Quantitative Exploration of Fiscal Rules for WAEMU Countries

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Abstract

West African Economic and Monetary Union (WAEMU) countries are capital market integrated and design jointly their fiscal and monetary policies. This paper offers a quantitative analysis of the fiscal rule in this economic and monetary union and characterizes an optimal reforms. The theoretical framework used is a model of fiscal policy where present-biased governments face shocks to their fiscal needs. The structure of the model implies a trade-off between flexibility for the government to react to shocks and commitment to limit its incentives to overborrow. I documented a significant heterogeneity in government revenue, spending, and debt across WAEMU countries. I found that the current uniform 3% deficit rule improves the citizens' welfare of all WAEMU countries compared to full discretion. However, country-specific fiscal rules would be Pareto improving reform over the current uniform rule either when the governments individually design their rules or when a central authority jointly designs the rules for the governments. Each country's optimal deficit limit level is influenced by the volatility of the shocks on it government revenues and the level of the present-bias of the government.

Keywords: Fiscal Rule, Economic and Monetary Union, Present-bias preferences, Welfare analysis, Uncoordinated Rule, Coordinated Rule, Optimal reform, WAEMU . . .

JEL Classification: E62 – F42 – F68 . . .

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Introduction

Fiscal rules are long-lasting constraints on fiscal policy through numerical limits on budget aggregates. The objective of fiscal rules is to contain pressures to overspend by ensuring fiscal responsibility and debt sustainability. Since 1985 there is a growing number of countries that adopted fiscal rules [1]. Those countries adopt either a national fiscal rule, a supranational fiscal rule or both. The supranational fiscal rules are designed for a group of countries generally constituted in union such as WAEMU, CEMAC, East Africa Economic and Monetary Community, European Union, ECCU [2]. This paper investigates the design of fiscal rules for an economic union with a focus on West African Economic and Monetary Union (WAEMU) countries. I show that the fiscal behavior of a government impacts the others members of the union such that a design coordination of the fiscal rule that consider the specificity of each country is beneficial for the union.

My work is motivated by two observations. The first one is that the eight WAEMU countries are subjected to the same fiscal rules as described in section 1.1: the main rule is either a balance budget rule (from 2000 to 2014) or a maximum of 3% deficit limit of GDP (since 2015). The second observation is the heterogeneity of fiscal needs of WAEMU countries that I documented in section 1.2. Indeed, I showed that the budget balance over GDP, the government expenditures over GDP, the government revenue over GDP and the government debt over GDP are globally and significantly different across WAEMU countries. Considering these heterogeneity the aim of this paper is to investigate a potential reform of fiscal rules in WAEMU countries such that it benefits the union.

In practice, in currency/monetary unions, as the objectives are mainly the convergence and stability of the union, a common rule is chosen for all the union members. Numerical targets are set on broad budget aggregates of the union. The rational behind these doing is of the scope of political matters; the union member should be equally treated. In the sens

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[1] Davoodi et al. (2022):from 9 countries in 1985 to 105 countries in 2021
[2] 8 countries in West African Economic and Monetary Union (WAEMU),

the fiscal needs are unequal across the members, an equal fiscal rule would be unjust. This paper explores the designing of fiscal rule in a fair way for a currency union.

I use a theoretical framework where the central authority that designs the fiscal rules for the union consider the specificity of each economy and internalize the spillovers effects of their decisions on the union. I rely on a standard model of fiscal policy from the literature (Halac and Yared (2018)). The central authority aggregates the decisions of each government of the union. The governments are different in two ways: - they experience an idiosyncratic shocks that determine the fiscal needs - the incentive of over-borrowing is different among governments: the degree of present-bias can be different across governments. In this model the spillover effect is capture by the interest rate. For example a fiscal irresponsibility of one member of union can increase the risk premium on regional bond market.

I discipline this model using the data on WAEMU countries from " La Base de Données Economiques et Financières de la BCEAO"[3] to quantify the optimal fiscal rules and make the welfare analysis of those rules. When I first abstract the spillover effect of interest rate, I first found that for all WAEMU countries having a maximum of 3% of GDP deficit limit is better than giving full discretion to the governments. Indeed, the rule discipline the governments from overspending as they are present-biased. However, if those governments optimally set their fiscal rules, I found that the citizens of Benin, Côte d'Ivoire, Mali, Niger and Senegal would have been better off with more tighter deficit limit of 3% while Burkina Faso and Guinea Bissau would choose around 4% deficit limit rule. when I take into account the fiscal stance of one member of the union on the others it turns out that interest rate of the union would increase from 5% to 6.8% and the joint rule provides large flexibility for some countries. Benin, and Mali would have been providing a large flexibility respectively 12% and 10% deficit limit while Côte d'Ivoire, Guinea Bissau, Niger, Senegal and Togo would be required a medium flexibility ranged from 3% to 5% deficit limit and Burkina Faso would have the tighter fiscal rule of 2% deficit limit.

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[3]BCEAO (Banque Centrale des Etats de l'Afrique de l'Oeust) is the Central Bank of West African states using the CFA currency

Literature Review : Fiscal Coordination in Economic and Monetary Unions

This paper relates to literature on the design of rules to discipline authority such that their decisions benefits more the citizen (). This paper is built on the seminal paper of Amador, Werning, and Angeletos (2006) and the contribution of Halac and Yared () to study the design of fiscal rule for economic union. This paper quantifies the fiscal rule to discipline the members of the WAEMU.

This paper is also related to literature on the necessity of fiscal coordination in monetary union (Grauwe (1992), Buiter et al. (1993), Kenen and Kenen (1995), Chari and Kehoe (2004), Hamada et al. (1985)). Those papers discuss the importance of fiscal rules in monetary union as the only tool to stabilize the national business cycle, the necessity of fiscal coordination to internalize the spillover effects of one member behavior on the others and limit the free-riding behaviors. This paper shows that the fiscal coordination doesn't imply a common rule for all the members of the union.

This paper contributes to literature on fiscal rules design in for WAEMU countries (David et al. (2022), Basdevant et al. (2015), Dessus et al. (2016)). Those works focus on the analysis of effectiveness and adequacy of fiscal rules in the union through the econometric estimation of structural models. My approach, in this paper, consist in calibrating a theoretical model and performing a conterfactual welfare analysis of the fiscal rules.

1 The WAEMU System of Fiscal Rules and Empirical Facts on Countries Heterogeneity

This section presents the backgrounds of fiscal rules in WAEMU countries and a description of those countries related to their fiscal practises.

1.1 The WAEMU System of Fiscal Rules

Seven countries of West Africa sharing the common West African CFA franc currency established, by signing a Treaty in 1994, the West African Economic and Monetary Union. The Member States Benin, Burkina Faso, Côte d'Ivoire, Mali, Niger, Senegal and Togo where joined lately in 1997 by Guinea Bissau. The union was established to strengthen the economic and financial competitiveness of the Member States through the market integration and monetary union established earlier in 1962. The union aimed also to reinforce the fiscal discipline and coordination of fiscal and monetary policy after the devaluation of CFA franc occurred in 1994. To this end, the eight members states adopted on December 1999 the "Growth, Stability, Convergence and Solidarity Pact (GSCSP)". The Pact has been revised in 2015.

The initial pact lasted from 1999 to 2015. It stated eight rules divided in two orders of convergence criteria. First-order convergence criteria gathered ceiling on fiscal deficit and debt to GDP and on CPI inflation and no accumulation of arrears. The second-order convergence criteria included ceilings on wages and salaries, floor on tax revenues, limits on current account deficits and floor on investment-expenditures to revenue ratio. This paper is interested in evaluating the fiscal rules of the first-order convergence criteria. The deficit rule is defined as basic fiscal balance which is fiscal balance excluding grants. The debt ceiling was set at 70 % of GDP.

The GSCSP has been revised in 2015. The number of rules was reduced by three. The rule on accumulation of arrears was withdrawn from the first-order criteria while the rules on current account deficit and investment-expenditures to revenue ratio were withdrawn from the second-order convergence criteria. The deficit rule was also modified such as the overall fiscal balance (grants included and externally financed capital expenditures) to be a maximum of 3% of GDP. This revised GSCSP is applicable since 2015 excepted that it has been suspended in 2019 in order to allow countries to overcome the COVID-19 pandemic crisis.

Indeed, a reason of GSCSP's revision is the violation of the fiscal rules by member states from 2000 to 2014. As we can see from table A.1 at least six out of eight countries have violated the basic deficit balance rule during the period 2000 to2014. We guest that violation might come non suitable of the rule due to the heterogeneity of member states of WAEMU.

1.2   Empirical Facts on WAEMU Countries Heterogeneity

This section presents the facts that prove the heterogeneity of member states of WAEMU. This heterogeneity is analysed in the dimension of fiscal needs and fiscal behavior of those countries. From those facts, I state that an heterogeneous fiscal rule for the countries should be more suitable.
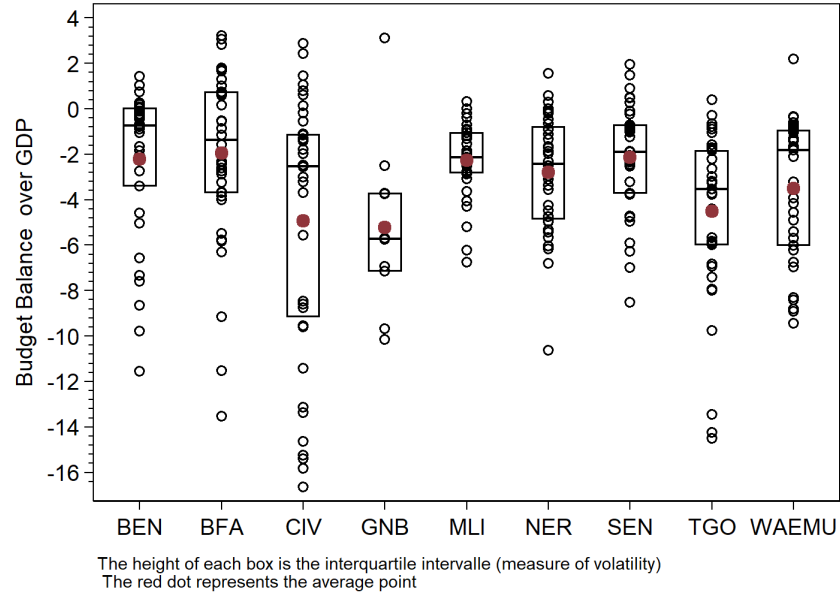
I use macro data from " La Base de Données Economiques et Financières de la BCEAO". This data is constructed by the Central Bank of West African States serving the eight west African countries of WAEMU.

To show this heterogeneity I compare the means and volatility of budget balance, government revenue, government spending and current debt for WEAMU countries.

Fact 1 :   I use time series from 1960 to 1999 to show that member states of WAEMU were heterogeneous before the setting of the uniform fiscal rule in GSCSP. As shown in figure (1) the budget balance is very different across countries in mean as well as in volatility. For example the average budget balance for Côte d'Ivoire is about two times that of Burkina Faso and the standard deviation of budget balance for Côte d'Ivoire is three times that of Mali. The mean difference and the volatility difference of budget balance across WAEMU countries before 2000 is confirmed by statistics tests reported in table B.1. As for budget balance, the WAEMU countries experienced different average and volatility, before 2000, in the government revenue over GDP, government expenditures over GDP and debt over GDP as reported in table (B.1) and shown figures A.1, A.2 and A.3.
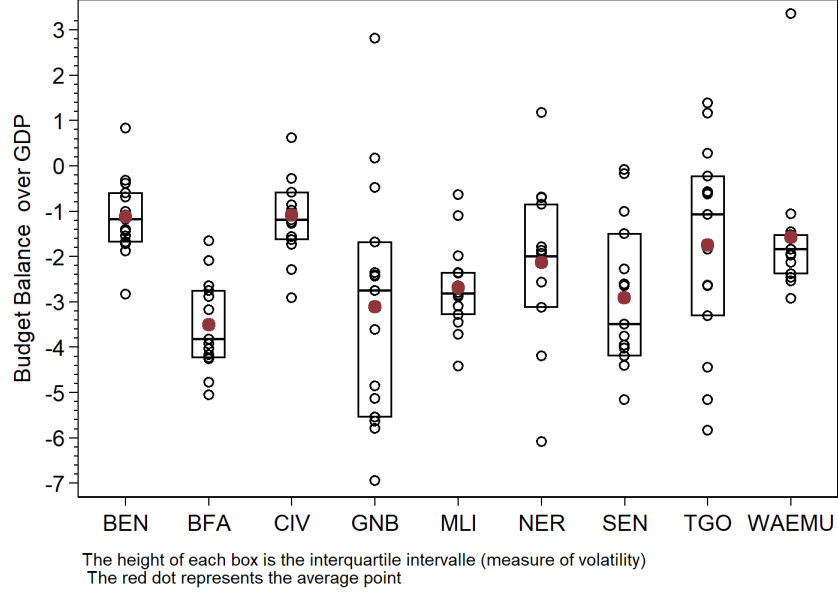
Fact 2: I use time series from 2000 to 2014 to show that member states of WAEMU stayed heterogeneous during the years of application of fiscal rule leading to the modification

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Figure 1 – Budget Balance over GDP from 1960-1999

The height of each box is the interquartile intervalle (measure of volatility)
The red dot represents the average point

of GSCSP. During this period, the average budget deficit of Burkina Faso was around three
times that of Benin and Togo budget deficit volatility was about double of that of Mali.
Those differences of mean and volatility of budget balance across WAEMU from 2000-2014
hold from statistics tests performed We observed the same pattern of heterogeneity in mean
and volatility on government revenue over GDP, Government expenditures over GDP and
government debt over GDP during this period (see figures B.1, B.2 and B.3 and table B.2).

Figure 2 – Budget Balance over GDP from 2000-2014

The height of each box is the interquartile intervalle (measure of volatility)
The red dot represents the average point

2 Theoretical Framework

This section presents the economic environment and model used to investigate the fiscal rule in WAEMU countries. The government objectives on spending on borrowing come from the interaction of the preferences shocks it experiences and the degree of present-bias toward spending of the government.

2.1 Setup

I rely on a simple model of fiscal policy for the quantitative evaluation of fiscal rule. I consider an Economic and Monetary Union of N countries in which government of each makes decisions of spending and borrowing. The setup is the same as that analysed in Halac and Yared (2018).

For now I will describe a two periods models to fix ideas. At the begin of the first period the government i observes a shock $\theta_i > 0$ to its economy draw from a bounded set $\Theta_i = [\underline{\theta_i}, \bar{\theta_i}]$ with a continuously differentiable distribution function $F_i(\theta_i)$. After this shock the government i chooses the first period spending g_i and the second period asset holding x_i

according to its budget constraint:

$$g_i + \frac{x_i}{R} = \tau_i + x_{0i} \tag{1}$$

Where τ_i is the government revenue at the initial period, x_{0i} is the level of assets the government i enters the first period and R is the gross interest rate that is endogenously determined in the Union.

The social planner welfare is

$$\mathbb{E}[\theta_i U(g_i) + \beta W(x_i)] \tag{2}$$

Where β is the discount factor, $U'(.) > 0$, $U''(.) < 0$, $W'(.) > 0$ and $W''(.) < 0$. $U(g_i)$ represents the government i's utility from spending g_i and $W(x_i)$ is the second-period utility from carrying forward assets x_i. I consider $U(.)$ to exponential function such that I interpret θ_i as a shock on government i's revenue (see section 5.4 of Amador et al. (2006)). For a general utility function, θ_i is a taste shock multiplying the first-period utility. As explained in Halac and Yared (2018) the task shock is a tractable way to introduce flexibility in the model; therefore the marginal benefit of government spending increases with a high value of θ_i.

After the realisation of the shock to the economy the government i's objective when choosing g_i and x_i is

$$\theta_i U(g_i) + \delta_i \beta W(x_i) \tag{3}$$

Where $\delta_i \in (0, 1]$.

We assume in this setting that the members of the Union cannot borrow or lend from abroad; the aggregate net borrowing in this Union is zero in equilibrium. Let $g_i(\theta_i, R)$ and $x_i(\theta_i, R)$ be respectively government i's spending and asset holding when he experiences

shock θ_i, the Union gross interest rate adjust then for global resource constraint (4) to be hold.

$$\sum_{i=1}^{N}(g_i(\theta_i, R) = \sum_{i=1}^{N} \tau_i \tag{4}$$

2.2 Fiscal Rules

There are two frictions in the setting that impose a trade-off for the rule-making body. Unless $\delta_i = 1$ there is a disagreement between the social planner objective (2) and that of government i (3). The government is present-biased in the sens that after the realisation of the shock to the economy, government i tend to overspend in the first period compared to what the social planner attribute. This structure of this preference is motivated in literature by two arguments. It arises because the government aggregate the citizen's preferences even if there are time consistent (see Jackson and Yariv 2014, 2015). The other argument of such preference is political turnover. when there is a political uncertainty,for instance, the government in power place a higher value to government spending. For the WAEMU countries, the latter argument appears more relevant.

The second frictions in the setting is the shock that experiences each government. I assume that a fiscal rule cannot be build on the value of that shock for many reasons. First, it may be very costly to build the fiscal rule on each realisation of shock due to the large set of this shock. A second reason is that even if the shock is observable, ex post, it value cannot be verifiable.

The two frictions in the setting induce a tension between flexibility and commitment. In one hand, a desirable rule should offer a sufficient flexibility to the government to react to the shocks he experiences and, in the other hand, the rule should discipline him from overspend.

I define the fiscal rule as a cutoff on government i's shock θ_i^* such that when this government experiences a shock $\theta_i > \theta_i^*$ its first-period spending and second-period asset are respectively $g_i^f(\theta_i^*, R)$ and $x_i^f(\theta_i^*, R)$, whereas when $\theta_i < \theta_i^*$ its first-period spending and

second-period asset are respectively $g_i^f(\theta_i, R)$ and $x_i^f(\theta_i, R)$. Where $g_i^f(.)$ and $x_i^f(.)$ are the optimal decision rules of government i's objective. $g_i^f(.)$ and $x_i^f(.)$ maximize (3) subject to (1) and verify (5).

$$\theta_i U'(g_i^f(\theta_i, R)) = \delta_i \beta W'(x_i^f(\theta_i, R)) \tag{5}$$

The definition of fiscal as provided can be implemented with maximum deficit limit as for WAEMU countries. This framework I set forth will be apply in evaluating the fiscal rule in WAEMU countries. The following section presents the quantitative strategies I use to answer the questions state in the introduction.

3 Evaluation of Current Uniform Fiscal Rule over No Rule

I start the evaluation of the fiscal rule stated in GSCSP before proposing an optimal one. I will evaluate both the balance deficit rule in place from 2000 to 2014 and the maximum of 3% deficit rule adopted since 2015. I compute for that evaluation the welfare variation from no rule situation of WAEMU countries to the uniform fiscal adopted in GSCSP. Indeed, before the adoption of GSCSP any WAEMU country was subjected to a fiscal rule. I then perform this analysis for each country individually. Before presenting the results, I will show the calibration strategy I adopted.

3.1 Calibration

As mentioned in section 2 there are two main ingredients in the model: the preference shock and the present-bias parameter. The identification of those ingredients are then crucial for my quantitative analysis.

Preference shock inference I infer the preference shock using data from 1960 to 1999 to identify the behavior of government in absence of fiscal rule. I start by assuming a CARA utility function to interpret the preference shocks as shocks on government revenue (I consider CRRA utility function for robustness analysis) : $U(g) = 1 - e^{-\alpha g}$. I calibrate the distribution of shocks on government revenue with the detrended time series of new government debt. Then I back up the distribution of preference shocks using the relation $\theta = e^{-\alpha \epsilon}$; where ϵ is the shock on government revenue.

α and δ parameters calibration

For each country, I choose the risk aversion parameter for utility function α and the government present-bias parameter δ such that the theoretical mean and variance of the budget balance match the mean and variance of the data budget balance up to 1999. The calibration results are summarised in table 1. All the WAEMU countries are risk-averse as

$\alpha > 0$. The more δ is far from 1 the more the government is present biased. My calibration results show that Côte d'Ivoire is the most present biased government and Mali the least present biased government in WAEMU.

The calibration procedure of the present-bias parameter for each country suggest the value found depend highly on the government behavior from 1960 to 1999. As this parameter is not observable and its calibration is not identified I will assume the same present-bias value for all the government as robustness check. Considering the same present-bias parameter for all the countries help identifying also the influence of preference shocks on the fiscal rule.

Table 1 – Calibration

	BEN	BFA	CIV	GNB	MLI	NER	SEN	TGO
α	0.365	0.121	0.621	0.654	0.178	0.482	0.533	0.569
δ	0.954	0.966	0.896	0.901	0.981	0.951	0.958	0.918

3.2   Welfare analysis

I use the notion of government spending equivalent variation to evaluate the welfare variation from a benchmark policy to an alternative policy. Let a subscripts bp and ap denote respectively benchmark policy and alternative policy allocations; Λ the government spending equivalent verify:

$$\mathbb{E}[\theta U(g^{bp}(\theta, R)(1 + \Lambda)) + \beta W(x^{bp}(\theta, R))] = \mathbb{E}[\theta U(g^{ap}(\theta, R)) + \beta W(x^{ap}(\theta, R))] \qquad (6)$$

Λ is the maximum fraction of government expenditure that the citizen would be willing to forgo in the benchmark economy for the government to choose allocations of the alternative economy. In order word, it is the mount the government would require to be indifferent between the benchmark economy and the alternative one. For example if the benchmark economy displays more welfare than alternative economy $\Lambda < 0$. This means the government would be willing to give up $100 * \Lambda\%$ of its spending every period to remain in the benchmark

economy. In opposite, when the alternative economy gives higher welfare, $\Lambda > 0$. The implication is that the government will require $100 * \Lambda\%$ of its spending every period to be willing to stay in the benchmark economy.

Using the calibrated parameters in table 1 I quantify the welfare variation for each member state of WAEMU from the no fiscal rule situation to its uniform fiscal rule. The results are displayed in table 2. It comes out, from this table, that all WAEMU countries are better off moving from no rule to 3% maximum deficit limit rule. For example, Benin citizen would be willing to accept an increase of government expenditures by 0.5% each period to move from no rule economy to maximum of 3% deficit rule.

The WAEMU homogeneous fiscal rule benefits all countries as $\Lambda > 0$. Guinea Bissau is the country benefiting the most the 3% deficit limit rule and Mali is the least benefiting this rule compare to no rule situation.

I will now turn on the design and the quantitative evaluation of a national optimal fiscal rule.

Table 2

	BEN	BFA	CIV	GNB	MLI	NER	SEN	TGO
From no rule to 3% deficit limit in %								
δ	0.954	0.966	0.896	0.901	0.981	0.951	0.958	0.918
Λ (in%)	0.51	0.71	0.69	1.77	0.11	0.38	0.16	0.61

4   Uncoordinated Optimal Fiscal Rule

The section 3 shows that the governments overspends when they are provided a full discretion such that a fiscal rule of a maximum 3% deficit limit of GDP is beneficial to all WAEMU countries. This section explores a potential reform for WAEMU countries when each government individually designs its fiscal rule ignoring its decisions on the union.

4.1 Uncoordinated Fiscal Rule Design

We consider that the Central Bank of the Union chooses the optimal fiscal for each country to maximize the Union expected welfare. When the Central Bank consider that the governments in the union face different interest rate on their borrowing, setting the fiscal rule for the union is equivalent to setting the fiscal rule for each country separately. This exogenous interest rate assumption implies a national fiscal rule design for each country.

Each government set then its fiscal rule to maximize the social welfare given that those allocations satisfy its objectives; it is an uncoordinated fiscal rule.

The government i sets its fiscal rule such that it maximizes the expected welfare as follow:

$$
\max_{\theta_i^* \in [\underline{\theta_i}, \bar{\theta}_i]} \left\{ \int_{\underline{\theta_i}}^{\theta_i^*} \left(\theta_i U(g_i^f(\theta_i, R)) + \beta W(x_i^f(\theta_i, R)) \right) f_i(\theta_i) d\theta_i \quad + \right. \tag{7}
$$
$$
\left. \int_{\theta_i^*}^{\bar{\theta}_i} \left(\theta_i U(g_i^f(\theta_i^*, R)) + \beta W(x_i^f(\theta_i^*, R)) \right) f_i(\theta_i) d\theta_i \right\}
$$

The optimal uncoordinated fiscal rule (national rule) is defined as - given the interest rate R, it is a cutoff θ_{iu}^* satisfying:

$$
\frac{\mathbb{E}[\theta_i | \theta_i \geq \theta_{iu}^*]}{\theta_{iu}^*} = \frac{1}{\delta_i} \tag{8}
$$

In practice however, as it is currently for WAEMU, the Central Bank constraint all the countries in the union to adopt the same fiscal rule. This constraint imply some additional assumptions in my model. Indeed, for all the countries to set the same rule, their must experience the same preference shocks and they must have the same present bias parameter. Under those assumptions, all the governments have the same behavior. The constraint uniform fiscal under exogenous interest rate is defined as - given the interest rate R, a cutoff

θ^*_{cu} satisfying:

$$\frac{\mathbb{E}\left[\theta|\theta \geq \theta^*_{cu}\right]}{\theta^*_{cu}} = \frac{1}{\delta} \tag{9}$$

Where θ represents the common shock to the union and δ the common present-bias parameter for the union.

I compare the uncoordinated fiscal rule in one hand to the current homogeneous 3% deficit limit rule and in the other hand to the constraint fiscal rule.

4.2 Quantifying National Fiscal Rule for WAEMU Countries

I use the notion of government spending equivalent variation (equation 6)to compare the welfare variation from the current homogeneous maximum of 3% deficit limit rule to the optimal uncoordinated fiscal rule for each country evaluation with equation (8). I summarize the results I found in table (3). The table shows that when the WAEMU countries independently design their fiscal Benin, Côte d'Ivoire, Mali, Niger, Senegal and Togo would have choosen a tighter rule than 3% deficit rule in place while Burkina-Faso and Guinea Bissau would have set optimally a slacker rule. In particular, it is optimal for Benin to set a balance fiscal; moving then from 3% deficit rule to a balance fiscal would increase the citizen welfare. Indeed, the Beninese citizen would accept to give the government a maximum of 0.125% of government spending each year to adopt 0.64% deficit limit rule.

Table 3

Optimal deficit limit (DL) and Λ from 3% to optimal rule in %								
	BEN	*BFA*	*CIV*	*GNB*	*MLI*	*NER*	*SEN*	*TGO*
δ	0.954	0.966	0.896	0.901	0.981	0.951	0.958	0.918
DL (in%)	0.64	3.91	1.79	3.50	2.06	1.80	1.06	2.17
Λ (in%)	0.125	0.000	0.019	0.013	0.006	0.025	0.038	0.013

5 Coordinated Optimal Fiscal Rule

The precedent section 4 started the investigation of potential reform of fiscal rules in WAEMU countries with the assumption that interest rate is specific for each country in the union. This section, however, explores a potential reform of fiscal rule in the union considering that each government decisions impact the remaining countries through the interest rate. This interest rate is then endogenously determined in the model from the interactions of the decisions of WAEMU's members states.

5.1 Design of coordinated Fiscal Rule

The Central Bank jointly chooses a fiscal rule for each country by maximizing the union's social welfare knowing that the allocation are chosen to satisfy each government objective; it is a coordinated fiscal rule. This setting rule differs from the uncoordinated rule as it takes into account the externality effect of each member state of union fiscal behavior on the rest of members; this externality is through the interest rate. Indeed, the union interest rate R level varies with the borrowing demand and lend offer such that when country i, for example, increases its demand, everything else equals, R increases. The Central Bank in this setting internalize this externality effect while it did not in designing the uncoordinated fiscal rule.

The Central Bank chooses a specific fiscal rule for each member state by maximizing the social welfare of the union. The program solved is :

$$\max_{\otimes_{i=1}^n \theta_i^* \in \otimes_{i=1}^n [\underline{\theta_i}, \bar{\theta_i}]} \sum_i^n \upsilon_i \bigg[\int_{\underline{\theta_i}}^{\theta_i^*} \left(\theta_i U(g_i^f(\theta_i, R(\theta^*))) + \beta W(x_i^f(\theta_i, R(\theta^*))) \right) f_i(\theta_i) d\theta_i \tag{10}$$
$$+ \int_{\theta_i^*}^{\bar{\theta_i}} \left(\theta_i U(g_i^f(\theta_i^*, R(\theta^*))) + \beta W(x_i^f(\theta_i^*, R(\theta^*))) \right) f_i(\theta_i) d\theta \bigg]$$

$$\text{s.t.} \sum_i^n \upsilon_i \int_{\underline{\theta_i}}^{\bar{\theta_i}} \left((g_i^f(\theta_i, R)) \right) f_i(\theta_i) d\theta_i = \sum_i^n \upsilon_i \int_{\underline{\theta_i}}^{\bar{\theta_i}} \tau_i f_i(\theta_i) d\theta_i$$

Where $\theta^* = (\otimes_{i=1}^n \theta_i^*)$ and $\sum_i^n \upsilon_i = 1$ with υ_i being the weight of country i.

The optimal coordinated fiscal rule is a cutoff $\theta_c^* = (\otimes_{i=1}^n \theta_{ic}^*)$ and its associated interest rate $R = R(\theta_c^*)$ satisfying, $\forall \quad \theta_c^* < \bar{\theta} = (\otimes_{i=1}^n \bar{\theta}_i)$ and $\forall \quad i \in 1, 2, ..., N$:

$$
\begin{cases}
\dfrac{\mathbb{E}[\theta_i | \theta_i \geq \theta_{ic}^*]}{\theta_{ic}^*} = \dfrac{1}{\delta_i} + \dfrac{R'(\theta_{ic}^*)}{(1 - F(\theta_{ic}^*))\theta_{ic}^* U'(g_i^f(\theta_{ic}^*, R)) \frac{\partial g_i^f(\theta_{ic}^*, R)}{\partial \theta_{ic}^*}} (\rho_i + \lambda_i) \\
\sum_i^n \upsilon_i \int_{\underline{\theta}_i}^{\bar{\theta}_i} \left(g_i^f(\theta_i, R) \right) f_i(\theta_i) d\theta_i = \sum_i^n \upsilon_i \int_{\underline{\theta}_i}^{\bar{\theta}_i} \tau_i f_i(\theta_i) d\theta_i
\end{cases}
\tag{11}
$$

Where $\rho_i \equiv$ redistributive effect and $\lambda_i \equiv$ Discipline effect;

$$
\rho_i = -\frac{1}{R} \left[\int_{\underline{\theta}_i}^{\theta_{ic}^*} W'(x_i^f(\theta_i, R)) x_i^f(\theta_i, R) f_i(\theta_i) d\theta_i + \int_{\theta_{ic}^*}^{\bar{\theta}_i} W'(x_i^f(\theta_{ic}^*, R)) x_i^f(\theta_{ic}^*, R) f_i(\theta_i) d\theta_i \right]
$$

$$
\lambda_i = - \left(\int_{\underline{\theta}_i}^{\theta_{ic}^*} \left(\theta_i U'(g_i^f(\theta_i, R)) - R W'(x_i^f(\theta_i, R)) \right) \frac{dg_i^f(\theta_i, R)}{dR} f_i(\theta_i) d\theta_i \right.
$$
$$
\left. + \int_{\theta_{ic}^*}^{\bar{\theta}_i} \left(\theta_i U'(g_i^f(\theta_{ic}^*, R)) - R W'(x_i^f(\theta_{ic}^*, R)) \right) \frac{dg_i^f(\theta_{ic}^*, R)}{dR} f_i(\theta_i) d\theta_i \right)
$$

The redistributive effect ρ_i captures the impact of interest on lenders and borrowers. Indeed, higher is the preference shock of a government, higher it expenditures would be and more likely the government will increase it borrowing. In this case the next period marginal cost of this debt depends on the level of interest rate such that high level of interest rate harms more government that experiences a high shock. The Central Bank searching to maximize the social welfare will put more weigh on the high type governments; it will be optimal to design a rule that lower the interest rate. The objective to redistribute from lower type to higher type leads the Central Bank to reduce the governments flexibility, which will reduce the interest rate, relative to the design of national rule.

The second externality effect that is not internalize when designing the national fiscal rule is the disciple effect λ_i. It captures the sensibility on interest rate of government spending and borrowing. Thus, assuming that a high level of interest rate limits the governments expenditure, this effect discourages governments that overborrow. In overall, a high interest

rate benefits more the governments that experience a low shock and overborrowed relative to the first best allocation. In other side a high interest rate harms governments that experience a high shock because they underborrowed relative to their first best allocation.

In the program solved by the Central Bank in equation (10) the fiscal rule is specific for each country. I will evaluate a similar design of rule where the Central Bank constraint all the members of the union to set the same rule as we observe currently in WAEMU countries. As mentioned earlier, the constraint uniform rule implies additional assumptions of common shocks and common present-bias parameter for all the countries of the union. I am going to compare the welfare implication of designing a country-specific joint rules and a constraint joint rule for WAEMU countries.

5.2   Quantifying Joint Fiscal Rule for WAEMU Countries

I use the calibrated parameters in table 1 to evaluate the joint fiscal rule; the results are summarized in table 4. The country-specific joint fiscal rule optimally provides large deficit limit for Benin and Mali, a medium deficit limit for Senegal, Niger, Togo, Côte d'Ivoire and Guinea Bissau and a small deficit limit for Burkina Faso. Comparing those rules to the current 3% deficit limit, only Burkina Faso is given less flexibility while more discretion is given to Benin, Mali, Senegal and Niger. Moving from the current fiscal rule to the country-specific joint rule would benefit the union. In particular, constraint Burkina Faso to 2% deficit limit instead of 3% is preferable for the citizen as the would willing to give the government each period 0.6% of its spending to adopt the 2% deficit limit rule.

The equilibrium net interest rate associated with the joint fiscal rule is 6.8% a year. This means that internalizing the impact of a WAEMU's country decisions to the other members rise the interest from 5% to 6.8%. This level of interest rate reflect the net effect of redistributive and discipline effect. It is such that the borrowers (the governments that experience high shock) benefit of the increase of the interest rate as well as the governments that experience a low shock are disciplined.

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Table 4

	BEN	BFA	CIV	GNB	MLI	NER	SEN	TGO
	Joint rule							
δ	0.954	0.966	0.896	0.901	0.981	0.951	0.958	0.918
DL (in%)	12.40	2.11	3.21	2.98	9.79	4.19	5.22	3.33
Λ (in%)	0.019	0.581	0.656	1.875	0.000	0.263	0.050	0.575

6   Conclusion

References

Amador, M., Werning, I., and Angeletos, G.-M. (2006). Commitment vs. flexibility. *Econometrica*, 74(2):365–396.

Basdevant, O., Imam, P. A., Kinda, M. T., and Zdzienicka, M. A. (2015). *Strengthening the West African Economic and Monetary Union: The role of fiscal and market institutions in economic stabilization.* International Monetary Fund.

Buiter, W., Corsetti, G., and Roubini, N. (1993). Excessive deficits: sense and nonsense in the treaty of maastricht. *Economic policy*, 8(16):57–100.

Chari, V. V. and Kehoe, P. J. (2004). On the desirability of fiscal constraints in a monetary union.

David, M. A., Nguyen-Duong, A., and Selim, H. (2022). *Strengthening the WAEMU Regional Fiscal Framework.* International Monetary Fund.

Davoodi, H. R., Elger, P., Fotiou, A., Garcia-Macia, D., Han, X., Lagerborg, A., Lam, W. R., and Medas, P. A. (2022). Fiscal rules and fiscal councils: Recent trends and performance during the covid-19 pandemic. *IMF Working Paper*.

Dessus, S., Diaz-Sanchez, J. L., and Varoudakis, A. (2016). Fiscal rules and the pro-cyclicality of public investment in the west african economic and monetary union. *Journal of international development*, 28(6):887–901.

Grauwe, P. d. (1992). The economics of monetary integration. *Paul de Grauwe*.

Halac, M. and Yared, P. (2018). Fiscal rules and discretion in a world economy. *American Economic Review*, 108(8):2305–34.

Hamada, K. et al. (1985). *The political economy of international monetary interdependence.* Cambridge, Mass.: MIT Press.

Jackson, M. O. and Yariv, L. (2014). Present bias and collective dynamic choice in the lab. *American Economic Review*, 104(12):4184–4204.

Jackson, M. O. and Yariv, L. (2015). Collective dynamic choice: the necessity of time inconsistency. *American Economic Journal: Microeconomics*, 7(4):150–78.

Kenen, P. B. and Kenen, P. B. (1995). *Economic and monetary union in Europe: Moving beyond Maastricht.* Cambridge University Press.

A Figure A: Heterogeneity in fiscal needs for WAEMU countries from 1960-1999

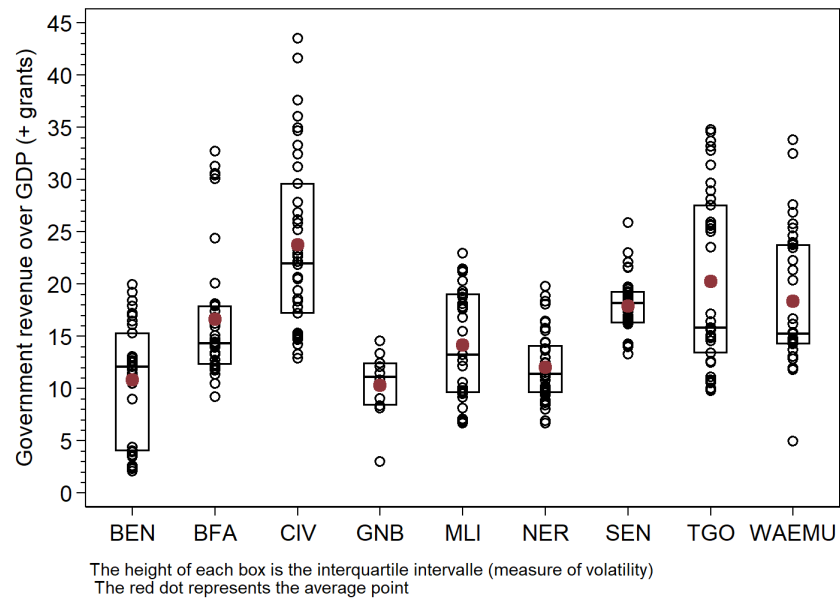Figure A.1 – Government revenue over GDP from 1960-1999

The height of each box is the interquartile intervalle (measure of volatility)
The red dot represents the average point

Figure A.2 – Government Spending over GDP from 1960-1999

The height of each box is the interquartile intervalle (measure of volatility)
The red dot represents the average point
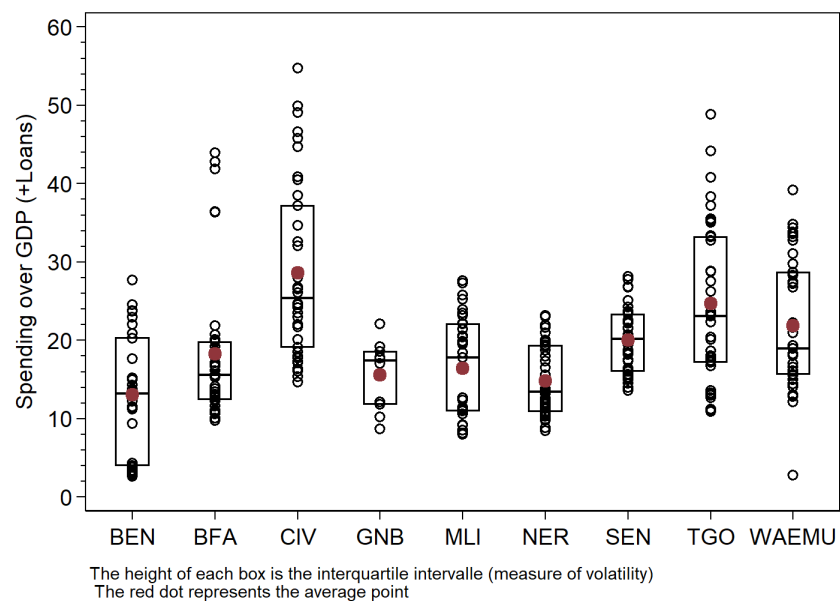
Figure A.3 – Government debt over GDP from 1960-1999

The height of each box is the interquartile intervalle (measure of volatility)
The red dot represents the average point
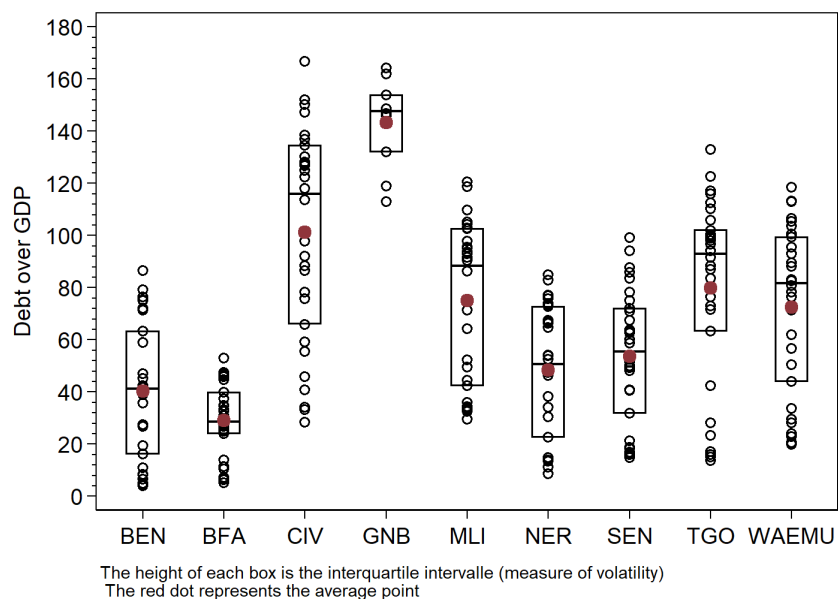
B Figure B: Heterogeneity in fiscal needs for WAEMU countries from 2000-2014

Figure B.1 – Government revenue over GDP from 2000-2014

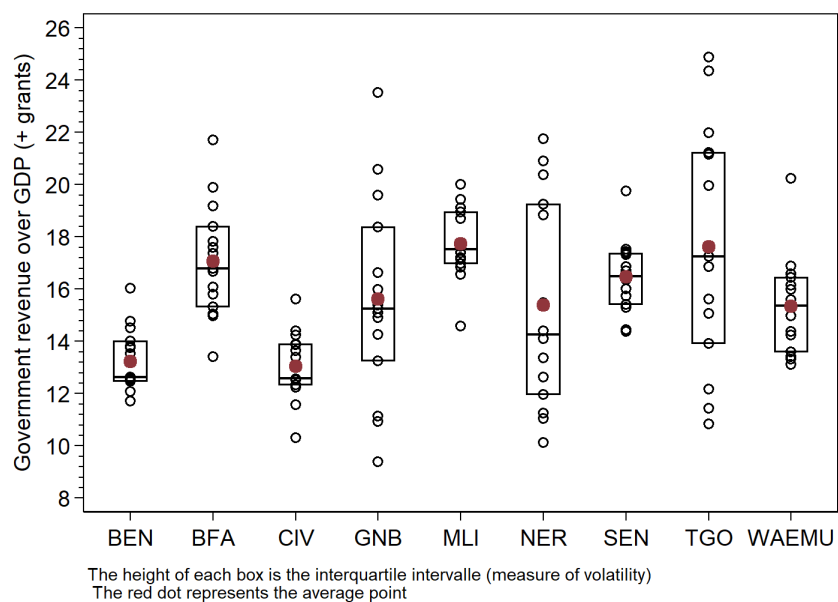The height of each box is the interquartile intervalle (measure of volatility)
The red dot represents the average point

Figure B.2 – Government Spending over GDP from 2000-2014

The height of each box is the interquartile intervalle (measure of volatility)
The red dot represents the average point
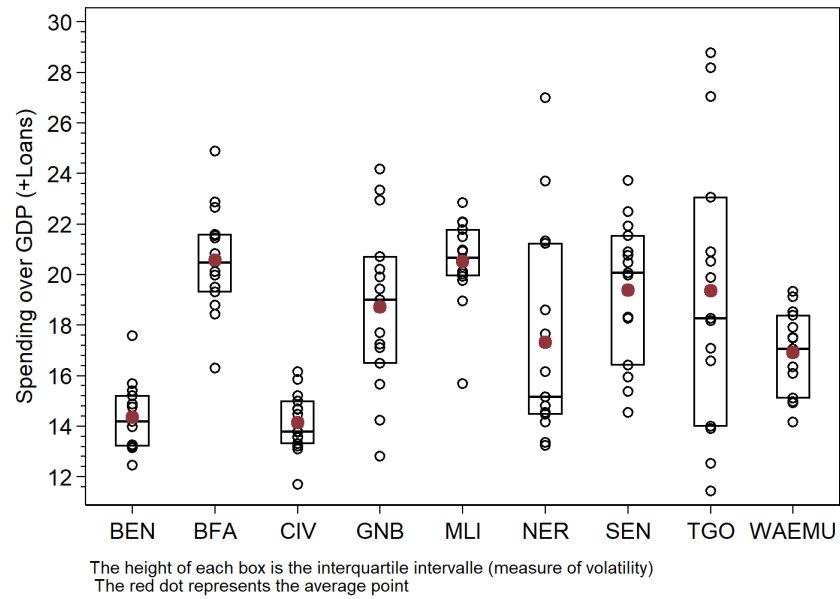
Figure B.3 – Government debt over GDP from 2000-2014

The height of each box is the interquartile intervalle (measure of volatility)
The red dot represents the average point
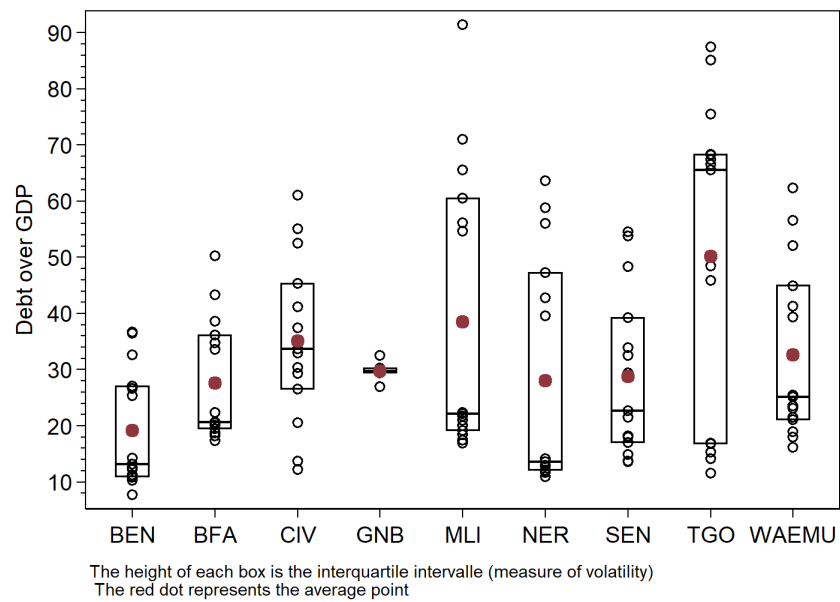
A Table A: Number of countries that derogate the deficit rule between 2000-2014

Table A.1

	2002	2004	2006	2008	2010	2012	2014
Deficit limit* > 3% GDP	3	2	2	3	2	2	2
Deficit limit > 0% GDP	8	7	6	7	6	8	8

Deficit limit * excluded externally financed capital expenditures

B Table B: Homogeneity tests

Table B.1

Homogeneity tests between WAEMU countries 1960-1999		Fstat	p-values
Revenue	H0: Mean equality	19.023	0.000
	H0: Variance equality	12.256	0.000
Spendings	H0: Mean equality	16.359	0.000
	H0: Variance equality	9.942	0.000
Budget Balance	H0: Mean equality	4.484	0.000
	H0: Variance equality	9.111	0.000
Debts	H0: Mean equality	30.454	0.000
	H0: Variance equality	7.817	0.000

Levene's test for equality of variances is used for test of variances homogeneity

Table B.2

Homogeneity tests between WAEMU countries 2000-2014		Fstat	p-values
Revenue	H0: Mean equality	*3.385*	*0.003*
	H0: Variance equality	*3.250*	*0.004*
Spendings	H0: Mean equality	*10.240*	*0.000*
	H0: Variance equality	*7.667*	*0.000*
Budget Balance	H0: Mean equality	*1.294*	*0.260*
	H0: Variance equality	*2.150*	*0.044*
Debts	H0: Mean equality	*15.971*	*0.000*
	H0: Variance equality	*19.085*	*0.000*

Levene's test for equality of variances is used for test of variances homogeneity

Table B.3

Homogeneity tests between WAEMU countries 1960-2019		Fstat	p-values
Revenue	H0: Mean equality	*13.601*	*0.000*
	H0: Variance equality	*12.558*	*0.000*
Spendings	H0: Mean equality	*12.583*	*0.000*
	H0: Variance equality	*14.435*	*0.000*
Budget Balance	H0: Mean equality	*2.040*	*0.049*
	H0: Variance equality	*3.454*	*0.001*
Debts	H0: Mean equality	*25.544*	*0.000*
	H0: Variance equality	*26.042*	*0.000*

Levene's test for equality of variances is used for test of variances homogeneity