A Model of Global Currency Pricing

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Currency of pricing in international trade

- Currency of trade pricing is a key feature of open economy macro models
  - Producer Currency Pricing (PCP): Clarida et al. (2002).
  - Local Currency Pricing (LCP): Engel (2011).
  - Dominant Currency Pricing (DCP): Egorov and Mukhin (2023).
- Each have different implications for exchange rate pass-through, macro volatility, and optimal monetary policy

What Does This Paper Do?

- This Paper: explores possibility of currency basket used for trade invoicing - we call it Global Currency Pricing
  - Active recent discussion of erosion of US dollar dominance
  - Could an alternative system be planned rather than evolving endogenously?
  - Basket suggested in proposals for reform of monetary system; Brunnermeier et al. (2021), Carney (2019), Meta's 'Libra'.
  - China suggests replacing US dollar with SDR, IMF basket of fiat currencies.
    IMF SDR

Framework

- New Keynesian open economy (NKOE) framework
  - Based on Gali-Monacelli (2005) and Mukhin (2022)
  - Compare exchange rate pass-through, equilibrium allocation, optimal policy under GCP.
  - Key question - assuming GCP, how should an 'optimal' basket be designed?
- Quantitative implications of a basket currency invoice
- Given optimal policy, would GCP be endogenously adopted at the micro level?

Preview of results

- Under GCP optimal policy is a linear mix of a domestic target and a global target, agreed to by all
- We derive a unique optimal currency basket, weighting countries by importance in international trade
    - Under the optimal basket - each country can ignore external shocks - just focus on domestic target
    - Small countries (large countries) should be overweighted (underweighted), relative to size

Preview II

- Welfare comparison
  - GCP always dominates DCP and LCP
  - Welfare comparison between GCP and PCP depends on limitations of monetary policy responses
- Calibrating the model to 20 countries
  - We show that there would be welfare gains from switching from a DCP pricing system to the used of the IMF's SDR
  - The U.S. gains far more than any of the other groups.

Preview III

- Endogenous currency choice: two scenarios where introduction of GCP will lead to equilibrium adoption
  - GCP dilutes the impact of idiosyncratic financial shocks
  - Complementarity in price setting enhances desirability of GCP
- Transiting from DCP to GCP
  - Conditions under which forming GCP vehicle may lead to endogenous departure from dollar currency pricing (DCP)

Related Literature

Invoicing patterns (Gopinath et al., 2010; De Gregorio et al., 2024) (Goldberg and Tille, 2009; Zhang, 2022; Cook and Patel, 2023).

Invoicing currency choices (Goldberg and Tille, 2016), market share (Devereux et al., 2015), (Novy, 2006; Lyonnet et al., 2022; Berthou et al., 2022), (Chung, 2016), (Gopinath and Stein, 2021; Amiti et al., 2022) Mukhin (2022)

Role of the US dollar Gopinath and Itskhoki (2022). (Maggiori et al., 2020) (Jiang et al., 2021; 2024). (Salomao and Varela, 2022), (Coppola et al., 2023), (Bocola and Lorenzoni, 2020; Drenik et al., 2022), (Chahrour and Valchev, 2022). for (Engel and Wu, 2023), (Hassan, 2013; Maggiori, 2017; Hassan and Zhang, 2021).

Global financial cycle (Miranda-Agrippino and Rey, 2020; Obstfeld and Zhou, 2022)

Internationalization of other currencies (Bahaj and Reis, 2020), (Clayton et al., 2024), (Horn et al., 2023), (BISpaper, 2022).

Baseline Model

- N countries with asymmetric sizes
  - In country i, there exists a continuum of n_i households and a continuum of n_i monopolistically competitive firms.
  - Normalize so that $\sum_{i=1}^{N} n_i = 1$.
  - Country 1 represents the US.
- Currencies
  - Each country has its own fiat currency.
  - The exchange rate between currency i and currency j is $\mathcal{E}_{ijt}$.
  - An increase indicates a depreciation of currency i.

Global Currency Basket

- $\mathcal{E}_{igt}$ is the price of the global currency in terms of currency i.
- The composition structure of the global currency is:

$$(\mathcal{E}_{1gt})^{\alpha_1}(\mathcal{E}_{2gt})^{\alpha_2}\cdots(\mathcal{E}_{Ngt})^{\alpha_N}=1, \quad \sum_{i=1}^{N}\alpha_N=1$$

- The exchange rate between currency i and global currency $\mathcal{E}_{igt}$ is:

$$\mathcal{E}_{igt}=(\mathcal{E}_{i1t})^{\alpha_1}(\mathcal{E}_{i2t})^{\alpha_2}\cdots(\mathcal{E}_{iNt})^{\alpha_N}$$

- α_i represents the share of currency i within the global currency basket.

Households in country i

- Preference: $\mathbb{E}\sum_{t=0}^{\infty}\beta^t\left(\ln C_{it}-L_{it}\right)$.
- Labor supply decision: $W_{it}=P_{it}C_{it}$.
- Consumption bundle: non-tradable goods C_{Nit} and tradable goods C_{Tit}
- Risk Sharing: $\mathcal{E}_{ijt}=\dfrac{P_{it}C_{it}}{P_{jt}C_{jt}}$.

Firms in country j

- One-period version of Calvo (1983) price
  - A fraction θ of firms can set goods prices at the beginning of period t, while the remaining fraction $1-\theta$ can adjust prices.
  - This assumption bridges between one-period in advance and Calvo price setting.
- Exogenous productivity shocks: Z_{jt}.
- Linear production function
  - non-tradable firms: $Y_{Njt}(\omega) = Z_{jt}L_{jt}(\omega)$.
  - tradable firms: $Y_{jt}(\omega) = Z_{jt}L_{jt}(\omega)$.

Definition of Equilibrium

- Monetary policy instrument: $M_{it} = P_{it}C_{it}$, with the committed central banks selecting M_{it} in response to various exogenous productivity shocks.
- Goods and labor markets clear as follows:

$$n_j L_{jt} = \frac{1}{Z_{jt}} n_j C_{Njt} \Delta_{Njt} + \frac{1}{Z_{jt}} n_j C_{jjt} \Delta_{jjt} + \frac{1}{Z_{jt}} \sum_{i \neq j} n_i C_{jit} \Delta^G_{j-jt}$$

where $\Delta_{Njt} = \frac{1}{n_j} \int_0^{n_j} (\frac{P_{Njt}(\omega)}{P_{Njt}})^{-\varepsilon} d\omega$, $\Delta_{jjt} = \frac{1}{n_j} \int_0^{n_j} (\frac{P_{jjt}(\omega)}{P_{jjt}})^{-\varepsilon} d\omega$, and $\Delta^G_{j-jt} = \frac{1}{n_j} \int_0^{n_j} (\frac{P^G_{j-jt}(\omega)}{P^G_{j-jt}})^{-\varepsilon} d\omega$ is the price dispersion term.

Equilibrium

- Global Currency Supply
  - We define a virtual monetary policy $m_{gt} = \sum_{i=1}^{N} \alpha_i m_{it}$
  - It is a weighted average of each country's policy based on their share in the global currency basket.
- From the risk sharing condition, we have

$$e_{ijt} = m_{it} - m_{jt}$$

where $i, j \in \{1, 2, \cdots, N, g\}$.

Allocations under log-linear approximation

- Efficient allocation: $\tilde{c}_{Nit} = z_{it}, \quad \tilde{c}_{jit} = z_{jt}$ (consumption of country j good by country i)
- Deviations from efficient allocation due to price rigidity:
  - For non-tradable goods c_{Nit} and domestically produced tradable goods c_{iit}:

$$c_{Nit} - \tilde{c}_{Nit} = \theta(m_{it} - z_{it})$$

$$c_{iit} - \tilde{c}_{iit} = \theta(m_{it} - z_{it})$$

  - For foreign produced tradable goods c_{jit}:

$PCP : c_{jit} - \tilde{c}_{jit} = \theta(m_{jt} - z_{jt})$	Source country policy
$LCP : c_{jit} - \tilde{c}_{jit} = \theta(m_{it} - z_{jt})$	Destination country policy
$DCP : c_{jit} - \tilde{c}_{jit} = \theta(m_{1t} - z_{jt})$	US policy
$GCP : c_{jit} - \tilde{c}_{jit} = \theta(m_{gt} - z_{jt})$	GCP policy

Optimal Coordinated Monetary Policy

The global loss function is:

$$\mathbb{E}\left[v\left(\sum_{i=1}^{N} n_i (c_{Nit} - \tilde{c}_{Nit})^2\right) + (1-v)\left(\sum_{i=1}^{N} n_i^2 (c_{iit} - \tilde{c}_{iit})^2 + \sum_{i=1}^{N}\sum_{j\neq i} n_i n_j (c_{jit} - \tilde{c}_{jit})^2\right)\right]$$

We define the common component $\mathcal{L}^c$ as:

$$\mathcal{L}^c = \underbrace{v\sum_{i=1}^{N} n_i (m_{it} - z_{it})^2}_{\text{related to } (c_{Nit}-\tilde{c}_{Nit})^2} + \underbrace{(1-v)\sum_{i=1}^{N} n_i^2 (m_{it} - z_{it})^2}_{\text{related to } (c_{iit}-\tilde{c}_{iit})^2}$$

For PCP, LCP, DCP and GCP, we have

$$PCP : \kappa\, \mathbb{E}\left(\mathcal{L}^c + (1-v)\sum_{i=1}^{N}\sum_{j\neq i} n_i n_j (m_{jt} - z_{jt})^2\right),$$

$$LCP : \kappa\, \mathbb{E}\left(\mathcal{L}^c + (1-v)\sum_{i=1}^{N}\sum_{j\neq i} n_i n_j (m_{it} - z_{jt})^2\right),$$

$$DCP : \kappa\, \mathbb{E}\left(\mathcal{L}^c + (1-v)\sum_{i=1}^{N}\sum_{j\neq i} n_i n_j (m_{1t} - z_{jt})^2\right),$$

$$GCP : \kappa\, \mathbb{E}\left(\mathcal{L}^c + (1-v)\sum_{i=1}^{N}\sum_{j\neq i} n_i n_j (m_{gt} - z_{jt})^2\right),$$

Producer currency pricing

- The global loss function under PCP is:

$$\mathbb{E}\left(\mathcal{L}^c + \underbrace{(1-v)\sum_{i=1}^{N}\sum_{j\neq i} n_i n_j (m_{it} - z_{it})^2}_{\text{related to } (c_{ijt} - \tilde{c}_{ijt})^2}\right)$$

- So, the optimal cooperative monetary policy under PCP is:

$$m_{it}^{opt,cP} = z_{it}$$

- Target only domestic shock ('divine coincidence')

Local currency pricing

- The global loss function under LCP is:

$$\mathbb{E}\left(\mathcal{L}^c + \underbrace{(1-v)\sum_{i=1}^{N}\sum_{j\neq i} n_i n_j (m_{it} - z_{jt})^2}_{\text{related to } (c_{jit}-\tilde{c}_{jit})^2}\right)$$

- The optimal policy under LCP is:

$$m_{it}^{opt,cL} = z_{it} + (1-v)\sum_{j\neq i} n_j (z_{jt} - z_{it})$$

- Target domestic and a foreign-country weighted sum of foreign-domestic differences

Dominant (Dollar) currency pricing

- The global loss function under DCP is:

$$\mathbb{E}\left(\mathcal{L}^c + \underbrace{(1-v)\sum_{i=1}^{N} n_i(1-n_i)(m_{1t} - z_{it})^2}_{\text{related to } (c_{ijt}-\tilde{c}_{ijt})^2}\right)$$

- For country i, $i \neq 1$, the optimal cooperative monetary policy under DCP is:

$$m_{it}^{opt,cD} = z_{it}, \quad \text{for } i \neq 1$$

- For country 1, the optimal cooperative monetary policy under DCP is:

$$m_{1t}^{opt,cD} = z_{1t} + (1-v)\sum_{j\neq 1} \frac{n_j(1-n_j)}{\Delta_1^{cD}}(z_{jt} - z_{1t})$$

- Target domestic shock and a *trade weighted* sum of foreign-domestic differences

Define a Shadow Currency: Crypto

- What's CCP?
  - In addition to the N national fiat currencies, a hypothetical separate currency independent of all other currencies - an 'as if' unit of account.
  - Imagine that all international trade must be priced in crypto.
- Why introduce CCP?
  - There are N monetary policy instruments in PCP and GCP, but $N + 1$ in CCP.

Loss under CCP

- The global loss function under CCP is:

$$\mathbb{E}\left(\mathcal{L}^c + \underbrace{(1-v)\sum_{i=1}^{N} n_i(1-n_i)({\color{red}m_{ct}} - z_{it})^2}_{\text{related to } (c_{ijt}-\tilde{c}_{ijt})^2} \right)$$

- For country i:

$$m_{it}^{opt,cC} = z_{it}, \quad \text{for } \forall i$$

- For crypto issuer:

$$m_{bt}^{opt,cC} = \sum_{i=1}^{N} \gamma_i z_{it}, \qquad \gamma_i \equiv \frac{n_i(1-n_i)}{\sum_{j=1}^{N} n_j(1-n_j)}$$

  - Expression $n_i(1-n_i)$ is a measure of country i's international trade importance
  - Captures both country i's export share n_i and import share $1-n_i$.

Global currency pricing

- The global loss function under GCP is:

$$E\left(\mathcal{L}^c + \underbrace{(1-v)\sum_{i=1}^{N} n_i(1-n_i)(m_{gt}-z_{it})^2}_{\text{related to } (c_{ijt}-\tilde{c}_{ijt})^2}\right)$$

- For country i:

$$\begin{aligned} m_{it}^{opt,cG} &= z_{it} + \frac{a(1-v)\alpha_i}{vn_i+(1-v)n_i^2}(m_{bt}^{opt,cC} - m_{gt}^{opt,cG}) \\ m_{gt}^{opt,cG} &= \frac{\sum_{i=1}^{N}\alpha_i z_i + ab(1-v)m_{bt}^{opt,cC}}{1+ab(1-v)} \end{aligned} \tag{1}$$

where $a = \sum_{i=1}^{N} n_i(1-n_i)$ and $b = \sum_{i=1}^{N}(\alpha_i^2/(vn_i+(1-v)n_i^2))$.

- Combination of domestic response and response to gap between GC and CC policy.

Interpretation

- Policy is a compromise between domestic objectives and closing the gap between the crypto target policy and the optimal GCP target
- With coordination, all countries agree on the target $m_{gt}^{opt,cG}$
- Currencies with a larger share in the global currency basket, i.e., larger α_i, deviate more from z_{it} compared to those with smaller shares.
- Larger countries deviate more from targeting $m_{gt}^{opt,cG}$

How should the GCP be designed for welfare maximization?

- Rewrite optimal $m_{it}^{opt,cG}$

$$m_{it}^{opt,cG} = z_{it} + \Gamma_i(\sum_{i=1}^{N}(\alpha_i - \gamma_i)z_{it})$$

- Optimal policy deviates from domestic objectives only to the extent that GCP weights differ from CCP weights

Proposition 1

The optimal cooperative global currency design involves the participation of every country in the global currency, with country i's share α_i equal to:

$$\alpha_i = \gamma_i = \frac{n_i(1-n_i)}{\sum_{j=1}^{N} n_j(1-n_j)}$$

Country i's optimal policy $m_{it}^{opt,cG}$ and global currency $m_{gt}^{opt,cG}$ is equal to:

$$m_{it}^{opt,cG} = z_{it}$$

$$m_{gt}^{opt,cG} = m_{it}^{opt,cC} = \sum_{i=1}^{N} \gamma_i z_{it}$$

Optimal GC design replicates the allocation in CCP.

Comments

- Under the optimal design of the global currency, each country need only target its domestic shock
- The global currency basket then optimally adjusts to as to maximize global welfare, conditional on global currency pricing
- The optimal GCP effectively adds one more currency to the global policy menu, replicating CCP, even though there are only N currencies available

Corollary

Corollary 1

The maximum share that any single country can hold in an optimal global currency basket is $1/2$*, given cooperative monetary policies are implemented by all countries.*

Corollary 2

If the Global Currency basket is constructed as in Proposition 1, the optimal allocation under CCP can be achieved in a decentralized (non-cooperative) equilibrium if each country i *chooses its monetary policy to minimize:*

$$\mathbb{E}(\mathcal{L}_i^c) = \mathbb{E}\left(\underbrace{v(m_{it} - z_{it})^2}_{\text{related to } (c_{Nit} - \tilde{c}_{Nit})^2} + \underbrace{(1-v)n_i(m_{it} - z_{it})^2}_{\text{related to } (c_{iit} - \tilde{c}_{iit})^2} \right)$$

where $\mathcal{L}_i^c = v(m_{it} - z_{it})^2 + (1-v)n_i(m_{it} - z_{it})^2$ *represents the part of the common component of the global loss specific to country* i*, with* $\mathcal{L}^c = \sum_{i=1}^N n_i \mathcal{L}_i^c$*.*

A Two-country case

- Optimal GCP weight is $1/2$ irrespective of size

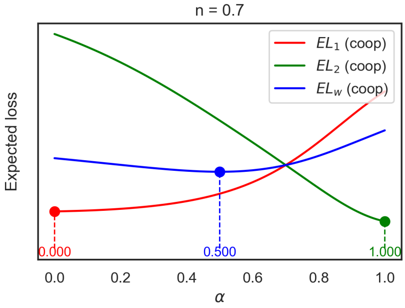


Figure: Expected loss of GCP under cooperative policy

Note: Figure 1 illustrates the expected loss for country 1, country 2, and global loss under the optimal monetary policy when $N = 2$, $n_1 = 0.7, n_2 = 0.3$, $\sigma^2_{1z} = \sigma^2_{2z}$ and $v = 0$, as country 1's global currency share α varies from 0 to 1 under cooperative policy.

A Two-country case

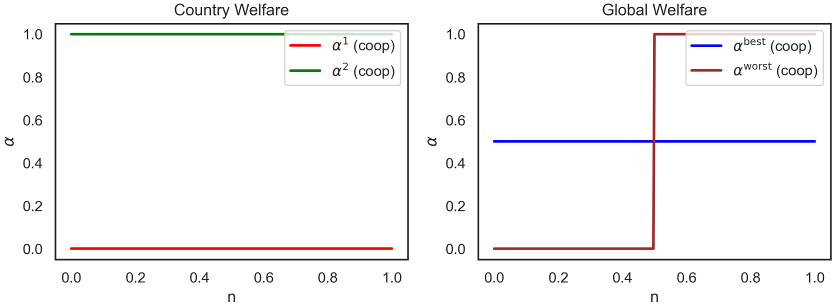


Figure: Optimal global currency design under cooperative policy

Worst global welfare when the larger country has more weight, since it focuses more on domestic objective

Non-cooperative policy

- Imagine each country could choose its crypto
- For country i, the optimal policy under CCP is:

$$m_{it}^{opt,nC} = z_{it}$$

- For country i the crypto supply i would be:

$$m_{cit}^{opt,nC} = \frac{1}{1-n_i} \sum_{j \neq i} (n_j z_{jt})$$

- Targets only imports

Global currency pricing

- For country i, the optimal non-cooperative monetary policy under GCP is:

$$m_{it}^{opt,nG} = z_{it} m_{it}^{opt,nG} = z_{it} + \frac{\alpha_i(1-v)(1-n_i)}{v+(1-v)n_i}\left(m_{cit}^{opt,nC} - m_{gt}^{opt,nG}\right)$$

$$m_{gt}^{opt,nG} = \frac{\sum_{i=1}^{N}\left(\alpha_i z_{it} + \frac{\alpha_i^2(1-v)(1-n_i)}{v+(1-v)n_i} m_{bit}^{opt,nC}\right)}{1+\sum_{i=1}^{N}\left(\frac{\alpha_i^2(1-v)(1-n_i)}{v+(1-v)n_i}\right)} \tag{2}$$

- Country i's optimal monetary policy involves balancing two objectives:
  - Attempt to set m_{it} to reach z_{it}.
  - Attempt to set m_{gt} to converge to $m_{cit}^{opt,nC}$.
- Countries have different targets for m_{gt}
- Negative externalities of global currency with non-cooperative policy

A Two-country case

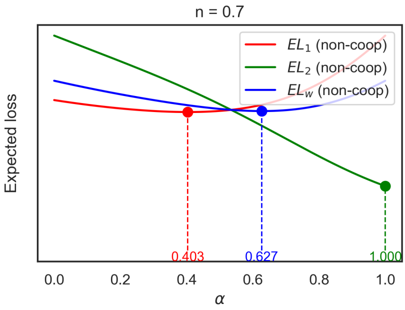


Figure: Expected loss of GCP under non-cooperative policy

- Larger country should have a bigger weight in the GC.
  - A larger country will give more weight to international trade in optimal policy
- Smaller country desires zero weight, while larger country desired weight less than the global welfare optimum

Extensions: Monetary/Financial Shocks

- Allow for imprecision in monetary rules
- Shocks to the policy rule, denoted as $\boldsymbol{\mu}_t = (\mu_{1t}, \cdots, \mu_{Nt})'$.
- The money supply is: $m_{it} = a_{i1} z_{1t} + \ldots + a_{iN} z_{1N} + \mu_{it}$
  - Central banks choose monetary policy parameters $\boldsymbol{a} = [a_{ij}]_{i,j=1}^{N}$ at the beginning of each period.
  - But they cannot control $\boldsymbol{\mu}_t$ - a proxy for shocks to the domestic financial sector
- All shocks are orthogonal
- Why do these shocks matter? These shocks are diffused under GCP and make GCP more desirable

Optimal Global Currency Design

Proposition 2

For any country sizes set $\boldsymbol{n}$, variance set $(\boldsymbol{\sigma}_z^2, \boldsymbol{\sigma}_\mu^2)$, we find that:

(1) The optimal global currency design $\boldsymbol{\alpha}$ to minimize currency misalignment:

$$\alpha_i = \frac{n_i(1-n_i)}{\sum_{j=1}^{N} n_j(1-n_j)}$$

Depends only on trade shares

(2) Optimal global currency design $\boldsymbol{\alpha}$ to minimize monetary volatility:

$$\alpha_i = \frac{1/\sigma_{i\mu}^2}{\sum_{j=1}^{N}(1/\sigma_{j\mu}^2)}$$

Depends (inversely) on monetary volatility

Welfare Ranking

Proposition 3

(1) In terms of reducing currency misalignment, we find that $PCP \succeq GCP \succeq DCP \succeq LCP$*, with global currency designed as* $\alpha_i^* = n_i(1-n_i)/\sum_{j=1}^N n_j(1-n_j)$ *under GCP.*

(2) In terms of reducing monetary volatility, we find that $GCP \succeq PCP = DCP = LCP$.

Extend to a dynamic model with Calvo pricing

- Definition of equilibrium remains the same
- We can approximate loss function under cooperative or non-cooperative policy under complete assets markets
- Compare DCP to an alternative that used the IMF's Special Drawing Rights (SDR) as a potential basket currency to be used for GCP.
- Calibrate the model for 20 countries to evaluate welfare implications of using the SDR as GCP.

Calibration with SDR

- global parameters
  - home bias $v = 0.8$ to reflect consumer preference for domestic goods;
  - substitution elasticity $\varepsilon = 8$, implying a pre-subsidy price markup of approximately 15%;
  - discount factor $\beta = 0.995$; price stickiness $\theta = 0.75$;
  - autocorrelation coefficients $\eta_z = 0.8$ for productivity shocks and $\eta_\mu = 0.75$ for monetary shocks.
- country-specific parameters
  - country size n_i: averaged GDP share relative to the global economy
  - global currency basket α_i: IMF's 2022-2027 SDR valuation cycle
  - covariance matrix Σ_z for productivity shocks: per capita GDP data across countries
  - covariance matrix Σ_μ for monetary shocks
    - GDP deflator covariance matrix($\Sigma_{\mu,a}$)
    - exchange rate covariance matrix ($\Sigma_{\mu,b}$)

Calibration with SDR

Country Name	Country Code	n	α	α^*	σ_z^2	$\sigma_{\mu,a}^2$	$\sigma_{\mu,b}^2$
United States	USA	0.2940	0.4338	0.2472	0.0568	0.0003	0.0009
Euro area	EMU	0.1976	0.2931	0.1888	0.1063	0.0005	0.0015
China	CHN	0.1501	0.1228	0.1519	0.1298	0.0049	0.0009
Japan	JPN	0.0738	0.0759	0.0814	0.0915	0.0008	0.0040
United Kingdom	GBR	0.0475	0.0744	0.0539	0.1893	0.0005	0.0023
India	IND	0.0298	0	0.0345	0.1831	0.0038	0.0014
Brazil	BRA	0.0282	0	0.0326	0.1722	0.0030	0.0102
Canada	CAN	0.0250	0	0.0291	0.0855	0.0016	0.0009
Korea, Rep.	KOR	0.0224	0	0.0261	0.0520	0.0010	0.0032
Russian Federation	RUS	0.0217	0	0.0253	0.3546	0.0297	0.0114
Australia	AUS	0.0211	0	0.0246	0.0166	0.0026	0.0024
Mexico	MEX	0.0192	0	0.0224	0.1975	0.0012	0.0031
Indonesia	IDN	0.0125	0	0.0147	0.0536	0.0167	0.0023
Turkiye	TUR	0.0124	0	0.0146	0.2699	0.0128	0.0061
Saudi Arabia	SAU	0.0097	0	0.0115	0.2587	0.0756	0.0009
Argentina	ARG	0.0091	0	0.0107	0.5982	0.0862	0.0361
Sweden	SWE	0.0080	0	0.0095	0.1124	0.0004	0.0024
Poland	POL	0.0074	0	0.0088	0.0812	0.0013	0.0041
South Africa	ZAF	0.0054	0	0.0064	0.1513	0.0009	0.0076
Denmark	DNK	0.0051	0	0.0060	0.0735	0.0008	0.0014

Figure: Calibrated country-specific parameter values

5.3 Welfare loss under four pricing paradigms

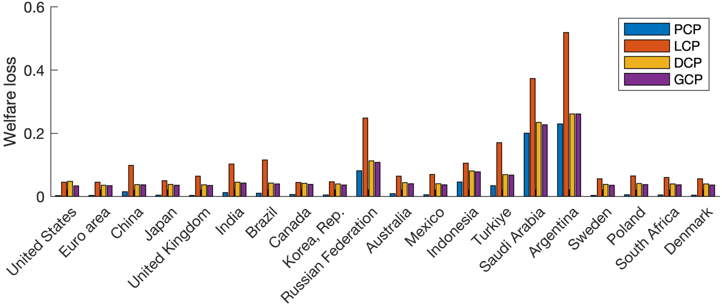


Figure: Calibrated countries' welfare loss under cooperation $(\Sigma_z, \Sigma_{\mu,a})$

Relative welfare improvement of GCP compared to DCP

	Cooperative policy			Uncooperative policy		
	$(\Sigma_z, \Sigma_{\mu,a})$	$(\Sigma_z, \Sigma_{\mu,b})$	i.i.d.	$(\Sigma_z, \Sigma_{\mu,a})$	$(\Sigma_z, \Sigma_{\mu,b})$	i.i.d.
United States	29.62%	29.23%	46.91%	23.98%	23.64%	40.82%
Euro area	3.61%	4.17%	7.34%	11.35%	11.31%	17.90%
China	2.92%	4.72%	15.16%	8.24%	11.57%	25.23%
Japan	8.14%	6.45%	15.93%	15.95%	13.06%	26.65%
United Kingdom	6.09%	6.62%	15.74%	14.98%	14.48%	27.28%
India	6.43%	8.29%	17.90%	12.66%	15.17%	28.03%
Brazil	6.47%	5.70%	17.55%	13.01%	10.34%	27.75%
Canada	7.58%	8.88%	18.13%	14.42%	15.81%	28.21%
Korea, Rep.	7.98%	8.02%	17.95%	15.02%	14.16%	28.09%
Russian Federation	4.10%	5.71%	17.64%	6.81%	10.23%	27.84%
Australia	7.93%	8.21%	17.61%	14.49%	14.76%	27.78%
Mexico	8.00%	7.33%	17.40%	14.96%	13.62%	27.61%
Indonesia	3.11%	7.85%	17.92%	7.03%	14.39%	28.04%
Turkiye	1.80%	7.62%	17.95%	6.44%	13.15%	28.08%
Saudi Arabia	3.13%	9.07%	17.83%	4.55%	16.18%	27.97%
Argentina	0.18%	3.10%	17.71%	1.46%	5.51%	27.86%
Sweden	8.21%	8.17%	17.61%	15.58%	14.66%	27.79%
Poland	7.78%	6.90%	17.70%	14.76%	12.91%	27.86%
South Africa	7.70%	6.02%	17.91%	14.85%	11.19%	28.04%
Denmark	8.00%	8.73%	17.65%	15.23%	15.54%	27.83%
Dominant country (USA)	29.62%	29.23%	46.91%	23.98%	23.64%	40.82%
Four other SDR countries	4.38%	5.05%	12.28%	11.50%	12.10%	22.85%
Non-SDR countries	4.67%	6.94%	17.77%	9.11%	12.57%	27.93%
All countries	11.91%	13.58%	27.13%	14.01%	15.71%	30.21%

Endogenous Currency Choice

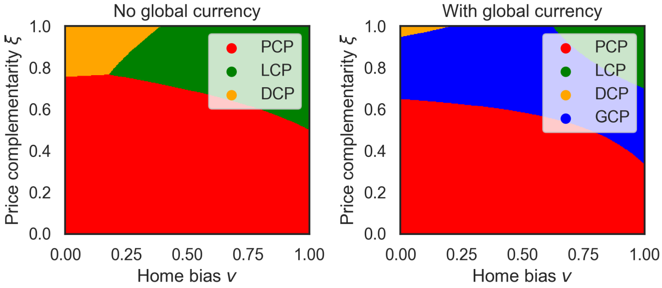
- Under what conditions will firms endogenously choose GCP over either DCP or PCP?
- Complex question due to possibility of multiple equilibrium and complementarity in price setting decisions
- Look at two cases
  - High monetary variability (financial shocks)
  - Assume price setting exhibits high complementarity

Endogenous GCP with financial shocks

- Lemma 1: With sufficiently large financial shocks, GCP will be endogenously chosen by all firms in all countries.
- Intuition - a global currency effectively diversifies the impact of country specific financial shocks and allows firms to more effectively target desired prices

Pricing complementarity

- Amend baseline model to incorporate Kimball aggregator
- In a 3 country example:
  - Assume monetary policy is set as optimal for PCP
  - Firms expect other firms to choose PCP - the picture shows the choice of an individual firm
  - Allowing for a GCP changes the range of parameters under which PCP, LCP and DCP represents an optimal choice



Transit from DCP TO GCP

- Following Mukhin (2022) we ask how pricing equilibria may depart from DCP, but now allowing for GCP as an option
  - Again focus on a 3 country model, with pricing complementarities
  - US (country 1), the EU (country 2), and the RoW (country 3).
- Solution approach: An iterative process to find a Nash equilibrium
  - At $t = 0^-$, the parameters (v, ξ) are set to produce a stable equilibrium dominated by DCP
  - At $t = 0$, the global currency with a given basket $(\alpha_1, \alpha_2, \alpha_3)$ becomes available, giving firms the option to price their goods in either the dollar or the newly introduced global currency (with only two choices).
  - In the first iteration step $(s = 1)$, we guess that all firms will **choose the dollar** and make their pricing decisions accordingly.
  - For $s \geq 2$, we update our guess based on the currency choices of all firms in $s - 1$ and then derive firms' currency choices.
  - The process continues until firms' expectations align with their actions. This algorithm identifies **a NE biased toward low GCP adoption**, as it starts with the initial guess that all firms use the dollar.

Adoption of the global currency under different designs

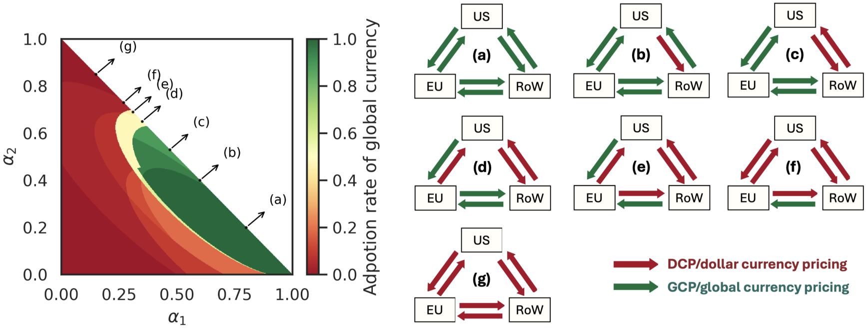
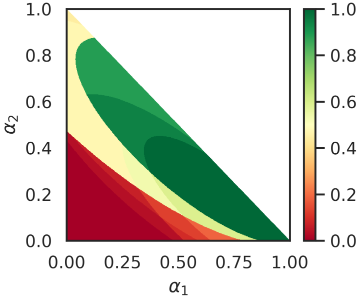


Figure: Adoption of the global currency under different designs

Alternative specification

- More favorable to GCP
- Left picture assumes that at $s = 1$, firms conjecture that EU firms will set prices in GCP
- Right picture assumes firms at $s = 1$ conjecture that all firms will set prices in GCP



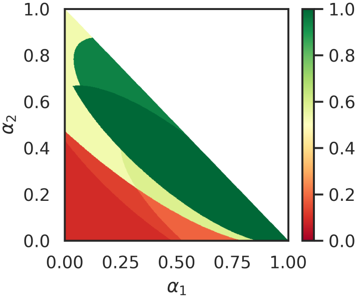


Figure: Two other Nash equilibria

Conclusion

- How GCP affects exchange rate pass-through, the international transmission of shocks, and optimal monetary policy.
- The optimal composition of a global currency - depends critically on stance of monetary policy
- Calibrating the model to 20 countries, we show that there would be welfare gains from switching from a DCP pricing system to the used of the IMF's SDR
- GCP may be the optimal regime for traded goods invoicing when there is a trade off between country specific productivity shocks and the effect of financial shocks.
- Pricing complementarities leads to a larger role for GCP

Appendix

Exchange rate pass-through

- Under the four pricing paradigms, the currency i price of tradable goods exported from country j to country i, p_{jit}, is given by:

$$PCP : p_{jit} = (1-\theta)mc_{jt} + e_{ijt}$$

$$LCP : p_{jit} = (1-\theta)mc_{jt} + (1-\theta)e_{ijt}$$

$$DCP : p_{jit} = (1-\theta)mc_{jt} + (1-\theta)e_{ijt} + \theta e_{i1t}$$

$$GCP : p_{jit} = (1-\theta)mc_{jt} + (1-\theta)e_{ijt} + \theta \sum_{k=1}^{N} \alpha_k e_{ikt}$$

Dynamic model (Calvo)

Table: The inflation targeting rule of country i, $i \in \{1, 2, ..., N\}$

Pricing Paradigm	Cooperative Game	Nash game
PCP	$\pi_{Nit} = \pi_{iit} = 0$	$\pi_{Nit} = \pi_{iit} = 0$
LCP	$\upsilon\pi_{Nit} + (1-\upsilon)n_i\pi_{iit} + (1-\upsilon)\sum_{j\neq i}^{N} n_j\pi_{jit}^{L} = 0$	$\upsilon\pi_{Nit} + (1-\upsilon)n_i\pi_{iit} + (1-\upsilon)\sum_{j\neq i}^{N} n_j\pi_{jit}^{L} = 0$
DCP	a special case of GCP	a special case of GCP
BCP	$\upsilon\pi_{Nit} + (1-\upsilon)n_i\pi_{iit} = 0$	$\upsilon\pi_{Nit} + (1-\upsilon)n_i\pi_{iit} = 0$
GCP	$\upsilon n_i\pi_{Nit} + (1-\upsilon)n_i^2\pi_{iit}$ $+(1-\upsilon)\alpha_i\sum_{j=1}^{N}(n_j(1-n_j)\pi_{j-jt}^{G}) = 0$	$\upsilon\pi_{Nit} + (1-\upsilon)n_i\pi_{iit}$ $+(1-\upsilon)\alpha_i\sum_{j\neq i}(n_j\pi_{j-jt}^{G}) = 0$

Intermediate Goods

- The production function

$$Y_{jt} = \frac{Z_{jt} L_{jt}^{1-\phi} I_{jt}^{\phi}}{(1-\phi)^{1-\phi} \phi^{\phi}}$$

- The optimal cooperative monetary policy under PCP is as follows:

$$m_{it} = \frac{1}{1-\phi v} z_{it} + \frac{\phi(1-v)}{(1-\phi)(1-\phi v)} z_t$$

- The introduction of the production network results in two key changes to the optimal monetary policy (for all pricing paradigms):
  - First, all currencies react more strongly to productivity shocks.
  - Second, each country's monetary policy becomes more responsive to foreign shocks.

Intermediate Goods

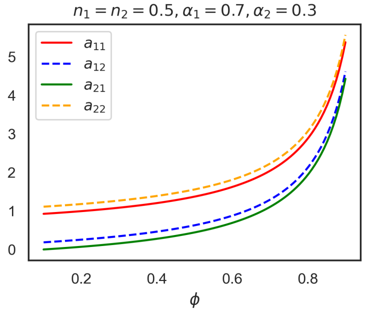


Figure: Optimal monetary policy of GCP under cooperative game with production network

Note: The figure 8 shows the response of the optimal monetary policy of when $N = 2, v = 0, n_1 = n_2 = 0.5$ and $\alpha_1 = 0.7, \alpha_2 = 0.3$, as the degree of intermediate goods ϕ changes from 0 to 1.

2.5 Policy implementation

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Table: The price targeting rule of country i under various pricing paradigms, $i \in \{1, ..., N\}$

Pricing Paradigm	Cooperative Policy	Non-cooperative Policy
PCP	PPI	PPI
LCP	CPI	CPI
DCP	The currency i price of all goods priced in currency i and consumed globally	The currency i price of all goods priced in currency i and consumed by country i
BCP	The currency i price of all goods priced in currency i	The currency i price of all goods priced in currency i
GCP	The currency i price of all goods priced in currency i + α_i $\times$ the global currency price of all goods priced in global currency and consumed globally	The currency i price of all goods priced in currency i + α_i $\times$ the global currency price of all goods priced in global currency and consumed by country i

(3) Dominant (Dollar) currency pricing

- The country i's loss function under DCP is:

$$E\left(\underbrace{v(m_{it}-z_{it})^2}_{\text{related to } (c_{Nit}-\tilde{c}_{Nit})^2} + \underbrace{(1-v)n_i(m_{it}-z_{it})^2}_{\text{related to } (c_{iit}-\tilde{c}_{iit})^2} + \underbrace{(1-v)\sum_{j\neq i} n_j(m_{1t}-z_{jt})^2}_{\text{related to } (c_{jit}-\tilde{c}_{jit})^2}\right)$$

- For country i, $i \neq 1$, the optimal non-cooperative monetary policy under DCP is:

$$m_{it}^{opt,nD} = z_{it}, \quad \text{for } i \neq 1$$

- For country 1, the optimal policy under DCP is:

$$m_{1t}^{opt,nD} = \frac{v}{\Delta_1^{nD}} z_{1t} + \frac{(1-v)n_1}{\Delta_1^{nD}} z_{1t} + (1-v)\sum_{j\neq 1}\left(\frac{n_j}{\Delta_1^{nD}} z_{jt}\right)$$

- Target only imports from country j.

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Households in country i

- Preference: $\mathbb{E}\sum_{t=0}^{\infty}\beta^t\left(\ln C_{it}-L_{it}\right)$.
- Labor supply decision: $W_{it}=P_{it}C_{it}$.
- Consumption bundle: non-tradable goods C_{Nit} and tradable goods C_{Tit}

$$C_{it}=\frac{C_{Nit}^{v}C_{Tit}^{1-v}}{v^{v}(1-v)^{1-v}},\qquad P_{it}=P_{Nit}^{v}P_{Tit}^{1-v}$$

  where non-tradable goods bundle C_{Nit} is given by

$$C_{Nit}=\left(n_i^{-\frac{1}{\varepsilon}}\int_0^{n_i}C_{Nit}(\omega)^{\frac{\varepsilon-1}{\varepsilon}}d\omega\right)^{\frac{\varepsilon}{\varepsilon-1}}$$

  and the tradable goods bundle C_{jit} is defined by

$$C_{Tit}=\Pi_{j=1}^{N}\left(\frac{C_{jit}}{n_j}\right)^{n_j},\quad C_{jit}=\left(n_j^{-\frac{1}{\varepsilon}}\int_0^{n_j}C_{jit}(\omega)^{\frac{\varepsilon-1}{\varepsilon}}d\omega\right)^{\frac{\varepsilon}{\varepsilon-1}}$$

- Complete market: $\mathcal{E}_{ijt}=\dfrac{P_{it}C_{it}}{P_{jt}C_{jt}}$.

Firms in country j

- One-period version of Calvo (1983) price
  - A fraction θ of firms can set goods prices at the beginning of period t, while the remaining fraction $1-\theta$ can adjust prices.
  - This assumption bridges between one-period in advance and Calvo price setting.
- Exogenous productivity shocks: Z_{jt}^N and Z_{jt}.
- Linear production function
  - non-tradable firms: $Y_{Njt}(\omega) = Z_{jt}^N L_{jt}(\omega)$, with $MC_{jt}^N = W_{jt}/Z_{jt}^N$.
  - tradable firms: $Y_{jt}(\omega) = Z_{jt} L_{jt}(\omega)$, with $MC_{jt} = W_{jt}/Z_{jt}$.

Firms in country j

- Price setting strategy for sticky firms

$$\bar{P}_{Njt} = \frac{E_{t-1}\left(Q_{jt} MC^{N}_{jt} (P_{Njt})^{\varepsilon} Y_{Njt}\right)}{E_{t-1}\left(Q_{jt}(P_{Njt})^{\varepsilon} Y_{Njt}\right)}$$

$$\bar{P}_{jjt} = \frac{E_{t-1}\left(Q_{jt} MC_{jt} (P_{jjt})^{\varepsilon} Y_{jjt}\right)}{E_{t-1}\left(Q_{jt}(P_{jjt})^{\varepsilon} Y_{jjt}\right)}$$

$$\bar{P}^{G}_{j-jt} = \frac{E_{t-1}\left(Q_{jt} MC_{jt} (P^{G}_{j-jt})^{\varepsilon}\left(\sum_{i\neq j} n_i Y_{jit}\right)\right)}{E_{t-1}\left(Q_{jt} \mathcal{E}_{jgt} (P^{G}_{j-jt})^{\varepsilon}\left(\sum_{i\neq j} n_i Y_{jit}\right)\right)}$$

- Additionally, there is a proportion of $1-\theta$ firms that set prices flexibly as follows:

$$\tilde{P}_{Njt} = MC^{N}_{jt}, \quad \tilde{P}_{jjt} = MC_{jt}, \quad \tilde{P}^{G}_{j-jt} = MC_{jt}\mathcal{E}_{gjt}$$

Definition of Equilibrium

- Money demand: $M_{it} = P_{it}C_{it}$, with the committed central banks selecting M_{it} in response to various exogenous productivity shocks.
- Goods and labor markets clear as follows:

$$n_j L_{jt} = \frac{1}{Z_{jt}^N} n_j C_{Njt} \Delta_{Njt} + \frac{1}{Z_{jt}} n_j C_{jjt} \Delta_{jjt} + \frac{1}{Z_{jt}} \sum_{i \neq j} n_i C_{jit} \Delta_{j-jt}^G$$

where $\Delta_{Njt} = \frac{1}{n_j} \int_0^{n_j} (\frac{P_{Njt}(\omega)}{P_{Njt}})^{-\varepsilon} d\omega$, $\Delta_{jjt} = \frac{1}{n_j} \int_0^{n_j} (\frac{P_{jjt}(\omega)}{P_{jjt}})^{-\varepsilon} d\omega$, and $\Delta_{j-jt}^G = \frac{1}{n_j} \int_0^{n_j} (\frac{P_{j-jt}^G(\omega)}{P_{j-jt}^G})^{-\varepsilon} d\omega$ is the price dispersion term.

Implementation under GCP

- Goods produced by country i and consumed domestically are priced in currency i, so m_{it} directly influences domestic consumption.
- Currency i comprises a share α_i of this global currency, m_{it} also influences global consumption through its proportional effect.
- In a cooperative equilibrium, country i needs to target the currency i price of all goods priced in currency i, along with α_i proportion of the global currency price of all goods priced in the global currency and consumed *globally*.

$$vn_i p_{Nit} + (1-v)n_i^2 p_{iit} + \alpha_i(1-v)\sum_{j=1}^{N}(n_j(1-n_j)p_{j-jt}^{G}) = 0, \qquad (3)$$

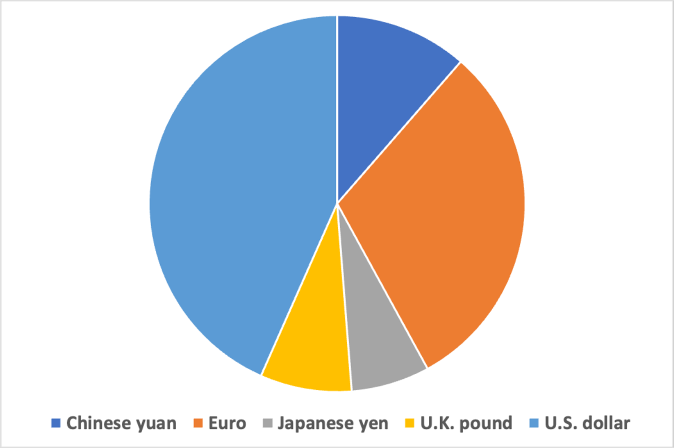
Implementation under GCP

- In a Nash equilibrium policy focus is solely on the global currency price of all goods consumed by *country* i:

$$vp_{Nit} + (1-v)n_i p_{iit} + \alpha_i(1-v)\sum_{j\neq i}(n_j p^G_{j-jt}) = 0. \tag{4}$$

- As α_i approaches 1, the price aligns with the CPI; when α_i approaches 0, the price reflects the overlap between CPI and PPI goods.

Composition of SDR



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