A Simple SFC Macroeconomic Model

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Money

1 Model SIM

Two kinds of Money:

- Outside/High-Powered Money—>Created by government
- Inside Money—> Created by banks when they make loans
- Simple model with only outside money

Assumptions

1 Model SIM

- Closed Monetary economy
- Pure labor economy—> Divide agents into their **business activities**: selling services and paying out wages, **receiving income, consuming, accumulating assets**
- No Capital
- Government buys services, levies taxes
- High powered money is the only financial asset
- Wages are given exogenously, unlimited supply of labor
- Three sectors (households, production, government)

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How do the balance sheets and the transaction-flow matrix look like?

	Households	Production	Government	$\sum$
Cash-Money Stock	$+H$	0	$-H$	0
Sum (net worth)	NW_h	$NW_f = 0$	NW_g	0

Table: Balance-sheet matrix

	Households (1)	Production (2)	Government (3)	$\sum$
Consumption				

Table: Transactions flow matrix

- What is the budget constraint of each sector?

	Households (1)	Production (2)	Government (3)	$\sum$
Consumption	-C	+C		0
Govt. expenditures				

Table: Transactions flow matrix

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Govt. expenditures		+G	-G	0
[Output]		[Y]		
Wages				

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Taxes-transfers				

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Taxes-transfers	-T		+T	0
Change in cash				

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Taxes-transfers	-T		+T	0
Change in cash	$-\Delta H$		$+\Delta H$	0
$\sum$	0	0	0	0

Table: Transactions flow matrix

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Govt. expenditures		+G	-G	0
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$\sum$	0	0	0	0

Table: Transactions flow matrix

- What is the budget constraint of each sector?

	Households (1)	Production (2)	Government (3)	$\sum$
Consumption	$-C_d$	$+C_s$		0
Govt. expenditures		$+G_s$	$-G_d$	0
[Output]		[Y]		
Wages	$+W \times N_s$	$-W \times N_d$		0
Taxes-transfers	$-T_s$		$+T_d$	0
Change in cash	$-\Delta H_h$		$+\Delta H_s$	0
$\sum$	0	0	0	0

Table: Transactions flow matrix

What are the variables of our model?

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Variables			
1	C_s	***7***	C_d
2	G_s	***8***	ΔH_s
3	T_s	***9***	ΔH_h
4	N_s	***10***	Y
5	YD	***11***	N_d
6	T_d		

Table: Transactions flow matrix

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Table: Transactions flow matrix

So we need to specify the same number of equations

Demand=Supply

1 Model SIM

- $C_s = C_d$
- $G_s = G_d$
- $T_s = T_d$
- $N_s = N_d$

Demand=Supply

How do markets adjust so that Demand=Supply?

- Price clearing
- Rationing—when Supply≠Demand—>Rigidities—>adjustment is done on the short side of the market
- Inventories
- Output adjustment

Other equations

- Disposable Income: $YD = W \times N_s - T_s$
- Taxes are a fixed proportion of income: $T_d = \theta Y = \theta \times W \times N_s$, where $\theta < 1$

Consumption Function

$$C_d = a_1 \times YD + a_2 H_{h-1}$$

$$\text{where } 0 < a_1 < a_2 < 1$$

Change in demand and Supply of Financial Assets

- $\Delta H_s =$ ....???????

Change in demand and Supply of Financial Assets

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- $\Delta H_s = H_s - H_{s-1} = G_d - T_d$
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Change in demand and Supply of Financial Assets

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- $\Delta H_s = H_s - H_{s-1} = G_d - T_d$
- $\Delta H_d = ...???????$
- $\Delta H_s = H_h - H_{h-1} = YD - C_d$

Output and Employment

$$Y = C_s + G_s$$

$$Y = W \times N_d$$

$$\text{so } N_d = Y/W$$

11 equations for 11 unknowns

1. $C_s = C_d$
2. $G_s = G_d$
3. $T_s = T_d$
4. $N_s = N_d$
5. $YD = W \times N_s - T_s$
6. $T_d = \theta Y = \theta \times W \times N_s$
7. $C_d = a_1 \times YD + a_2 H_{h-1}$
8. $H_s = H_{s-1} + G_d - T_d$
9. $H_h = H_{h-1} + YD - C_d$
10. $Y = C_s + G_s$
11. $N_d = Y/W$

Model

1 Model SIM

The solution for each period depends on the stock variables created in the previous period; and will create the stock variables necessary for the solution of the next period....

Is demand and supply for money equal?

Is demand and supply for money equal?

- Walras' law—>Redundant equation: $\Delta H_s = \Delta H_d$
- We have to drop it because system would otherwise be over-determined

Short-run equilibrium

Let $\theta = 0.2$, $a_1 = 0.6$ and $a_2 = 0.4$

Period	1	2	3	n
G	0	20		
$Y = G + C$	0	?		
$T = \theta Y$	0	?		
$YD = Y - T$	0	?		
$C = a_1 YD + a_2 H_{h-1}$	0	?		
$\Delta H_s = G - T$	0	?		
$\Delta H_h = YD - C$	0	?		
$H = \Delta H + H_{-1}$	0	?		

Short-run equilibrium

- Solve for Y
- Let $\theta = 0.2$, $a_1 = 0.6$ and $a_2 = 0.4$
- Solve it in .R!!!

Short-run equilibria

Period	1	2	3	∞
G	0	20	20	20
$Y = G + C$	0	38.5	47.9	100
$T = \theta Y$	0	7.7	9.6	20
$YD = Y - T$	0	30.8	38.3	80
$C = a_1 YD + a_2 H_{h-1}$	0	18.5	27.9	80
$\Delta H_s = G - T$	0	12.3	10.4	0
$\Delta H_h = YD - C$	0	12.3	10.4	0
$H = \Delta H + H_{-1}$	0	12.3	22.7	80

Long run solutions

- The long run equilibrium is defined as the state where the various-stock flow ratios remain stable
- In this simple model the long-run equilibrium is stationary; the output does not grow
- So, in the long run equilibrium the stocks are constant.

Long run solutions

1 Model SIM

- What is the long run value of income?

Long run solutions

- What is the long run value of income?
- So, $\Delta H_s = 0 \Longrightarrow G - T = 0 \Longrightarrow G = T = \theta Y \Longrightarrow Y^* = G/\theta$
- G/θ is sometimes called fiscal stance

Long run solutions

What is the long run value of disposable income?

Long run solutions

What is the long run value of disposable income?

Also, $\Delta H_h = 0 \Longrightarrow YD - C = 0 \Longrightarrow YD = C \Longrightarrow YD^* = \frac{G(1-\theta)}{\theta}$

Long run solutions

- What is the long run value of the money stock?

Long run solutions

- What is the long run value of the money stock?
- $C = a_1 YD + a_2 H_{-1} \Longrightarrow YD = a_1 YD + a_2 H \Longrightarrow$
- $\Longrightarrow H^* = \left[\frac{1-a_1}{a_2}\right] YD^* = a_3 YD^* = a_3 \frac{G(1-\theta)}{\theta}$

- Plot Y
- Plot, YD, C
- Plot Wealth (H), Hhold Saving (ΔH)

The Cons. Fnc as a Wealth Accumulation fnc

- $C = YD - \Delta H_h$
- $C = YD - \Delta H_h = a_1 YD + a_2 H_{h-1} \Longrightarrow$
- $\Delta H_h = (1 - a_1) YD - a_2 H_{h-1} \Longrightarrow$
- $\Delta H_h = a_2 \Big[a_3 YD - H_{h-1} \Big]$

The Cons. Fnc as a Wealth Accumulation fnc

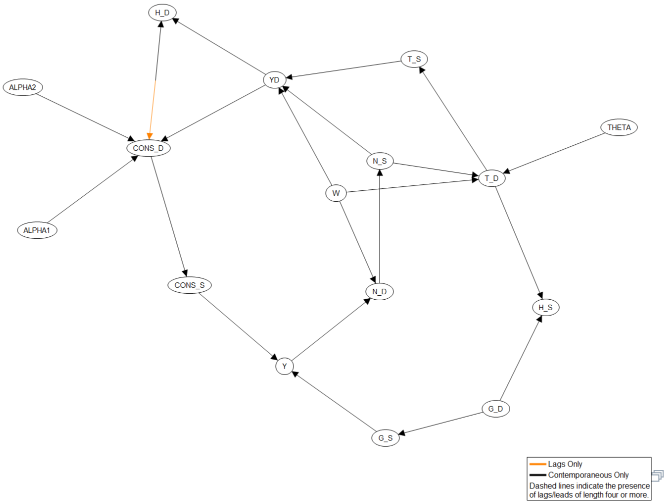
- $\Delta H_h = a_2\Big[a_3 YD - H_{h-1}\Big] = a_2\Big(V^T - H_{h-1}\Big)$
- Households adjust their wealth towards a certain proportion of their disposable income $a_3 = \frac{1-a_1}{a_2}$
- a_2 is the adjustment parameter
- Plot V^T, C, W

The Cons. Fnc as a Wealth Accumulation fnc

- $\Delta H_h = a_2\left[a_3 YD - H_{h-1}\right] = a_2\left(V^T - H_{h-1}\right)$
- Households adjust their wealth towards a certain proportion of their disposable income $a_3 = \frac{1-a_1}{a_2}$
- a_2 is the adjustment parameter
- Plot V^T, C, W
- Calculate and plot C, YD, Wealth (H) when a_1 increases from 0.6 to 0.7

Dependency Graph

1 Model SIM



Expectations

- So far we have assumed that households have perfect foresight and know what on beforehand that their income will be each period
- What happens if we drop this assumption?
- $C_d = a_1 YD^e + a_2 H_{h-1}$

Expectations

- So far we have assumed that households have perfect foresight and know what on beforehand that their income will be each period
- What happens if we drop this assumption?
- $C_d = a_1 YD^e + a_2 H_{h-1}$
- What else changes?

Expectations

1 Model SIM

- Now $\Delta H_d = H_d - H_{d-1} = YD^e - C_d$
- What is the difference between the demand for money and the actual holding of money for the households?

Expectations

- Now $\Delta H_d = H_d - H_{d-1} = YD^e - C_d$
- What is the difference between the demand for money and the actual holding of money for the households?
- $H_h - H_d = YD - YD^e$

Expectations

- We know have 13 unknowns (YD^e and H_d in addition)
- We need two more equations

Expectations

- We know have 13 unknowns (YD^e and H_d in addition)
- We need two more equations
- $\Delta H_d = H_d - H_{d-1} = YD^e - C_d$
- And a specification for expectations: $YD^e = YD_{-1}$

Expectations—Short-run equilibria

1 Model SIM

Period	1	2	3	∞
G	0	20		
$Y = G + C$	0	?		
$T = \theta Y$	0	?		
$YD = Y - T$	0			
$YD^e = YD_{-1}$	0			
$C = a_1 YD^e + a_2 H_{h-1}$	0			
$\Delta H_s = G - T$	0			
$\Delta H_h = YD - C$	0			
$H = \Delta H + H_{-1}$	0			
$\Delta H_d = YD^e - C$	0			
$H_d = \Delta H_d + H_{-1}$	0			

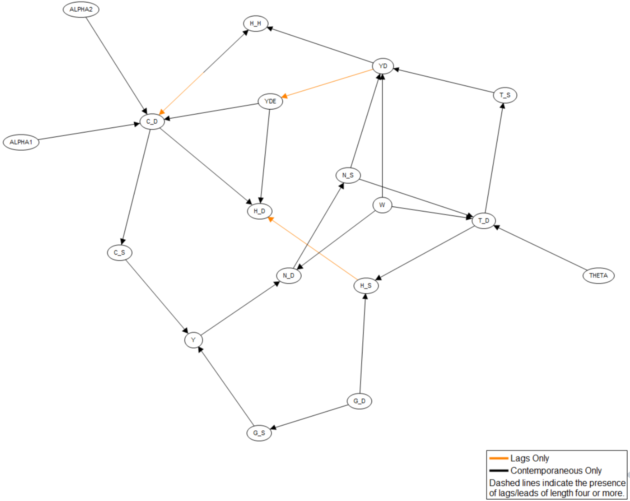
Plot disposable Income and expected disposable income

Expectations

- Assume that expectations do not change
- What happens?
- Start from the previous equilibrium and assume G=25 and YD^e is constant

Dependency Graph

1 Model SIM



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▶ Simulations

Steps to simulate a time-series macro-model

1. Specification of time range
2. Definition of variables
3. Definition of equations
4. Calibration/Estimation
5. Initialization
6. **Solve!!!**

Scenarios

1. Changes in exogenous variables/parameters.
2. **Solve again!!!**
3. (Baseline+Scenarios)

Issues

2 Simulations

1. How may of the properties of the model depend on the specific calibration
2. Possibility of multiple equilibria
3. Thus, initial values matter...

Assignment

In the model SIM of chapter 3, starting from a stationary state simulate the effect of an increase in government expenditure under four variations of the model:

1. the simple deterministic model of the book
2. a model with simple adaptive expectations $YD^e = YD_{-2}$
3. a model where expected disposable income depends upon its past value net of the increase in government deficit disposable income: $YD^e = YD_{-1} - (G - T)$
4. a model where expected disposable income is always constant and equal to 25: $YD^e = 25$

Plot *in the same graph* the trajectory of output from the original stationary state to the new one.
Discuss.

Bibliography

Bemanke, Ben, and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review* 79 (1): 14–31.

Bielschowsky, Ricardo, Miguel Torres, and NU CEPAL. 2018. *Desarrollo e Igualdad: El Pensamiento de La CEPAL En Su Septimo Decenio. Textos Seleccionados Del Periodo 2008-2018*. CEPAL.

Blecker, Robert A. 2016. "Wage-Led Versus Profit-Led Demand Regimes: The Long and the Short of It." *Review of Keynesian Economics* 4 (4): 373–90.

Carnevali, Emilio, Matteo Deleidi, Riccardo Pariboni, and Marco Veronese Passarella. 2019. "Stock-Flow Consistent Dynamic Models: Features, Limitations and Developments." In *Frontiers of Heterodox Macroeconomics*, 223–76. Springer.

Bibliography

Caverzasi, Eugenio, and Antoine Godin. 2013. “Stock-Flow Consistent Modeling Through the Ages.” *Levy Economics Institute of Bard College Working Paper*, no. 745.

Cespedes, Luis Felipe, Roberto Chang, and Andres Velasco. 2004. “Balance Sheets and Exchange Rate Policy.” *American Economic Review* 94 (4): 1183–93.

Dixon, Robert, and Anthony Thirlwall. 1975. “A Model of Regional Growth-Rate Differences on Kaldorian Lines.” *Oxford Economic Papers* 27 (2): 201–14. https://econpapers.repec.org/article/oupoxecpp/v_3a27_3ay_3a1975_3ai_3a2_3ap_3a201-14.htm.

Dornbusch, Rudiger. 1976. “Expectations and Exchange Rate Dynamics.” *Journal of Political Economy* 84 (6): 1161–76. https://doi.org/10.1086/260506.

Bibliography

Dutt, Amitava Krishna. 2002. "Thirlwall's Law and Uneven Development." *Journal of Post Keynesian Economics* 24 (3): 367–90. https://doi.org/10.1080/01603477.2002.11490331.

Dvoskin, Ariel, Germán David Feldman, and Guido Ianni. 2020. "New-Structuralist Exchange-Rate Policy and the Pattern of Specialization in Latin American Countries." *Metroeconomica* 71 (1): 22–48. https://doi.org/https://doi.org/10.1111/meca.12265.

Fajnzylber, Fernando. 1990. *Industrialization in Latin America: From the Black Box" to the "Empty Box": A Comparison of Contemporary Industrialization Patterns"*. ECLAC. https://repositorio.cepal.org//handle/11362/27811.

Bibliography

2 Simulations

Frenkel, Roberto, and Martin Rapetti. 2011. "Exchange Rate Regimes in Latin America." *The Oxford Handbook of Latin American Economics.* https://doi.org/10.1093/oxfordhb/9780199571048.013.0008.

Gertler, Mark, Simon Gilchrist, and Fabio M. Natalucci. 2007. "External Constraints on Monetary Policy and the Financial Accelerator." *Journal of Money, Credit and Banking* 39 (2-3): 295–330. https://doi.org/https://doi.org/10.1111/j.0022-2879.2007.00027.x.

Godley, W., and M. Lavoie. 2012. *Monetary Economics: An Integrated Approach to Credit, Money, Income, Production and Wealth.* 2nd ed. Palgrave Macmillan UK. https://doi.org/10.1007/978-1-137-08599-3.

Kaldor, Nicholas. 1966. "Causes of the Slow Rate of Economic Growth in the UK." *Economic Growth in Theory and Practice: A Kaldorian Perspective.* Cambridge, Cambridge University Press.

Bibliography

———. 1970. "The Case for Regional Policies*." *Scottish Journal of Political Economy* 17 (3): 337–48. https://doi.org/https://doi.org/10.1111/j.1467-9485.1970.tb00712.x.

Kalecki, Michal. 1971. *Selected Essays on the Dynamics of the Capitalist Economy 1933-1970*. CUP Archive.

Macedo, Jorge Braga de. 1983. "Optimal Currency Diversification for a Class of Risk-Averse International Investors." *Journal of Economic Dynamics and Control* 5 (February): 173–85. https://doi.org/10.1016/0165-1889(83)90020-9.

Minsky, Hyman P. 1996. "The Essential Characteristics of Post Keynesian Economics." In *Money in Motion: The Post Keynesian and Circulation Approaches*, edited by Ghislain Deleplace and Edward J. Nell, 70–88. The

Bibliography

Jerome Levy Economics Institute Series. London: Palgrave Macmillan UK. https://doi.org/10.1007/978-1-349-24525-3_3.

Nikiforos, Michalis, and Gennaro Zezza. 2017. "Stock-Flow Consistent Macroeconomic Models: A Survey." *Journal of Economic Surveys* 31 (5): 1204–39.

Ocampo, José Antonio. 1986. "New Developments in Trade Theory and LDCs." *Journal of Development Economics* 22 (1): 129–70. https://doi.org/10.1016/0304-3878(86)90054-4.

Ocampo, José Antonio, and M. A. Parra. 2003. "The Terms of Trade for Commodities in the Twentieth Century." *REVISTA DE LA CEPAL*. https://repositorio.cepal.org/handle/11362/10926.

Perez Caldentey, Esteban, and Matias Vernengo. 2015. "Towards an Understanding of Crisis Episodes in Latin America: A Post-Keynesian

Approach." *Review of Keynesian Economics* 3 (2): 158–80. https://ideas.repec.org/a/elg/rokejn/v3y2015i2p158-180.html.

Perri, Fabrizio, Kate Kisselev, Nouriel Roubini, and Michele Cavallo. 2004. "Exchange Rate Overshooting and the Costs of Floating." In *Federal Reserve Bank of San Francisco Proceedings*. Jun.

Prebisch, Raul. 1949. *El Desarrollo Económico de La América Latina y Algunos de Sus Principales Problemas*. CEPAL. https://www.cepal.org/es/publicaciones/40010-desarrollo-economico-la-america-latina-algunos-sus-principales-pr

Rodriguez, Octavio. 1977. "Sobre La Concepción Del Sistema Centro-Periferia." *REVISTA DE LA CEPAL*. https://repositorio.cepal.org/handle/11362/12422.

Bibliography

———. 2006. *El Estructuralismo Latinoamericano.* Cepal. https://repositorio.cepal.org/handle/11362/1952.

Rodrik, Dani. 2008. "The Real Exchange Rate and Economic Growth." *Brookings Papers on Economic Activity* 39 (2 (Fall)): 365–439. https://econpapers.repec.org/article/binbpeajo/v_3a39_3ay_3a2008_3ai_3a2008-02_3ap_3a365-439.htm.

Ros, Jaime, and Peter Skott. 1998. "Dynamic Effects of Trade Liberalization and Currency Overvaluation Under Conditions of Increasing Returns." *The Manchester School* 66 (4): 466–89.

Singer, H. W. 1950. "The Distribution of Gains Between Investing and Borrowing Countries." *The American Economic Review* 40 (2): 473–85. https://www.jstor.org/stable/1818065.

Bibliography

Thirlwall, A. P. 1979. “The Balance of Payments Constraint as an Explanation of the International Growth Rate Differences.” *PSL Quarterly Review* 32 (128). https://ojs.uniroma1.it/index.php/PSLQuarterlyReview/article/view/12804.

———. 1997. “Reflections on the Concept of Balance-Of-Payments–Constrained Growth.” *Journal of Post Keynesian Economics: Vol 19, No 3.*

———. 2013. “Economic Growth in an Open Developing Economy: The Role of Structure and Demand.” Cheltenham: Edward Elgar Publishing.

Tobin, James, and J Braga De Macedo. 1980. “The Short Run Macroeconomics of Floating Exchange Rates.” *Economia* 4 (1): 1–23.

UNCTAD. 2017. *Debt Vulnerabilities in Developing Countries: A New Debt Trap? (Volume I) Regional and Thematic Analyses.* Vol. 1.

Bibliography

Verdoorn, P. J. 2002. “Factors That Determine the Growth of Labour Productivity.” In *Productivity Growth and Economic Performance: Essays on Verdoorn’s Law*, edited by John McCombie, Maurizio Pugno, and Bruno Soro, 28–36. London: Palgrave Macmillan UK. https://doi.org/10.1057/9780230504233_2.

Zezza, Gennaro, and Francesco Zezza. 2019. “On the Design of Empirical Stock-Flow-Consistent Models.” wp_919. Levy Economics Institute. https://ideas.repec.org/p/lev/wrkpap/wp_919.html.

Q&A

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