Simulating Financial Integration: A Stock-Flow Consistent Perspective

Saed Khalil  
University of Trento

Stephen Kinsella*  
University of Limerick

February 23, 2010

Abstract

We simulate changes in financial integration between two countries in a stock-flow consistent model. Our model describes two economies that start from virtual autarky, with trade flows opening up gradually, until the countries reach full monetary union. By introducing measures of financial integration into an SFC model, we can explore the effects of fiscal and monetary policies in the presence of financial integration on output, income, wealth and households’ portfolio decisions. We find that monetary union has no significant effect on the real side of the economy, but it has effect on households’ portfolio distributions. On the other hand, the convergence of asset prices and returns leads to a convergence on the households demand for foreign assets.

*Correspondence to stephen.kinsella@ul.ie. Paper prepared for the Eastern Economic Association meetings, Philadelphia, February 2010
1 Introduction

The goal of this paper is to ask how introducing measures of financial integration into the new stock-flow consistent models pioneered by Godley and Lavoie (2007a, 2007b) affects levels of production, consumption, and output in two simulated economies. This is a timely question, since the current global financial crisis is leading to a re-evaluation of the net benefits from international financial integration. Recent data indicate that developing countries have not required net capital inflows in order to grow (Prasad at al, 2007, Rodrik and Subramanian, 2009).

Financial integration between developed countries has substantially increased during the past few decades. In Europe, the creation of economic and monetary union has accelerated the pace of financial integration regionally within Europe (Eichengreen, 2007). Other regions in the world are considering the opportunity to replicate the European integration process, for example the Association of Southeast Asian Nations (ASEAN) plus three other Asian countries, the Gulf Cooperation Council, and others.

Baele et al (2004) define financial integration as follows:

The market for a given set of financial instrument and/or services is fully integrated if all potential market participants with the same relevant characteristics:
1. they face a single set of rules when they decide to deal with those financial instruments and/or services;
2. they have equal access to the above-mentioned set of financial instruments and/or services; and
3. they are treated equally when they are active in market.

Perhaps because of the multifaceted nature of the issue of financial integration, opinions differ on what it is, and how it should be measured. Some authors aver that if assets generating identical cash flows command the same return, then two or more markets can be considered financially integrated. Others emphasize the important role of financial integration by contributing to economic growth through removing frictions and barriers to exchange (Baele et al 2004). The argument for financial integration avers that increasing financial markets integration improve the quality of macroeconomic management in emerging markets, that increased financial integration results in increased economic growth, decreased volatility, and smoothed inter-temporal consumption (Anderson and Moreno, 2005). Baele et al (2004) suggest further benefits of financial integration: more opportunities of risk sharing and risk diversification, and better allocation of capital among investment opportunities.

On the other hand, financial integration can expose countries, and particularly those with small open economies, to external shocks, which may reduce any potential growth and consumption smoothing benefits. The issue of uncertain returns in emerging markets leading to flows of capital from emerging markets to developed markets (Reinhart et al, 2003 and Reinhart and Rogoff, 2004) has not been resolved in the literature. Mendoza et. al. 2009 claim that when countries differ in the level of development of their financial markets, then financial integration can be the cause of the global financial imbalances1.

1Kose et al (2006), for example, emphasize financial integration is beneficial for economic performance if only a threshold of financial development is attained. Quality of institutions and macroeconomic policies are therefore key variables in increasing the impact of financial integration on welfare, per capita output, and capital inflows (see Lane and Milesi-Ferretti 2001, Lane 2004, Gourinchas and Jeanne 2008, and Alfaro et al 2008).
This paper aims to explore the effects of financial integration on prices, income distribution, and the business cycle for two, initially closed economies after they open up to trade with each other. We simulate three scenarios to tease out the effects of a specific set of fiscal and monetary policies in enhancing financial integration between the two countries. This paper uses an SFC approach in lines of Godley and Lavoie (2007a, 2007b), Zhao (2006), Dos Santos and Zezza (2008), and Lavoie and Zhao (2009), to simulate financial integration between two hypothetical countries.

The growth in cross-border investment positions in recent years has prompted a multi-layered global debate about the macroeconomic impact of increased financial integration. Our contribution to this debate is twofold: we introduce a novel modeling tool to that debate in the form of a stock-flow consistent model with endogenous money, and we extend the new class of stock flow consistent models to allow for financial integration, which, to our knowledge, has not been done before in the stock flow consistent literature.

We assume one country is small in terms of its gross national product, and the other is large. Starting from an autarky condition in both countries, we are going to run some simulation experiments to explore the effect of some policies and agreements on the degree of the financial integration in both countries. There are several ways of measuring financial integration directly or indirectly. Some are based on checking the number of existing frictions and barriers to the intermediation process, so the more symmetric frictions and barriers the more the degree of financial integration. Others concentrate on the prices of assets in each economy, so the closer these relative prices (or their coefficient of dispersion) the more financial integration measured (Flood and Rose 2004, Pagano 2002).

In this paper we use the index built by Lane and Milesi-Ferretti (2001a and 2007a). This index is a volume-based measure of international financial integration:

$$IFI_i^t = \frac{FA_i^t + FL_i^t}{GDP_i^t},$$

where $IFI_i^t$ is the index for country $i$ at time $t$, $FA$ is foreign assets held, and $FL$ is foreign liabilities held.

This measure has two advantages: first, it is the financial analogue to measuring trade openness by the ratio of exports plus imports over GDP, and so is easily interpreted. Second, the measure is well established in the literature, and so the results of our simulations can be compared with other studies such as Lane and Milesi-Ferretti (2007a, 2007b).

This paper is organized as follows. The model’s balance sheets and transactions flows matrix are constructed in section 2. A description of the model equations and identities for both economies are introduced in section 3. We report the results of our scenarios in section 4. Section 5 concludes.

---

More precisely, SFC models are macrodynamic models based on national income and product accounts (NIPA) and flow of funds accounts (FOF). Godley and Lavoie (2007) and Taylor (2004b) introduce a promising approach to modeling and analyzing NIPA and FOF. SFC models are set up in such a way as to facilitate the construction of behavioral macroeconomic model in the tradition of Keynes-Kalecki. SFC models incorporate real and financial relations for all economic sectors in a consistent way (Dos Santos and Zezza, 2008), consequently, all flows to one economic sector are coming from the other sectors, so the inflows for one sector are outflows from other sectors.
2 Model Matrices

Figure 1 shows the balance sheets of the first and the second country, respectively. Each country’s economy is divided into five sectors: households, firms, government, central bank, and private banks. All rows and columns of the balance sheet matrix must sum to zero. Apart from fixed capital $K$, inventories $IN$, and reserves $R$, every asset (+) is a financial asset which has a counterpart liability (-). Household wealth in each country has five components: cash or high powered money $H$, deposits $M$, domestic bills $B_{hi,d}^i$, foreign bills $B_{hi,d}^j$, and equities $e$ values at their price $p_e$, where $i$ and $j$ are equal to 1 and 2 and $i \neq j$.

The net worth of firms, $NW_f$, in each economy is defined as the difference between all their assets—fixed capital and inventories—and all their liabilities—loans, $L_{f,d}^1$, and the market value of equities. The net worth of the government (the government deficit) is equal to total bills supplied, such that the sign of government net worth is always negative. Central banks’ assets are their holdings of domestic and foreign bills, and of course, their reserves. The main role of the central banks is to supply money, considered here as a liability for the central banks. Private banks’ net worths are assumed to equal zero in this model. Loans, vault cash, and domestic bills are the assets of banks, and deposits are their counterpart liabilities.

Governments supply bills to domestic and foreign households, banks, and domestic and foreign central banks. Firms are assumed to take loans from the private banks and supply equities to households. Private banks also accept deposits from households, and must keep a portion of their liabilities as vault cash as mandated by the central bank in each country.

Figure 2 describes the transactions and flows within and between all economic sectors of the two economies. As with the balance sheet shown in figure 1, all rows and columns must sum up to zero. Each country’s transactions are measured in its currency. Source of funds are in (+) signs and use of funds are in (-) signs. As shown in the matrix in the current account column of the firms, households consumption, government expenditure, investment, exports, and the change in inventories are used to finance wages, taxes, imports, and interest on loans taken from the private banks. The remainder are profits transferred to households. Firms take loans and issue equities to finance their investments, and the change in inventories, as shown in the firms’ capital account column.

Households receive wages, profits, and interest on their holdings of financial assets, and they use these flows for consumption and to pay taxes on their income. The residual, savings, is used to acquire more financial assets. Governments collect taxes from the households and the firms, and take all the central bank’s profits to finance governmental expenses. The difference between the government’s inflows and outflows determines the public sector borrowing requirement (PSBR).

Central banks receive profits in the form of interest payments on their holdings of domestic and foreign assets, and they transfer these profits to the government. The change in their holdings of the assets determines the quantity of money they have to supply in any period. Banks generate profit from the difference between their ingoing and outgoing interest rates. Changes in deposits determine how much banks can give in loans and acquire in assets. The assumption of no private holdings of foreign cash money implies that all transactions of foreign currency by trade of goods or assets are simultaneously exchanged by the central bank into domestic currency. In section 3, we introduce and describe the model’s equations and accounting identities.
3 Model Equations and Identities

In this section, the model’s equations and identities are introduced. These equations and identities describe the balance sheets and transactions flows constraints, the behavior, and decisions taken in each economic sector for both countries. The uppercase variables are in nominal values and the lower case variables are in real terms.

3.1 Firms

Before starting with the equations that describes the firms’ decisions, we first describe nominal gross domestic product (GDP) for each country. $Y^i$ here is GDP, equal to the values of consumption $C^i$, government expenditure $G^i$, real gross investment $I^i$, change in inventories $\Delta in^i.UC^i$, exports $X^i$, and imports $IM^i$, where $i = 1$ (the first country) and $i = 2$ (the second country).

\[
Y^1 = C^1 + G^1 + I^1 + \Delta in^1.UC^1 + X^1 - IM^1 \tag{1}
\]
\[
Y^2 = C^2 + G^2 + I^2 + \Delta in^2.UC^2 + X^2 - IM^2 \tag{2}
\]

We account for total sales $s$ in each country, comprised of real consumption, $c$, real government expenditure, $g$ real gross investment, $i$, and real exports, $x$, via:

\[
s^1 = c^1 + g^1 + i^1 + x^1, \tag{3}
\]

and

\[
s^2 = c^2 + g^2 + i^2 + x^2. \tag{4}
\]

The real value of fixed capital of firms is assumed to accumulate at the rate $gr^i_k$ in each economy, following:

\[
\Delta k^1 = 1 + gr^1_k \tag{5}
\]
\[
\Delta k^2 = 1 + gr^2_k. \tag{6}
\]

Real gross investment, of course, depends upon the accumulation rate:

\[
i^1 = gr^1_k.k^1_{-1} \tag{7}
\]
\[
i^2 = gr^2_k.k^2_{-1}. \tag{8}
\]

The values of fixed capital are equal to the level of real fixed capital, $k$, multiplied by the price of domestic sales. The equations below denote the values of gross investment, via
\[ K^1 = k^1 \cdot P^1_{ds} \]  \[ K^2 = k^2 \cdot P^2_{ds}, \]  

and

\[ I^1 = i^1 \cdot P^1_{ds} \]  \[ I^2 = i^2 \cdot P^2_{ds}. \]

At any period \( t \), the price level \( P \) of sales is a mark up, \( \phi \), on costs, where \( WB \) is the wage bill and \( IM \) is imports. All profits earned by firms as a result of the mark up are assumed to be transferred to the households as they are considered the owners of firms.

\[ P^1_s = \frac{(1 + \phi^1)(WB^1 + IM^1)}{s^1} \]  \[ P^2_s = \frac{(1 + \phi^2)(WB^2 + IM^2)}{s^2} \]

The domestic sales price level is given by the interaction of domestic and foreign products.

\[ P^1_{ds} = \frac{(S^1 - X^1)}{(s^1 - x^1)} \]  \[ P^2_{ds} = \frac{(S^2 - X^2)}{(s^2 - x^2)} \]

The wage bill in each country is equal to the wage rate multiplied by the number of employees.

Firms’ profits are determined from the current account column in the transactions flows matrix. Profits are what left from output (sales and change in inventories) after deducting individual and total costs (imports, taxes, wage bill, interest on loans).

\[ F^1_f = S^1 - IM^1 + \Delta IN^1 - T^1_f - WB^1 - r_{l-1}^1 \cdot L^1_{fd-1} \]  \[ F^2_f = S^2 - IM^2 + \Delta IN^2 - T^2_f - WB^2 - r_{l-1}^2 \cdot L^2_{fd-1} \]

The change in the volume of inventories is the difference between real output, \( y \), and real sales. Inventories are valued at their cost of production, \( UC \), via

\[ \Delta in^1 = y^1 - s^1 + im^1 \]  \[ \Delta in^2 = y^2 - s^2 + im^2, \]
and

\[ IN^1 = in^1.UC^1 \]  \hspace{1cm} (21)
\[ IN^2 = in^2.UC^2. \]  \hspace{1cm} (22)

Loans demanded by firms can be computed from their capital account column. Loans are used by firms to absorb unexpected changes in financial requirements. Firms’ demand for loans will increase if inventories increase, as they want to finance their investments, and diminish when firms make new issues of equities \((\Delta e_{s,p_e})\).

\[
\Delta L^1_{fd} = \Delta I N^1 + I^1 - \Delta e_{s,P_e}^1 \\
\Delta L^2_{fd} = \Delta I N^2 + I^2 - \Delta e_{s,P_e}^2
\]  \hspace{1cm} (23)

We assume the unit costs faced by each firm is equal to the ratio of wage bill to real output in each country:

\[
UC^1 = \frac{WB^1}{y^1} \\
UC^2 = \frac{WB^2}{y^2}
\]  \hspace{1cm} (25)

The desired number of employees in production process is equal to the real output divided by labor productivity:

\[
N^1 = \frac{y^1}{Pr^1} \\
N^2 = \frac{y^2}{Pr^2}
\]  \hspace{1cm} (27)

Price inflation \(p_{1,2}\) in each country is given by:

\[
\pi^1 = \frac{\Delta P^1}{P^1_s} \\
\pi^2 = \frac{\Delta P^2}{P^2_s}
\]  \hspace{1cm} (29)

We construct the output price deflator as follows:

\[
P^1_y = \frac{Y^1}{y^1} \\
P^2_y = \frac{Y^2}{y^2}
\]  \hspace{1cm} (31)

Below we describe the dynamics of determining the wage rate in each country. Employees put a real target wage rate \((W/P)^T\) based on labor productivity, \(\theta\), plus an initial value. The nominal
wage rate, $W$, depends upon the real target wage rate, and the ratio of the nominal wage rate to the sales prices in the previous period. Export and import price equations and the volume of imports equations are in logs.

\[
\omega^T_1 = \left( \frac{W^1}{P^s_1} \right)^T = \Omega_0^1 + \Omega_1^1 Pr^1
\]

\[
W^1 = W^1_{-1} \left( 1 + \Omega_3^1 \left( \omega^T_{-1} - \left( \frac{W^1}{P^s_{-1}} \right) \right) \right)
\]

\[
\omega^T_2 = \left( \frac{W^2}{P^s_2} \right)^T = \Omega_0^2 + \Omega_1^2 Pr^2
\]

\[
W^2 = W^2_{-1} \left( 1 + \Omega_3^2 \left( \omega^T_{-1} - \left( \frac{W^2}{P^s_{-1}} \right) \right) \right)
\]

### 3.2 Foreign trade

The following equations describe the trade flows between the two countries and their relevant prices. Equations 37 and 38 describe the import price level. Import prices are determined by the exchange rate, domestic and foreign prices, and taxes levied on imports. They show that if the domestic currency appreciates with respect to the other country’s currency then import prices decline. We see that import prices increase with the increase of domestic price deflator, the foreign price deflator, and taxes on imports.

\[
p^1_m = v_0^1 - v_1^1.E_1 + v_2^1p_1^y + v_3^1p_2^y + v_4^1T^1_{im}
\]

\[
p^2_m = v_0^2 + v_1^2 \frac{1}{E_1} + v_2^2p_2^y + v_3^2p_1^y + v_4^2T^2_{im}
\]

where $0 < v < 1$.

Export prices can be determined on the same way as import prices except that there are no taxes levied on exports:

\[
p^1_x = v_0^1 - v_1^1.E_1 + v_2^1p_1^y + v_3^1p_2^y
\]

\[
p^2_x = v_0^2 - v_1^2 \frac{1}{E_1} + v_2^2p_2^y + v_3^1p_1^y
\]

where $0 < v < v < 1$.

One can also discover export prices by multiplying the import prices by the relevant exchange rate equations, given that all costs of trading like shipments and insurance are equal to zero for simplicity (equations 41 and 42).
\[
P^1_x = P^2_m \frac{1}{E_1} \quad (41)
\]
\[
P^2_x = P^1_m \cdot E_1 \quad (42)
\]

One can use either equations 41 or 42 to determine the currency exchange rate between the first and the second country:

\[
E_1 = \frac{P^2_m}{P^1_x} \quad (43)
\]

where \( E_1 \) is the price of one unit currency of country one in terms of the second country currency, i.e. the price that country two needs to buy one unit of the first country currency. The price of the second country currency in terms of the first country currency is the reciprocal of \( E_1 \). Real imports of each country respond with elasticities \( \mu_1 \) with respect to import prices relative to domestic prices–valued in domestic currency–and \( \mu_2 \) with domestic real output (equations 44 and 45).

\[
im^1 = \mu_0^1 - \mu_1^1.(P^1_{m-1} - P^1_{y-1}) + \mu_2^1.y^1 \quad (44)
\]
\[
im^2 = \mu_0^2 - \mu_1^2.(P^2_{m-1} - P^2_{y-1}) + \mu_2^2.y^2 \quad (45)
\]

Equations 46 and 47 are real exports of each country to the other two countries. Volume of exports of country one to two are the volume of imports of country two from one.

\[
x^1 = im^2 \quad (46)
\]
\[
x^2 = im^1 \quad (47)
\]

Equations 48 and 49 are the values of exports of each country to the other countries.

\[
X^1 = x^1.P^1_x \quad (48)
\]
\[
X^2 = x^2.P^2_x \quad (49)
\]

Value of imports of each country is equal to the real imports times the import price:

\[
IM^1 = im^1.P^1_m \quad (50)
\]
\[
IM^2 = im^2.P^2_m \quad (51)
\]
3.3 Current and capital accounts

Here we describe the current and capital accounts of each country. Below we show the current account equations of the two countries. The current account balance is the difference between the values of exports and imports plus the net current transfers, which in this model is the difference between ingoing and outgoing interests on treasury bills acquired in the two countries.

\[
CAB^1 = X^1 - IM^1 + r_{b-1}^2 B_{h1d-1}^2 + r_{b-1}^1 B_{cb1d-1}^2 - r_{b-1}^1 B_{h2d-1}^1 E_1 
\]

\[
CAB^2 = X^2 - IM^2 + r_{b-1}^1 B_{h2d-1}^1 - r_{b-1}^2 B_{h1d-1}^1 \frac{1}{E_1} - r_{b-1}^1 B_{cb1d-1}^2 \frac{1}{E_1} 
\]

(52)

(53)

Capital account balance in this model is the net change of treasury bills in each country:

\[
KAB^1 = \Delta B_{h2s}^1 - \Delta B_{h1s}^2 . E_1 - \Delta B_{cb1s}^2 . E_1, 
\]

(54)

and:

\[
KAB^2 = \Delta B_{h1s}^2 + \Delta B_{cb1s}^1 - \Delta B_{h2s}^1 . \frac{1}{E_1}. 
\]

(55)

3.4 Households sector

This subsection describe the income flows, wealth level, and decisions regarding consumption and portfolio distribution.

Equations 56 and 57 describes the evolution of personal income, \(YP\) which depends upon wages, profits (\(F\)) transferred from the firm and bank sectors, interests on their holdings of financial assets \(r\), and the capital gains or losses generated from the changes in the exchange rate \(E\), and in equity prices \(P_e\). In the following equations, for example, \(B_{h1d-1}^1\) means that bills issued by country one and demanded by country one’s households in the previous period, and \(B_{h2d-1}^2\) means that bills issued by country two and demanded by country one’s households in the previous period.

\[
YP^1 = WB^1 + F^1 + r_{m-1}^1 . M_{d-1}^1 + r_{b-1}^1 . B_{h1d-1}^1 + r_{b-1}^2 . B_{h2d-1}^2 + \Delta \left( \frac{1}{E_1} \right) . B_{h1s-1}^2 + \Delta (P_e^1) . e_{d-1}^1 
\]

(56)

\[
YP^2 = WB^2 + F^2 + r_{m-1}^2 . M_{d-1}^2 + r_{b-1}^1 . B_{h2d-1}^1 + r_{b-1}^2 . B_{h1d-1}^2 + \Delta (E_1) . B_{h1s-1}^1 + \Delta (P_e^2) . e_{d-1}^2 
\]

(57)
The following two equations are households disposable income, which equals to the personal income after deducting the income tax which in turn is a fixed portion, $\theta$, of the personal income.

\begin{align}
Y D^1 &= Y P^1 - T^1 = (1 - \theta)Y P^1 \\
Y D^2 &= Y P^2 - T^2 = (1 - \theta^2)Y P^2
\end{align}

Equations 60 and 61 are the change in the households wealth level, which is what left from disposable income after consumption.

\begin{align}
\Delta V^1 &= Y D^1 - C^1 \\
\Delta V^2 &= Y D^2 - C^2
\end{align}

Capital gains or losses are given by equations 62 and 63.

\begin{align}
CG^1 &= \Delta \left( \frac{1}{E_1} \right) . B_{h1}^2 . s_{-1} + \Delta \left( P_e^1 \right) . e_{d-1}^1 \\
CG^2 &= \Delta \left( E_1 \right) . B_{h2}^2 . s_{-1} + \Delta \left( P_e^2 \right) . e_{d-1}^2
\end{align}

Households net accumulation of financial assets is what left from the change in their wealth level after deducting the capital gains or losses:

\begin{align}
NAFA^1 &= \Delta V^1 - CG^1, \\
NAFA^2 &= \Delta V^2 - CG^2.
\end{align}

Consumption decisions taken by the households in real terms depend upon two factors: real disposable income this period, $yd^1$, and their previous level of real wealth, $v_{-1}^1$. In this model it is assumed that households consume proportionately more from their disposable income than from their wealth level i.e., $0 < \alpha_2 < \alpha_1 < 1$. The value of societal consumption $C$, is the multiplication of real consumption with domestic prices:

\begin{align}
c^1 &= \alpha_1^1 . yd^1 + \alpha_2^1 . v_{-1}^1 \\
c^2 &= \alpha_1^2 . yd^2 + \alpha_2^2 . v_{-1}^2
\end{align}

\begin{align}
C^1 &= c^1 . P_{ds}^1 \\
C^2 &= c^2 . P_{ds}^2
\end{align}
Real disposable income is not simply equal to nominal disposable income over domestic prices but it needs another term that take into account the possible inflation losses, which we call $\frac{\Delta P_{1ds}}{P_{1ds}}$. Godley and Lavoie 2007 provides an equation that explains the possible inflation losses:

\[
yd^1 = \frac{YD^1}{P_{1ds}} \cdot \frac{\Delta P_{1ds}}{P_{1ds}},
\]
(70)

\[
yd^2 = \frac{YD^2}{P_{2ds}} \cdot \frac{\Delta P_{2ds}}{P_{2ds}}.
\]
(71)

Real household wealth is the value of the households wealth, $V$, deflated by the domestic sales price level:

\[
v^1 = \frac{V^1}{P_{1ds}},
\]
(72)

\[
v^2 = \frac{V^2}{P_{2ds}}.
\]
(73)

In this model it is assumed that firms’ and banks’ profits are transferred to the households sector. Total profits earned by the households are equal to the firms’ profits and bank’s profits:

\[
F^1 = F^1_f + F^1_b,
\]
(74)

\[
F^2 = F^2_f + F^2_b.
\]
(75)

Households portfolio contains cash money or high powered money, deposits, domestic and foreign bills, and equities. It is assumed that households keep a portion $\lambda_c$ of their consumption as cash money:

\[
H^1_{h,d} = \lambda_c^1 \cdot C^1,
\]
(76)

\[
H^2_{h,d} = \lambda_c^2 \cdot C^2.
\]
(77)

Now, before defining demand functions for the rest households’ assets, it is possible to subtract the cash money from the total households’ wealth and have a net of cash wealth level, which we can measure in our simulations.

\[
V^1_{nc} = V^1 - H^1_{h,d}
\]
(78)

\[
V^2_{nc} = V^2 - H^2_{h,d}
\]
(79)
Below, we describe the demand functions for deposits \( M^1_d / V^1_{nc} \), domestic and foreign bills \( B^1/V \), and equities \( e^1_d. P^1_e / V^1_{nc} \). The demand for one asset is positively related to its interest or return rate and negatively on the other assets’ interest or return rates. Regarding foreign assets, there is another factor besides the interest rate determining the demand for money, which is the growth rate of the exchange rate,

\[
\begin{align*}
M^1_d / V^1_{nc} &= \lambda^1_{10} + \lambda^1_{11} r^1_m + \lambda^1_{12} r^1_b + \lambda^1_{13} (r^2_b + d \left( \frac{1}{E_1} \right)) + \lambda^1_{14} r^1_k \quad (80) \\
B^1_{h1, d} / V^1_{nc} &= \lambda^1_{20} + \lambda^1_{21} r^1_m + \lambda^1_{22} r^1_b + \lambda^1_{23} (r^2_b + d \left( \frac{1}{E_1} \right)) + \lambda^1_{24} r^1_k \quad (81) \\
B^2_{h1, d} / V^1_{nc} &= \lambda^1_{30} + \lambda^1_{31} r^1_m + \lambda^1_{32} r^1_b + \lambda^1_{33} (r^2_b + d \left( \frac{1}{E_1} \right)) + \lambda^1_{34} r^1_k \quad (82) \\
e^1_d. P^1_e / V^1_{nc} &= \lambda^1_{50} + \lambda^1_{51} r^1_m + \lambda^1_{52} r^1_b + \lambda^1_{53} (r^2_b + d \left( \frac{1}{E_1} \right)) + \lambda^1_{54} r^1_k \quad (83)
\end{align*}
\]

Subject to our demand equations satisfying a diagonal constraint, we can rewrite the above as

\[
\begin{align*}
M^1_d &= V^1_{nc} - B^1_{h1, d} - B^2_{h1, d} - e^1_d. P^1_e \quad (88) \\
M^2_d &= V^2_{nc} - B^1_{h2, d} - B^2_{h2, d} - e^2_d. P^2_e \quad (89)
\end{align*}
\]

The growth rate of the exchange rates are:

\[
\begin{align*}
d(E_1) &= \frac{\Delta E_1}{E_1} \quad (90) \\
d \left( \frac{1}{E_1} \right) &= \frac{\Delta (1/E_1)}{(1/E_1)} \quad (91)
\end{align*}
\]

Here \( E_1 \) the number of units of the first country currency in terms of one unit of the second country’s currency, \( E_2 \) is the number of units of the first country currency in terms of one unit of the third country’s currency, and \( E_3 \) is the number of units of the second country currency in terms of one unit of the third country’s currency.
3.5 The government

Real government expenditure is given by equations 92 and 93, and in both countries are assumed to grow at a constant rate, $gr_g$. The value of the government expenditure is equal to the real government expenditure multiplied by the domestic price level (equations 94 and 95).

$$g^1 = g^1(-1).(1 + gr^1_g) \quad (92)$$

$$g^2 = g^2(-1).(1 + gr^2_g) \quad (93)$$

$$G^1 = g^1.P^1_{ds} \quad (94)$$

$$G^2 = g^2.P^2_{ds} \quad (95)$$

Governments are assumed to collect taxes on income, sales, and imports. Equations 96 and 97 describe the total taxes collected by the government.

$$T^1 = T^1_h + T^1_f \quad (96)$$

$$T^2 = T^2_h + T^2_f \quad (97)$$

where income tax, $T_h$, proportional to total household wealth $YP$, where the tax rate is a policy variable $\theta$ set by the government, is given by equations 98 and 99:

$$T^1_h = \theta^1.YP^1 \quad (98)$$

$$T^2_h = \theta^2.YP^2 \quad (99)$$

and tax on firms $T_f$ are given by equations 100 and 101, which is the sum of sales tax and import tax.

$$T^1_f = T^1_s + T^1_im \quad (100)$$

$$T^2_f = T^2_s + T^2_im \quad (101)$$

Sales tax is a proportion $(\tau_s/(1+\tau_s))$ of the firms’ sales (equations 102 and 103).

$$T^1_s = S^1 \cdot \frac{\tau_s}{1 + \tau_s} \quad (102)$$

$$T^2_s = S^2 \cdot \frac{\tau_s}{1 + \tau_s} \quad (103)$$

Taxes on imports are assumed to be a portion $(\tau_{im}/(1+\tau_{im}))$ of the value of imports:

$$T^1_{im} = IM^1 \cdot \frac{\tau_{im}}{1 + \tau_{im}} \quad (104)$$

$$T^2_{im} = IM^2 \cdot \frac{\tau_{im}}{1 + \tau_{im}} \quad (105)$$

Governments supply bills $B_s$ based on their budget balance, to cover the budget deficit:

$$\Delta B^1_s = G^1 + \tau^1_b \cdot B^1_{s-1} - (T^1 + F^1_{cb}) \quad (106)$$

$$\Delta B^2_s = G^2 + \tau^2_b \cdot B^2_{s-1} - (T^2 + F^2_{cb}) \quad (107)$$
Governments supply bills to fulfill the domestic and foreign demands. Bills are supplied to domestic and foreign households and domestic banks. The rest goes to the domestic central bank. The second country is assumed to supply bills to domestic and foreign households, domestic banks and foreign central bank. The rest goes to the domestic central bank.

3.6 The central bank

The central banks supply high powered money to households and banks. High powered money assumed not to be purchased outside the country. Equations 108 and 109 are the supply of high powered money and they depend upon the change in domestic and foreign bills acquired by the central banks.

\[
\Delta H_s^1 = \Delta B_{cb1d}^1 + \Delta B_{cb2d}^2 \tag{108}
\]

\[
\Delta H_s^2 = \Delta B_{cb2d}^2 \tag{109}
\]

The central bank in each country is assumed to purchase the residual of the supplied bills by the government after what is sold to the domestic and foreign households, banks, and central banks:

\[
B_{cb1d}^1 = B_s^1 - B_{h1s}^1 - B_{b1s}^1 - B_{h2s}^1 \tag{110}
\]

\[
B_{cb2d}^2 = B_s^2 - B_{h2s}^2 - B_{b2s}^2 - B_{h1s}^2 - B_{cb1s}^2 \tag{111}
\]

Since the exchange rate between both currencies are assumed to be floating, \(B_{cb1d}^2\) can be set as a constant and reserves can be neglected in both countries. Central banks profits are the interest they receive on their holdings of domestic and foreign bills:

\[
F_{cb}^1 = r_{b-1}s \cdot B_{cb1d-1}^1 + r_{b-1}B_{cbd-1} \tag{112}
\]

\[
F_{cb}^2 = r_{b-1}s \cdot B_{cb2d-1}^2 \tag{113}
\]

Central banks supply cash money \(H_h\) to households based on their demand:

\[
H_{hs}^1 = H_{hd}^1 \tag{114}
\]

\[
H_{hs}^2 = H_{hd}^2 \tag{115}
\]

3.7 Private banks

Private banks generate profits by giving loans to firms and by holding domestic bills. Banks also pay interest on deposits they accept from households. Equations 116 and 117 are banks’ profits in each country.

\[
F_b^1 = r_{f-1}s \cdot L_{f1s-1}^1 + r_{b-1}s \cdot B_{b1d-1}^1 - r_{m-1}s \cdot M_{s-1}^1 \tag{116}
\]

\[
F_b^2 = r_{f-1}s \cdot L_{f2s-1}^2 + r_{b-1}s \cdot B_{b2d-1}^2 - r_{m-1}s \cdot M_{s-1}^2 \tag{117}
\]

Banks assumed to supply loans on demand:

\[
L_{f1s}^1 = L_{f1d}^1 \tag{118}
\]

\[
L_{f2s}^2 = L_{f2d}^2 \tag{119}
\]
Money supplied to banks is equal to the difference between the total money supply and cash money demand by households:

\[ H_{bs}^1 = H_s^1 - H_{hd}^1 \]  
\[ H_{bs}^2 = H_s^2 - H_{hd}^2 \]

Banks are obliged by the central bank orders to keep reserves in form of vault cash and these reserves must be some proportion of their liabilities, which are deposits in this model:

\[ H_{bd}^1 = \rho^1 M_s^1 \]  
\[ H_{bd}^2 = \rho^2 M_s^2 \]

where \( \rho \) is called the compulsory or required reserve ratio. The demand for domestic bills is the residual of deposits after subtracting vault cash and loans (equations 124 and 125).

\[ B_{b1d}^1 = M_s^1 - H_{bd}^1 - L_{f1d}^1 \]  
\[ B_{b2d}^2 = M_s^2 - H_{bd}^2 - L_{f2d}^2 \]

Bank liquidity ratio is the bank’s liquid assets over liabilities (equations 126 and 127).

\[ BLR^1 = \frac{B_{b1d}^1}{M_s^1} \]  
\[ BLR^2 = \frac{B_{b2d}^2}{M_s^2} \]

Interest on deposits depends upon bank liquidity ratio and change in bills interest rate. If bank liquidity ratio goes above (below) a certain level then banks increase (decrease) the interest rate on deposits to keep the liquidity ratio in a specific range. Bills rate also affect the interest rate on deposits, if the change in bills interest rate increase (decrease) then banks are assumed to increase (decrease) the deposits rate to keep deposits at a certain level. Below we show the dynamics of setting the deposit interest rates in both countries.

\[ r_m^1 = r_{m-1}^1 + \Delta r_m^1 + \xi_b^1 \Delta r_b^1 \]  
\[ \Delta r_m^1 = \xi_{m1}(z_1^1 - z_2^1) \]  
\[ z_1^1 = 1 \quad iff \quad BLR^1 < bot^1 \]  
\[ z_2^1 = 1 \quad iff \quad BLR^1 > bot^1 \]

\[ r_m^2 = r_{m-1}^2 + \Delta r_m^2 + \xi_b^2 \Delta r_b^2 \]  
\[ \Delta r_m^2 = \xi_{m2}(z_1^2 - z_2^2) \]  
\[ z_1^2 = 1 \quad iff \quad BLR^2 < bot^2 \]  
\[ z_2^2 = 1 \quad iff \quad BLR^2 > bot^2 \]

Banks work to keep their profits margins in a specific range. If this margin goes below (above) a certain value then banks increase (decrease) the interest rate on loans, also interest rate on
loans affected by the change by the bills interest rate. If the change in bills interest rate increase (decrease) then the loans interest rate increase (decrease). Equations 136–145 show the dynamics of setting the loans interest rate in the two countries.

\[ r^1_t = r^1_{t-1} + \Delta r^1_t + \Delta r^b_t \]  
\[ \Delta r^1_t = \xi^1_t.(z^1_3 - z^1_4) \]  
\[ z^1_3 = 1 \quad \text{iff} \quad BPM^1 < botpm^1 \]  
\[ z^1_4 = 1 \quad \text{iff} \quad BPM^1 > botpm^1 \]  

\[ r^2_t = r^2_{t-1} + \Delta r^2_t + \Delta r^b_t \]  
\[ \Delta r^2_t = \xi^2_t.(z^2_3 - z^2_4) \]  
\[ z^2_3 = 1 \quad \text{iff} \quad BPM^2 < botpm^2 \]  
\[ z^2_4 = 1 \quad \text{iff} \quad BPM^2 > botpm^2 \]  

where bank profit margin is given by the following equations.

\[ BPM^1 = \frac{F^1_b + F^1_{b-1}}{M^1_{s-1} + M^1_{s-2}} \]  
\[ BPM^2 = \frac{F^2_b + F^2_{b-1}}{M^2_{s-1} + M^2_{s-2}} \]

This closes our model\textsuperscript{3}.

\section{Model Simulations}

We present the results of our simulation experiments in this section. The baseline scenario assumes an autarky condition in both countries. Both countries are assumed to be closed, and do not trade goods, services, or assets. Both economies are assumed to grow by a constant growth rate in real government expenditure, 1 percent, and real fixed capital, 1 percent, in the two countries.

\subsection{First scenario: Countries open to trade from autarky}

What happens in both countries after they open to trade between each other? The two countries now export goods and services to each other, and households in both countries can now purchase foreign treasury bills, equities, products, and services. The first country is considered to be the smaller one, and as a consequence the first country’s central bank purchases foreign treasury bills from the second country, but the second country’s central bank does not, initially. When countries tend to open to trade, they need to build or upgrade needed infrastructure, introduce legislation and relevant laws in order to facilitate trade between both countries, and alter the productive structure of the economy as a result of competitive pressures.

\textsuperscript{3}An Eviews work file to run the program may be obtained by contacting the authors.
We simulate each scenario for various random seeds, over a notional period of 65 years.

Governments are assumed to spend more after they open to trade. Governments have to fulfill the foreign demand for their treasury bills, but the supply of bills is constrained by the government budget. The best way to increase the supply of treasury bills is by increasing government expenditure.

Figures 5 and 6 show the evolution of each country’s real GDP in the case of autarky, free trade, and monetary union. Clearly the impact of a full monetary union is beneficial, moving both economies to a higher permanent level of output, as documented in the existing literature.

4.2 Second scenario: When different free trade agreements meet

The aim of this scenario is to see the effect of fiscal and monetary policies on financial integration. In the second scenario two experiments are going to be conducted: the first is by assuming that both countries sign an agreement to free the trade between them by eliminating all trade barriers between them. In this scenario, taxes on imports are considered as a proxy of trade barriers, so we reduce the import tax to zero in this experiment. The second part of this experiment assumes that both countries set the interest rate on treasury bills at the same rate.

Treasury bills rate in the first country is equal to 3.8 percent and in the second country is equal to 3.3 percent. Moving to interest rate parity, both bills rate are now set equal to 3.3 percent. In this model, the price of each treasury bill issued by the government is equal to one unit currency of that country, one can assume that the prices are different and then equalize them to see the effect on financial integration. Clearly the impact on GDP of the smaller economy as shown in figure 7 is much larger than the corresponding trade effect in the larger economy.

4.3 Third scenario: Monetary union

One may increase financial integration between countries by entering monetary union. This scenario assumes that both countries sign an agreement for monetary union and are now using a single currency (the second country currency). As a consequence, the value of all assets, liabilities, and stocks in the first country are valued in terms of the second country’s currency\(^4\).

Following this scenario, the two countries now have one central bank which accepts treasury bills from both government, issues currency to both countries based on their demand, and transfers its profits to both governments based on returns generated from its holdings of each country’s assets (treasury bills).

Figure 3 describes the balance sheet and figure 4 describes the transactions flows matrix in the case of monetary union.

\(^4\)For example, if each unit of the first country currency was equal to 1.18 units of the second country currency, all values in the first country will increase by 1.18.
\[
H_s = H_s^1 + H_s^2, \\
B_{cb,d}^1 = B_{cb,1}^1 d + B_{cb,1}^2, \\
B_{cb,d}^2 = B_{cb,2}^2, \\
R = R^1 + R^2, \\
F_{cb} = F_{cb}^1 + F_{cb}^2.
\]

Figures 5 and 6 show the evolution of real GDP in the first and the second country. The Figures show that real GDP in both countries jumps after opening to trade. This jump is mainly due to the increase in household consumption and government expenditure. After opening to trade the price level in both countries declines, see figures 7 and 8, and leads to more consumption of the households sectors due to the increase in real disposable income and real wealth (see equations 66 and 67). The increase in the real government expenditure in both countries, which is needed to facilitate the trade between the two countries, leads to an increase in firms production and thus real GDP.

In the first experiment for the second scenario, the two governments sign a free trade agreement and the tax rate on imports become zero. This agreement leads to a decline in the import prices in both countries which in turn leads to a decline in the price levels in both countries. This leads to an increase in the households consumption. This is reflected into a more production and trade between both countries and thus an increase in the real GDP for both countries. The increase in real government expenditure in the first scenario and the decline in the tax collection in the second scenario lead to an increase in the government budget deficit. A Government budget deficit is financed by issuing treasury bills to the domestic and foreign public, domestic commercial banks, and the rest will be purchased by the central bank of that country. Figures 9 and 10 show the evolution of treasury bills supplied by the government in each country.

The second part of the second scenario is conducted to see the effect of symmetric and asymmetric treasury bills rate on the demand for foreign bills and if symmetric bills rate leads to a convergence on the demand for foreign assets, which considered as a sign of financially integrated markets. Figure 11 shows the demand for foreign assets or foreign treasury bills in the cases of symmetric and asymmetric bills rate. The figure shows that when bills rate in both countries is symmetric, then the demand for foreign assets converges or the gap between both countries demand are less.

As shown in figures 5 and 6, the third scenario (monetary union) leads to a no positive or negative change in real GDP which may be due to the following reasons:

1. The single currency is now the second country currency.
2. No discrepancy between bills, deposits, and lending rates between the two countries.
3. No inflation generated due to this action. i.e., if the price of a given good in country one was equal to 1 unit currency of the first country is now equal to exactly 1.18182 units of the single currency which is the exchange rate before the monetary union.
4. No intervention from both governments either by monetary or fiscal policy.
Figures 12 and 13 show the index of financial integration in the first and the second country before and after the monetary union. The figures show that the index is higher in the case of monetary union than without a monetary union in the first country, and is a slightly higher in the case of monetary union than before in the second country.

Regarding the households portfolio choice in the two countries, it is assumed that when both countries open to trade, households will start purchasing foreign treasury bills by reallocating their portfolio. Households at the beginning are going do decrease their holdings of domestic treasury bills and deposits in favour of foreign ones as shown in figures 14 and 15. These graphs show the evolution of households portfolio choice as a share of wealth after opening to trade (the first scenario). In the second and third scenario the evolution of the households portfolio decision as a share of wealth do not change except for foreign treasury bills as their share of wealth increase after the monetary union (third scenario). One can notice that from the index of financial integration in figures 12 and 13.

Figures 16 and 17 show the evolution of current account balance (CAB), government budget balance, trade balance, and net acquisition of financial assets (NAFA) by the household sector in both countries after they open to trade. CAB and trade balance remain around zero due to the assumption of equal volume of imports and exports in both countries. The figures show a deficit in the government budget balance in both countries due to the increase in real government expenditure needed to facilitate the trade and the deficit is predicted to increase after removing the import tax. The deficit is assumed to be covered by issuing more treasury bills as shown in figures 9 and 10. Opening to trade leads to an increase in the wealth of households and this is reflected in the NAFA.

5 Conclusion

The goal of this paper was to produce a stock flow consistent macrodynamic model to study financial integration, as measured by a volume-based measure of international financial integration. The contribution of this paper is to build a relatively detailed models that can explain much about financial integration between countries, as it can explore several policies, and agreements, can be taken in order to enhance financial integration, and thus to contribute both to the emerging literature on stock-flow consistent modeling, as well as the current debate on the costs and benefits of ever-closer financial and economic integration amongst the world’s economies.

Clearly, for both countries, opening to trade goods and assets is better in terms of their GDP, than to be closed. When countries open to trade the economy shifts upward and firms and households become more wealthy. Having more investment opportunities, locally and internationally, leads households to reallocate their portfolio choices towards more profitable financial assets, and thus increase their wealth and improve living standards. Opening to trade from the other hand increase competitiveness on the firms sector, and enhances productivity and thus households incomes still further. Our model is capable of describing these feedback mechanisms in detail, assuming an endogenous money.

This paper shows that freeing trade by eliminating trade barriers leads to higher levels of output, income and wealth, and its components for both countries. On the other hand, converging asset
prices or rates of return on these assets do not lead to a significant change in output, income, and wealth, but this convergence trend does change the households' portfolio allocation and converges the demand for these assets.

Monetary union, considered as an advanced level of financial integration between countries, is also modeled. In this model, Monetary union has no significant effect on the real side of the economy. This can be due to lack of fiscal or monetary policy accompanied the process of monetary union in this model. Thus, each agreement aimed at promoting financial integration between countries should be parallel with fiscal and monetary policies that would stimulate economic growth, income, wealth, improve the competitive opportunities in each country and converge asset prices. Relating this finding back to the European Union’s current problems, a more developed system of automatic fiscal stabilisers (or a fiscal algorithm or rule set) would be beneficial to reduce the effect of asymmetric shocks to individual countries.

The volume measure of financial integration used in Lane and Milesi-Ferretti (2001a and 2007a) does not reflect the effect of converging asset prices on the process of financial integration between countries. This measure can be an appropriate measure in cases such as a certain agreement or in cases of fiscal policies, but it does not reflect the picture in cases such as converging asset prices or returns. In these cases, if one wishes to explore the effect of assets prices or returns convergence, we feel it is better to look at the convergence of the demand for foreign assets, as we document above. This model may also be calibrated with real world data to assist policy formation. Several other points and extensions on the model can be taken in order to explore financial integration more widely such as assuming that households can also purchase foreign equities, firms can also demand loans from foreign banks. One can explore financial integration between developing and developed countries. Financial integration may also be explored in the case of fixed exchange rate and see the effect of financial integration on countries reserves.

References


Figure 1: Balance sheet of the two economies.
Figure 2: Transactions flows matrix of the two economies.
<table>
<thead>
<tr>
<th>Country 1</th>
<th>Household</th>
<th>Firms</th>
<th>Central Bank</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+(H_{1i})</td>
<td>+(L_{P1})</td>
<td>-(E_{1})</td>
<td>IN</td>
</tr>
<tr>
<td></td>
<td>-(Y_{1})</td>
<td>-(J_{1})</td>
<td>0</td>
<td>EX</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country 2</th>
<th>Household</th>
<th>Firms</th>
<th>Central Bank</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+(H_{2i})</td>
<td>+(L_{P2})</td>
<td>-(E_{2})</td>
<td>IN</td>
</tr>
<tr>
<td></td>
<td>-(Y_{2})</td>
<td>-(J_{2})</td>
<td>0</td>
<td>EX</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Households</th>
<th>Firms</th>
<th>Central Bank</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inventories</td>
<td>+(I_{1})</td>
<td>-(I_{1})</td>
<td>0</td>
<td>IN</td>
</tr>
<tr>
<td>Fixed Capital</td>
<td>+(F_{1})</td>
<td>+(F_{1})</td>
<td>-(F_{1})</td>
<td>EX</td>
</tr>
<tr>
<td>Loans</td>
<td>+(L_{1})</td>
<td>+(L_{1})</td>
<td>-(L_{1})</td>
<td>IN</td>
</tr>
<tr>
<td>Foreign Loans</td>
<td>+(L_{1})</td>
<td>+(L_{1})</td>
<td>-(L_{1})</td>
<td>EX</td>
</tr>
<tr>
<td>Deposits</td>
<td>-(D_{1})</td>
<td>-(D_{1})</td>
<td>0</td>
<td>IN</td>
</tr>
<tr>
<td>Reserve</td>
<td>-(R_{1})</td>
<td>-(R_{1})</td>
<td>0</td>
<td>EX</td>
</tr>
</tbody>
</table>

Figure 3: Balance sheet in the case of monetary union.
Figure 4: Transactions flows matrix in the case of monetary union.
Figure 5: The evolution of country one real GDP in the case of autarky condition, open to trade, free trade, and monetary union.
Figure 6: The evolution of country two real GDP in the case of autarky condition, open to trade, free trade, and monetary union.
Figure 7: Price level in country one in the case of autarky condition, open to trade, and free trade.
Figure 8: Price level in country two in the case of autarky condition, open to trade, and free trade.
Figure 9: Supply of treasury bills in country one in the case of autarky condition, open to trade, and free trade.
Figure 10: Supply of treasury bills in country two in the case of autarky condition, open to trade, and free trade.
Figure 11: Demand for foreign assets with symmetric and asymmetric bills rate in both countries.
Figure 12: Index of financial integration in country one before and after monetary union.
Figure 13: Index of financial integration in country two before and after monetary union.
Figure 14: Household portfolio choice in the first country (first scenario).
Figure 15: Household portfolio choice in the second country (first scenario).
Figure 16: CAB, government budget balance, NAFA, and trade balance in the first country after opening to trade (first scenario).
Figure 17: CAB, government budget balance, NAFA, and trade account in the second country after opening to trade (first scenario).