Beware the Side Effects: Capital Controls, Trade, Misallocation and Welfare

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Capital controls: Evolving views and new perspective

- **Evolving views:** CCs disliked since 1971 BW's collapse, gained favor after 1990s Sudden Stops & 2008 GFC (macroprudential CCs on inflows)

  ▸ CCsInflows

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- **New perspective**: Study CCs with heterogeneous firms to determine
  1. How important are the side effects on misallocation and exports?
  2. What are their aggregate and social welfare implications?

What we do in this paper

1. Provide theoretical, quantitative and empirical answers
2. Analyze effects of CCs in a dynamic SOE Melitz model with:
   - entrepreneurs heterogeneous in productivity, age, assets & trade
   - monopolistic competition
   - export entry choice
   - collateral constraints
3. Calibration: Chile 1990-91 (pre-CCs) + CCs (*encaje* on inflows)
   - Unremunerated reserve requirement (91-98): 20% to 30%, 6 to 12 mos.

   ▸ CCevolution
4. Quantify effects on misallocation, macro-aggregates, trade & welfare
5. Empirical analysis using Chilean manufacturing firm-level data

Main findings

- **Analytic**:
  1. MRPKs change via *static* ($\uparrow$), *dynamic* ($\downarrow$) & *GE* ($\uparrow$ / $\downarrow$) effects
  2. Effects are non-monotonic in net worth, tfp & trade
  3. LTV regulation distributes burden of credit adjustment more evenly

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- **Quantitative**:
  1. Misallocation worsens (0.5pp) and social welfare falls (0.6%)
  2. Much worse for exporters (1.25pp) & high-prod. firms (1.5pp)
  3. Strong GE effects: Υ (-0.6%), w (-1.1%), p (-0.4%)
  4. Large drops in exports (-0.82%) & exporting firms (-5.7%)
  5. LTV regulation cuts credit by the same amount at a 1/3rd of the cost

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- **Empirical:**
  1. CCs worsened misallocation more for exporters, high-prod., & large OSG
  2. Non-linear interactions of productivity and trade in line with theory

Model

Model overview

- Builds on Buera & Moll (15), Brooks & Dovis (20), Midrigan & Xu (14), Gopinath et. al. (16), Andreasen et. al. (21)

1. **Heterogeneous entrepreneurs**: Produce inputs with C-D technology under monopolistic competition, die with prob. ρ (Blanchard-Yaari), draw TFP at birth (z), supply labor inelastically, make exporting choice ($e = 1$)
2. **Final goods producer**: CES technology with domestic and foreign inputs
3. **Rest of the world**: Credit market (r^*), foreign demand for home inputs (exports) driven by y^*, p^*
4. **Government**: CCs as a tax on *inflows* (i.e., debt). Initial capital $k_0(z) = \kappa \bar{k}(z)$ financed with lump-sum tax $T(z)$.

Trade costs & financial distortions

Trade costs

- Sunk cost wF at t for irreversible decision to become exporter at $t+1$
  - Exporters
- Iceberg costs for fraction ζ of exports

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Capital Controls

$$r = \begin{cases} \hat{r} = r^* + \nu \quad (\hat{q} = 1/(1 + r^* + \nu)) & \text{if } d_t > 0 \\ r^* \quad (q^* = 1/(1 + r^*)) & \text{if } d_t \leq 0 \end{cases}$$

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Two regimes ***NCC:*** $\theta > 0, \nu = 0$ ***CC:*** $\theta > 0, \nu > 0$

Payoff & constraints for individual entrepreneur

- Utility function: $\sum_{t=0}^{\infty} \tilde{\beta}^t \frac{c_t^{1-\gamma}}{1-\gamma}, \quad \tilde{\beta} \equiv \beta(1-\rho)$
- Demand functions: $y_{h,t}(i) = \left(\frac{p_{h,t}(i)}{p_t}\right)^{-\sigma} y_t, \quad y_{f,t}(i) = \left(\frac{p_{f,t}(i)}{p^*}\right)^{-\sigma} y^*$
- Technological constraint: $y_{h,t} + e(\zeta y_{f,t}) = z k_t^{\alpha} n_t^{1-\alpha}.$
- Capital evolution: $(1-\rho)k_{t+1} = [(1-\delta)k_t + x_t]$
- Net worth: $a_{t+1} \equiv k_{t+1} - q_t d_{t+1}$

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- Net worth: $a_{t+1} \equiv k_{t+1} - q_t d_{t+1}$
- Cash on hand (single state variable):

$$p_t m_t \equiv w_t + \frac{p_{h,t}^{1-\sigma} y_t}{p_t^{-\sigma}} + e_t \frac{p_{f,t}^{1-\sigma} y^*}{p^{*-\sigma}} - w_t n_t + p_t(1-\delta)k_t - p_t d_t - T_t$$

- Budget constraint: $c_t = m_t - (1-\rho)a_{t+1}$

Recursive problem of a non-exporter

- **Ex-ante payoff**:

$$v(m,z) = \max_{e \in \{0,1\}} \left\{ (1-e) v^{NE}(m,z) + e v^{S}(m,z) \right\}$$

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- **Two-stage optimization problem**:

$$v^{NE}(m,z) = \max_{a'} \left[u\left(m - (1-\rho)a'\right) + \tilde{\beta} v\left(\tilde{m}'(a',z),z\right) \right]$$

$$\tilde{m}'(a',z) = \max_{k',d',p'_h,n'} \left[\frac{w' + \frac{p'^{1-\sigma}_h}{p'^{-\sigma}} y' - w'n' + p'(1-\delta)k' - p'd' - T}{p'} \right]$$

$$\text{s.t.} \quad \left(\frac{p'_h}{p'}\right)^{-\sigma} y' = z k'^{\alpha} n'^{1-\alpha}$$

$$a' = k' - qd'$$

$$qd' \leq \theta k' \quad \& \quad q^* d' \leq 0$$

Recursive problem of an exporter

- **Two-stage problem**:

$$v^E(m,z) = \max_{a'} \left[u\left(m - (1-\rho)a'\right) + \tilde{\beta} v^E\left(\tilde{m}'(a',z),z\right) \right]$$

$$\tilde{m}'(a',z) =$$

$$\max_{k',d',p'_h,p'_f,n'} \left[\frac{w' + \frac{p'^{1-\sigma}_h}{p'^{-\sigma}} y' + \frac{p'^{1-\sigma}_f}{p^{*-\sigma}} y^* - w'n' + p'(1-\delta)k' - p'd' - T}{p'} \right]$$

$$\text{s.t.} \quad \left(\frac{p'_h}{p'}\right)^{-\sigma} y' + \zeta \left(\frac{p'_f}{p^*}\right)^{-\sigma} y^* = z k'^{\alpha} n'^{1-\alpha}$$

$$a' = k' - qd'$$

$$qd' \leq \theta k' \quad \& \quad q^* d' \leq 0$$

Recursive problem of a switcher

- **Two-stage problem**:

$$v^S(m,z) = \max_{a'} \left[u\left(m - (1-\rho)a' - wF\right) + \tilde{\beta} v^E\left(\tilde{m}'(a',z),z\right) \right]$$

$$\tilde{m}'(a',z) =$$

$$\max_{k',d',p'_h,p'_f,n'} \left[\frac{w' + \frac{p'^{1-\sigma}_h}{p'^{-\sigma}} y' + \frac{p'^{1-\sigma}_f}{p^{*-\sigma}} y^* - w'n' + p'(1-\delta)k' - p'd' - T}{p'} \right]$$

$$\text{s.t.} \quad \left(\frac{p'_h}{p'}\right)^{-\sigma} y' + \zeta \left(\frac{p'_f}{p^*}\right)^{-\sigma} y^* = z k'^{\alpha} n'^{1-\alpha}$$

$$a' = k' - qd'$$

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Final goods producer & stationary equilibrium

- Final goods producer:

$$\max_{y_h(i),y_m} \; p\left[\int_0^1 y_h(i)^{\frac{\sigma-1}{\sigma}}di + y_m^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} - \int_0^1 p_h(i)y_h(i)di - p_m y_m,$$

where $p = [\int_0^1 p_h(i)^{1-\sigma}di + p_m^{1-\sigma}]^{1/(1-\sigma)}$

- Recursive stationary equilibrium:
  1. Entrepreneurs make optimal plans given w, p, y, r
  2. Final goods producer makes optimal plans given $p_h(i)$'s
  3. Labor market clears: $\int [n'(m,z) + F\mathbb{I}_{\tilde{m}'(m,z)=\hat{m}(z)}]d\phi(m,z) = 1$
  4. Final goods market clears: $\int [c'(m,z) + x'(m,z)]d\phi(m,z) + \rho\underline{k} = y$
  5. Government budget constraint holds: $p\rho\underline{k} = T$
  6. Distribution of firms over m,z is stationary:

$$\phi(m',z') = \int\int [(1-\rho)I^S(m',m,z) + \rho I^D(m',m,z)]\phi(m,z)dmdz$$

How do Capital Controls Affect Misallocation?

Equilibria without financial frictions

- **Prop. 1** No misallocation in the *decentralized equilibrium*:

$$MRPN_i = w, \quad MRPK_i = p(r^* + \delta), \quad \forall \quad i$$

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$$MRPN_i = w, \quad MRPK_i = p(r^* + \delta), \quad \forall \quad i$$

- **Prop. 2** Same is true for a *utilitarian social planner*:

$$\overline{MRPK} = p^{SP}(r^* + \delta)$$

  - Planner also equates consumption across entrepreneurs
  - Same allocations and MRPs as *competitive* stationary equilibrium
  - Firms move to optimal scale in one period by borrowing to finance trade deficit (zero OSGs)

Static effects (2nd-stage optimality conditions)

1. MRPK (financial distortions cause capital misallocation)

$$MRPK_i \equiv \frac{p'_{h,i}}{\varsigma}\alpha z_i (k'_i)^{\alpha-1}(n'_i)^{1-\alpha} = \qquad \left(\varsigma \equiv \frac{\sigma}{\sigma-1}\right)$$

$$\mathbb{I}_{d'\leq 0}\left[p'(r^*+\delta)+\mu_i\right] + \mathbb{I}_{d'>0}\left[p'(\hat{r}+\delta)+\eta_i(1-\theta)\right]$$

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2. MRPL (no labor misallocation)

$$MRPL_i \equiv \frac{p'_{h,i}}{\varsigma}(1-\alpha)z_i (k'_i)^{\alpha}(n'_i)^{-\alpha} = w'$$

3. Pricing arbitrage

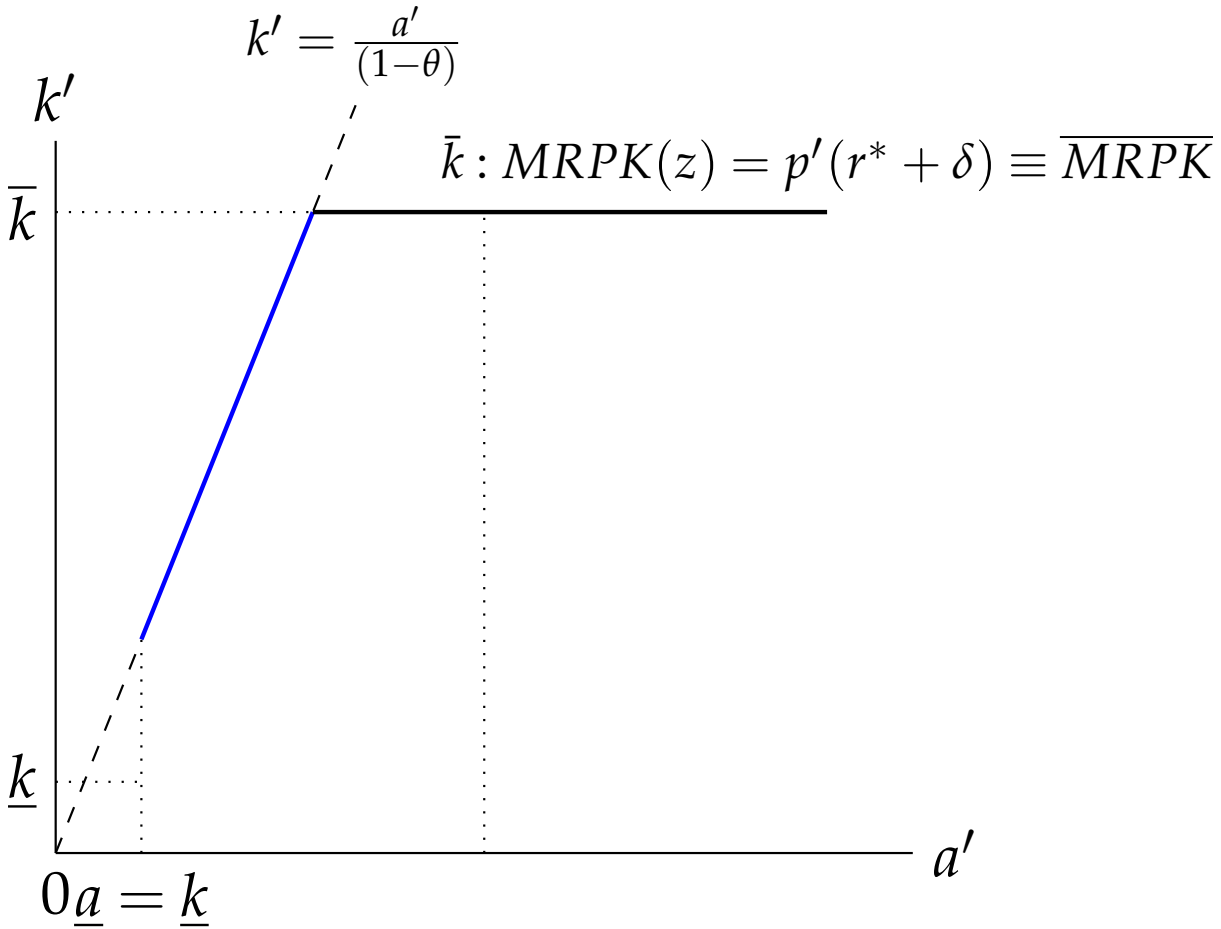
$$p'_{f,i} = \zeta p'_{h,i}$$

4. Technological constraint

$$\left(\frac{p'_{h,i}}{p'}\right)^{-\sigma} y + \zeta\left(\frac{p'_{f,i}}{p^*}\right)^{-\sigma} y^* = z_i {k'_i}^{\alpha} {n'_i}^{1-\alpha}$$

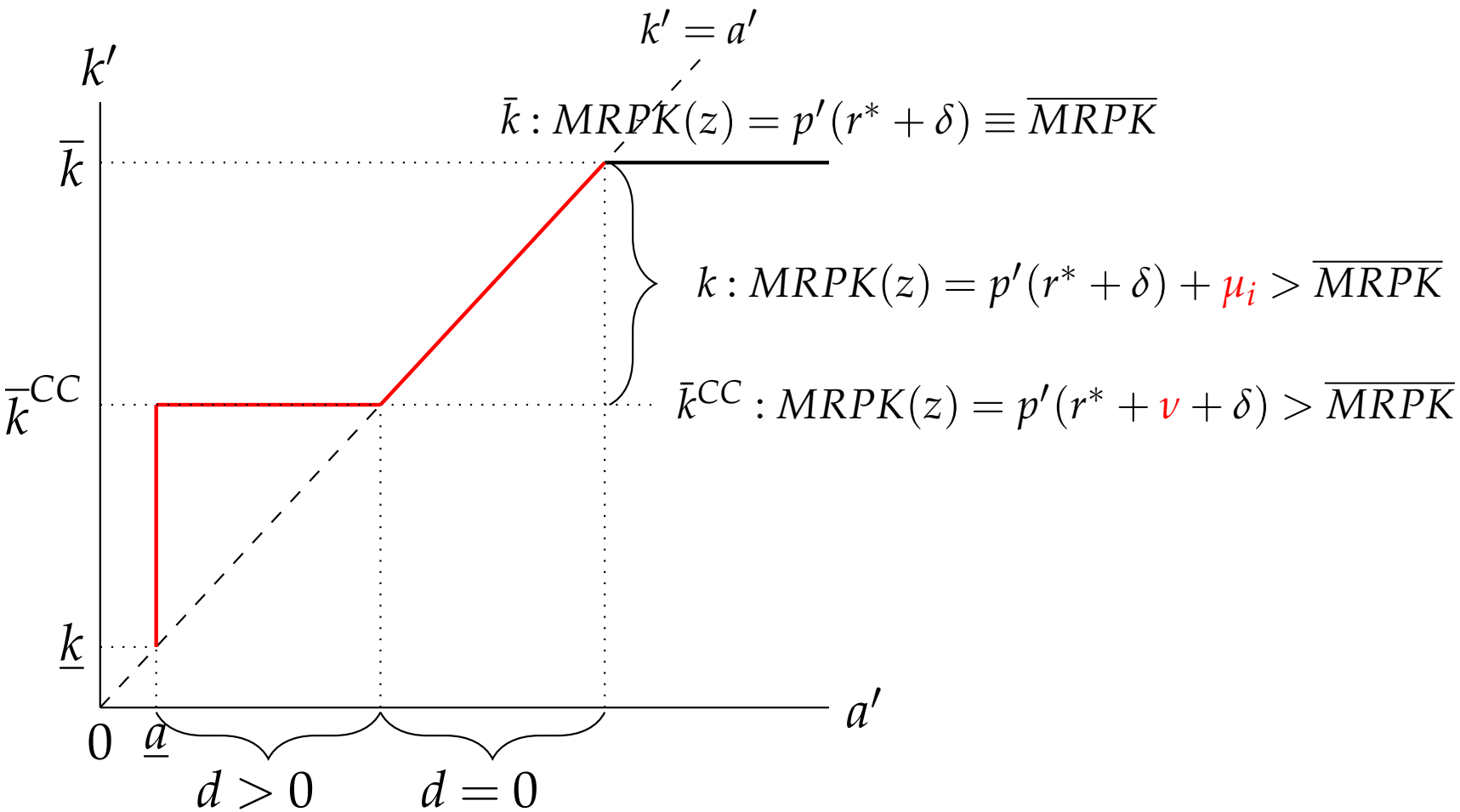
Static effects of collateral constraint in NCC regime

Prop. 3: $MRPK_i = p'(r^* + \delta) + \eta_i(1-\theta) > \overline{MRPK}, \quad k_i < \bar{k}$

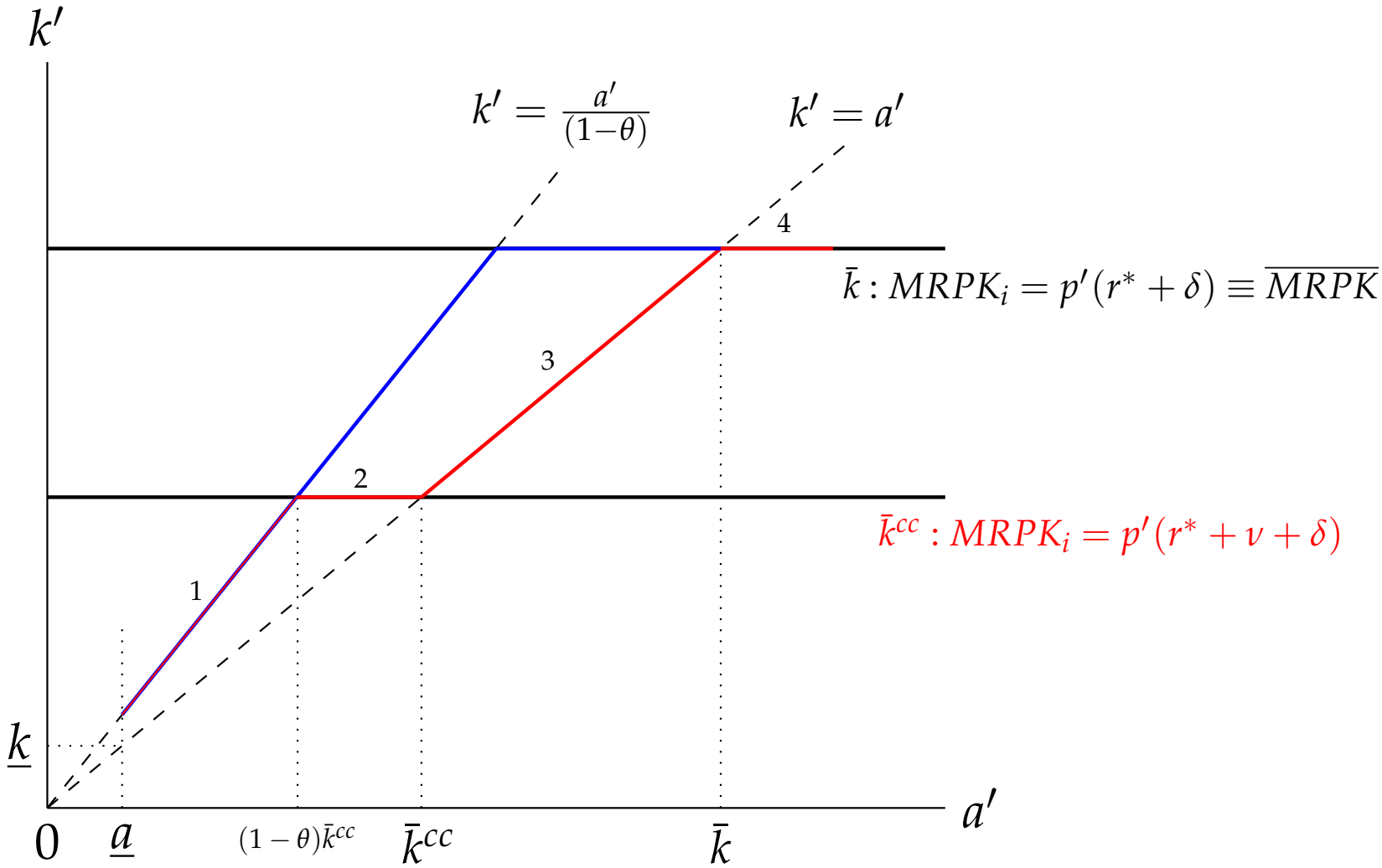


Static effects of CCs without collateral constraint

Prop. 4: $MRPK_i = \mathbb{I}_{d_i>0}[p'(r^* + \nu + \delta)] + \mathbb{I}_{d_i \leq 0}[p'(r^* + \delta) + \mu_i] > \overline{MRPK}$
$k_i < \bar{k}$



Static effects: Comparing NCC v. CC regime



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- ...which increases firm prices

$$\uparrow p'_h(z) = \left[\frac{\left[(p')^{\sigma} y' + (p^*)^{\sigma} \zeta^{1-\sigma} y^* \right]^{\alpha}}{z \left(\downarrow k'(z) \right)^{\alpha} \left[\frac{1-\alpha}{w' \varsigma} \right]^{1-\alpha}} \right]^{\frac{1}{1+\alpha(\sigma-1)}}$$

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- ...which reduces capital-labor ratios

$$\downarrow \frac{k'}{n'}(z) = \left[\frac{\varsigma}{(1-\alpha) z} \left(\frac{w'}{\uparrow p'_h(z)} \right) \right]^{1/\alpha}$$

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- ...so that MRPKs and misallocation rise (difference relative to $\overline{MRPK}$)

$$\uparrow MRPK(z) = \frac{\alpha z}{\varsigma} \frac{\uparrow p'_h(z)}{\left[\downarrow \frac{k'}{n'}(z)\right]^{1-\alpha}}$$

Dynamic and GE effects of CCs

- **Dynamic (1st-stage) effects**: financial distortions increase marginal benefit of saving

$$\frac{u'(c)}{\beta u'(c')} = \mathbb{I}_{d'>0}\left[\hat{R} + \frac{\eta}{p'}\right] + \mathbb{I}_{d'\leq 0}\left[R^* + \frac{\mu}{p'}\right]$$

  - Firms grow net worth *faster*, spend less time at lower k, higher MRPK
  - In R. 2, firms pay debt down to zero and R. 3 mimics financial autarky
  - $\beta R^* = 1 \Rightarrow \bar{k}$ and steady state c are the same with CCs and in autarky

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  - Quantitatively, $\uparrow$ ($\downarrow$) optimal scales & MRPK diffs. for Es (NEs)

- Overall effects are ambiguous

Quantitative Analysis

Calibration strategy

- $\theta^E > \theta^{NE}$, with $\theta^E = (\theta_f + 1)\theta^{NE}$, so that exporters have better credit access (e.g., Muuls (2015))
- Set $\{\gamma, \beta, \sigma, \delta, \rho, r^*\}$ to common values in the misallocation literature
- Set $\{\zeta, \omega_z, F, \theta_f, \theta^{NE}, \kappa, \alpha\}$ to match seven data targets by SMM

Baseline NCC calibration

Predetermined parameters				Targeted parameters		
β	Discount factor	0.96	Standard	ζ	Iceberg trade cost	3.7134
γ	Risk aversion	2	Standard	ω_z	Productivity dispersion	0.4289
σ	Substitution elasticity	4	Leibovici (21)	F	Sunk export entry cost	1.5564
δ	Depreciation rate	0.06	Midrigan & Xu (14)	θ^{NE}	NEs collateral coef.	0.0610
ρ	Death probability	0.08	Chilean data	θ_f	Es collateral factor	1.6977
				α	Capital intensity	0.4673
				κ	Fraction of std. st. capital as initial capital	0.3002

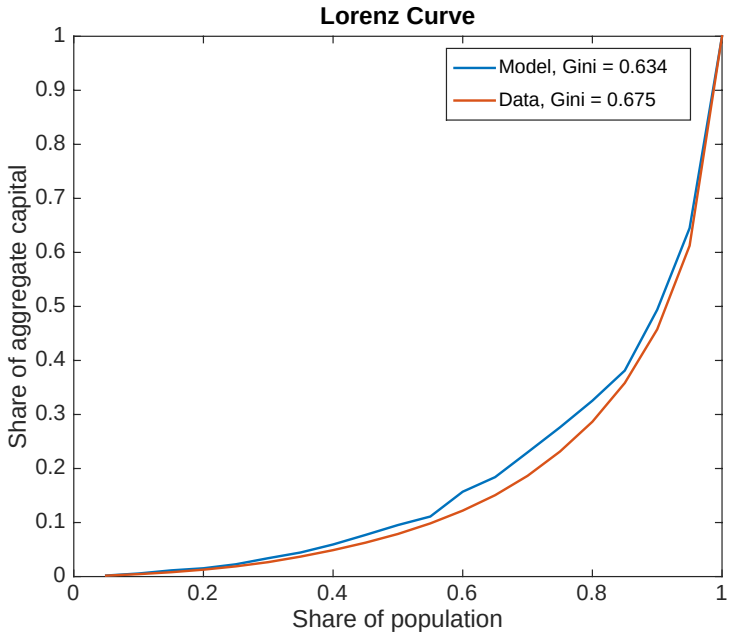
- For CC regime, ν =1.75% (average tax-equivalent of Chilean *encaje*)

▸ Tax

Calibration data targets and model results

Target Moment	Data (1990-1991) (1)	Model (NCC regime) (2)
Share of exporters	0.18	0.18
Average sales (exporters/non-exporters)	8.55	8.55
Average sales (age 5 / age 1)	1.26	1.27
Aggregate exports / sales	0.21	0.21
Aggregate credit / Value added	0.33	0.33
Aggregate capital stock / wage bill	6.60	6.61
(Investment /VA)$_{exporters}$ / (Investment/VA)$_{non-exporters}$	1.84	1.85

Firm size distribution: Lorenz curves in data & model



Quintile	Data (1990) (1)	Model (NCC regime) (2)
0.2	0.0128	0.0154
0.4	0.0361	0.0441
0.6	0.0732	0.0977
0.8	0.1645	0.1684
1	0.7134	0.6745

Aggregate effects of capital controls

	$(\Delta\%)$
Exports	-0.82%
Share of exporters	-5.74%
Domestic Sales	-0.94%
Investment	-1.46%
Consumption	-0.73%
Final goods output	-0.85%
Real GDP	-0.56%
Real wage	-0.70%
Wage	-1.06%
Price level (Real ex. rate)	-0.36%
Agg. credit/Value Added	$-4.24pp$

Measures of misallocation & welfare

- **Firm misallocation:**

$$mis_i = |ln(MRPK_i) - ln(\overline{MRPK})|, \qquad \overline{MRPK} \equiv p(r^* + \delta)$$

- **Aggregate misallocation** (mean deviation in mis_i):

$$MIS = \sum_{\tau}\sum_{z} mis(\tau,z)\phi(\tau,z), \qquad \phi(\tau,z) = \rho(1-\rho)^{\tau} f(z)$$

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- **Welfare:** Compensating consumption variation in utilitarian SWF

$$G = \left[\frac{\sum_{\tau}\sum_{z} V^{CC}(\tau,z)\phi(\tau,z)}{\sum_{\tau}\sum_{z} V^{NCC}(\tau,z)\phi(\tau,z)} \right]^{\frac{1}{1-\gamma}} - 1,$$

where, for $i = CC, NCC$, the payoff of each entrepreneur is:

$$V^i(\tau,z) = \begin{cases} v(\tau,z) & \text{for } \tau \leq \hat{\tau}^i(z) : v^{NE}(\hat{\tau}^i(z),z) = v^S(\hat{\tau}^i(z),z) \\ v^E(\tau,z) & \text{for } \tau > \hat{\tau}^i(z) \end{cases}$$

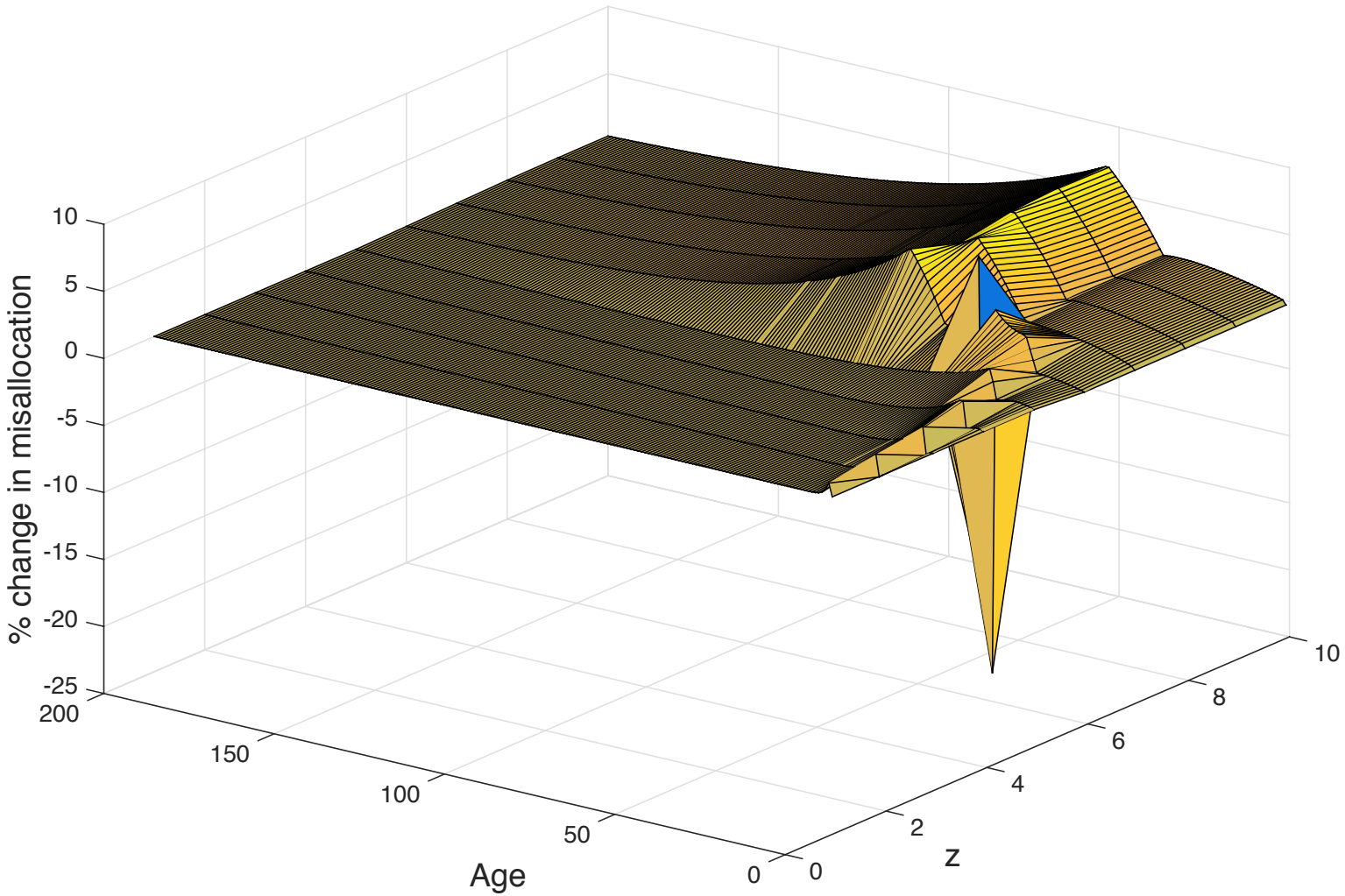
Effects of CCs on misallocation and welfare

	% change Misallocation	% change Welfare
All firms	$0.50pp$	-0.61%
Exporters	$1.25pp$	-1.82%
Non-exporters	$0.34pp$	-0.56%
Large OSG	$0.51pp$	—
Small OSG	$0.23pp$	—

Effects of CCs on misallocation and welfare

	% change Misallocation	% change Welfare
All firms	$0.50pp$	-0.61%
Exporters	$1.25pp$	-1.82%
Non-exporters	$0.34pp$	-0.56%
Large OSG	$0.51pp$	—
Small OSG	$0.23pp$	—

Effect of capital controls on misallocation across firms



Effecs of CCs on misallocation & welfare by productivity

Productivity	% change Misallocation	% change Welfare
1	$0.11pp$	-0.69%
2	$0.22pp$	-0.67%
3	$0.43pp$	-0.59%
4	$0.61pp$	-0.47%
5	$0.64pp$	-0.44%
6	$0.24pp$	-0.89%
7	$0.67pp$	-1.13%
8	$0.60pp$	-1.20%
9	$0.58pp$	-1.22%
10	$0.57pp$	-1.23%

Heterogeneous income effects of capital controls

- **Labor income:** w/p falls for everyone but matters more for those earning more from labor than capital (low-z and/or young)

Heterogeneous income effects of capital controls

- **Labor income:** w/p falls for everyone but matters more for those earning more from labor than capital (low-z and/or young)
- Firm's relative prices fall with fall in w/p, rise with misallocation:

$$\frac{p^h(\tau,z)}{p} = \frac{\varsigma(r+\delta)^\alpha}{(1-\alpha)^{1-\alpha}\alpha^\alpha z}\left(\frac{w}{p}\right)^{1-\alpha}\left(\frac{MRPK(\tau,z)}{p(r+\delta)}\right)^\alpha$$

Heterogeneous income effects of capital controls

- **Labor income:** w/p falls for everyone but matters more for those earning more from labor than capital (low-z and/or young)
- Firm's relative prices fall with fall in w/p, rise with misallocation:

$$\frac{p^h(\tau,z)}{p} = \frac{\varsigma(r+\delta)^\alpha}{(1-\alpha)^{1-\alpha}\alpha^\alpha z}\left(\frac{w}{p}\right)^{1-\alpha}\left(\frac{MRPK(\tau,z)}{p(r+\delta)}\right)^\alpha$$

- **Capital income:** π/p rises (falls) if p^h/p falls (rises):

$$\frac{\pi(\tau,z)}{p} = \frac{y + \frac{1}{\tau^{\sigma-1}}\left(\frac{p^*}{p}\right)^\sigma y^*}{\left(\frac{p^h(\tau,z)}{p}\right)^{\sigma-1}}\left[1 - \frac{(1-\alpha)}{\varsigma}\right]$$

  - It also rises with y, and falls with p for exporters (real appreciation)

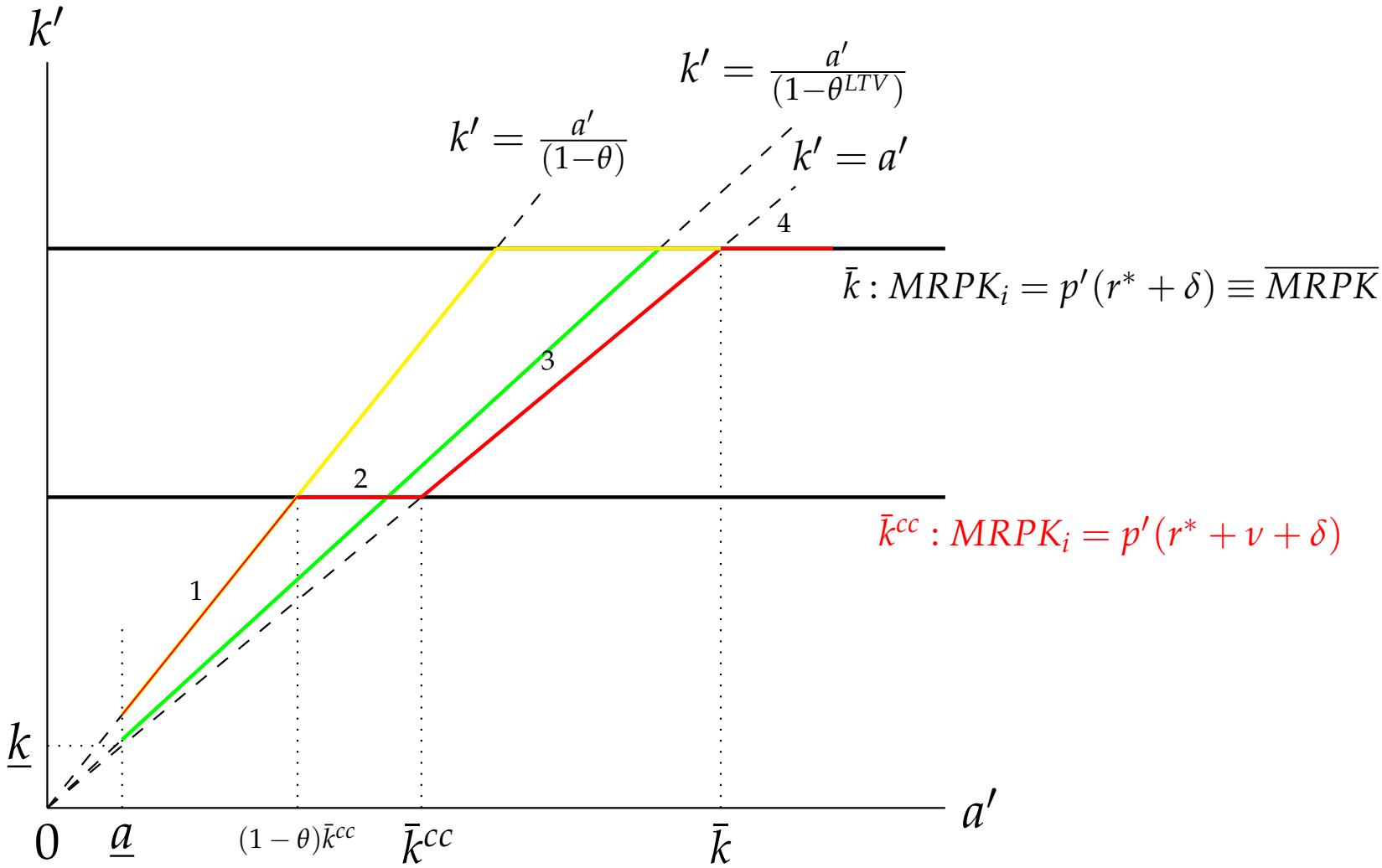
Counterfactuals & robustness

1. **LTV regulation**: Set $\nu = 0$, reduce θ to θ^{LTV} to match agg. credit drop
2. **Tighter capital controls**: Higher ν in CC regime
3. **Tax rebates**: Rebate debt tax paid by each entrepreneur
4. **Earnings-based constraint**: Profits instead of k as pledgeable collateral
   ▸ EBCC
5. **Domestic credit market**: Allow firms to choose investing v. lending to others (analytic results) ▸ DCM

LTV regulation is better than capital controls

- The burden of the credit cut is distributed more evenly across firms
- Region 1: Firms with low net worth unaffected by CCs now borrow less, have less capital, higher MRPKs
- Regions 2 and 3: Firms more severely affected by CCs borrow more, have more capital, lower MPRKs (nonmonotonic effect)
- w, y, p fall less, misallocation still rises but better aggregate outcomes reduce welfare costs (higher real wage, less dispersion in real profits)

Comparing LTV regulation with capital controls



LTV v. CCs: Aggregate Effects

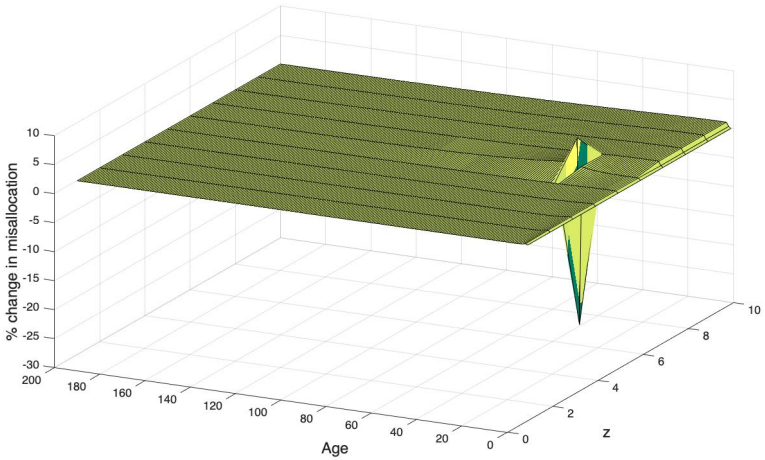
	CC regime $\nu = 0.0175$ $\theta^{NE} = 0.0610$	LTV regulation $\nu = 0$ $\theta^{NE} = 0.0538$
Exports	-0.82%	-0.94%
Share of exporters	-5.74%	-1.62%
Domestic Sales	-0.94%	-0.21%
Investment	-1.46%	-0.91%
Consumption	-0.73%	-0.08%
Final goods output	-0.85%	-0.21%
Real GDP	-0.56%	-0.38%
Real wage	-0.70%	-0.42%
Wage	-1.06%	-0.40%
Price level (Real ex. rate)	-0.36%	0.02%
Agg. credit/Value Added	$-4.24pp$	$-4.24pp$

LTV v. CCs: Effects on misallocation & welfare

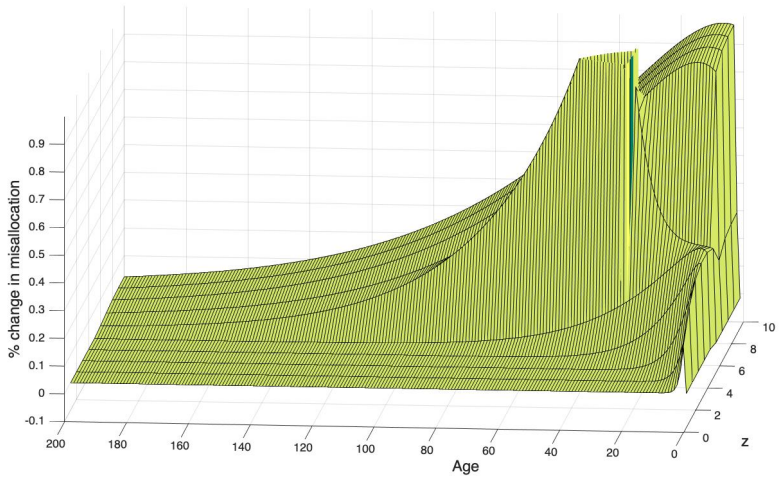
	Baseline w. CCs		LTV regulation	
	Misallocation	Welfare	Misallocation	Welfare
All firms	$0.50pp$	-0.61%	$0.29pp$	-0.20%
Exp. status				
Exporters	$1.25pp$	-1.82%	$0.91pp$	-0.15%
Non-exporters	$0.34pp$	-0.56%	$0.16pp$	-0.20%
OSG				
Large	$0.51pp$	—	$0.31pp$	—
Small	$0.23pp$	—	$0.04pp$	—

Effect of LTV regulation on misallocation across firms

(a) Full scale



(b) Truncated scale



Tighter CCs: Aggregate Effects

	NCC regime ($\nu = 1.75\%$)	$\nu = 2.75\%$	$\nu = 6\%$
Exports	-0.82%	-1.76%	-5.54%
Share of exporters	-5.74%	-7.97%	-6.90%
Domestic Sales	-0.94%	-1.29%	-1.71%
Investment	-1.46%	-2.66%	-6.52%
Consumption	-0.73%	-0.92%	-0.88%
Final goods output	-0.85%	-1.20%	-1.78%
Real wage	-0.70%	-1.22%	-2.99%
Wage	-1.06%	-1.58%	-2.68%
Price level (Real ex. rate)	-0.36%	-0.36%	0.31%
Agg. credit/Value Added	$-4.24pp$	$-10.0pp$	$-30.0pp\%$

Tighter CCs: Effects on misallocation & welfare

	CC regime ($\nu = 1.75\%$)		$\nu = 6.0\%$	
	Misallocation	Welfare	Misallocation	Welfare
All firms	$0.50pp$	-0.61%	$2.28pp$	-1.41%
Exp. status				
Exporters	$1.25pp$	-1.82%	$5.38pp$	0.03%
Non-exporters	$0.34pp$	-0.56%	$1.66pp$	-1.45%
OSG				
Large	$0.51pp$	—	$2.36pp$	—
Small	$0.23pp$	—	$0.27pp$	—

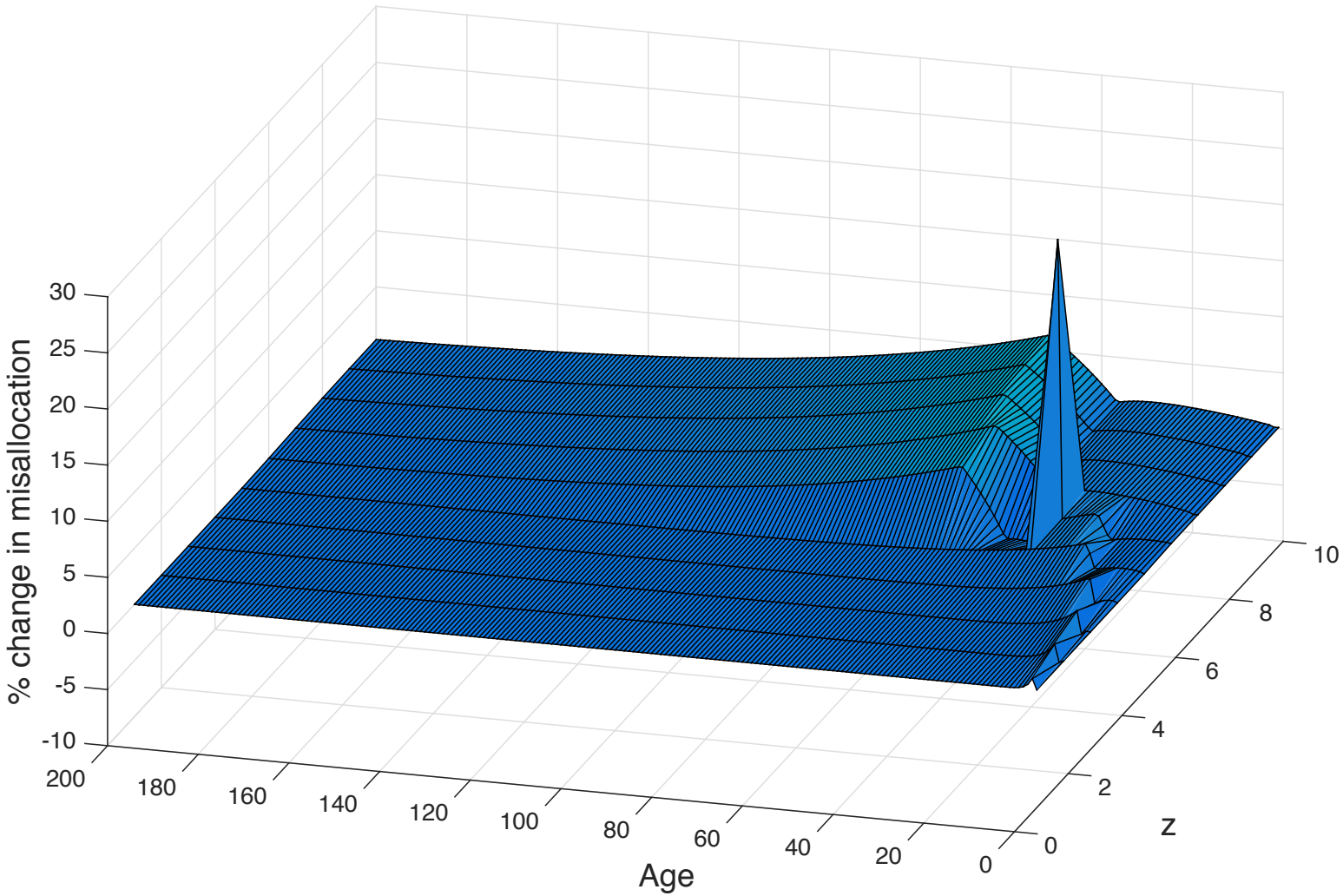
Aggregate effects of capital controls with & without rebates

	CC regime (no rebates)	With rebates
Exports	-0.82%	-0.28%
Share of exporters	-5.74%	3.67%
Domestic Sales	-0.94%	-0.43%
Investment	-1.46%	-1.80%
Consumption	-0.73%	-0.27%
Final goods output	-0.85%	-0.51%
Real GDP	-0.56%	-0.72%
Real wage	-0.70%	-0.63%
Wage	-1.06%	-0.31%
Price level (Real ex. rate)	-0.36%	0.33%
Agg. credit/Value Added	$-4.24pp$	$-4.04pp$

Effects of CCs with tax rebates on misallocation & welfare

	CC regime (no rebates)		W/rebates	
	Misallocation	Welfare	Misallocation	Welfare
All firms	$0.50pp$	-0.61%	$0.74pp$	-0.23%
Exp. status				
Exporters	$1.25pp$	-1.82%	$1.55pp$	0.89%
Non-exporters	$0.34pp$	-0.56%	$0.55pp$	-0.23%
OSG				
Large	$0.51pp$	—	$0.76pp$	—
Small	$0.23pp$	—	$0.23pp$	—

Effect of CCs with rebates on misallocation across firms



Empirical Analysis

Objective & data

Objective

- Evaluate empirical relevance of firms' productivity, exporting status and OSG in shaping the effect of CCs on misallocation.

Data

- Chilean manufacturing establishments data (ENIA), 1990-2007.
  ▸ Sum. Statistics
  - All manufacturing firms with more than 10 workers (around 5,000 firms per year, 90,000 observations aprox.).
  - Data on capital stock, investment, workers, sales, exports, income taxes (proxy for profits).

- Tax-equivalent of the CC by year. ▸ more

Measure of misallocation

- As in Gopinath et al. (2017), Hsieh & Klenow (2009):

$$MRPK = \frac{\sigma - 1}{\sigma}(p_h y_h + p_f y_f)\frac{\alpha}{k}.$$

where: $p_h y_h + p_f y_f$ = value added or total sales; $k_{i,t}$= fixed capital; σ and α take calibrated values.

- Firm misallocation as defined earlier:

$$mis_{ijt} = \mid Ln(MRPK_{ijt}) - Ln(\overline{MRPK_{jt}}) \mid$$

using yearly industry mean (4-digit ISIC) of MRPK to proxy for $\overline{MRPK_{jt}}$

Econometric model

$$mis_{ijt} = \omega_1 CC_{t-1} * TFP_{ijt} + \omega_2 CC_{t-1} * Exp_{ijt} + \omega_3 CC_{t-1} * OSG_{ijt} + \omega_4 X_{ijt} + A_i + B_t + \epsilon_{ijt}$$

- CC_{t-1}: tax-equivalent *encaje* lagged one period
- $Exp_{ijt} = 1$ for firms that export in current period
- OSG_{ijt} is the % diff. between date-t firm's capital and industry-year mean for firms older than 10 years
- X_{ijt}: time varying firm characteristics, including TFP_{ijt}, Exp_{ijt}, OSG_{ijt}
- A_i: firm fixed effects
- B_t: time fixed effects (includes direct effect of CCs)

CCs effects on misallocation by TFP, OSG & export status

	(1)	(2)	(3)	(4)	(5)	(6)
		$mis_{ijt}(VA)$			$mis_{ijt}(total\_sales)$	
VARIABLES	All firms	Balanced Panel	W/o crisis cohort	All firms	Balanced Panel	W/o crisis cohort
CC*TFP	0.876***		0.883***	0.713***		0.728***
	(0.122)		(0.126)	(0.078)		(0.080)
CC*Exp	0.224***		0.208***	0.317***		0.299***
	(0.030)		(0.030)	(0.031)		(0.032)
CC*OSG	0.248***		0.244***	0.255***		0.250***
	(0.031)		(0.031)	(0.032)		(0.032)
CC*TFP_BP		1.363***			1.108***	
		(0.190)			(0.189)	
CC*Exp_BP		0.296***			0.410***	
		(0.060)			(0.064)	
CC*OSG_BP		0.309***			0.380***	
		(0.056)			(0.059)	
Observations	91,374	22,204	90,359	87,469	21,935	86,524
R-squared	0.624	0.579	0.625	0.600	0.573	0.601
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Heterogeneous effects by exporting status

VARIABLES	All firms (1)	All firms (2)	All firms (3)	Non-Exporters (4)	Exporters (5)
CC*TFP	0.990***	0.880***	0.995***	1.029***	0.243
	(0.142)	(0.130)	(0.144)	(0.135)	(0.236)
CC*Exp	1.326**	0.215***	1.339**		
	(0.523)	(0.046)	(0.540)		
CC*OSG	0.246***	0.237***	0.248***	0.268***	0.220***
	(0.032)	(0.036)	(0.037)	(0.037)	(0.073)
CC*TFP*Exp	-0.500**		-0.501**		
	(0.240)		(0.244)		
CC*TFP*OSG		0.010	-0.032		
		(0.072)	(0.073)		
Observations	91,374	91,374	91,374	72,751	17,755
R-squared	0.624	0.624	0.625	0.658	0.578
Controls	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES

Additional exercises and robustness checks

- Forward-looking definition of exporters (next 2 years) ▸ More
- Interaction of firms' characteristics with macroeconomic controls ▸ More
- Winsorization for outliers ▸ More
- Industry level regressions ▸ More

Conclusions

- CCs affect misallocation via static, dynamic and GE effects that work in different directions and are non-monotonic in net worth, tfp & trade status
- The model calibrated to Chilean *encaje* predicts that:
  1. Misallocation worsened and more so for Es, high-prod. & large OSG firms
  2. Strong GE effects reduced real wages, consumption and output
  3. Sizable social welfare loss and larger for exporters & high-prod. firms
  4. Substantial heterogeneity in MRPKs and income effects
- LTV regulation is far superior (same credit cut at 1/3rd of the cost)
- Empirical evidence consistent w. larger effects for exporters and high prod. firms, and non-monotonic effects
- Relevant for fin. repression, fin. integration & size-dependent policies

Exporters' behavior in Chile

Back

Periods as Exporter	Exporter (t+1)	Non-exp. (t+1)
1	71%	29%
2	79%	21%
3	93%	7%
4	94%	6%

Exporters' behavior in Chile

Back

Periods as Exporter	Exporter (t+1)	Non-exp. (t+1)
1	71%	29%
2	79%	21%
3	93%	7%
4	94%	6%

Fixed Capital Interval	Share of Exporters
$x < p(25)$	3.03%
$p(25) < x < p(50)$	2.89%
$p(50) < x < p(75)$	12.65%
$p(75) < x$	30.21%
$p(95) < x$	53.97%

Effects on misallocation: Relative Size and Export Status by prod.

VARIABLES	(1) Misallocation All firms High z	(2) Misallocation All firms Low z	(3) Taxes All firms High z	(4) Taxes All firms Low z
CC*Rel_Size	-0.002*	-0.022***	0.014***	-0.002
	(0.001)	(0.008)	(0.005)	(0.007)
CC*Exp	0.190***	0.061**	-0.085**	-0.117***
	(0.030)	(0.028)	(0.043)	(0.043)
Observations	46,340	46,350	46,337	46,350
R-squared	0.177	0.259	0.093	0.173
Number of id	7,959	8,734	7,959	8,734
Controls	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

Forward looking definition of exporters

Back

VARIABLES	Backward All firms (1)	Backward Balanced panel (2)	Backward W/o crisis cohort (3)	Forward All firms (4)	Forward Balanced panel (5)	Forward W/o crisis cohort (6)
CC*TFP	0.817***	1.508***	0.804***	0.821***	1.523***	0.817***
	(0.120)	(0.208)	(0.125)	(0.120)	(0.205)	(0.125)
CC*OSG	0.003**		0.003**	0.003**		0.003**
	(0.001)		(0.001)	(0.001)		(0.001)
CC*B_Exp	0.109***	0.151***	0.107***			
	(0.027)	(0.047)	(0.027)			
CC_OSG_BP		0.009**			0.009**	
		(0.005)			(0.005)	
CC*F_Exp				0.095***	0.131***	0.081***
				(0.028)	(0.046)	(0.029)
Observations	92,143	22,203	91,112	92,690	22,203	91,659
R-squared	0.224	0.196	0.224	0.224	0.196	0.224
Number of id	11,780	1,586	11,664	12,155	1,586	12,039
Firm FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES

Interaction with macroeconomic controls: Misallocation

Back

VARIABLES	Libor	Inflation	Growth	RER	PrivCreditGDP	WorldGrowth
	(1)	(2)	(3)	(4)	(5)	(6)
CC*TFP	0.890***	0.859***	1.007***	0.494***	1.052***	0.921***
	(0.121)	(0.119)	(0.127)	(0.104)	(0.126)	(0.118)
CC*OSG	0.249***	0.255***	0.207***	0.286***	0.248***	0.258***
	(0.031)	(0.031)	(0.034)	(0.034)	(0.031)	(0.031)
CC*Exp	0.211***	0.230***	0.139***	0.273***	0.202***	0.258***
	(0.030)	(0.030)	(0.033)	(0.034)	(0.032)	(0.030)
Observations	91,374	91,374	91,374	91,374	91,374	91,374
R-squared	0.624	0.625	0.625	0.625	0.625	0.626
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Interaction with macroeconomic controls: Taxes

Back

VARIABLES	(1) Taxes Libor	(2) Taxes Inflation	(3) Taxes Growth	(4) Taxes RER	(5) Taxes PrivCreditGDP	(6) Taxes WorldGrowth
CC*TFP	-0.003***	-0.003***	-0.002	-0.005***	-0.002*	-0.002**
CC*Rel_Size	0.010***	0.008**	0.014***	0.011***	0.002	0.012***
CC*Exp	-0.097***	-0.090***	-0.087**	-0.053	-0.131***	-0.099***
Exp*Libor	0.016					
TFP*Libor	0.000					
Rel_size*Libor	0.008***					
Exp*Inflation		0.015***				
TFP*Inflation		-0.001***				
Rel_sizeInflation		0.003**				
Exp*Growth			-0.002			
TFP*Growth			-0.001***			
Rel_size*Growth			-0.001			
Exp*TCR				0.008**		
TFP*TCR				-0.001***		
Rel_size*TCR				-0.000		
Exp*PrivCreditGDP					-1.302***	
TFP*PrivCreditGDP					0.042***	
Rel_size*PrivCreditGDP					-0.320***	
Exp*WorldGrowth						-0.123***
TFP*WorldGrowth						0.004***
Rel_size*WorldGrowth						-0.004
Observations	92,687	92,687	92,687	92,687	92,687	92,687
R-squared	0.136	0.136	0.136	0.136	0.137	0.136
Number of id	12,155	12,155	12,155	12,155	12,155	12,155
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Sub-samples

Back

VARIABLES	(1) Misallocation W/o crisis cohort	(2) Taxes W/o crisis cohort	(3) Taxes Since 1992
CC*TFP	0.010***	-0.003***	-0.003***
	(0.001)	(0.001)	(0.001)
CC*Rel_Size	-0.004**	0.012***	0.012***
	(0.002)	(0.004)	(0.004)
CC*Exp	0.097***	-0.095***	-0.078**
	(0.021)	(0.031)	(0.033)
Constant	1.235*	-10.246***	-2.670***
	(0.734)	(1.180)	(0.476)
Observations	91,659	91,656	83,475
R-squared	0.218	0.137	0.132
Number of id	12,039	12,039	11,780
Controls	YES	YES	YES
Firm FE	YES	YES	YES
Time FE	YES	YES	YES

Winsorization, Industry Level & Exporters Definition

Back

VARIABLES	Wins. MRPK (1)	Wins. Controls (2)	Wins. Sectors (3)	Backward-looking (4)	Forward-looking (5)	Industry level (6)
CC*TFP	0.855***	1.289***	0.902***	0.901***	0.897***	0.033
	(0.126)	(0.093)	(0.130)	(0.121)	(0.121)	(0.133)
CC*Exp	0.229***	0.238***	0.234***	0.177***	0.156***	0.347***
	(0.019)	(0.031)	(0.030)	(0.028)	(0.029)	(0.132)
CC*OSG	0.248***	0.263***	0.246***	0.234***	0.218***	1.260***
	(0.022)	(0.031)	(0.031)	(0.031)	(0.031)	(0.133)
Observations	91,374	83,348	91,374	91,030	91,374	1,600
R-squared	0.624	0.630	0.622	0.623	0.624	0.595
Controls	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	NO
Industry FE	NO	NO	NO	NO	NO	YES

Recursive Equilibrium

For a given value of the interest rate r, a recursive stationary competitive equilibrium of this economy consists of prices (w, p) policy functions and value functions v and g such that:

1. Policy and value functions solve the entrepreneurs' problem.
2. Policy functions solve the final good producers' problem.
3. Labor market clears.
4. The government's budget constraint is satisfied.
5. Markets for domestic varieties and final goods market clear.
6. The measure ϕ of entrepreneurs is stationary.

Back to analysis

Table: Summary Statistics: 1990-2007

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
Fixed Capital	92,690	11.39	2.771	0	22.47
Total Workers	92,690	3.578	1.112	0	8.656
Interest Expenditures	92,690	4.895	4.675	0	18.24
TFP	92,690	2.151	0.149	-3.536	2.858
L_Exp	92,690	0.334	0.472	0	1
F_Exp	92,690	0.195	0.396	0	1
Misallocation	92,690	4.715	3.127	0	17.72
Rank_TFP	92,690	2,584	1,502	1	5,765
Young	92,690	0.486	0.500	0	1
Number of id	12,155	12,155	12,155	12,155	12,155

back

Summary Statistics: Macroeconomic Indicators 1990-2007

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) max
CC	18	0.881	1.109	0	2.649
Inflation	18	0.017	0.536	-0.626	1.887
RER_dev	18	-0.009	0.055	-0.082	0.113
Growth	18	0.055	0.028	-0.021	0.120
World Growth	18	3.054	1.000	1.369	4.476
Private Credit/GDP	18	0.613	0.107	0.442	0.743
Libor 12m	18	4.918	1.799	1.364	8.415

back

The Chilean *Encaje*

- Policy: Unremunerated Reserve Requirement: 20% (to 30%) of capital inflows had to be deposited at the Central Bank at 0% interest rate for a fixed period of time (6 to 12 months).
  $\Rightarrow$ Analogous to a tax on the interest rate for borrowers (De Gregorio et al., 2000).

- Context: Surge of capital inflows, RER appreciation.

- Aggregate effects: Longer maturity of capital inflows, increased interest rate differential, small effect on RER, not so robust. (De Gregorio, Edwards and Valdes, 2000.; Edwards, 1999)

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Main changes in the URR administration

Jun-1991	20% URR introduced for all new credit Holding period (months)=min(max(credit maturity, 3),12) Holding currency=same as creditor Investors can waive the URR by paying a fix fee (Through a repo agreement at discount in favor of the central bank) Repo discount= US$ libor
Jan-1992	20% URR extended to foreign currency deposits with proportional HP
May-1992	Holding period (months)=12 URR increased to 30% for bank credit lines
Aug-1992	URR increased to 30% Repo discount= US$ libor +2.5
Oct-1992	Repo discount= US$ libor +4.0
Jan-1995	Holding currency=US$ only
Sep-1995	Period to liquidate US$ from Secondary ADR tightened
Dec-1995	Foreign borrowing to be used externally is exempt of URR
Oct-1996	FDI committee considers for approval productive projects only
Dec-1996	Foreign borrowing $<$US$ 200,000 (500,000 in a year) exempt of URR
Mar-1997	Foreign borrowing $<$US$ 100,000 (100,000 in a year) exempt of URR
Jun-1998	URR set to 10%
Sep-1998	URR set to zero

Source: De Gregorio et al. (2000).

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The evolution of the Chilean encaje

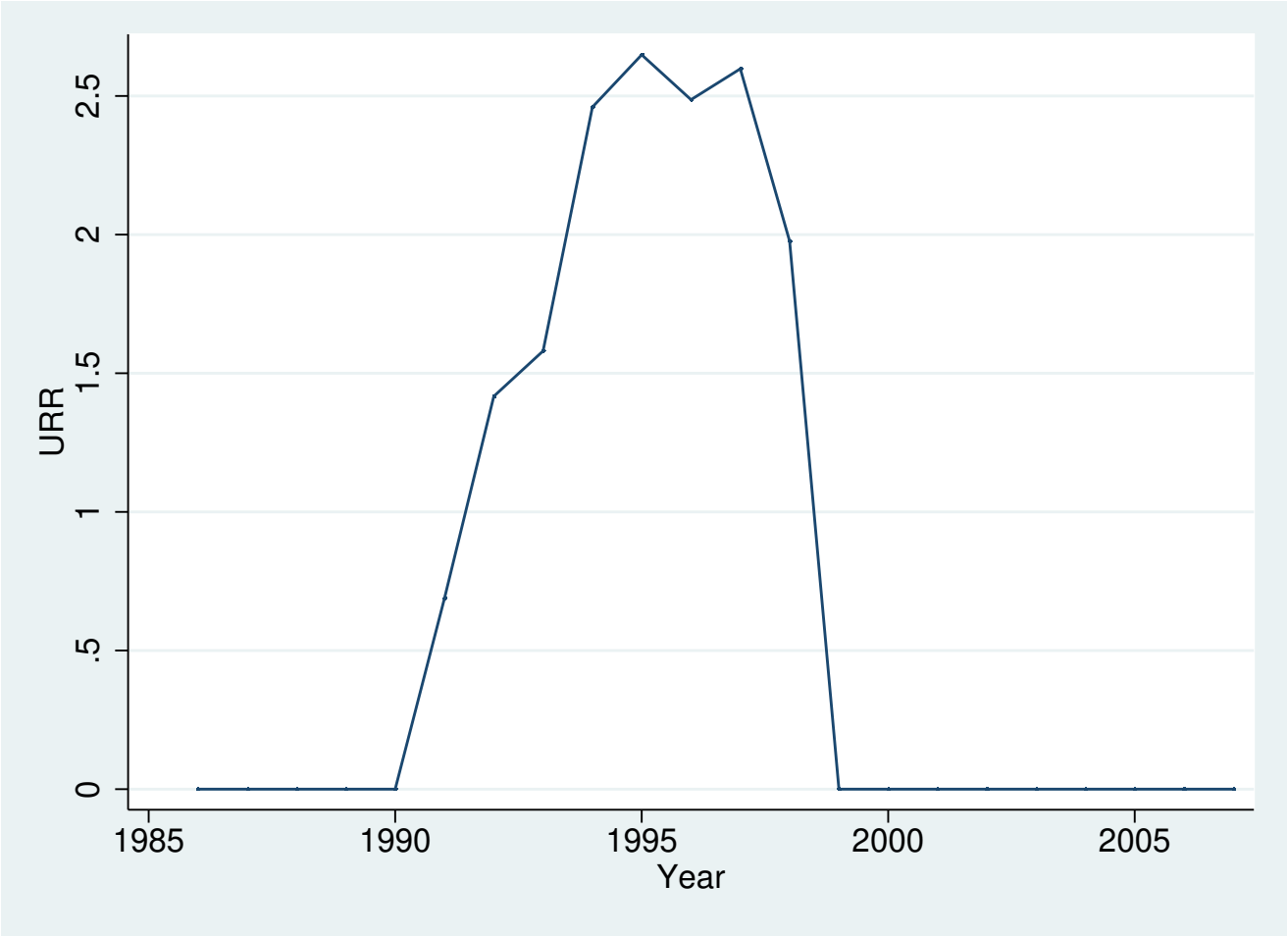

Figure: Tax equivalent

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Why Chile?

- Most well-known example of market-based control.
- Economic importance: 1.9% of GDP (Gallego, Hernandez and Schmidt-Hebbel, 2002).
- Firm level data in period of analysis.
- Time period large enough to do SS analysis and to have enough variation for the empirical analysis.

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Capital controls on inflows (Fernandez et. al., IMF ER (2016))

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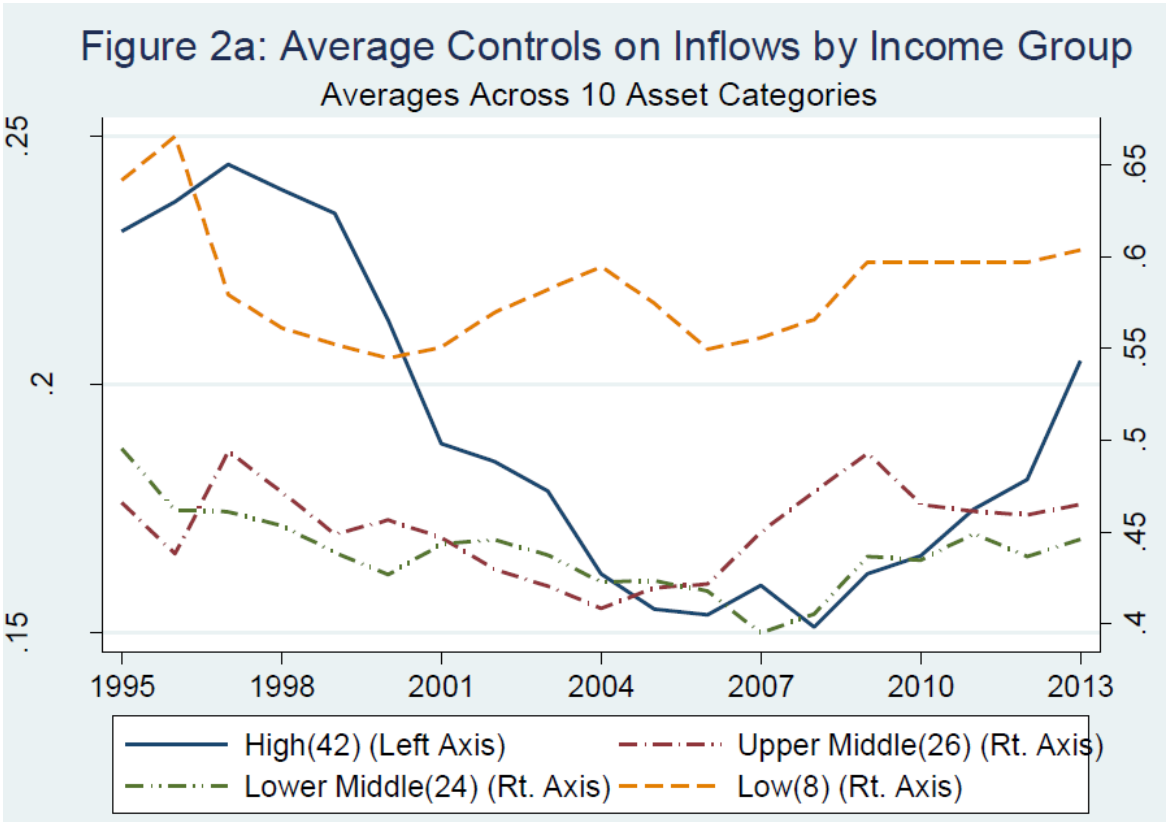

Effects of capital controls on aggregate outcomes

	Benchmark ($\Delta\%$) (1)	Lump-sum ($\Delta\%$) (2)	LTV ($\Delta\%$) (3)
Exports	-0.92%	-0.35%	-1.01%
Share of exporters	-5.74%	3.67%	-1.62%
Domestic Sales	-0.96%	-0.46%	-0.23%
Investment	-1.55%	-1.90%	-1.00%
Consumption	-0.74%	-0.28%	-0.09%
Final goods output	-0.87%	-0.54%	-0.24%
Real GDP	-0.60%	-0.77%	-0.43%
Wage	-1.09%	-0.35%	-0.44%
Price level (Real ex. rate)	-0.35%	0.33%	0.03%
Agg. credit/Value Added	-14.09%	-13.49%	-14.11%

Lump Sum: % change in misallocation and welfare, by z

Productivity	% change Misallocation	% change Welfare
1	0.12%	−0.62%
2	0.23%	−0.59%
3	0.43%	−0.51%
4	0.61%	−0.37%
5	0.63%	−0.27%
6	0.88%	0.01%
7	0.81%	−0.56%
8	0.73%	−0.51%
9	0.71%	−0.49%
10	0.70%	−0.49%

LTV: % change in misallocation and welfare, by z

Productivity	% change Misallocation	% change Welfare
1	0.02%	−0.42%
2	0.05%	−0.41%
3	0.10%	−0.39%
4	0.18%	−0.33%
5	0.25%	−0.22%
6	0.21%	−0.11%
7	0.70%	0.11%
8	0.72%	0.19%
9	0.73%	0.21%
10	0.73%	0.22%

Earnings-linked collateral constraint

$$qd_{t+1} \leq \theta(\pi_{t+1}/p_{t+1})$$

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$$qd_{t+1} \leq \theta(\pi_{t+1} / p_{t+1})$$

- Static effects: Capital in region 1 solves a nonlinear eq.

$$k' = \frac{1}{1 - \theta \frac{\pi(k', z; w', p', y')}{p'k'}} a',$$

1. Effective pledgeable collateral shrinks by $\pi(\cdot) / p'k'$ (flatter region 1)
2. Feedback effect: $\pi(\cdot) / p'k'$ falls with k' (constraint tightens endogenously)

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- Pecuniary and nonpecuniary externalities via p', w', y'
- Calibration to observed credit ratio requires higher θ than with KLCC (similar effects of CCs)

Effects of CCs with earnings-linked collateral constraint

	% change Misallocation	% change Welfare
All firms	0.61%	−0.33%
Exp. status		
Exporters	0.93%	−1.08%
Non-exporters	0.55%	−0.30%
OSG		
Large	0.64%	—
Small	0.18%	—

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Parameter Values: ELCC

Predetermined parameters				Calibrated parameters		
β	Discount factor	0.96	Standard	ζ	Iceberg trade cost	3.8271
γ	Risk aversion	2	Standard	ω_z	Productivity dispersion	0.4350
σ	Substitution elasticity	4	Leibovici (21)	F	Sunk export entry cost	1.3993
δ	Depreciation rate	0.06	Midrigan & Xu (14)	θ^{NE}	NEs collateral coef.	0.3481
ρ	Death probability	0.08	Chilean data	θ_f	Es collateral factor	1.0361
				α	Capital intensity	0.4491
				κ	Fraction of std. st. capital as initial capital	0.4012

Moments: ELCC

Target Moment	Data (1990-1991) (1)	Model (No C.controls) (2)
Share of exporters	0.18	0.18
Average sales (exporters/non-exporters)	8.55	8.64
Average sales (age 5 / age 1)	1.26	1.24
Aggregate exports / sales	0.21	0.21
Aggregate credit / Value added	0.33	0.33
Aggregate capital stock / wage bill	6.60	6.53
(Investment /VA)$_{exporters}$ / (Investment/VA)$_{non_exporters}$	1.84	1.84

Domestic Credit Market

- Simplifying assumptions: no exporters, no imported inputs, and no labor market. Firms use fixed amount of labor $\bar{n}$, with $\tilde{z} = z\bar{n}^{1-\alpha}$
- Domestic bonds b traded at price q^b ($R^b \equiv 1/q^b$).
- Collateral constraint applies to net bond position:

$$qd' - q^b b' \leq \theta k'.$$

- Net worth also uses net bond position:

$$a' = k' - qd' + q^b b'.$$

- ...so collateral constraint in terms of net worth is unchanged:

$$k' \leq \frac{a'}{1-\theta}.$$

Possible outcomes & portfolio choice

1. $R^b > \hat{R}$: all firms that borrow do so from abroad, so $b' = 0$ for all firms. Firms in region 3 accumulate net worth along the ray $k' = a'$ as before (*no domestic debt market*)

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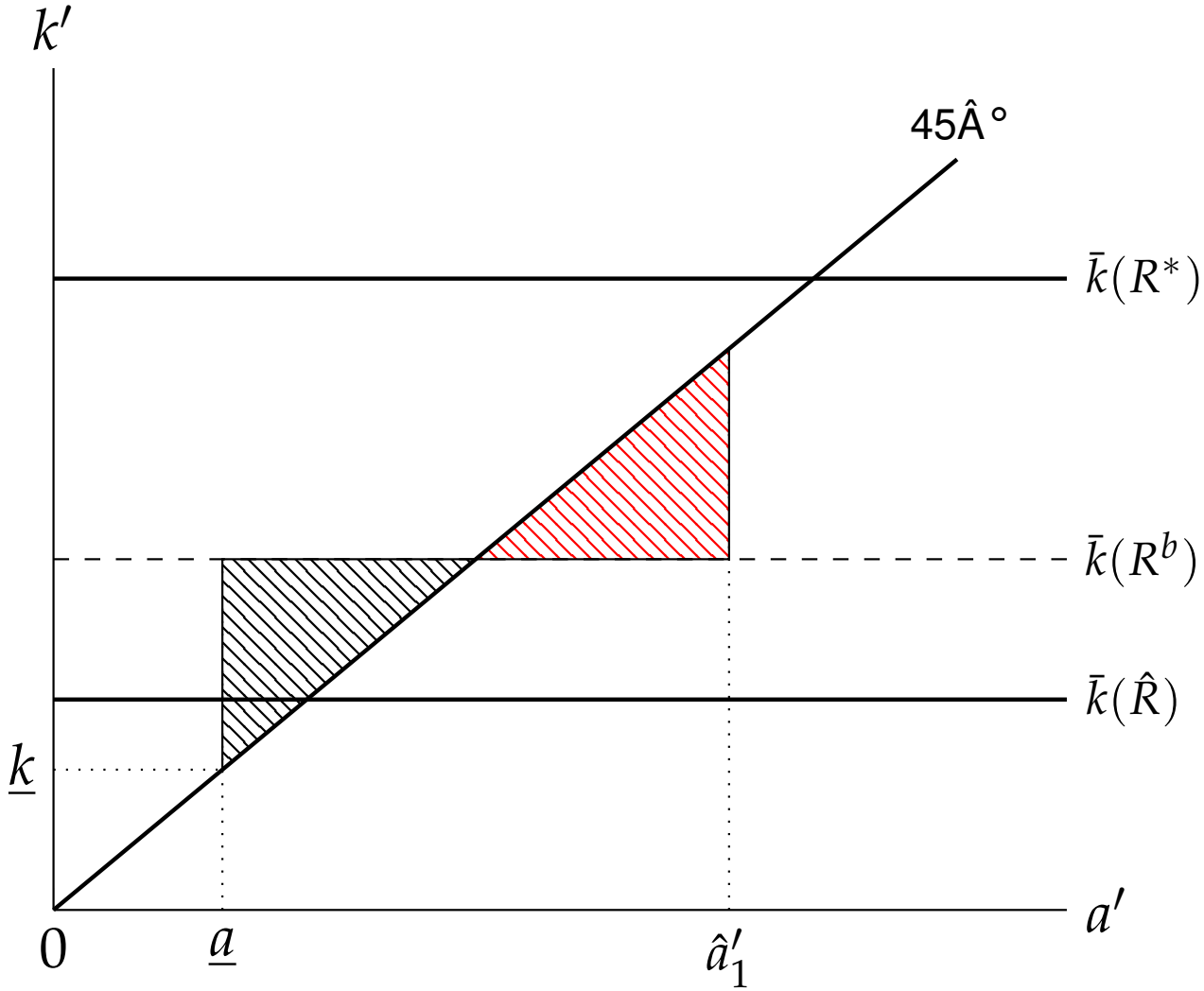
4. $R^b < R^*$, firms that save always prefer foreign bonds so no firm can borrow domestically at R^b (n*o domestic debt market*).

Do entrepreneurs in region 3 become lenders?

Proposition F.1 Assume that $R^* < R^b \leq \hat{R}$ ($q^* > q^b \geq \hat{q}$), an entrepreneur with net worth $a' \geq \bar{k}^{cc}(\tilde{z})$ increases its cash-on-hand more by investing its additional net worth into domestic bonds than by accumulating capital.

Proof: Entrepreneur's increase in cash-on-hand in response to increase in a' is larger by investing into bonds than into capital, because the marginal return of the former exceeds that of the latter.

Equilibrium in domestic credit market



Effects of CCs with domestic credit market

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