Berlin FMM Conference 2019, 24-26 October

A reassessment of adjustment criteria in fixed exchange-rate areas

Thibault Laurentjoye – EHESS Paris

Preliminary version – Do not quote

The objective of this article is to reproduce in a coherent stock-flow context (SFC) Mundell's (1961c) argument in order to first validate, or not, the various proposals, secondly to examine their implications - in particular with regard to the closure of agents' balances - and finally to compare different adjustment mechanisms that may prove optimal within the meaning of monetary zone theory.

The first section (2.1.1) will introduce the general characteristics of the modelling used in this section, before moving on to a detailed presentation of the different adjustment modes studied:

- **Recession in the deficit country (2.1.2)**
- **Wage and price flexibility (2.1.3)**
- Flexible or adjustable fixed change (2.1.4)
- **Workers' mobility (2.1.5)**
- Trade policy instruments (2.1.6)
    - Export subsidies (2.1.6.1)
    - Customs duties (2.1.6.2)
    - Mix of subsidies and customs duties (2.1.6.3)

A final section (2.1.7) will review the results to make a comparative assessment.

These models are based on Chapter 12 of Godley & Lavoie (2012) and incorporate variations, extensions and simplifications of it, depending on the required analytical framework.

2.1.1. General characteristics of the models

To represent the content of Mundell (1961c) in an SFC framework, we need to make a methodological compromise between the macroeconomics of post-war synthesis, the current in which Mundell wrote his paper, and the post-Keynesian approach that gave rise to SFC formalization - although in a way one could say that the SFC approach, also inspired by James Tobin, itself has more traditional neo-Keynesian influences.

We hope that post-Keynesians will not see this compromise as a compromise, as the idea is to demonstrate the relevance and usefulness of the SFC approach to clarify the theory of optimal monetary zones (TZMO) and highlight some aspects that had hitherto remained in the background.

In the models that follow, we consider an economy composed of two goods (1 and 2) and two countries (A and B). The conditions for the production of goods are as follows:

1) Each country has a monopoly on the production of a good: A produces 1 and B produces 2.

2) There is only one factor of production, labour, and it is homogeneous.

3) Production yields are constant.

4) Wages are downwardly rigid.

5) There is no international mobility of workers - this hypothesis will be addressed in Section 3.

The assumption of constant returns ensures the existence of pure and perfect competition (Sraffa, 1925, 1926, Kaldor, 1968) within each country, which is consistent with the Marshallo-Ricardian analytical framework underlying Mundell's (1961c) approach. Pure and perfect competition makes it impossible for companies to make profits, resulting in the full payment of the value of production in the form of wages. The hypothesis of wage rigidity, considered at the time of Mundell (1961c) as inherited from Keynes (1936), however, limits the scope of the competition field.

The shock applied to the different models comes from Mundell (1961c), inspired by Meade (1951), and consists of a change in consumer preferences. This change is similar in both countries and simultaneous. As a result, global demand for goods has shifted significantly in favour of one country and to the logical detriment of the other - hence the term "asymmetric shock".

In order to simplify the analysis, we will assume that the countries are of the same size. This assumption is not necessary for the analysis, it would be quite possible to consider a small and a large country, but it seems more consistent with the idea that consumers have similar preferences in both countries, in a context where there are only two goods. Without this, it would be necessary to assume that the large country has a much greater propensity than the small country to consume the good it produces. This will be easier when we model the McKinnon (1963) argument, which considers the existence of more goods, divided between tradable and non-tradable goods.

We also assume, as Mundell (1961c) did, that both countries are initially at full employment. We have chosen to define full employment on a conventional basis, corresponding to the number of hours that it is considered normal to work during a given period without this resulting in remuneration higher than the basic remuneration. This'conventional' full employment is therefore not a physical limit to the volume of employment, but is simply equal to the product of the active population by the legal duration of working time. If we take the example of France, where the active population is 30 million people, the legal working time is 7 hours per day in the private sector, and the number of days worked is approximately equal to 215, this means that the number of basic annual hours per worker is 1505, or a conventional full employment equivalent to just over 45 billion hours.

If, as a result of the demand on an economy, the amount of work required for production exceeds the amount corresponding to full employment, the number of hours exceeding full employment shall be paid as overtime, at a multiple of the basic hourly wage. It can also be specified that to the extent that work is homogeneous and countries in pure and perfect competition, it is impossible for a worker to receive a remuneration higher than basic pay until full employment is achieved.

This modelling of employment and wages has the advantage of being relatively realistic (all proportions considered), while being consistent with Mundell's (1961c) narrative, according to which countries are initially at full employment, and experience inflationary pressures if output exceeds full employment output, or conversely experience the emergence of unemployment if output falls below its level of full employment.

Another general characteristic of the models concerns the demand functions, and more precisely the price and demand income iso-elasticity, which we assume to be equal to -1 and 1 respectively for all goods. In practice, this means that:

- If the price of a good is multiplied by a factor X and in the absence of a change in nominal income, the quantity requested for that good will be divided by X, which will leave the value of the transactions corresponding to that good unchanged. This applies to any X greater than zero.

- If nominal incomes are multiplied by Y in the absence of price changes, demand for goods will be multiplied by Y.

- If incomes and prices increase in the same proportion, this will have no impact on the quantities requested.

The choice of these characteristics comes from the fact that these values are considered acceptable in most of the literature, and in particular in international economics, insofar as they verify the Marshall-Lerner-Robinson constraint according to which the sum of the algebraic value of import and export price elasticities must be less than -1 for the exchange rate devaluation to have a positive effect on a country's trade balance.

Finally, we have chosen to reduce financial structures to a strict minimum, by basing the closure of the economic circuit on a system of direct loans between households in different countries. This choice is linked on the one hand to the fact that Mundell (1961c) provides no indication of the potential financing modalities of the current imbalances that appear following the shock, and on the other hand to the desire not to multiply the number of equations of the model, when these did not seem necessary to us to understand the central dynamics at work. We therefore assume that households in the surplus country finance the other country's entire current account deficit through direct loans. As a corollary, this means that there is no explicit mention of the banking systems of the various countries.

2.2.2. Non-optimal monetary union: recession as the default adjustment mode

The comparison between fixed and flexible exchange rates, to put it simply, requires exposing both situations. The order in which these situations are presented depends on the object under study. It is sometimes preferable to start by presenting a flexible exchange rate situation and then move on to fixed exchange rates - for example, when you want to talk about the Euro Zone by following a chronological narrative.

It seems to us that, in order to present the issues raised by Mundell (1961c) in an SFC framework, it is preferable to start by considering the case of a monetary union without an'optimal' adjustment structure. The interest to start with this case is twofold: on the one hand for formal introductory purposes of the modelling used in this part, and on the other hand to provide a benchmark in terms of adjustment performance.

The absence of an adjustment structure corresponding to the'criteria of optimality' of the TZMO does not mean that there is no adjustment. Rather, as we will see, it means that the'default' adjustment dynamic between two or more countries constituting a monetary zone is a quantity adjustment (Harrod, 1933, Lerner, 1947, Mundell, 1961b, Thirlwall, 1979) marginally reinforced by a price adjustment following inflationary and deflationary pressures in the various countries in the zone. This'default' adjustment mode corresponds in a way to the fact that imbalances cannot last forever.

2.2.2.2.a. Specification of the basic model

The first two equations of the base model focus on the nominal income of both countries (following Godley & Lavoie (2012), the real variables and prices are in lowercase letters, while the nominal variables are in uppercase letters):

$$Y_A = C_A + X_A - IM_A \quad (2.1.1)$$

$$Y_B = C_B + X_B - IM_B \quad (2.1.2)$$

Equation (2.1.1) defines the national nominal income of country A as the sum of country A's consumption expenditure, plus country A's exports to country B in value, minus country A's imports of goods produced by country B, in value as well. Equation (2.1.2) applies the same reasoning to country B - we will now present the variables without specifically referring to the country concerned, except in the case of some equations that require somewhat more precise explanations.

Output prices, or GDP deflators, are obtained by dividing the effective hourly wage by the (assumed constant) productivity:

$$p_{yA} = \frac{w_A}{pr_A} \quad (2.1.3)$$

$$p_{yB} = \frac{w_B}{pr_B} \quad (2.1.4)$$

By having the nominal production and the production prices available, it is possible to calculate the production in volume:

$$y_A = \frac{Y_A}{p_A} \quad (2.1.5)$$

$$y_B = \frac{Y_A}{p_A} \quad (2.1.6)$$

The actual hourly wage is obtained by calculating the average of the wages corresponding to the basic remuneration and overtime, weighted by the respective associated durations:

$$w_A = \frac{w_{normA} \cdot h_{normA} + w_{supA} \cdot h_{supA}}{h_{totA}} \quad (2.1.7)$$

$$w_B = \frac{w_{normB} \cdot h_{normB} + w_{supB} \cdot h_{supB}}{h_{totB}} \quad (2.1.8)$$

With :

w_norm : basic hourly wage,

h_norm : standard legal working time over a period, expressed in hours,

w_norm : hourly wage associated with overtime pay,

h_norm : number of overtime hours worked, expressed in hours,

h_tot : total number of hours worked.

The basic hourly wage is set externally to the model - it will become variable in the following section only:

$$w_{normA} = \overline{w_{normA}} \tag{2.1.9}$$

$$w_{normB} = \overline{w_{normB}} \tag{2.1.10}$$

We assume (w_norm)̅=31.25 in both countries. This value was chosen so that production in each country would initially be 2000 billion, taking into account the other variables.

The standard legal working time duration is also fixed outside the model:

$$h_{normA} = \overline{h_{normA}} \tag{2.1.11}$$

$$h_{normB} = \overline{h_{normB}} \tag{2.1.12}$$

We assume (h_normB)̅=1600, which is close to the European standard.

The hourly wage for overtime is defined as a multiple of the basic hourly wage, we will assume that overtime is paid 50% more than the basic hours:

$$w_{supA} = 1{,}5 \,.\, w_{normA} \tag{2.1.13}$$

$$w_{supB} = 1{,}5 \,.\, w_{normB} \tag{2.1.14}$$

As far as the number of overtime hours is concerned, the relationship is quite logical:

$$h_{supA} = h_{totA} - h_{normA} \tag{2.1.15}$$

$$h_{supB} = h_{totB} - h_{normB} \tag{2.1.16}$$

The amount of nominal wages paid is given by the following equations:

$$WB_A = w_A . h_{totA} . pop_{eA} \tag{2.1.17}$$

$$WB_B = w_B . h_{totB} . pop_{eB} \tag{2.1.18}$$

Where pop_e represents the employed population, which is calculated on the basis of the ratio between the real level of production in the economy and the volume of production corresponding to full employment:

$$\text{If } \; y_A \geq y_{feA} \; \text{ then } \; pop_{eA} = pop_{tA} \; \text{ else } pop_{eA} = \frac{y_A}{pr_A . h_{normA}} \tag{2.1.19}$$

$$\text{If } \; y_B \geq y_{feB} \; \text{ then } \; pop_{eB} = pop_{tB} \; \text{ else } pop_{eB} = \frac{y_B}{pr_B . h_{normB}} \tag{2.1.20}$$

When actual production is greater than or equal to the volume of production corresponding to full employment in a country, the employed population is equal to the total population, since there is no inactive population in this model. It also means that unemployment is zero. If, on the other hand, real output is below its level of full employment, the employed population will be equal to the ratio of output in volume terms to productivity and base hours.

The total population is fixed in the basic model - it will become variable when we introduce the possibility for workers to migrate from one country to another:

$$pop_{tA} = \overline{pop_{tA}} \tag{2.1.21}$$

$$pop_{tB} = \overline{pop_{tB}} \tag{2.1.22}$$

We assume pop_tA=pop_tB= 4.10^7 or 40 million workers in each country.

The volume of production corresponding to full employment is obtained by multiplying productivity by the total population and the standard legal working time (in hours) in each country:

$$y_{feA} = pr_A . pop_{tA} . h_{normA} \tag{2.1.23}$$

$$y_{feB} = pr_B . pop_{tB} . h_{normB} \tag{2.1.24}$$

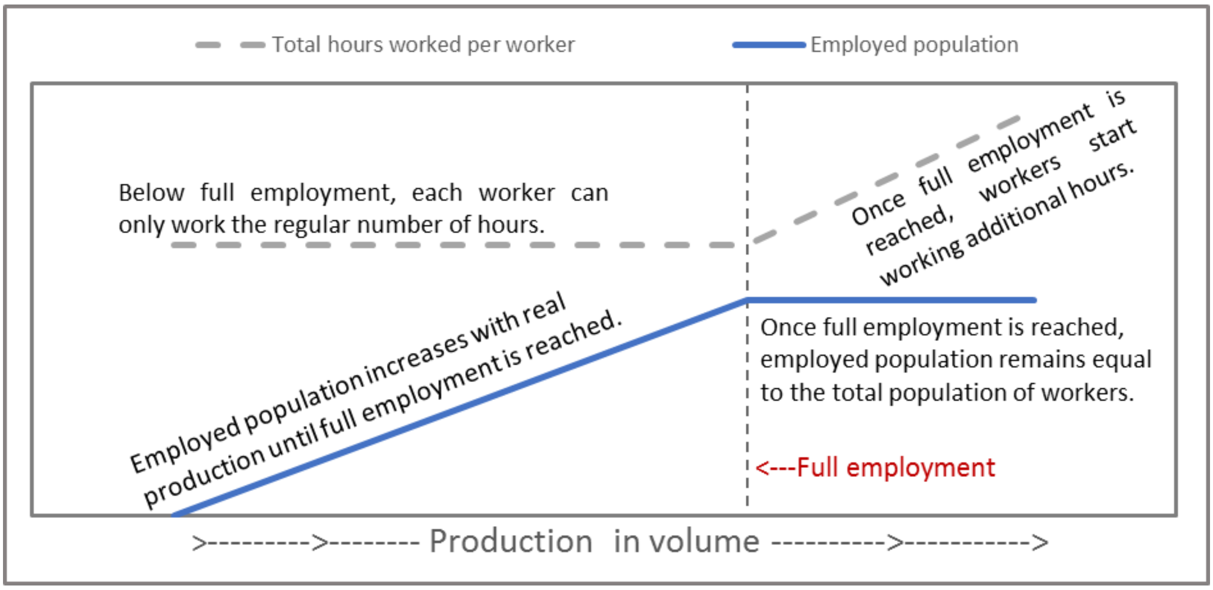
The total number of hours worked by each worker can be calculated by dividing production in volume by the employed population and productivity:

$$h_{totA} = \frac{y_A}{pop_{eA} . pr_A} \tag{2.1.25}$$

$$h_{totB} = \frac{y_B}{pop_{eB} . pr_B} \tag{2.1.26}$$

When production is below its level of full employment, the employed population is lower than the total population, and under equation (2.1.11) it can be seen that the number of hours worked by each employed worker will equal h_norm.

If at present the volume production is equal to or greater than its level of full employment, the employed population will be equal to the total population and the number of hours worked by each worker will be greater than h_norm.



We can finish describing how the basic employment model works by presenting the equations of the variables that serve as indicators of the employment situation in each period. The first indicator is the unemployed population, which is logically equal to the difference between the total population and the employed population - again, in the absence of an inactive population:

$$pop_{uA} = pop_{tA} - pop_{eA} \tag{2.1.27}$$

$$pop_{uB} = pop_{tB} - pop_{eB} \tag{2.1.28}$$

The second indicator is complementary and corresponds to the number of full-time equivalent jobs that could be created. They are obtained by dividing the number of overtime hours worked by the legal working time:

$$jobs_A = \frac{h_{supA} \cdot pop_{eA}}{h_{normA}} \tag{2.1.29}$$

$$jobs_B = \frac{h_{supB} \cdot pop_{eB}}{h_{normB}} \tag{2.1.30}$$

It should be noted that it would have been possible to condense the last two variables presented, namely the number of unemployed (pop_e) and full-time equivalent jobs available (jobs), at the cost of a formal complication that we preferred to avoid. Moreover, when we introduce the possibility of worker migration between countries, the distinction between pop_u and jobs will make it easier to understand the mechanism.

Disposable income is calculated in the traditional way for an SFC model without Government:

$$YD_A = WB_A + INTE_A \tag{2.1.31}$$

$$YD_B = WB_B + INTE_B \tag{2.1.32}$$

Where INTE is the interest paid (or received) by households in the country concerned, which is calculated as follows:

$$INTE_A = r_{-1}.V_{A-1} \tag{2.1.33}$$

$$INTE_B = r_{-1}.V_{B-1} \quad (2.1.34)$$

avec r_{-1} le taux d'intérêt en vigueur dans la période précédente (initialement égal à 2%) et V_{-1}la richesse nette du pays concerné à la fin de la période précédente. Dans la mesure où la seule forme de dette qui existe dans ce modèle est un endettement direct entre ménages des deux pays, et en l'absence de richesse non financière, il s'ensuit que la richesse d'un pays correspond à son montant de créance ou de dette envers l'autre pays. Cela implique également que la richesse nette d'un pays correspond à l'opposé de la richesse nette de l'autre pays.

La fonction de consommation est d'une forme assez classique pour un modèle SFC sans Etat, avec une légère modification dans le premier terme, puisque la consommation incompressible est une fonction linéaire de la population totale :

$$C_A = \alpha_{0A}.pop_{tA}.p_{cA,-1} + \alpha_{1A}.YD_{A,-1} + \alpha_{2A}.V_{A-1} \quad (2.1.35)$$

$$C_B = \alpha_{0B}.pop_{tB}.p_{cB,-1} + \alpha_{1B}.YD_{B,-1} + \alpha_{2B}.V_{B-1} \quad (2.1.36)$$

With :

α_0 : real incompressible consumption per person,

p_(cA,-1) : consumer price level at the end of the previous period,

α_1 : marginal propensity to consume according to disposable income,

α_2 : marginal propensity to consume according to net wealth.

The values of the parameters we will use are α_0=2500,α_1=0.5 and α_2=0.05.

The inclusion of the total population in the consumption function does not significantly change the overall behaviour of the model, since the total population in each country is fixed. This inclusion will become interesting, and even essential, when we consider labour migration, which changes the distribution of the population between countries.

We will now model the consumption of agents in both countries with a little more precision. To do this, we consider that the distribution of consumption between the two goods takes place by allocating a portion of the nominal consumption to each of the two goods.

The notation we have chosen uses the Greek symbol μ, which is usually associated with the propensity to import into SFC models in open economy. Since both goods are consumer goods, and since each country produces only one good and must therefore import the other, we can write that each country's demand for the good produced by the other country is equal to the nominal consumption of the importing country multiplied by μ and deduct the values of the nominal consumption of the different goods:

$$IM_A = \mu_A.C_A \quad (2.1.37)$$

$$IM_B = \mu_B.C_B \quad (2.1.38)$$

$$C_{1A} = (1 - \mu_A).C_A \quad (2.1.39)$$

$$C_{1B} = IM_B \tag{2.1.40}$$

$$C_{2A} = IM_A \tag{2.1.41}$$

$$C_{2B} = (1 - \mu_B).C_B \tag{2.1.42}$$

The parameter μ is initially identical in both countries and equal to 0.5, which allows symmetry in commercial transactions, taking into account the equality of countries in terms of size.

For each country, the nominal amount of imports is defined as a proportion of nominal consumption (2.1.17 and 2.1.18). Logically, these imports correspond respectively to the nominal consumption of country A in good 2 (2.1.20) and country B in good 1 (2.1.21). It follows logically that the consumption of locally produced goods in both countries is equal to the difference between total nominal consumption and the amount of imports (2.1.19 and 2.1.22).

This rating may seem confusing at first glance, the reader might think that it would have been possible to use more uniform ratings for both countries by defining nominal consumption in good 1 in the same way, then defining nominal consumption in good 2 as the residue of total nominal consumption minus nominal consumption in good 1. the result would have been exactly the same, from a purely mathematical point of view.

The reason why we prefer the rating method presented above is that when calculating the conditions for equalizing trade balances, it will appear simpler and more intuitive to use similar ratings based on the respective import propensities of the two countries.

We can now calculate the prices of the different goods in each country:

$$p_{1A} = p_{yA} \tag{2.1.43}$$

$$p_{1B} = p_{imB} \tag{2.1.44}$$

$$p_{2A} = p_{imA} \tag{2.1.45}$$

$$p_{2B} = p_{yB} \tag{2.1.46}$$

$$p_{imA} = p_{xB} \tag{2.1.47}$$

$$p_{imB} = p_{xA} \tag{2.1.48}$$

$$p_{xA} = p_{yA} \tag{2.1.49}$$

$$p_{xB} = p_{yB} \tag{2.1.50}$$

with:

p_ij the price of good i in country j,

p_im import prices,

p_x export prices.

Equations (2.1.23) and (2.1.26) correspond to the prices of goods in their respective countries of production, and mean that these goods are sold locally at their production price. Equations (2.1.24) and (2.1.25) refer to the prices of goods to be imported into the country concerned. They are completed by equations (2.1.27) to (2.1.30). Since both countries have the same currency, and there are no customs duties or export subsidies, import prices in each country are equal to the production prices in the country of origin of the goods.

We now want to calculate the consumer price index. To do this we need to calculate the volume consumption in advance. This is possible on the basis of the data we have on the prices of the various goods and the associated consumer spending:

$$c_{1A} = \frac{C_{1A}}{p_{1A}} \tag{2.1.51}$$

$$c_{2A} = \frac{C_{2A}}{p_{2A}} \tag{2.1.52}$$

$$c_{1B} = \frac{C_{1B}}{p_{1B}} \tag{2.1.53}$$

$$c_{2A} = \frac{C_{2A}}{p_{2B}} \tag{2.1.54}$$

$$c_A = c_{1A} + c_{2A} \tag{2.1.55}$$

$$c_B = c_{1B} + c_{2B} \tag{2.1.56}$$

$$p_{cA} = \frac{C_A}{c_A} \tag{2.1.57}$$

$$p_{cB} = \frac{C_B}{c_B} \tag{2.1.58}$$

In detail, we first calculate the volume consumption of each good in each country by dividing nominal consumption by the associated price (2.1.31 to 34), which then allows us to determine the actual consumption in each country (2.1.35 and 36) and finally the level of consumer prices (2.1.36 and 37).

This procedure is different from the method usually used in open economy SFC models, such as Godley & Lavoie (chp.12, 2012) or Brochier (2018), which calculate the price of domestic sales on the basis of a mark-up equation whose costs include wages, depreciation and imports, depending on the context.

The reason we decided to use a different method is twofold. On the one hand, in this model, imports only concern consumer goods, and not intermediate goods or goods used in domestic production in general. It is not justified to mark-up these prices when we assume that there are no transport and transaction costs. On the other hand, we thought it would be interesting to provide a calculation of the consumer price level, which is an index that is not often found in SFC models, for the time being.

We can use this opportunity to determine the volume amounts of imports and exports:

$$im_A = c_{2A} \tag{2.1.59}$$

$$im_B = c_{1B} \quad (2.1.60)$$

In the model as it is constructed, the real imports of country A correspond to its real consumption in good 2, while the real imports of country B correspond to its real consumption in good 1.

By virtue of equations (2.1.20, 21, 24, 24, 25, 32, and 33), it can be seen that the two above equations could have been written using a more general formulation:

$$im_A = \frac{IM_A}{p_{imA}} \quad (2.1.59b)$$

$$im_B = \frac{IM_B}{p_{imB}} \quad (2.1.60b)$$

There is a direct and unconditional equality relationship between the volume of exports from one country and the volume of imports from the other country, in a two-country model:

$$x_A = im_B \quad (2.1.61)$$

$$x_B = im_A \quad (2.1.62)$$

We have the variables needed to calculate exports in value terms, by multiplying the volume of exports by their price:

$$X_A = x_A \cdot p_{xA} \quad (2.1.63)$$

$$X_B = x_B \cdot p_{xB} \quad (2.1.64)$$

Finally, we still have to calculate the sectoral balances and the associated accumulation dynamics. Since firms pay back their production in full in the form of wages, their sectoral balance is zero, as is their accumulation since they have neither fixed capital nor inventories.

Only households can have a non-zero sectoral balance, calculated in a traditional way, by taking the difference between disposable income and consumption, thus corresponding to household savings in national accounts:

$$SAV_A = YD_A - C_A \quad (2.1.65)$$

A comparable equation could be defined for country B, but to the extent that we have already defined a sufficient number of variables, this is not necessary. Since the SFC models are based on an exhaustive formalization, an X-variable model can be described on the basis of (X - 1) equations, making the Xth equation redundant.

The redundant equation of this model is as follows:

$$SAV_B = -SAV_A \quad (2.1.66^*)$$

This equation has two meanings. First, it corresponds to the condition of nullity of the sum of the sectoral balances - here reduced to two under the assumptions of the model. It also implies that the financing of the current account deficit of households in country A after the demand shock is covered by the savings of households in country B, or that the savings of the latter is a counterpart to the deficit of households in country A.

In each country, savings are added to the wealth inherited from the previous period, which it determines the variation in the basic model:

$$V_A = V_{A-1} + SAV_A \qquad (2.1.67)$$

$$V_B = V_{B-1} + SAV_B \qquad (2.1.68)$$

The last three variables for each country are not essential for the smooth functioning of the model, they are indicators corresponding to balance of payments balances. For each country we calculate the trade balance (CB), the current balance (CAB) and the financial account balance (KAB):

$$CB_A = X_A - IM_A \qquad (2.1.69)$$

$$CB_B = X_B - IM_B \qquad (2.1.70)$$

$$CAB_A = CB_A + INTE_A \qquad (2.1.71)$$

$$CAB_B = CB_B + INTE_B \qquad (2.1.72)$$

$$KAB_A = -SAV_A \qquad (2.1.73)$$

$$KAB_B = -SAV_B \qquad (2.1.74)$$

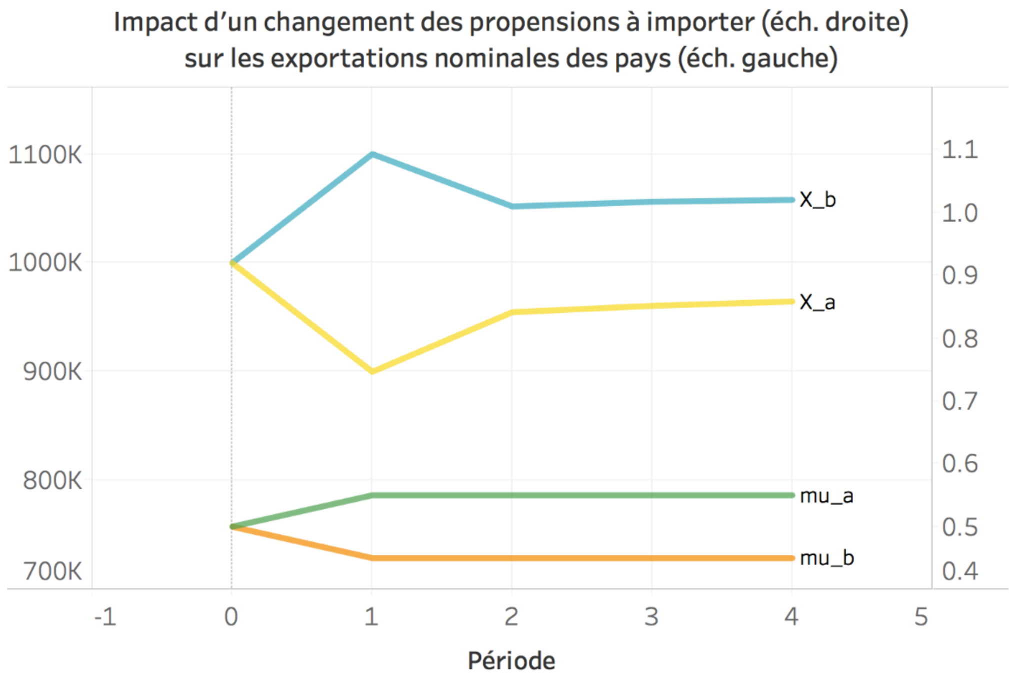
We can now run the model and introduce the demand shock.

2.2.2.b. Simulation of the demand shock

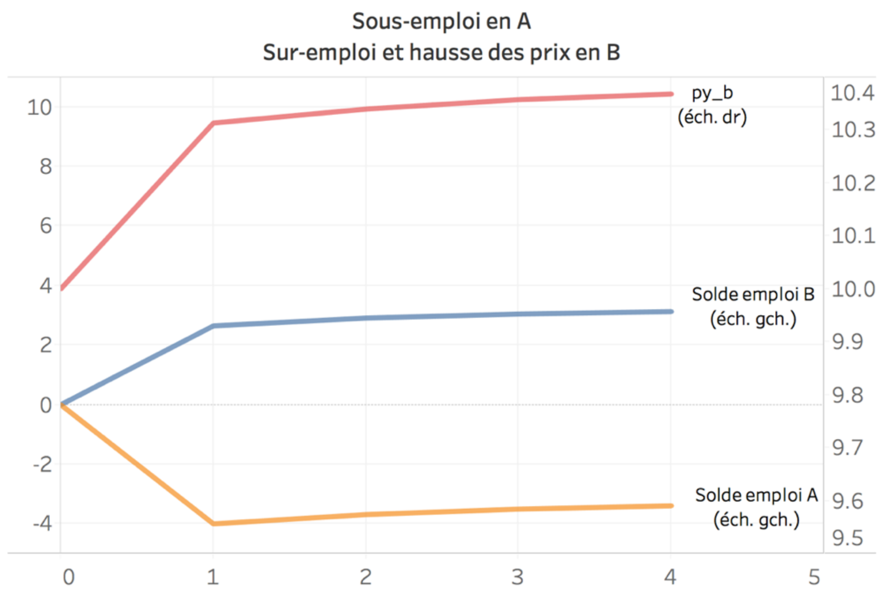
We take up Mundell's (1961) idea of a demand shift in a two-country model – itself strongly inspired by Meade (1951). The demand for goods 1 (produced by country A) decreases in favour of the demand for goods 2 (produced by country B). This shock concerns consumers residing in both countries, but it is asymmetric in the sense that the consequences for the two countries are not the same.

Before the shock, consumers in both countries distributed their nominal demand for goods and services equally between goods 1 and 2. Under the assumption that countries are of the same size, this resulted in coefficients μ_A and μ_B both equal to 0.5. The demand displacement shock consists of an increase from μ_A to 0.55 coupled with a simultaneous decrease from μ_B to 0.45.

The immediate effect of this shock is to increase country B's exports, while country A's exports decrease - which will have two sets of related consequences.

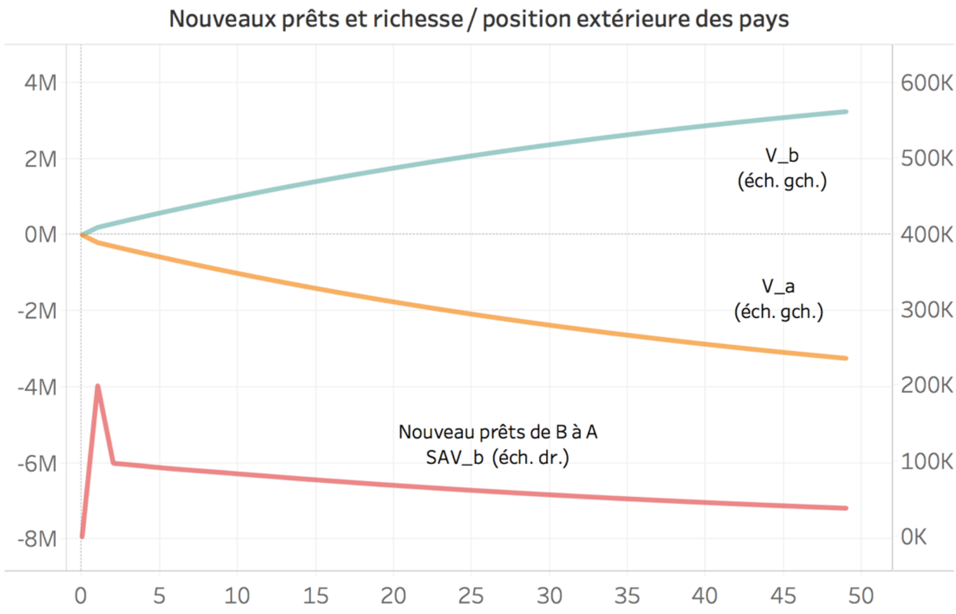


A first set of consequences is the impact on production in both countries. It falls in country A, causing unemployment to rise, as long as it rises in country B, triggering the payment of overtime, causing an increase in average wages and consequently an increase in prices. We find ourselves in exactly the situation described by Mundell (1961: 658): "the shift in demand from[A] to[B] due to unemployment in[A] and inflationary pressures in[B]".

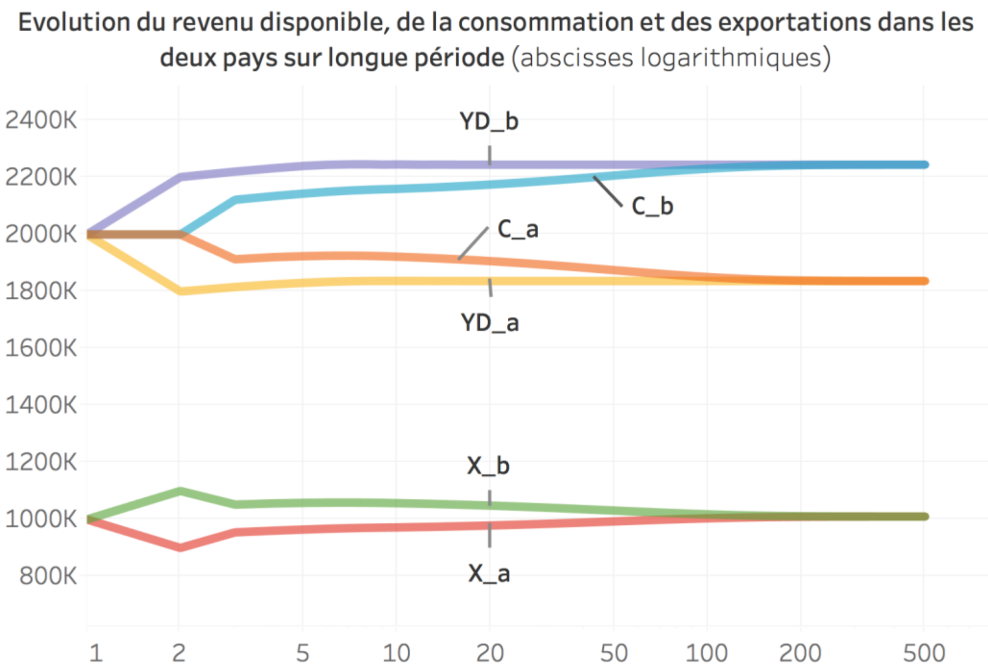


These changes in production and nominal income in both countries affect the respective levels of consumption in each country - with consumption moving in the direction of production. This has the indirect effect of increasing the demand of country B in good 1, and decreasing the demand of country A in good 2, but this second round effect is very insufficient to offset the initial effect.

A second consequence of the inverse variation in exports in the two countries is the widening of a trade deficit in country A associated with the realization of a trade surplus in country B. This polarization results in the need for country A to have its deficit financed by country B, since we are starting from a situation without pre-existing external debt. Under this model, it is households that have the option of lending or borrowing: households in country A will therefore go into debt with households in country B.



The financing requirement immediately following the shock is high (200,000) and falls fairly rapidly as a result of the shock's impact on production, income and consumption in both countries. Nevertheless, a trade imbalance remains, which has as a necessary counterpart the increase in the stock of external debt of households in country A held by households in country B. This imbalance is resolved when nominal consumption converges on disposable income in each country.



It can be noted that the third term of consumption functions (2.1.35 and 2.1.36) is based on the level of household wealth. The negative wealth of households in country A negatively affects their consumer spending, while the positive wealth of households in country B increases theirs. This effect becomes more important as the stock of external debt increases, until exports are equal to imports for both countries.

It can be seen that in the baseline scenario, autonomous consumption has the same value in both countries. This is because the two variables that influence this component, namely a country's population and the level of consumer prices, are equal in both countries. Indeed, the population of the two countries was initially 40 in each country and no migration took place. On the other hand, the consumer price index is the same in both countries, because the distribution of the real basket of consumption is identical between the two countries - even if country B consumes more than country A. This is due to the fact that both countries use the same unit of account and do not use tools such as exchange rates, export subsidies or customs duties, which are likely to vary relative prices unilaterally.

While the central feature of the steady state resulting from the reaction and adjustment process described above is the equalization of trade balances to zero in both countries, many imbalances remain. The presence of unemployment in country A, an overheating situation in country B and an external debt that is stable but close to 5,000,000 are the most notable negative results of the adjustment to an asymmetric demand shock by quantities (Harrod, 1933).

This scenario is the base scenario, the default adjustment performance in the absence of structures explicitly designed to repair or compensate for the initial shock.

2.2.3. Internal flexibility: prices and salaries

Price and wage flexibility is the archetype of the ideal adjustment in the collective unconscious of the neoclassical economy, for which any economic problem can be expressed in terms of supply and demand, the intersection of which determines an equilibrium price.

However, following Keynes (1936), economists gradually accepted the idea that wages and indeed a large part of prices are downwardly rigid. It is therefore futile to expect a decline in wages and prices to correct imbalances. This is what led Friedman (1953) to advocate a system of flexible exchange rates - at the time of Bretton Woods when developed countries' exchange rates were fixed against the US dollar. For Friedman:

"If internal prices were as flexible as exchange rates, it would make little economic difference whether adjustments were brought about by changes in exchange rates or equivalent changes in internal prices. But this condition is clearly not fulfilled. The exchange rate is potentially flexible in the absence of administrative action to freeze it. At least in the modern world, internal prices are highly inflexible. They are more flexible upward that downward, but even on the upswing all prices are not equally flexible." (Friedman 1953:165)

Mundell's position on Friedman's equivalence between internal and external flexibility is complex. On the one hand, Mundell (1961c) accepts the idea that price and wage flexibility would make an optimal monetary zone. However, in an article published the previous year but based on the same wave of ideas, Mundell (1960) seeks to counter Friedman's argument that exchange rate flexibility would compensate for insufficient domestic price flexibility. According to Mundell (1960), this argument is paradoxically based on the existence of a "monetary illusion" among economic agents. The monetary illusion is inspired by Keynes' (1936) "nominal illusion", according to which agents tend to refuse decreases in their nominal incomes but can accept decreases in real incomes, in the event that prices increase more than their incomes. Mundell transposes this reasoning into international economics, to describe the implicit idea behind Friedman's (1953) argument:

> "The community refuses to accept changes in real income through changes in monetary prices, but will accept the same changes in real income through exchange rate adjustments" (Mundell, 1960: 227).

According to Mundell, this argument "may be valid in static, under certain circumstances,[but] it is wrong in dynamic". The two exchange rate systems, fixed and flexible, are "based on an inversion of roles, during the adjustment process, between the terms of trade and the interest rate":

"In a fixed exchange rate system, monetary income (further down the price level) varies to balance the market for domestic goods and services, and monetary policy is dictated by balance of payments imperatives; but in a flexible exchange rate system, the exchange rate varies to correct external imbalances, and monetary policy aims at internal stabilization. These dynamic differences have important implications for economic policy." (Mundell, 1960: 228).

It should be recalled that we are looking at an extremely simple economy here, with no government or complex financial structures. Thus, the remarks made by Mundell above cannot be studied - we focus on the question of what are the characteristics of the adjustment provided by internal flexibility in the face of an asymmetric demand shock.

2.2.3.3.a. Model specification

Taking into account price and wage flexibility is relatively easy to achieve, simply by varying the basic wage rate w_normA according to predetermined objectives. This variable, which until now has been constant and considered as a model parameter, is endogenized here. We have tried to define a simple heuristic to practice a trial and error search that converges on a desirable value.

After several tests comparing different objectives, we chose to target full employment in country A as the economic policy target, varying w_normA as follows:

- Starting from an initial value of 31.25 w_normA, decreases by 5 if unemployment is found in country A, increases by 5 if overtime is found, and remains constant if full and perfect employment is achieved. In this case, country A is unemployed, so it follows that w_normA will decrease from 31.25 to 26.25.
- If this decline is not enough to eliminate unemployment, w_normA drops again by 5 to 21.25.
- If, on the other hand, the wage jump was too big because the economy has gone beyond full employment, wages must be raised. Since the jump changes direction and in order to avoid an infinite succession of jumps of the same magnitude in one direction and then in the other, we divide the length by 2 to reduce it to 2.5, which would correspond to w_normA= 28.75.
- Finally, if country A is exactly at full employment, w_normA no longer moves.

- The heuristic continues in this way: as long as the jump does not change direction, its magnitude remains unchanged, while it is halved at each change of direction, until full employment is very accurately achieved in country A.

The associated pseudocode is:

$$If\ pop_{uA} \geq 0\ then \quad ($$
$$w_{normA} = w_{normA,-1} - jump$$
$$direction = down \quad)$$
$$Elseif\ jobs_A \geq 0\ then\ ($$
$$w_{normA} = w_{normA,-1} + jump$$
$$direction = up \quad)$$
$$Else\ w_{normA} = w_{normA,-1}$$
$$End\ If$$
$$If\ direction <> direction_{-1}\ then$$
$$jump = jump : 2$$
$$End\ If$$

The size of the initial jump is completely arbitrary and therefore modifiable. It is also possible to create a rule to increase the size of the jump if its initial value is too low, for example by doubling it after three jumps in the same direction. This would also make it possible to recover convergence more quickly in the event of an exogenous shock on employment - or in general the variable corresponding to the chosen objective.

2.2.3.b. Simulation

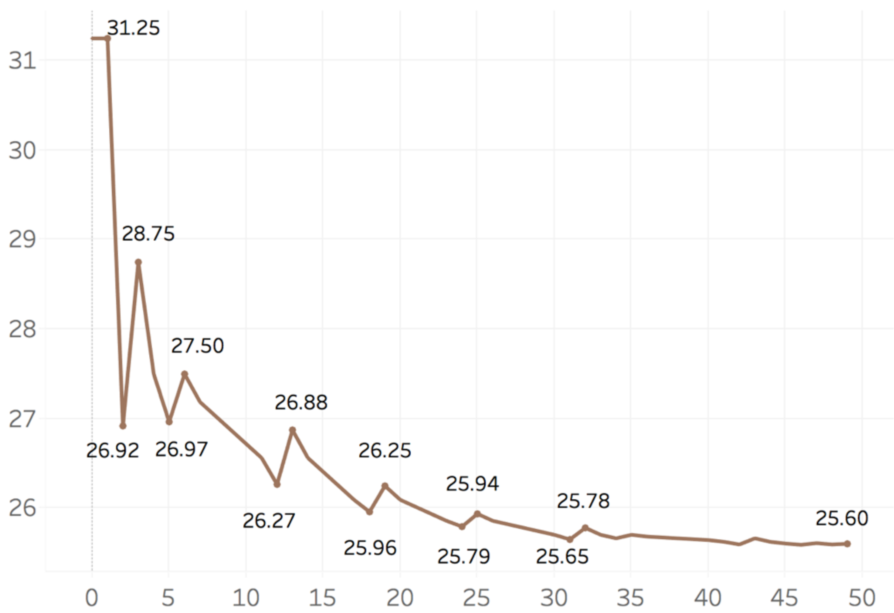
As soon as the shock occurs, the presence of unemployment in country A reduces w_normA. This has the immediate effect of lowering producer prices there, but also reducing disposable income. Lower producer prices make good 1 more affordable for consumers in country B.

Evolution des variables-clés sur périodes choisies
Ajustement par variation de w_a

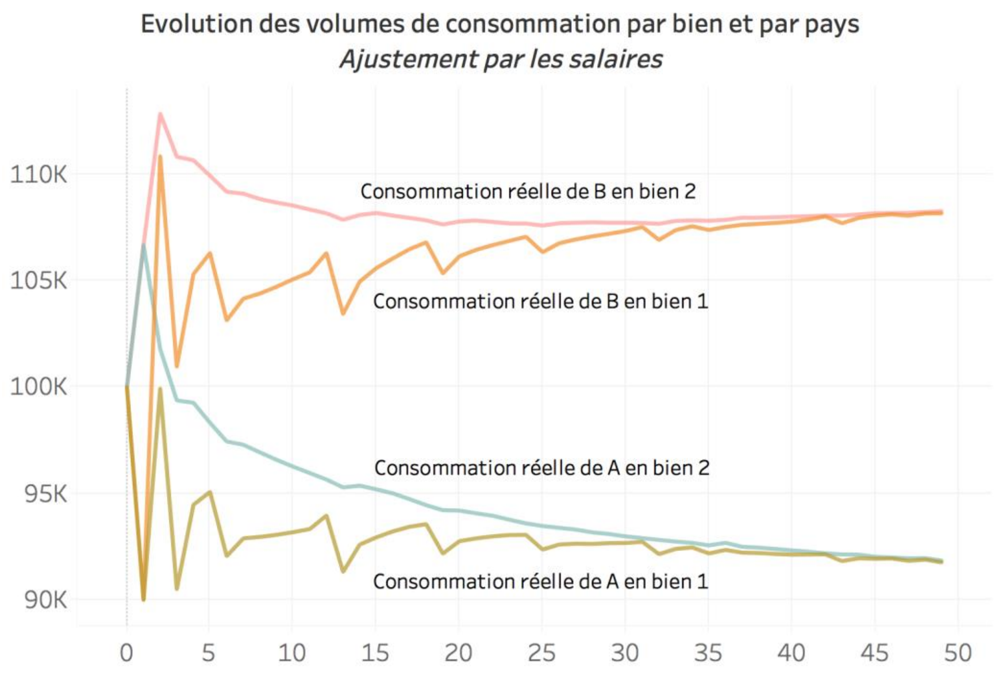
	0	1	2	3	4	10	25
mu_a	0.50	0.55	0.55	0.55	0.55	0.55	0.55
mu_b	0.50	0.45	0.45	0.45	0.45	0.45	0.45
X_a	1,000,000	900,000	954,785	928,708	926,588	898,234	882,497
X_b	1,000,000	1,100,000	1,052,136	1,017,634	1,016,083	973,778	937,014
w_a	31.25	31.25	26.92	28.75	27.50	26.72	25.94
w_b	31.25	32.23	32.31	32.01	31.99	31.62	31.33
YD_a	2,000,000	1,800,000	1,815,595	1,761,318	1,757,929	1,694,962	1,648,789
YD_b	2,000,000	2,201,371	2,218,472	2,153,437	2,149,994	2,073,382	2,015,662
C_a	2,000,000	2,000,000	1,912,975	1,850,244	1,847,424	1,770,506	1,703,662
C_b	2,000,000	2,000,000	2,121,691	2,063,795	2,059,085	1,996,076	1,961,103
py_a	10.00	10.00	8.61	9.20	8.80	8.55	8.30
py_b	10.00	10.31	10.34	10.24	10.24	10.12	10.03

It should be noted that the initial decrease in the basic wage rate is too high and puts country A in an over-employment situation, which triggers the payment of overtime, pushing the actual wage upwards and is a reason to raise the basic wage rate in the following period.

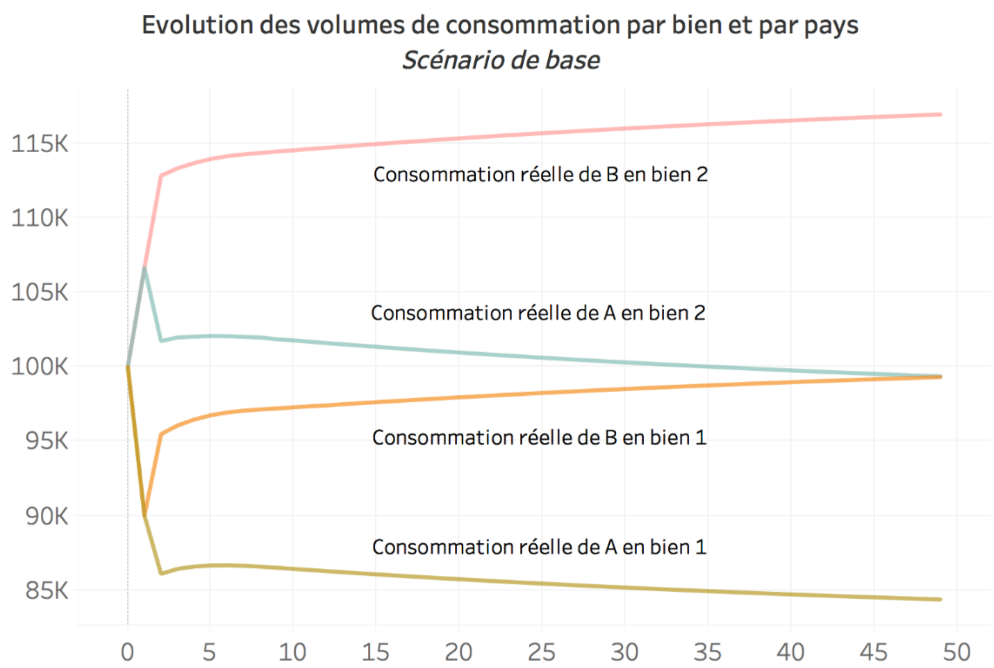
Evolution du taux de salaire effectif durant la phase d'ajustement



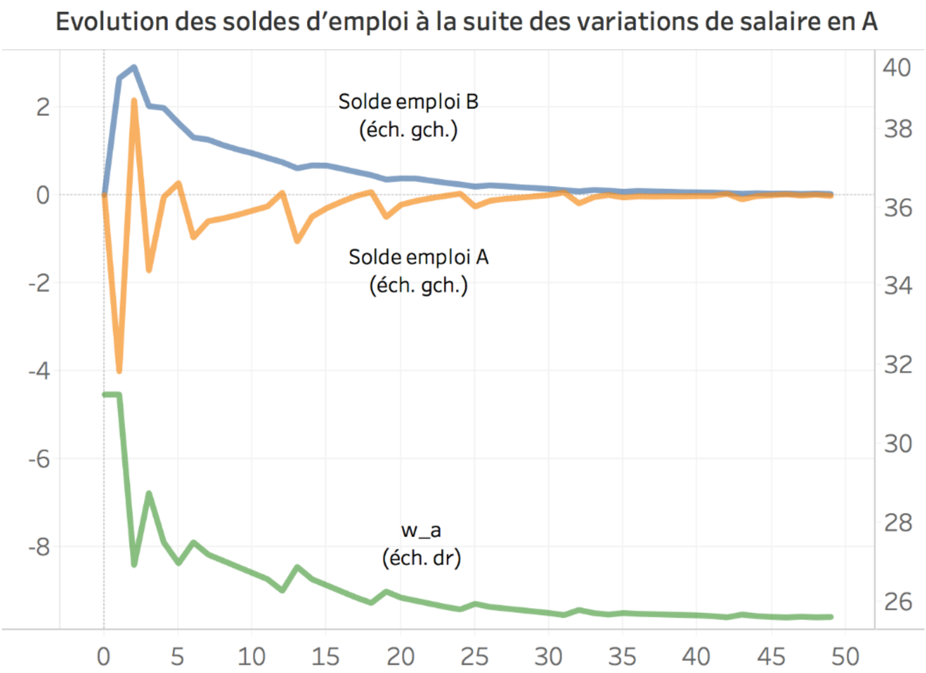
The decrease in disposable income in A has the effect of reducing consumption, causing in particular a decrease in imports of goods 2. with regard to consumption of goods 1, the price decrease associated with the decrease in wages makes it possible to limit the decrease in real consumption from A to goods 1.



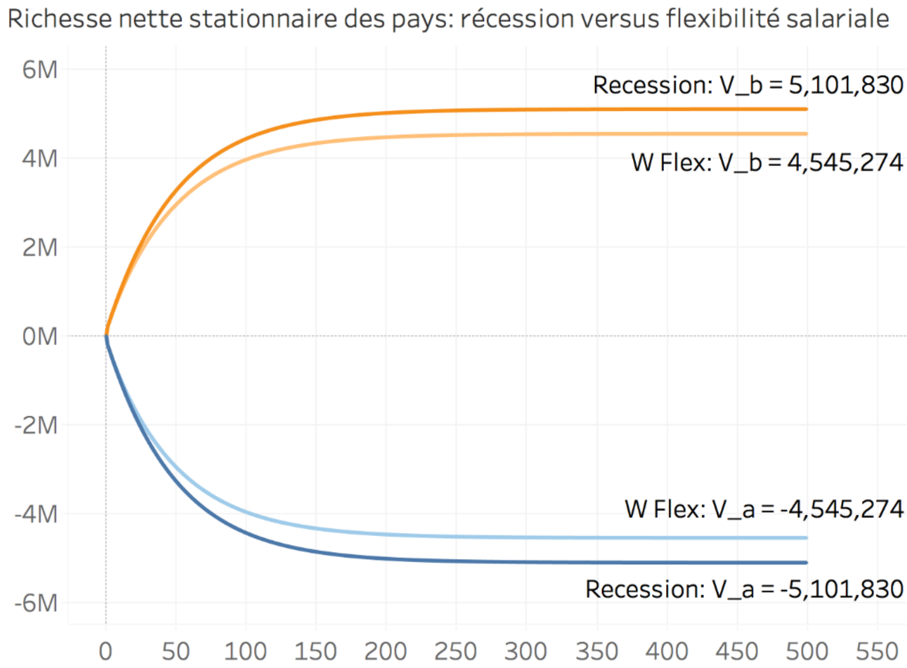
This contrasts quite strongly with the evolution of the same variables in the baseline scenario:



The most significant effects of lower wages in country A are the same as those that would be achieved if the exchange rate fell, namely lower imports in volume and higher exports in volume. The consequences on the respective employment balances of countries A and B are quickly felt, bringing both back to full employment:



However, all this is not enough to equalize the trade balances of both countries to zero. Indeed, there remains an imbalance, which is certainly less important than in the baseline scenario for an equivalent period, but which will also only be resolved once the respective net wealth of the two countries, i.e. their external position, is sufficiently high (or low) for nominal consumption to reach levels that allow trade balances to be equalized to zero. It is interesting to note that the stationary level of net wealth is lower in absolute terms than it was in the base scenario, where the adjustment was due to the recession in the deficit country.



It should be remembered that the model starts from a situation where there is no debt. Here, all debt is due to the need to close the economic circuit in a context of trade imbalances. However, one of the most frequent arguments against falling prices and wages comes precisely from the fact that deflation makes the real burden of pre-existing debt more difficult to bear (Keynes, 1923, Fisher, 1933). We will return to this point when we introduce a government sector into the model, whose initial debt is approximately equal to the value of output over a period of time.

One of the characteristics of adjustment through internal price and wage devaluation is to lower consumer price indices in both countries. This is due to the fact that country A actively reduces its producer prices, while country B sees the price supplement accompanying the overemployment situation disappear at the end of the adjustment process.

2.2.5. Workers' mobility

The idea that labour mobility can substitute for the use of the exchange rate is considered Mundell's main contribution to the theory of optimal monetary areas. This is a somewhat simplistic vision, because while Mundell (1961c) can be credited with raising relevant questions and to some extent providing an interesting answer grid, he cannot be credited with the'criterion' of worker mobility. Meade (1957) and Scitovsky (1958), cited by Mundell (1961c), had already mentioned this phenomenon by looking at the possibility of a monetary union in Western Europe. But we can go back further in time, to find in Lerner's words (1947: 594):

> Where there is mobility of labor, and for this purpose it is real and not just legal mobility which is relevant, there is no need for an exchange adjustment to restore equilibrium between a deficit area and a surplus area. This is because the unemployed in one area where there is a depression can go to the other area, where there is a boom, and get a job.

As McKinnon (1963) and Kenen (1969) point out, the idea of mobility mentioned by Mundell (and Lerner) is both sectoral - in other words, that work is homogeneous - and geographical. Workers in the country in crisis must be able to go to work in another country, where the same goods are not necessarily produced in the same way. It may be noted that if one considered the existence of non-tradable goods or services such as local services or the construction sector, it would be possible to consider limited geographical mobility in certain sectors. This is not the case in this model where each country is considered to produce a different good.

2.2.5.5.a. Model specification

Taking into account the mobility of workers requires us to amend and add some equations to the basic model:

- First of all, it is important to add a migration equation. We use as a determinant the employment balances in both, so workers will decide to migrate if they are in a country experiencing unemployment while the other country is overemployed.
- Equations (2.1.21) and (2.1.22) determining the total populations in each country will have to be modified to take into account migration flows.
- It is also necessary to take into account the implications of migration in terms of wealth transfers between countries. We simplify by assuming that a migration of x% of workers from one country leads to a migration of x% of the country's wealth at the time of migration to the other country. To model this, we will calculate the net wealth of each country before and after migration for each period.

The migration equations are as follows:

$$migr_A = 0.5 * \min(jobs_A\ ; pop_{uB}) \qquad (2.1.77)$$

$$migr_B = 0.5 * \min(jobs_B\ ; pop_{uA}) \qquad (2.1.77)$$

migr_A expresses the amount of migration flow to A, and migr_B the amount to B. For each country, this flow is determined by comparing the number of unemployed in the country of origin and the number of full-time equivalent positions available in the other country.

The reason why a 'min' operator is used is to prevent more people from migrating than the host country can economically receive - this would only shift unemployment. Finally, a coefficient of 0.5 is used to smooth migration and avoid sudden waves that should be compensated by opposing flows in the following period.

These equations in turn affect the equations determining the total population in countries:

$$pop_{tA} = pop_{tA-1} + migr_{A-1} - migr_{B-1} \qquad (2.1.21\text{mob})$$

$$pop_{tB} = pop_{tB-1} - migr_{A-1} + migr_{B-1} \qquad (2.1.21\text{mob})$$

With :

pop_(tA-1) : total population in country A during the previous period before migration

pop_(tB-1) : total population in country B during the previous period before migration

〖migr〗_(A-1) : migration flow from B to A at the end of the previous period

migr_(B-1) : migration flow from A to B at the end of the previous period

A methodological clarification is required here. Taking into account the migration of workers over a period of time poses risks of a runaway model. We therefore preferred to assume that the decision to migrate takes place at the end of each period. Migrant workers have been unemployed during the period and decide to leave at the end of the period.

The amount of the total population in each country is defined at the beginning of each period, as it is required to calculate the actual product in the country and the employment balance. Thus, migration and the total population of a given period correspond to different temporalities within the period. Another possibility would have been, as we will do for the calculation of net wealth, to distinguish a total population amount before and after migration for each period.

In any case, the total population in each country in a given period is equal to the sum of the total population of that country in the previous period (before migration) plus the net migration entering that country in the previous period.

Finally, we need to calculate the impact that migration has on the amount of net wealth in each country. As already mentioned, we will distinguish between net wealth before migration (V_ante) and after migration (V_post).

The central idea can be expressed in literary terms before showing the equations. In the traditional SFC methodology, net wealth is a quantity that is affected by flows during the period and comes to a certain amount at the end of that period. We can therefore say that in a way net wealth is an end-of-period variable. What we are trying to do here is to add an element even more at the end of the period, which will change this net wealth.

What will determine the difference between V_ante and V_post is the proportion of the population that migrates. Therefore we have:

$$V_{postA} = V_{anteA} + \frac{migr_A}{pop_{tB}} * V_{anteB} - \frac{migr_B}{pop_{tA}} * V_{anteA} \qquad (2.1.67post)$$

$$V_{postB} = V_{anteB} - \frac{migr_A}{pop_{tB}} * V_{anteB} + \frac{migr_B}{pop_{tA}} * V_{anteA} \qquad (2.1.68post)$$

In a way, then, V_postB and V_postA can be considered as values at the very end of the period, after taking into account the wealth movements induced by the migration process. These are therefore also the relevant variables when considering the amount of net wealth in each country at the beginning of the next period.

This means that the calculation of V_ante must be performed starting from the value of V_post corresponding to the previous period:

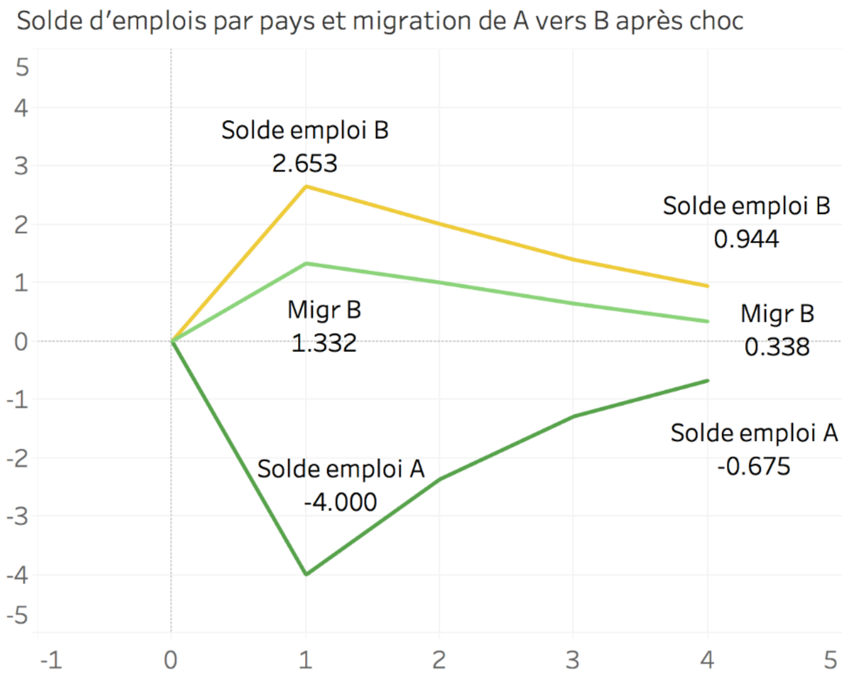
$$V_{anteA} = V_{postA-1} + SAV_A \qquad (2.1.67ante)$$

$$V_{anteB} = V_{postB-1} + SAV_B \qquad (2.1.68ante)$$

It is easy to see that equations (2.1.67ante) and (2.1.68ante) are amended versions of equations (2.1.67) and (2.1.68), taking into account the distinction between net wealth before and after migration.

2.2.5.b. Simulation

The initial shock due to the change in import propensity in both countries is reflected in a deficit employment balance in country A and a surplus in country B. By virtue of the way in which the migration function is specified, there is a population movement from country A to country B that extends over several periods.



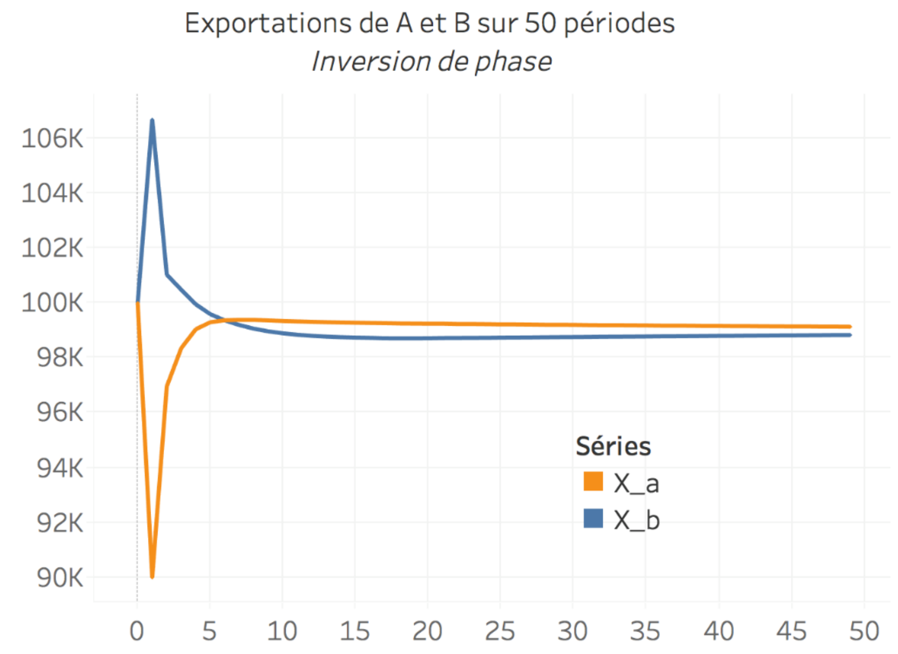
The consequences of this displacement of several percent of the initial population of A are multiple. First of all, it reduces the total population in country A and therefore, with a constant employed population, the number of unemployed in the country.

Second, work that was previously performed in the form of overtime in country B as a result of the demand shock is now partially performed by new workers in the form of regular hours. This has the effect of lowering the effective wage in country B, and therefore the production price of the good 2.

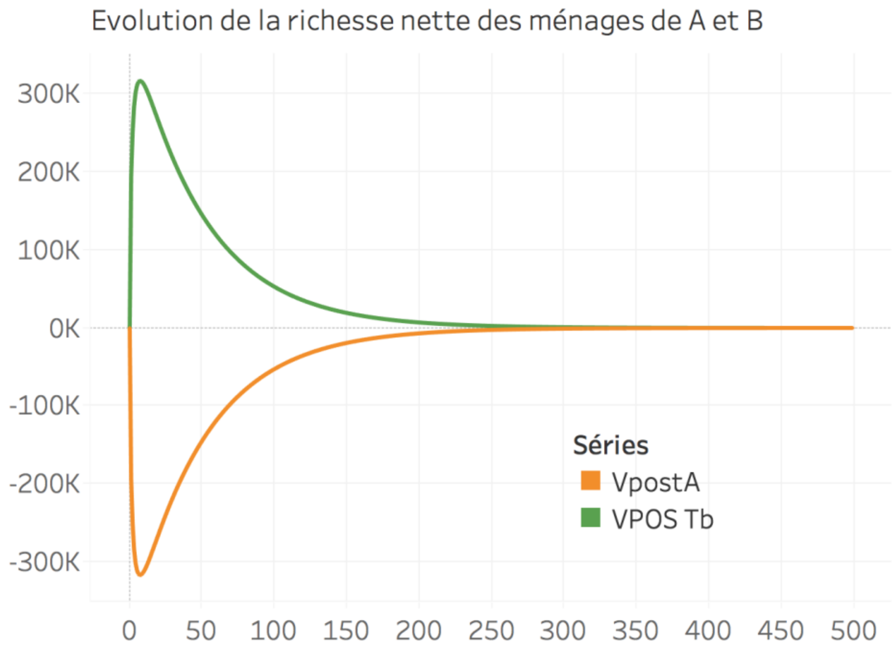
Third, the population transfer has a direct effect on the amount of consumption. Indeed, autonomous consumption is a function of the total population in the country concerned, which means that autonomous consumption decreases in country A while it increases in country B. This has the effect of reducing A's imports and increasing B's imports, thus contributing to a rebalancing of trade and a realignment of production levels.

Finally, the wealth movements induced by labour migration reduce the net wealth of B and increase (algebraically at least, since it remains negative) the net wealth of A. In detail, the migration of workers from A after the shock means that they are carrying debt, since their net wealth is negative. Once in country B, this debt thus becomes a debt of B. However, to the extent that this debt was due to other households in B, it neutralizes itself at the macroeconomic level, in particular as a determinant of the consumption function. This has the secondary and very marginal effect of increasing imports of A and decreasing imports of B.

The consequence of these phenomena is that the trade imbalance will not only be resolved, but reversed. B's imports become higher than the country's exports, to equalize in the long term.



A second notable consequence of labour mobility is the reduction of country A's external debt.



Of all the means of adjustment we have tested, only tariffs can achieve the same result - with the difference that tariffs raise consumer prices in the country that sets them up and thus change the distribution of real consumption between goods 1 and 2.

In conclusion, in a model where agents who can take on debt are mobile, factor mobility has incomparable results in terms of adjustment: reduction of unemployment, price stability, reduction of trade imbalances and debt between countries.

However, this conclusion is only valid within the framework of assumptions in which it is obtained. It would be interesting to look at what happens when not all agents are mobile, especially when they have constrained expenditures - such as social services provided by the government. We will study this case later on.

Another aspect that we have not taken into account here concerns the impact of population displacements on property prices. The existence of increased land pressure in the destination country may lead to an increase in house prices, which is likely to be reflected sooner or later in overall economic prices. Unfortunately, the modelling apparatus to be deployed to analyse this type of analysis is cumbersome and beyond the scope of this work.

2.2.7. Comparison of results

First, we presented what happens when two countries in a monetary union have no capacity for mutual adjustment, and a demand shock affecting consumer preferences occurs. The immediate consequence of this shock is a temporary trade imbalance between the two countries, which is only resolved when the deficit country's production is reduced enough to bring its imports to a level compatible with the stabilisation of its current account balance. At the same time, the debt generated by the initial widening of the trade deficit has as its counterpart an increase in the country's financial wealth, which stimulates its consumption and therefore its imports. These two phenomena are the main drivers of the stabilization of the model's macroeconomic variables following the shock. The resulting situation is characterized by reduced production in the deficit country compared to its initial level and accompanied by unemployment, while production in the surplus country stabilizes at a level higher than its initial level, which corresponded to full employment of the single production factor, thus increasing the hourly wage and thus the general price level.