Reserve Accumulation, Growth and Financial Crises

Gianluca Benigno Luca Fornaro

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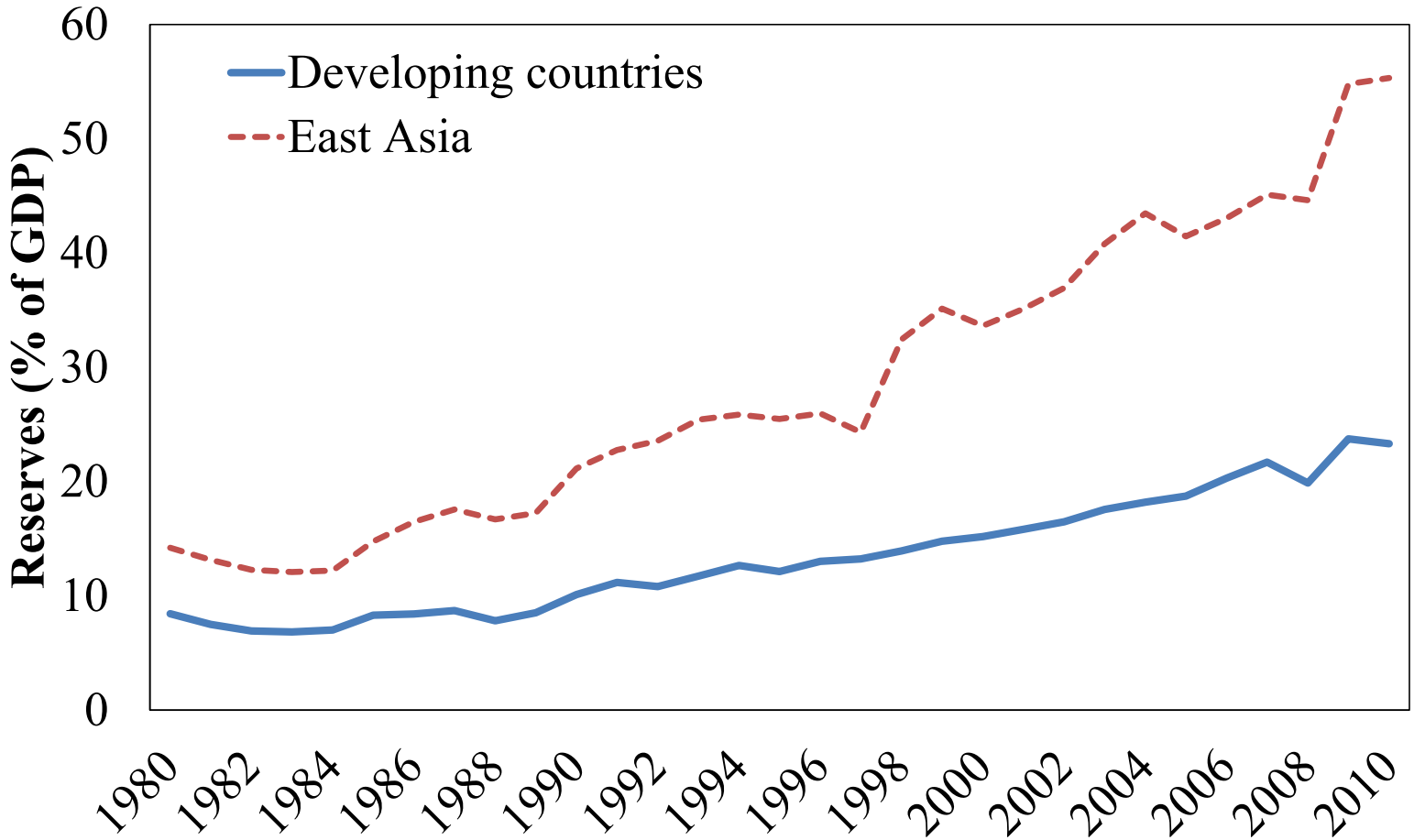
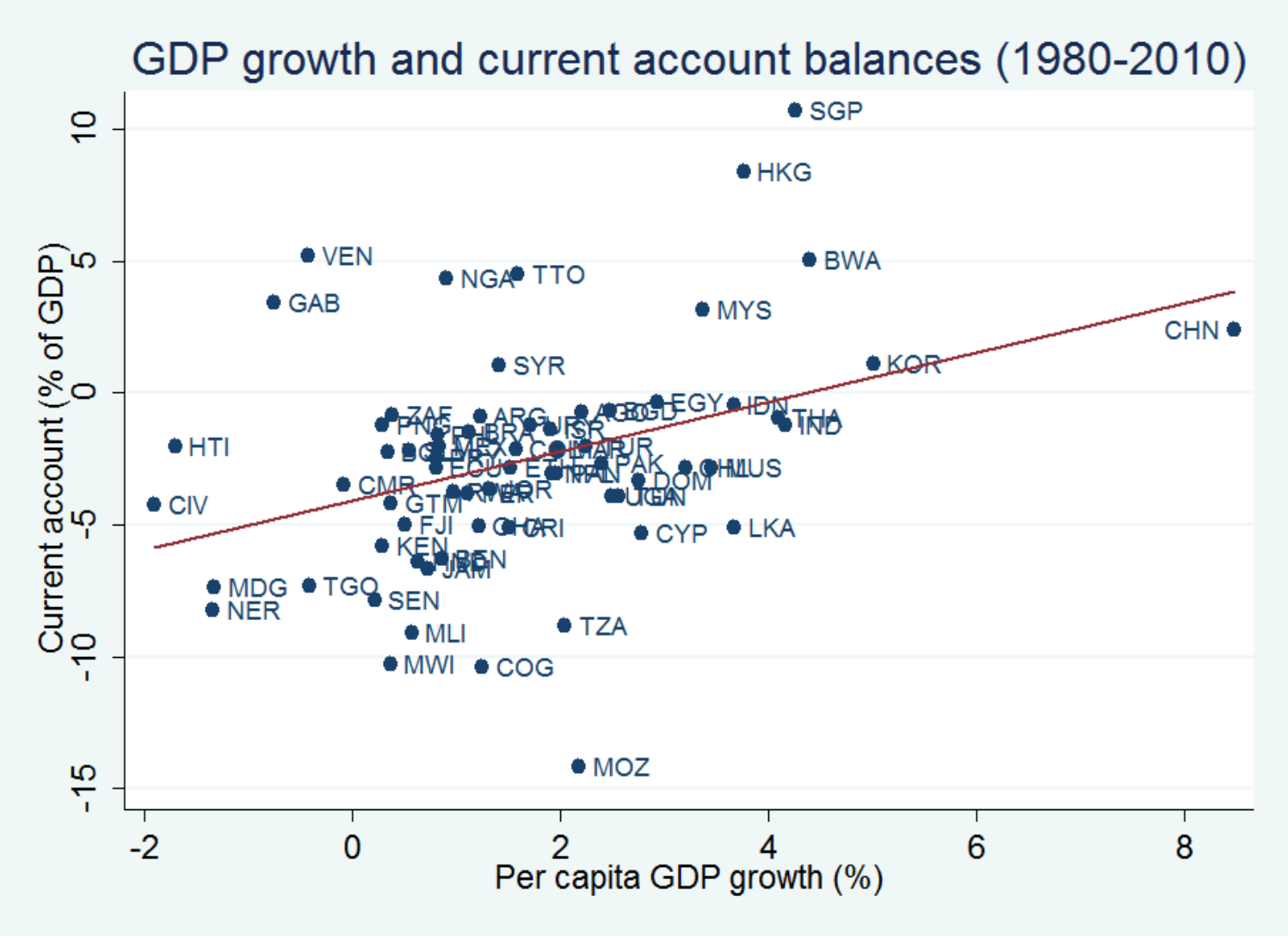
Research questions

- What explains the spectacular accumulation of foreign exchange reserves in developing countries?
- Why do we observe a positive relationship between growth and current account surpluses?

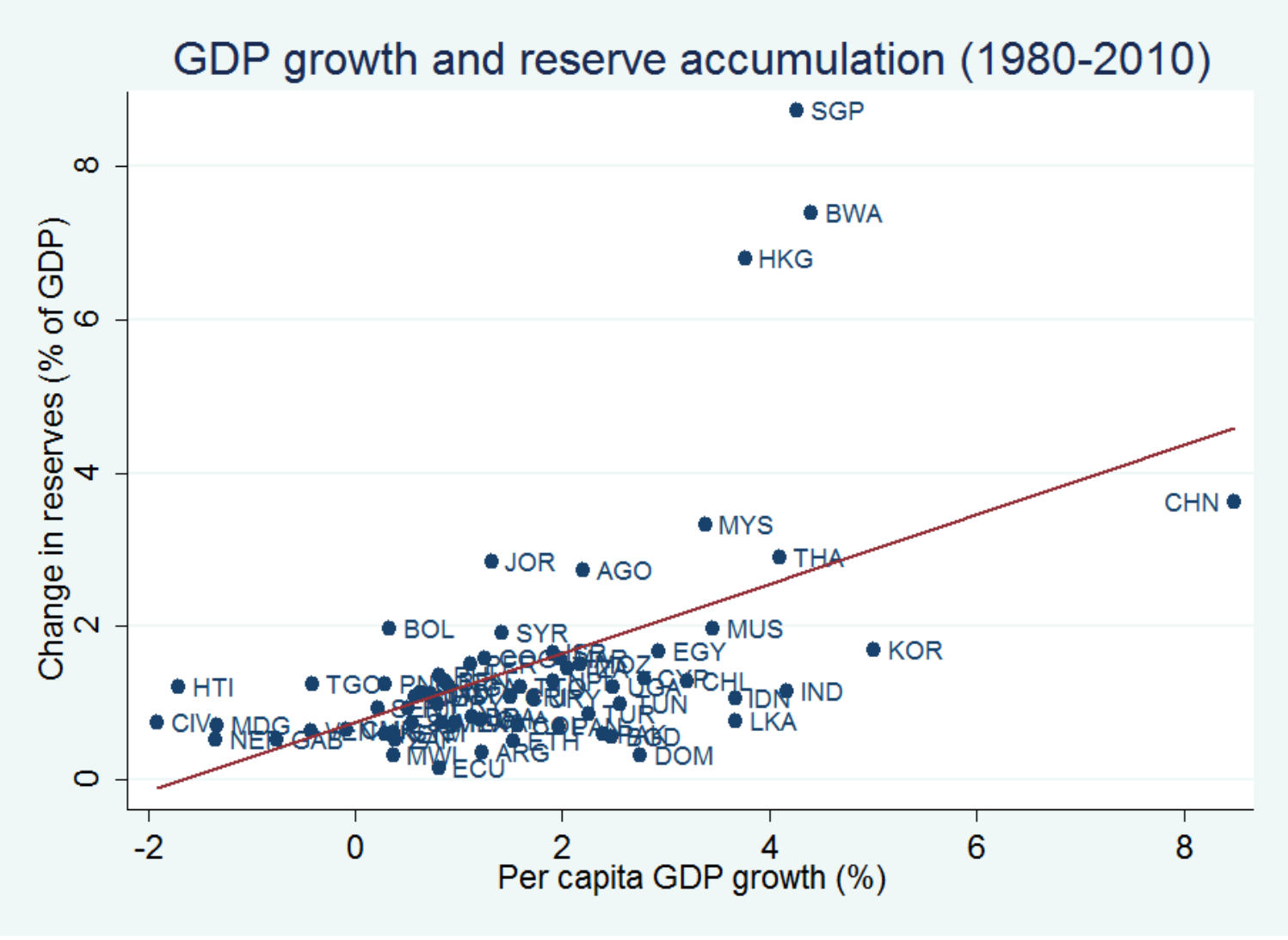
Reserve accumulation in developing countries



GDP growth and current account (1980-2010)



GDP growth and reserve accumulation (1980-2010)



Empirical evidence

- Empirical regularities first emphasized by Gourinchas and Jeanne (2011) and by Alfaro, Kalemli-Ozcan and Volosovych (2011)
- These facts are hard to reconcile with the neoclassical growth model
- In the neoclassical growth model:
  - Faster growth is associated with higher capital inflows
  - The competitive equilibrium is efficient, hence no role for public intervention in capital flows

Our contribution

- We develop a theory of public intervention in capital flows
- Key elements:
  - Knowledge externalities in the tradable sector
  - International borrowing constraint
- The combination of these two elements provides an incentive for the government to accumulate reserves in order to stimulate growth

Our contribution (cont'd)

- Accumulation of reserves is associated with exchange rate undervaluation and faster growth
- Financial frictions create imperfect substitutability between private and public capital flows
- The possibility of using reserves during crises amplifies the positive relationship between reserve accumulation and growth
- The welfare gains from an appropriate reserve policy are substantial (in the order of a 1 percent permanent increase in consumption in our baseline calibration)

Related literature

- **Theories of reserve accumulation:** Durdu et al. (2010), Jeanne and Ranciere (2011), Dooley et al. (2003), Aizenman and Lee (2007), Rodrik (2009), Korinek and Serven (2010)

- **Related empirical evidence**: Gourinchas and Jeanne (2011), Alfaro, Kalemli-Ozcan and Volosovych (2011), Rodrik (2008), Cerra and Saxena (2008)

Plan of the talk

- Model
- Explanation of the mechanisms
- Reserve management in an economy opening to capital flows
- Welfare

Model

- Small open economy
- Two sectors: tradable and non-tradable
- Households, firms, foreign investors, government

Households

- Expected lifetime utility

$$E_0 \left[\sum_{t=0}^{\infty} \beta^t \frac{C_t^{1-\gamma}}{1-\gamma} \right]$$

- Consumption aggregator

$$C_t = \left(C_t^T\right)^{\omega} \left(C_t^N\right)^{1-\omega}$$

- Supply inelastically one unit of labor during each period
- Budget constraint

$$C_t^T + P_t^N C_t^N = W_t + \Pi_t^T + \Pi_t^N$$

Real exchange rate and non-tradable sector

- Real exchange rate

$$P_t^N = \frac{1-\omega}{\omega} \frac{C_t^T}{C_t^N}$$

- Firms in the non-tradable sector maximize

$$\Pi_t^N = P_t^N \left(L_t^N\right)^{\alpha_N} - W_t L_t^N$$

Firms: tradable sector

- Produce using labor L_t^T, imported inputs M_t and knowledge X_t

$$Y_t^T = \left(X_t L_t^T\right)^{\alpha_T} M_t^{1-\alpha_T}$$

- Dividends

$$\Pi_t^T = Y_t^T - W_t L_t^T - P^M M_t - B_{t+1} + RB_t - T_t$$

- Firms maximize

$$E_0 \left[\sum_{t=0}^{\infty} \beta^t \lambda_t \Pi_t^T \right]$$

Working capital

- Working capital requirement: a fraction ϕ of the imported inputs has to be paid before production takes place

$$\underbrace{\phi P^M M_t}_{\text{work. cap. requirement}} = \underbrace{D_t^G}_{\text{gov. loans}} + \underbrace{D_t^P}_{\text{loans from foreign investors}}$$

- We assume a zero interest rate on intraperiod loans

Borrowing constraint

- To prevent defaults foreign investors impose the borrowing limit

$$\underbrace{-RB_t}_{\text{bonds maturing in period } t} + \underbrace{D_t^P}_{\text{intratemporal loan at time } t} \leq \underbrace{\kappa_t}_{\text{credit shock}} X_t$$

- Binding borrowing constraint interferes with:
  - Consumption smoothing
  - Import of intermediate goods

Knowledge accumulation

- Knowledge evolves according to

$$X_{t+1} = \psi X_t + M_t^{\xi} X_t^{1-\xi}$$

- This is meant to capture spillovers of foreign knowledge through the imports of intermediate goods

- **Externality:** since knowledge is non-excludable firms do not internalize the impact of their actions on the future stock of knowledge

Discussion of growth process

- **Cross-country knowledge spillovers:** Klenow and Rodriguez-Clare (2005)
- **Transmission of knowledge trough trade:** Coe, Helpman and Hoffmaister (1997), Amiti and Konings (2007), Blalock and Gertler (2004), Park, Yang, Shi and Jiang (2010)
- **Tradable sector as engine of productivity convergence:** Rodrik (2012)
- **Knowledge externalities:** Romer (1990), Grossman and Helpman (1991), Aghion and Howitt (1992)

Government

- Collects taxes to finance reserve accumulation
- Uses reserves to provide working capital loans to firms (efficiency loss as in Gertler and Karadi (2009))

$$FX_{t+1} = R^{FX} FX_t + T_t - D_t^G \frac{\theta}{1-\theta}$$

- Reserves cannot be negative and pay a return lower than the world interest rate

Market clearing

- Tradable good

$$C_t^T = Y_t^T - P^M M_t - B_{t+1} + RB_t - FX_{t+1} + R^{FX} FX_t - D_t^G \frac{\theta}{1-\theta}$$

- Non-tradable good

$$C_t^N = Y_t^N$$

- Labor

$$L_t^T + L_t^N = 1$$

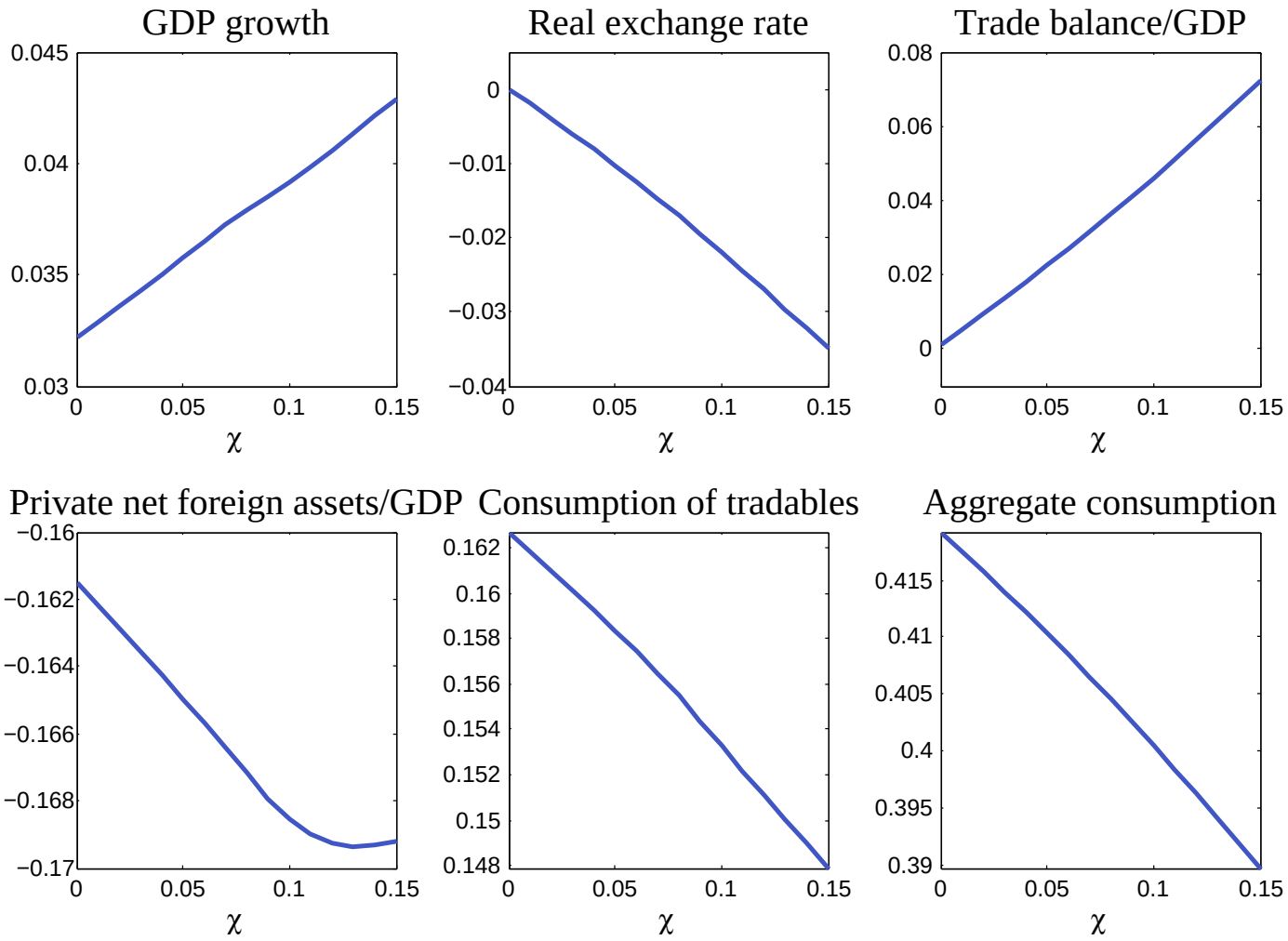
Intervention - tranquil times

- When firms are not financially constrained an increase in reserves leads to a higher use of imported inputs and faster growth
  - Increase in the stock of reserves
  - Decrease in consumption of tradables
  - Real exchange rate depreciation
  - Wages decrease and firms in tradable sector employ more labor
  - Use of imported inputs increases
  - Faster accumulation of knowledge

- Focus on reserve accumulation rules of the form

$$FX_{t+1} - R^{FX} FX_t = \chi {Y_t}^T$$

Intervention - tranquil times ($FX_{t+1} - R^{FX} FX_t = \chi Y_t^T$)



Intervention - crises

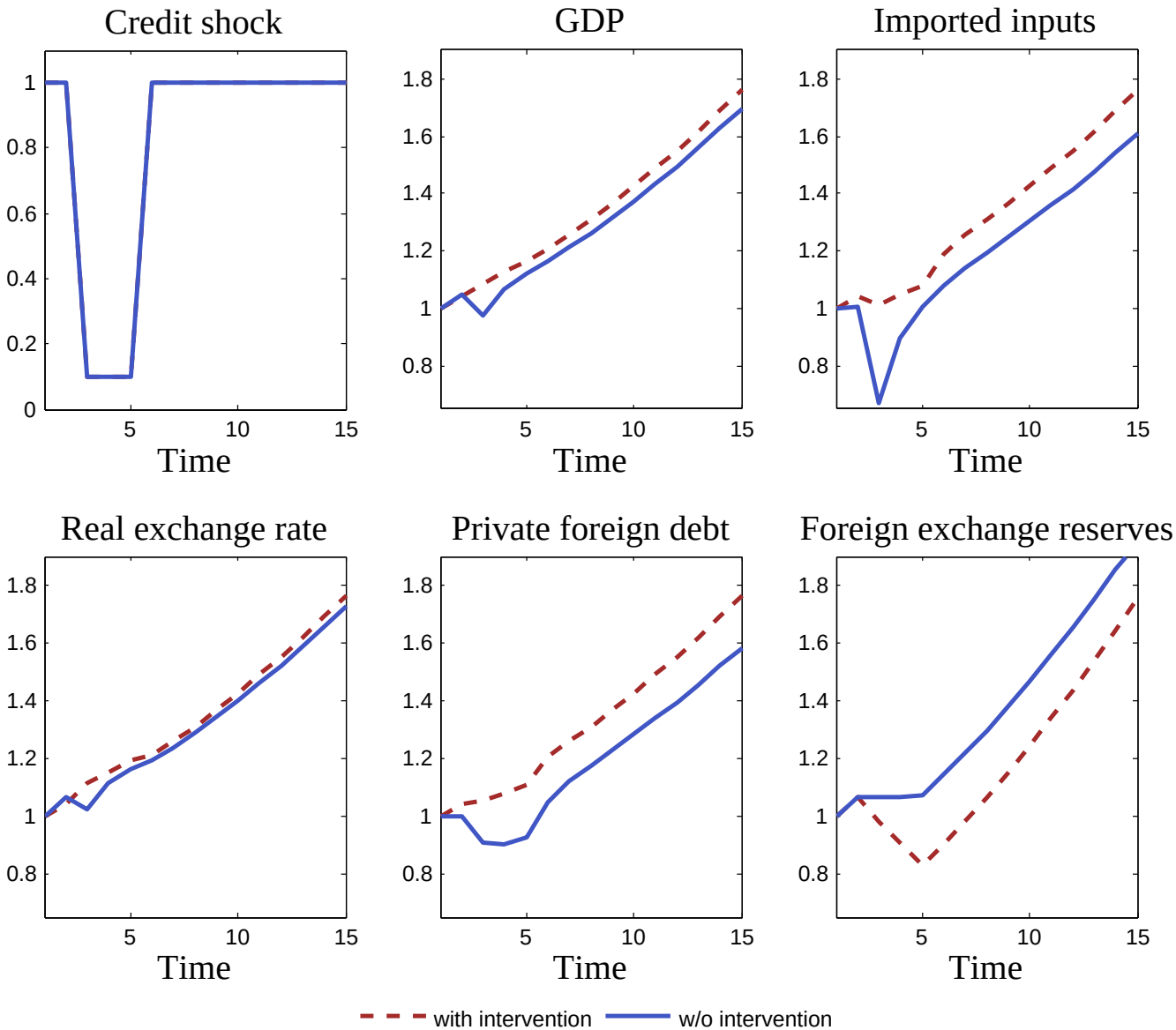
- When firms are financially constrained

$$M_t = \frac{X_t \kappa_t + RB_t + D_t^G}{\phi P^M}$$

- Government can increase the use of imported inputs by using foreign exchange reserves to finance working capital

- We assume that the government uses at most a fraction χ^{WK} of its stock of reserves to finance working capital

Intervention - crises (cont'd)



Policy intervention and financial liberalization

- To illustrate the properties of the model we look at the impact of policy on an economy that it is opening to capital flows (i.e. $B_0 = FX_0 = 0$)

- 1. We look at the effect on growth and capital flows by comparing an economy without intervention to one with the optimal policy rule ($\chi = 0.09$, $\chi^{WK} = 1$)

- 2. We compute the welfare gains from policy intervention

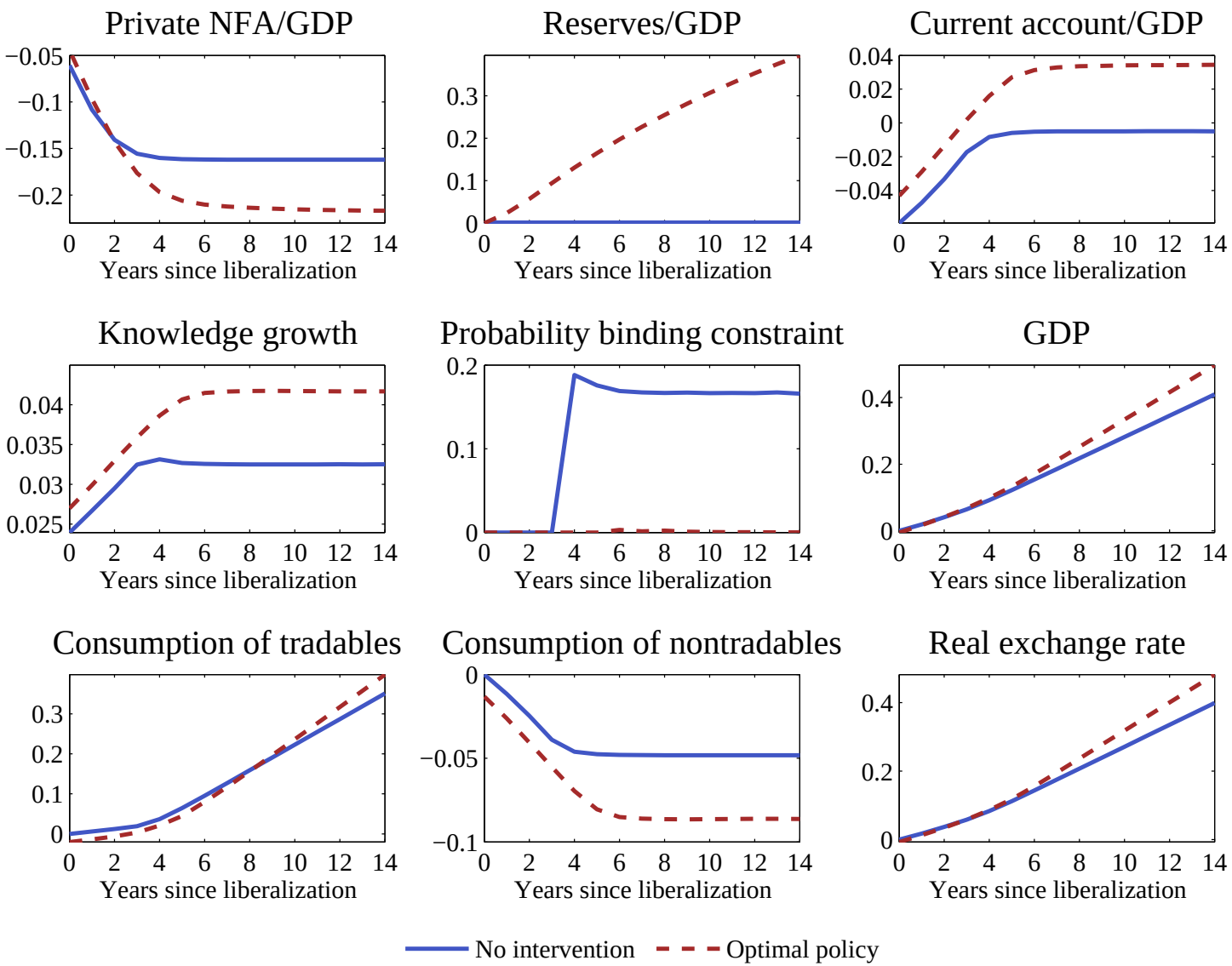
- We assume two possible realizations for the credit shock $k_H > k_L$

Calibration

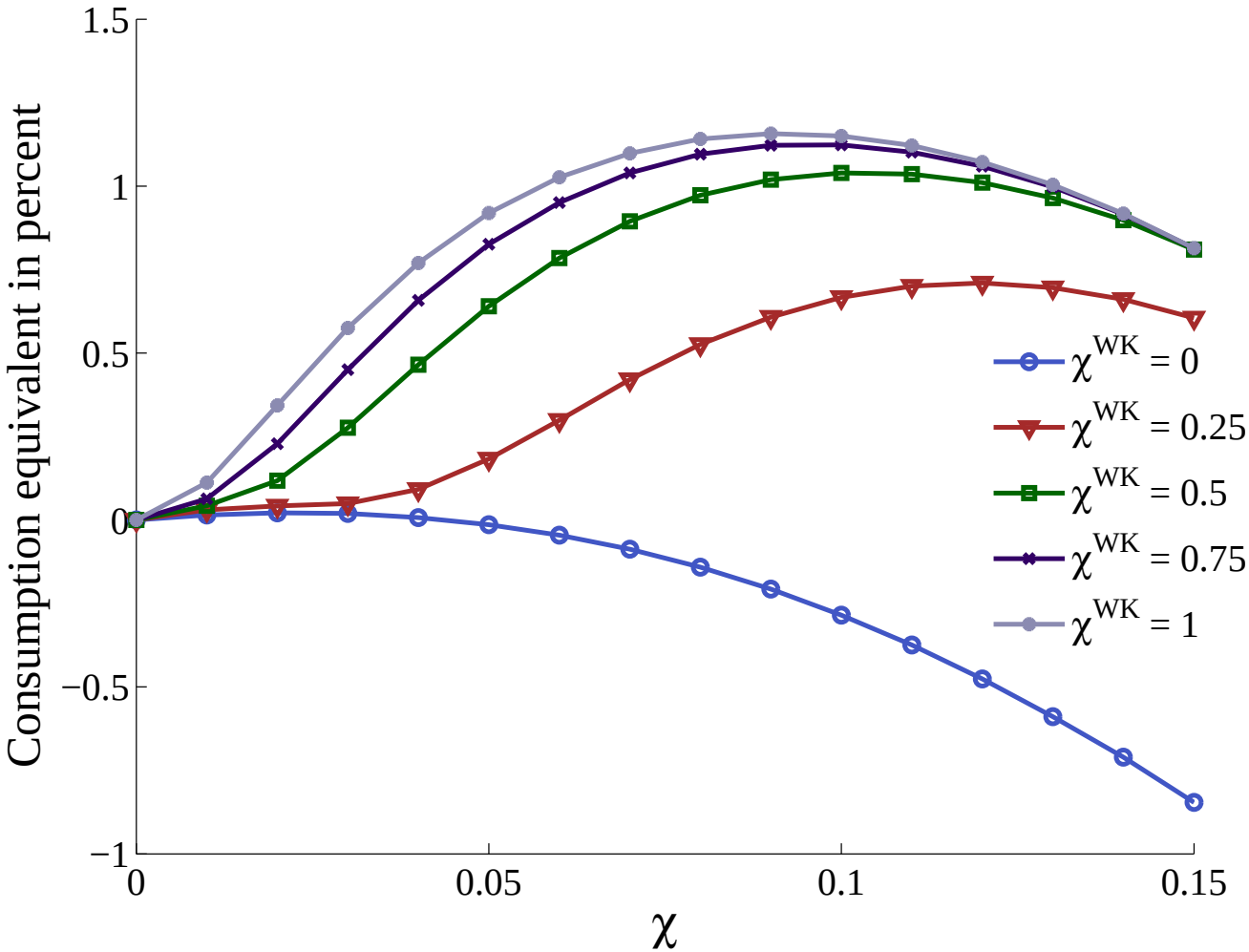
Table 1: Parameters

Parameter	Symbol	Value
Risk aversion	γ	2
Interest rate on private borrowing	R	1.04
Discount factor	β	$1/R$
Labor share in output in tradable sector	α_T	0.65
Labor share in output in non-tradable sector	α_N	0.65
Share of tradable goods in consumption	ω	0.341
Price of imported inputs	P^M	1
Borrowing limit	κ_L	0.1
Probability of bad credit shock	$1-\rho_H$	0.1
Probability of exiting bad credit shock	$1-\rho_L$	0.5
Working capital coefficient	ϕ	0.33
Elasticity of TFP w.r.t. imported inputs	ξ	0.15
Constant in knowledge accumulation process	ψ	0.34
Interest rate on reserves	R^{FX}	1
Efficiency of government intervention during crises	θ	0.5

Reserve management, growth and capital flows



Welfare


Consumption equivalent in percent
1.5
1
0.5
0
−0.5
−1
0
0.05
0.1
0.15
χ
χ^WK = 0
χ^WK = 0.25
χ^WK = 0.5
χ^WK = 0.75
χ^WK = 1

Social planner

- The social planner does not accumulate reserves
- The first best can be replicated by subsidizing the purchase of intermediate inputs
- Subsidies to exporters can conflict with trade agreements
- Reserve accumulation can be used to circumvent the restrictions imposed by trade agreements

Conclusions

- We provide a novel framework able to reproduce the positive correlation between reserve accumulation, current account surplus and growth observed in the data

- Future research:
  - Interaction between reserve management and capital controls
  - Global imbalances and reserve accumulation