Efficient Sovereign Default

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Sovereign Defaults in the Data

- Sovereign defaults (suspension of payments) are recurrent but infrequent events

- Associated with:
  - Severe output and consumption losses
  - Large fall in imports of intermediate goods
  - Maturity of debt shortens as default is more likely
Conventional Approach

Incomplete market approach to sovereign debt:

- Sovereign borrower can issue only non-contingent debt
- Sovereign borrower cannot commit to fully repay its debt

Typically:

- Exogenous maturity composition of debt
- Exogenous cost of default
- Markov equilibrium
Conventional View of Debt Crises

- Pervasive inefficiencies
  - Defaults due to incomplete contracts

- Excessive reliance on short-term debt causes crises
My Approach

As in conventional approach:

- Sovereign borrower can issue only non-contingent debt
- Sovereign borrower cannot commit to fully repay its debt

Extend by allowing for:

- Endogenous maturity composition of debt
- Endogenous cost of default (Production economy)
- Best equilibrium
My View of Debt Crises

- Best equilibrium outcome is constrained efficient

- High reliance on short-term when default is likely part of the efficient arrangement
  - Symptom, not cause
The best equilibrium outcome is the solution to an optimal contracting problem with two frictions:

- Lack of commitment by sovereign borrower
- Private information

- Non-contingent defaultable debt of multiple maturities sufficient to implement efficient outcome
Features of the Best Outcome

Recurrent but infrequent defaults associated with:

- Output and consumption losses
- Fall in imports of intermediate goods
- Maturity of debt shortens as indebtedness increases before default
Policy Implications

Defaults and associated costs (trade disruption) *not* driven by

- Market incompleteness
- The high reliance on short-term debt

But by the underlying informational and commitment frictions.

Therefore:

- Adding assets is irrelevant
- Policies that penalize short-term debt are welfare reducing
Contribution to the Literature

Incomplete market literature on sovereign default:


Extend by allowing for:

- Endogenous maturity composition of debt
- Endogenous cost of default (Production economy)
- Best equilibrium

Develop efficiency benchmark useful for policy analysis
Optimal dynamic contracting literature:

- Atkeson (1991) and Ales, Maziero, and Yared (2012)

Implementation: Relate efficient outcome to data on default, bond prices, maturity composition of debt
Outline

- Physical Environment
  - Baseline economy
  - Isomorphic taste shock formulation

- Sovereign Debt Game
  - Best Equilibrium Outcome is Efficient

- Characterization of Efficient Allocation

- Implementation
  - Default, Bond Prices, and Maturity Composition of Debt

- Relate to Evidence
PHYSICAL ENVIRONMENT
Baseline Economy

- $t = 0, 1, \ldots, \infty$

- 2 types of agents:
  - Foreign lenders
  - Domestic agents (government)

- 3 types of goods:
  - Intermediate good, $m$
  - Domestic consumption good, $y$ (Non-Tradable)
  - Export good, $y^*$
Foreign Lenders

- Risk neutral, discount factor $q \in (0, 1)$

- Value consumption of the export good

- Large endowment of the intermediate good

- Technology of the foreign lenders is such that relative price between intermediate and export good is one
Domestic Agents

- Preferences over domestic consumption good

$$E_0 \sum_{t=0}^{\infty} \beta^t U(y_t)$$

with $U$ strictly increasing and concave, and $\beta \leq q$

- Endowed with 1 unit of labor
Domestic Technology

- Domestic consumption and export good produced using
  - \( \ell \): domestic labor
  - \( m \): imported intermediate good

\[
y = z F(m_1, \ell_1) \quad y^* = F(m_2, \ell_2)
\]

\[
m_1 + m_2 \leq m \quad \ell_1 + \ell_2 \leq 1
\]

- \( z \) is the productivity of domestic sector:
  \( z \in \{z_L, z_H\} \) iid according to \( \pi \)

- \( F \) CRS, \( F(0, 1) > 0, \lim_{m \to 0} F_m(m, \ell) = \infty \)

- Let \( f(m) = F(m, 1) \)
Observables in the Baseline Economy

- Domestic consumption and export good produced using
  - $\ell$: domestic labor
  - $m$: imported intermediate good

\[
y = zF(m_1, \ell_1) \quad y^* = F(m_2, \ell_2)
\]

\[
m_1 + m_2 \leq m \quad \ell_1 + \ell_2 \leq 1
\]

- Foreign lenders observe inputs devoted to domestic consumption, $m_1, \ell_1$

- Cannot observe $z$ or $y$, only $y/z$

- Let $c \equiv y/z$ be “consumption” of resources devoted to domestic good production
Observables in the Baseline Economy

- Domestic consumption and export good produced using
  - $\ell$: domestic labor
  - $m$: imported intermediate good

\[
y = zF(m_1, \ell_1) \quad y^* = F(m_2, \ell_2)
\]

\[
m_1 + m_2 \leq m \quad \ell_1 + \ell_2 \leq 1
\]

- The technological restrictions boil down to

\[
\frac{y}{z} + y^* = c + y^* \leq f(m)
\]
Rewrite as a Taste Shock Economy

If $U(y) = \frac{y^{1-\gamma}}{1-\gamma}$, let $c = \frac{y}{z}$ and $\theta = z^{1-\gamma}$

With this change of variable:

- Domestic agent preferences

$$\sum_{t=0}^{\infty} \sum_{\theta^t} \beta^t \Pr(\theta^t) \theta_t U(c(\theta^t))$$

- Domestic resource constraint

$$c + y^* \leq f(m)$$
Rest of the Talk

- Present the results using the taste shock notation

- Under the assumption $\gamma > 1$:
  
  High taste shock corresponds to low productivity shock

  $$\theta_H = z_L^{1-\gamma} > \theta_L = z_H^{1-\gamma}$$

  With either low productivity or high taste shock, marginal utility of imported intermediates is high

- Refer to $c = y/z$ as consumption
SOVEREIGN DEBT GAME
Players

- Benevolent domestic government
- Private domestic firms
- Foreign exporters
- Foreign lenders (debt-holders)
Foreign exporters choose $p_t$

Foreign lenders choose $q_t$

Gov't chooses policy $(h_t, \theta_t)$
Timing

Foreign exporters choose

Firms

choose \( p_t \) \quad m_t

Gov't chooses policy

Gov't private history \((h_t, \theta_t)\)

Foreign lenders choose debt prices, \( q_t \)
Timing

Foreign exporters choose $p_t$ and $m_t$ (private info)
Timing

Foreign exporters choose debt prices, $q_t$

Foreign Firms choose $\theta_t$ is realized

Gov’t chooses policy

choose $p_t$, $m_t$ (private info)
Foreign exporters choose $p_t$, $m_t$ (private info)

$\theta_t$ is realized

Gov’t chooses policy

Foreign lenders choose debt prices, $q_t$
Gov’t Policies: Capital Controls and Debt Policies

- Government taxes payment by firms to foreign exporters at rate \( \tau_t \)
  - Interpret as \textit{capital controls}
  - Revenue = \( \tau_t p_t m_t \)

- Government issues two non-contingent defaultable bonds
  - Short-term: 1 period
    - \( b_{S,t+1} \): amount issued
    - Promise to pay \( b_{S,t+1} \) next period
  - Long-term: Consol
    - \( b_{L,t+1} \): amount issued
    - Promise to pay \( b_{L,t+1} \) in every subsequent period
Gov’t Policy: Default and Payment of Debt

Three levels of payment at $t$, $\delta_t \in \{1, r, 0\}$

- $\delta_t = 1$: Full payment
- $\delta_t = r \in (0, 1)$: Partial payment
  - Pay $r$ to each short-term debt holder
  - Pay $\frac{r}{1-q}$ to each long-term debt holder
- $\delta_t = 0$: Suspension of payments in current period

The government is in default whenever $\delta_t < 1$
Timing

Foreign exporters choose realized debt prices, $q_t$

Firms choose $p_t$ and $m_t$ (private info)

Gov’t chooses $g_t = (\tau_t, \delta_t, b_{t+1})$

Foreign lenders choose debt prices, $q_t$
Timing

Public History

\[ h^{t-1}, (h^{t-1}, p_t) \quad h^t = (h^{t-1}, p_t, m_t) \quad h^t = (h^t, g_t) \]

Foreign exporters choose \( p_t, m_t \) (private info) \( \theta_t \) is realized \( g_t = (\tau_t, \delta_t, b_{t+1}) \)

Gov’t chooses

Foreign lenders choose debt prices, \( q_t \)

Gov’t private history \( (h^t_g, \theta_t) \)
Consistent with lenders’ arbitrage condition

\[ q_S(h^t) = q\mathbb{E} \left[ \chi_S(h^{t+1}) | h^t \right] \]

where

\[ \chi_S(h^{t+1}) = \begin{cases} 
1 & \text{if } \delta_{t+1} = 1 \\
r & \text{if } \delta_{t+1} = r \\
q\mathbb{E} \left[ \chi_S(h^{t+2}) | h^{t+1} \right] & \text{if } \delta_{t+1} = 0 
\end{cases} \]
Pricing Function: Long-Term Bond

Consistent with lenders’ arbitrage condition

\[ q_L(h^t) = q \mathbb{E} \left[ \chi_L(h^{t+1}) | h^t \right] \]

where

\[ \chi_L(h^{t+1}) = \begin{cases} 
1 + q_L(h^{t+1}) & \text{if } \delta_{t+1} = 1 \\
\frac{r}{1-q} & \text{if } \delta_{t+1} = r \\
q \mathbb{E} \left[ \chi_L(h^{t+2}) | h^{t+1} \right] & \text{if } \delta_{t+1} = 0
\end{cases} \]
Government Budget Constraint

- If there is full payment, $\delta = 1$:

$$c + b_S + b_L \leq Y(\tau) + q_S(h_{g, t}^t, g)b_S' + q_L(h_{g, t}^t, g)(b_L' - b_L)$$

- If there is partial payment, $\delta = r$:

$$c + \left(b_S + \frac{b_L}{1-q}\right)r \leq Y(\tau) + q_S(h_{g, t}^t, g)b_S' + q_L(h_{g, t}^t, g)b_L'$$

- If there is suspension of payments, $\delta = 0$:

$$c \leq Y(\tau) \quad \text{and} \quad \left(b_S', b_L'\right) = \left(b_S, b_L\right)$$

where $Y(\tau) = f(m_t) - (1 - \tau)p_t m_t$
Trade: Private Agent’s Optimality

- Foreign exporters no-arbitrage condition:

\[ 1 = \mathbb{E} [p_t(h^{t-1}) (1 - \tau(h^t_g, \theta_t)) | h^{t-1}] \]

- Firms’ optimality:

\[ f'(m(h_m^t)) = p(h_{t-1}^t) \]
A sustainable equilibrium is \((\sigma, p, m, q)\) such that for all histories

- The government’s strategy, \(\sigma\), maximizes domestic agents utility subject to budget constraints given private strategies
- Given the government’s strategy, private strategies are such that:
  - \(p\) is consistent with foreign exporters’ arbitrage condition
  - \(m\) satisfies firms’ optimality
  - \(q\) is consistent with foreign lenders’ arbitrage condition
Worst Equilibrium

- Assumption: Lenders can deny access to foreign savings
- Autarky is the worst equilibrium for the government
- Value associated with autarky is

\[ v_a = \frac{\mathbb{E}(\theta)U(f(0))}{1 - \beta} \]
Sustainable Equilibrium Outcome

- Focus on outcomes:
  - What happens along the equilibrium path

- Denote outcomes as $y = (x, g, p)$ where

$$
x = \{m(\theta^{t-1}), c(\theta^t), y^*(\theta^t)\}_{t=0}^{\infty}
$$

$$
g = \{\tau(\theta^t), \delta(\theta^t), b_S(\theta^t), b_L(\theta^t)\}_{t=0}^{\infty}
$$

$$
p = \{p_t(\theta^{t-1}), q_S(\theta^t), q_L(\theta^t)\}_{t=0}^{\infty}
$$

and $v(\theta^t) = \text{continuation value for the domestic agent}$
BEST SUSTAINABLE EQUILIBRIUM OUTCOME IS CONSTRAINED EFFICIENT
Incentive Compatibility and Sustainability Constraint

Any sustainable equilibrium outcome must satisfy

- Incentive Compatibility Constraint

\[ \theta_t U(c(\theta^t)) + \beta v(\theta^t) \geq \theta_t U(c(\theta^{t-1}, \theta')) + \beta v(\theta^{t-1}, \theta') \] (IC)

Government must have no incentive to conduct undetectable deviations
Incentive Compatibility and Sustainability Constraint

Any sustainable equilibrium outcome must satisfy

- **Sustainability Constraint**

\[\theta_t U(c(\theta^t)) + \beta v(\theta^t) \geq \theta_t U(f(m(\theta^{t-1}))) + \beta v_a\]  \hspace{1cm} (SUST)

Government must have no incentive to conduct *detectable* deviations
Best Equilibrium Outcome is Constrained Efficient

Main Proposition of the Paper

The best sustainable equilibrium outcome solves the following optimal contracting problem:

\[
J(v_0) = \max_x \sum_{t=0}^{\infty} \sum_{\theta^t} q^t \Pr(\theta^t) \left[ -m(\theta^{t-1}) + f\left( m(\theta^{t-1}) \right) - c(\theta^t) \right]
\]

subject to (IC), (SUST) and

\[
\sum_{t=0}^{\infty} \sum_{\theta^t} \beta^t \Pr(\theta^t) \theta_t U(c(\theta^t)) \geq v_0 \quad \text{(PC')}
\]
CHARACTERIZATION OF THE CONSTRAINED EFFICIENT ALLOCATION
Efficient Allocation Solves Nearly Recursive Problem

- Problem at $t = 0$

- Problem for $t \geq 1$ where
  - Efficient allocation
  - Lenders’ value (total value of debt), $B$

are recursive in borrower’s value, $v$
Recursive Problem for $t \geq 1$

The efficient allocation solves

$$B(v) = \max_{m,\{c_s,v'_s\}_{s=H,L}} \sum_{s \in \{L,H\}} \pi_s \left[ -m + f(m) - c_s + qB(v'_s) \right]$$

subject to

$$\theta_L U(c_L) + \beta v'_L \geq \theta_L U(c_H) + \beta v'_H \quad \text{(IC)}$$

$$\theta_H U(c_H) + \beta v'_H \geq \theta_H U(f(m)) + \beta v_a \quad \text{(SUST)}$$

$$v'_H, v'_L \geq v_a \quad \text{(SUST')}$$

$$\pi_H \left[ \theta_H U(c_H) + \beta v'_H \right] + \pi_L \left[ \theta_L U(c_L) + \beta v'_L \right] = v \quad \text{(PKC)}$$
Problem at $t = 0$

The efficient allocation solves

$$J(v) = \max_{m,\{c_s,v'_s\}_{s=H,L}} \sum_{s\in\{L,H\}} \pi_s \left[-m + f(m) - c_s + qB(v'_s)\right]$$

subject to (IC), (SUST), (SUST’) and

$$\pi_H \left[\theta_H U(c_H) + \beta v'_H\right] + \pi_L \left[\theta_L U(c_L) + \beta v'_L\right] \geq v \quad (PC)$$

where $J$ is the Pareto Frontier
Problem at $t = 0$

The efficient allocation solves

$$J(v) = \max_{m, \{c_s, v'_s\} \ s \in \{H, L\}} \sum_{s \in \{L, H\}} \pi_s \left[ -m + f(m) - c_s + qB(v'_s) \right]$$

subject to (IC), (SUST), (SUST’), and

$$\pi_H \left[ \theta_H U(c_H) + \beta v'_H \right] + \pi_L \left[ \theta_L U(c_L) + \beta v'_L \right] \geq v \quad \text{(PC)}$$

where $J$ is the Pareto Frontier

Asymmetry between $t = 0$ and $t \geq 1$ because:

- (PKC) is an equality constraint
- (PC) is an inequality constraint
- If $B(v)$ is increasing then (PC) is slack and $J(v) > B(v)$
PROPERTIES

- Region with ex-post inefficiencies
  - Lack of commitment plays critical role

- Transit to the region with ex-post inefficiencies
  - Private information plays critical role

- Low borrower values are associated with low imports of intermediates and low output
Region of Ex-Post Inefficiencies
When borrower’s value is low, can make both borrower and lenders better off ex-post
\( B(v) \) has the Depicted Shape

Proposition (Region with Ex-Post Inefficiencies Exists)

\[ \exists \tilde{v} > v_a \text{ such that there exist} \]

- Region with ex-post inefficiencies:
  \( B \text{ is increasing for } v \in [v_a, \tilde{v}) \)

- Efficient region
  \( B \text{ is decreasing for } v \in [\tilde{v}, \bar{v}) \)
Any Efficient Allocation Starts on the Efficient Region
Transits to the Region with Ex-Post Inefficiencies

Starting from $v_0$, a sequence of high taste shocks pushes the economy to the region with ex-post inefficiencies
After the realization of a high taste shock, the continuation value is lower than the current one: $v_H'(v) < v$
Two Countervailing Forces

- Incentive force: Want to spread continuation values
  - Cheapest way to provide utility
    - Make $c_H$ large and $c_L$ small
    - Spread out continuation values
  - Desirable to make $v'_H$ low

- Commitment force: Want to back-load borrower payoff
  - By back-loading, relax future sustainability constraint
  - Low production distortions in the future
  - Want high $v'_H$
Optimality of Ex-Post Inefficiencies

Proposition (Transit to Region with Ex-Post Inefficiencies)

If either (i) $\theta_H - \theta_L$ sufficiently high or (ii) $\pi_H$ sufficiently low, then any efficient allocation transits to and out of the region with ex-post inefficiencies with strictly positive probability.

Lemma

If either (i) or (ii) then $\forall \ v \in [\tilde{v}, \bar{v}]$

$$v'_H(v) < v$$
Intuition for the Sufficient Conditions in the Lemma

(i) $\theta_H - \theta_L$ large: Incentive force large
   - Insurance motive is large
   - Incentive compatibility makes $v'_H(v)$ lower than $v$

(ii) $\pi_H$ low: Small cost of not back-loading
    - Low probability of reaching state in which future (SUST) is tight and production is highly distorted

Incentive force outweighs commitment force $\Rightarrow v'_H(v) < v$
Transits to the Region with Ex-Post Inefficiencies

Starting from $v_0$, a sequence of high taste shocks pushes the economy to the region with ex-post inefficiencies.
What Happens When Reach Autarky?

Bounce up the first time $\theta_L$ is realized
Is There a Stationary Distribution?

If $q > \beta$ there exists a non-degenerate limiting distribution
Low $v$ Associated with Low Output and Intermediates

$m^* = \text{statically efficient amount of intermediates}, \ f'(m^*) = 1$
Recap

- A sequence of high taste shocks pushes the economy to the region with ex-post inefficiencies
- This path is associated with falling imports of intermediates and output
- Autarky is a reflecting point, not absorbing
- If $q > \beta$ there exists a stationary distribution

Next:

- Implementation: interpret ex-post inefficient outcomes as debt crises
- Implications for maturity composition (and interest rates)
IMPLEMENTATION:
DEFAULTS, BOND PRICES, AND MATURITY COMPOSITION
Construct Equilibrium Outcome

- Allocation and total value of debt from contracting problem
- \( p \) and \( \tau \) are immediate

Next, construct:
- Payment policy, \( \delta \)
- Bond prices, \( q_S \) and \( q_L \)
- Debt holdings, \( b_S \) and \( b_L \)

Using \( v \) as a state variable
Equilibrium Payment Policy

- If $v > v_a$: Full payment, $\delta = 1$

- If $v = v_a$:
  - If $\theta = \theta_H$: Suspension of payments, $\delta = 0$
  - If $\theta = \theta_L$: Partial payment, $\delta = r$
Equilibrium Bond Prices

Given the equilibrium payment policy, prices consistent with lenders’ arbitrage conditions

\[
qs(v) = \begin{cases} 
q & \text{if } v \in (v_a, \bar{v}] \\
q\bar{r} & \text{if } v = v_a 
\end{cases}
\]

\[
qL(v) = \begin{cases} 
q \sum_{s=L,H} \pi_j [1 + qL(v'_s(v))] & \text{if } v \in (v_a, \bar{v}] \\
q\frac{\bar{r}}{1-q} & \text{if } v = v_a 
\end{cases}
\]

where \(\bar{r}\) is the expected recovery rate:

\[
\bar{r} = \pi_L r + \pi_H [0 + q\bar{r}] = \frac{\pi_L r}{1 - q\pi_H}
\]

LT bond price strictly increasing in borrower continuation value
Equilibrium Maturity Composition of Debt

- From the contracting problem, the total value of debt is:

\[ b(v, \theta_s) \equiv f(m(v)) - m(v) - c_s(v) + qB(v_s'(v)) \]

- When \( \delta = 1 \), given prices, \( b_L(v) \) and \( b_S(v) \) must solve

\[
\begin{align*}
    b(v, \theta_L) &= b_S(v) + b_L(v) \left[ 1 + q_L \left( v_L'(v) \right) \right] \\
    b(v, \theta_H) &= b_S(v) + b_L(v) \left[ 1 + q_L \left( v_H'(v) \right) \right]
\end{align*}
\]
How is Insurance Provided?

When there is default (only when $v = v_a$):
- Suspension and partial payments provide insurance

When there is no default:
- **After $\theta_H$: Debt dilution**
  - Borrower’s continuation value decreases
  - Higher probability of default in the near future
  - Long-term debt price falls $\Rightarrow$ capital loss for lenders
  - Wealth transfer from lender to the borrower
- **After $\theta_L$: Debt buyback**
  - Borrower’s continuation value increases
  - Lower probability of default in the near future
  - Long-term debt price rises $\Rightarrow$ capital gain for lenders
  - Wealth transfer from the borrower to the lenders
On-Path Default and Off-Path Punishment

- **On-path:** When there is a default
  - After a partial repayment regain access to credit market
  - Do not trigger autarky

- **Off-path:** Autarky to deter detectable deviations
  - Can use less severe punishment to deter detectable deviations
CHARACTERIZING BEST OUTCOME
RELATION TO THE EVIDENCE:

- Sovereign debt crises are associated with:
  - Output and consumption losses
  - Fall in imports of intermediate goods
  - Maturity of debt shortens as default is more likely
Sample Path Leading Toward Default

Sample Path for Productivity Shock, $z_t = 1/\theta_t$

Enter the region with ex-post inefficiencies

$z_L = 1/\theta_H$

Default

$z_H = 1/\theta_L$

Partial Repayment

$\tilde{t}$ $t_d$ $t_r$ Time
Defaults are Associated with Output Losses
Defaults are Associated with Drop in Imports

Intermediate Imports

\[ \tilde{t}, t_d, t_r \]

Time
Maturity of Debt Shortens as Default is More Likely

ST Debt to LT Debt Ratio

$\tilde{t}$ $t_d$ $t_r$ Time
Maturity of Debt Shortens as Default is More Likely

Recall: $b_L(v)$ and $b_S(v)$ solve

\[
 b(v, \theta_L) = b_S(v) + b_L(v) \left[ 1 + q_L(v'_L(v)) \right]
\]

\[
 b(v, \theta_H) = b_S(v) + b_L(v) \left[ 1 + q_L(v'_H(v)) \right]
\]

When indebtedness is high (future default is likely):

- Long-term bond prices more sensitive to shocks
- Can obtain needed insurance with small amount of long-term debt
- Overall indebtedness is high so short-term debt must be high
Recap

Recurrent but infrequent defaults associated with:

- Output and consumption losses
- Fall in imports of intermediate goods
- Shortening of maturity of debt as default approaches
Conclusion

- Key aspects of sovereign debt and default rationalized as best outcome of a sovereign debt game

- Best outcome is constrained efficient
  - It solves optimal contracting problem with informational and commitment frictions

- Default is not driven by
  - Market incompleteness
  - The high reliance on short-term debt

But by the underlying frictions

- Method to implement efficient allocation likely generalize to other contracting problems
Dynamics Around Default Episodes

Sample of Defaults Episodes from Mendoza and Yue (2012)

Source: WDI, UN Comtrade and Feenstra
\[ \text{imports}_{i,t} = \beta_0 + \beta_1 \text{GDP}_{i,t} + \sum_{j=0}^{3} \delta_j 1\{\text{default}_{i,t-j} = 1\} + \epsilon_{i,t} \]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient Estimate</th>
<th>Standard Error</th>
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</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.007</td>
<td>0.960</td>
</tr>
<tr>
<td>GDP</td>
<td>1.810</td>
<td>0.145</td>
</tr>
<tr>
<td>Default at (t)</td>
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<td>0.044</td>
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<tr>
<td>Default at (t-1)</td>
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<tr>
<td>Default at (t-2)</td>
<td>-0.040</td>
<td>0.044</td>
</tr>
<tr>
<td>Default at (t-3)</td>
<td>-0.005</td>
<td>0.043</td>
</tr>
</tbody>
</table>
From the contracting problem, I get $m(v)$

Construct $p(v)$ and $\tau(v)$ consistent with firms optimality and foreign exporters no-arbitrage conditions:

$$f'(m(v)) = p(v)$$

$$1 = p(v)(1 - \tau(v))$$
Defaults are Associated with Consumption Losses

Consumption

$\tilde{t}$ $t_d$ $t_r$ Time

$f(0)$
Recovery Driven by Exports

From autarky, once the economy recovers, large trade surplus