The Effects of Financial Cooperation among Emerging Economies

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Motivation: Financial Cooperation

- Financial crises
  - Sudden stops: Mexican peso crisis (1994), Asian financial crisis (AFC, 1997) — liability dollarization + currency depreciation
  - Global financial crisis (GFC, 2008-2009)
  - Covid-19 crisis (2020)
- Domestic policies
  - Capital controls (e.g., Bianchi, 2011)
  - FX market intervention (e.g., Arce et al., 2019)
  - Credit guarantee program (e.g., ADB, 2019)
- Financial cooperation
  - Chiang-Mai Initiative (CMI, 2000-): ASEAN+3
  - Central bank swap lines (2008): Fed & ECB, BOJ, etc.
  - Market integration: Asian Bond Market Initiative (2003-)

Literature

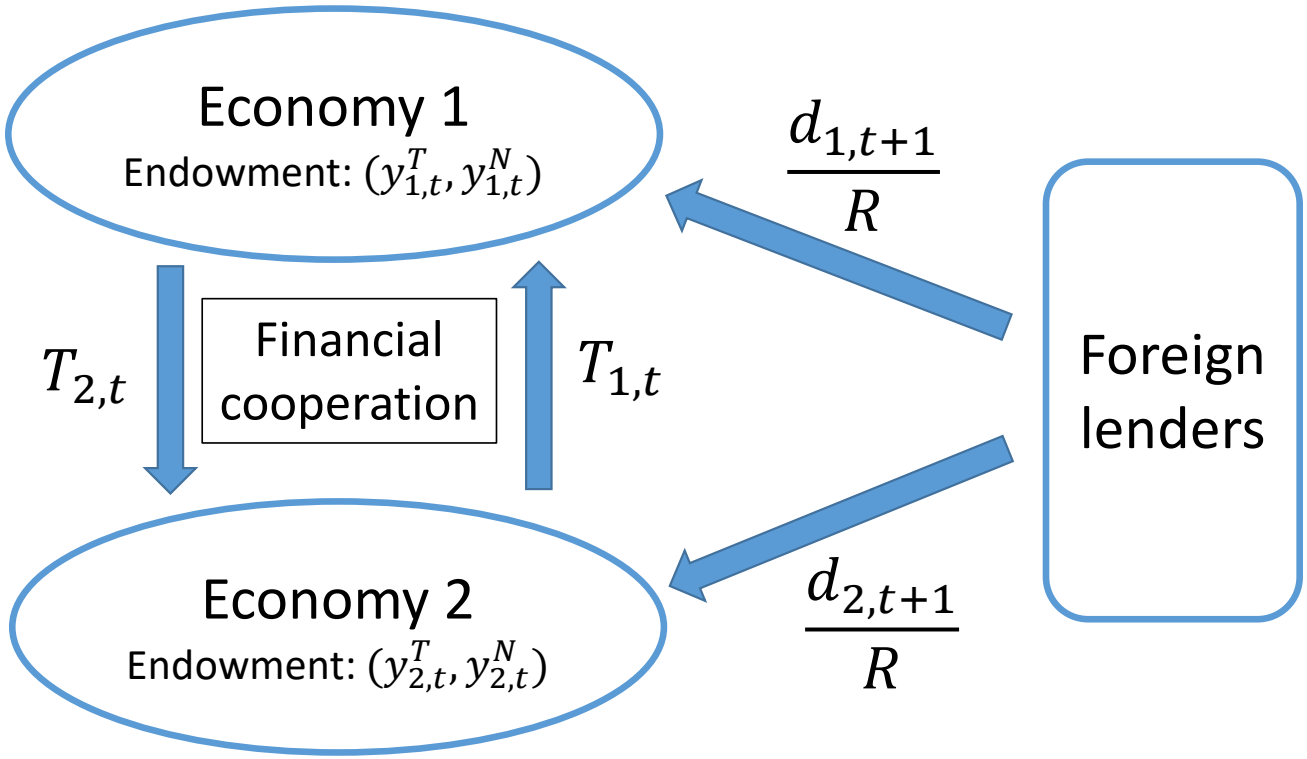
- Financial frictions and crises
  - Kiyotaki and Moore (1997)
  - Emerging markets — Calvo (1998), Mendoza (2002, 2005)
  - Domestic policies — Jeanne and Korinek (2010), Bianchi (2011), Arce et al. (2019)
- International risk sharing
  - Cole and Obstfeld (1991)
  - Backus and Smith (1993)
- Swap arrangements
  - AFC — Aizenman et al. (2011)
  - GFC — Obstfeld et al. (2009), Aizenman and Pasricha (2010), Bahaj and Reis (2019)
  - Covid-19 — Bahaj and Reis (2020), Aizenman et al. (2022)
- Financial market integration
  - Devereux and Yu (2020, RES)

This Paper

- **Question**: How effective is regional financial cooperation?
  - Emergency lending vs. Credit guarantee
  - Roles of business cycle co-movements, interest rates, and exchange rates
  - Effects on welfare, debt levels, crisis frequency and severity
- **Model**
  - Small-open economy under debt dollarization
  - Occasionally binding (nonlinear) financial friction
  - Temporary cooperation: emergency lending & credit guarantee
- **Results**
  - Credit guarantee outperforms emergency lending
  - Welfare gains more or less than 0.1% of consumption
  - Positive output correlation (as among ASEAN)
    $\rightarrow$ small or negative welfare gain + less frequent financial crises

Model

Model



- Small open economies $i = 1, 2$ under collateral constraints
- Financial dollarization: external debt $d_{i,t+1}/R$ denominated in tradable goods

Households

- Households consume tradables (c_t^T) and nontradables (c_t^N):

$$U_{i,t} = E_t \sum_{s=t}^{\infty} \beta^{s-t} \frac{c_{i,s}^{1-\sigma}}{1-\sigma},$$

$$c_{i,t} = [\omega (c_{i,t}^T)^{-\eta} + (1-\omega)(c_{i,t}^N)^{-\eta}]^{-\frac{1}{\eta}}$$

- Budget constraint:

$$c_{i,t}^T + p_{i,t}^N c_{i,t}^N = y_{i,t}^T + p_{i,t}^N y_{i,t}^N \underbrace{+ \frac{d_{i,t+1}}{R}}_{\text{new borrowing}} \underbrace{- d_{i,t}}_{\text{repayment}}$$

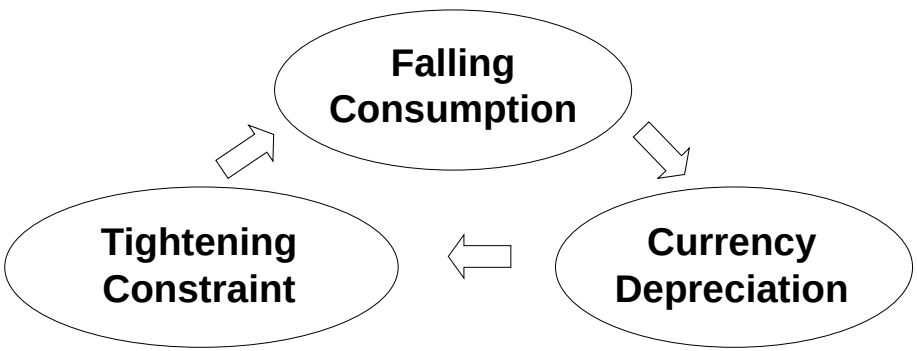
  - p_t^N: nontradables price$\approx$ real FX rate ($p_t^N \downarrow =$ depreciation)

Financial Constraint

- Collateral constraint (Kiyotaki and Moore, 1997; Mendoza, 2002; Bianchi, 2011):

$$\frac{d_{i,t+1}}{R} \leq \kappa \left(y_{i,t}^{T} + p_{i,t}^{N} y_{i,t}^{N} \right).$$

1. Amplification effect through depreciation (Mendoza, 2002):



2. Overborrowing problem (Bianchi, 2011)
   ($\because$ constraint not internalized)
   $\Rightarrow$ probability and severity of financial crises increase

Exogenous Shocks

- Endowment processes:

$$\mathbf{y}_{i,t} = (y_{i,t}^T, y_{i,t}^N)$$

- Tradables $y_{i,t}^T$ and nontradables $y_{i,t}^N$:

$$y_{i,t}^T = y_{i,t}^N = \bar{y}_i + \Delta y_{i,t}$$

where $\bar{y}_i = 1$.

- Deviations from the mean:

$$(\Delta y_{1,t}, \Delta y_{2,t}) \sim N(\mathbf{0}, \Sigma),$$

$$\text{where } \Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix}$$

Financial Cooperation

- Financial cooperation:
  - Temporary provision of credit
  - No collateral constraint

1. Emergency lending
   - Repay the external debt ($b_{i,t}$) with the borrowing from the other economy ($T_{i,t}$)
   - E.g., Chiang-Mai Initiative (ASEAN + 3), Central Bank Swap Lines (Fed & ECB, BOE, BOJ, etc.)
2. Credit guarantee
   - Pledge some portion of the source economy's income $T_{i,t}$ as collateral
     - Cf. government guarantee (Devereux and Yu, 2020)
   - E.g., Temporary Liquidity Guarantee Program (Federal Deposit Insurance Corporation, after the GFC)
   - E.g., Credit guarantee scheme for SMEs (Ireland, Korea, in response to Covid-19. Gopinath, 2020)

Model of Cooperation 1: Emergency Lending

- Emergency lending $T_{i,t}$
  $\Rightarrow$ Repayment & additional collateral of the recipient economy
  $\Rightarrow$ Both budget and collateral constraints affected
- Budget constraint:

$$c_{i,t}^T + p_{i,t}^N c_{i,t}^N = y_{i,t}^T + p_{i,t}^N y_{i,t}^N + \frac{d_{i,t+1}}{R} - d_{i,t} + T_{i,t} - (1 + r_i) T_{i,t-1}$$

  - $T_{i,t}$ used for the repayment of $d_{i,t}$
  - r_i: interest rate

- Collateral constraint:

$$\frac{d_{i,t+1}}{R} \leq \kappa \left(y_{i,t}^T + p_{i,t}^N y_{i,t}^N + T_{i,t} - (1 + r_i) T_{i,t-1} \right).$$

Model of Cooperation 2: Credit Guarantee

- Credit guarantee $T_{i,t}$:
  - Beginning of period t: $T_{i,t}$ pledged as collateral in the recipient economy
  - End of period t: $T_{i,t}$ consumed in the source economy

  $\Rightarrow$ mainly affects the collateral constraint
- Budget constraint:

$$c_{i,t}^T + p_{i,t}^N c_{i,t}^N = y_{i,t}^T + p_{i,t}^N y_{i,t}^N + \frac{d_{i,t+1}}{R} - d_{i,t} - r_i^T T_{i,t-1}$$

  - r_i: guarantee fee rate (payed in the next period)
- Collateral constraint:

$$\frac{d_{i,t+1}}{R} \leq \kappa \left(y_{i,t}^T + p_{i,t}^N y_{i,t}^N + T_{i,t} - r_i^T T_{i,t-1} \right).$$

Contract Design

- Size of $T_{i,t}$: proportional to output volatility ($\alpha\sigma_i$)
- Requirements:
  - Large negative shock in the recipient economy ($\Delta y_i < -\theta\sigma_i$)
  - No negative shock in the source economy ($\Delta y_j > 0$)

Contract Design

1. Unilateral case (1: recipient, 2: source)

$$(T_{1,t}, T_{2,t}) = \begin{cases} (\alpha\sigma_1, -\alpha\sigma_1), & \text{if } \Delta y_{1,t} < -\theta\sigma_1 \text{ and } \Delta y_{2,t} >= 0 \\ (0,0) & \text{otherwise} \end{cases}$$

2. Reciprocal case ($i, j \in \{1,2\}, i \neq j$)

$$T_{i,t} = \begin{cases} \alpha\sigma_i & \text{if } \Delta y_{i,t} < -\theta\sigma_i \text{ and } \Delta y_{j,t} >= 0 \\ -\alpha\sigma_j & \text{if } \Delta y_{i,t} >= 0 \text{ and } \Delta y_{j,t} < -\theta\sigma_j \\ 0 & \text{otherwise} \end{cases}$$

Calibration

Parameter	Description	Value
Basic structural parameters (Bianchi, 2011)		
σ	Risk aversion	2.00
β	Discount factor	.91
R	Gross world interest rate	1.04
ω	Weight on tradable goods in CES	.32
η	Elasticity of substitution	.20
κ	Leverage ratio	.32
Shock and policy parameters		
ρ	Correlation of output shocks	$[-.5, .5]$
σ_i	Standard deviation of output shocks	.05
r_i^T	Interest rate or guarantee fee	[.00, .02]
α	Size of lending or guarantee	[1, 10]
θ	Threshold	1

Simulation

For each α (size), r_i (fee), and ρ (correlation),

1. Solve for the competitive equilibrium in Economies $i = 1, 2$ with a global solution method
2. Calculate welfare gains (in % of consumption composite).
   - Unilateral case (recipient economy)
   - Unilateral case (source economy)
   - Reciprocal case

Results

Lending vs. Guarantee (Recipient, Welfare)

Table: Recipient economy's welfare gains (unilateral case)

		ρ				
	r_i	-.5	-.3	0	.3	.5
Lending	.00	−.5063	−.6699	−.8912	−1.1381	−1.2297
	.01	−.5159	−.6799	−.9022	−1.1506	−1.2426
	.02	−.5250	−.6899	−.9133	−1.1601	−1.2555
Guarantee	.00	.0383	.0337	.0239	.0099	.0005
	.01	.0226	.0184	.0086	−.0052	−.0146
	.02	.0071	.0033	−.0066	−.0202	−.0296

Note: % unit of consumption composite, $\alpha = 1.0$. Highlighted = 0 or positive.

- Lending: negative welfare gains
- Guarantee: small but positive welfare gains

Lending vs. Guarantee (Recipient, Crisis Probability)

		ρ				
	r_i	$-.5$	$-.3$	0	.3	.5
Lending	.00	+5.594	+2.648	+3.634	+3.080	+2.686
	.01	+5.742	+2.692	+3.640	+3.066	2.724
	.02	+5.758	+2.690	+3.630	+3.074	+2.8140
Guarantee	.00	+1.156	+.962	+.322	−1.234	−1.222
	.01	+1.184	+.996	+.350	−1.226	−1.210
	.02	+1.210	+1.020	+.380	−1.216	−1.190

Note: %pt change in crisis probability, $\alpha = 1.0$. Highlighted = 0 or negative.

- Lending: crisis probability increases
  - Cf. Equity market integration increases crisis probability (Devereux and Yu, 2020)
- Guarantee: crisis probability decreases when $\rho > 0$

Lending vs. Guarantee (Source, Welfare)

Table: Source economy's welfare gains (unilateral case)

		ρ				
	r_i	-.5	-.3	0	.3	.5
Lending	.00	−.3695	−.3555	−.3331	−.3095	−.2925
	.01	−.3681	−.3543	−.3322	−.3089	−.2926
	.02	−.3667	−.3530	−.3312	−.3085	−.2927
Guarantee	.00	.0000	.0000	.0000	.0000	.0000
	.01	−.0008	−.0009	−.0010	−.0012	−.0013
	.02	−.0017	−.0018	−.0021	−.0024	−.0027

Note: % unit of consumption composite, $\alpha = 1.0$. Highlighted = 0 or positive.

- Lending: negative welfare gain ($\because$ reduction in income)
- Guarantee: almost unaffected ($\because$ slack of collateral constraint)
  - Receiving the fee reduces welfare by increasing borrowing

Lending vs. Guarantee (Source, Crisis Probability)

		ρ				
	r_i	$-.5$	$-.3$	0	.3	.5
Lending	.00	+6.984	+7.196	+7.212	+7.064	+6.800
	.01	+6.982	+7.190	+7.242	+7.080	+6.844
	.02	+6.962	+7.222	+7.242	+7.106	+6.880
Guarantee	.00	.000	.000	.000	.000	.000
	.01	+.202	+.204	+.204	+.202	+.202
	.02	+.326	+.322	+.322	+.320	+.326

Note: %pt change in crisis probability, $\alpha = 1.0$. Highlighted = 0 or negative.

- Lending: crisis probability increases
- Guarantee: almost unchanged when $r_i = 0$

Result: Credit guarantee outperforms emergency lending both in terms of welfare and crisis probability

$\Rightarrow$ Focus on credit guarantee in the following

Welfare Gains (Recipient)

Closer look at credit guarantee:

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
.5	.00	.0200	.0186	.0148	.0091	.0048
	.01	.0121	.0107	.0071	.0014	$-.0028$
	.02	.0042	.0029	$-.0007$	$-.0063$	$-.0104$
1.0	.00	.0383	.0337	.0239	.0099	.0005
	.01	.0226	.0184	.0086	$-.0052$	$-.0146$
	.02	.0071	.0033	$-.0066$	$-.0202$	$-.0296$
3.0	.00	.1387	.1089	.0532	.0132	$-.0058$
	.01	.0917	.0636	.0062	$-.0337$	$-.0532$
	.02	.0455	.0191	$-.0405$	$-.0806$	$-.1007$

Note: Welfare gains represented as % unit of consumption composite.
Highlighted = 0 or positive.

- High correlation ($\rho \uparrow$) $\Rightarrow$ welfare gain $\downarrow$ + crisis probability $\downarrow$

Crisis Probability (Recipient)

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
	.00	$+.496$	$+.452$	$+.278$	$-.148$	$-.974$
.5	.01	$+.502$	$+.472$	$+.306$	$-.114$	$-.968$
	.02	$+.512$	$+.486$	$+.336$	$-.016$	$-.952$
	.00	$+1.156$	$+.962$	$+.322$	-1.234	-1.222
1.0	.01	$+1.184$	$+.996$	$+.350$	-1.226	-1.210
	.02	$+1.210$	$+1.020$	$+.380$	-1.216	-1.190
	.00	$+2.660$	$+1.888$	-1.642	-2.126	-2.360
3.0	.01	$+2.728$	$+1.932$	-1.816	-1.906	-2.010
	.02	$+2.486$	$+1.776$	-2.266	-1.804	-1.844

Note: %pt change in crisis probability. Highlighted = 0 or negative.

- High correlation ($\rho \uparrow$) + larger size $\alpha \uparrow \Rightarrow$ crisis probability $\downarrow$
- Negative correlation $\Rightarrow$ crisis probability $\uparrow$ ($\because$ borrowing $\uparrow$)

Change in Borrowing (Recipient)

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
	.00	+.0060	+.0057	+.0048	+.0037	+.0029
.5	.01	+.0060	+.0056	+.0047	+.0037	+.0029
	.02	+.0059	+.0055	+.0047	+.0036	+.0028
	.00	+.0118	+.0110	+.0091	+.0068	+.0050
1.0	.01	+.0117	+.0109	+.0090	+.0067	+.0049
	.02	+.0116	+.0108	+.0089	+.0066	+.0048
	.00	+.0295	+.0264	+.0202	+.0131	+.0085
3.0	.01	+.0289	+.0258	+.0196	+.0127	+.0082
	.02	+.0283	+.0252	+.0190	+.0123	+.0078

Note: %change in mean borrowing in the recipient economy

- Mean borrowing always increases
  $\Rightarrow$ credit guarantee can worsen overborrowing problem

Effects of Credit Guarantee (Recipient Economy)

- Welfare gains of the recipient economy: up to 0.14%
  — Similar to other policy measures:
  - Contingent securities (Cole and Obstfeld, 1991): 0.20%
  - Prudential capital tax (Bianchi, 2011): 0.14%
  - Equity market integration (Devereux and Yu, 2020): 0.26%
- High correlation ($\rho \uparrow$) $\Rightarrow$ welfare gain $\downarrow$ + crisis probability $\downarrow$
  — Trade-off between welfare and crisis probability
- Payment of the guarantee fee r_i reduces the welfare gain considerably, particularly when the size α is large

Effects of Credit Guarantee (Recipient Economy)

- Pros and cons of credit guarantee for the recipient:
  1. Pros: prevent severe reduction in consumption under a recession (bailout effect)
  2. Cons: reduction in precautionary saving (moral hazard)
     $\Rightarrow$ Overborrowing problem worsened
- Positive correlation $\rho > 0$
  $\Rightarrow$ Credit guarantee implemented less often
  $\Rightarrow$ Less moral hazard problem + less welfare gain

Welfare Gains (Source)

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
	.00	.0000	.0000	.0000	.0000	.0000
.5	.01	$-.0004$	$-.0004$	$-.0005$	$-.0006$	$-.0007$
	.02	$-.0008$	$-.0009$	$-.0010$	$-.0012$	$-.0013$
	.00	.0000	.0000	.0000	.0000	.0000
1.0	.01	$-.0008$	$-.0009$	$-.0010$	$-.0012$	$-.0013$
	2	$-.0017$	$-.0018$	$-.0021$	$-.0024$	$-.0027$
	.00	.0003	.0003	.0003	.0003	.0003
3.0	.01	$-.0024$	$-.0026$	$-.0029$	$-.0035$	$-.0040$
	.02	$-.0058$	$-.0061$	$-.0069$	$-.0080$	$-.0090$

Note: Welfare gains in % unit of consumption composite. Highlighted = 0 or positive.

- Welfare almost unaffected
- Welfare gain when $\alpha = 3.0 \leftarrow$ precautionary saving
- Welfare loss when $r_i > 0 \leftarrow$ overborrowing due to the increase in income

Crisis Probability (Source)

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
	.00	.000	.000	.000	.000	.000
.5	.01	+.130	+.130	+.132	+.130	+.132
	.02	+.202	+.204	+.204	+.202	+.202
	.00	.000	.000	.000	.000	.000
1.0	.01	+.202	+.204	+.204	+.202	+.202
	.02	+.326	+.322	+.322	+.320	+.326
	.00	−.022	−.024	−.020	−.024	−.022
3.0	.01	+.414	+.418	+.418	+.416	+.414
	.02	+.890	+.894	+.892	+.892	+.888

Note: %pt change in crisis probability. Highlighted = 0 or negative.

- Crisis probability almost unaffected
- Decrease in probability when $\alpha = 3.0 \leftarrow$ precautionary saving
- Increase in probability when $r_i > 0 \leftarrow$ overborrowing

Change in Borrowing (Source)

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
	.00	.0000	.0000	.0000	.0000	.0000
.5	.01	+.0001	+.0001	+.0001	+.0001	+.0001
	.02	+.0002	+.0002	+.0002	+.0002	+.0002
	.00	.0000	.0000	.0000	.0000	.0000
1.0	.01	+.0002	+.0002	+.0002	+.0002	+.0002
	.02	+.0004	+.0005	+.0005	+.0005	+.0004
	.00	.0000	.0000	.0000	.0000	.0000
3.0	.01	+.0007	+.0007	+.0007	+.0007	+.0007
	.02	+.0014	+.0014	+.0014	+.0014	+.0013

Note: % change in mean borrowing. Highlighted = 0 or negative.

- Mean borrowing in the source economy is almost unaffected
- Precautionary saving increases slightly when $\alpha = 3.0$
  $\because$ credit guarantee for the other economy $\approx$ precautionary tax in a normal time

Effects of Credit Guarantee (Source Economy)

- Little impact on the source economy's welfare and crisis probability
- Small but positive precautionary effect
  - Welfare gain $= 0.0003\%$ consumption
  - Decrease in crisis probability $\approx -0.02\%$pt
- Receiving guarantee fee r_i does not improve welfare
  $\because$ Source economy is also under collateral constraint
  $\Rightarrow$ overborrowing problem

Welfare Gains (Reciprocal Case)

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
	.00	.0200	.0186	.0148	.0091	.0048
.5	.01	.0117	.0102	.0065	.0008	$-.0035$
	.02	.0032	.0017	$-.0020$	$-.0075$	$-.0119$
	.00	.0383	.0337	.0239	.0099	.0005
1.0	.01	.0221	.0174	.0078	$-.0056$	$-.0154$
	.02	.0060	.0015	$-.0082$	$-.0211$	$-.0312$
	.00	.1224	.0988	.0590	.0204	$-.0008$
3.0	.01	.0782	.0523	.0116	$-.0290$	$-.0518$
	.02	.0361	.0081	$-.0354$	$-.0766$	$-.1018$

Note: % unit of consumption composite. Highlighted = 0 or positive.

- Similar to the recipient economy under the unilateral case

Crisis Probability (Reciprocal Case)

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
.5	.00	$+.496$	$+.452$	$+.278$	$-.148$	$-.974$
	.01	$+.610$	$+.520$	$+.430$	$+.068$	$-.748$
	.02	$+.696$	$+.616$	$+.516$	$+.210$	$-.222$
1.0	.00	$+1.156$	$+.962$	$+.322$	-1.234	-1.222
	.01	$+1.360$	$+1.116$	$+.584$	-1.016	-1.134
	2	$+1.534$	$+1.262$	$+.778$	$-.176$	$-.944$
3.0	.00	$-.262$	-2.690	-3.046	-3.304	-2.762
	.01	$+.172$	$-.852$	-2.510	-2.432	-2.646
	.02	$+.462$	$-.208$	-2.406	-2.004	-2.024

Note: %pt change in crisis probability. Highlighted = 0 or negative.

- When the size is large ($\alpha = 3.0$), crisis probability decreases for a wide range of correlation ρ
  - Large bailout effect
  - Precautionary saving (or at least, less moral hazard)

Change in Borrowing (Reciprocal Case)

		ρ				
α	r_i	$-.5$	$-.3$	0	.3	.5
.5	.00	+.0060	+.0057	+.0048	+.0037	+.0029
	.01	+.0061	+.0057	+.0049	+.0038	+.0030
	.02	+.0061	+.0058	+.0049	+.0038	+.0031
1.0	.00	+.0118	+.0110	+.0091	+.0068	+.0050
	.01	+.0119	+.0110	+.0092	+.0069	+.0051
	.02	+.0120	+.0111	+.0094	+.0070	+.0053
3.0	.00	+.0228	+.0202	+.0161	+.0112	+.0075
	.01	+.0223	+.0197	+.0157	+.0111	+.0077
	.02	+.0218	+.0192	+.0153	+.0108	+.0077

Note: %change in mean borrowing.

- Mean borrowing always increases (close to the recipient economy in the unilateral case)

Effects of Credit Guarantee (Reciprocal Case)

- Welfare gains and crisis probability in the reciprocal case mainly reflect those of the recipient economy
- When $\alpha = 3$ and ρ is positive, the decrease in crisis probability is large (around 3%pt)
- Welfare gain is less than 0.1% in most cases and decreasing in output correlation ρ and guarantee fee r_i

Conclusion

- Temporary credit guarantee might outperform emergency lending
- Welfare gains from credit guarantee are close to those of other stabilization policies
- Regional financial cooperation (i.e., among highly correlated economies) might lower the crisis probability, while the welfare gain could be negative

Appendix

Output Correlation (ASEAN, 1980–2019)

Table: Output volatility and correlation (1980–2019)

		Correlation (ρ)				
	S.D. (%)	IDN	MYS	PHL	SGP	THA
IDN	5.61	1.00				
MYS	4.70	.44	1.00			
PHL	3.89	.50	.37	1.00		
SGP	5.10	.27	.61	.28	1.00	
THA	4.40	.48	.55	.52	.39	1.00
Mean	4.74	.44 (min = .27, max= .61)				

Note: Standard deviations and correlations of the log differences of real GDP. Source: Penn World Tables 10.

Output Correlation (ASEAN, 1999–2019)

Table: Output volatility and correlation (1999–2019)

		Correlation (ρ)				
	S.D. (%)	IDN	MYS	PHL	SGP	THA
IDN	6.40	1.00				
MYS	3.41	.30	1.00			
PHL	2.97	.63	.20	1.00		
SGP	5.78	.11	.47	−.08	1.00	
THA	3.09	.40	.42	.39	.56	1.00
Mean	4.33	.34 (min = −.08, max= .63)				

Note: Standard deviations and correlations of the log differences of real GDP. Source: Penn World Tables 10.

- Correlation became smaller after the Asian Financial Crisis (1997-98).