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Optimal Capital Controls and Real Exchange Rate Policies: A Pecuniary Externality Perspective

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Capital Controls, Financial Stability and Pecuniary Externalities

- IMF view refers “to the use of capital controls for financial-stability purposes. If there are external effects from foreign borrowing ... then capital controls can act as Pigouvian taxes and constitute an optimal response at the country level, helping agents to internalize the external effects of their borrowing”.

This paper and previous work

- Economic literature has developed to justify policy consensus on capital controls
  - DSGE models with occasionally binding borrowing constraints (Mendoza 2010)
  - Compare Competitive equilibrium with a Social Planner equilibrium
  - Find policy tool to equate the two equilibria (achieve 2\textsuperscript{nd} best outcome)

- We adopt the same theoretical DSGE model as the literature
  - We study an optimal policy problem in the same model
  - We endow our policy maker with various combinations of policy instruments
  - Part of our research agenda aimed at understanding the interaction of ex-ante and ex-post policy design when 'sudden stops' might occur
General Message of our Results

- In economies with borrowing constraint there are two dimensions of the problem: the size of the debt and the price of the collateral
  - The existing literature emphasizes the quantity of borrowing with the resurgence of the idea that capital controls can restrain borrowing

- We focus on the price of collateral and price support policies aimed at removing or minimizing the impact of the constraint
  - We show that price support policies can in theory undo the constraint (achieve first best)
  - Current literature limits objective to finding a tool to reach second best
  - Price support policies to limit impact of the constraint more powerful than capital controls to restrain debt, even if we don’t achieve first best

- The design of ex-ante policies is conditional on ex-post policies effectiveness.

- Capital controls are optimal if capital controls are the only policy instrument
The model is a small, open economy with traded and nontraded goods

Flexible prices

Asset markets are incomplete and access is imperfect
  - One bond economy with endogenous borrowing constraint

The model can potentially match many of the quantitative features of emerging market business cycles, both before and during financial crises

It is the same model Bianchi (AER, 2011) uses to justify capital controls. His result will be a special case of our more general results.
Household Utility

- There is a continuum of households $j \in [0, 1]$ that maximize the utility function

$$U^j \equiv E_0 \sum_{t=0}^{\infty} \left\{ \beta^t \frac{1}{1-\rho} \left( C^j_t \right)^{1-\rho} \right\}$$

- Consumption is a composite of traded and nontraded consumption goods

$$C_t \equiv \left[ \omega \frac{1}{\kappa} \left( C^T_t \right)^{\frac{\kappa-1}{\kappa}} + (1-\omega) \frac{1}{\kappa} \left( C^N_t \right)^{\frac{\kappa-1}{\kappa}} \right]^{\frac{\kappa}{\kappa-1}}. \quad (1)$$

- We drop the $j$ subscript to simplify notation, but all choices are made at the individual level and households do not internalize the impact of their decision on aggregate prices or aggregate debt
**Endowment and Budget Constraint**

- Stochastic endowment streams of tradable and non-tradable output: \{ Y_t^T \} and \{ Y_t^N \}
- Budget Constraint

\[ C_t^T + P_t^N C_t^N + B_{t+1} = Y_t^T + P_t^N Y_t^N + (1 + r) B_t, \]

- Borrowing is in units of tradeable consumption: Currency mismatch (borrow in traded goods, pledge traded and nontraded as collateral)
- We normalize to the traded good price to 1. The relative price of the nontradable goods (\( P^N \)) is then:

\[ P_t = \left[ \omega + (1 - \omega) \left( P_t^N \right)^{1-\kappa} \right]^{\frac{1}{1-\kappa}}. \]
Borrowing Constraint

- Borrowing limited as a fraction of current income

\[ B_{t+1} \geq -\frac{1 - \phi}{\phi} \left[ Y_t^T + P_t^N Y_t^N \right]. \]  \hspace{1cm} (2)

- Constraint can be derived from explicit microfoundations
- Liquidity constraint: Lenders require households to finance a fraction of current spending out of income
- Equilibrium of a model with default where lenders only lend an amount they can extract in the case of default
- Results are robust to other types of constraints
- Since \( \beta(1 + r) < 1 \) agents are impatient and want to borrow despite risk of crisis
Households maximize utility subject to budget and borrowing constraints

\[
L = E_0 \sum_{t=0}^{\infty} \beta^t \left[ \frac{1}{1-\rho} C_{j,t}^{1-\rho} + \lambda_t \left( B_{t+1} + \frac{1-\phi}{\phi} \left[ Y_t^T + P_t^N Y_t^N \right] \right) + \mu_t \left( Y_t^T + P_t^N Y_t^N - B_{t+1} + (1 + r) B_t - C_t^T - P_t^N C_t^N \right) \right]
\]

by choosin \( B_{t+1}, \ C_t^N \) and \( C_t^T \)
First Order Conditions

- FOCs for $C^N_t$ and $C^T_t$ can be combined to yield

$$\frac{(1 - \omega) \frac{1}{\kappa} (C^N_t)^{-\frac{1}{\kappa}}}{\omega \frac{1}{\kappa} (C^T_t)^{-\frac{1}{\kappa}}} = P^N_t,$$

- FOC for $B_{t+1}$

$$B_{t+1} : \mu_t = \lambda_t + \beta (1 + r) E_t [\mu_{t+1}]$$

- $\mu_t$ is marginal utility of tradable consumption
Why is there a role for a policy intervention?

- In the model agents do not internalize the effects of their decisions on relative prices
  - With no borrowing constraint this would be irrelevant
  - Relative price appears in the borrowing constraint
  - Literature labels this a ’pecuniary externality’
- General idea (e.g., Arnott, Greenwald and Stiglitz, 1994): in economies with financial frictions, agents do not take into account the consequences of their individual actions on the key market prices on which financial frictions are defined
- The nature of the inefficiency can most easily be seen by studying a social planners problem
Constrained-Efficient Social Planning problem

- Social planner maximizes utility subject to the resource constraints, the international borrowing constraint and the competitive pricing rule
- FOC for $C_t^T$
  \[
  C_T : u'(C_t)C_{C_t} = \mu_{1,t}^{SP} - \lambda_t^{SP}\Sigma_t^{SP}
  \]
- FOC for $C_t^T$ in Competitive Equilibrium
  \[
  C_T : u'(C_t)C_{C_t} = \mu_t
  \]
- The social planner internalizes the consequences of decisions on $P_t^N$
  - when the constraint binds ($\lambda_t^{SP} > 0$), there is an additional marginal benefit in consuming an extra unit tradable consumption, represented by the term $\lambda_t^{SP}\Sigma_t$
  - This captures the increase in the price of non-tradable goods associated with the marginal increase in tradable consumption.
  - This effect also applies when the constraint is expected to bind
Unconstrained Equilibrium

- We have three benchmark equilibria: Competitive Equilibrium, Social Planner, Unconstrained Equilibrium.
- The unconstrained equilibrium is one in which there is no borrowing constraint.
- We refer to this as the first best case, though markets are still incomplete.
- We illustrate the difference between the three allocations with policy functions.
- A policy function is the non-linear equilibrium relation between the endogenous variables of the model and its exogenous and endogenous state variables (the triplet \( \{ B_t, Y_t^N, Y_t^T \} \)).
- These are constructed by hitting the economy with a sequence of one standard deviation negative shocks to the \( C_t \) endowment.
Three Equilibrium Allocations

- Debt
- Tradable Consumption
- Nontradable Price

Notes: CE denotes the competitive equilibrium allocation; SP the social planner allocation; UE the unconstrained equilibrium. The figure plots the equilibrium decision rules or policy functions of the endogenous variables plotted conditional on one-standard deviation shocks. Borrowing decreases from left to right on the x-axis.
Government Policy Instruments

- Policy instruments: three distortionary taxes on $B_{t+1}, C_t^T, C_t^N$.
- The tax on $B_{t+1}$ as a capital tax (capital control)
- Interpret the tax on $C_t^T$ or $C_t^N$ as an exchange rate intervention.
- Balanced budget:
  - Non distortionary financing (first)
    \[ T_t = \tau_t^N P_t^N C_t^N \quad \text{or} \quad T_t = \tau_t^B B_{t+1} \]
  - Distortionary financing (later)
    \[ \tau_t^B B_{t+1} = \tau_t^N P_t^N C_t^N \quad \text{or} \quad \tau_t B_{t+1} = \tau_t^N P_t^N C_t^N + \tau_t^T C_t^T \]
- Ramsey approach: maximizes agents' utility subject to resource constraint, FOCs of competitive equilibrium and government budget constraint conditional on policy tools available.
The Ramsey problem when restricted to $\tau_t^B$ is to maximize the consumers expected utility subject to the resource constraints, the government budget constraint, the borrowing constraint, the first order conditions of the household.

Proposition: The Ramsey optimal policy with $\tau^B$ as the government policy instrument replicates the social planner allocation (SP). Moreover the optimal policy is time-consistent.

Intuition: In a crisis CE and SP solutions are the same. Then optimal policy sets tax to 0 in a crisis. The best the Ramsey planner can do with this instrument is to make the same decisions as a social planner before the crisis.

Proof: Show that the taxes from the OP problem are the same as the taxes that implement the social planners allocation from above.
Figure 2: Optimal Capital Control Policy

- The figure plots the optimal debt tax rate and the associated welfare gain relative to the competitive equilibrium conditional on one-standard deviation shocks. Borrowing decreases from left to right on the x-axis.

- Notes: The figure plots the optimal debt tax rate and the associated welfare gain relative to the competitive equilibrium conditional on one-standard deviation shocks. Borrowing decreases from left to right on the x-axis.
Ergodic Debt Distribution

Figure 3: Optimal Capital Control Policy

Notes: The figure plots the ergodic distribution of debt in units of tradable consumption in the competitive equilibrium (CE) and the social planner allocations (SP). Borrowing decreases from left to right on the x-axis.
Optimal Exchange Rate Policy

- We interpret taxes on $C^N_t$ or $C^T_t$ as exchange rate interventions.
- We focus on taxes on $C^N_t$ as $C^T_t$ taxes have a one to one mapping into the $C^N_t$ tax.
- With a tax on nontradable consumption budget constraint becomes:
  \[ C^T_t + P^N_t (1 + \tau^N_t) C^N_t = Y^T_t + P^N_t Y^N_t + T_t - B_{t+1} + (1 + r) B_t \]
- Government interventions are rebated lump sum to household.
Exchange Rate Interventions

- Competitive equilibrium choice for consumption determined by:

\[
(1 - \omega)^{\frac{1}{\kappa}} (C_t^N)^{-\frac{1}{\kappa}} = P_t^N \left(1 + \tau_t^N\right)
\]

- This equation directly links \( P_t^N \) with \( \tau_t^N \)

- When the constraint binds tax can be used to affect the collateral value (and hence tradable consumption)
  - In a crisis tax can be used to help undo impact of collateral constraint
Ramsey Optimal Policy

- As before Ramsey planner chooses $\tau_t^N$ to maximize the welfare of the agent subject to the same set of conditions.
- Proposition: The optimal policy replicates the first best (unconstrained allocation)
  - Policy promises to relaxes the borrowing constraint when needed
  - It does so by supporting the relative price of non tradeables when the constraint binds
  - In equilibrium the constraint never binds
  - Private agents behave as if the constraint does not exist
- Result is higher tradables good consumption than in CE or SP
  - For a given endowment of nontradable goods OP has a higher relative price of nontradables
  - Which increases borrowing capacity of private agents
- Proof: Compare FOCs for OP and UE problems
Implication: normative analysis should use optimal Ramsey problem conditional on the set of available instruments rather than the social planner problem

- Exchange rate policy dominates precautionary capital control policy in welfare terms
  - Under optimal policy with $\tau^N$ the probability of a financial crisis is zero
  - OP replicates the unconstrained first-best allocation
  - Capital controls can achieve only a second best allocation
- Policy function for $\tau^N$ eliminates the effects of the pecuniary externality
  - Policy can be interpreted as a price support intervention that avoids the collapse of the relative prices
  - This policy commitment is a time consistent equilibrium
- The Ramsey planner can manipulate the relative price of non tradables directly while SP is constrained by the pricing function
Optimal Exchange Rate Policy

Figure 4: Optimal Exchange Rate Policy

Nontradable Consumption Tax

![Graph of Nontradable Consumption Tax]

Welfare Gain

![Graph of Welfare Gain]

Notes: The figure plots the optimal nontradable consumption tax rate and the associated welfare gain relative to the competitive equilibrium conditional on one-standard deviation shocks. Borrowing decreases from left to right on the x-axis.
Ramsey Optimal Policy

- Our analysis in the previous section showed that real exchange rate policy dominates capital control policy.
- The result hinges on the ability of the Ramsey planner to manipulate the price that enters the borrowing constraint without costs because the subsidy on the relative price of nontradables is financed with lump sum taxes.
- We now consider an environment in which lump-sum transfers/taxes are not available, so that it is costly to manipulate the relative price of nontradables.
- In practice managing the real exchange rate is costly during crisis times although we don’t model these costs explicitly.
- We consider $\tau_t^B$ and $\tau_t^N$ to allow for both exchange rate interventions and capital controls.
- We solve the model numerically.
Distortionary Financing

**Taxes on Debt and Nontradable Consumption**

- **τ_B(t)**
- **τ_N(t)**

**Welfare Gain**

- Percent of C^T

Notes: The figure plots the optimal debt and nontradable consumption tax rates and the associated welfare gain relative to the competitive equilibrium, conditional on one-standard deviation shocks. Borrowing decreases from left to right on the x-axis.
Distortionary Financing

Figure 6: Optimal Capital Control and Exchange Rate Policy: Decision Rules

Notes: CE denotes the competitive equilibrium allocation; OP the optimal policy equilibrium with both debt tax and nontradable consumption tax. The figure plots the equilibrium decision rules of the endogenous variables plotted conditional on one-standard deviation shocks. Borrowing decreases from left to right on the x-axis.
Distortionary Financing

Figure 7: Optimal Capital Control and Exchange Rate Policy

Notes: The figure plots the ergodic distribution of debt in units of tradable consumption in the competitive equilibrium (CE) and the optimal policy equilibrium with both debt tax and nontradable consumption tax (OP). Borrowing decreases from left to right on the x-axis.
## Comparison of Allocations

<table>
<thead>
<tr>
<th>Equilibrium</th>
<th>Debt to Income</th>
<th>Prob of a Crisis</th>
<th>Welfare Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE</td>
<td>29.2%</td>
<td>6.7%</td>
<td>NA</td>
</tr>
<tr>
<td>SP</td>
<td>28.4%</td>
<td>1.2%</td>
<td>0.41%</td>
</tr>
<tr>
<td>UE</td>
<td>NA</td>
<td>0.0%</td>
<td>33.8%</td>
</tr>
<tr>
<td>OP</td>
<td>30.5%</td>
<td>4.9%</td>
<td>1.10%</td>
</tr>
</tbody>
</table>
OP lessens impact of a crisis

![Consumption Growth in Crises](image)

Notes: CE denotes the competitive equilibrium allocation; SP the social planner allocation; OP the optimal policy equilibrium. The figure plots the ergodic distribution of consumption growth in the period after the constraint was binding. Borrowing decreases from left to right on the x-axis.
Main Results

- The interaction between ex post, crisis management policies and ex ante, crisis prevention policies is critical for determining
- Ex-post policies work better than ex-ante because they work to alleviate the crisis by supporting the value of collateral
- Limited use of capital controls is justified when ex-ante interventions are costly