Política monetaria á la Ramsey para economías exportadoras de materias primas

[Ramsey monetary policy for commodity-exporting economies]

José Báez

jbaezm@bcp.gov.py

Banco Central del Paraguay
Universidad de York

III Jornada de Economía del BCP
15 de septiembre de 2023

Motivación

- De 2013 a 2017, 102 de 189 países (54 %) dependían de sus exportaciones de commodity (UNCTAD, 2019).
  - Del 100 % de las economías desarrolladas, 13 % son dependientes de sus exportaciones de commodities.
  - Del 100 % de las economías en desarrollo y en transición, el 64 % son commodity-dependientes.
- La mayoría de los precios de commodities (PCs) se han vuelto más relacionados con las fluctuaciones macroeconómicas internacionales (Shousha, 2016; Fernández, Schmitt-Grohé and Uribe, 2017; Drechsel and Tenreyro, 2018).
  - Integración económica, globalización y financialización.
  - Los PCs y los shocks de actividad mundial afectan a los precios relativos locales, los términos de intercambio, el tipo de cambio y el producto interno bruto.
- La correlación entre los shocks de PC y la actividad mundial
  - relevante para la política monetaria de países exportadores de commodities.

Literatura I

- Drechsel, McLeay and Tenreyro (2019, referido como DMT)
  - agrega una fricción financiera de endeudamiento intratemporal al capital de trabajo de
  - la empresa representativa productora de commodities, introducida por Ferrero and Seneca (2019) a la
  - pequeña economía abierta al estilo de Galí and Monacelli (2005).
- DMT
  - Asume una tasa de inflación cero en el estado estacionario y subsidios al trabajo.
  - Asume una restricción de endeudamiento estática.
  - No aborda consideraciones de DESCALCE DE DIVISAS.

Literatura II

- Báez (2021) muestra que
  - una fricción financiera de endeudamiento basada en ACTIVOS y/o
  - una fricción financiera de endeudamiento basada en INGRESOS
    ... pueden generar fricciones en el ciclo económico (real) y
    ... son relevantes para la política monetaria.
  - Kiyotaki and Moore (1997), Mendoza (1991), Iacoviello (2005), Drechsel (2018).
- Evaluación de la política monetaria óptima desde el enfoque de...
  - Ramsey á la Marcet and Marimon (2019)
    - Khan, King and Wolman (2003), Monacelli (2006), Jensen and Mccallum (2010)
    - Faia and Monacelli (2008)
    - Faia (2009)
    - ...entre otros.

Pregunta de investigación

- ¿Cuál es la política monetaria óptima (á la Ramsey) para una economía pequeña, abierta y exportadora de commodities
  - con rigideces de precios y
  - fricción financiera
    en forma de restricción de endeudamiento de préstamos internacionales colateralizados por los ingresos esperados de la firma y denominados en moneda extranjera que se halla expuesta a
  - ... shocks correlacionados de PCs y actividad global (AG)?
  - ... shocks de PC (no correlacionado)?

Contribuciones

- Utiliza una fricción financiera de endeudamiento en el sector de commodities colateralizada por sus ingresos esperados
  - los préstamos son nominales y están denominados en moneda extranjera
  - se aplican consideraciones de descalce de divisas
  - relevantes para la política monetaria.
- Aplica la metodología recursiva de Ramsey a EPAEC (*SOCEE*).
  - Khan, King and Wolman (2003), Faia and Monacelli (2008) y Faia (2009).
- Proporciona una estructura de validación cruzada para
  - la evaluación de la política monetaria óptima teórica bajo compromiso total realizada por Ferrero and Seneca (2019) y Drechsel et al. (2019) utilizan el enfoque ACL (*LQA*).

Esquema para el resto de la presentación

- El modelo
  - Estructura
- Ramsey
  - El planificador
- Simulación del modelo
  - Calibración referencial
- Resultados
  - Política monetaria óptima
    - Shocks correlacionados: precios de commodities y actividad global
- Conclusión

Outline

Estructura del modelo

- Hogares (familias)
  - Decisión de consumo (ecuac. de Euler), decisión de oferta de trabajo y de ocio
- Firmas (empresas)
  - Empresa productora de bienes no transables ($C_{h,t}$ y $M_{h,t}$)
    - Fijación de precio (Curva de Phillips) á la Rotemberg (1982)
    - Productividad del sector de bienes no transables
  - Empresa productora/exportadora de commodities
    - Decisiones de produción y de endeudamiento en moneda extranjera
    - Productividad del sector de bienes transables
- Gobierno (autoridad monetaria)
  - Regla de Taylor á la Schmitt-Grohé and Uribe (2007)
- Resto del mundo (sector externo)
  - Procesos estocásticos: precios de commod., actividad global, inflación externa, tasa de interés externa.

Empresa productora de commodities

- La firma representativa productora de commodities escoge las secuencias de bienes intermedios (o insumos) y préstamos internacionales respectivas $\{M_{h,t}, B_{o,t}\}_{t=0}^{\infty}$ que maximizan el valor descontado de la firma (V_o)

$$\max_{M_{h,t+s},\ B_{o,t+s}} V_o = \mathbb{E}_0 \sum_{t=0}^{\infty} Q_{0,t} \Psi_{o,t}$$

$$\text{Where} \quad \Psi_{o,t} = P_{o,t} Y_{o,t} + \mathcal{E}_t B_{o,t} - [P_{h,t} M_{h,t} + \mathcal{E}_t R^*_{t-1} B_{o,t-1}] \tag{1}$$

$$\text{s.t.} \qquad \mathbb{E}_0 Y_{o,t+1} = A_{o,t} M^{\nu}_{h,t} \tag{2}$$

$$R^*_t B_{o,t} \leq \chi \mathbb{E}_0 \frac{P_{o,t+1}}{\mathcal{E}_{t+1}} Y_{o,t+1} \tag{3}$$

$$\lim_{t\to\infty} \mathbb{E}_0 Q_{0,t} \frac{\mathcal{E}_t B_{o,t}}{R^*_t} = 0 \ , \ \lim_{t\to\infty} \mathbb{E}_0 Q_{0,t} V_{o,t} = 0$$

$$P_{o,t} = \mathcal{E}_t P^*_{o,t}, \quad 0 < \nu < 1, \quad 0 < \chi \lessgtr 1$$

Outline

Planteamiento (versión no recursiva)

$$\min_{\{\lambda_{1,t},\lambda_{2,t},\lambda_{3,t},\lambda_{4,t},\lambda_{5,t}\}_{t=0}^{\infty}} \max_{\{C_t,N_t,\mathcal{T}_t,\Pi_{h,t},M_{h,t},\mathbb{E}_t Q_{t,t+1}\}_{t=0}^{\infty}} \mathbb{E}_0 \Bigg\{ \sum_{t=0}^{\infty} \beta^t \Bigg\{ \Big(\ln C_t - \frac{N_t^{1+\phi}}{1+\phi} \Big) \tag{4}$$

$$+\lambda_{1,t} \Bigg[\Big\{ \Pi_{h,t} \big(\Pi_{h,t} - \Pi_h \big) - \big[\frac{W_t}{P_t} \frac{\mathcal{T}_t^{\alpha}}{A_{h,t}} - \frac{\epsilon - 1}{\epsilon} \big] \frac{\epsilon}{\theta} A_{h,t} N_t \Big\} (\mathcal{T}_t^{\alpha} C_t)^{-1}$$

$$- \beta \mathbb{E}_t \Big\{ (\mathcal{T}_{t+1}^{\alpha} C_{t+1})^{-1} \Pi_{h,t+1} \big(\Pi_{h,t+1} - \Pi_h \big) \Big\} \Bigg]$$

$$+\lambda_{2,t} \Big[\frac{\mathcal{T}_t^{\alpha}}{A_{o,t} M_{h,t}^{\nu}} \frac{B_{o,t}}{P_t} - \chi \mathbb{E}_t Q_{t,t+1}^{*} \frac{P_{o,t+1}^{*}}{P_{t+1}} \mathcal{T}_{t+1}^{\alpha} \Pi_{h,t+1} \Big]$$

$$+\lambda_{3,t} \Bigg[\frac{1}{A_{o,t}} M_{h,t}^{1-\nu} - \nu \mathbb{E}_t \frac{P_{o,t+1}^{*}}{P_{t+1}^{*}} \mathcal{T}_{t+1} \Pi_{h,t+1} \Big\{$$

$$[1 - \chi] \mathbb{E}_t \frac{Q_{t,t+1}}{Q_{t,t}} + \chi \mathbb{E}_t Q_{t,t+1}^{*} \Big(\frac{\mathcal{T}_{t+1}}{\mathcal{T}_t} \Big)^{-1} \Pi_{h,t+1}^{-1} \Pi_{t+1}^{*} \Big\} \Bigg]$$

$$+\lambda_{4,t} \Big[C_t - C_t^{*} \mathcal{T}_t^{1-\alpha} \Big]$$

$$+\lambda_{5,t} \Bigg[A_{h,t} N_t - (1 - \alpha) \mathcal{T}_t^{\alpha} C_t - M_{h,t} - \frac{\theta}{2} \big(\Pi_{h,t} - \Pi_h \big)^2 \Bigg] \Bigg\} \Bigg\}. \blacksquare$$

Outline

Principales parámetros calibrados

- Tasa de inflación doméstica, $\Pi_h = 1{,}0359^{1/4}$; Tasa de interés nominal, $R = 1{,}0713^{1/4}$; Factor de descuento subjetivo, $\beta = 0{,}9916$. Datos de Noruega (1978Q1-2017Q4).
- La demanda de insumos del sector productor de commodities (M_h) en relación con la producción del sector de bienes no transables (Y_h), $M_h/Y_h = 15\,\%$ (de acuerdo con Ferrero and Seneca, 2019 y Drechsel et al., 2019).
  - Sesgo del consumo interno, $1 - \alpha = 0{,}71$; Parámetro de escala a retornos en el sector productor de commodities, $\nu = 0{,}19$; Relación préstamo-valor, $\chi = \{2{,}94; 0{,}5\}$.
  - La calibración de estos parámetros también garantiza que se cumpla la restricción de recursos económicos.
- Procesos estocásticos
  - precios de commodities reales: autocorr. 0,90 y desviación estándar de 0,10.
  - actividad global: autocorr. 0,90 y desviación estándar de 0,0011.
- La tasa de elasticidad inversa de Frisch, $\phi = 1$.
- Parámetro de costo de ajuste de precios, $\theta = 48{,}8$ (Probabilidad de no reajustar precios, 0,75; Margen de recargo deseado, 20 %; Elasticidad de sustitución entre variedades, 6).

Criterios de evaluación

- El bienestar condicional e incondicional como criterios de evaluación

(Faia and Monacelli, 2007; Schmitt-Grohé and Uribe, 2007).

  - Func. de utilidad de referencia
    $W^b_{0,t} = U(C_{b,t}, N_{b,t}) + \beta \mathbb{E}_0 W^b_{0,t+1}$
  - Bienestar C. (C. Welfare)
    $W^{C,o}_0 = \mathbb{E}_0 \Big\{ \sum_{t=0}^{\infty} \beta^t U((1+\Omega) C_{b,t}, N_{b,t}) \Big\}$
  - Costo de C. C. (C. C. cost)
    $\Omega^C = e^{(1-\beta)(W^{C,o}_0 - W^{C,b}_0)} - 1$, (Faia and Monacelli, 2007).
  - Bienestar Incond. (U. Welfare)
    $W^{U,o}_0 = \mathbb{E} \Big\{ \sum_{t=0}^{\infty} \beta^t U((1+\Omega) C_{b,t}, N_{b,t}) \Big\}$
  - Costo de C. Incond. (U. C. cost)
    $\Omega^U = e^{(1-\beta)(W^{U,o}_0 - W^{U,b}_0)} - 1$, (Faia and Monacelli, 2007; Schmitt-Grohé and Uribe, 2007).

Outline

Reglas de política monetaria optimizadas I

Escenario shock corr(PC,AG)

Evaluación del bienestar

Regime (policy rule)	C. Welfare $W_0^{C,b}$	C. C. cost Ω^C (%)	U. Welfare $W_0^{U,b}$	U. C. cost Ω^U (%)	Optimized parameters					
					α_R	α_Π	α_{Π_h}	α_Y	$\alpha_\mathcal{E}$	$\alpha_{\Delta\mathcal{E}}$
Ramsey	-41.766	0.000	-41.777	0.000	–	–	–	–	–	–
Strict CPI (Π_t)	-42.054	-0.240	-42.063	-0.239	–	–	–	–	–	–
Strict domestic ($\Pi_{h,t}$)	-41.825	-0.049	-41.830	-0.044	–	–	–	–	–	–
NER ($\mathcal{E}_t$)	-43.486	-1.428	-43.524	-1.451	–	–	–	–	–	–
NER change ($\Delta\mathcal{E}_t$)	-43.486	-1.428	-43.524	-1.451	–	–	–	–	–	–
Taylor rule 1	-41.986	-0.184	-41.997	-0.183	0.5	3.0	–	0.0	0.0	–
Taylor rule 2	-41.986	-0.184	-41.997	-0.183	0.5	3.0	–	0.0	–	0.0
Taylor rule 3	-41.868	-0.085	-41.874	-0.081	0.0	–	3.1	0.0	0.0	–
Taylor rule 4	-41.868	-0.085	-41.874	-0.081	0.0	–	3.1	0.0	–	0.0

C. = Conditional; U. = unconditional; C. cost = compensation cost; CPS = commodity price shock; WAS = world activity shock. Corr(CPS,WAS) = Corr(10 %,3.33 %). Rules are evaluated under the same steady state. A dash indicates the absence of the respective parameter in the specified rule. Parameter values increase at 0.1 step within its respective grid, which is defined as $\{\alpha_R\} \in$[0,0.9], $\{\alpha_\Pi, \alpha_{\Pi_h}\} \in$[0,3.1] and $\{\alpha_Y, \alpha_\mathcal{E}, \alpha_{\Delta\mathcal{E}}\} \in$[0,1]. Note that the Ramsey plan is taken as the conditional or unconditional welfare baseline measure ($W_0^{\{C,U\},b}$).

Reglas de política monetaria optimizadas II

Escenario shock corr(PC,AG)

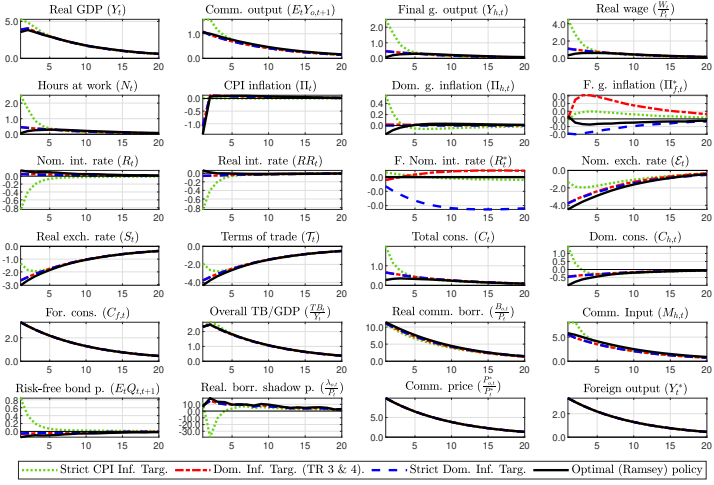
Segundos momentos

	Standard deviation (%)										
Regime	Y_t	$Y_{h,t}$	$Y_{o,t}$	C_t	Π_t	$\Pi_{h,t}$	$\Delta\mathcal{E}_t$	R_t	RR_t	N_t	$W^C_{0,t}$
Ramsey	6.67	3.55	6.86	2.57	1.73	0.24	6.28	1.27	0.83	0.78	0.34
	[0.76]	[0.37]	[0.62]	[0.26]	[0.12]	[0.03]	[0.43]	[0.10]	[0.06]	[0.09]	[0.03]
Strict CPI (Π_t)	12.27	5.37	8.73	3.93	0.00	0.75	3.49	1.08	1.08	3.78	0.51
Strict domestic ($\Pi_{h,t}$)	11.47	5.63	8.45	3.90	1.45	0.00	5.86	1.00	0.72	1.26	0.50
NER ($\mathcal{E}_t$)	13.34	6.56	8.90	4.78	2.36	2.42	0.00	1.31	1.19	6.27	0.52
NER change ($\Delta\mathcal{E}_t$)	13.34	6.56	8.90	4.78	2.36	2.42	0.00	1.31	1.19	6.27	0.52
Taylor rule 1	11.89	5.01	8.67	3.60	0.45	0.61	3.89	0.87	0.80	3.05	0.50
Taylor rule 2	11.89	5.01	8.67	3.60	0.45	0.61	3.89	0.87	0.80	3.05	0.50
Taylor rule 3	11.40	5.28	8.50	3.61	1.35	0.36	5.55	1.13	0.61	1.41	0.49
Taylor rule 4	11.40	5.28	8.50	3.61	1.35	0.36	5.55	1.13	0.61	1.41	0.49

Note. Standard deviations are in percentage and correspond to the percentage deviation of each variable with respect to its respective steady state. The row of numbers in brackets under the Ramsey second moments are the standard deviation of the simulation of 2000 replications for 20 periods corresponding to each variable.

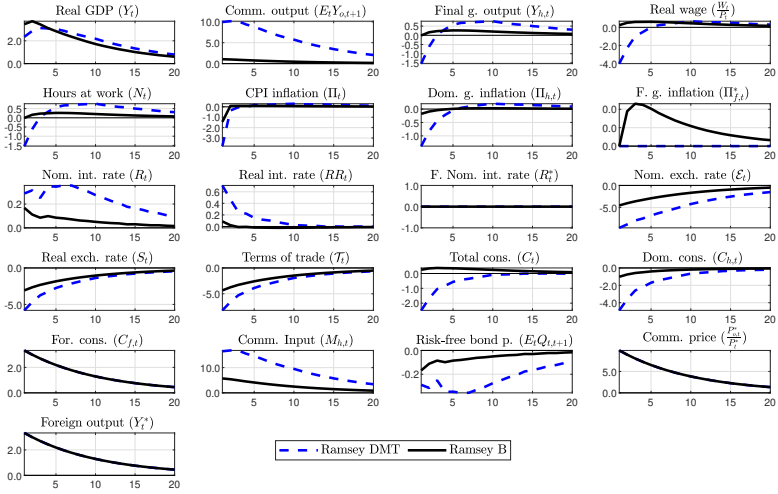
FIR para regímenes seleccionados de PMO

Escenario shock corr(PC,AG)



El sector de commodities de DMT en el presente modelo

Escenario shock corr(PC,AG)



FIR para regímenes seleccionados de PMO

Escenario shock corr(PC,AG)

- Otros resultados Go

■

Índice

Comentarios finales I

- La política monetaria á la Ramsey para shocks de PC y AG correlacionados
  - eleva el NIR,
    permite una apreciación nominal del NER y un
    ajuste en los precios relativos de la economía que
    incentiva a los agentes económicos a reconsiderar sus decisiones de una menera óptima,
    dado el shock de boom de commodities.
  - La respuesta óptima y la volatilidad del NER son menores en una economía donde el riesgo de descalce de divisas es posible.
  - La regla simple e implementable óptima es la de apuntar a la tasa de inflación interna, sin embargo,
  - la regla de meta de inflación del IPC proporciona un volatilidad menor –no nula– del NER (atractiva para los formuladores de políticas porque reduce el miedo a flotar).

Comentarios finales II

- A pesar de que los préstamos se establecen en moneda extranjera, las reglas de control de la tasa de cambio nominal (y las reglas de paridad de la tasa de cambio) son (muy) perjudiciales para el bienestar.
- Bajo la política de Ramsey, una mayor rigidez de precio está asociada a un mayor bienestar y menor volatilidad del NER.

Gracias por su atención

Main References I

Báez, J. (2021), Monetary policy for commodity-exporting economies, PhD thesis, Department of Economics and Related Studies, University of York.

Drechsel, T. (2018), 'Earnings-Based Borrowing Constraints and Macroeconomic Fluctuations', *University of Maryland* p. 89.
URL: *http://econweb.umd.edu/ drechsel/jmp$_d$rechsel.pdf*

Drechsel, T., McLeay, M. and Tenreyro, S. (2019), 'Monetary policy for commodity booms and busts', *Jackson Hole Economic Policy Symposium. Federal Reserve Bank of Kansas City* p. 66.
URL: *http://personal.lse.ac.uk/tenreyro/jacksonhole.pdf*

Drechsel, T. and Tenreyro, S. (2018), 'Commodity booms and busts in emerging economies', *Journal of International Economics* **112**, 200–218.

Faia, E. (2009), 'Ramsey monetary policy with labor market frictions', *Journal of Monetary Economics* **56**(4), 570–581.
URL: *https://linkinghub.elsevier.com/retrieve/pii/S0304393209000427*

Faia, E. and Monacelli, T. (2007), 'Optimal interest rate rules, asset prices, and credit frictions', *Journal of Economic Dynamics and Control* **31**(10), 3228–3254.
URL: *https://linkinghub.elsevier.com/retrieve/pii/S0165188906002077*

Main References II

Faia, E. and Monacelli, T. (2008), 'Optimal monetary policy in a small open economy with home bias', *Journal of Money, Credit and Banking* **40**(4), 721–750.
URL: *http://www.jstor.org/stable/25096275*

Fernández, A., Schmitt-Grohé, S. and Uribe, M. (2017), 'World shocks, world prices, and business cycles: An empirical investigation', *Journal of International Economics* **108**, S2–S14.

Ferrero, A. and Seneca, M. (2019), 'Notes on the Underground: Monetary Policy in Resource-Rich Economies', *Journal of Money, Credit and Banking* **51**(4), 953–976.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.1111/jmcb.12556*

Galí, J. and Monacelli, T. (2005), 'Monetary Policy and Exchange Rate Volatility in a Small Open Economy', *The Review of Economic Studies* **72**(3), 707–734.
URL: *https://academic.oup.com/restud/article/72/3/707/1553469*

Iacoviello, M. (2005), 'House Prices, Borrowing Constraints, and Monetary Policy in the Business Cycle', *American Economic Review* **95**(3), 739–764.
URL: *http://pubs.aeaweb.org/doi/10.1257/0002828054201477*

Jensen, C. and Mccallum, B. T. (2010), 'Optimal Continuation versus the Timeless Perspective in Monetary Policy', *Journal of Money, Credit and Banking* **42**(6), 1093–1107.
URL: *https://onlinelibrary.wiley.com/doi/10.1111/j.1538-4616.2010.00321.x*

Main References III

Khan, A., King, R. G. and Wolman, A. L. (2003), 'Optimal Monetary Policy', *The Review of Economic Studies* **70**(4), 825–860. Publisher: [Oxford University Press, Review of Economic Studies, Ltd.].
URL: *https://www.jstor.org/stable/3648626*

Kiyotaki, N. and Moore, J. (1997), 'Credit Cycles', *Journal of Political Economy* **105**(2), 211–248.
URL: *https://www.jstor.org/stable/10.1086/262072*

Marcet, A. and Marimon, R. (2019), 'Recursive Contracts', *Econometrica* **87**(5), 1589–1631. _eprint: https://onlinelibrary.wiley.com/doi/pdf/10.3982/ECTA9902.
URL: *https://onlinelibrary.wiley.com/doi/abs/10.3982/ECTA9902*

Mendoza, E. G. (1991), 'Real Business Cycles in a Small Open Economy', *The American Economic Review* **81**(4), 797–818. Publisher: American Economic Association.
URL: *https://www.jstor.org/stable/2006643*

Monacelli, T. (2006), Optimal monetary policy with collateralized household debt and borrowing constraints, Working Paper 12470, National Bureau of Economic Research.
URL: *http://www.nber.org/papers/w12470*

Rotemberg, J. J. (1982), 'Monopolistic Price Adjustment and Aggregate Output', *The Review of Economic Studies* **49**(4), 517–531. Publisher: Oxford Academic.
URL: *https://academic.oup.com/restud/article/49/4/517/1581964*

Main References IV

Schmitt-Grohé, S. and Uribe, M. (2007), 'Optimal simple and implementable monetary and fiscal rules', *Journal of Monetary Economics* **54**(6), 1702–1725.
URL: *https://www.sciencedirect.com/science/article/pii/S030439320600167X*

Shousha, S. (2016), 'Macroeconomic effects of commodity booms and busts: The role of financial frictions', *Unpublished Manuscript* .

UNCTAD (2019), *State of Commodity Dependence 2019*, United Nations Conference on Trade and Development.
URL: *https://www.un-ilibrary.org/content/books/9789210043014*

Outline

Key facts

- During 2013–2017 period, 102 out of 189 countries (54 %) were commodity-dependent (UNCTAD, 2019).
  - Among developed countries, 13 % are commodity-dependents.
  - Among developing and transition economies, 64 % are commodity-dependents.

Key facts

- During 2013–2017 period, 102 out of 189 countries (54 %) were commodity-dependent (UNCTAD, 2019).
  - Among developed countries, 13 % are commodity-dependents.
  - Among developing and transition economies, 64 % are commodity-dependents.
- Most of commodity prices (CPs) have become more related to international macroeconomic fluctuations (Shousha, 2016; Fernández, Schmitt-Grohé and Uribe, 2017; Drechsel and Tenreyro, 2018).

Key facts

- During 2013–2017 period, 102 out of 189 countries (54 %) were commodity-dependent (UNCTAD, 2019).
  - Among developed countries, 13 % are commodity-dependents.
  - Among developing and transition economies, 64 % are commodity-dependents.
- Most of commodity prices (CPs) have become more related to international macroeconomic fluctuations (Shousha, 2016; Fernández, Schmitt-Grohé and Uribe, 2017; Drechsel and Tenreyro, 2018).
  - Economic integration, globalization and financialization.
  - CPs and world activity shocks affect home relative prices, terms of trade, exchange rate and output.

Key facts

- During 2013–2017 period, 102 out of 189 countries (54 %) were commodity-dependent (UNCTAD, 2019).
  - Among developed countries, 13 % are commodity-dependents.
  - Among developing and transition economies, 64 % are commodity-dependents.
- Most of commodity prices (CPs) have become more related to international macroeconomic fluctuations (Shousha, 2016; Fernández, Schmitt-Grohé and Uribe, 2017; Drechsel and Tenreyro, 2018).
  - Economic integration, globalization and financialization.
  - CPs and world activity shocks affect home relative prices, terms of trade, exchange rate and output.
- Correlated CP and world activity shocks are important for monetary policy of commodity-exporting countries.

Back

■

Outline

Households' setting I

- The representative household agent of the SOE seeks to maximize a respective sequence of consumption, hours at work, and state-contingent domestic and foreign securities $\left\{C_t, N_t, B_{h,t+1}, B_{f,t+1}\right\}_{t=0}^{\infty}$, derived from its expected lifetime utility

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\ln C_t - \frac{N_t^{1+\phi}}{1+\phi} \right), \tag{5}$$

- subject to the sequence of budget constraints

$$P_t C_t + \mathbb{E}_t Q_{t,t+1} B_{h,t+1} + \mathbb{E}_t \mathcal{E}_t Q^*_{t,t+1} B_{f,t+1} \leq W_t N_t + B_{h,t} + \mathcal{E}_t B_{f,t} + \Psi_t, \tag{6}$$

- where $\Psi_t = \int_0^1 \Psi_{h,t}(i) + \Psi_{o,t}$ represents nominal profit payments from the ownership of intermediate goods firms (in the non-traded final goods sector) and from the representative commodity-producing firm, respectively.

Back

■

Outline

Non-traded final goods firms: optimization program I

- The wholesale firm i of this sector chooses a plan for its price setting $P_{h,t}(i)$ that maximizes the current market value of its expected sequence of nominal profits,

$$\max_{P_{h,t}(i)} \mathbb{E}_0 \left\{ \sum_{t=0}^{\infty} Q_{0,t} \left[P_{h,t}(i) Y_{h,t}(i) - W_t N_t(i) - \frac{\theta}{2} \left(\frac{P_{h,t}(i)}{P_{h,t-1}(i)} - \Pi_h \right)^2 P_{h,t} \right] \right\}, \tag{7}$$

- subject to its technology constraint

$$Y_{h,t}(i) = A_{h,t} N_t(i). \tag{8}$$

- and to the sequence of demand for final goods of the retailers $(Y_{h,t})$,

$$Y_{h,t}(i) = \left(\frac{P_{h,t}(i)}{P_{h,t}} \right)^{-\epsilon} Y_{h,t}, \tag{9}$$

- taking wages (W_t) as given. Back

Outline

Ramsey planner's problem: definition I

Definition (A constrained efficient allocation)

For a given set of exogenous processes $\{A_{h,t}, A_{o,t}, R_t^*, C_t^*, \Pi_t^*, \frac{P_{o,t}^*}{P_t^*}\}_{t=0}^{\infty}$ and a sequence of Lagrangian multipliers $\{\lambda_{1,t}, \lambda_{2,t}, \lambda_{3,t}, \lambda_{4,t}, \lambda_{5,t}\}_{t=0}^{\infty}$ on the constraints for non-traded final goods firm's effic. cond. (the NKPC), the borrowing constraint, the demand for inputs of the comm. sector, the perf. inter. risk-sharing condition and the home resource constraint,

a constrained efficient allocation (or constrained competitive equilibrium) is defined by a plan for the sequences of control variables $\{C_t, N_t, \mathcal{T}_t, \Pi_{h,t}, M_{h,t}, \mathbb{E}_t Q_{t,t+1}\}_{t=0}^{\infty}$, and co-state variables $\{\lambda_{1,t}, \lambda_{2,t}, \lambda_{3,t}, \lambda_{4,t}, \lambda_{5,t}\}_{t=0}^{\infty}$ that maximize the non-recursive problem. Back

■

Ramsey planner's problem I

- Ramsey planner
  - The recursive Ramsey planner problem

$$\mathcal{W}(C_t, N_t, \mathcal{T}_t, \Pi_{h,t}, M_{h,t}, \mathbb{E}_t Q_{t,t+1}, Z_{1,t}, Z_{2,t}, Z_{3,t}) \equiv \ln C_t - \frac{N_t^{1+\phi}}{1+\phi}$$

$$- Z_{1,t}(\mathcal{T}_t^{\alpha} C_t)^{-1} \Pi_{h,t}\Big(\Pi_{h,t} - \Pi_h\Big) - Z_{2,t}\chi Q_{t,t}^{*} \frac{P_{o,t}^{*}}{P_t} \mathcal{T}_t^{\alpha} \Pi_{h,t} \quad - Z_{3,t}\nu \frac{P_{o,t}^{*}}{P_t^{*}} \mathcal{T}_t \Pi_{h,t}\Big\{[1-\chi]\frac{Q_{t,t}}{Q_{t,t-1}} + \chi Q_{t,t}^{*}\Big(\frac{\mathcal{T}_t}{\mathcal{T}_{t-1}}\Big)^{-1} \Pi_{h,t}^{-1} \Pi_t^{*}\Big\}.$$

$$\begin{aligned}
&\underset{\{\Lambda_{\Re,t}\}_{t=0}^{\infty}}{\text{mín}} \underset{\{\Xi_{\Re,t}\}_{t=0}^{\infty}}{\text{máx}} \mathbb{E}_0 \Bigg\{ \sum_{t=0}^{\infty} \beta^t \Bigg\{ \mathcal{W}(C_t, N_t, \mathcal{T}_t, \Pi_{h,t}, M_{h,t}, \mathbb{E}_t Q_{t,t+1}, Z_{1,t}, Z_{2,t}, Z_{3,t}) \\
&+\lambda_{1,t}\Bigg\{\Pi_{h,t}\Big(\Pi_{h,t} - \Pi_h\Big) - \Big[\frac{W_t}{P_t}\frac{\mathcal{T}_t^{\alpha}}{A_{h,t}} - \frac{\epsilon - 1}{\epsilon}\Big]\frac{\epsilon}{\theta} A_{h,t} N_t\Bigg\}(\mathcal{T}_t^{\alpha} C_t)^{-1} \\
&+\lambda_{2,t}\frac{\mathcal{T}_t^{\alpha}}{A_{o,t} M_{h,t}^{\nu}} \frac{B_{o,t}}{P_t} + \lambda_{3,t}\frac{1}{A_{o,t}} M_{h,t}^{1-\nu} + \lambda_{4,t}\Big[C_t - C_t^{*}\mathcal{T}_t^{1-\alpha}\Big] \\
&+\lambda_{5,t}\Bigg[A_{h,t} N_t - (1-\alpha)\mathcal{T}_t^{\alpha} C_t - M_{h,t} - \frac{\theta}{2}\Big(\Pi_{h,t} - \Pi_h\Big)^2\Bigg]\Bigg\}\Bigg\}.
\end{aligned}$$

Back

Ramsey planner's problem II

- The optimality conditions for the Ramsey dynamics can be read as:

Ramsey planner's problem III

$$
\begin{aligned}
C_t : & \frac{1}{C_t} \quad - \lambda_{1,t}\Big\{\Pi_{h,t}\big(\Pi_{h,t}-\Pi_h\big) - [\frac{W_t}{P_t}\frac{\mathcal{T}_t^{\alpha}}{A_{h,t}} - \frac{\epsilon-1}{\epsilon}]\frac{\epsilon}{\theta}A_{h,t}N_t\Big\}\mathcal{T}_t^{-\alpha}C_t^{-2} \\
& + Z_{1,t}\mathcal{T}_t^{-\alpha}C_t^{-2}\Pi_{h,t}\big(\Pi_{h,t}-\Pi_h\big) \quad + \lambda_{4,t} \quad - \lambda_{5,t}(1-\alpha)\mathcal{T}_t^{\alpha} = 0 \\
N_t : & - N_t^{\phi} \quad - \lambda_{1,t}[\frac{W_t}{P_t}\frac{\mathcal{T}_t^{\alpha}}{A_{h,t}} - \frac{\epsilon-1}{\epsilon}]\frac{\epsilon}{\theta}A_{h,t}(\mathcal{T}_t^{\alpha}C_t)^{-1} + \lambda_{5,t}A_{h,t} = 0 \\
\mathcal{T}_t : & - \alpha\lambda_{1,t}\Big\{\Pi_{h,t}\big(\Pi_{h,t}-\Pi_h\big) + \frac{\epsilon-1}{\epsilon}\frac{\epsilon}{\theta}A_{h,t}N_t\Big\}\mathcal{T}_t^{-\alpha-1}C_t^{-1} \\
& + \alpha Z_{1,t}\mathcal{T}_t^{-\alpha-1}C_t^{-1}\Pi_{h,t}\big(\Pi_{h,t}-\Pi_h\big) \\
& + \lambda_{2,t}\frac{\alpha\mathcal{T}_t^{\alpha-1}}{A_{o,t}M_{h,t}^{\nu}}\frac{B_{o,t}}{P_t} - Z_{2,t}\chi Q_{t,t}^{*}\frac{P_{o,t}^{*}}{P_t}\alpha\mathcal{T}_t^{\alpha-1}\Pi_{h,t} \\
& - Z_{3,t}\nu\frac{P_{o,t}^{*}}{P_t^{*}}\Pi_{h,t}[1-\chi]\frac{Q_{t,t}}{Q_{t,t-1}} \\
& - Z_{3,t}\nu\frac{P_{o,t}^{*}}{P_t^{*}}\Pi_{h,t}\chi Q_{t,t}^{*}\Big(\frac{\mathcal{T}_t}{\mathcal{T}_{t-1}}\Big)^{-1}\Pi_{h,t}^{-1}\Pi_t^{*} \\
& + Z_{3,t}\nu\frac{P_{o,t}^{*}}{P_t^{*}}\mathcal{T}_t\Pi_{h,t}\chi Q_{t,t}^{*}\Pi_{h,t}^{-1}\Pi_t^{*}\Big(\frac{\mathcal{T}_t}{\mathcal{T}_{t-1}}\Big)^{-2}[\frac{1}{\mathcal{T}_{t-1}} - \beta\frac{\mathcal{T}_{t+1}}{\mathcal{T}_t^{2}}] \\
& - \lambda_{4,t}C_t^{*}(1-\alpha)\mathcal{T}_t^{-\alpha} \quad - \lambda_{5,t}(1-\alpha)\alpha\mathcal{T}_t^{\alpha-1}C_t = 0
\end{aligned}
$$

Ramsey planner's problem IV

$$\Pi_{h,t}: \lambda_{1,t}(\mathcal{T}_t^{\alpha} C_t)^{-1}[2\Pi_{h,t} - \Pi_h] - Z_{1,t}(\mathcal{T}_t^{\alpha} C_t)^{-1}[2\Pi_{h,t} - \Pi_h] - Z_{2,t}\chi Q_{t,t}^{*} \frac{P_{o,t}^{*}}{P_t} \mathcal{T}_t^{\alpha}$$

$$- Z_{3,t}\nu \frac{P_{o,t}^{*}}{P_t^{*}} \mathcal{T}_t[1-\chi] \frac{Q_{t,t}}{Q_{t,t-1}} - \lambda_{5,t}\theta\left(\Pi_{h,t} - \Pi_h\right) = 0$$

$$M_{h,t}: - \lambda_{2,t} \frac{\nu \mathcal{T}_t^{\alpha}}{A_{o,t} M_{h,t}^{1+\nu}} \frac{B_{o,t}}{P_t} + \lambda_{3,t} \frac{1}{A_{o,t}} (1-\nu) M_{h,t}^{-\nu} - \lambda_{5,t} = 0$$

$$\mathbb{E}_t Q_{t,t+1}: - Z_{3,t}\nu \frac{P_{o,t}^{*}}{P_t^{*}} \mathcal{T}_t \Pi_{h,t} \Big\{ [1-\chi] \mathbb{E}_t \Big(\beta \frac{1}{Q_{t,t}} - \beta^2 \frac{Q_{t,t+2}}{Q_{t,t+1}^2} \Big) \Big\} = 0.$$

Ramsey planner's problem V

- The optimality conditions that describe the deterministic Ramsey steady state can be read as:

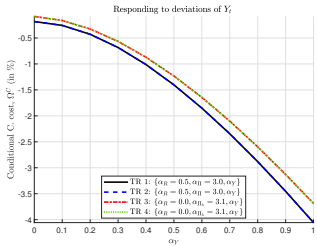
$$
\begin{aligned}
C_t &: \frac{1}{C} \quad + \lambda_4 \quad - \lambda_5(1-\alpha)\mathcal{T}^{\alpha} = 0 \\
N_t &: - N^{\phi} \quad + \lambda_5 A_h = 0 \\
\mathcal{T}_t &: - \alpha\lambda_1 \mathcal{T}^{-\alpha-1} C^{-1} \frac{\epsilon-1}{\theta} A_h N \quad + \lambda_2 \frac{\alpha \mathcal{T}^{\alpha-1}}{A_o M_h^{\nu}} \frac{B_o}{P} \quad - \lambda_2 \chi \frac{\beta^*}{\Pi^*} \frac{P_o^*}{P} \alpha \mathcal{T}^{\alpha-1} \Pi_h \\
&\quad - \lambda_3 \nu \frac{P_o^*}{P^*} \Pi_h [1-\chi] \quad - \lambda_3 \nu \frac{P_o^*}{P^*} \chi \beta^* \quad - \lambda_4 C^* (1-\alpha) \mathcal{T}^{-\alpha} \\
&\quad - \lambda_5 (1-\alpha) \alpha \mathcal{T}^{\alpha-1} C = 0 \\
\Pi_{h,t} &: - \lambda_2 \chi \frac{\beta^*}{\Pi^*} \frac{P_o^*}{P} \mathcal{T}^{\alpha} \quad - \lambda_3 \nu \frac{P_o^*}{P^*} \mathcal{T} [1-\chi] = 0 \\
M_{h,t} &: - \lambda_2 \frac{\nu \mathcal{T}^{\alpha}}{A_o M_h^{1+\nu}} \frac{B_o}{P} \quad + \lambda_3 \frac{1}{A_o} (1-\nu) M_h^{-\nu} \quad - \lambda_5 = 0
\end{aligned}
$$

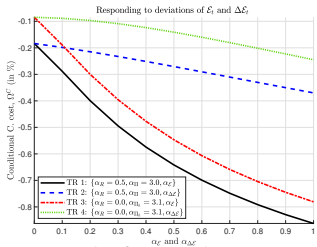
Back

Outline

Responding to deviations of Y_t, $\mathcal{E}_t$ and $\Delta\mathcal{E}_t$ from its SS?

Corr(CPS,WAS) scenario





The optimal (Ramsey) policy

Corr(CPS,WAS) scenario

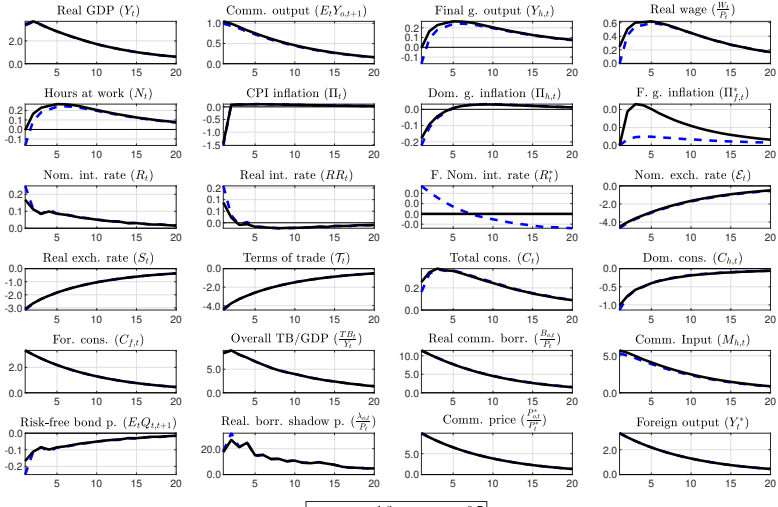
A higher loan-to-value ratio (χ)

LR	C. Welfare	U. Welfare	Standard deviation (%)										
χ	$W_0^{C,b}$	$W_0^{U,b}$	Y_t	$Y_{h,t}$	$Y_{o,t}$	C_t	Π_t	$\Pi_{h,t}$	$\Delta\mathcal{E}_t$	R_t	RR_t	N_t	$W_{0,t}^{C,b}$
0.5	-41.77	-41.78	6.67	3.55	6.86	2.57	1.73	0.24	6.28	1.27	0.83	0.78	0.34
			[0.76]	[0.37]	[0.62]	[0.26]	[0.12]	[0.03]	[0.43]	[0.10]	[0.06]	[0.09]	[0.03]
1.3	-41.80	-41.81	6.62	3.56	6.82	2.54	1.81	0.29	6.55	1.42	0.94	0.80	0.34
			[0.75]	[0.38]	[0.61]	[0.26]	[0.13]	[0.04]	[0.46]	[0.12]	[0.08]	[0.09]	[0.03]

Note. LR = loan-to-value ratio (χ); C. = conditional; U. = unconditional; $W_0^{\{C,U\},b}$ = {conditional, unconditional} welfare baseline measure (b). Optimal (Ramsey) monetary policy under a correlated commodity price shock and world activity shock. Both shocks are positive and set to 10 % and 3,33 %, respectively. Standard deviations are in percentage and correspond to the percentage deviation of each variable with respect to its respective steady state. The row of numbers in brackets are the standard deviation of the simulation of 2000 replications for 20 periods corresponding to each variable.

The optimal (Ramsey) policy: IRFs varying χ (in %)

Corr(CPS,WAS) scenario



The optimal (Ramsey) policy

Corr(CPS,WAS) scenario

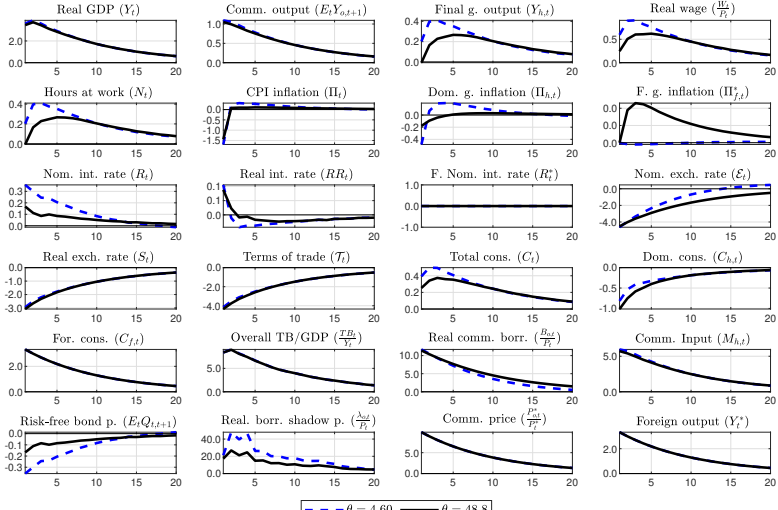
A lower price rigidity (θ)

AC	C. Welfare	U. Welfare	Standard deviation (%)										
θ	$W_0^{C,b}$	$W_0^{U,b}$	Y_t	$Y_{h,t}$	$Y_{o,t}$	C_t	Π_t	$\Pi_{h,t}$	$\Delta\mathcal{E}_t$	R_t	RR_t	N_t	$W_{0,t}^{C,b}$
Optimal (Ramsey) policy regime													
48.8	-41.77	-41.78	6.67	3.55	6.86	2.57	1.73	0.24	6.28	1.27	0.83	0.78	0.34
			[0.76]	[0.37]	[0.62]	[0.26]	[0.12]	[0.03]	[0.43]	[0.10]	[0.06]	[0.09]	[0.03]
4.60	-42.05	-42.20	6.85	3.69	6.90	2.66	2.41	1.27	6.67	2.14	0.81	0.86	0.34
			[0.79]	[0.39]	[0.62]	[0.28]	[0.26]	[0.19]	[0.52]	[0.24]	[0.08]	[0.11]	[0.04]
Strict domestic inflation targeting regime													
48.8	-41.83	-41.83	11.47	5.63	8.45	3.90	1.45	0.00	5.86	1.00	0.72	1.26	0.50
4.60	-41.83	-41.83	11.47	5.63	8.45	3.90	1.45	0.00	5.86	1.00	0.72	1.26	0.50
Strict CPI inflation targeting regime													
48.8	-42.05	-42.06	12.27	5.37	8.73	3.93	0.00	0.75	3.49	1.08	1.08	3.78	0.51
4.60	-41.87	-41.79	11.58	5.44	8.53	3.85	0.00	1.25	4.29	0.70	0.70	1.67	0.50

Note. AC = adjustment cost parameter (θ); C. = conditional; U. = unconditional; $W_0^{\{C,U\},b}$ = {conditional, unconditional} welfare baseline measure (b). Optimal (Ramsey) monetary policy under a correlated commodity price shock and world activity shock. Both shocks are positive and set to 10 % and 3,33 %, respectively. Standard deviations are in percentage and correspond to the percentage deviation of each variable with respect to its respective steady state. The row of numbers in brackets are the standard deviation of the simulation of 2000 replications for 20 periods corresponding to each variable.

The optimal (Ramsey) policy: IRFs varying θ (in %)

Corr(CPS,WAS) scenario



The optimal (Ramsey) policy

Corr(CPS,WAS) scenario

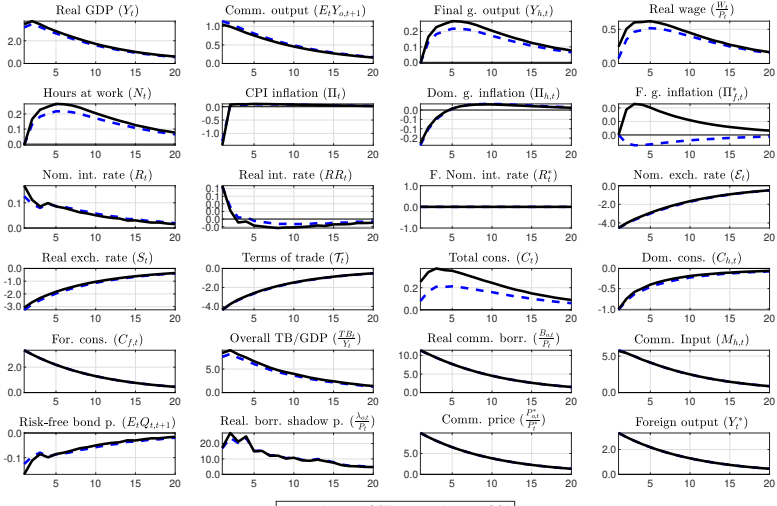
A lower home consumption bias $(1-\alpha)$

HCB	C. Welfare	U. Welfare	Standard deviation (%)										
$1-\alpha$	$W_0^{C,b}$	$W_0^{U,b}$	Y_t	$Y_{h,t}$	$Y_{o,t}$	C_t	Π_t	$\Pi_{h,t}$	$\Delta\mathcal{E}_t$	R_t	RR_t	N_t	$W_{0,t}^{C,b}$
0.71	-41.77	-41.78	6.67	3.55	6.86	2.57	1.73	0.24	6.28	1.27	0.83	0.78	0.34
			[0.76]	[0.37]	[0.62]	[0.26]	[0.12]	[0.03]	[0.43]	[0.10]	[0.06]	[0.09]	[0.03]
0.75	-36.06	-36.07	6.33	3.51	6.98	2.65	1.50	0.25	6.25	1.10	0.75	0.59	0.41
			[0.72]	[0.38]	[0.63]	[0.28]	[0.10]	[0.03]	[0.42]	[0.09]	[0.06]	[0.07]	[0.04]

Note. HCB = home consumption bias $(1-\alpha)$; C. = conditional; U. = unconditional; $W_0^{\{C,U\},b} = \{$conditional, unconditional$\}$ welfare baseline measurement (b). Optimal (Ramsey) monetary policy under a correlated commodity price shock and world activity shock. Both shocks are positive and set to 10 % and 3,33 %, respectively. Standard deviations are in percentage and correspond to the percentage deviation of each variable with respect to its respective steady state. The row of numbers in brackets are the standard deviation of the simulation of 2000 replications for 20 periods corresponding to each variable.

The optimal (Ramsey) policy: IRFs varying α (in %)

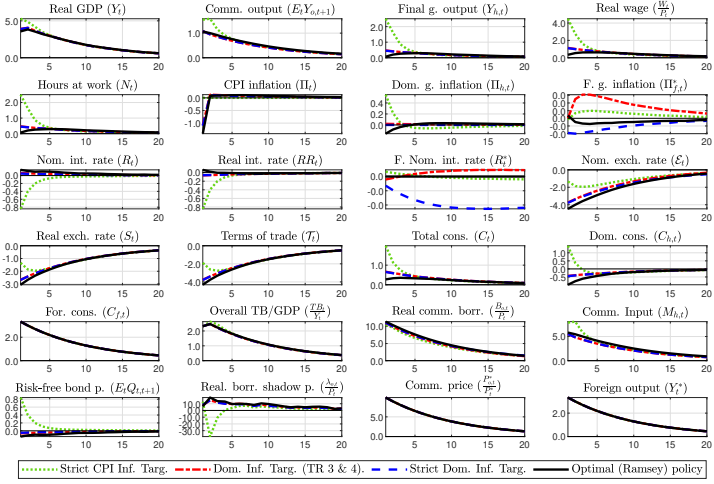
Corr(CPS,WAS) scenario Back



IRFs under selected optimized policy regimes (in %)

Corr(CPS,WAS) scenario

Back



Optimized monetary policy rules I

CPS scenario

Welfare evaluation

Regime (policy rule)	C. Welfare W_0^C	C. C. cost Ω^C (%)	U. Welfare W_0^U	U. C. cost Ω^U (%)	Optimized parameters					
					α_R	α_Π	α_{Π_h}	α_Y	$\alpha_\mathcal{E}$	$\alpha_{\Delta\mathcal{E}}$
Ramsey	-42.029	0.000	-42.053	0.000	–	–	–	–	–	–
Strict CPI (Π_t)	-42.204	-0.146	-42.224	-0.143	–	–	–	–	–	–
Strict domestic ($\Pi_{h,t}$)	-42.039	-0.008	-42.056	-0.003	–	–	–	–	–	–
NER ($\mathcal{E}_t$)	-43.494	-1.218	-43.539	-1.235	–	–	–	–	–	–
NER change ($\Delta\mathcal{E}_t$)	-43.494	-1.218	-43.539	-1.235	–	–	–	–	–	–
Taylor rule 1	-42.156	-0.106	-42.175	-0.102	0.0	2.9	–	0.0	0.0	–
Taylor rule 2	-42.156	-0.106	-42.175	-0.102	0.0	2.9	–	0.0	–	0.0
Taylor rule 3	-42.081	-0.043	-42.099	-0.039	0.0	–	3.1	0.0	0.0	–
Taylor rule 4	-42.081	-0.043	-42.099	-0.039	0.0	–	3.1	0.0	–	0.0

Note. C. = Conditional; U. = unconditional; C. cost = compensation cost; CPS = commodity price shock. CPS = 10 %. Rules are evaluated under the same steady state. A dash indicates the absence of the respective parameter in the specified rule. Parameter values increase at 0.1 step within its respective grid, which is defined as $\{\alpha_R\} \in [0,0.9]$, $\{\alpha_\Pi, \alpha_{\Pi_h}\} \in [0,3.1]$ and $\{\alpha_Y, \alpha_\mathcal{E}, \alpha_{\Delta\mathcal{E}}\} \in [0,1]$. Note that the Ramsey plan is taken as the conditional or unconditional welfare baseline measure ($W_0^{\{C,U\},b}$).

Optimized monetary policy rules II

CPS scenario

Second moments

	Standard deviation (%)										
Regime	Y_t	$Y_{h,t}$	$Y_{o,t}$	C_t	Π_t	$\Pi_{h,t}$	$\Delta\mathcal{E}_t$	R_t	RR_t	N_t	$W^C_{0,t}$
Ramsey	7.27	3.59	7.08	3.27	1.43	0.34	5.46	1.32	0.92	0.93	0.60
	[0.92]	[0.38]	[0.65]	[0.34]	[0.10]	[0.04]	[0.37]	[0.13]	[0.09]	[0.14]	[0.07]
Strict CPI (Π_t)	13.11	5.10	9.47	4.77	0.00	0.66	3.38	1.01	1.01	3.37	1.06
Strict domestic ($\Pi_{h,t}$)	13.16	5.90	9.45	4.75	1.29	0.00	5.41	1.01	0.77	2.15	1.06
NER ($\mathcal{E}_t$)	13.41	5.83	9.51	5.45	2.29	2.29	0.00	1.31	1.12	5.50	1.05
NER change ($\Delta\mathcal{E}_t$)	13.41	5.83	9.51	5.45	2.29	2.29	0.00	1.31	1.12	5.50	1.05
Taylor rule 1	13.10	5.10	9.47	4.55	0.40	0.56	3.66	1.17	0.95	3.05	1.05
Taylor rule 2	13.10	5.10	9.47	4.55	0.40	0.56	3.66	1.17	0.95	3.05	1.05
Taylor rule 3	13.13	5.58	9.49	4.48	1.20	0.37	5.10	1.16	0.67	2.28	1.05
Taylor rule 4	13.13	5.58	9.49	4.48	1.20	0.37	5.10	1.16	0.67	2.28	1.05

Note. Standard deviations are in percentage and correspond to the percentage deviation of each variable with respect to its respective steady state. The row of numbers in brackets under the Ramsey second moments are the standard deviation of the simulation of 2000 replications for 20 periods corresponding to each variable.

Política monetaria á la Ramsey para economías exportadoras de materias primas

[Ramsey monetary policy for commodity-exporting economies]

José Báez

jbaezm@bcp.gov.py

Banco Central del Paraguay
Universidad de York

III Jornada de Economía del BCP
15 de septiembre de 2023