

Hitotsubashi University

Graduate School of Economics

Doctorate Thesis Summary

**An Analysis of the Trilemma since the 1970s: Existence,  
Performance and Choice**

Fabien Durringer

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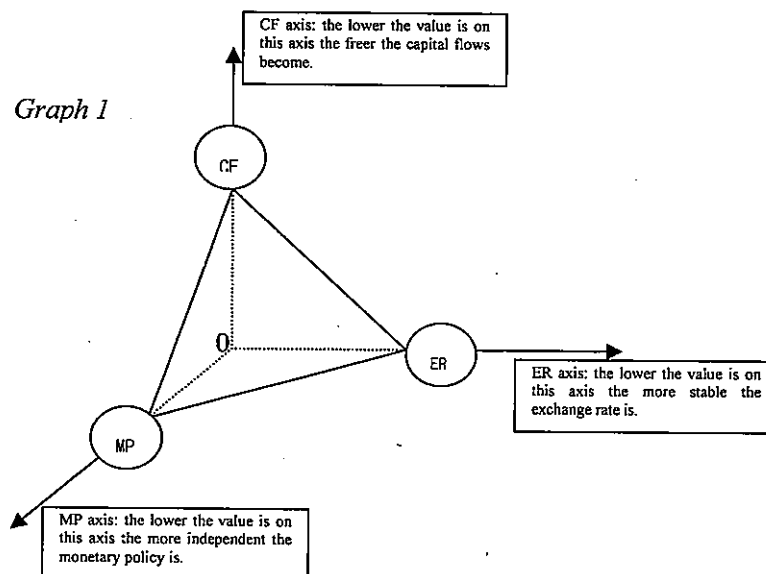
## Introduction

Our thesis attempts to study the trilemma first patented as an *impossible trinity*, or a *triangle of incompatibility* by Mundell in the 1960s (1961, 1968). The trilemma states that it is impossible for a country to achieve simultaneously the triple contradicting but desirable goals of fixing its exchange rate (to foster stabilization of trade and growth), of running an independent monetary policy (to achieve domestic monetary policy goals) and of freeing completely its capital flows (for an optimal allocation of resources). In other words, a country is left with the following 3 sets of choices:

- Fix the exchange rate; run an independent monetary policy; restrict capital flows.
- Fix the exchange rate; give up monetary policy independence; free capital flows.
- Let the exchange rate float; run an independent monetary policy; free capital flows.

Economists have started to suspect the existence of the trilemma mainly on historical grounds, where monetary systems that functioned well during a certain period of time by respecting one of the cases of the trilemma collapsed or entered into a crisis because the trilemma rule was not respected any longer (Gold Standard, Bretton Woods, Europe in the 1990s, and so forth). Some studies have attempted to prove the existence of this phenomenon by checking the relationship between the three variables of the trilemma, but their results were contradicting. Hence, Rose (1996) found that there was not any incompatibility between the three variables of the trilemma, while Shambaugh, Obstfeld and Taylor (2005) proved that the trilemma framework was valid.

Our thesis tries to reassess the trilemma issue in a global way, including the controversial issue of its existence, by using the methodology described in *Graph 1* below:



## 1. Methodology

In order to check if the trilemma exists, we first proceeded to the calculation of three indices (ER=exchange rate volatility index, MP= monetary policy independence index and CF= capital flows restriction index), so that the minimum value 0 of these indices represents the ideal non-reachable state of perfect stability of exchange rate, full independence of monetary policy and complete freedom of capital flows, as described in the first paragraph. Hence, if the trilemma exists we should be able to observe a constraint as that shown in the *Graph 1*. This methodology has allowed us to tackle three issues concerning the trilemma:

- a- First, we checked if the trilemma does exist, i.e. if one can verify econometrically some significant relationship between the three aforementioned variables. We first checked the equation with only the three main variables (non-conditional trilemma). According to the first results, we then checked whether it was necessary to include some extra explanatory variables to make the trilemma a significant relationship (conditional trilemma).
- b- Second, we introduced the concept of performance. In the case of a non-conditional trilemma, the performance is defined by the distance of a country's position in the three dimensional graph to the ideal state (origin of the graph). Such a definition implies that certain countries are able to perform better than others by having a constraint closer to the origin (in other words, countries that perform well manage to achieve at the same time more stability of exchange, more independence of monetary policy and more freedom of capital flows relatively to other countries). If the trilemma we find is conditional, i.e. includes extra explanatory variables to make the trilemma relationship significant, then we would need to re-define the concept of performance by taking into account the ability of countries to cope with the trilemma and the extra-explanatory variables. Whichever definition we face concerning the trilemma performance value calculation, our aim is to understand its determinants. Using the performance value as a dependent variable we thus attempted to understand econometrically what characteristics of countries allow them to perform well.
- c- Finally, the last problem we were able to address with this methodology was the choice countries made in the policy-mix (tradeoff) facing the trilemma constraint. Here, as a benchmark, we provided a triangle graph (Mundell's triangle of incompatibility) in which we have positioned countries to see if some patterns of

choice can be observed over time. After that, assuming countries optimize their behavior regarding the tradeoff, we proceeded to the optimization of a spherical function tangent to the trilemma plane, in which we isolated the parameters of preference in order to study their determinants on an econometrical basis.

## 2. The indices

The panel includes 56 countries and the data are split into 4 periods (1970s, 1980s, 1990s, and 2000s) for a period of 35 years starting in 1970. In the thesis the three indices ER, MP, and CF are calculated as follows:

- a- ER: The index is the standard deviation of the logarithm of the data per period of time for one country, normalized to the average of the whole sample. The value 0 for the ER index represents a complete stable exchange rate (null standard deviation value).
- b- MP: The independence of the monetary policy is measured by the coefficient of correlation between country  $i$ 's monthly interest rate, and the average monthly interest rate of 4 main countries (US, UK, Germany, and Japan), to which we add the value 1, and normalize to the mean of the whole panel. The value 0 for the MP index represents perfect independence of monetary policy (we assume that prior to adding the value 1 to the index a value of -1 signifies a perfect independent monetary policy).
- c- CF: The capital flows restriction index is measured using the Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER) published by the IMF. For periods prior to 1996 we encoded the category of restriction called *Restriction exists on payments in respect of capital transactions* into 0 (perfect freedom) and 1 (full restriction), because there exist no other categories that can properly measure capital flows. After 1996, a new classification of 13 capital flows restrictions was released by the IMF. Using a probit-logit model between years 1995 and 1996 (the years of change) we express the 13 categories of capital flows restrictions into a single category, creating a function that allowed us to calculate the years following 1996. The probability (ranging from 0 to 1) yielded by the function is maintained as it is, assuming that it constitutes a better measurement than what we could obtain for the years prior to 1996. The average value of restrictions was taken according to the panel periods and normalized to the panel average. The value 0 for the CF index means that countries enjoy complete freedom of capital flows.

### 3. The trilemma existence check

Prior to checking the existence of the trilemma relationship, tests were carried out to show that the well-known dilemma relationship between the index ER and MP (a negative relationship as MP increases, i.e. countries lose monetary policy independence, ER decreases, i.e. the exchange rate stabilizes) exists. Very significant results were found for the dilemma existence. However, such was not the case for the trilemma check when we added the index CF. Using fixed-effect model with only the three variables ER, MP and CF, we were indeed only able to prove that MP and ER are negatively and significantly related. For CF, although we have obtained the expected negative sign (as capital flows restriction increases, the exchange rate should stabilize), the result was not significant. However, adding two extra explanatory variables, namely inflation and current account, the trilemma relationship between ER, MP and CF indices became very significant with the expected signs, showing us that what we have named “conditional trilemma” does exist. Robustness tests involving changes in capital flows restriction index calculations, as well as the addition of new extra explanatory variables did not alter the significance of the results we obtained, confirming the validation of the existence of the conditional trilemma.

### 4. Performance analysis

After having proved that the trilemma exists, we analyzed performance related type of issues concerning the trilemma. Since we are dealing with the case of a conditional trilemma, and as explained at the beginning of this summary, for the performance value that countries are able to achieve one needs to take into account the added extra explanatory variables. In a simplified form we can write the conditional trilemma equation as follows:

$$\frac{ER - \beta \ln MP - \mu CF}{\text{Trilemma constraint}} = \frac{\gamma \ln INF_{\text{rate}} + \theta CA + \text{Fixed\_effect}}{\text{Performance value}}$$

The left side of the equation shows the trilemma constraint, i.e. sacrifice made due to the effort put on ER stability to compromise with certain values of MP and CF. Since the left-hand side represents the trilemma, the right-hand side, which is equal to the left-hand side, stands for the performance value that countries have managed to achieve. The lower this value becomes the better the performance.

Descriptive statistics about the performance value show that industrialized countries perform better than developing countries. The econometric analysis carried out to understand the determinants of the performance value

shows us that rich (high GDP per Capita) and open (high openness ratio) countries tend to perform better, as the values taken by these two variables are very significant and robust. Being part of the European Union is also significantly related to a better performance. By emphasizing on the structure of the economy that might affect the performance value (because the fixed-effect is included in the performance measurement), we also tested two extra explanatory variables: industrial and agricultural value added in terms of percentage of GDP. Here we have found that as the share of the value added in the industrial sector increases, the trilemma performance decreases, this result being opposite for the variable of agricultural value added in terms of percentage of GDP. This illustrates the fact that demand of products from the industrial sector might be more sensitive to economic crises, which exposes countries of large value added in the industrial sector to higher variation of their macroeconomic fundamentals. Other explanatory variables, like GDP or deficit, do not show any significant results concerning their relation to the trilemma performance value.

## 5. Choice analysis

In this last part of our thesis we first analyzed the tradeoff that countries have adopted regarding the trilemma constraint. We also tried to understand the determinants of preferences in these countries. In order to carry out such an analysis we assumed that the conditions for the trilemma constraint to exist are fulfilled (we can therefore have the plane represented as in the *Graph 1*) and that countries face the same slope (allowing only the distance to the origin to vary).

For the first analysis, using a triangle graph representing Mundell's triangle of incompatibility, we managed to show graphically that, regarding tradeoff issues, the trilemma can be seen as split into three dilemmas. Placement on the triangle graph shows that countries tend to choose one main "good goal" to be achieved (one of the three variables), leaving them to face a dilemma between the two remaining variables (for example, countries that chose stability of the exchange rate face a dilemma between monetary policy independence and capital flows freedom).

Study of the evolution of the tradeoff over the 4 decades tends to show an increase in the emphasis put on stabilization of exchange rate, except for the 1980s, which are marked by a reinforcement on monetary policy independence in the trilemma tradeoff (excluding Europe which follows a regular trend of reinforcement on exchange rate stability).

After analyzing graphically the tradeoff adopted by countries, we tried to understand if the adopted position (which reflects some preferences) relied on any characteristics of these countries. In order to do so, and assuming that

countries optimize their behavior (the observed measurement of indices are optimal), we then introduced a loss function that we submit to the trilemma constraint as follows:

$$\text{Min } W(ER, MP, CF) = aER^2 + bMP^2 + cCF^2 \quad \text{with } a + b + c = 1$$

$$\text{s.t. } ER + \beta MP + \mu CF = \alpha \quad \beta, \mu > 0$$

Parameters  $a$ ,  $b$ , and  $c$  represent respectively the preferences for ER, MP and CF. We express them in terms of our three indices while carrying out the optimization, and then calculate their values.

Descriptive statistics of the evolution over time of the preference parameters tend to show that preferences regarding exchange rate volatility and preferences regarding capital flows freedom usually evolve in opposite directions. The evolution between the 1970s and the 1980s is marked by a reinforcement of preference for exchange rate flexibility and capital flows freedom. After the 1980s this tendency is inverted for both parameters, although the rise for the preference for exchange rate stability is relatively stronger than the rise for the preference of capital flows restriction. As for the preference related to monetary policy independence, the value of the parameter is relatively stable over time.

Using a multivariate regression analysis to determine the factors motivating preferences, we found the following main results:

- For preferences toward exchange rate volatility (parameter  $a$ ), countries with higher GDP prefer more flexible type of arrangements; this being a very significant result. Two periods representing time dummies also show significant and robust results: in the 1980s countries overall preferred a flexible exchange rate, while the 2000s is the opposite, being marked by preference toward fixing the exchange rate.
- For preferences toward independence of monetary policy (parameter  $b$ ), rich (higher GDP per Capita) and open (higher Openness ratio) countries tend to prefer having less monetary policy independence, even when *EU belonging dummy* is controlled in the equation.
- For preferences toward capital flows freedom (parameter  $c$ ), results show that countries with a higher ratio of openness also tend to be more open to capital flows. The GDP variable also shows a significant relationship with capital flows freedom; as a country's GDP gets higher, the country then becomes less

restricted in terms of capital flows.

## Conclusion

As a policy implication stemming from our study of the trilemma, we suggest the trilemma as a framework to consider for macroeconomic policy makers. In that regard, we would like to stress on the fact that some institutional issues might arise if the trilemma is to be considered. This is due to the fact that authorities deciding the monetary policy (the central bank) and bodies regulating capital flows are different. Besides this potential institutional issue we believe there is a need for governments to think within the framework of the trilemma in order to be able to draw lessons from past crises and settle an efficient new monetary order.

## Extra-appendix correction summary

Following the advice of the jury members, two main corrections have been added to the thesis. Firstly, as an extra analysis, we have carried out a regression using a two-stage least square in the framework of a fixed-effect model in order to test for endogeneity of the trilemma variables. This test was carried out on the equation of the conditional trilemma, taking the monetary policy independence index (LnMP) and the capital flow restriction index (CF) as the instrumented variables (endogenous variables). Using this methodology we were also able to obtain significant results, which allowed us to maintain the hypothesis of the existence of the conditional trilemma.

The second correction concerns the use of a *Euro\_zone dummy* variable (members of the Euro zone) instead of an *EU\_dummy* (members belonging to the European Union) in the analysis of the trilemma performance section and the analysis of the preference parameters. For the trilemma performance regression results are globally improved (especially *Euro\_zone dummy* which is very significant in all the regressions) but remain very similar. In the analysis of the preference parameters, the use of the new dummy shows that Euro zone countries have a marked preference for stability of their exchange rate, which is an improvement compared to the previous results. Regarding the exchange rate volatility preference, one other difference as compared with the previous results is the lack of robustness of the *year\_dummy\_80s*, which is a decade that can no longer be interpreted as marked by preferences for more flexibility of the exchange rate. Besides of these two differences, an overall improvement of the regressions can be noticed, although not leading to any major changes in the conclusions previously drawn in the thesis.