***Modelling small open developing economies in a financialized world – Adaptation for Colombian economy.***

**Production and Prices.**

1. *Variation of expected sales*

1. *Aggregate demand*

1. *Inventories and real investment in inventories*
2. *Desired inventories*
3. *Desired investment in inventories*
4. *Production*
5. *Domestic production*
6. *Capital output ratio*
7. *Imports in real terms*
8. *Variation of import propensity*
9. *Target import propensities*
10. *Real exchange rate*
11. *Exports equation*

1. *Autonomous exports growth rate.*
2. *Variation of exports propensity*
3. *Targeted exports propensity*
4. *Desired price level*
5. *Mark-up*
6. *Variation of historical unit cost*
7. *Unit cost*
8. *Change in domestic price level*

**Firms.**

1. *Gross Capital Formation.*
2. *Realized real investment.*
3. *Desired real investment.*
4. *Gross expected profits for firms*

1. *Net expected profits*
2. *Expected return per unit of capital*
3. *Total financing needs of the firms*
4. *Desired demand for FX loans*

=

1. *Effective variation of firms’ loans in foreign exchange*
2. *Variation of firms’ loans in domestic currency*
3. *FX loans arbitrage parameter.*
4. *Arbitrage criteria.*
5. *Variation of firms’ deposits in foreign exchange*
6. *Gross profits of firms*
7. *Net profits of firms*
8. *Return rate on capital*
9. *Firms dividends*

1. *Firms Dividends distributed to the rest of the world.*
2. *Firms Dividends distributed to the households.*

**Households and Labour Market.**

1. *Labour*
2. *Variation of output to labour ratio*
3. *Change in nominal wages.*
4. *Households net labour income*
5. *Households financial income.*
6. *Desired target consumption*
7. *Marginal propensities to consume out of labour income*
8. *Marginal propensities to consume out of financial income*
9. *Marginal propensities to consume out of wealth*
10. *Desired consumption variation.*
11. *Effective consumption.*
12. *Households’ loans demand.*
13. *Sensitivity parameter.*
14. *Burden of the Households (where rep is the average repayment ratio)*
15. *Households savings.*
16. *New government bonds purchased by the households.*
17. *New households’ deposits in domestic currency.*
18. *Portfolio allocation of households’ savings.*

**Government.**

1. *Fiscal revenue (where are royalties)*

1. *Tax revenue*
2. *Value added tax.*
3. *Import taxes.*
4. *Royalties.*
5. *New government deposits.*
6. *Total government spending.*
7. *Government demand.*
8. *Operating expenses.*
9. *Target public investment (we are studying how to incorporate the supply side effects).*
10. *Public investment adjustment equation.*
11. *Transfers from the government to the households.*
12. *Public deficit.*
13. *Bonds interest rate*

**Banks.**

1. *New government bonds purchased by the banks.*
2. *Desired Banks demand for cross border lending.*
3. *Effective Banks demand for cross border lending.*
4. *Cross border lending rationing parameter.*
5. *Cross border lending rate.*
6. *Cross border lending risk premium*
7. *Interest rate on FX loans charged to the firms.*
8. *Change in the premium on FX loans charged by the domestic banks.*
9. *Target premium*
10. *Interest rate on households’ loans (where is a mark – up over interest rate charged to the firms)*
11. *Required regulatory change in Banks foreign reserves*
12. *Change in central bank FX reserves*
13. *Domestic banks reserves*
14. *Total financial needs of the banks.*
15. *Liquidity advances granted by the CB*
16. *Own funds needed to accomplish the leverage regulation*
17. *Retained earnings by the banks*
18. *Change in the funds owned by the banks*
19. *Gross profits of banks*
20. *Interest rate on household deposits*
21. *Target interest rate on firms loans in domestic currency.*
22. *Average Funding Cost of the banks.*
23. *Change in interest rate on firms loans in domestic currency.*
24. *Net profits of banks*
25. *Banks dividends*
26. *Bank dividends distributed to the rest of the world.*
27. *Bank dividends distributed to the households.*

**Central Bank.**

1. *Monetary policy interest rate (simple Taylor rule)*
2. *Change in FX reserves owned by the CB.*
3. *Central Bank profits*

**World Trends and Capital Inflows.**

1. *Global Portfolio Flows*
2. *Portfolio flows entering to the domestic economy.*
3. *Share of total government bonds supply purchased by the rest of the world.*

1. *Expected domestic yield.*
2. *Expected foreign yield.*
3. *Country risk.*
4. *Net International Investment Position (NIIP)*
5. *Total FDI distribution (where is greenfield FDI and is non – greenfield FDI)*
6. *Total FDI growth.*
7. *Greenfield FDI.*
8. *Non – greenfield FDI.*
9. *Private equity accumulation by the rest of the world.*
10. *Firm’s equities accumulation by the rest of the world.*
11. *Bank’s equities accumulation by the rest of the world.*
12. *Private equity accumulation by the households.*
13. *Change in NFC equities*
14. *Change in NFC equities*
15. *Firms’ equities accumulation by the households.*
16. *Banks’ equities accumulation by the households.*

**Exchange Rate Dynamics.**

1. *Change in nominal exchange rate*
2. *FX demand.*
3. *FX supply.*
4. *Rate of change in real exchange rate.*
5. *Uncovered interest rate parity condition*
6. *Expected variation of the nominal exchange rate*

**Balance of Payments.**

1. *Income account.*
2. *Remittances recived from abroad*
3. *Balance of payments identity.*
4. *New government bonds purchased by the rest of the word*

**Consistency.**

We start with the identity of the Central Bank balance sheet in its flow form:

We replace the definition of required change in bank reserves:

We incorporate the Total Financial Needs of the banks:

Simplifying we get to:

We add the loans in foreign currency to both sides of the equation (multiplied by the nominal exchange rate):

We subtract the variation of the firms FX deposits (multiplied by the nominal exchange rate):

We add to both sides the foreign direct investment that received by the firms, knowing that :

Now we replace the firms savings knowing that :

The banks savings are equal to the retained earnings , therefore:

Knowing that , we get to:

We incorparate

Replacing the Balance of Payments Identity:

We simplify knowing that

Taking the current account definition, we get to:

Finally, taking into account the relationship between the government savings and the debt accumulation given by , we get to:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Industry | | Households | Banks | | Central Bank | | Government | RoW | ∑ |
| Current | Capital |  | Current | Capital | Current | Capital |
| Consumption  Realized Investment  Government Spending  Imports  Exports  Value Added Tax  ***[GDP]*** |  |  |  |  |  |  |  |  |  | 0  0  0  0  0 |
| Wages  Taxes on Imports  Royalties  ***[Gross Operating Surplus]*** |  |  |  |  |  |  |  |  |  | 0  0  0 |
| Interest on Deposits  Interest on Firms Loans  Interest on Households Loans  Interest on Firms FX Loans  Interest on Banks FX Loans  Interest on Bonds  Interest on Advances  Firms Dividends  Banks Dividends  ***[Gross National Income]*** |  |  |  |  |  |  |  |  |  | 0  0  0  0  0  0  0  0  0 |
| Remittances  Central Bank Profits  Taxes on Income and Profits  Welfare Spending  Savings |  |  |  |  |  | 0 | 0 |  |  | 0  0  0  0  0 |
| [Capital]  [Inventories] |  |  |  |  |  |  |  |  |  |  |
| Deposits  Reserves  Firms Loans  Households Loans  Bonds  Advances  FX deposits  FX Reserves  Firms FX Loans  Banks FX Loans  Firms Equities  Banks Equities |  |  |  |  |  |  |  |  |  | 0  0  0  0  0  0  0  0  0  0  0  0 |
| ∑ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Initial Values** | | | |
| Expected Sales |  | Government Bonds Owned by the RoW |  |
| Inventories |  | Greenfield Foreign Direct Investment |  |
| Capital Stock |  | Portfolio Foreign Direct Investment |  |
| Households Deposits | 30 | Firms Equities Owned by the RoW |  |
| Firms Indebtness (Domestic Currency) | 40 | Banks Equities Owned by the RoW |  |
| Liquidity Advances | 70 | Equities Owned by the RoW |  |
| Banks Reserves | 3 | Households Indebtness |  |
| Government Debt |  |  |  |
| Government Debt Owned by the Households |  | Desired Consumption |  |
| Historical Unitary Cost |  | Government Deposits |  |
| Banks Own Funds |  | Public Investment |  |
| Armington Propensity to Import – Exports |  | Nominal wages |  |
| Armington Propensity to Import – Investment |  | Government Bonds Owned by the Banks | 75 |
| Armington Propensity to Import – Consumption | 0.250535535322 |  |  |
| Armington Propensity to Import – Public Spending | 0.1175548075 |  |  |
| Exports Elasticity |  |  |  |
| FX Loans Arbitrage Parameter |  |  |  |
| World GDP |  |  |  |
| Population |  |  |  |
| Output to Labour Ratio |  |  |  |
| Domestic Price Level | 1 |  |  |
| International Price Level |  |  |  |
| Nominal Exchange Rate |  |  |  |
| Expected Nominal Exchange Rate |  |  |  |
| Premium on Loans |  |  |  |
| Interest Rate on Domestic Loans |  |  |  |
| Firms FX Indebtness |  |  |  |
| Banks FX Indebtness |  |  |  |
| FX Deposits |  |  |  |
| Interest Rate on FX Loans |  |  |  |
| FX Reserves |  |  |  |
| FX Reserves Owned by the Central Bank |  |  |  |
| FX Reserves Owned by the Banks |  |  |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | **Description** | **Value** | Parameter | **Description** | **Value** |
|  | Population growth rate | 0,015 |  | Proﬁt retention rate | 0,45 |
|  | Labour productivity growth rate | 0,0384 |  | Minimum FX borrowing ratio for ﬁrms | 0 |
|  | Output adjustment speed | 4 |  | Tax rate on proﬁts | 0,253 |
|  | Desired Inventory ratio | 0,25 |  | Arbitrage parameter for ﬁrms | 0 |
|  | Labour productivity | 0,21 |  | Speed of adjustment of ﬁrm debt currency allocation | 0 |
|  | Capital productivity | 0,4 |  | Firm FX deposits ratio to Firm FX debt | 0 |
|  | Elasticity of consumption imports | 0,7 |  | Exogenous share of bank bond demand | 0,7 |
|  | Elasticity of investment imports | 0,22 |  | Elasticity of bank bond demand to relative lending rates | 1 |
|  | Elasticity of export-input imports | 0,3 |  | Scaling parameter for domestic banks’ bond demand | 0,155118 |
|  | Elasticity of government spending imports | 0,2 |  | Scaling parameter for global bank leverage | 0 |
|  | Armington share parameter for consumption bundle | 0,823563 |  | Elasticity of global bank leverage to risk | -4 |
|  | Armington share parameter for investment bundle | 0,943976 |  | Elasticity of global bank leverage to foreign policy rates | -4 |
|  | Armington share parameter for export bundle | 0,990253 |  | Scaling parameter for cross-border lending supply | 0,0426 |
|  | Armington share parameter for government bundle | 0,999957 |  | Ratio of global banks’ own funds to world GDP | 0,1 |
|  | Minimum import intensity thresholds | - |  | Speed of adjustment for cross-border lending rate | 2 |
|  | Tax Rate on Imports | 0,025 |  | Speed of adjustment for premium on lending rates | 2 |
|  | Elasticity of exports to real exchange rate | 0,75 |  | Exogenous parameter in premium on lending rates | 0,005 |
|  | Scaling parameter in export share | 0,0080233 |  | Scaling parameter in premium on lending rates | 0,00096 |
|  | Import adjustment speed | 1 |  | Elasticity of premium to total debt/expected proﬁt ratio | 2 |
|  | Export adjustment speed | 1 |  | Required reserve ratio on domestic currency deposits | 0,1 |
|  | Tariffs on Exports | 0,25 |  | Capital adequacy ratio | 0,12 |
|  | Exógenous mark-up | 0 |  | Speed of adjustment to regulatory CAR ratio | 1 |
|  | Sensitivity of mark-up to inventories | 0 |  | Scaling parameter for markdown on deposit rates | 0,00047868 |
|  | Percentage of price-adjusting firms | 0,2 |  | Elasticity of mark-down on deposit rates to bank liquidity | 0,8 |
|  | Depreciation rate | 0,2 |  | Inverse maturity of domestic currency debt of ﬁrms | 0,2 |
|  | Autonomous investment | 0,23 |  | Tax rate on bank proﬁts | 0,2 |
|  | Sensitivity of investment to expected real proﬁt rate | - |  | Ratio of government spending to total production | 0,2743 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Ratio of welfare spending per unemployed to wages | 0,08 |  | Speed of exchange rate adjustment | 0,8 |
|  | Tax rate on wages | 0,025 |  | Speed of exchange rate expectations adjustment | 0,9 |
|  | Scaling parameter on government bond interest rate | 0,05 |  | Elasticity of exchange rate expectation to interest diﬀerential | 1 |
|  | Sensitivity of interest on bonds to public debt/GDP ratio | 1 |  | Scaling parameter in exchange rate expectations | 1 |
|  | Exogenous real interest rate in the Taylor Rule | 0,0325 |  | Ratio of remittances to world GDP | 0,0004 |
|  | Sensitivity of Taylor Rule to inﬂation | 1 |  | Scaling parameter for risk | 0,015 |
|  | Target FX reserve/Imports ratio for central bank | - |  | Scaling parameter for risk sigmoid | 5 |
|  | Speed of adjustment of the Phillips curve | 0,9 |  | Sensitivity of risk to net investment position | 300 |
|  | Exogenous nominal wage growth rate | 0,06 |  | Exegenous risk at zero IIP | - |
|  | Sensitivity of nominal wages to employment rate | 0,12 |  | Foreign policy rate | 0,0537032 |
|  | Base employment rate in wage dynamics | 0,8 |  | Foreign bond rate | 0,0505997 |
|  | Sensitivity of nominal wages to inﬂation | 1 |
|  | Scaling parameter for mpc out of wages | 1,15768 |
|  | Scaling parameter for mpc out of capital income | 0,902923 |
|  | Scaling parameter for mpc out of wealth | 1,14086 |
|  | Elasticity of mpc out of wages to real deposit rates | 0 |
|  | Elasticity of mpc out of capital income to real deposit rates | 0 |
|  | Elasticity of mpc out of capital income to real deposit rates | 0 |
|  | Adjustment speed of consumption to target | 4 |
|  | Exogenous share of household bond holdings | 0 |
|  | Scaling parameter for household bond holdings | - |
|  | Elasticity of household bond holding to relative returns | 0 |
|  | Ratio of global portfolio ﬂows to world GDP | - |
|  | Scaling coeﬃcient for foreign portfolio ﬂows | 0,1 |
|  | Arbitrage parameter for portfolio ﬂows | 0 |
|  |  |  |

|  |  |  |
| --- | --- | --- |
|  | Autonomous Exports | 12 |
|  |  |  |
|  |  |  |