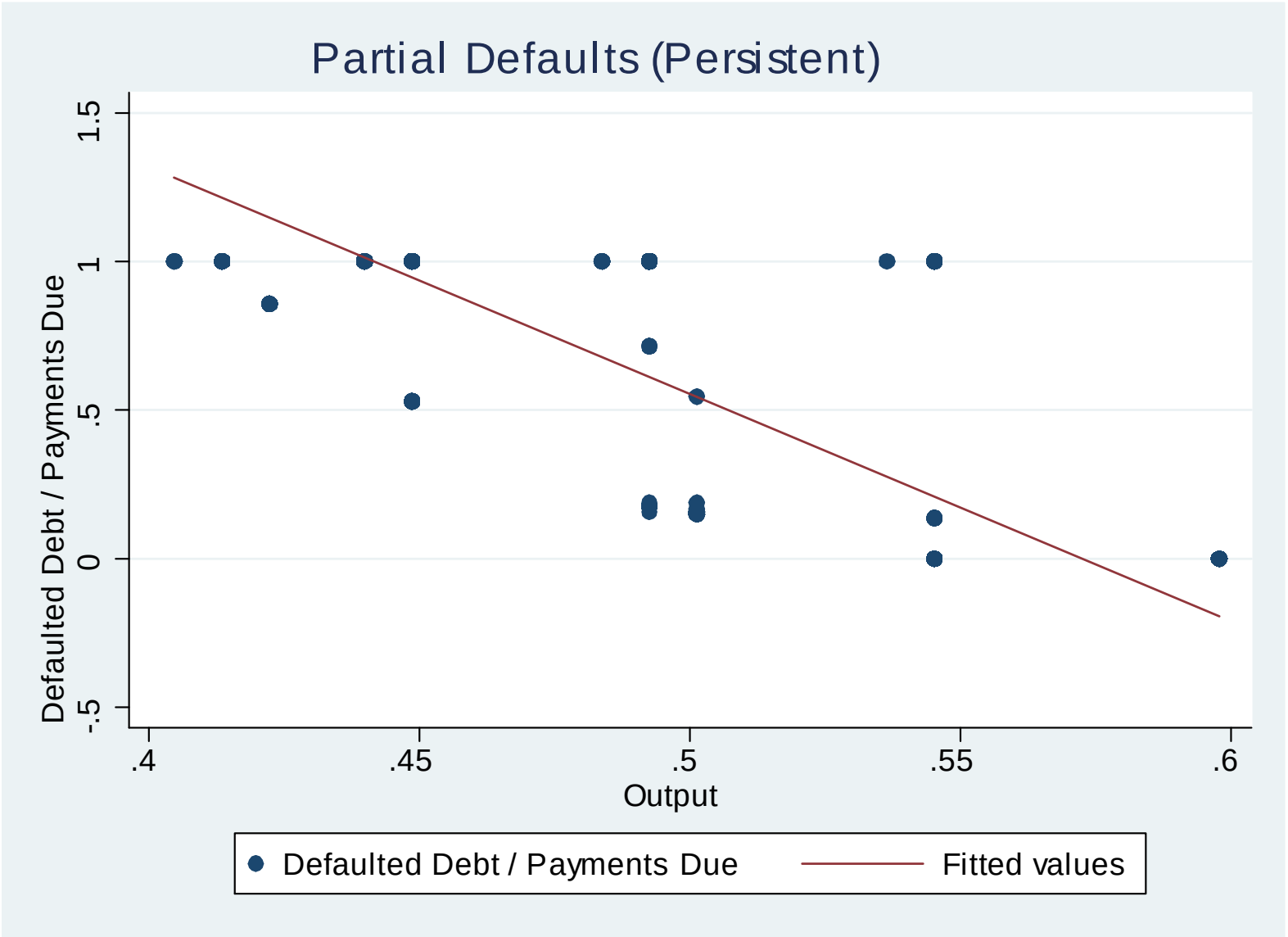
New loans and defaults actively used. Large substitution between two

Implication 3: Larger Default in Downturns



Defaults only with the lowest income

Implication 3: Larger Default in Downturns

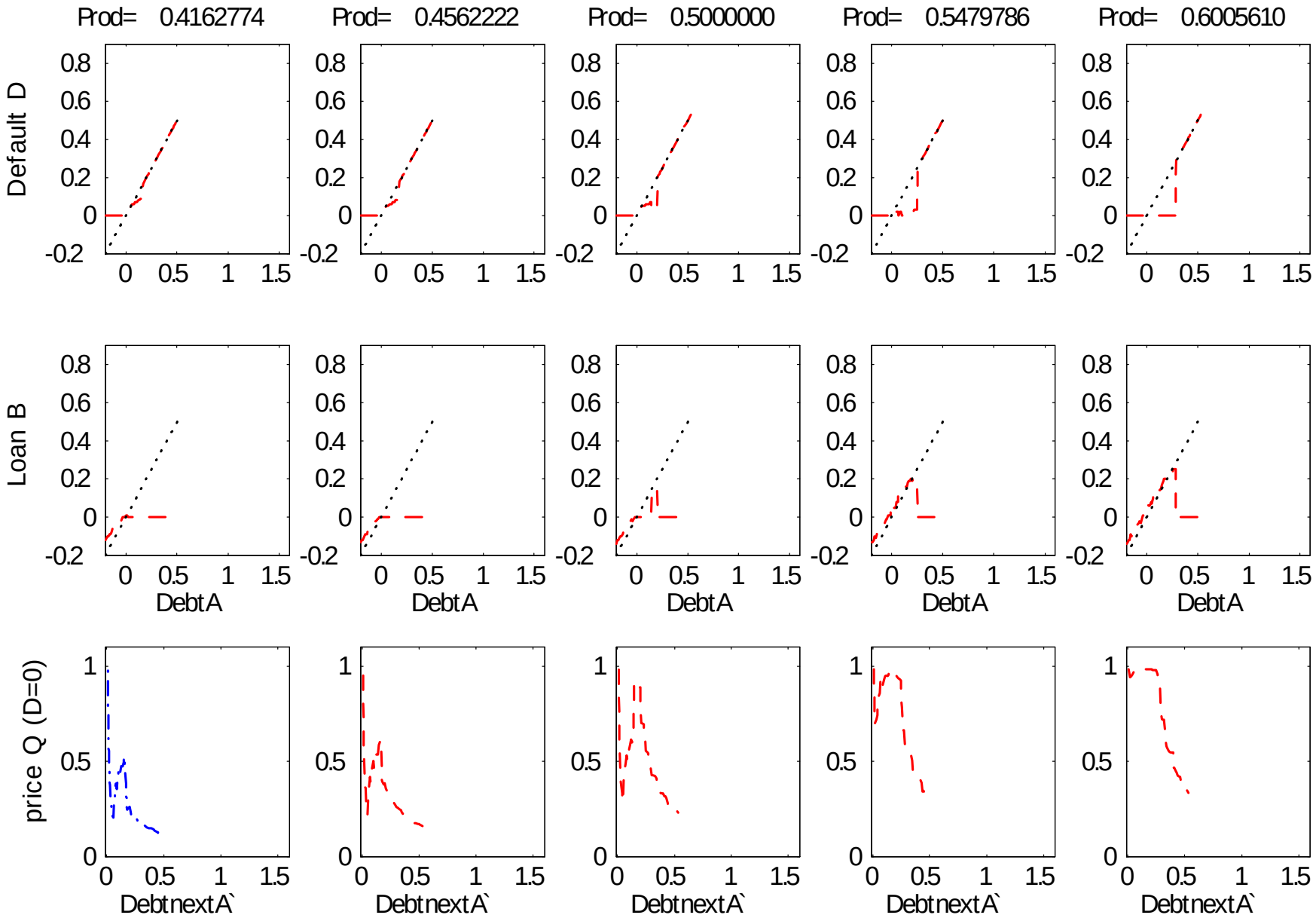


Larger defaults with lower income

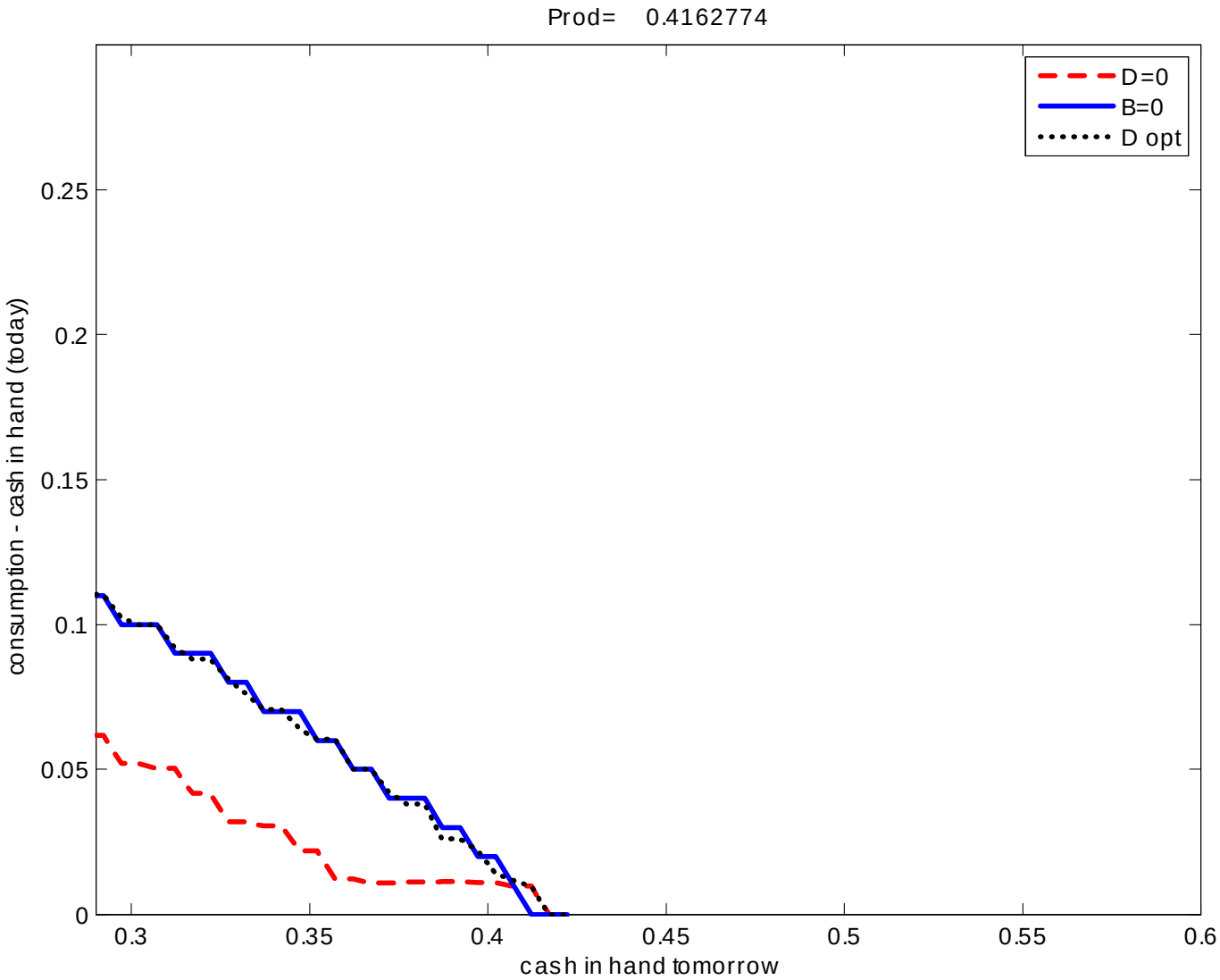
Conclusion

- Sovereign default is partial and countries continue to borrow during defaults.
- Propose new (Markovian) theory consistent with these facts .
- Continuing work: .
  - Take model to data. Move a bit out of examples.
  - Model as laboratory for recovering costs of default.
- Link it with partial individual default (Herkenhoff and Ohanian (13)).

Policy Functions: Persistent Case



Persistent case: Frontier low shock



Persistent case: Frontier high shock