

The Future of the CFA Franc: a Game Theory Approach

ABSTRACT

Aims: Based on the theory of non-cooperative games, this paper aims to determine whether the African Franc Zone (AFZ) countries should leave or remain in monetary cooperation with France.

Study design:

Methodology: Empirically, we implement a non-cooperative game pitting France against the AFZ countries. The strategies defined for the two players are "Maintain (M)" and "Exit (E)", the potential gains being the pooling of 50% of foreign exchange reserves within the French Treasury.

Results: The analysis technique is inspired by Nash's work and consists of formulating a no-regrets equilibrium. At the end of technical manipulations, we obtain two results: (i) Assuming that the AFZ is the first player, and the decision being taken by political leaders without consulting the other sociological components, the optimal solution would be (M, M), reflecting the preservation of 50% of foreign exchange reserves within the French Treasury; (ii) Then, when the leaders of the AFZ countries incorporate the will of the people and the aspirations of the African Union, we arrive at two Nash equilibria, (E, E) and (E, M) respectively, giving gains of 50% for the AFZ and 0% for the French Treasury, significantly implying an exit decision for AFZ countries.

Conclusion: However, these equilibria could be sensitive to the order of the game (who plays first), political shocks such as coups d'état, types of threat, grouped or solitary exit strategies, but also to the bargaining power of the players and a mixed-strategy equilibrium.

Keywords: CFA Franc, African Franc Zone, Game theory, Nash equilibrium.

1. INTRODUCTION

The evolution of monetary systems is attracting growing interest in an increasingly globalized world. The future of the CFA Franc (CFAF) is at the heart of this debate. The CFAF is the currency used by several West and Central African countries that are members of the Franc Zone. This currency, created in colonial times, has recently been the subject of criticism regarding its viability and relevance in the current economic and political context (Gueye et al., 2019). Indeed, created in 1945, it initially stood for "Franc des Colonies Françaises d'Afrique". Following the independence of the French colonies in Africa, it became the "Franc de la Communauté Financière d'Afrique" in the West African Economic and Monetary Union (WAEMU) and the "Franc de la Coopération Financière en Afrique Centrale" in the Economic and Monetary Community of Central Africa (CEMAC). It is issued by two financial institutions: the Bank of Central African States (BEAC) and the Central Bank of West African States (BCEAO). The CFA franc has been in existence for over 70 years.

The two economic needs that gave rise to the CFAF were to regulate capital flows within the French colonial empire and to rationalize the issue of currency in the French colonies. During the first half of the twentieth century, the latter was gradually transferred to private issuing bodies and often left in disarray, before being severely neutralized by the two World Wars. The two monetary unions comprising the African Franc Zone are the CEMAC and the WAEMU. In Africa, the CFAF is often criticized for several reasons. Guillaumont and Guillaumont (2017) point out that, despite the many changes that have been made to it, it still appears to those who reject it as a vestige of colonialism. Its cause is embedded in the movement of ideas that reject this legacy. The reforms that could be implemented in this area should express the Unions' independence from the French authorities.

As a result of monetary cooperation agreements, each central bank in the French zone has an account in the French Treasury, and is required to deposit a portion of its monetary reserves, which are mainly, but not exclusively, export earnings. This percentage fell from 100% in the early 1960s to 65% in 1973, then stabilized at 50% from 2005 onwards (Nepo, 2016). On December 31, 2013, the combined net foreign assets of the BCEAO and BEAC were estimated at 13,073.6 billion CFA Francs (Nepo, 2016).

In recent years, these CFA zone countries have attracted a great deal of attention for three main reasons. Firstly, they have discussed the supposed benefits of monetary stability in the face of the

severe and persistent economic crises in these countries. Secondly, most economists agree that the CFA franc is overvalued by between 20% and 60%, depending on the country, and that this could seriously hamper the structural adjustment plans that the majority of CFA zone countries have put in place. This conclusion is the most controversial in the literature (Abdih & Tsangarides, 2010; Couharde et al., 2013, Coulibaly, 2014; Grekou, 2015; Gnimassoun, 2017). Finally, the question of the future of the CFA Franc has become more pressing today since the European Monetary Union and the Maastricht Agreement of December 1991 (Touna Mama & Ongono, 2019; Avom & Nomba, 2019; Avom, 2020, Mignamissi, & Mouhamed, 2022).

In this paper, we propose an innovative approach to analyzing the future of the CFA Franc using game theory. Game theory is a powerful mathematical tool for studying the strategic interactions between different actors in situations where their mutual choices influence overall outcomes. By applying this theory to the study of the future of the CFA Franc, we can explore the different possible strategies of the actors involved, as well as the potential consequences of these choices on the evolution of the monetary system. Several authors have already addressed this question using traditional economic approaches. Diallo (2002), for example, has examined the advantages and disadvantages of pegging the CFA Franc to the Euro, based on standard economic models. However, few studies to our knowledge have adopted a game-theoretic approach to analyzing the future of the CFA Franc, which makes this article original.

There are several reasons for this article to fill the gap in the literature:

- First, the study aims to fill this gap by examining the strategic interactions between the various players involved in the CFA Franc monetary system, notably the French Treasury, CEMAC, and WAEMU. We will consider central banks, governments, international financial institutions, and other stakeholders with a direct or indirect interest in the future of the CFA Franc. In monetary union, game theory, with its formal analysis tools, offers a valuable framework for understanding these dynamics and clarifying the relevant political choices. Several questions will therefore be addressed here. They include cooperation versus prisoner's dilemma, monetary policy coordination, stabilization and asymmetries, integration and heterogeneity, crises and renegotiations, among others.
- Second, using non-cooperative game models, we will evaluate the possible choices of each actor, the incentives that motivate them, and the outcomes that might result from their decisions. Here, non-cooperative game theory is particularly useful for analyzing economic, political and social situations where players interact strategically, but where formal cooperation is difficult or impossible. Specifically, for Franc Zone countries, it enables us to better understand strategic interactions in a competitive environment, to predict behavior and outcomes in conflict situations, to assess the impact of incentives and institutional structures, and to design coordination and incentive mechanisms, among others;
- Third, several sensitivity tests are carried out to lend further credibility to the analysis and pave the way for future research. These relate to taking into account the order of the game, the impact of political shocks, the types of threat (credible or non-credible), possible exit strategies (solitary or joint exit), the negotiating power of the parties (AFZ versus France), the prisoner's dilemma that may arise between CEMAC and WAEMU countries, and a mixed-strategy solution approach, among others.

The analysis technique is inspired by Nash's work and consists of formulating a no-regrets equilibrium. At the end of technical manipulations, we obtain two main results: (i) Assuming that the AFZ is the first player, and the decision being taken by political leaders without consulting the other sociological components, the optimal solution would be (M, M), reflecting the preservation of 50% of foreign exchange reserves within the French Treasury; (ii) Then, when the leaders of the AFZ countries incorporate the will of the people and the aspirations of the African Union, we arrive at two Nash equilibria, (E, E) and (E, M) respectively, giving gains of 50% for the AFZ and 0% for the French Treasury, significantly implying an exit decision for AFZ countries.

Following this introduction, the article is structured as follows. The second section presents a brief history of the CFA Franc. The third section develops a selective literature review. The fourth section presents the game. The fifth section presents the game resolution and discussions, and the sixth section concludes.

2. A CONCISE HISTORY OF THE CFA FRANC

The history of the CFA Franc is complex and fascinating, dating back several decades. This monetary system, which has been used in several West and Central African countries, has undergone various evolutions and controversies. Indeed, the CFA Franc has its roots in the period of French colonization in Africa. After the Second World War, France sought to maintain its hold on its colonies by creating close economic ties. In 1945, the CFA Franc was introduced to replace the French Franc in the French colonies of Africa, establishing a close monetary relationship between these countries and France. In accordance with Article 3 of French decree no. 45-0136, it was officially created on December 26, 1945, and its parity with the Euro has been fixed ever since. The French Treasury must receive 50% of the reserve funds of the countries in the French zone. The 2005 report on the Franc Zone indicates that the two Franc Zone central banks, BEAC and BCEAO, had around 72 billion Euros (over 3,600 billion CFA francs) at their disposal from the French Treasury.

Since the conversion of the French franc into Euros in 1999, one Euro has been equivalent to 655,957 CFA Francs. Under the principle of monetary cooperation agreements, the central banks of the WAEMU and CEMAC are required to deposit at least 50% of their currency with the French Treasury, as a condition for guaranteeing unrestricted convertibility. The severe devaluation that took place in 1994, followed by numerous civil wars and political instability in most of the countries affected, has left a painful legacy for African countries, particularly those in Central Africa.

West African countries were not as affected by the devaluation, as they had managed their foreign exchange reserves better in light of French operations. In addition, faced with the crisis caused by falling oil prices, the six Central African countries abandoned the idea of revaluing their CFA Franc. For this reason, they decided in December 2016 to negotiate financial assistance from the International Monetary Fund (IMF); this assistance was deemed necessary to increase inflationary pressures without enabling them to achieve real export gains. For proof, Central African economies are mostly undiversified and dependent on oil rents, whose prices are determined by global market forces (IMF, 2016). Faced with this situation, the French Treasury proposed to the French President to revalue the CEMAC CFA (XAF) at the rate of 1 Euro = 1300 CFA XAF, i.e. 50% of its current value, and the WAEMU CFA (XOF) at the rate of 1 Euro = 500 CFA XOF. However, the countries of West Africa, which have no interest in seeing their currency revalued, are demanding that France respect its convertibility commitments. The people of Central Africa must be wary of the hypothetical effects of a revaluation.

Supporters of the CFA Franc argue that this monetary system has brought financial stability and confidence to trade within member countries. The link with the Euro, the reference currency, is often cited as an advantage, offering a degree of protection against currency fluctuations and facilitating trade transactions with Eurozone countries. However, the CFA Franc has also been the subject of much criticism. Some believe that it perpetuates a form of economic neo-colonialism, as it maintains member countries in a relationship of dependence on France. Others point out that the CFA Franc's fixed exchange rate can be detrimental to local economies, hampering their competitiveness and their ability to adjust their monetary policy according to their own needs. Over the years, there have been growing calls for reform of the CFA Franc or even its replacement by a new currency. Some member countries have expressed their desire to have more control over their monetary policy and to free themselves from the influence of France. Discussions are underway to explore different alternatives and envisage transition scenarios.

3. LITERATURE REVIEW

3.1 THEORETICAL REVIEW OF THE LITERATURE

Here, we develop three main theories: stakeholder theory, decision theory, and the shaky hand theory.

About the stakeholder theory, it is an approach that considers that organizations are influenced by a set of internal and external actors who have an interest in the organization's activities. First of all, CFA Franc stakeholders could include the governments of the African countries that use this currency (WAEMU and CEMAC). These governments could express concerns about the economic impact of the CFA Franc on their countries. Some authors, such as Nubukpo (2015); Cissé and Gueye (2024), have argued that the CFA Franc limits the monetary sovereignty of CFA zone countries, as it is linked to the Euro and managed by the Banque de France. These criticisms led to calls for monetary reforms and the abandonment of the CFA Franc. Secondly, economic actors, such as companies and investors, can also be seen as stakeholders in the CFA Franc. Some authors have argued that the CFA Franc

facilitates trade within the CFA zone by reducing transaction costs and guaranteeing monetary stability (Gnimassoun et al., 2016). However, other authors have criticized the CFA Franc for its supposed overvaluation, which harms the competitiveness of CFA zone countries' exports (Hugon, 1999; Schröder, 2013).

Finally, the citizens of CFA zone countries are also important stakeholders. Some authors have highlighted concerns linked to the perception of the CFA Franc as a symbol of colonialism and economic dependence. These criticisms have fueled social movements calling for greater monetary autonomy and the creation of a single African currency. The impact of the stakeholder theory on the future of the CFA Franc will therefore depend on the complex dynamics between the various stakeholders and how they manage to assert their respective interests. The debates surrounding the CFA Franc are numerous and opinions are divergent, making it difficult to predict the exact outcome of these discussions.

Decision theory is a field of study that examines how individuals or organizations make decisions in situations of uncertainty. The decision on the future of the CFA Franc may be influenced by complex economic, political, and social factors. Decision theory under uncertainty, developed by researchers such as Neumann and Morgenstern (1944), can provide a framework for understanding how decision-makers evaluate and make decisions in uncertain environments. Indeed, these authors introduced the concept of expected utility and developed the framework of decision theory under uncertainty. They proposed that decisions taken in situations of uncertainty can be analyzed in terms of subjective probabilities assigned to possible outcomes, and the utility associated with these outcomes. Expected utility is calculated by multiplying the probabilities of possible outcomes by their respective utility, and then summing these values.

Using this framework, it is possible to analyze decisions about the future of the CFA Franc by evaluating possible outcomes and assigning subjective probabilities to these outcomes. For example, the governments of CFA zone member countries could assess the potential advantages and disadvantages of maintaining the CFA Franc in the face of other alternatives, such as adopting a single African currency. They could assign subjective probabilities to different outcomes, such as economic stability, monetary sovereignty, export competitiveness, etc., and assess the utility associated with these outcomes.

Simon (1955) developed the concept of bounded rationality, which has relevance to the decision theory and could be applied in the context of the future of the CFA Franc. According to him, human decision-makers are limited in terms of cognitive capacity and available information, which leads them to make satisfactory rather than perfectly optimal decisions. In the context of the CFA Franc, this could mean that governments and economic players making decisions about the future of this currency may face time, resource, and information constraints. They may not have all the data they need to fully assess the consequences of their choices, and may therefore make decisions based on approximations and heuristic rules. Consequently, Simon's (1955) bounded rationality approach may be relevant to understanding how decision-makers evaluate and make decisions about the future of the CFA Franc. They may look for practical solutions that meet certain objectives and constraints, rather than seeking a complete optimal solution. This may include political, economic, social, and historical considerations that shape decisions on whether to maintain or abandon the CFA Franc.

As for the trembling hand theory, developed by Selten (1978), it is a key concept for analyzing negotiations between France and the countries of the CFA Franc Zone. This principle states that players can sometimes make "irrational" or "shaky" choices that affect the course of events, thus calling into question forecasts based on perfect rationality. In the case of the CFA Franc, the application of this theory is particularly relevant. Indeed, relations between France and its former African colonies are marked by a long history of economic dependence, political interference, and mutual distrust (Hugon, 1999). This affective and symbolic dimension introduces a degree of unpredictability into the decision-making of the various players, who do not always behave in a strictly rational manner.

For example, France might be tempted to make more generous concessions than expected on the issue of control over treasury reserves, for example, to preserve its geopolitical influence in French-speaking Africa (Lelart, 2007). Conversely, Franc Zone countries could adopt a more intransigent stance than their relative economic weakness would suggest, in a bid to assert their sovereignty (Hugon, 2007). Similarly, the emergence of unforeseen socio-political tensions, such as popular protests or coups d'état, could upset the balance of power and force both parties to review their strategies (Lelart, 2003). The

trembling hand theory therefore makes it possible to take these hazards and irrational behaviors into account in the analysis of negotiations on the future of the CFA Franc.

In this uncertain context, classical game theory models, which assume perfect rationality on the part of the players, show their limitations. This is why more dynamic approaches, incorporating the possibility of errors or abrupt changes, are needed to grasp the complexity of the issues at stake (Selten, 1978; Kreps and Wilson, 1982). Ultimately, the trembling hand theory sheds additional light on the analysis of the balance of power between France and the countries of the CFA Franc Zone. It invites us to take into account the irrational, affective, and unpredictable factors that shape negotiations on the future of the CFA Franc, over and above purely economic and strategic considerations.

Finally, game theory, developed by researchers such as John Nash (1950), may also be relevant in analyzing the future of the CFA franc. Decisions to maintain or abandon the CFA Franc may be influenced by strategic interactions between the various member countries of the CFA Franc Zone. Game theory can be used to analyze these interactions and determine the possible outcomes based on the choices made by the various players. This theory will be used to analyze the results of this article from the perspective of non-cooperative games.

3.2. REVIEW OF EMPIRICAL LITERATURE

In the existing literature on the future of the CFA Franc, several factors have been discussed, notably: economic, political, intra-regional, and historical perspectives. In this paper, we focus on the economic aspect, in this case, the study of the CFA Franc's misalignment, which is important for the CFA Franc's future because of its peg to the Euro, but also because of strong economic integration that has not followed monetary integration (Gnimassoun, 2012). Researchers have often examined the effects of misalignments on growth while paying less attention to how they affect current affairs (Ghura and Grennes, 1993; Razin and Collins, 1997; Bleaney and Greenaway, 2001; Aguirre and Calderón, 2005; Rodrik, 2008; Gala, 2008; Berg and Miao, 2010; Béreau et al., 2012; Schröder, 2013). This issue has become more pressing due to growing external imbalances in developed countries, particularly those in the Eurozone (Obstfeld and Rogoff, 2005; Belke and Dreger, 2013; Gnimassoun and Mignon, 2015). On the other hand, it follows from the definition of the equilibrium exchange rate that misalignments in the exchange rate could be detrimental to the current situation. Furthermore, due to the logic of competitiveness, money supply is more directly exposed to monetary imbalances and the main channel through which they influence growth.

Based on this premise, the study of the relationship between current account imbalances and misalignments linked to exchange rate variations usefully complements those concerning the link between growth and misalignments, which are far from unanimous. Djakaridja and Grekou (2024) analyze the degree of misalignment between the real exchange rate in the CFA Franc Zone between CEMAC and WAEMU over the period 2005 to 2022. They use the Pooled Mean Group method and find that the degrees of misalignment appear to vary from year to year, which may reflect the influence of region-specific economic, political, and monetary factors. In addition, Zongo et al. (2023), compare the magnitude of the exchange rate under the two exchange regimes to analyze the nature of the misalignment. To do so, they use the behavioral equilibrium exchange rate model and the PMG estimator of the ARDL model on a panel of 36 Sub-Saharan African (SSA) countries over the years 1998-2018. According to their assessments, there are significant differences between countries and the globalization of the real exchange rate effect (RRCE) of ASEAN countries that have adopted a fixed exchange rate regime.

Another study by Nvuh et al. (2018) on the misalignments of real exchange rates in the French Zone using a non-stationary panel data model applied to a sample of 14 "Françafrique" countries between 1995 and 2016, shows that export diversification not only reduces the magnitude of misalignments, but also more easily adjusts the exchange rate to the region's long-term dynamics. Schröder (2013), using the OLS and GMM method on 63 DCs covering the period 1970-2007 finds evidence to support the view that the economic policies suggested by the Washington Consensus work to show that both undervaluation and overvaluation hurt economic growth in developing countries. In contrast, Rodrick (2008), using the fixed-effect model on a panel of 188 DCs over 11 five-year periods from 1950-1954 to 2000-2004, provides theoretical and empirical arguments showing that undervaluation is beneficial for developing countries.

Berg and Miao (2010) turn to Rodrick (2008), also using the fixed-effect model and the same five-year periods as the latter on 181 developing countries, and show that only overvaluation has negative consequences on growth, while undervaluation is beneficial. Supporting Rodrick's (2008) thesis, Nourira et al. (2011) use data from 52 developing countries in Africa, Asia, and Latin America over the period 1980-2005 and show that developing countries have resorted to a deliberate policy of undervaluation to boost price competitiveness in their manufacturing sectors. Other authors also point to a threshold effect in the relationship between exchange rate misalignments and growth, suggesting that the latter is non-linear (Razin and Collins, 1997; Aguirre and Calderón, 2005; Béreau et al., 2012).

Couharde et al. (2011) estimated the monetary asymmetry between CFA Zone member countries and examined how their real exchange rate towards equilibrium should converge between 1985 and 2007. To do this, they estimate the long-run relationship between the real effective exchange rate and their underlying economic assumptions using panel cointegration methodology (VECM) over the period 1985-2007, which employs Double Ordinary Least Squares (DOLS) developed by Kao and Chiang (2000) and Mark and Sul (2003). They use a smooth transition model with panel error correction to account for non-linearity in the convergence process of variations in the real impact rate. As a result, they found in 2007 that the appreciation of CFA Zone member countries' real exchange rates from 2000 onwards did not correspond to a real appreciation in their respective currencies. However, several countries are significantly overvalued, resulting in strong heterogeneity and the absence of a convergence process within the CFA zone. Finally, they demonstrate that the process of convergence towards fundamentals is characterized by non-linearities, with countries falling into either undervalued or overvalued regimes.

The works on misalignments have shown that over- or undervaluation has either a positive or negative effect on growth, but has not pronounced itself on the future of the CFA Franc. This article will attempt to do just that, by examining the maintenance or withdrawal of the CFA Franc by member countries, using non-cooperative game theory.

4. MODELLING THE GAME

In this game, we assume two hypotheses. Firstly, the leaders of the Franc Zone countries are not subject to popular pressure, and in the second hypothesis, the leaders are subject to popular pressure for a possible exit from the CFA Franc.

4.1. GAME 1: THE STARTING SCENARIO

The question on the future of the CFA Franc, as it has been since 2002, is a two-player game: France on one side, and the 14 Franc Zone countries on the other. More precisely, we have the governments of the African Franc Zone countries (player 1) on one side and the French government (player 2) on the other. Player 2 has two strategies: "Maintain the CFA Franc" (M) and "Exit the CFA Franc" (E). Conversely, Player 1 has only one strategy: "Maintain the CFA Franc". This is because, given their current situation and the advantages it brings, and to remain in power, the rulers of the Franc Zone have no interest in seeing the current system changed. All their strategies boil down to the singleton "Maintain the CFA Franc". Considering only the 50% of foreign exchange reserves held in the French treasury as the stake in the game, player 2's "Maintain the CFA Franc" strategy gives him the full stake. On the other hand, his "Exit the CFA Franc" strategy results in a payout of 0. Player 1's payout is 0 and 50 respectively, depending on whether Player 2 plays "Maintain the CFA Franc" or "Exit the CFA Franc". The matrix form of the game is presented in Table 1.

Table 1: Game 1 matrix

| | | Player 2 | |
|----------|----------------------------|----------------------------|------------------------|
| | | Maintain the CFA Franc (M) | Exit the CFA Franc (E) |
| Player 1 | Maintain the CFA Franc (M) | (0 ; +50) | (+50 ; 0) |

Source: Authors.

Table 1 shows the gains of the different players. Since the two players do not consult each other to decide whether to keep or leave the CFA Franc, the game is non-cooperative. It also appears to be a static game of two players with complete information.

The structure of this matrix stipulates that strategic economic and political decisions are taken exclusively by the public authorities, who see no need to consult the grassroots. In this context, the Executive is overpowering and governs according to its sole interests, namely to stay in power. In this context, remaining in the AFZ is an advantage for the rulers, who *de facto* rule out the strategy of withdrawing from the CFAF.

4.2. GAME 2: CASE OF AGREEMENT BETWEEN THE TWO PARTIES

The populations of the Franc Zone countries are aware that their misery is not solely attributable to the CFA Franc. They know that their poverty is also a result of poor governance, with its attendant corruption and embezzlement of public funds, which are tending to become institutionalized in Franc Zone countries. Knowing full well that these two variables are linked, these populations blame their suffering on the relationship between their governments and political elites and their French counterparts. For them, it's time to break the monetary umbilical cord by means of which France holds and remotely controls both the governments and the economies of the African countries in the Franc Zone. The rise of pan-Africanism in public opinion, through the media, and within certain opposition political parties and civil society organizations are all indicators that the populations of AFZ countries no longer want this currency.

In Africa, particularly in Franc Zone countries, leaders are obliged to serve the interests of the people, not their own. This is still a two-player game, with Player 1 representing the Franc Zone governments and Player 2 representing the French government. In this two-player game, the main change is that the Franc Zone leaders are willing to leave or stay in the CFA Franc Zone solely based on the gains/losses of the community as a whole. As a result, they can easily consider the CFA Franc issue. In this case, Player 1 also has two strategies in the same way as Player 2: "Maintain the CFA Franc" and "Exit the CFA Franc". This situation thus leads to a new configuration of a static, non-cooperative, two-player game with complete information, in the following form:

Table 2: Game 2 matrix

| | | | |
|----------|----------------------------|----------------------------|------------------------|
| | Player 2 | Maintain the CFA Franc (M) | Exit the CFA Franc (E) |
| Player 1 | | | |
| | Maintain the CFA Franc (M) | (0 ; +50) | (+50 ; 0) |
| | Exit the CFA Franc (E) | (+50 ; 0) | (+50 ; 0) |

Source: Authors.

This representation is more global, as it incorporates a second strategy for player 1, representing the aspirations of the population, which generally motivate the idea of leaving the CFAF. Political power is no longer overwhelming, and now takes into account the weight of the people when making strategic decisions. We are in a system in which the political (government) and social (population) components, far from neutralizing each other, have a relative importance in the conduct of different policies.

5. GAME RESOLUTION AND DISCUSSION

In solving the various games, we resort, in the sense of Nash (1950), to the elimination of strictly dominated strategies or to the choice of the best possible answers.

5.1. SOLVING GAME 1

The aim here is to find the Nash equilibrium(s) and discuss the implications of the results obtained. According to Nash (1950), an equilibrium is a state in which each player in a game maximizes his or her payoff, given the choices made by the other players. Formally, in a game with n players, a strategy profile is a Nash equilibrium if no player can improve his or her payoff by changing strategy, given the strategies of the other players. The fundamental idea behind the Nash equilibrium is that players make their decisions taking into account the actions of other players. Nash equilibrium is a concept of self-fulfilling equilibrium, because once all players are in equilibrium, they have no incentive to change strategy. Nash equilibrium is therefore a Pareto-optimal equilibrium.

5.1.1. NASH EQUILIBRIUM SEARCH

We proceed here by eliminating strictly dominated strategies to achieve equilibrium. The matrix form of this game is shown in Table 3.

Table 3: Game 1 equilibrium

| | | Player 2 | |
|----------|----------------------------|----------------------------|------------------------|
| | | Maintain the CFA Franc (M) | Exit the CFA Franc (E) |
| Player 1 | Maintain the CFA Franc (M) | (0 ; +50)** | (+50 ; 0) |

Source: Authors.

Since we are dealing with a non-cooperative, static game with complete information, we are looking for one or more Nash equilibria. In this game, player 2's "Exit the CFA Franc" strategy is strictly dominated by his "Maintain the CFA Franc" strategy. He therefore has no interest in playing his second strategy. Player 2's "Exit the CFA Franc" strategy can therefore be eliminated. As a result, this game admits a Nash equilibrium, i.e. (M, M), which leads to a payoff of 0 for player 1 and 50 for player 2.

5.1.2. DISCUSSION

The stability of the "current situation" in the two-player game stems from the perfect nature of the information held by both players. The history of the relations of dependence between the rulers of the African countries in the CFA Franc Zone and the French political elite provides each player with information that imposes on them the strategy that has led to the current equilibrium. The former know that they won power with the backing of politicians in France and that they need their support to consolidate their power. This moral debt puts them in a position where they don't dare to rely on the principle of international relations to decide to leave the CFA Franc, which justifies the zero gain to be attributed to it. On the other hand, the French government has every interest in maintaining the current system, which gives it half the foreign exchange reserves of all Franc Zone countries. This result is in line with those of Feindouno et al. (2020), who examine the impact of Franc Zone membership on economic growth and poverty reduction. The results of the study show that Franc Zone countries recorded higher growth rates than countries outside the Franc Zone. In particular, the Franc Zone as a whole recorded a growth rate at least 1.5% higher than the other two sets in 2018. These authors argue that Franc Zone countries should remain in the Zone because of the monetary stability and regional integration it offers.

5.2. SOLVING GAME 2

As outlined above, the aim here is to find the Nash equilibrium(s) and discuss the implications of the results obtained.

5.2.1. FINDING NASH EQUILIBRIA

In this second game, the payoff matrix is shown in Table 4.

Table 4: Game 2 equilibrium

| | | Player 2 | |
|----------|----------------------------|----------------------------|------------------------|
| | | Maintain the CFA Franc (M) | Exit the CFA Franc (E) |
| Player 1 | Maintain the CFA Franc (M) | (0 ; +50)* | (+50 ; 0)* |
| | Exit the CFA Franc (E) | (+50 ; 0)** | (+50 ; 0)** |

Source: Authors.

The immediate observation here is that neither player has strictly dominated strategies. So we'll take a box-by-box approach. In the box corresponding to the pair (M, M), player 1 has every interest in unilaterally changing strategy: this is not a Nash equilibrium.

For the box corresponding to the pair (M, E), it is player 2 who has every interest in unilaterally changing strategy: this is not a Nash equilibrium. On the other hand, the box corresponding to the pair (E, E) is indeed a Nash equilibrium, since neither player improves his situation by changing strategy unilaterally. Similarly, the pair (E, M) is also a Nash equilibrium for the same reasons. We thus obtain two Nash equilibria: (E, E) and (E, M) with payoffs (50, 0).

5.2.2. DISCUSSION

In this second scenario, where Franc Zone leaders are willing to leave or remain in the CFA Franc solely based on gains/losses for the community as a whole, solving the game leads to two Nash equilibria, all of which advocate leaving the CFA Franc. Indeed, the equilibrium (E, E) resulting from the choice of the Franc Zone countries and the French government to leave the CFA Franc leads to a gain that enables the Franc Zone countries to recover all their foreign exchange reserves and regain their financial autonomy. In the case where the French government decides to maintain the CFA Franc and the Franc Zone countries decide to leave, based on one of the principles of international law which stipulates that each State is sovereign and no State should interfere in the affairs of another State, we obtain the equilibrium (E, M) which also leads to a gain enabling the countries of this Zone to recover all their foreign exchange reserves and also their financial autonomy. Based on these results, it's clear that Franc Zone countries have every interest in leaving the CFA Franc. The fixed peg of the CFA Franc to the Euro should therefore be reviewed, or at least the operations account clause. In other words, people's aspirations are an essential determinant of monetary relations between France and the African countries of the franc zone.

This finding is in line with that of Agbohohou (1999) in his book "Le Franc CFA et l'Euro contre l'Afrique", who argues that the CFA Franc is a colonial, servile, and predatory currency that keeps African countries in a situation of economic and financial dependence on Europe, particularly France. He points out that the CFA Franc is linked to the Euro, which means that the value of the African currency is determined by the value of the Euro. This enables European companies, particularly French ones, to benefit from favorable economic conditions and maintain their influence on African economies. He also believes that maintaining the CFA Franc is an obstacle to the emergence of African economies, as it prevents African states from pursuing an autonomous monetary policy that is permanently different from that of the Eurozone. He points out that the fixed parity with the Euro provides relative monetary stability and international credibility, but this is not enough to offset the disadvantages of maintaining the CFA Franc. He also believes that African countries must leave the Franc Zone to develop their own currencies and take control of their own economies. He argues that leaving the CFA Franc would enable African countries to pursue a more autonomous monetary policy and reduce their economic dependence on Europe.

5.3. SENSITIVITY ANALYSIS OF RESULTS

In this section, we review the different scenarios, namely: the order of the game, coups d'état, types of threat, grouped or solitary exit strategies, players' bargaining power, and mixed-strategy equilibrium.

5.3.1. GAME ORDER

According to Game 1, which is a non-cooperative game in which players must seek one or more Nash equilibria. In this setting, player 1's "Maintain CFA Franc (M)" strategy is strictly dominated by player 2's "Exit CFA Franc (E)" strategy. This means player 2 should play first, as his dominant strategy will enable him to achieve a better result, regardless of the strategy chosen by player 1. So, in this game, player 2 should play first. In this way, we find the same equilibrium as in the status quo situation (hypothesis 1).

For Game 2, the order of play is in two stages. Firstly, player 1 decides whether he wants to maintain the CFA Franc (M) or exit it (E). This initial decision by player 1 is important, as it will condition the options available to player 2. Once player 1 has made his choice, player 2 in turn decides whether he wants to maintain the CFA Franc (M) or exit it (E). Player 2 makes his decision based on that of Player 1. The results of these choices are then presented in the payoff matrix (Game 2). This matrix shows the respective payoffs of the two players according to the strategies adopted by each. In the case where both players choose to maintain the CFA Franc (M, M), it is in Player 1's interest to change strategy. This suggests that Player 1 has the possibility of modifying his initial choice, while Player 2 does not. Thus, the dynamics of the game are characterized by an initial decision by player 1, followed by the choice of player 2, with the possibility for player 1 to change strategy in certain cases. So, when we are dealing with the social forces (population) in the game, whether France wants to maintain the CFA Franc or not, countries will always leave the CFA Franc Zone. This leads us to conclude that the people have the power.

5.3.2. POLITICAL SHOCKS: COUPS D'ÉTAT

In the event of a coup d'état and a new president coming to power, the position of Franc Zone countries vis-à-vis the CFA Franc may vary according to several factors, such as the legitimacy of the new government, political relations with Franc Zone member countries and the economic interests at stake. In some situations, the new government may decide to maintain the CFA Franc and continue using the common currency. This could be motivated by considerations of economic stability, continuity of trade with partner countries, and continued access to the benefits of using a common currency. This is the case, for example, in Gabon, where the president of the republic was deposed on August 30, 2023, following a military intervention coordinated by the Committee for the Transition and Restoration of Institutions (CTRI). The latter decided to remain in the Franc Zone to stabilize the country's economy.

However, in other cases, the new government could envisage an exit from the CFA Franc. This could be for political reasons, notably if the coup was directed against institutions or policies supported by France, which plays an important role in the management of the CFA Franc. An exit from the CFA Franc could also be seen as a means of strengthening economic independence and national sovereignty. Indeed, coups d'état weaken the position of political forces, since politicians who need the support of the population will themselves support the ideas of the population that will lead to an exit from the CFA Franc. This is what Nubukpo et al. (2016) show, for whom maintaining the CFA Franc, and by extension the financial link with France, encourages the interference of foreign powers in the political and economic affairs of African countries. This monetary dependence affects the ability of African countries to make sovereign decisions for their economic and political development, which can sometimes lead to unrest and coups d'état. By advocating an end to the monetary servitude of the CFA Franc, they argue that African countries could regain greater autonomy in the management of their economic and political affairs, which would contribute to greater stability on the continent.

5.3.3. THE TYPE OF THREATS

In this game scenario, the two players - France on the one hand, and the Franc Zone countries on the other - face various potential threats that influence the course and outcome of the conflict. For France, the main threat lies in the loss of its economic and geopolitical influence over French-speaking Africa. Indeed, should the Franc Zone countries succeed in seizing 50% of French treasury reserves, this would considerably weaken France's position vis-à-vis its former colonies. Not only would it call into question the CFA Franc monetary system, but it would also affect trade relations, investments, and all the economic ties that bind France to this region. France would then face a loss of control over strategic resources and an erosion of its geopolitical influence in Africa, to the benefit of rivals such as China and Russia, who would seek to capitalize on the situation.

For Franc Zone countries, the main threat is the risk of direct military confrontation with France. Indeed, France could be tempted to use force to preserve its hold on these reserves at all costs, even if it means resorting to armed intervention. African states would then have to contend with French military superiority, in terms of equipment, logistics, and experience. This would force them to develop defensive and asymmetrical strategies to counter possible aggression. Moreover, open conflict with France could weaken the unity of the Franc Zone and foster internal divisions, making coordinated collective action more difficult.

In addition to these direct threats, both sides also face economic and diplomatic challenges. For France, the challenge would be to convince its European allies to support its position, while for African countries, the challenge would be to forge new international alliances to counterbalance French influence. Each player's ability to navigate these complex diplomatic waters would therefore be crucial to victory. Ultimately, this game scenario features a multi-faceted strategic conflict, where military, economic, and diplomatic threats intertwine, forcing each player to deploy a variety of tactics and resources to achieve their goal of controlling the French treasury reserves.

France has historically wielded considerable influence in the countries of the CFA Franc Zone, thanks in part to the use of the CFA franc as a common currency. However, an exit of these countries from the CFA Franc Zone could call this French influence into question. As France has close ties with the European Union, the latter could potentially support an embargo policy against countries leaving the CFA Franc. In this context, France and the EU could threaten to impose a trade and financial embargo against any country unilaterally leaving the CFA Franc Zone. This embargo could include sanctions such as blocking bank transactions, interrupting supplies, or denying access to European markets. The aim would be to put pressure on these countries to dissuade them from leaving the CFA Franc and to

preserve French and European influence in the region. However, such a threat would probably raise strong diplomatic tensions and could be perceived as neo-colonialism by some African countries. What's more, the effectiveness of an embargo would also depend on these countries' ability to turn to other trading partners outside Europe, notably China, the USA, and Russia. There would also be a risk of economic retaliation and regional destabilization if the embargo were effectively implemented. These analyses corroborate those of Pigeaud and Sylla (2024), who show that the common currency (CFA Franc) used by several African countries is a key tool of the French economy, enabling Paris to maintain economic control over independent African countries.

According to Conte (1997), the debt of Franc Zone countries could be used as a threat if these countries were to leave the CFA Franc. Indeed, France, as the historical colonial power of these countries, has forged close ties with the European Union. So, if these countries were to leave the CFA Franc, France, and its European allies could take economic and financial reprisals against them. One of the main levers would be the external debt of these countries, which is largely held by France and its European partners. Conte (1997) points out that "France and its European allies could threaten to stop refinancing the external debt of these countries, which would plunge them into a serious financial crisis". This threat would be all the more credible as these countries depend heavily on external financing to balance their budgets and repay their debt. What's more, he explains, "France and the EU could also block these countries' access to international financial markets, preventing them from refinancing themselves". This would have disastrous consequences for these economies, which need external capital to finance their investment and development. Finally, Conte (1997) points out that "France and its European allies could also exert pressure on international financial institutions such as the IMF and the World Bank to refuse new loans to countries that have left the CFA Franc". This would deprive these States of essential funding for their development policies.

Similarly, Pigeaud and Sylla (2024) assert that France and the EU could attempt to destabilize countries wishing to leave the CFA Franc by funding rebel movements or supporting coups d'état. This would enable them to maintain their economic and political influence in the region, by preventing these countries from emancipating themselves from the monetary system inherited from colonization. A case in point is Chad, where France has provided military and financial support to Idriss Déby's regime for years, despite the human rights violations committed by his regime.

5.3.4. GROUPED, SOLITARY OR MONETARY UNION EXIT STRATEGIES

Franc Zone countries have every interest in adopting grouped and united exit strategies against France, to increase their chances of gaining control of 50% of French treasury reserves. First and foremost, a coordinated and unified exit from the Franc Zone would enable the African States to present a stronger common front against the economic and diplomatic power of France. Indeed, collective and united action would give them greater weight and legitimacy in negotiations on the sharing of reserves. Rather than confronting France individually, African countries could adopt a firmer negotiating stance and demand greater concessions.

What's more, a group exit would facilitate the establishment of new common monetary and financial institutions to replace the CFA Franc system. This would enable African states to strengthen their economic sovereignty and independence from French tutelage. The creation of a new regional currency, backed by a common reserve fund, would be a means of gradually freeing themselves from dependence on the French treasury. However, according to Mbaye et al. (2017), leaving the Franc Zone could entail a significant "systemic risk" for the countries concerned. Indeed, recent financial indicators show that the economic and monetary situation of these countries is not always worse than that of countries outside the Franc Zone. Moreover, Guillaumont and Guillaumont (2017) warn of the risk of capital outflows induced by expectations of currency depreciation in the event of an exit. This could weaken the financial and economic stability of these countries. Furthermore, Nubukpo et al. (2016) point out that the Franc Zone is seen by some as an important tool for regional integration, which should be extended to the whole of ECOWAS. A grouped exit would call into question this process of regional economic integration, with potentially high costs. Moreover, Diallo (2002) highlights the transition costs and uncertainties over the value of the currency that would accompany such an exit. Finally, a joint exit would offer the opportunity to better coordinate the military and economic strategies of Franc Zone countries. Rather than acting in isolation, they would be able to deploy common armed forces, pool their resources and investments, and thus increase their leverage against France. This strategic cohesion would be essential if they were to succeed in capturing a significant share of France's treasury reserves.

Of course, implementing such group exit strategies would not be without its challenges for African countries. They would have to overcome historical rivalries, diverging interests, and the free-riding temptations of certain states. However, it is at this price that they could hope to win out over France in this game scenario.

If a country were to leave the Franc Zone on its own, the solution could be seen as sub-optimal at a time when large regional economic blocs are being formed. The costs of a solitary exit could include readjustment, rebalancing, negotiation, stabilization, and reputational costs, notably in terms of adapting financial institutions and economic policies, managing imbalances in balances of payments and foreign exchange reserves, the complex negotiation and time required, major financial interventions and adjustments in economic policies, as well as the negative impact on the reputation of the country and its financial institutions (Diallo, 2002).

On the one hand, advocates of an exit point out that the Franc Zone is perceived as a tool of France's economic domination over its former colonies. They argue that exit would enable these countries to pursue more autonomous monetary and economic policies, better adapted to their realities (Mbaye et al., 2019). In addition, a peg to a basket of currencies rather than the Euro could be more favorable to their exports. However, opponents of the exit warn of the risks of such a decision, including transition costs, uncertainties over the value of the new currency, and the risks of capital outflows. They also point out that the Franc Zone has provided a degree of monetary and macroeconomic stability, avoiding episodes of hyperinflation. Moreover, a monetary union rather than a solitary exit could better manage these risks and preserve the benefits of regional integration. According to some authors, the Franc Zone could even be extended to the whole of ECOWAS, thereby strengthening African economic integration. However, economic differences between Franc Zone countries complicate this option and raise questions about the relevance of an identical parity for all.

5.3.5. THE BARGAINING POWER OF THE PLAYERS

In this hypothetical scenario, the negotiating power of both parties - France and the Franc Zone countries - is based on advantages and constraints that will shape the course and outcome of the negotiations. France's main advantage is its considerable economic and financial weight. As a depositary of the treasury's reserves, it has considerable negotiating leverage. Moreover, its control of the common currency, the CFA franc, gives it a decisive influence over the economies of African States. This position of strength would theoretically enable it to impose its conditions on Franc Zone countries. However, France also faces limitations that temper its negotiating power. Firstly, the need to preserve its influence in French-speaking Africa forces it to find a compromise acceptable to these States. Indeed, too brutal a confrontation would risk undermining its relations with this strategic region for a long time to come. What's more, France also has to contend with pressure from the international community, which might disapprove of an overly interventionist policy.

Conversely, the countries of the Franc Zone have less negotiating power in the face of France's economic power. Their States are generally weaker, with economies heavily dependent on the CFA Franc monetary system. Nevertheless, they can draw on several advantages to strengthen their position. Firstly, greater unity and coordination within the Franc Zone would enable them to present a stronger common front against France. Secondly, the possibility of forging new international alliances, notably with emerging powers such as China and Russia, would give them greater leverage in negotiations. Finally, the threat of open conflict with France, even if it entails significant risks, could push Paris to accept concessions. The balance of power between these two players is constantly shifting, as each seeks to exploit its strengths and counter the weaknesses of the other. It is in this unstable equilibrium that the negotiations over the sharing of French treasury reserves will be played out.

5.3.6. MIXED-STRATEGY EQUILIBRIUM

In a mixed strategy, some Franc Zone countries might choose to maintain the common currency (the CFA Franc), while others might opt to leave the Franc Zone. It is important to note that the decision to maintain or leave the Franc Zone will depend on the specific economic, political, and social interests of each country. In the case of a mixed strategy, countries choosing to maintain the CFA Franc may do so because of the perceived benefits of monetary stability, access to financial and technical support from the Banque de France, and economic cooperation with other Franc Zone member countries. These

countries may find that the CFA Franc facilitates trade, mitigates the risk of currency fluctuations, and offers credibility to foreign investors.

On the other hand, countries opting to leave the Franc Zone may do so to assert their monetary sovereignty, implement monetary policies customized to their specific needs, foster economic development, and reinforce their independence from France. These countries may seek to establish their own national currency or join other regional monetary unions. It should be noted that the consequences of leaving the Franc Zone can be complex, and may vary depending on the policies put in place to manage this transition. Elements such as debt management, the establishment of strong national monetary institutions, and regional economic coordination can play an important role in the success or otherwise of a Franc Zone exit.

6. Conclusion

This article aimed to determine whether or not Franc Zone countries should leave the CFA Franc. To achieve this, we have used a game-theoretic approach, contrasting France with the member countries of the Zone. Considering only the 50% of foreign exchange reserves held in the French treasury as the stake in the game, the "Maintain the CFA Franc" strategy gives Player 2 (the French treasury) the full stake (50%) and 0% to the Zone member countries considered as Player 1. By contrast, the "Exit the CFA Franc" strategy leads to the opposite of gains. Following our analysis, we arrive at two main results: (i) The solution to the two-player game leads initially to a Nash equilibrium which is (M, M). This justifies the zero gain to be attributed to the Franc Zone member countries. On the other hand, the French government has every interest in maintaining the system in place, which gives it half the foreign exchange reserves of all the Franc Zone countries. (ii) Next, assuming that the leaders of the Franc Zone member countries aim to implement the will of the people, we end up with two Nash equilibria, respectively (E, E) and (E, M), which give payoffs of 50% and 0% to the Franc Zone member countries and the French Treasury respectively, advocating the exit from the CFA Franc. However, a two-player game involving France and the Franc Zone countries may find its limits in that the interests and positions of the various Franc Zone countries may diverge, reducing the relevance of the game. In addition, such a game could be perceived as being too focused on the interests of France; the game should therefore be opened up to include other partners, notably China, the USA, and Russia.

However, leaving the CFA Franc is clear-cut, but as is sometimes advocated, it would plunge the Zone's economies into the abyss. The path of reform is the wisest and most appropriate, and is conditioned by the following:

- Monetary transformation in phase with the new mutations: indeed, depositing 50% of external reserves in an operating account opened at the French Treasury to guarantee unlimited convertibility between the CFA Franc and the Euro is now obsolete. While this measure facilitates trade between the Franc Zone and the Eurozone, it is detrimental to the fluidity of transactions with new partners such as China and India. From now on, it will no longer be appropriate to continue depositing the 50% reserves in the books of the French Treasury, but rather in institutions such as the AfDB, or simply in the central banks of the Zone, provided that their use to cover new convertibility is seriously supervised. The current ultra-dependence of Franc Zone countries on exports necessitates such hedging.
- Integral renovation of the economic model: if the Franc Zone were an iceberg (a large block of ice floating in the sea), the monetary issue would be its emerging face, and its economic model would be its submerged part. The economic structure inherited from independence has not changed over time. The economies of CFA Zone countries are outward-looking, relying heavily on export earnings from their raw materials. This type of organization leaves the States vulnerable to exogenous shocks, which is why they face chronic difficulties in the event of a price collapse, even if the French Treasury, backed by the reserves it holds, momentarily provides support for the Zone's imports. The real problem will be solved with the end of outward-oriented economies. The CFA Zone, and the vast majority of African countries, must move from a model of extractive economies to transformation economies.
- Institutional simplification: no economic and monetary policy can be effective without clear governance. In Central and West Africa, countries are suffering from the double burden of sub-regional membership. In West and Central Africa, countries are respectively members of both WAEMU and ECOWAS, or CEMAC and ECCAS. It is important to simplify community governance by merging all bodies, including central banks, between WAEMU and ECOWAS on

the one hand, and CEMAC and ECCAS on the other. The new institutions resulting from these absorptions will provide greater legibility with single community bodies.

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