Review of Economics and Statistics
Fellowship for NBER 2023 Summer Institute

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University Affiliation: **University of Yaounde II and Euro Area Business Cycle Network**
Date of Ph.D. : **26 June 2013**
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Short Summary of Current Research Activity

My research activities are broadly based on microeconomics foundations of macroeconomics and developing countries' currency unions, by the means of Dynamic Stochastic General Equilibrium Models.

Summer Institute Sessions of Most Interest

- Development Economics
- Energy and Environmental Economics
- Methods Lectures
- Publics Economics
- Economics of Social Security
- Labor Studies
- Real Estate
- Gender in the Economy

Dr. Kame Babilla

CURRICULUM VITAE

LinkedIn:**www.linkedin.com/in/dr-thierry-kame-babilla-10083549/**
Personal Website:**www.eabcn.org/person/thierry-kame-babilla**
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February 25th, 2023

Born
on March 2, 1982
at Bonaberi-Douala

Contact
Address : 35185, Bastos, Yaounde
Tel:+237 699 42 92 25.

Proficiency

Macroeconomics, DSGE Models, Monetary Policy, Finance, and International Economics.

Current Positions

2020-present: **Asst Professor**, Monetary Economics Department,University of Yaounde II.
2018-present: **Fellow**, Global Labor Organization (GLO), Cologne, Germany.
2014-present: **Regional Standing Committee Member**, Econometric Society, USA.
2010-present: **Member,** Euro Area Business Cycle Network (EABCN), London, UK.

Previous Positions

2014-2017: **Lead Researcher and Principal Investigator** of the DFID-IDRC Project. The **successful outcomes of the Project** and its public policy impact led Cameroonian Authorities to commit to the creation of the National Financial Inclusion Strategy.

Panel Speaker

2017: **International Monetary Fund (IMF)**, Panel Speaker on Financial Inclusion at the Research Department Conference. The IMF Managing Director, and the IMF Eco- nomic Counsellor and Director of Research Department, deliver opening remarks on Second and on First day respectively, Washington D.C., March.

2016: **International Development Research Centre (IDRC)**, Panel Speaker on Economic Development in Low-Income Countries, Ottawa, Canada, June.

Post-Doctoral Fellowships

Winter 2020: **Visiting Research Fellow** on Dynamic Stochastic General Equilibrium (DSGE) Models and Distributed Ledger Technologies (DLT) , at the National Bank of Ukraine, Kyev, Ukraine.

Summer 2018: **Visiting Research Fellow** on Globalization, World Trade Organization (WTO) Scenarios and 21st century Trade Agreements, at the Robert Schuman Centre of Advanced Studies, at the European University Institute, Florence, Italy.

Spring 2016: **Visiting Research Fellow** on DSGE Models at University Laval, Quebec, Canada.

Winter 2015: **Visiting Research Fellow** on DSGE Models at University Laval, Quebec, Canada.

Spring 2014: **Research Fellow** on Monetary Policy and DSGE Model at OXFORD University, OXFORD, United Kingdom.

Summer 2013: **Visiting Research Fellow** on DSGE Model and External Finance at the University of Montesquieu-Bordeaux IV, Bordeaux, France.

Spring 2013: **Research Fellow** on Monetary Policy and DSGE Model at OXFORD University, Oxford, United Kingdom.

Education

January 2009-June 2013: **Ph.D in Macroeconomics and Economic Modelling** at University of Yaounde II, (PTCI scholarship), graduated with Highest Honors.
Thesis: Central Bank Mandates and Monetary Policy Strategies within African Monetary Zones.

January 2006-April 2008: **MASTER Degree in International Economics** at the University of Yaounde II, (PTCI scholarship), graduated with Highest Honors.
Dissertation: Public Debt and Private Investment in Cameroon: crowding-out effect or crowding-in effect?

October 2004-June 2005: **MASTER Degree in Money, Finance and Banking** at the University of Yaounde II, graduated in Regular Session with Highest Honors.

October 2003-September 2004: **BACHELOR Degree in Money, Finance and International Economics** at the University of Dschang.

Modelling, Empirical and Computer Skills

Theoretical Modelling Skills

Macroeconomics: Modelling Dynamic Stochastic General Equilibrium (DSGE) Models of monetary policy mandates evaluation; Modelling DSGE Models of monetary policy strate- gies assessment; Modelling DSGE Models of African Monetary Zones; Modelling multi- country DSGE Models; Modelling DSGE Models of optimal monetary policy; Modelling DSGE Models with external finance premium; Modelling DSGE Models with collateral constraints; Modelling DSGE Models of inflation dynamic; Modeling DSGE Models of exchange rates choice; Modelling Real Business Cycle Models; Modeling New-Keynesian DSGE Models; Modelling DSGE Models of fiscal policy analysis; Modelling DSGE Mod- els of structural reforms; Modelling DSGE Models of product market reforms; Modelling DSGE Models of labor market reforms; Modelling DSGE Models of free trade area.

Microeconomics: Behavior optimization of individual economic agents; Heterogeneous eco- nomic agents micro-foundation; Dynamic banking sector micro-foundation; Financial fric- tions micro-foundation; Gender frictions micro-foundation; Financial crisis forecasting and resolution; Modelling nominal and real rigidities; Modelling wages dynamic; Modeling oil prices dynamic and commodities crisis; Modelling food prices dynamic. Assessing unconventional monetary policies; Assessing monetary policy performance at the zero lower bound; Quasi-fiscal policies analysis; contingent liabilities analysis; Structural transforma- tion and productivity analysis; Trade spillover effects on some group of agents or on keys sectors.

Empirical Methods: Static and dynamic analysis of macroeconomic policies; Simulations of shocks and scenarios; Welfare analyses of macroeconomics policies; Calibration of the- oretical DSGE Models; Estimation of theoretical DSGE Models; DSGE Models forecast- ing; Performing sensitivity and identification analysis; Computing the stochastic solution; Finding steady-state with DYNARE non-linear solver; Performing deterministic simula- tions; Determining Blanchard and Khan conditions; Performing Monte-Carlo Marcov- Chain (MCMC) method; Performing Metropolis-Hasting method; Programming DSGE Models in DYNARE; Programming DSGE Models in MATLAB.

Others Econometrics Methodology

Panel Data Models: Dynamic panel data models; Fixed effects panel data models; Ran- dom effects panel data models; Random coefficients panel data models; Panel data model without specific effects and without random effects; Estimation via instrumental variables of random effects panel data models; Estimation via Generalized Moments Method (GMM) of dynamic panel data models. Estimation of robust co-variance; Estimation via within estimator of panel data model; Estimation via between estimator of panel data model; Estimation via Generalized Least Squares (GLS) Method of panel data models. Estimation via Ordinary Least Squares (OLS) Method of panel data models.

Time Series Models: Vector Auto-Regressions (VAR) models; Dynamic and Vectoriel Er- ror Correction (VEC) models; Error Correction model (ECM); ARIMA model; ARMA models; SARIMA model; ARMAX models; ARCH models; Linear ARH models; GARCH models; IGARCH models; GARCH-M models; ARCH-M models; Non-linear ARH models; TARH models; TGARCH models; EGARCH-M models; ARCH-M models.

Qualitative Variables Econometric Models: Discrete choice models; Binary choice mod- els; Bivariete Probit model; Multivariate Probit model; Logit model of multiple choices; Census data models; Limited dependent variables models; Troncature models; Censured data model; Sample selection models; Durability model; Binary Gombit model; Univariete dichotomy models.

Game Theory: Normal-form games and Nash equilibrium; Cournot model of duopoly; Bertrand model of duopoly; The problem of commons; Mixed strategies and existence of equilibrium; Stackelberg model of duopoly; Wages and sequential bargaining; Two stages games of complete but imperfect information; Subgame perfection; Bank runs;

Tariffs and imperfect international competition; Repeated games. Perfect Bayesian equilibrium in signaling games; Job-market signaling; Corporate investment and capital structure; Monetary policy; Sequential bargaining under asymmetric information; Reputation in the finitely repeated prisoners dilemma; Refinements of perfect Bayesian equilibrium.

Computer Skills

Programming: MATLAB, DYNARE, Latex, GAMS, EVIEWS, STATA, Mathematica.

Qualitative Analysis: Epi DATA, R, NVivo, Sphinx-Plus.

Operation system: Mac, Windows, Microsoft Office.

Language Skills

1. **English**: Fluent; Graduated from English Language Program, American Language Center, Yaounde, Cameroon.

2. **French**: Native Language.

3. **Spanish**: Basics.

4. **Italian**: Basics.

International Awards Nominating Committee

2019-present: **Erwin Plein Nemmers Prize in Economics**, Nominating Committee Member.

2014-present: **Central Banking International Awards**, Nominating Committee Member.

Peer Reviewer in Top Journals

1. **Economic Modelling**

2. **International Journal of Finance & Economics**

Teaching Activities

Ph.D Course:
1. Dynamic Stochastic General Equilibrium Models (Advanced, Adaptative Learning, HANK, TANK, SIR)

Master Courses:
1. Dynamic Stochastic General Equilibrium Models
2. Real Business Cycle (RBC) Models
3. Applied Microeconomics

Undergraduate Courses:
(i) Macroeconomics; (ii) Banking Theory; (iii) Computer Programming ; (iv) Mathematics ; (v) Statistics ; (vi) Operational Research; (vii) Demographics; (viii) Microeconomics.

Conferences Organizer.

2015 (October): Organizer of a **National Policy Conference** to disseminate research findings of the DFID-IDRC Project, Yaounde, Cameroon.

2015 (March): Organizer of the **Joint Executive Seminar** between the World Bank (Economists from the Washington D.C. Headquarter) and Economists of University of Yaounde II on the Memorandum of Cameroon Economy, Yaounde, Cameroon.

2014 (November): Organizer of the **Joint Executive Seminar** between the World Bank (Economists from the Washington D.C. Headquarter) and Economists of University of Yaounde II on Structural Transformation in Cameroon, Yaounde, Cameroon.

Research Communication Strategy

2014: Training on Communication Strategy to Disseminate Research Findings, Inform Policymakers, and Influence Policies, Santa Cruz de la Sierra, Bolivia.

Publications

Published:

1. " Digital innovation and financial access for small and medium-sized enterprises in a currency union". ***Economic Modelling***, 2023-01. DOI: 10.1016/j.econmod.2022.106182, January, 2nd, 2023.

2. "Bank-lending Channel of Monetary Policy Transmission in WAEMU: an Estimated DSGE Model Approach". ***International Journal of Finance & Economics***, 1-24. https : //doi.org/10.1002/ijfe.2729, November, 14th, 2022.

3. "New-Keynesian DSGE Models and Monetary Policy Modeling in Africa: A Narrative Approach",***Harmattan Paris***, (with Co-author), ISBN: 978-2-14-026724-6, p. 571- 601, June, 2022.

4. "A DSGE Model of Trade and Risk-sharing Effects of Currency Union on Economic Integration of the CFA Zone",***Palgrave Macmillan***, ISBN 978-1-137-46204- 6, p. 197-217, January, 2015.

5. "Aid Effectiveness and Selectivity in the CEMAC",***Cameroonian Economic Review***, 2017, (with Co-authors).

6. Title of Book Published: ***Public Debt and Private Investment in Cameroon***,ISBN: 978-613-1-57549-5, ***European Universities Edition***, March, 2012.

Revised and Resubmitted (R&R):

1. "Universal Basic Income Effectiveness and Implications for Long-term Growth", (R&R).

2. "Does Counter-cyclical Central Bank Green Finance offset Oil Subsidies in an Oil-dependent Currency Union?", (R&R).

3. "Macro-prudential Regulation and Crypto Optimal Selection in China: a DSGE Model of Crypto Assets", (R&R).

4. "A DSGE Model with Sector-Specific Financial Frictions in a Currency Union", (R&R).

5. "Monetary Policy Evaluation in African's Currency Union: Monte-Carlo Markov- Chain approach of a Dynamic Stochastic General Equilibrium Model", (R&R).

6. "Sovereign Wealth Funds and Oil-Dominance Currency Union: Evidence with a DSGE Model", (R&R).

7. "A Bayesian Analysis of Financial Frictions in Macroeconomic Modelling within a Monetary Union", (R&R).

Submitted (First Round):

1. "The Bank Balance-sheet Channel of Macro-prudential Policy After COVID-19 Crisis: a DSGE Model Analysis in a Currency Union facing Financial Imbalances",(Under Journal Review).

2. "Central Bank Mandate and Information Frictions in a Currency Union with Incomplete Financial Assets Market: a DSGE Model Evidence",(Under Journal Review).

3. "Macro-financial Implications of Central Bank Digital Currency: a Dynamic Stochastic General Equilibrium Model Analysis",(Under Journal Review).

4. "Migration, Frictional-Segmented Labor Market, and Monetary Policy Transmission Mechanism: a DSGE Model Approach", (Under Journal Review).

Working Papers:

1. "Food Price Volatility Implications for Trade and Monetary Policy between Nigeria and CEMAC: a two-country DSGE Model Approach", ***GTAP Working Paper 2014-06***, 2014.

2. "A DSGE Model with Gender-Specific Financial Frictions", ***Dynare Working Paper 2015-11***, 2015.

3. "Exchange Rate Policies and East Africa Monetary Union Effectiveness: Evidence with a DSGE Model of Alternatives Exchange Rates", ***SSRN Working Paper***, 2016.

4. "External Financing Premium and Macroeconomic Outcome in Nigeria", ***SSRN Working Paper***, 2016.

5. "Macroeconomics Implications of Female Entrepreneur facing Financial Frictions to Access to Credit: a DSGE Model Approach", ***PEP Working Paper 2016-02***, 2016.

Policy Papers:
1. "From Credit-constraint Female Entrepreneurs to Structural Transformation", ***PEP Impact Story***, 2016.

2. "Female entrepreneurship and financial frictions in the credit market in Cameroun", ***PEP Policy Brief MPIA No 125***, December, 2015.

Awards, Grants, Scholarships, and Honors

2023: Certificate of Publication at Economic Modelling.

2023: Certificate of Elsevier Reviewer Recognition.

2019: Nominated for the INFER Excellence Prize.

2018: Scholarship of the Academy of Global Governance.

2018: Robert Schuman Centre Certificate on 21st century Trade Agreements.

2017: IMF/DFID/Hewlett Foundation Grant: "Macro Implications of Gender Financial Frictions".

2016: DFID/IDRC Grant: "DSGE Model and Policy Making in Low-income Countries".

2015: Best Practice Awards in Macroeconomics.

2015: DFID/IDRC Grant: "Applying DSGE Model to Gender Policy".

2015: DYNARE Network/DFID/IDRC Grant:"DSGE Model with Gender Financial-Frictions".

2014: Laureate of CODESRIA Research on Social Sciences.

2014-2017: DFID and IDRC Research Project (20,000 USD).

2014: Certificate of Global Trade, Assistance, and Production Network (GTAP).

2014: World Bank Grant:"DSGE Model of Labor Market Reform and Regulation in a LICs Monetary Union".

2014: UNECA/GTAP Grant :"Food Price Implications for Trade and Monetary Policy between Nigeria and CEMAC".

2014: DFID/IDRC Grant:"DSGE Model and Development Macroeconomics".

2014: DFID Grant:"Bank-lending Channel of Monetary Transmission Mechanism in WAEMU".

2014: UNU-WIDER/World Bank Grant:"Structural Transformation and Financial Inclusion in a LICs Currency Union".

2013: Econometric Society Grant:"A DSGE Model of Monetary Policy Under Uncertainty in BEAC issuing zone".

2013: DFID Grant:"Monetary Policy Evaluation and Economic Development in Africa".

2013: French Government Grant:"A DSGE Model of External Finance Premium in a LICs Currency Union".

2013: University of Montesquieu-Bordeaux IV DSGE Modeling Testimony.

2012: IDRC Doctoral Research Award in Economics.

2010: IDRC/CODESRIA Grant:"Monetary Policy Renaissance of African Economies: a Narrative Approach".

2009: African Excellence Award in Economics for Ph.D. (PTCI).

2006: World Bank Certificate.

2005: African Excellence Award in Economics for Master (PTCI).

Presentation and Participation at International Conferences

2022: **25th Central Bank Macroeconomic Modeling Conference**, on Monetary Policy Uncertainty, The Better Policy Project and Banco de la Republica de Columbia, Columbia, November.

2022: **25th Forecasting and Policy Analysis System (FAS) Workshop**, The Better Policy Project and Banco de la Republica de Columbia, Columbia, November.

2022: **Fifteenth Annual Conference of the Association for the Study of the Middle East and Africa (ASMEA),** Washington D.C., November.

2022: **International Symposium on Pedagogic Innovation in Africa**, Yaounde, October.

2022: **International Forum on Agricultural and Rural Financing Models in Africa**, Yaounde, October.

2022: **XXIV Applied Economics Annual Meeting**, Palma de Mallorca, June.

2022: **Economic Modelling-Shandong Normal University-Queen Marry University of London Conference**, Jinan, China, May.

2022 : **Sovereign Wealth Funds and Journal of International Business Policy Annual Conference**, Dubai, United Arab Emirates, May.

2021: **The National Bureau of Economic Research (NBER) and the Shanghai Advanced Institute of Finance (SAIF) Second Biennial Research Conference**, on Real Estate Markets and Housing Finance in China, Massachusetts, Boston, May.

2020: **National Bank of Ukraine-USAID-IMF-World Bank-IFC Conference** on Central Bank Digital Currencies:New Opportunities for Payments, at the National Bank of Ukraine, Kyev, Ukraine, February.

2019: **The Global Political Economy Network (GPEN) Conference**, at the Loborough University, London, UK, April.

2019: **Georgetown Center for Economic Research (GCER) Biennial Conference**, at the Georgetown University, Washington D.C., US, May.

2019: **The 15th International Symposium on Econometric Theory and Application (SETA) Conference**, at the Graduate School of Economics, Osaka University, Osaka, Japan, June.

2019: **The INFER Annual Conference**, at the Vrije University, Brussels, Belgium, June.

2019: **The Singapore Economic Review Conference (SERC),** at the Singapore University, Singapore, August.

2018 : **New Zealand Annual Finance Meeting**, at the Auckland University of Technology, Queenstown, New Zealand, December.

2018 : **Economic Modelling special issue Conference** on Applied Finance, Macroeconomic Performance, and Economic Growth, Hangzhou, China, October.

2018 : **International Monetary Fund (IMF) Sovereign Debt Book Conference**, Washington D.C., September.

2018 : **The 5th Annual Conference of the Journal of Financial Regulation (JFR)** on New Frontiers: Technology, Finance and Regulation, Oxford University, Oxford, UK, June.

2018: **Annual Conference of International Association for Applied Econometrics (IAAE),** Montreal, Canada, June.

2018: **The Global Governance Programme Conference** on Trade in Services in the Global Economy, at the European University Institute, Florence, Italy, June.

2017: **International Monetary Fund (IMF) Conference** on Gender and Macroeconomics, at the International Monetary Fund, Washington D.C., March.

2016: **1st AFRICA TRADE FORUM**, on Continental Free Trade Area (CFTA), at the Africa Union (AU), Addis Ababa, Ethiopia, November-December.

2016: **50th Canadian Economics Association Annual Conference**, at the University of Ottawa, Ottawa, Canada, June.

2016: **Bank of Canada Conference** on Monetary Macroeconomics and Financial Economics, at the University of Ottawa, Ottawa, Canada, June.

2016: **Canadian Macroeconomics Study Group (CMSG) Conference**, on Monetary Policy Transmission, Macroeconomics and Business Cycle, at the University of Ottawa, Ottawa, Canada, June.

2016: **The Rimini Center for Economic Analysis (RCEA) Conference**, on Inflation Targeting, at the University of Ottawa, Ottawa, Canada, June.

2016: **Canadian Development Economics Study Group (CDESG) Conference**, on Economics of Welfare and Development Macroeconomics, at the University of Ottawa, Ottawa, Canada, June.

2016: **Canadian International Trade Study Group (CITSG) Conference,** on International Finance, Trade, and Exchanges Rates, at the University of Ottawa, Ottawa, Canada, June.

2016: **Canadian Experimental and Behavioral Economics Research Group (CEBERG) Conference**, on Macro, Preferences, and Markets, at the University of Ottawa, Ottawa, Canada, June.

2016: **Canadian Labor Economic Forum (CLEF)**, on Wages, Employments, and Demographic Economics, at the University of Ottawa, Ottawa, Canada, June.

2016: **Canadian Public Economics Group (CPEG) Conference**, on Ageing, Taxation and Fiscal Policy, at the University of Ottawa, Ottawa, Canada, June.

2015: **11th DYNARE-National Bank of Belgium-Banque de France Conference**, on DSGE Models, (Chair of Financial Frictions Session), Brussels, Belgium, September.

2015: **The Econometric Society annual Conference**, on Advances in Econometrics versus policy Challenges, Lusaka, Zambia, July.

2015: **The 21st International Conference on Computing in Economics and Finance (CEF 2015)**, AI-ECON Research Center, Department of Economics, National Chengchi University, Taipei, Taiwan, June.

2015: **World Bank Technical Seminar** on the Presentation and Discussion of Preliminary Findings and Recommendations of Economic Analysis within the framework of the Memorandum of Cameroon Economics, Yaounde, Cameroon, May.

2015: **Jonkoping University and University of Rwanda Conference** on Economic Development, Finance and Management Research in Eastern Africa, Kigali, Rwanda, May.

2015: **LAVAL University, Applied Economics Conference**, Quebec, Canada, February.

2014: **AERC Collaborative Research Workshop** on Financial Sector Reforms in Africa, Nairobi, Kenya, March.

2014: **OXFORD University, Center for the Study of African Economies (CSAE) annual Conference** on Economic Development in Africa, Oxford, UK, March.

2014: **World Bank Worksho**p, for the preparation of The 2015 World Bank Africa Re- port, OXFORD University, Oxford, UK, March.

2014: **5th Euro-African Conference** in Finance and Economics, Agadir, Morocco, April.

2014: P**EP Annual Conference** on Fostering Entrepreneurship for Inclusive Growth and Poverty Reduction, Santa Cruz de la Sierra, Bolivia, May.

2014:**AERC Biannual Research Workshop** on Public Finance: Tax and Expenditure Reforms in Africa, Accra, Ghana, June.

2014: **17th GTAP-UNECA-AGRODEP annual Conference** on Global Economic Analysis, Dakar, Senegal, June.

2014: **UNU-WIDER Development Conference** on Institutional Reforms for Trans- formation, Inclusion, and Sustainability, Hanoi, Vietnam, June.

2014: **African Econometric Society (AES) 19th annual Conference** on Econometric Analysis and Policy Challenges in Africa, Addis Ababa, Ethiopia, July.

2014: **CODESRIA Research Workshop** on Fields and Theories of the Qualitative Survey, Yaounde, Cameroon, August.

2014: **World Bank-DFID-Columbia University-Cornell University Conference** on Markets, Labor and Regulation, New Delhi, India, December.

2013: **OXFORD University, CSAE annual Conference** on Economic Development in Africa, Oxford, England, March.

2013: **World Bank Workshop**, for the preparation of The 2014 World Development Report (WDR), OXFORD University, Oxford, UK, March.

2013: **AES 18th annual Conference** on Econometric Analysis and Policy Challenges in Africa, held in Accra, Ghana, July.

2013: **African Economic Conference 8th annual Conference** on Regional Integration in Africa, held in Johannesburg, South Africa, October.

2012: **2nd International Symposium** in Economics and Finance, Tunis, Tunisia, March.

2011: **Second Congress of African Economists**, in Abidjan, Ivory Coast, November.

2010: **CODESRIA Annual Conference** on the Renaissance and Revival of African Economies, Dar es Salem, Tanzania, December.

2006: **World Bank Workshop,** on Banking,Youth Employment and Governance, World Bank Cameroon Country Office, Yaounde, Cameroon, February.

Chair Person, Discussant, and Dissertation Supervisor

2022: **Discussant** of the paper: "Industry and Regulatory Outlook for Fintech in Australia", Economic Modeling-Shandong Normal University-Queen Marry University of Lon- don Conference, Jinan, China, May.

2016: **Discussant** of the paper: "Oil, Metals and Minerals: World Prices and Quebec Regions", 50th CAE Annual Conference, University of Ottawa, Ottawa, Canada, June.

2015: **Chair**, Financial Frictions Session, 11th DYNARE-National Bank of Belgium-Banque de France annual Conference on DSGE Models, Brussels, Belgium, September.

2013-2014: **Dissertation supervisor** (second reader) on: Public Debt and Private In-vestment: a Non-linear Approach. CERDI, Clermont School of Economics, University of Auvergne (France), Magistere in Economic Development.

2014: **Chairperson,** Defense Jury of Professional Master end of academic training Dissertations, Yaounde-Cameroon, February.

2014: **Conference Discussant**, UNU-WIDER Development Conference on Institutional Reforms for Transformation, Inclusion, and Sustainability, Hanoi, Vietnam, June.

2014: **Conference Discussant**, World Bank-DFID-Columbia University-Cornell University Conference on Markets, Labor and Regulation, New Delhi, India, December.

2014: **Discussant** of the paper: "The Effect of Monetary Policy on Prices in Nigeria: a FAVAR Modelling Approach", CSAE Annual Conference, Oxford, England, March.

2014: **Discussant** of the paper: "Trade Liberalization and Employment Effects in Indian Manufacturing: An Empirical Assessment", Annual PEP Conference, Bolivia, May.

2014: **Discussant** of the paper: "Determinants of Short Term Foreign Debt in Ghana", AERC Biannual Research Workshop, Accra, Ghana, June.

2013: **Discussant** of the paper: "Monetary Transmission Mechanism in the EAC: An Empirical Investigation", CSAE Annual Conference, Oxford University, England, March.

Grants Project

Department for International Development (DFID) of the United Kingdom (or UK Aid) and the International Development Research Centre (IDRC) of Canada: *PEP MPIA 12617 Project, Principal Investigator, 2014/2017.*
Project Title: "Macroeconomic implications of female entrepreneurs facing financial fric- tions to access to credit: A DSGE model approach in Cameroon".

Project Achievement

From June 2014 to June 2017, I served as Lead Research Fellow of the Partnership for Economic Policy (PEP), a renowned Think-thank in the studies of economic development.

My responsibilities was to lead my team on the research on Macroeconomics Implications of Female Entrepreneur facing Financial Frictions to Access to Credit; design a DSGE model conducive in the resolution of the structural problem; provide policy recommendations for policymakers and donors; mentor junior staff by strengthening capacity building in DSGE modeling for the study of economic development; and finally inform policymakers by permanently interacting with Cameroonian and CEMAC officials, stakeholders, civil society, private sector, as well as, international organizations officials.

The findings and recommendations of the research help the team to directly assist in the preparation of the Memorandum of the Cameroon Economy. This Memorandum was then submitted officially by the World Bank to the Higher Cameroonian Authority. Because of the keen interest of the research, my team was the only local experts invited to participate in a special high-level advisory meeting, co-organized by World Bank Mission in Central Africa and Cameroon Authorities, to discuss the adoption of policies and measures to pro- mote development in Cameroon and achieve the country's emergence by 2035.

Actually, the output of the research comprises, **3 Working Papers, a Policy Impact Story, a Policy Brief, and a Final report**. Nationally, I organized a National Policy Conference, as well as many Executive Seminars and Consultations. At the international level, the research results have been presented at **6 leading International Conferences.** The research has been awarded the Best Practice Award in Development Macroeconomics.

As for Public Policy Impact Action, the successful outcomes of this project led Cameroonian authorities to commit on January 2018 to the creation of the **National Financial Inclusion Strategy,** which aims at easing financial constraints to Small and Medium Size Enterprises (SME), especially those managed by female entrepreneurs.'

Previous Experience

2016: **Research Expert** on Trade in Africa (Advancing Socio-Economic Structural Trans- formation through Intra-Africa Trade), at the African Union (AU), Addis Ababa, Ethiopia, November-December.

2010: **Economist**, International Transport Department (ADC), Ministry of Transport, Yaounde, Cameroon.

2006: **Economist**, World Bank Campus Project, World Bank Mission to Central Africa, Yaounde, Cameroon.

ZOOM-Webinar International Conferences Participation

2023: **Conference in Honor of Guillermo Calvo**, on The Credibility of Government Policies, NewYork FED and Columbia University SIPA, February 22-24.

2022: **Conference in Honor of Maurice Obstfeld**, International Monetary Fund (IMF) 23rd Jacques Polak Annual Research Conference, on The Global Economy: Looking Back, Moving Forward,Washington DC, November 10-11.

2021 : **The Rimini Center for Economic Analysis (RCEA) 2021 Webinar Series**, on Financial Conditions, Rising Leverage, and Risks to Macro-Financial Stability, by Adolfo Barajas, September 23.

2021 : **The World Moskowitz 2020 Prize Research Conference**, on Impact and Sustainable Finance, Northwestern University, September 22.

2021 : **The World Finance Conference**, University of Agder, Kristiansand, Norway, August 3-6.

2021: **The 2021 Global Finance Conference (GFC)**, Global Finance Association (GFA), May 27-28.

2021: **The Journal of International Money and Finance (JIMF) and the Global Research Unit Conference**, on Globalization and De-globalization, May 3-4.

2021: **The African Union Commission (AUC) and the Africa Training Institute (ATI) of the International Monetary Fund (IMF) joint-Conference**, on The Macroeconomics of Climate Change, April 28.

2021: **The 2021 Center for European Studies (CefES)-JRC Webinar Series**, on COVID-19 and Global Income Inequality, by Nobel Prize Laureate Sir Angus Deaton, March 22.

2021: **International Monetary Fund (IMF) and the Institute for Monetary and Financial Stability (IMFS) Conference**, on Negative Interest Rates : Taking Stock on The Experience So Far, March 3.

2021: **The Rimini Center for Economic Analysis (RCEA) 2021 Webinar Series**, on Monetary and Macroprudential Policy with Endogenous Risks, by Tobias Adrian, January 28.

2020: **Petterson Institute for International Economics (PIIE) Conference**, on A Reconsideration of Fiscal Policy in the Era of Low Interest Rate, by Jason Furman, 1st December.

2020: **The Federal Reserve Bank of Dallas Global Perspectives Conference,** on The Taylor Rule, Accommodative Policy, Low Interest Rates and Expanded Central Bank Mandates, by John Taylor, November 24.

2020: **The 2020 Dallas and Kansas City Federal Reserve Bank's Energy and The Economy Conference**, November 20.

2020: **The Center for Monetary and Financial Alternatives (CATO CMFA) 38th Annual Monetary Conference**, on Digital Currency, November 19.

2020: **Petterson Institute for International Economics (PIIE) Conference**, on Trade and COVID-19 Pandemic, featuring Adam Posen, Chad Bown, Ngozi Okonjo-Iweala, Arancha Gonzalez, November 16.

2020: **The Institute of International Monetary Research (IIMR) 2020 Annual Conference**, on Modern Central Bank and The Covid-19 Pandemic, October 28.

2020: **The 6th Annual Money Macro and Finance Society (MMF) Policy Conference,** October 19-23.

2020: **The Florence School of Banking and Finance, of European University Institut**e, 2020 Distributed Inter-discipline Sovereign Debt Research and Management Conference (D-DebtCon), October 8-14.

2020: **The 2020 Nobel Prize Teacher Summit,** on How Education is Impacted by Migration and What Teachers Can do for a Sustainable Future, October 9.

2020: **Petterson Institute for International Economics (PIIE) Conference**, on Fiscal Policy, Sovereign Debt, and The COVID-19-led Recession, by Maurice Obstfeld, October 1st.

2020: **Petterson Institute for International Economics (PIIE) Conference**, on The Presentation of the Book titled: "The Great Demographic Reversal: Ageing Societies, Waning Inequality, and an Inflation Revival", by Adam

Posen, Manoj Pradhan, and Charles Goodhart, September 24.

2020: **The Harvard University' 2020 Global Empowerment Meeting (GEM20) Special Conference** celebrating the 2019 Nobel Laureates in Economics, by Ester Duflo, Abhijit Banerjee, Michael Kremmer, and Murey Gibss, September 23.

2020: **International Monetary Fund (IMF) Value Added Tax (VAT) Conference**, on The VAT Experience:What Have We Learned In The Last 20 Years?, September 23. 2020: The European University Institute 2020 World Trade Forum, on The Fu- ture of Trade Policy and External Cooperation, September 22-23.

2020: **The 3rd International Monetary Fund (IMF) Annual Macro-Financial Research Conference**, September 15-16.

2020: **European University Institute (EUI), Florence School of Banking and Finance Annual 2020 Conference**, on Sovereign Debt, September 8-14.

2020: **Columbia University-SIPA Conference**, on Race, Protest, and Global Economic Inequalities, by Nobel Prize Laureate Joseph Stiglitz, and Thomas Piketty, September 10. 2020: The 2020 CATO Summit, on Financial Regulation, September 9.

2020: **Petterson Institute for International Economics (PIIE) and The Federal Reserve Board System Conference**, on The FED's New Statement on Longer-run Goals and Monetary Policy Strategy, by Richard Clarida, September 4.

2020: **Money Macro and Finance Society (MMF) 51st Annual Conference**, on Monetary Policy and Finance, September 1-3.

2020: **The 2020 Bruegel Annual Meetings**, on Monetary Policy After The COVID-19 Pandemic, September1-3.

2020: **Brookings Institute of Political Economy Panel,** on How the FED will Re- spond to the COVID-19 Pandemic in an Era of Low Rates and Low Inflation, featuring, Janet Yellen, Ben Bernanke, Roberto Pelli, Julia Coronado, Lael Brainard, and David Wessel, 1st September.

2020: **The 2020 Jackson Hole and the Federal Reserve of Kansas City Economic Policy Symposium** on Navigating the Decade Ahead:Implications for Monetary Policy, August 27-28.

2020: **Petterson Institute for International Economics (PIIE) Conference**,on Financial Statement:Challenges and Opportunities for Financial Technology,Regulation,and Super Technology,by Stanley Fisher, Bernard Coeure, and Nicholas Veron,August 19.

2020: **International Association of Applied Econometrics (IAAE) and Cambridge University Conference**, on Modelling The COVID-19 Pandemic, by Olivier Linton, August 12.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**,on COVID-19:A View from Outside The Industrialized Word,by Raghuram Rajan,July 24.

2020: **International Association of Applied Econometrics (IAAE) and Federal Reserve Bank of Dallas Conference** , on Joint Bayesian Inference About Impulse Re- sponses in VAR Models, by Lutz Kilian, July 15.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on Narrative Economics and COVID-19, by Nobel Prize Laureate Robert Shiller, July 10.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on Tracking The Global Pandemic Economy, by Michael Spence, July 6.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on Corporate Debt Overhang and COVID Credit Policy, by Arvind Krishnamurty, June29.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**,on Understanding ECB's Pandemic Emergency Purchase Program, by Philip Lane, June 22.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**,on COVID-19:Can Supply Shocks Cause Demand Shortages?,by Veronica Guerrieri,June 19.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference,** on The Economic Impacts of COVID-19: Real-time Evidence from Private Sector Data, by Raj Chetty, June 15.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on Global Sovereign Debt and the Dollar Post-COVID, by Kenneth Rogoff, June 12.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference,** on The Economic and Social Implications of Racial Disparities, by Lisa Cook, June 8.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on Redesigning The US Treasury Market, by Darrell Duffie, June 5.

2020: **Macroeconomic Modelling and Model Comparison Network (MMCN) Conference**, on Health vs. Wealth ; On the Distributional Effects of Controlling an Epidemic, by Dirk Krueger (jointly with Andrew Glover, Jonathan Heathcote and Jose-Victor Rios-Rull), June 3.

2020: **Virtual Macro Seminar**, on Uncertainty-induced Reallocations and Growth, by M. Croce, and S. Rosen, June 1st.

2020: **Search and Matching in Macro and Finance (SaMMF) Conference**, by Ricardo Lagos, June 1st.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on The Great Lockdown Through The Lens of The IMF, by Gita Gopinath, May 29. 2020: The Economica-Phillips Lecture, on Capital Flow Cycles: A Long Global View, delivered by Carmen Reinhart, at the London School of Economics, May 28.

2020: **Macroeconomic Modelling and Model Comparison Network (MMCN)Conference**,on The Corona Stimulus Package:How Large is The Transfer Multiplier?,by Gernot Mulller (jointly with Christian Bayer, Benjamin Born, Ralph Luetticke),May 25.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on COVID-19 and The Global Economy, by Larry Summers, May 22.

2020: **Macroeconomic Modelling and Model Comparison Network (MMCN) Conference**, on Social Distancing and Supply Disruptions in a Pandemic, by Luca Guerrieri (jointly with Martin Bodenstein and Giancarlo Corsetti), May 21.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on COVID-19 and Reopening the Economy, by John Cochrane, May 18.

2020: **Macroeconomic Modelling and Model Comparison Network (MMCN) Conference**, on The Global Macroeconomic Impacts of COVID-19:Seven Scenarios, by Warwick McKibbin (jointly with Roshen Fernando), May 18.

2020: **Harvard University and MIT Conference**, on 1918 Flu, by Robert Barro, May 15.

2020: P**rinceton University Bendheim Center for Finance Conference**,on The Audacity of Slope: How Fast a Recovery?,by Nobel Prize Laureate Paul Krugman,May 15.

2020: **Petterson Institute for International Economics (PIIE) and The Federal Reserve Board System Conference**, on The FED's New Monetary Policy Strategy, by Jerome Powell, May 13.

2020: **Macroeconomic Modelling and Model Comparison Network Conference**, on The COVID-19 Pandemic in the EU:Macroeconomic Transmission and Economic Policy Response, by Werner Roeger (jointly with Jan Veld and Philipp Pfeiffer), May 13.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on An Evaluation of the FED-Treasury Credit Programs, by Jeremy Stein, May 11.

2020: **Macroeconomic Modelling and Model Comparison Network (MMCN) Conference**, on Strategies for Controlling the Medical and Socio-economic Costs of The Corona Pandemic, by Daniel Gros (jointly with Claudius Gros, Roser Valenti, Killian Valenti), May 11.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on The Benefits of Targeted COVID-19 Policies, by Daron Acemoglu, May 8.

2020: **Macroeconomic Modelling and Model Comparison Network (MMCN) Conference**, on The Macroeconomics of Epidemics, by Mathias Trabandt (jointly with Martin Eichenbaum, Sergio Rebelo), May 6.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference,** on The Future of Globalization After the COVID-19 Crisis, by Dani Rodrik, May 4.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference,** on Encouraging Development and Manufacturing of Vaccines and Diagnostics, by Nobel Prize Laureate Michael Kremer, May 1st.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on The US Response to COVID-19, by Nobel Prize Laureate Joseph Stiglitz, April 27.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on Debt Monetization and Lessons From War Financing, by Harold James, April 24.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on International Capital Flows to Emerging Market Economies and Original Sin Reflux, by Hyun Song Shin, April 20.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on What COVID-19 Means for Inequality and Deaths of Despair, by Nobel Prize Laureate Angus Deaton, April 13.

2020: **Princeton University Bendheim Center for Finance Conference,** on What It Will Take To Save The Economy from COVID-19, by Olivier Blanchard, April 6.

2020: **Princeton University Bendheim Center for Finance (BCF) Conference**, on Evaluating US Financial Liberalization Measures for COVID-19, by Markus Brunnermeier and Nellie Liang, March 26.

Research Affiliations

Member of the **Academy of the Global Governance**;
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Sovereign Wealth Funds and Oil-Dominance Currency Union: an Opportunity for Global Financial World or a Threat for both Host Economy and Home Economy ?

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Abstract

The global financial cycle and the macroeconomic stabilization effects of sovereign wealth funds (SWFs) are theoretically and empirically unsettled. This paper features simultaneously the global financial crisis, the oil crisis, and the COVID-19 crisis, to assess the effectiveness of sovereign wealth funds in fostering global financial cycle stabilization on the one hand, and macroeconomic stabilization of an oil-dominance currency union on the other hand. To address this ongoing debate, we developed a Multiple-Crises Dynamic Stochastic General Equilibrium (DSGE) Model that disentangles five types of sovereign funds, such as stabilization sovereign wealth fund, savings sovereign wealth fund, reserve investment sovereign wealth fund, development sovereign wealth fund, and pension reserve sovereign wealth fund. Our results reveal heterogeneity in the effects of sovereign wealth funds. Saving and pension reserves SWFs by improving the efficiency of global asset allocation, having a better stabilizing impact on output and the global financial cycle. Stabilization SWFs, in contrast, have better stabilization effects on inflation, notably oil inflation, as well as the global financial cycle. Nevertheless, investment and development SWFs, while having better stabilizing impacts on investment, exert destabilizing effects on the global financial cycle as they are unable to minimize the distortions of large and volatile oil prices and address sovereign contingent liabilities.

JEL Codes: E12, E52, G11, G15, F21, F34, F44, F45, H54, Q34, Q43.

Keywords: Global Financial Cycle Stabilization, Macroeconomic Stabilization, DSGE Model, Stabilization Sovereign Wealth Fund, Savings Sovereign Wealth Fund, Pension Sovereign Wealth Fund, Investment Sovereign Wealth Fund, Development Sovereign Wealth Fund, Oil-Dominance Currency Union, Global Financial Crisis, Oil Crisis, Covid-19 Crisis.

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1 Introduction

Sovereign wealth funds are among the most important players in global financial markets and represent a means of inter-generational wealth redistribution for resource-rich countries that own them. They are often used to provide long-term macroeconomic stability and to safeguard financial assets. Indeed, they can have a long-term stabilizing influence on liquidity and international financial markets while also promoting, in turn, higher economic growth and low inflation in the home economy. The global financial and oil price crises, and recently the COVID-19 crisis, revealed this prominent status due to the involvement of sovereign wealth funds during these crises (Baker and Boatright, 2010; Betbèze, 2009; Butt et al., 2008; Das, 2009; Keller, 2008; Makhlouf, 2010; Alhashel, 2015; Frankel, 2018; Dixon, 2020; Wurster and Schlosser, 2021).

Basically, the global financial crisis saw large investments by sovereign wealth funds (SWFs) made into some of the largest financial firms in the world.[1] This is supported, for example, by the very significant capital injections the SWFs made into various United States financial institutions during the early stages of the financial crisis. In emerging market economies, the global financial crisis offered an opportunity for sovereign wealth funds to raise their participation and invest more. For instance, in the second half of 2010, more than half of publicly reported direct investments by sovereign wealth funds occurred in the Asia-Pacific region, including Brazil, Russia, and India. In low-income countries, as several wealth funds have emerged, domestic investments have comprised increasing portions of their portfolios, leading to increased total investment in these markets (Aslund, 2007; Aizenman and Glick, 2007; Balding 2008; Truman 2008; Devlin and Brummitt, 2007; Balin 2008; Gieve, 2009; Dyck and Morse, 2011; Anderloni and Vandone, 2012; In, Park, Ji, and Lee, 2013; Faria-e-Castro, 2018; Gyeyir, 2019; Markowitz, 2020)

The oil crisis revealed sovereign wealth funds' benefits in enabling commodity exporting economies to diversify their income sources. This strategy proved especially useful when global commodity prices fell abruptly in 2009 and 2014–15. In fact, income source diversification allows the minimization of risk and does not leave developing economies completely exposed to the volatilities of commodities prices. Basically, countries whose exports are relatively concentrated on oil experience terms of trade that are highly volatile, notably those that share the same currency. This volatility is one of the possible explanations for the proposition of sovereign wealth funds as a financial instrument to help countries manage commodity volatility and help make sure that commodity wealth is a blessing. Thus, many resource-rich countries have created sovereign wealth funds in order to deal with the pro-cyclical expenditure associated with oil revenues. In addition, resource-rich developing countries such as Angola and Nigeria have established SWFs with an expanded

[1] Specifically firms such as Citicorp and Merrill Lynch.

role as national investors. Because investing SWFs locally allows governments to use them to attract private investors and strengthen infrastructure investment, all while contributing to national wealth (Mendoza 1997; Hausmann and Rigobon 2003; Kaminsky et al. 2005; Blattman and Williamson 2007; Poelhekke and van der Ploeg 2007; Beck and Fidora, 2008; Aghion et al., 2010; Urban, 2011; Frankel 2012; Wills et al. 2016; Venables and Wills 2016; Brueckner and Carneiro 2016; Amoako-Tuffour, 2016; Ackah, 2021).

The COVID-19 crisis exposed unprecedented challenges for SWFs held by the global financial market. With the provision of stimulus plans, the tapping of reserve funds and new bond issues came as optimal responses to maintain stability. In fact, SWFs, as state-owned investment funds, are usually created using balance of payment surpluses, often from resource exports or the sale of public assets. Given that they are among a few widely-used financial mechanisms created for the benefit of future generations, they have the potential to play an important role in helping to achieve the stability of global financial markets during pandemic turmoil. In an environment with a need for high investment to drive economic recovery, the role of these instruments is more important than ever before.[2] In an oil-dominance currency union, sovereign funds were called on to stabilize rapidly depleting resources even as member governments scrambled to find other available funding to backstop the economic and financial impacts of the crisis. As a result, from July 2019 through September 2020, the largest and most endowed sovereign wealth funds once again dominated SWF direct investments (Acemoglu et al., 2020; Alon et al. 2020; Avery et al. 2020; Baqaee and Farhi 2020; Chetty et al. 2020; Eichenbaum et al. 2020; Goldberg and Reed, 2020; Guerrieri et al., 2020; Ngozi Okonjo-Iweala et al., 2020; Schena et al., 2020).

Nonetheless, sovereign wealth funds have recently piqued the interest of many experts due to a shift in their characteristics from riskless assets and debt instruments to more risk-return profile assets.The main concern is that changes in the asset allocations of SWFs as a result of the multiple crisis would destabilize international financial markets and lead to macroeconomic instability in the home economy.

This paper aims to address the theoretical and empirical unpredictability of the global financial cycle and the macroeconomic stabilization effects of sovereign wealth funds. The paper will contribute to filling the void and extending the nascent literature about these financial instruments by asserting that sovereign wealth funds can be leveraged not only to stabilize the global financial cycle but also for macroeconomic stabilization in an oil-dominance currency union, following three major different crises, including the global financial crisis, the oil crisis, and the COVID-19 crisis.

[2]According to Sovereign Wealth Fun Institute, for the first time in history SWF surpassed the UDS 9 trillion dollars barrier in assets under management during the COVID-19 crisis.

2 The State of Sovereign Wealth Funds

Sovereign Wealth Funds are state-owned investment vehicles that invest globally in various types of assets ranging from financial, to real, and to alternative assets.[3] These investment vehicles are usually funded by commodity export revenues or the transfer of assets directly from official foreign exchange reserves. The Norwegian Government Pension Fund is the largest sovereign wealth fund in the world.[4] Second is China's Investment Cooperation fund.[5] Indeed, most of the assets of various SWFs are tied up in stocks, bonds, and real estate in the global financial markets.[6] At the same time, specific financial contracts are structured so as to hedge risk. Practically, sovereign wealth funds can be classified into five groups (Butt et al., 2008; Truman, 2009; Dewenter et al., 2010; Knill et al., 2012; Alhashel, 2014; Sovereign Wealth Fund Rankings, 2020). [7]

2.1 The Stabilization Sovereign Wealth Fund

The first group of SWFs represents the stabilization sovereign wealth fund. The stabilization fund's role is to protect the domestic economy against commodity price swings and external shocks. The list of stabilization funds includes Kiribati Revenue Equalization Reserve Fund (1956), Nauru Phosphate Royalties Trust (1968), Tuvalu Trust Fund (1987), Colombia Oil Stabilization Fund (1995), Venezuela Stabilization Fund (1998), Azerbaijan State Oil Fund (1999), Iran Oil Stabilization Fund (1999), Peru Fiscal Stabilization Fund (1999), Algerian Revenue Regulation Fund (2000), Sudan Oil Revenue Stabilization Account (2002), Russia Oil Stabilization Fund (2004), Timor Leste Petroleum Fund (2005), Mauritania National Fund for Hydrocarbon Reserve (2006), Chilean Economic and Social Stabilization Fund (2007), Trinidad and Tobago Heritage and Stabilization Fund (2007), Chad Revenue Management Plan (2008), Turkmenistan Stabilization Fund (2008), and Mongolia Fiscal Stability Fund (2011). (Arrau and Claessens, 1992; Clemente et al., 2002; Mattoo and Subramanian, 2009; Merlevede et al., 2009; Mezzacapo, 2009; Caner and Grennes, 2010; Sinnott et al., 2010; Truman, 2010; Bagattini, 2011; Sun and Hesse, 2011; Urban, 2011).

[3] The term sovereign wealth funds was coined by Rozanov (2005) in his work "Who Holds the Wealth of Nations?".

[4] According to data from the SWF Institute, the fund contained more than USD1.1 trillion as of January 2021.

[5] It manages a similarly large amount of assets of just above USD1 trillion, according to data of SWF Institute as of January 2021.

[6] In the United States, their principal host country, with a share of more than 90% invested, sovereign wealth funds remain the largest single investors in its financial institutions.

[7] The number into bracket is the creation date of the specific sovereign wealth funds.

2.2 The Savings Sovereign Wealth Fund

The second group stands for the savings sovereign wealth fund. The savings funds are designed for natural resources income redistribution from current to future generation. Effective savings funds are Kuwait Investment Authority (1953), New Mexico State Investment Council (1958), Permanent Wyoming Mineral Trust Fund (1974), Singapore Temasek Holdings (1974), Abu Dhabi Investment Corporation (1976), USA Alaska Permanent Fund (1976), Canada Alberta Heritage Fund (1976), Brunei Investment Authority (1983), Government Investment Corporation of Singapore (1991), Botswana Pula Fund (1993), Malaysia Khazanah Nasional Berhad (1993), Gabon Sovereign Fund (1998), Fund for Future Generation of Equatorial Guinea (2002), Qatar Investment Authority (2005), Bahrain Future Generations Reserve Fund (2006), Libya Investment Authority (2007), Ghana Petroleum Fund (2011) and Panama Sovereign Wealth Fund (2012)(Fasano, 2000; Jeffrey et al., 2001; Rose, 2008; Shih, 2009; Fawcett, 2013; Miceli, 2013; Dewenter and Malatesta, 2010).[8]

2.3 The Reserve Investment Sovereign Wealth Funds

The third group considers the outlook for sovereign wealth funds that invest in reserves.The reserve investment funds aim at managing foreign exchange reserves by allocating assets to higher yielding investments, such as equities and alternative instruments. Operational reserve investment funds are Kuweit General Reserve Fund (1960), Oman State General Reserve Fund (1980), Government of Singapore Investment Corporation (1981), International Petroleum Investment Company (1985), Mubadala Investment Company (2002), Korea Investment Corporation (2005), Ras Al Khaimah Investment Authority (2005), Investment Corporation of Dubai (2006), Oman Investment Fund (2006), Indonesia Government Investment Unit (2006), China Investment Corporation (2007), Emirates Investment Authority (2007), Abu Dhabi Investment Council (2007), France Strategic Investment Fund (2008), Russia Reserve Fund (2008), Italy Strategic Fund (2011), North Dakota Legacy Fund (2011), Kazakhstan National Investment Corporation of National Bank (2012), and Western Australian Future Fund (2012), and Western Australian Future Fund (2012)(Hartwick,1977; Chhaochharia and Laeven, 2008; Plotkin, 2008; Avendano and Santiso, 2009; Kunzel et al., 2010; Raymond, 2010; Sojli and Tham, 2011; Anderloni and Vandone, 2012; Knill et al, 2012; Al-Hassan et al., 2013; Bernstein et al., 2013; Bortolotti

[8]Kuwait Investment Authority was one of the first sovereign wealth funds created in 1953.

et al., 2013; Johan et al., 2013; Lee and In, 2013; Megginson et al., 2013).[9]

2.4 The Development Sovereign Wealth Funds

The fourth group denotes development sovereign wealth funds. The development funds are organized to achieve various domestic or foreign socio-economic objectives, namely infrastructure. Among the development funds are the Louisiana Education Quality Trust Fund (1986), Kazakhstan National Oil Fund (2000), Iraq Development Fund (2003), Vietnam State Capital Investment Corporation (2005), China-Africa Development Fund (2007), Saudi Arabia Public Investment Fund (2008), Iran National Development Fund (2011), Nigeria Sovereign Investment Authority (2011), Papua New Guinea SWF (2011), Russian Direct Investment Fund (2011), and Fund Soberanu de Angola (2012)(Kalyuzhnova, 2006; Chhaochharia and Laeven, 2008; Raymond, 2008; Truman, 2008; Fernandes, 2009; Dewenter et al., 2010; Kotter and Lel, 2011; Sojli and Tham, 2011; Dixon and Monk, 2011; Knill and Mauck, 2012; Lee and In, 2013; Bortolotti and Megginson, 2013; Bertoni and Lugo, 2014; Gelb et al., 2014; Hove, 2016).

2.5 The Contingent Pension Reserve Sovereign Sealth Funds

The last group concerns contingent pension reserve sovereign wealth funds. The pension reserve funds' objective is to cover upcoming pension costs or finance government pension funds. Korea National Pension Service (1988), Norway Government Pension Fund (1990), China National Social Security Fund (2000), Ireland Oil Stabilization Fund (2001), New Zealand Superannuation Fund (2003), Australian Future Fund (2006), Chilean Pension Reservation Fund (2006), Japan Government Pension Investment Fund (2006), Kazakhstan Samruk-Kazyna JSC (2008), and Russia Welfare Fund (2008) are among the pension reserve funds (Jen and Miles, 2007; Jen, 2007; Beck and Fidora, 2008; Reisen, 2008; Klein and Zur, 2009; Dyck and Morse, 2011; Bertoni and Lugo, 2014; Boubakri et al., 2011; Boubakri et al., 2016;).[10]

[9]The Sovereign Wealth Fund Institute estimates that the world second largest SWFs is the China Investment Corporation

[10]The Sovereign Wealth Fund Institute estimates that the world largest SWFs is Norway's Government Pension Fund

3 The DSGE Model of Sovereign Wealth Funds

3.1 Households

The representative households derives utility from consumption C_t and leisure $1 - N_t$, by maximising an inter-temporal utility function given by:

$$Max_{U_0} E_0 \sum_{t=0}^{\infty} \beta^t u\Big(log(C_t - hC_{t-1}) - N_t^{1+\eta}/(1+\eta)\Big), \tag{1}$$

Here $0 < \beta < 1$ stands for the subjective discount factor, N_t represents the household's labor effort, E_0 is the conditional expectations operator, hC_{t-1} denotes an external habit which is assumed to be proportional to aggregate past consumption and η is the intertemporal elasticity of labor.

The BEAC issuing Zone's oil dominance feature affects the household labor effort supply decision. Household has the privilege to supply labor effort either in the non-oil sector or in the oil sector. Total labor effort is thus expressed, by Constant Elasticity of Substitution (CES) aggregator of hours worked in the two sectors as follow:

$$N_t = \Big[(1-\theta_n)^{1/\tau_n}(N_{g,t})^{\tau_n - 1/\tau_n} + \theta_n^{1/\tau_n}(N_{o,t})^{\tau_n - 1/\tau_n}\Big]^{\tau_n/\tau_n - 1}, \tag{2}$$

Here θ stands for the steady-state share of the work done in oil sector, τ_n denotes the elasticity of substitution between the two kind of labor supply, $N_{g,t}$ represents hours worked in the non-oil sector while $N_{0,t}$ is the hours worked in the oil sector.

At time t, households purchase assets denominated in foreign currency B_t^* which pay one unit of foreign currency at the end of period with a foreign gross nominal interest rate R_t^*. Likely, they also purchase at time t government bonds denominated in domestic currency B_t, which pay one unit of domestic currency at the end of period with a domestic nominal gross interest rate R_t. In addition, households benefit from transferts T_t^G from government, and profits T_t^o from oil sector.

The representative household is subject to an intertemporal budget constraint:

$$\begin{aligned} P_t C_t + \frac{B_{t+1}}{R_t} + \frac{Z_t B_{t+1}^*}{R_t^* \Psi} + P_t I_{g,t} + P_t I_{o,t} &= W_{g,t} N_{g,t} + W_{o,t} N_{o,t} + B_{t-1} + Z_t B_{t-1}^* \\ &\quad + P_t q_{g,t} K_{g,t} + P_t q_{o,t} K_{o,t} + T_t^G + T_t^o, \end{aligned} \tag{3}$$

Here P_t represents the aggregate price index, $I_{g,t}$ and $I_{o,t}$, are investments in the non-oil sector and in the oil sector respectively, $W_{g,t}$ and $W_{o,t}$ are nominal wage rates in the non-oil sector and in oil the sector respectively, $q_{g,t}$ and $q_{o,t}$,are the real rental rates of capital in the non-oil sector and in the oil sector respectively, $K_{g,t}$ and $K_{o,t}$ are the accumulated stocks of capital in non-oil sector and in the oil sector respectively, and Z_t represents the nominal exchange rate.

Since the BEAC issuing zone are linked to international market via foreign assets hold by its citizens, we feature risk premium which is modeled as an increase with the ratio of foreign assets to the value of domestic output (Ambler et al., 2004):

$$Log(\Psi_t) = \kappa\Big(exp(Z_t B_t^*/Y_t) - 1\Big), \tag{4}$$

Furthermore, corporations benefit from an implicit oil subsidies, namely, a less than optimal tax rate on realized capital gain τ^G. The law of motion of the stocks of installed capital in the non-oil sector and in the oil sector are respectively expressed as :

$$K_{g,t+1} = K_{g,t}(1-\delta_g) + I_{g,t} - (\psi_g/2)\tau^G((K_{g,t+1}/K_{g,t}) - 1)^2 \bar{K}_{g,t}, \tag{5}$$

and

$$K_{o,t+1} = K_{o,t}(1-\delta_o) + I_{o,t} - (\psi_o/2)\tau^G((K_{o,t+1}/K_{o,t}) - 1)^2 \bar{K}_{o,t}, \tag{6}$$

In each of both sectors, $\bar{K}_{g,t}$ and $\bar{K}_{o,t}$ stand for the aggregate stock of capital, δ_g and δ_o represent the constant depreciation rates of capital, ψ_g and ψ_o are adjustments cost parameters, of non-oil sector and oil sector respectively.

The Lagrangian for the household optimization problem can been written as follow:

$$\begin{aligned} L &= E_0\Big[\sum_{t=0}^{\infty}\beta^t u(C_t, hC_{t-1}, N_{g,t}, N_{g,t}) + \sum_{t=0}^{\infty}\beta^t\lambda_t(W_{g,t}N_{g,t} + W_{o,t}N_{o,t} + B_{t-1} + Z_t B_{t-1}^* \\ &\quad + P_t q_{g,t}K_{g,t} + P_t q_{o,t}K_{o,t} - P_t C_t - B_{t+1}/R_t - Z_t B_{t+1}^*/R_t^*\Psi_t - P_t I_{g,t} - P_t I_{o,t}\Big], \end{aligned} \tag{7}$$

Here λ_t is the Lagrange multiplier on the representative household budget constraint.

The representative household intertemporal optimization problem yield first order conditions for consumption C_t , hours worked in non-oil sector and oil sector $N_{g,t}$; $N_{o,t}$, non-oil sector and oil sector physical capital $K_{g,t+1}$; $K_{o,t+1}$, domestic and foreign assets B_t ; B_t^*, as follow:

$$(1-\theta_n)^{1/\tau_n} N_{g,t}^{-1/\tau_n} N_t^{(\tau_n\eta+1/\tau_n)} = W_{g,t}\lambda_t, \tag{8}$$

$$1/(C_t - hC_{t-1}^*) = P_t\lambda_t, \tag{9}$$

$$(1-\theta_n)^{1/\tau_n} N_{g,t}^{-1/\tau_n} N_t^{(\tau_n\eta+1/\tau_n)} = W_{g,t}\lambda_t, \tag{10}$$

$$\theta_n^{1/\tau_n} N_{o,t}^{-1/\tau_n} N_t^{(\tau_n\eta+1/\tau_n)} = W_{o,t}\lambda_t, \tag{11}$$

$$\beta E_t\Big\{\lambda_{t+1}P - t + 1\Big[q_{g,t=1} + 1 - \delta_g + \psi_g\tau^G\frac{K_{g,t+2}^2}{K_{g,t+1}^2} - \frac{K_{g,t+2}}{K_{g,t+1}}\Big]\Big\} = \lambda_t P_t\Big[1 + \psi_g\tau^G\frac{K_{g,t+1}}{K_{g,t}} - 1\Big], \tag{12}$$

$$\beta E_t\Big\{\lambda_{t+1}P-t+1\Big[q_{o,t=1}+1-\delta_o+\psi_o\tau^G\frac{K^2_{o,t+2}}{K^2_{o,t+1}}-\frac{K_{o,t+2}}{K_{o,t+1}}\Big]\Big\}=\lambda_t P_t\Big[1+\psi_o\tau^G\frac{K_{o,t+1}}{K_{o,t}}-1\Big], \quad (13)$$

$$\beta R_t E_t(\lambda_{t+1}/\pi_{t+1})=\lambda_t, \quad (14)$$

$$\beta R^*_t\Psi_t E_t[(e_{t+1}/e_t)(\lambda_{t+1}/\pi^*_{t+1})]=\lambda_t, \quad (15)$$

Here π_t stands for the domestic inflation and is defined as follow:

$$\pi_t=P_t/P_{t-1} \quad (16)$$

e_t represents the real exchange rate between the BEAC issuing zone and the rest of the world and is given as :

$$e_t=Z_tP^*_t/P_t \quad (17)$$

π^*_t denotes the foreign inflation (where $P^*_t$is the foreign aggregate price index) and its evolution is governed by the following exogenous process:

$$log\pi^*_t=\rho_{\pi^*}log\pi^*_{t-1}+\epsilon_{\pi^*,t}, \quad (18)$$

Here ρ_{π^*} stands for the autoregressive coefficient and ϵ_{π^*} represents the foreign price shock which is normally distributed with zero mean and standard deviation equals to σ_{π^*}.

3.2 Productive Sector, Commodity Exports Proceeds, and Financial Frictions

3.2.1 The Final Goods Sector

The final good Y_t is the CES aggregation of a basket of domestic intermediate tradable goods and a basket of imported intermediate tradable goods,$Y_{T,t}$, and a basket of intermediate non-tradable goods $Y^d_{NT,t}$, expressed as follow:

$$Y_t=\Big[(1-\theta_y)^{\frac{1}{\tau_y}}(Y_{T,t})^{\frac{\tau_y-1}{\tau_y}}+\theta_y^{\frac{1}{\tau_y}}(Y^d_{NT,t})^{\frac{\tau_y-1}{\tau_y}}\Big]^{\frac{\tau_y}{\tau_y-1}}, \quad (19)$$

Here θ_y represents the share in the final good production, of intermediate non-tradable goods, and τ_y is the elasticity of substitution between intermediate non-tradable goods and intermediate tradable goods in the final domestic good.

This final domestic good is used for consumption, C_t, investment in the oil sector $I_{o,t}$, and investment in the non-oil sector, $I_{g,t}$, defined as:

$$Y_t=C_t+I_{o,t}+I_{g,t}, \quad (20)$$

The final domestic good producers evolve in a perfectly competitive environment by maximising their profit as given:

$$Max_{Y_{T,t},Y_{NT,t}} \; P_t Y_t - P_{T,t} Y_{T,t} - P_{NT,t} Y^d_{NT,t}, \tag{21}$$

Subject to the demand of the final goods (19).

The first order conditions of this optimisation problem leads to the two demands for the intermediate non-tradable goods and the intermediate non-tradable goods:

$$Y_{T,t} = (1-\theta_y)(P_{T,t}/P_t)^{-\tau_y} Y_t, \tag{22}$$

$$Y^d_{NT,t} = \theta_y (P_{NT,t}/P_t)^{-\tau_y} Y_t, \tag{23}$$

Using these two first order conditions and the production function, the no profit condition yields to :

$$P_t = \Big[(1-\theta_y)(P_{T,t})^{1-\tau_y} + \theta_y (P_{NT,t})^{1-\tau_y}\Big]^{1/(1-\tau_y)}. \tag{24}$$

3.2.2 Domestic Tradable Goods sector

Under monopolistic competition within the monetary union, a basket of domestic tradable intermediate goods is produced by combining capital, labor and oil inputs, as follows:

$$Y^d_{T,t}(i) = A_t A_{T,t}\Big[\Big(\tau^K K^{1-1/x_1}_{g,t}(i)\Big)\Big(Y^{1/x_1}_{o,t}(i)\Big)(x_1/x_0)^{1/x_1}\Big]^{\alpha_g} N^{1-\alpha_g}_{g,t}(i), \tag{25}$$

Here $Y^{1/x_1}_{o,t}(i)$ is the oil used in the production of domestic tradable intermediate goods by a corporation (i), $(1-\alpha_g)$ is the share of labor used in production and α_g represents the share of the combined capital and oil inputs. Out of this combined share, $1/x_1$ denotes oil's share and $1-1/x_1$ stands for the capital share. A_t is an aggregate technology shock, which affects the non-oil sector and the oil sector. Finally, $A_{g,t}$ is the non-oil sector technology shock.

Each corporation that operate in the non-oil sector minimizes its cots by choosing, labor $N_{g,t}(i)$, capital $K_{g,t}(i)$ and utilized oil $Y_{o,t}(i)$, as given :

$$Min_{N_{g,t}(i),K_{g,t}(i),Y_{o,t}(i)}\Big[\frac{\Big(W_{g,t}N_{g,t}(i) + P_t q_{g,t}\tau^K K_{g,t}(i) + P_{o,t}Y_{o,t}(i)\Big)}{P_t}\Big], \tag{26}$$

Subject to aforementioned varieties of domestic tradable intermediate goods demand (25).

The first order condition of this minimization problem is give by:

$$\frac{W_{g,t}}{P_t} = (1-\alpha_g) mc_{g,t} \frac{Y_{T,t}(i)}{N_{g,t}(i)}, \tag{27}$$

$$q_{g,t} = (1-\frac{1}{x_1}) \alpha_g mc_{g,t} \frac{Y_{T,t}(i)}{K_{g,t}(i)}, \tag{28}$$

$$\frac{P_{T,t}}{P_t} = mc_{g,t} \frac{\alpha_g}{x_1} \frac{Y_{T,t}(i)}{N_{g,t}(i)}, \tag{29}$$

Here $mc_{g,t}$ is the Lagrangian multiplier and can be interpreted as the marginal cost of production, $mc_{g,t}Y_{g,t}(i)$ represents the total costs.

Engaged in monopolistic competition, non-oil sector goods varieties producer (i) maximizes profits, Ξ_{t+s}, by choosing the price of variety, $P_{g,t}(i)$, as follow:

$$Max_{P_{T,t}(i)} \; E_t\Big[\sum_{s=0}^{\infty} \beta^s \Big((\lambda_{t+s}/\lambda_t)(\Xi_{t+s}(i)/P_{T,t+s} \Big) \Big], \tag{30}$$

Following Rotemberg (1982) price setting, the real dividends are given by:

$$\frac{\Xi_{t+s}}{P_t} = \Big(P_{T,t+s}(i) \frac{P_{T,t+s}(i)}{P_t} - mc_{g,t} Y_{T,t}(i) - \Omega_{P_{T,t(i)}} \Big(P_{T,t}(i), P_{T,t-1}(i) \Big), \tag{31}$$

Where $\Omega_{P_{T,t}(i)}$ represents a quadratic cost of changing its price, expressed as :[11]

$$\Omega_{P-T,t(i)} \Big(P_{T,t}(i), P_{T,t-s}(i) \Big) = (\psi_{P_T}/2) \tau^K \Big(\Big(P_{T,t}(i)/(P_{T,t-1}(i)) \pi_T \Big) - 1 \Big)^2 Y_{T,t}, \tag{32}$$

Here π_T stands for the steady-state inflation in the non-oil sector goods varieties market.

Given the first order condition for the price decision, the demand for non-oil sector goods varieties and the assumption that every producer (i) will decide of the same price $P_{T,t}$, so $P_{T,t}(i) = P_{T,t}$ and we obtain that:

$$\begin{aligned} P_{T,t} \;=\; & \frac{P_t}{1-\omega} E_t \Bigg\{ - \beta \psi_{P_T} \tau^K \frac{\lambda_{t+1}}{\lambda_t} \Big(\frac{\pi^2_{T,t+1}}{\pi^2_T} - \frac{\pi_{T,t+1}}{\pi_T} \Big) \frac{Y_{T,t+1}}{Y_{T,t}} + \psi_{P_T} \frac{\lambda_{t+1}}{\lambda_t} \Big(\frac{\pi^2_{T,t}}{\pi^2_T} - \frac{\pi_{T,t}}{\pi_T} \Big) \\ & - \omega mc_{g,t} \Bigg\}. \end{aligned} \tag{33}$$

[11] Note that the cost of changing price equal zero when retailers decides to change prices at the same rate as average inflation in the sector.

Retailers aggregate different non-oil sector goods varieties $Y_{T,t}(i)$ produced domestically into wholesale non-oil goods $Y_{T,t}$ and sell them domestically and in the foreign economy. The representative retailer maximizes thus its non-oil goods yields choosing the optimal quantity of each non-oil goods varieties (i) as follow:

$$Max_{Y_{T,t}(i)} P_{T,t} Y_{T,t} - \int_0^1 P_{T,t}(i) Y_{T,t}(i) di, \tag{34}$$

Subject to the demand of wholesale non-oil goods

$$Y_{T,t} = \Big(\int_0^1 Y_{T,t}^{(\omega-1)/\omega}(i) di \Big)^{\omega/(\omega-1)}, \tag{35}$$

Here ω denotes the elasticity of substitution between different varieties of non-oil goods.

The first-order conditions of this optimization problem lead to the demand of non-oil goods varieties as follow:

$$Y_{T,t}(i) = (P_{T,t}(i)/P_{T,t})^{-\omega} Y_{T,t}, \tag{36}$$

Here $P_{T,t}$ stands for price of the wholesale non-oil goods. $P_{T,t}(i)$ is the price of a non-oil goods variety (i).

Retailers supply part of wholesale non-oil goods in the domestic market and export another part in the foreign market as follow :

$$Y_{T,t} = Y_{T,t}^d + Y_{T,t}^f, \tag{37}$$

Here $Y_{T,t}^d$ stands for domestically sold domestic tradable good. $Y_{T,t}^f$ represents exported domestic tradable goods.

Hence the foreign demand for the BEAC issuing zone wholesale non-oil sector domestic tradable good is given by:

$$Y_{T,t}^f = \alpha_f \Big(P_{T,t}/Z_t P_t^* \Big)^{-\omega^*} Y_t^*, \tag{38}$$

Here α_f denotes the share of import in the foreign economy. ω^* is the price elasticity for exports of wholesale domestic tradable goods.

The price index of the wholesale domestic tradable goods is defined as:

$$P_{T,t} = \Big(\int_0^1 P_{T,t}^{1-\omega}(i) di \Big)^{1/(1-\omega)}. \tag{39}$$

3.2.3 Imported Tradable Goods Sector

Manufactured goods are exclusively produced in foreign countries. Subsidiaries of foreign multinational evolve in monopolistic market within the monetary union. They core role is to import manufactured good $Y^*_{f,t}$ at price P^*_t, which is $Z_t P^*_t$ in term of domestic currency, so as to supply differentiated imported tradable goods $Y_{f,t}(j)$ in the domestic economy.

Subsidiaries of foreign multinational minimize their cost of import as follows:

$$Min \ \Big[(Z_t P^*_t Y^*_{f,t})/P_t\Big], \tag{40}$$

subject to the assumption that

$$Y_{f,t}(j) = Y^*_{f,t}, \tag{41}$$

The first order condition of this minimization problem gives us:

$$Z_t P^*_t / P_t = mc_{f,t}, \tag{42}$$

Where $mc_{f,t}$ represents the marginal cost of importers.

Subsidiaries of foreign multinational are engaged in commercial activities with retailers and also maximize profits $\Xi_{f,t+s}(j)$ by choosing the price of their variety $P_{f,t}(j)$ as follow:

$$Max_{P_{f,t}(j)} \ E_t\Big[\sum_{s=0}^{\infty} \beta^s \Big((\lambda_{t+s}/\lambda_t)(\Xi_{f,t+s}(j)/P_t\Big)\Big], \tag{43}$$

The real profit is thus given by:

$$\frac{\Xi_{f,t+s}}{P_t} = \Big(P_{f,t+s}(j)\frac{P_{f,t+s}(j)}{P_t} - mc_{f,t}Y_{f,t}(j) - \Omega_{Pf,t(j)}\Big(P_{f,t}(j), P_{f,t-1}(j)\Big), \tag{44}$$

Where $\Omega_{Pf,t(j)}$ represents a cost of changing its price between periods and is expressed as :

$$\Omega_{Pf,t(j)}\Big(P_{f,t}(j), P_{f,t-s}(j)\Big) = (\psi_{Pf}/2)\Big(\Big(P_{f,t}(j)/(P_{f,t-1}(j))\pi_f\Big) - 1\Big)^2 Y_{f,t}, \tag{45}$$

Here π_f stands for the steady-state inflation in the imported manufactured goods market.

Given the first order condition for the price decision, the demand for imported manufactured goods and the assumption that every producer (i) will decide of the same price $P_{f,t}$, so $P_{f,t}(i) = P_{f,t}$ and we obtain that:

$$P_{f,t} = \frac{P_t}{1-\mu}E_t\Bigg\{ -\beta\psi_{Pf}\frac{\lambda_{t+1}}{\lambda_t}\Big(\frac{\pi^2_{f,t+1}}{\pi^2_f} - \frac{\pi_{f,t+1}}{\pi_f}\Big)\frac{Y_{f,t+1}}{Y_{f,t}} + \psi_{Pf}\frac{\lambda_{t+1}}{\lambda_t}\Big(\frac{\pi^2_{f,t}}{\pi^2_f} - \frac{\pi_{f,t}}{\pi_f}\Big) - \omega mc_{f,t}\Bigg\}. \quad (46)$$

Retailers purchases varieties of manufactured goods $Y_{f,t}(i)$ to subsidiaries of foreign multinational, repackage them, and retail them in the domestic market as final imported tradable goods, $Y_{f,t}$, according to the following production function:

$$Y_{f,t} = \Big(\int_0^1 Y_{f,t}^{\mu-1/\mu}(j)dj\Big)^{\mu/1-\mu}, \quad (47)$$

Here μ stands for the elasticity of substitution between different varieties of imported tradable goods.

The representative retailer then maximise its profit by choosing the optimal quantity of each imported manufactured differentiated good (j) as given:

$$Max_{Y_{g,t(i)}}\ P_{f,t}Y_{f,t} - \int_0^1 P_{f,t}(j)Y_{f,t}(j)dj, \quad (48)$$

Subject to the aforementioned production function (47).

Here $P_{f,t}$ represents the price imported tradable good in the domestic market. $P_{f,t}(j)$ is the price of imported varieties of manufactured goods.

The first order condition of this optimisation problem is given by:

$$Y_{f,t}(j) = \Big(P_{f,t}(j)/P_{f,t}\Big)^{-\mu}Y_{f,t}, \quad (49)$$

The price index of imported tradable goods in domestic market is thus defined as:

$$P_{f,t} = \Big(\int_0^1 P_{f,t}^{1-\mu}(j)dj\Big)^{1/1-\mu}, \quad (50)$$

3.2.4 Oil sector, Commodity Exports Proceeds, and Financial Frictions

The representative domestic oil producer uses public capital and labor as inputs, according to the following production sector:

$$Y_{o,t} = A_t[A_{o,t}K_{o,t}^{\alpha_o}N_{o,t}^{1-\alpha_o}], \tag{51}$$

Here $Y_{o,t}$ represents the oil produced, α_o denotes the share of capital in the oil production, A_t is the aggregate technology shock affecting both the intermediate manufactured good sector and the oil sector, and $A_{o,t}$, is a oil sector technology shock.

In the oil production process, the representative oil producer makes decisions about how much labor and capital it may use for oil production to maximize profits, as follow:

$$Max_{N_{o,t},K_{o,t}}\Big[P_{o,t}Y_{o,t} - W_{o,t}N_{o,t} - P_t q_{o,t}K_{o,t}\Big], \tag{52}$$

Subject to the aforementioned oil production function (19).

The first-order maximization conditions for labor demand and capital provide us, the real wage and the real marginal productivity of capital, in the oil production sector, respectively as follow:

$$W_{o,t}/P_{o,t} = (1-\alpha_o)Y_{o,t}/N_{o,t}, \tag{53}$$

$$P_t q_{o,t}/P_{o,t} = \alpha_o(Y_{o,t}/N_{o,t}), \tag{54}$$

Oil produced within BEAC issuing zone is exported in the rest of the world $Y_{o,t}^f$ and sold within the economy $Y_{o,t}^d$. Hence total oil produced is basket of domestic oil and exported oil expressed as:

$$Y_{o,t} = Y_{o,t}^d + Y_{o,t}^f, \tag{55}$$

Since BEAC issuing zone is a small open economy, domestic oil producers are oil price taker, which is set internationally and defined as:

$$logP_{o,t}^* = \rho_{P_o^*} logP_{o,t-1}^* + \epsilon_{P_o^*}, \tag{56}$$

Here $\rho_{P_o^*}$ stands for the autoregressive coefficient and $\epsilon_{P_o^*}$ the oil price shock which is normally distributed with zero mean and standard deviation equals to $\sigma_{P_o^*}$.

Hence the law of one price gap implies that the domestic oil price is defined in term of foreign price as follow:

$$P_{o,t} = Z_t P_{o,t}^*, \tag{57}$$

The profits from the oil sector are allocated to households as subsidies against any increases in oil prices as follow:

$$T_t^o = P_{o,t}^* Y_{o,t}. \tag{58}$$

Entrepreneurs begin thus period t with commodity exports proceeds (CEP), k_{t-1}, which they earned in the preceding period using bank loans. During period t they use that commodity exports proceeds (CEP), alongside hired labor, to produce oil; with the proceeds, they will pay labor, consume, pay back bank loans, and earn new CEP for tomorrow subject to a financing constraint. Since entrepreneurs are credit constrained, they discount the future more heavily than the households and this behavior guarantees that the credit constraints will bind in the neighborhood of the steady state. In that context, entrepreneur maximizes expected utility as follows:

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta_M^t log(C_t^M - h^M C_{t-1}^M), \tag{59}$$

where β_M stands for entrepreneur's intertemporal discount factor and C_t^M is his individual consumption.

To obtain a loan $\bar{l}_t(i)$ from commercial banks, entrepreneurs minimize the due total repayment as follow:

$$min \int_{t=0}^{1} r_t^l(j) l_t(i,j) dj, \tag{60}$$

subject to loans aggregation

$$\left[\int_0^1 l_t(i,j)^{\frac{\gamma_t^l - 1}{\gamma_t^l}} dj \right]^{\frac{\gamma_t^l}{\gamma_t^l - 1}} \geq \bar{l}_t(i), \tag{61}$$

The first order conditions for this optimization problem gives us the following entrepreneurs demand for loans $l(i)$ at retail lending bank (j) as follows:

$$l_t(i) = (\frac{r_t^l(j)}{r_t^l})^{-\gamma_t^l} l_t, \tag{62}$$

This entrepreneurs' demands for loans depends on overall volumes and on the lending rates charged by retail lending bank relative to the average rates in the economy. Here $l_t \equiv \eta^l l_t(i)$ and γ_t^l stands for elasticities of substitution among loans contracts offered to different entrepreneurs ($\gamma_t^l > 1$).

The lending rate set by the retail lending bank is given as :

$$r_t^l = \left[\int_0^1 r_t^l(j)^{1-\gamma_t^l} dj \right]^{\frac{1}{1-\gamma_t^l}}, \tag{63}$$

Thus, entrepreneur maximizes (19) subject to the following budget constraint:

$$c_t^M(i) + w_t n_t(i) + \frac{1+r_{t-1}^l}{\pi_t} l_{t-1}(i) + P_{o,t}^* k_t(i) + \phi(\nu_t(i)) k_{t-1}(i) = \frac{y_t^M(i)}{z_t} + l_t(i) + P_{o,t}^*(1-\delta)k_{t-1}(i) \quad (64)$$

The right hand side of (24) describes the entrepreneur's resources and the left hand side the uses of these resources. Financial resources come from sales of oil produced, $\frac{y_t^M(i)}{z_t}$, new bank loans, l_t, and the value of undepreciated commodity exports proceeds (CEP) she owns, $P_{o,t}^*(1-\delta)k_{t-1}$. These resources are used to consume, C_t^M, to pay wage to workers, $w_t n_t$, pay back bank loans from last period, $\frac{1+r_{t-1}^l}{\pi_t} l_{t-1}(i)$, earn new CEP for tomorrow, $P_{o,t}^* k_t$, pay the the real cost of setting a level ν_t of utilization rate of CEP $\phi(\nu_t)k_{t-1}$. [12]

Each entrepreneur has access to the following production function that takes labor and capital inputs and turns them into intermediate goods:

$$y_t^M = a_t^M [k_{t-1}(i)\nu_t(i)]^\alpha n_t(i)^{1-\alpha}, \quad (65)$$

where α represents the capital share in the production sector and a_t^M being a stochastic process for total factor productivity.

The financial frictions arise as follows. We assume that the amount of loans one entrepreneur can obtain is constrained by the value of the collateral he can pledge. In this model, collateral is materialized by commodity exports proceeds (CEP). Indeed, entrepreneurs in oil rich-countries borrow using Oil Exports Proceeds (CEP) as collateral. For this reason, the supply of funds increases during commodity booms and falls during commodity busts. Hence, capital flows to an oil-dominance currency union tend not to be counter-cyclical, as in inter-temporal optimisation theory, but rather pro-cyclical (Kaminsky et al. 2005). The process implies that how much commodity exports proceeds an entrepreneur can accumulate depends on the minimum loan return required by banks, which in turn depends on three mains components: the LTV ratio, the expected future price $[E_t P_{o,t+1}^*]$ of commodity exports pledged as collateral, and the lending rate r_t^l. Consequently, variations in the quantity and in the value of collateral modify the transmission of various crisis or shocks and can amplify their effects.

Written in equation term, this friction reads like:

$$(1+r_t^l) l_t(i) \leq V_t^M E_t[P_{o,t+1}^* \pi_{t+1}(1-\delta)k_t(i)]. \quad (66)$$

where V_t^M stands for the maximum loan to value (LTV) ratio available to a given entrepreneur. The borrowing constraint (19) shows that entrepreneurs cannot borrow

[12] $P_t^W/P_t = 1/z_t$ is the relative competitive price of the intermediate goods produced by each entrepreneurs.

more than a fraction V_t^M of the expected future value of the commodity exports proceeds they pledged.[13]

3.3 Sovereign Wealth Funds Program

Sovereign wealth funds operate through five different types. The central role of Investment and Development Sovereign Wealth Funds are to pursue higher returns by high allocations in equities and alternative investments as well as to allocate resources to priority socio-economic projects, usually infrastructures. The fundamental role of Savings and Pension Reserve Sovereign Wealth Funds are to transform nonrenewable assets into diversified financial assets and to meet identified future outflows with respect to contingent liabilities. The core role of Stabilization Sovereign Wealth Fund is to insulate the economy from commodity price volatility.

3.3.1 Investment and Development Sovereign Wealth Funds

Investment and development SWFs sign a loans contract with entrepreneurs operating in the good production sector. Indeed, They will choose the lending rates that maximize their margins as follows :

$$max E_0 \sum_{t=0}^{\infty} \Upsilon_{o,t}^R \left[r_t^l(j) l_t(j) - R_t^l L_t(j) - \frac{\varrho_l}{2} \left(\frac{r_t^l(j)}{r_{t-1}^l(j)} - 1 \right)^2 r_t^l l_t \right], \tag{67}$$

subject to loans demand by entrepreneurs and $L_t(j) = l_t(i)$.

3.3.2 Savings and Pension Reserve Sovereign Wealth Funds

Saving and pension SWFs sign a deposits contract with the oil-dominance currency union in exchange of an expected deposits yields. In fact, They will choose the deposit rates that maximize their margins as follows :

$$max E_0 \sum_{t=0}^{\infty} \Upsilon_{o,t}^R \left[r_t D_t(j) - r_t^d(j) d_t(j) - \frac{\varrho_d}{2} \left(\frac{r_t^d(j)}{r_{t-1}^d(j)} - 1 \right)^2 r_t^d d_t \right], \tag{68}$$

subject to deposits demand by households and with $D_t(j) = d_t(j)$.

[13] This type of collateral constraints is used in several contributions to the literature on financial frictions. See Iacovello (2005) for instance.

3.3.3 The Stabilization Sovereign Wealth Fund

The stabilization SWF chooses loans and deposits so as to maximize the following discounted sum of cash flows:

$$maxE_0 \sum_{t=0}^{\infty} \Upsilon_{o,t}^{R} \left[(1+R_t^l)L_t - L_{t+1} + D_{t+1} - (1+R_t^d)D_t + \Delta K_{t+1}^b - \frac{\varrho_{K_b}}{2} \left(\frac{K_t^b}{L_t} - \mu^b \right)^2 K_t^b \right], \quad (69)$$

subject to a balance sheet constraint

$$L_t = D_t + K_t^b, \quad (70)$$

3.4 Central Bank

Consistent with its monetary policy framework, the BEAC conducts monetary policy by adjusting the monetary policy rate $r_{M,t}$ in response to changes in inflation objective π_t, real exchange rate rer_t, and output Y_t, as follows :

$$r_{M,t} = \beta_M r_{M,t-1} + \beta_\pi (\pi_t - \pi) + \beta_\mu (rer_t - rer) + \beta_Y (Y_t - Y) + \gamma_{M_t}, \quad (71)$$

Where r_M, π, rer, and Y, are the steady-state values of $r_{M,t}$, π_t, rer_t and Y_t, respectively. β_π, β_μ and β_Y are monetary policy rate's response coefficients to inflation, real exchange rate, and output, respectively. γ_{M_t} is zero-mean, serially uncorrelated innovation.

The central bank's main liability is the amount of foreign reserves within the framework of several sovereign wealth funds. The BEAC's international reserves mainly stem from the surrender of foreign assets generated by oil exports, received from member states. In exchange for depositing their foreign exchange earnings, member states receive CFA francs, which are recorded as liabilities in the BEAC's balance sheet, and as assets in member states' balance sheets. These international reserves NFR_t finance the oil-dominance currency union's holdings of , investment and development SWFs net assets b_t , saving and pension SWFs net assets B_t, as well as stabilization SWFs net assets, $r_{M,t-1}NFR_{t-1}$.

Combining all these elements, the flow budget of the central bank is:

$$NFR_t - NFR_{t-1} = r_{M,t-1}NFR_{t-1} + b_t + e_t B_t - r_t b_t - e_t r_{B,t} B_t \quad (72)$$

Investment and development SWFs pay a riskless return $r_{M,t}$. Central bank yields, for saving and pension SWFs is r_t, and for stabilization SWFs is $r_{B,t}$. The BEAC is free to set the interest rate on its liabilities at whatever level it likes, and the only link between the unit of account in successive periods arises from the central bank's willingness to deliver future money in exchange for money held now on particular terms. Monetary policy consists thus of choices of the interest rate paid on foreign exchange reserves and balance-sheet policies through sovereign wealth funds transmission channel.

The BEAC will thus conduct its monetary policy by considering the sovereign wealth funds dimension of monetary policy that result from variations in the size of its balance sheet. Variations in the size of the balance sheet induces variations in the supply of assets NFR_t that need not be associated with any change in the central bank's monetary policy rate. Let the monetary policy rate be fixed, but consider that the BEAC sovereign wealth funds operation which consists in acquiring investment and development SWFs net assets, and saving and pension SWFS net assets, balanced by stabilization SWFs assets as follows:

$$\Delta NFR_t = r_t \Delta b_t + e_t r_{B,t} \Delta B_t, \tag{73}$$

3.5 Government

Fiscal policy is conducted in BEAC issuing zone by national governments which influence the economy by complying to a common fiscal rule. Governments revenues to finance their spending comes from two main sources. Primarily, governments collect taxes from economic agents which are part of their income as follow:

$$T_t = \tau_t P_{Y,t} Y_t, \tag{74}$$

Here T_t stands for the net total income tax.[14] τ_t corresponds to the average income tax.

The lion share of government' revenues come from the oil sector. Member governments control the crude oil sector and own share in the crude oil exporting corporation. As result, member governments earn revenues from exporting crude oil in foreign market, which is given by:

$$P_{Z,t} \psi_O Y_{Z,t}, \tag{75}$$

where $P_{Z,t}$ denotes the long-run price of oil, which is the reference price. ψ_O denotes the government share in total crude oil production. $\psi_O Y_{Z,t}$ represents the crude oil sales from the crude oil corporation.

Member governments use the collected tax and oil revenue to redistribute back, on the one hand to households in terms of explicit oil-consumption subsidies T_t^G, and on the other hand to corporations in terms of less than optimal capital income tax τ^K as well as less than optimal capital gain taxes τ^G.

Within the framework of central bank sovereign wealth funds policy, the oil-dominance currency union will be receiving the following amount of assets :

$$NFR_{t-1} = r_{M,t-1} P_{Z,t-1} \psi_O Y_{Z,t-1}, \tag{76}$$

[14] Total income tax revenues minus income redistribution by governments via transfers to economic agents.

3.6 Rest of the world and International Oil Prices

We feature the rest of the world based on the exogenous international oil prices. As a small open oil-dependent economy, BEAC issuing zone is an oil price taker, which is set internationally and defined as:

$$logP^*_{o,t} = \rho_{P^*_o} logP^*_{o,t-1} + \epsilon_{P^*_o}, \tag{77}$$

Here $\rho_{P^*_o}$ stands for the autoregressive coefficient and $\epsilon_{P^*_o}$, the oil price shock which is normally distributed with zero mean and standard deviation equals to $\sigma_{P^*_o}$.

3.7 Market clearing

- Domestic Tradable goods market

Non-oil goods are sold on domestic market and exported

$$Y_{T,t} = Y^d_{T,t} + Y^f_{T,t}, \tag{78}$$

Every non-oil goods varieties producer makes identical decision in equilibrium, so we have:

$$Y_{T,t}(i)^d = Y^d_{T,t}, \tag{79}$$

and

$$Y_{T,t}(i)^f = Y^f_{T,t}. \tag{80}$$

- Oil Market

Oil are sold on domestic market and exported

$$Y_{o,t} = Y^d_{o,t} + Y^f_{o,t}. \tag{81}$$

- Imported Tradable goods market

Every importer of manufactured goods makes identical decision in equilibrium, so we have:

$$Y_{f,t}(i) = Y_{f,t}. \tag{82}$$

- Final good market

The final good is used for consumption or investment as given:

$$Y_t = C_t + I_{o,t} + I_{g,t}. \tag{83}$$

- Capital market

Every producers make identical decision in equilibrium for the acquisition of physical capital in each sector as follows:

$$K_{PT,t}(i) = K_{PT,t}, \tag{84}$$

and

$$K_{Po,t}(i) = K_{Po,t}. \tag{85}$$

- Labor Market

$$N_{g,t}(i) = N_{g,t}. \tag{86}$$

- Trade balance of Balance of Paiement is defined as:

$$p_{o,t}Y^f_{o,t} + Y^d_{T,t} + Z_t b^*_{t-1}\pi_f = Z_t Y_{f,t} + Z_t b^*_t / R^*_t \Psi_t. \tag{87}$$

Here we denotes real wages in the non-oil sector and in the oil sector as:

$$w_{g,t} = W_{g,t}/P_t, \tag{88}$$

and

$$w_{o,t} = W_{o,t}/P_t. \tag{89}$$

We denotes real quantities of domestic denominated assets and foreign denominated assets as :

$$b_t = B_t/P_t, \tag{90}$$

and

$$b^*_t = B^*_t/P_t. \tag{91}$$

The real exchange rate is expressed as follows:

$$e_t = Z_t P^*_t/P_t. \tag{92}$$

Moreover the real domestic price of oil, non-oil good and imported tradable good is defined as:

$$p_{o,t} = P_{o,t}/P_t, \tag{93}$$

$$p_{T,t} = P_{T,t}/P_t, \tag{94}$$

$$p_{f,t} = P_{f,t}/P_t. \tag{95}$$

4 Parameters Calibration

This section discusses calibration of the structural model parameters. Tables 1-2 present the parameters of the model, which are calibrated to match the salient features of BEAC issuing zone.

The subjective discount factor, β, is set to 0.995 in order to get an annual nominal binding rate for BEAC' tenders of 18% in the steady state. Habit formation, h is calibrated to 0.7, to reflects a large degree of consumption inertia in BEAC issuing zone. This value is in line with the value found by Kano and Nason (2014).The quarterly gross steady-state inflation is calibrated to 3/4, which assumes a trend annual inflation rate of 3 percent. The gross quarterly real growth rate is set to 1.757 in order to match the average annual per capital real GDP of 2.8 percent. The inverse of the Frish elasticity of labor supply σ_N is calibrated to 10 so as to capture the characteristic that labour supply is inelastic in BEAC issuing zone.This value is consistent with the value found by Goldberg (2015). The labor mobility between the oil sector and the non-oil sector τ_n is set to 1 to reflects the low level of labor flexibility across both sectors. This value is identical to the value found by Horvath (2000). The steady-state share of work done in the oil sector θ_n is calibrated to be consistent with average ratio of oil used in consumption to aggregate consumption, 0.046. The elasticity of the risk premium with respect to net-foreign asset position κ is calibrated to 0.002, because BEAC issuing zone is more exposed to risk.

To feature the scarcity of physical capital in BEAC issuing zone, the depreciation rate of physical capital in the oil sector δ_o is calibrated to 2.5 percent. The depreciation rate of physical capital in the non-oil sector δ_g is calibrated to 5 percent. To take in consideration the feature of absorptive capacity constraint in BEAC issuing zone, the physical capital adjustment cost in the oil sector ψ_o is calibrated to 4 percent. The physical capital adjustment cost in the non-oil sector ψ_g is also calibrated to 25 percent. The share of physical capital in the oil producing sector α_o is calibrated to 55 percent, so as to match the 45 percent of labor share in the oil production process.We calibrate the degree of price rigidity to feature the fact that, prices are more rigid in BEAC issuing zone relatively to developed countries.

The domestic price rigidity ψ_{Pg} is calibrated to 0.7, whereas the the foreign price rigidity ψ_{Pf} is calibrated to 0.6. The implicit oil subsidies τ^K is calibrated to 11.4 percent, less than the optimal tax rate to capital income. In addition the second implicit oil subsidies parameter $\tau^G$is set to 10.7 percent less than the optimal tax for realized capital gain. These implicit oil subsidies parameters are calibrated so as to be below the optimal tax rate, which in average is 15 percent for low-income countries.

We calibrate the elasticity of substitution between different varieties of non-oil goods to capture the feature that BEAC issuing zone is relatively less diversified than developed countries. The elasticity of substitution between different varieties of domestic non-oil goods ω, is set to -0.9 in order to generate a high degree of short-run inelasticity in oil demand. Whereas the elasticity of substitution between different varieties of foreign non-oil

goods $\omega*$, is set to 0.75. The share of combined physical capital and oil in the production of non-oil goods α_g is calibrated to 30 percent to match the 70 percent of labor contribution in the production of non-oil goods varieties. The oil share in the production sector x_1 representing 1/3 of the combined input, that is 0.1, while the capital input represent 2/3, that is 0.2. The elasticity of substitution between oil and capital $1/x_0$, is set to -0.9, which is larger in absolutate term than the -0.7 used by Kim and Loungani (1992) for the United States.This calibration generates the most price-inelastic short-term factor demand for the model. The negative sign means that oil and capital are complement inputs in the production process.

Table 1: Calibration of Preference and Oil Sector Parameters

Parameter	Meaning	value	Source
β	Discount factor	0.995	To match BEAC' tenders rate
h	Habit formation	0.8	Consumption inertia
η	Inverse of the Frish elas.	10	Inelastic labor supply
τ_n	Labor mobility	1	Low flexibility
θ_n	Share labor in oil sector	0.046	National Income Account
κ	Risk premium	0.002	Exposure to risk
δ_g	Deprec. rate private capital	0.05	Scant priv. capital
δ_o	Deprec. rate public capital	0.025	Scant publ. capital
ψ_g	Private capital adjust. cost	0.25	Asorp. cap. constraint
ψ_o	Public capital adjust. cost	0.04	Asorp. cap. constraint
α_o	Share public capital in oil prod.	55%	Match 45% labor share
ψ_{Pg}	Domestic price rigidity	0.7	Higher rigidity
ψ_{Pf}	Foreign price rigidity	0.6	Lower rigidity
τ^K	Implicit oil subsidies	11.4	Less than optimal income tax
τ^G	Implicit oil subsidies	10.7	Less than optimal capital gain tax

The elasticity of substitution among differentiated intermediates of non-oil goods τ_y are evaluated by considering the steady-state domestic price mark-up $\frac{\tau_y}{\tau_y-1}$. We calibrate the elasticity to 6.54 to match the the steady-state price mark-up $\frac{\tau_y}{\tau_y-1}$ of 1.1, consistent with Chari et al. (2001). The elasticity of substitution among differentiated intermediates of labor input τ_n are related to the steady-state wage mark-up $\frac{\tau_n}{\tau_n-1}$. We calibrate the elasticity to 6.3 to match the the steady-state wage mark-up $\frac{\tau_n}{\tau_n-1}$ of 1.15. The elasticity of substitution between different varieties of imported tradable goods μ is calibrated to 6 to match the foreign price mark-up $\frac{\mu}{\mu-1}$ of 1.2, which is the parameter generally used for advanced economies. The share of domestic non-tradable goods θ_y is calibrated to 0.25. To emphasize the oil-dependent currency union feature of BEAC issuing zone. Whereas the share of imported tradable goods in the foreign economy α_f is calibrated to 0.50. To highlight import-dependence in BEAC issuing zone.

We calibrate the parameters of the monetary policy rule, consistent with monetary policy objective of the BEAC. The inertia parameter of the binding rate for BEAC tenders ρ_R, is calibrated to 0.95 to indicate a significant degree of policy inertia. The parameter that captures the response of the binding rate for BEAC tenders to inflation β_1 is calibrated to 1.61, above the standard value of 1.5. While the response of the binding rate for BEAC tenders to output growth β_2 is lower than the response to inflation and calibrated to 0.28 below the standard value (0.5).The persistence of the technology shock ρ_A, is assumed to be equal to 0.95, while the standard deviation of the technology shock σ_A is set to 0.47 percent. The persistence of the oil price shock ρ_o is equal to 0.92. The standard deviation of the shock σ_o is set to 1.26 percent.

Table 2: Calibration of Goods Sectors and Policy Parameters

Parameter	Description	value	Method
ω	Elas. varieties dom. non-oil goods	-0.9	Inelasticity in oil demand
ω^*	Elas. varieties for. non-oil goods	0.75	More diversified
α_g	Share oil and capital in non-oil s.	30%	Match 70% labor share
x_1	Share of capital in non-oil s.	20%	Match 10% oil input
$1/x_0$	Elas. oil and capital	-09	Asumption
μ	Elas. varieties imported goods	6	Match foreign price mark-up
τ_y	Elas. varieties non-oil goods	6.54	Match dom price mark-up
τ_n	Elas labor varieties input	6.3	Match wage mark-up
α_f	Share of imported tradable goods	0.50	Import-dependence
θ_y	Share of non-tradable good	0.25	Oil-dependent CU
β_r	Policy inertia parameter	0.95	Policy inertia
β_π	Policy response to inflation	1.61	BEAC Mandate
β_y	Policy response output growth	0.28	BEAC Mandate
ρ_A	Persistence technology shock	0.95	Higher
σ_A	Stand dev technology shock	0.47	Less than one
ρ_o	Persistence oil price shock	0.92	Higher
σ_A	Stand dev oil price shock	1.26	More than one

5 Macroeconomic and Financial Effects of SWFs during the Global Financial Crisis

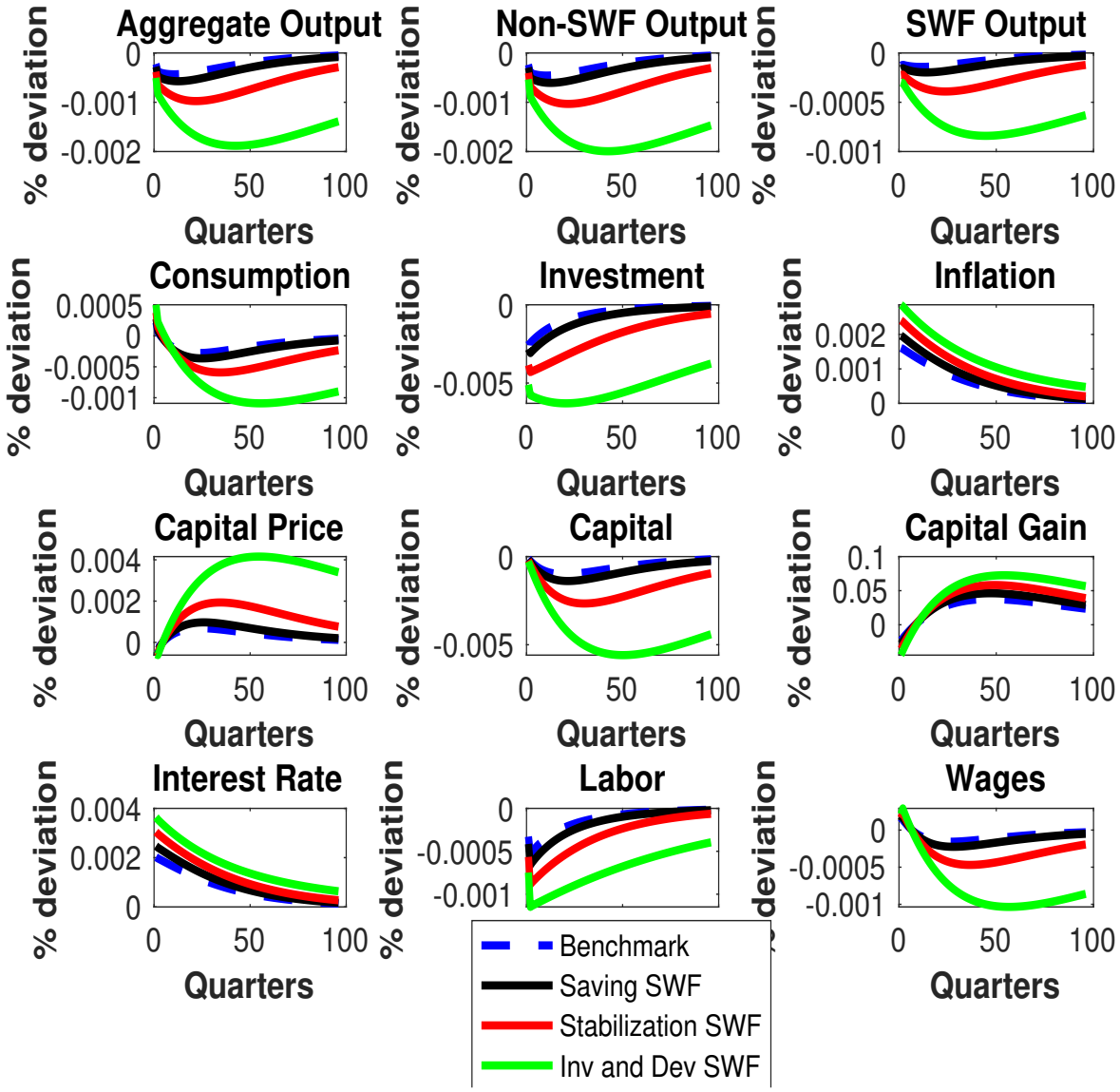
This section analyses the stabilization effects of SWFs on both the global financial cycle and within an oil-dominant currency union. The paper conducts three scenarios which are based on different types of SWFs. The first scenario concerns the saving and pension reserve SWFs. This scenario is materialized within the figures by a solid black line. The second scenario is about the stabilization of SWF. This scenario is materialized by a solid red line. The last scenario is relative to the investment and development SWFs. This scenario is materialized by a solid green line. The benchmark is indicated in the figures by a dashed blue line. Figure 1 displays the impulse responses of key economic variables to the benchmark and the three scenario specifications. The vertical axis of each chart reports the percent deviation from the steady state. The horizontal axis displays the number of quarters, from 0 to 100. Findings reveal heterogeneity in the effects of SWFs on both the global financial cycle and macroeconomic stabilization, which manifests itself in the type of SWF.

As Figure 1 denotes, SWFs have an important role in the macroeconomic stabilization process. The presence of SWFs substantially affects the central bank's response to macroeconomic fluctuations. The dynamics of output and inflation are different across various SWFs. Under stabilization SWFs as well as savings and pension reserve SWFs, hours worked have a dominant effect on inflation, so that production costs matter for inflation. Due to their counter-cyclical properties, Figure 1 shows that inflation significantly drops, causing a decrease in interest rates. In the case of investment and development SWFs, public spending for investment purposes leads to inflation. In other words, investment and development SWFs act like additional boosters of external shocks, strengthening the import price channel of inflation determination because of their pro-cyclicality properties. Monetary policy is thus impacted by wide fluctuations in procyclical implications for aggregate demand that typically affect inflation. In the presence of saving and pension SWFs, the nominal interest rate falls more than inflation. As the global financial crisis deepens, the nominal interest rate moves more than under the benchmark and the previous scenarios relative to inflation. The significant impact of the SWF on inflation and interest rates is due to the effects that the monetary policy instrument triggered.

Moreover, the impulse response functions of almost all variables under saving and pension SWFs show deeper effects than under stabilization, investment, and development SWFs. Capital flows into an oil-dominance currency union tend not to be counter-cyclical, as in inter-temporal optimisation theory, but rather pro-cyclical. In fact, creditworthiness is imperfect, and therefore borrowing requires collateral in the form of oil export proceeds. For this reason, the supply of funds usually increases before the global financial crisis and falls during it. Savings and pension SWFs, because of their counter-cyclical properties, stabilize the economy better by cushioning the effects of adverse global financial shocks on

output.

Figure 1. Sovereign Wealth Funds and Global Financial Crisis



Investment and development SWFs, meanwhile, explicitly respond to that shock, causing more variations in other variables, notably global financial market variables, such as capital prices, capital, and capital gain. So stabilization SWFs stablize the currency union better than investment and development SWFs, which induce higher volatility in the global

financial market. In particular, under the first scenario, headline inflation increases less because of the improvement in the efficiency of global asset allocation. This is explained by the fact that the presence of counter-cyclical features in saving and pension SWFS raises the central bank's response to inflation for any given value of its inflation objective. Inflation and the nominal interest rate move less under saving and pension SWFs, as well as investment and development SWFs, than under stabilization SWFs. Since inflation response is higher than output response in the monetary policy rule, interest rates tighten the economy when there is inflation and stimulate demand when inflation declines.

Basically, SWF assets and the returns they generate exert a significant effect on balance sheet linkages with the rest of the global financial world. Global financial cycle stabilization calls for limiting the procyclicality properties of SWFs. Savings and pensions have inherent properties for depositing and withdrawing resources to smooth out financial fluctuations.During the crisis, savings and pensions SWFs helped to ensure that earnings or profits were spent in a way that allowed for long-term wealth sharing.Both funds strengthened the vulnerable balance sheets of the global financial markets, as they appeared as counter-cyclical providers of capital in the global economy. Hence, saving and pension funds helped to keep long-term interest rates low and improve access to capital for the global financial market. A capital injection into global financial institutions by those SWFs helped the global economy avoid a harder fall and a deeper recession. Savings and pension SWFs have thus significantly helped in improving the efficiency of global asset allocation by dampening the effect of financial market downturns. Those SWFs do not have a destabilizing effect on global financial markets and do not pose a threat to global financial cycle stability because they lead to more global market liquidity and lower costs of capital. Savings and pension SWF operations in their markets provided more efficient risk diversification and resource allocation to global financial markets.As a result, during the global financial crisis, savings and pension SWFs outperform other SWFs in mitigating the negative effects of a liquidity or credit crisis.

Overall, saving and pension reserve SWFs have a more stabilizing impact on output from their demand side and on the global financial cycle by improving the efficiency of global asset allocation. Those shocks eradicate the adverse effects of the global financial crisis on the achievement of output stabilization within the currency union and global financial cycle stabilization. Monetary policy should thus be counter-cyclical in the oil-dominance currency union rather than pro-cyclical.

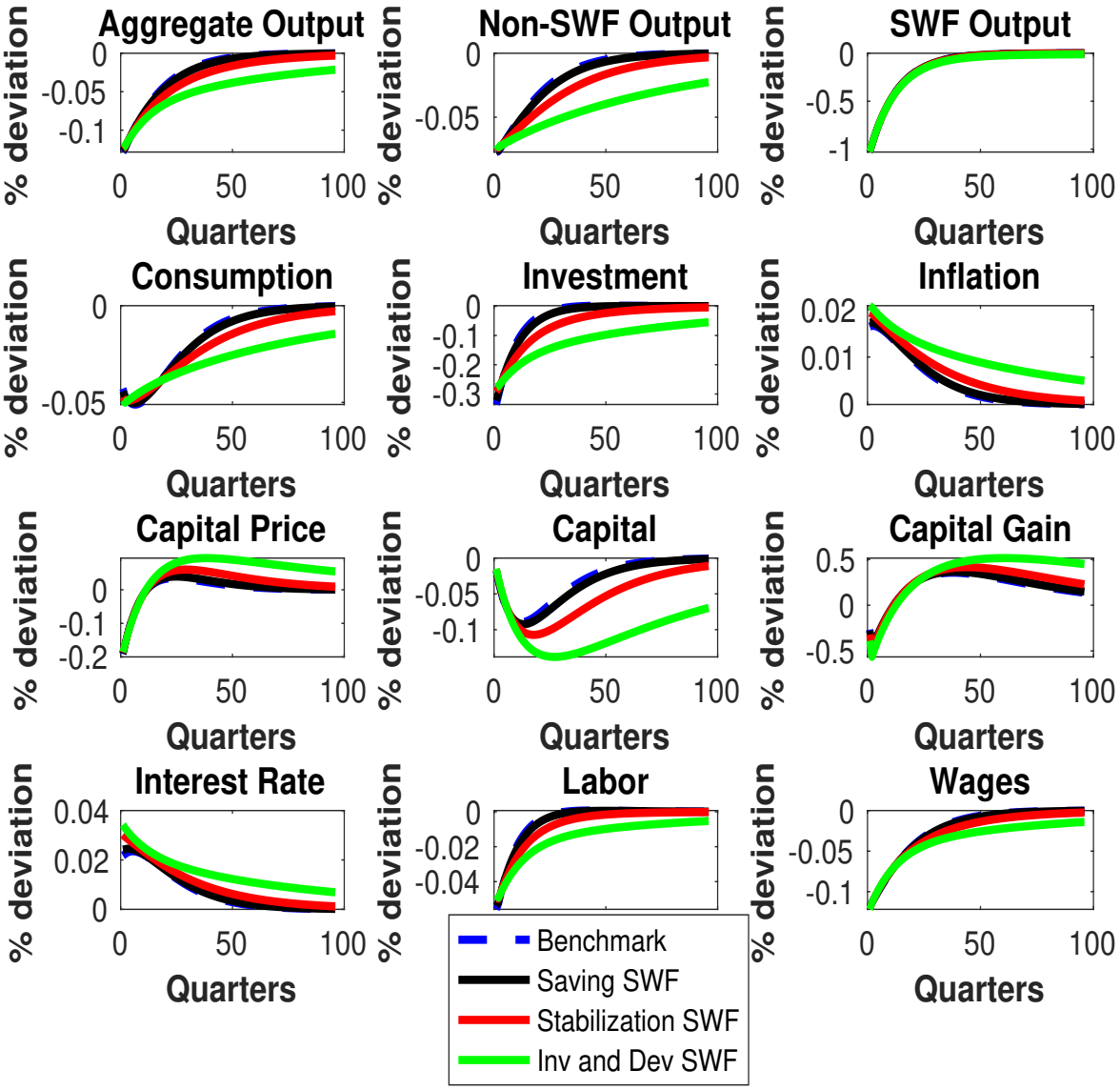
6 Macroeconomic and Financial Effects of SWFs following the Collapse of International Oil Price

Some sovereign wealth funds are successful in dealing with commodity volatility, while some are much less so. The impulse response functions to a negative world oil price shock are examined first to understand the real channels of transmission mechanism. The 1-percent oil price shock causes an immediate decline in output in the benchmark, which worsens more under investment and development SWFs. In fact, Figure 2 shows that a sudden drop in oil prices depletes savings and pension reserve SWFs because the cash flows in foreign currency from oil output decrease. Depleted SWFs raise the cost of imported goods, increase the burden of foreign debt, and reduce capital gains in the global financial market due to lower oil revenues in real terms, all of which discourage labor hours worked as labor income declines.The reduced labor, as a main production input, contributes to a fall in non-oil output. Because final goods output is falling and income is low, private consumption falls as well, lowering domestic prices.Thus, aggregate output falls as well. The collapse in inflation expectations acts as a negative wealth shock and amplifies the drop in output after a negative oil price shock. Over time, there is a prolonged recession as all variables decline.

The response of consumption to an oil price crisis is influenced by households' ability to smooth consumption given SWFs. Immediately following a negative oil price shock, households expect the oil price to decline for a longer period of time and anticipate that the oil price will remain persistently low in the long term. They will slightly increase their current oil consumption by reducing their expectations of normalizing it in the long run when the fall in international oil prices reverses. They reduce non-oil consumption as a response to the short-run increase in oil consumption. However, the stabilization SWF will make unachievable the households' anticipated low oil prices for a long time. After stabilization of SWF counter-cyclical policy, the decline in oil prices within the currency union begins to diminish rapidly, and in turn, households' incomes start to drop because they pay additional associated oil prices, which pushes them to drastically cut their demand for oil. The collapse of oil consumption is accentuated by stabilization SWF policy, which crowds in the decrease of non-oil consumption and leads to a sharp contraction of overall consumption. Low consumption, which is associated with a reduction in domestic absorption, improves net exports and, in turn, enhances efficiency in capital allocation in the global financial market under savings and pension reserve SWFs. Indeed, figure 2 shows that downward swings in commodity prices within the oil dominance currency union result in a collapse in aggregate domestic demand and deflationary pressures. Those conditions, in turn, make the non-oil sector more competitive in international markets. Saving and pension SWFs help an oil-dominant currency union experiencing an oil price crisis to maintain external stability over the long term by adjusting their net external asset position in a way consistent with their economy's fundamentals and features. In addition, saving and pension

funds boost the competitiveness of non-oil sectors and mitigate the macroeconomic risk associated with the collapse of international oil prices.

Figure 2. Sovereign Wealth Funds and Oil Prices Crisis



Under the stabilization SWF strategy, lower energy prices following a negative oil price shock push down production costs, which in turn encourages firms to raise production. The inflation response is lower than under saving and pension SWFs, as well as investment

and development SWFs. This is because monetary rule includes oil price inflation, which is volatile in the presence of its shock and needs to be properly stabilized to achieve the low variations in output within the oil dominance currency union. The decrease in oil inflation dampens the increase in core inflation and pushes down headline inflation. As a result, headline inflation under stabilization SWF operations is lower than it is under saving, investment, and development SWF operations.This is explained by the contr-cyclical properties of the stabilization SWF. In fact, member states react to the decrease in international oil prices by using yields and the return of stabilization SWF to strengthen their stabilization strategy. SWF stabilization appears to be effective in protecting against short-term drops in the world price of the export commodity.

Moreover, under the oil price crisis, investment and development SWFs help to boost investments, notably in infrastructure, but they are unable to ensure external stability because of the accumulation of public debt, as automatic stabilizers suggest, and the realization of continent-wide liabilities due to the fall in oil export proceeds. This is explained by the fact that declining economic growth harms the profitability of firms that rely more on macroeconomic fundamentals in their production process and leads to a gradual exit from the global financial market. So, investment and development SWFs are unable to minimize the distortions of high and volatile oil prices and are unable to address sovereign explicit contingent liabilities. By reducing the country‘s net external asset position in a way consistent with economic structure and fundamentals for investment and infrastructure purposes, investment and development SWFs are unable to maintain external stability over the long term. So, investment and development SWFs accentuate the lower accumulation of foreign assets in tandem with changes in oil exports, and the resulting increase in investment is insufficient to mitigate the domestic macroeconomic impact associated with the oil price crisis.

In sum, sovereign wealth funds offset the adverse effects of the collapse of international oil prices in an oil-dominant currency union. In particular, stabilization SWF has better stabilization effects on inflation, notably oil and imported inflation, as well as the global financial cycle. Monetary authorities in an oil dominance currency union can use sovereign wealth funds to smooth commodity price volatility, achieve macroeconomic stabilization, and contribute to global financial cycle stability as well.

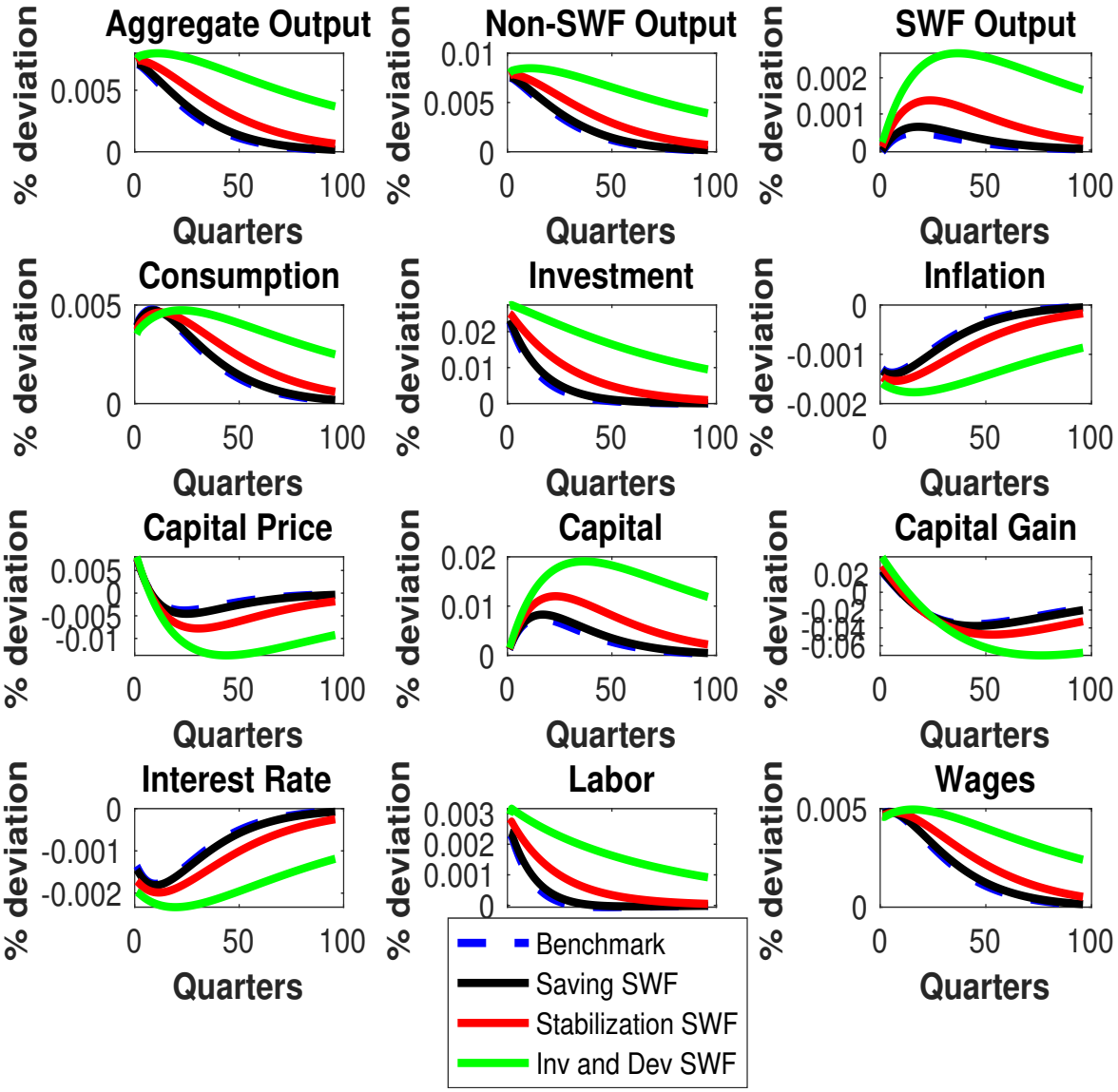
7 Macroeconomic and Financial Effects of SWFs after the Coronavirus Outbreak

This section examines the impact of sovereign wealth funds on the COVID-19 crisis. Figure 3 depicts the responses following a one-percent negative pandemic shock. The COVID-19 pandemic engenders the largest economic contractions. As the pandemic deepened, economic activity ground to a stop, impeding revenue generation while dramatically increasing the demands on resources both directly and indirectly via sovereign wealth funds. Under saving and pension SWFs strategies, the contractionary effect of a pandemic shock is accentuated via the income effect. As more SWFs' funding is reduced due to their countercyclical properties, the income effect dampens the substitution effect, so that households consume fewer. A diminishing expansion of total factor productivity moderates both labor demand and wage increases, which puts downward pressure on labor productivity. Stability, as well as saving and pension SWFs, allows the full operation of less competitive corporations, which inhibits the profitability of investment within the union and, in turn, total factor productivity growth. In response, the opportunity costs of current consumption decrease and households find it optimal to consume more and invest less. This substitution effect intensifies the fall in investment and the abatement of total factor productivity expansion.

Given these facts, investment and development SWFs provide a cheap source of finance for the oil-dominant currency union with constrained access to capital. Investments and development of SWFs enhance the efficiency of the combined oil and capital input and, as a result, counter the contraction of total factor productivity due to the pandemic. This is explained by the absorption capacity of the oil-dominance currency union, which includes needed public infrastructure and investment in human capital over the long term. The income effect further offset the contraction of total factor productivity via investment input productivity. As a result of the income effect, aggregate output and consumption will rise above the benchmark level and the other two scenario levels, on the one hand, and labor demand and wage will rise on the other.The increase in labor income is justified by the unleashing of labor productivity. Because stimulus takes place, counteracting the pandemic crisis output cycle The key benefit of investment and development sovereign wealth funds in an oil-dominance currency union is the increasing reduction of infrastructure gaps. The match between investment and development SWFs' long-term investment horizons and the long-term nature of infrastructure investments supports their substantial investment in infrastructure projects within the union. Investment and development SWFs are thus preferred to saving and pension SWFs and stabilization SWFs because the adjustment is immediate in the former case, even if capital gains fall overtime, causing foreign liabilities to accumulate in order to finance public investment and development infrastructural projects. The prospect of low capital gains in the global financial markets and decreased availability of government bonds within the currency union allow economic

agents to properly smooth their consumption and investment, thus aggregate output is relatively well stabilized. This seems better than saving and pension SWFs and stabilization SWFs, where foreign liabilities accumulate to a lesser extent.

Figure 3. Sovereign Wealth Funds and COVID-19 Crisis



Basically, if the financial sector within the oil-dominance currency union were deep and efficient, a sustained decrease in productivity caused by the COVID-19 would result not

only in less investment, as firms borrow less because of a lack of investment opportunities, but also in less consumption as consumers borrow less to consume in anticipation of their lower income. Moreover, nominal rigidities change the effect of a pandemic shock on private consumption and capital gain. When prices are rigid under stabilization as well as saving and pension SWFs, the adjustment to the pandemic crisis is delayed in Figure 3. Since prices are rigid and inflation with interest rates stays low over time, private consumption rebounds around zero after an initial fall, contributing to the same pattern of aggregate output from its demand side. Stabilization SWFs, in contrast, cause capital gains to drop initially, then rise, following the dynamics of domestic and imported prices, which fall due to a reduction in private consumption (headline inflation persistently declines due to the fall of core inflation), then increase over time. Savings and pension SWFs do not generate any changes for capital gain, resulting in a lower accumulation of foreign liabilities. As a result, weak financial systems under investment and development SWFs do not help in efficiently intermediating foreign capital. The seemingly perverse flows of capital from host to resource-rich countries are a sign of inefficiencies in global financial markets. In fact, due to the changing structure, the shift of SWFs from capital to more risky markets in response to the COVID-19 pandemic's resource needs triggers a net capital outflow from global financial markets.

The effects of the changing structure of SWFs may represent a threat to global financial stability. Indeed, a large current account deficit makes countries more vulnerable to the rapid reversal of capital inflows. Furthermore, surplus countries are exposed to risks linked to large international fluctuations as foreign funding inflows may generate higher inflation and asset price bubbles. Apart from the macroeconomic implications of SWFs, the increasing transfer of SWFs' portfolios is expected to result in a significant rebalancing of capital flows in the global financial markets. As investment and development SWFs essentially seek to better diversify risks and generate higher returns, their investments lead to an increasing demand for risky assets. Investment and development SWFs appear to be value-destroying as a result of driving firm managers to pursue goals that are not value-maximizing in a pandemic crisis.

All in all, investment and development SWFs, while having better stabilizing impacts on investment and output, exert destabilizing effects on the global financial cycle. Because both SWFs are unable to address sovereign explicit contingent liabilities, As a result, the trade-off between the counter-cyclicality and procyclicality properties of sovereign wealth funds determines macroeconomic stability and global financial cycle dynamics.

8 Conclusion and Policy Implications

This paper's aim was to assess the role of sovereign wealth funds for macroeconomic and global financial cycle stability in the three major crises of the past decades, namely, the global financial crisis, the oil crisis, and the COVID-19 crisis. To address this theoretical and empirical undeterminacy, we developed a Multiple-Crises Dynamic Stochastic General Equilibrium Model that disentangles five types of sovereign funds, such as stabilization sovereign wealth fund, savings sovereign wealth fund, reserve investment sovereign wealth fund, development sovereign wealth fund, and pension reserve sovereign wealth fund.

The model is applied to an oil-dominance currency union to feature the fact that, on the one hand, sovereign wealth fund operations are closely linked to monetary policy through liquidity conditions. On the other hand, sovereign wealth fund resources emanate principally from commodity export proceeds. So, in an oil-dominance currency union, the financial frictions generated by sovereign wealth funds arise as follows. We assume that the amount of loans available to an entrepreneur is limited by the value of the collateral he can pledge.In the model, collateral is materialized by commodity export proceeds. The process implies that how much commodity export proceeds an entrepreneur can accumulate depends on the minimum loan return required by banks, which in turn depends on three main components: the loan-to-value ratio, the expected future price of commodity exports pledged as collateral, and the lending rate. Consequently, variations in the quantity and value of collateral modify the transmission of financial and oil prices, as well as the COVID-19 crisis, and can amplify their effects.

Our findings reveal heterogeneity in the effects of sovereign wealth funds on both the global financial cycle and macroeconomic stabilization, which manifests itself according to the type of each sovereign wealth fund. First, saving and pension reserves SWFs have a better stabilizing impact on output from their demand side and on the global financial cycle by improving the efficiency of global asset allocation. Those shocks eradicate the adverse effects of the global financial crisis on the achievement of output stabilization within the currency union and global financial cycle stabilization. Second, stabilization SWF has better stabilization effects on inflation, notably oil inflation and imported inflation, as well as the global financial cycle, since they offset the adverse effects of the collapse of international oil prices in an oil-dominant currency union. Nevertheless, investment and development SWFs, while having better stabilizing impacts on investment, exert destabilizing effects on the global financial cycle as they are unable to minimize the distortions of large and volatile oil prices and address sovereign contingent liabilities.

Three main policy implications are drawn out of this research: firstly, policymakers can use sovereign wealth funds to smooth commodity price volatility, achieve macroeconomic stabilization, and contribute to global financial cycle stability as well. Secondly, monetary

policy should be counter-cyclical in an oil-dominant currency union rather than pro-cyclical, for the effectiveness of sovereign wealth funds. Finally, policymakers should be aware that the trade-off between the counter-cyclicality and procyclicality properties of sovereign wealth funds affects macroeconomic stability and the global financial cycle dynamic.

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