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INTEREST GROUPS AND DEMAND FOR IMF ARRANGEMENTS:

**Empirical Analysis of the Duration of Periods without Agreement
between the IMF and Sub-Saharan African Countries**

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Abstract

This article aims to establish a connection between the political economy of the reform process in Sub-Saharan African countries and the intervention of the International Monetary Fund (IMF). It focuses on the impact of IMF conditionality on the internal factors of the government decision-making process to reform. The paper examines the relationship between a government's decision to turn to the IMF for assistance and the opposition capacity of interest groups. This link is tested through the estimation of a duration model, where the periods without agreement between the IMF and countries constitute the dependent variable. Parametric and non-parametric analyses show that economic factors are not the only ones that are taken into account by a government to request an IMF arrangement. The anticipated reaction of interest groups opposed to reforms can be an incentive for the government to request the intervention of the IMF. As an external actor, the IMF can initiate and support reforms with high political costs that a weak government cannot implement alone.

Résumé

L'objectif de cet article est de lier l'économie politique du processus de réforme dans les pays d'Afrique Subsaharienne à la problématique de l'intervention du Fonds Monétaire International (FMI). Il vise à mettre en évidence l'impact des conditionnalités du FMI sur les facteurs internes de prise de décision par le gouvernement de réformer, en examinant la relation entre la décision du gouvernement d'avoir recours au FMI et la capacité de d'opposition des groupes d'intérêt. Ce lien est analysé en estimant un modèle de durée, dans lequel les périodes sans accord entre le FMI et le pays constituent la variable expliquée. Les analyses paramétriques et non-paramétriques montrent que les facteurs économiques ne sont pas les seuls à être pris en compte par les gouvernements pour demander un arrangement avec le FMI. Les anticipations relatives aux réactions des groupes d'intérêt opposés aux réformes peuvent constituer une incitation pour le gouvernement d'avoir recours au Fonds. En effet, en tant qu'acteur externe, le FMI peut être en mesure d'initier et de soutenir des réformes ayant un coût politique important, qu'un gouvernement peu assuré de son pouvoir ne peut mettre en œuvre de lui-même.

Keywords: Interest Groups, IMF, Conditionality, Sub-Saharan Africa, Duration Models

JEL: C14, C41, F33, F34, F4, O55

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I. INTRODUCTION

During the 1980s and 1990s, the world economy experienced severe shocks that had damaging consequences for Sub-Saharan African countries. The surge of oil prices in 1979 and 1980, the world recession, increases of interest rates, and debt crises slowed their economic growth (World Bank, 1989 and 1994). This period was also characterized by inadequate domestic economic policies which aggravated their macroeconomic disequilibria. Most of Sub-Saharan African countries that did not request assistance from the IMF before 1980, had to apply later on for arrangements with the Fund to overcome the degradation of their financial situation (Helleiner, 1983; IMF, 1985; Guillaumont and Guillaumont-Jeanneney, 1994).

To address this situation, the IMF adapted its instruments to the needs of member countries. Its intervention in Sub-Saharan African countries involved an increase in its financial assistance and an extension of its commitments to the region. The Fund developed stabilization and adjustment programs with strong macroeconomic conditionality focusing on management and stabilization of demand and increase and reorientation of supply. These programs had important impacts on domestic income distribution and therefore involved political costs for governments concerned about the reaction of the population and interest groups. A government decision to request IMF assistance is thus not only an economic one but also a political one (Nelson, 1984; Killick, 1985; Thomas and Grindle, 1990; De Janvry *et al.*, 1991).

The objective of this study is to identify the determinants of the duration of periods without agreement between the IMF and Sub-Saharan African countries. The set of explanatory variables includes country-specific and time-specific characteristics that are likely to be determinants of either a country's decision to seek Fund assistance, or the macroeconomic policy actions that are likely to lead to Fund approval of financial arrangement. Besides these economic and institutional determinants, the study also takes into account the effect of the opposition capacity of interest groups on the government decision-making process to request IMF assistance and to reform. The objective of the estimation of this duration model is to measure how interest groups affect the government capacity to sign an agreement with the IMF and therefore the length of periods without agreement.

Compared to the research already conducted on the determinants of IMF financial arrangements (Bird and Orme, 1981; Goldstein and Montiel, 1986; Cornelius, 1987; Joyce, 1992; Conway, 1994; Bird, 1995; Knight and Santaella, 1997), this study has a new approach in two ways. First, the role of interest groups in delaying reforms is explicitly included in the empirical analysis. The ethno-linguistic fractionalization index is used as a proxy of the society's polarization and the degree of social conflict. Second, unlike previous research, this study takes into account the concept of duration, which is central to understanding the effects of the institutional environment and opposition capacity of interest groups. Indeed, the duration of the negotiation process is the best indicator of the obstacles that a government has to overcome to conclude such an arrangement and to implement reforms.
In the following section of this paper, a descriptive analysis of the dependent variable is conducted and methodological specifications are given about the analysis of economic duration data. The third section presents the results of the parametric and non-parametric analyses, and the final section is the conclusion.

II. DESCRIPTIVE ANALYSIS AND PRESENTATION OF THE DURATION MODELS

II.1. Descriptive analysis of the dependent variable

The dependent variable studied in this empirical analysis is the duration of periods without agreement between the IMF and Sub-Saharan African countries over the period 1971-1998. The observation period starts when the Bretton Woods monetary system collapsed, which is the beginning of the evolution of the IMF's role, and it ends the last year allowed by the availability of data.
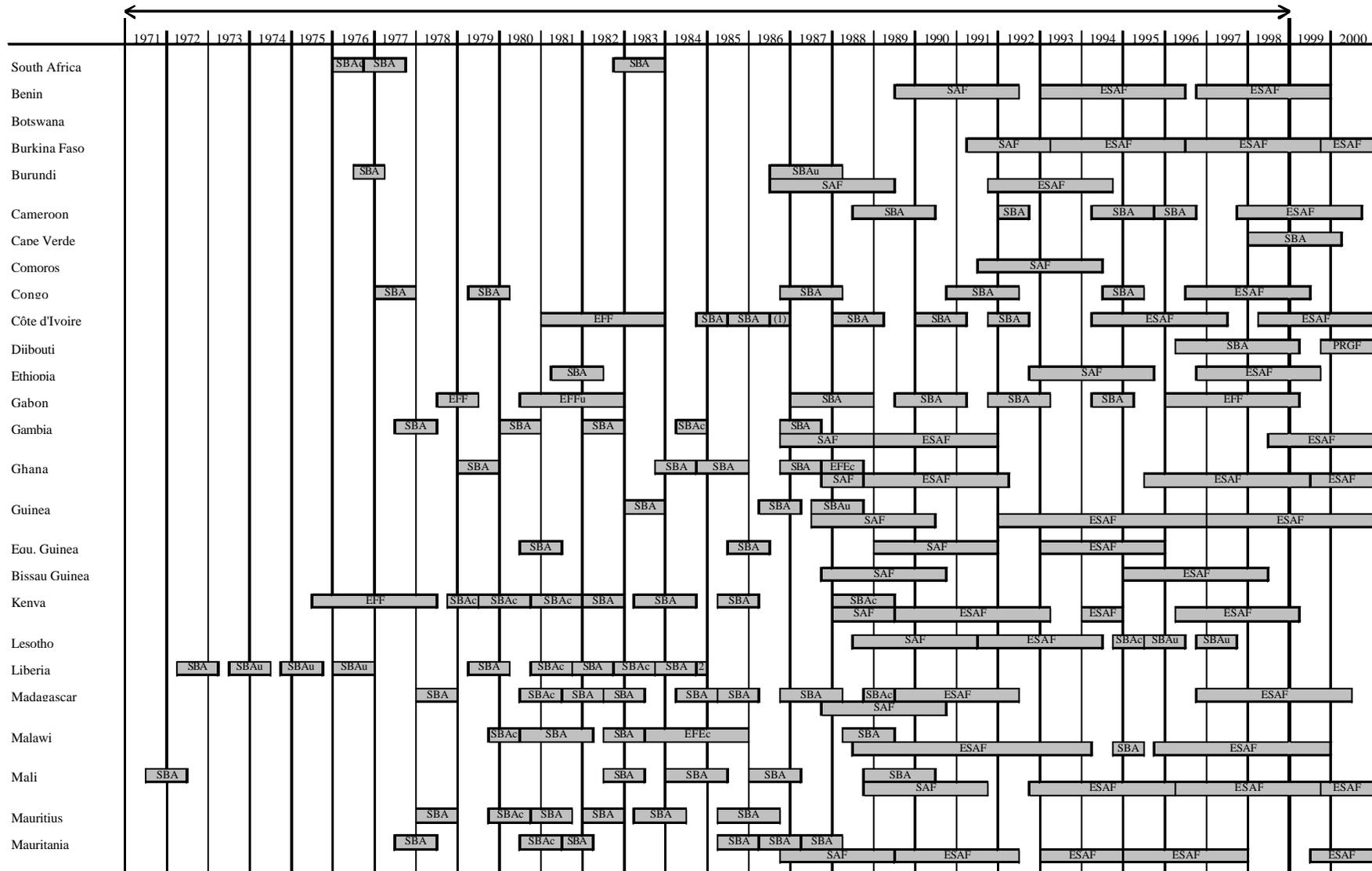
An inventory of all the financial agreements between Sub-Saharan African countries and the IMF has been made, but only those which involve conditions of economic policy have been considered in our empirical analysis[3]: Stand-by Agreements (SBA), Extended Fund Facilities (EFF), Structural Adjustment Facilities (SAF), and the Enhanced Structural Adjustment facilities (ESAF). Data on these agreements by country is presented in Figure 2.1.

Some arrangements were canceled, either because they were interrupted before the initial expiration date, or because they were replaced by another type of arrangement. Others were undrawn, often reflecting the decision of the recipient government. For instance, in June 1980 Gabon signed an EFF in the amount of SDR34 million, which remained undrawn. The Gabonese government's objective was to give to the international financial markets proof of its willingness to implement sound macroeconomic policies. Also, in the case of Nigeria, efforts to pursue structural adjustment have been supported by three SBAs between 1986 and 1992. The amounts committed under IMF arrangements reached SDR1.44 billion; however, after organizing a referendum, the Nigerian government decided to leave the arrangements undrawn.

In selecting the data for this study, the following arrangements were made. First, if an agreement was interrupted, the interruption date rather than the original end date of the program was used as the start of the period without a program. Second, countries with agreements with the IMF were considered as having an agreement, even if no disbursements were made. Third, since most of the independent variables are observed on an annual basis, the same annual periodicity for the duration of periods without agreement was kept. A rule was used to deal with cases where duration was less than a year. Periods without agreement for more than six months were counted as a full year. Periods without agreement for less than six months were not counted, assuming that a brief interruption corresponds with necessary time for negotiations with the IMF.

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[3] The arrangements with low conditionality like the temporary oil facilities were not included.

Figure 2.1
IMF programs with Sub-Saharan African countries

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000

Mozambique — SAF; ESAF; ESAF; ESAF

Niger — SBA; SBA; SBA; SBA; SAF; ESAF; SBA; ESAF

Nigeria — SBAu; SBAu; SBAu

Uganda — SBA; SBA; SBA; SBA; SBA; SAF; ESAF; ESAF; ESAF

Central Afr. Repub. — SBA; SBA; SBA; SBA; SBA; SBA; SAF; SBA; ESAF

Rwanda — SBAu; SAF; ESAF

Sao Tome and P. — SAF; PRGF

Senegal — SBA; EFFc; SBA; SBAc; SBA; SBA; SBAc; SBA; SAF; ESAF; SBAc; ESAF; ESAF

Sierra Leone — SBA; SBA; EFFc; SBA; SBA; SAF; SAF; ESAF

Somalia — SBA; SBA; SBA; SBA; SBAc; SAF

Sudan — SBA; SBA; SBA; EFFc; SBA; SBA; SBA

Tanzania — SBAu; SBA; SBA; SAF; ESAF; ESAF; FPRC

Chad — SAF; SBA; ESAF; PRGF

Togo — SBA; SBA; SBA; SBA; SBA; SBAc; SBA; SAF; ESAF; ESAF

Zaire — SBA; SBA; SBA; (3); SBA; SBA; SBAc; SBA; SBA; SAF

Zambia — SBA; SBA; SBA; EFFc; SBA; SBAc; SBAc; SAF; ESAF; ESAF

Zimbabwe — SBA; SBA; EFFc; EFF; ESAF; SBA; SBA

SBA: Stand-By Agreement
EFF: Extended Fund Facility
SAF: Structural Adjustment Facility
ESAF: Enhanced Structural Adjustment Facility
PRGF: Poverty Reduction and Growth Facility
c: Canceled
u: Undrawn
(1) Stand-By Agreement canceled (initial expiration date: June 1988, but last disbursement: December 1986)
(2) Stand-By Agreement canceled (initial expiration date: June 1986, but last disbursement: December 1984)
(3) Extended Fund Facility canceled (initial expiration date: June 1984, but last disbursement: December 1981)

Figure 2.1, which gives the time distribution of arrangements per country, shows that the arrangements are concentrated in the last 20 years. Due to the intensification of macroeconomic disequilibria during the 1980s, the assistance programs of the IMF were adopted to the needs of Sub-Saharan African countries.

Many countries did not apply for IMF assistance before the 1980s. This pattern suggested that this study should distinguish between periods before first arrangements and periods between two arrangements. The average duration of the periods in both categories is significantly different: 11 years for the periods before the first arrangements and three years for the periods between two arrangements.

The final sample includes 146 observations of periods without agreements. The number of observations per country varies and the duration ranges from one to 28 years (the latter is Botswana which has never requested IMF assistance). The average of the sample is 5.47 years and the standard deviation is 5.83. These observed durations are the dependent variable of the following parametric and non-parametric analyses. Before presenting the results of those analyses, the theoretical foundations of economic duration data analysis are described.

II.2. Economic duration data analysis: the method

II.2.a. The basic functions

The method of econometric analysis of duration data first appears in the 1930s. It was then essentially used for biostatistics (to estimate the survival duration of species), physics (to estimate the resistance of materials), and medicine (to estimate human lifetimes). Quite recently, the method's application to economic data has concerned mainly the duration of unemployment (Mortensen, 1986). It has also been applied to macroeconomics, in particular for the estimation of models of endogenous growth.

Duration could *a priori* be treated like any other continuous variable and be estimated with the method of Ordinary Least Squares (OLS). However, the econometric estimation of duration with OLS creates some problems relative to the nature of the dependent variable:

    (i)   The duration is always positive or equal to zero, whereas OLS errors have a normal distribution from minus infinity to plus infinity.

    (ii)   The possibility that at the end of the sample period, some countries are within a period without agreement (the survey interrupts spells still in progress). In this case, information on the total duration of the period is not available, but only on the elapsed duration of this spell up to the end of the sample period (See Figure 2.2, case 3 and 5). Those observations of duration are right-censored. The elapsed duration is always inferior to the total duration; therefore the censoring problem can be the cause of bias of estimation.

To take into account and estimate the values associated with individuals whose duration is not completed at the last period of observation, it is necessary to use the method of duration models. The data for this study present these characteristics, since in 1998, the year of the last observation in our sample, some countries remain without agreement with IMF. The length of this situation is unknown[4].

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[4] Since several durations for a same event for a same country are available, the method of transition model should be used. It would allow taking into account the eventual dependence of different durations between each other. However, given the constraint of degrees of freedom, the assumption has be made that the different

In duration models, elapsed time is considered as the result of a stochastic process, and not as a continuous quantitative variable like in OLS. The central concept in these statistical methods is not dealing with the unconditional probability of an event taking place (e.g. the probability of a country without agreement with the IMF exactly one year), but with its conditional probability (e.g. the probability of a country continuing without an agreement in the second year given that it has already been without agreement for one year). The duration model takes into account the dates of status change: in this case, the dates when countries enter or terminate agreements with the IMF.

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Figure 2.2
Right-censored data
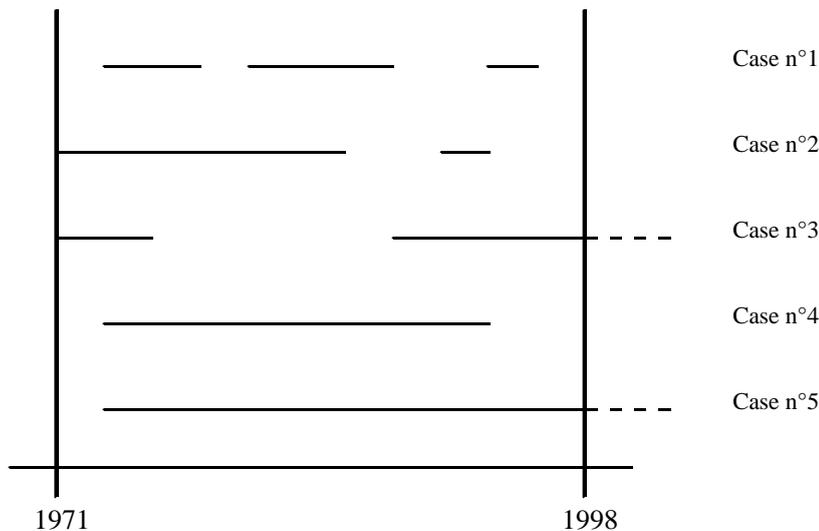
Two major functions exist to characterize the distribution of a duration: the survivor function and the hazard function.

The survivor function, representing the probability that the duration is greater than *t,* is:

$$S(t) = \int_t^\infty f(u)du = 1 - F(t)$$

with $f(t)$ being the probability density and $F(t)$ its distribution function.

The Hazard function gives us the probability that spells will be completed at duration *t*, given that they last until *t*:

$$h(t) = \frac{f(t)}{S(t)}$$

For this study, *h(t)* represents the conditional probability that a country signs an agreement with the IMF at duration *t*, given that the country remained without agreement until *t*.

To estimate hazard functions, non-parametric methods can be used. But to determine the influence of exogenous variables, parametric or semi-parametric models have to be used.

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durations are independent (Cf. section III.2.a). The method of duration model will be used instead of the method of transition models.

II.2.b. Non-parametric estimations

The first category of models, non-parametric, allows an estimation of the exit probability out of the status of countries without agreements, at each period and for the whole sample. Due to the observed exit rate, these models calculate the exit probability for the right-censored data. The advantage of these models is that they do not necessitate postulating a specific distribution.

The most commonly used model is the Kaplan-Meier, based on an empirical distribution function. In the case with no censoring, the survivor in t is estimated by:
$$S(t) = 1 - F(t) \quad with \ F(t) = n_t / N$$

This estimated survivor function can be presented as a product of conditional probabilities:
$$S(t) = P(T > t) = \prod_{t_i \leq t} P(T > t_i / T > t_i - 1) = \prod_{j < i} (1 - q_j)$$
with q_j the exit probability at t_j. This probability is then equal to $1 / (N - j + 1)$, since we observe an exit at j among the $N - (j - 1)$ countries which "survive" right after t_{j-1}.

A modification is required to allow for censoring. Let r_j be the number of spells neither completed nor censored before duration t_j. The Kaplan-Meier estimator for the hazard function is d_j / r_j (the number of "failures" at duration t_j divided by the number "at risk" at duration t_j) and the corresponding estimator for the survivor function is:
$$S(t) = \prod_{t_j \leq t} (1 - d_j / r_j)$$

Basically, this estimator is obtained by setting the estimated conditional probability of completing a spell (signing an agreement with the IMF) at t_j equal to the observed relative frequency of completion at t_j. These estimations can be done for different groups of countries and some tests can be performed to check whether there are significant different durations between groups.
To explain the origin of these differences, we must use parametric or semi-parametric models. Parametric survival analysis involves detailed knowledge of the likely distribution of the survival time, whereas semi-parametric method (the Cox proportional hazard model) does not require the same detailed knowledge of the distribution of the hazard function.

II.2.c. Semi-parametric estimations (Cox): proportional hazards models

In the proportional hazards model, the exogenous variables have the same influence on the exit probability regardless of the duration (Cox, 1972). A variation of $x\%$ of one variable causes a variation of $y\%$ of the hazard function at any period of time. Thus the hazard function for each period is:
$$h(t) = h_0(t) \boldsymbol{f}(X, \boldsymbol{b})$$
with $h_0(t)$ the "basic" hazard, i.e. the hazard when all the explicative variables are equal to zero. $\boldsymbol{f}(X, \boldsymbol{b})$ is a positive function of exogenous variables X and $\boldsymbol{b}$ is a vector of parameters. Usually, $\boldsymbol{f}(X, \boldsymbol{b}) = \exp(X\boldsymbol{b})$ is assumed.

This specification assumes that the effect of exogenous variables *X* on the conditional exit probability does not depend on time. If different values of *X* correpond to distinct types of individuals, the ratio of hazard rates between two individuals is constant over time (but depends on these individuals' characteristics).

III.2.d. Parametric estimations: accelerated lifetime models

In the accelerated lifetime models, the exogenous variables have a scale parameter over the duration, meaning that the effect of regressors is to rescale the time axis. Therefore the influence of an exogenous variable on the exit probability can change over time.

The most common parametric hazard functions are Exponential, Weibull, Log-Logistic, and Log-Normal. The survivor and hazard functions for each of them are as follow:

- Exponential $\qquad h(t) = \boldsymbol{q}$ (constant hazard) $\qquad S(t) = \exp(-\boldsymbol{q}.t)$

- Weibull $\qquad h(t) = \boldsymbol{a}\boldsymbol{q}.t^{\boldsymbol{a}-1}$ $\qquad S(t) = \exp(-\boldsymbol{q}.t^{\boldsymbol{a}})$

  The hazard increases if $\alpha > 1$, decreases if $\alpha < 1$, and reduces to exponential if $\alpha = 1$.

- Log-logistic $\qquad h(t) = \dfrac{\boldsymbol{q}\boldsymbol{a}.t^{\boldsymbol{a}-1}}{1+\boldsymbol{q}.t^{\boldsymbol{a}}}$ $\qquad S(t) = \dfrac{1}{1+\boldsymbol{q}.t^{\boldsymbol{a}}}$

  When $\alpha > 1$, the hazard first increases and then decreases. When $0 < \alpha \leq 1$, the hazard increases with duration.

- Log-normal $\qquad f(t) = (\boldsymbol{a}/t)\boldsymbol{f}[\boldsymbol{a}\ln(\boldsymbol{q}t)]$ $\qquad S(t) = \Phi[\boldsymbol{a}\ln(\boldsymbol{q}t)]$

III. ESTIMATION

III.1. Non-parametric analysis of the durations of periods without IMF agreement

The non-parametric estimation techniques allow a first evaluation of the probabilities for the countries to remain without IMF agreement (survivor probabilities), without taking into account the other explanatory variables (i.e. the observable heterogeneity).

The estimation with the Kaplan-Meier model is first performed on the sample with all the countries. Graph 3.1 shows that the cumulated probability to remain without an IMF agreement decreases sharply over time. This means that the rate of exit out of the status of country without agreement (the probability to sign an agreement), is increasing with time. Three cycles can be distinguished:
  (i)   a very strong growth of the exit rate for the first three years, if a country has experienced two years without IMF agreement, it has a cumulated probability of 50% of signing an agreement during the third year;
  (ii)   a slow growth of the exit rate between three and 10 years, after nine years without agreement, the countries have a cumulated probability of 71% of exiting this situation and;
  (iii)   an even slower growth rate of the cumulated probability of exit beyond 10 years.

Graph 3.1
Probability to remain without IMF agreement
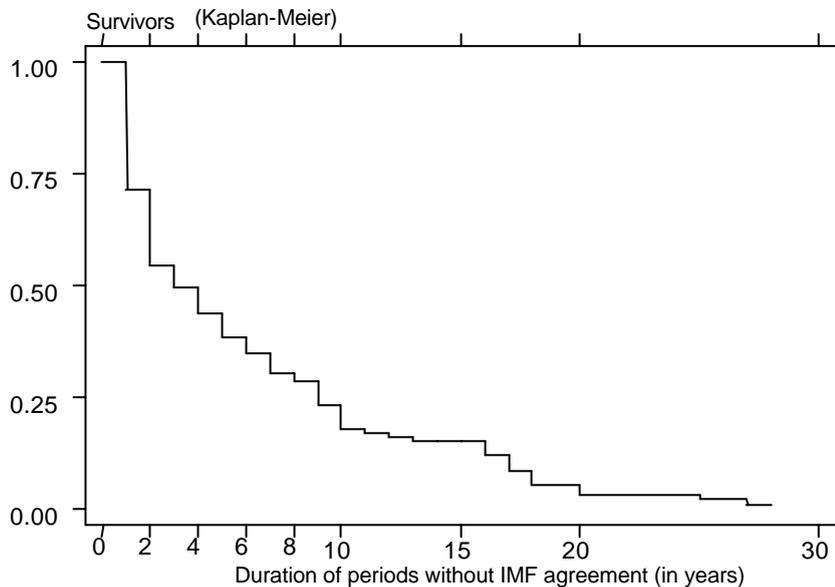
The corresponding figures are as follow:

Table 3.1

Duration	Number of observations at the beginning of the period	Number of exit during the period	Cumulated probability to remain without IMF agreement at the end of the period	Cumulated probability to exit at the end of the period
1 year	146	47	0.7123	0.2877
2 years	99	23	0.5468	0.4532
3 years	76	8	0.4965	0.5035
5 years	68	16	0.3861	0.6139
10 years	52	30	0.2869	0.7131
15 years	22	7	0.0549	0.9451
20 years	15	11	0.0329	0.9671
28 years	4	3	0.011	0.989

These tendencies are difficult to interpret at this stage of the analysis, because they can be the result of a non-linearity of the exit rates, as well as the result of not taking into account other explanatory variables (heterogeneity of the sample). In general, it seems that the longer African countries remain without IMF agreement, their cumulated probability to sign an agreement is higher, but the growth of the probability is increasingly slow.

A classification of the durations based on certain characteristics of the countries allows going beyond the limits of this kind of analysis, by verifying whether the whole sample hides important disparities. The objective is to identify potential differences, by splitting the sample in two sub-groups with a dummy. With a rank order test, a conclusion can be made whether durations are significantly different between both sub-groups. The principle of the test is simple: for each sub-sample, the number of exits out of the status of country without agreement and the number estimated by the model for each period are taken into account. The assumption that the two groups have the same survivor curve is tested by using the χ^2 statistic.

The first criterion to split the sample is the number of months spent with an IMF agreement before the country ends up without an agreement. On average, the countries of the sample have experienced 46 months with an agreement before experiencing a period without and the median is 32 months. The sample is split into two sub-groups with a dummy equal to one, if the country, before the considered period without agreement, has experienced less than 32 months with an agreement. The results of the test are as follow:

Group	Event	Estimations
Less than 32 months (nbmoiacd = 1)	71	85.19
More than 32 months (nbmoiacd = 0)	58	43.81

$$\chi^2(1) = 9.97$$
$$Pr > \chi^2 = 0.0016$$

The hypothesis that the two sub-groups have similar durations can be rejected with 99 percent confidence. Therefore, it seems appropriate to estimate the Kaplan-Meier model with the two groups separately. Graph 3.2 presents the survivor curve for each group.

Graph 3.2
Probability to remain without IMF agreement and number of months with agreement before
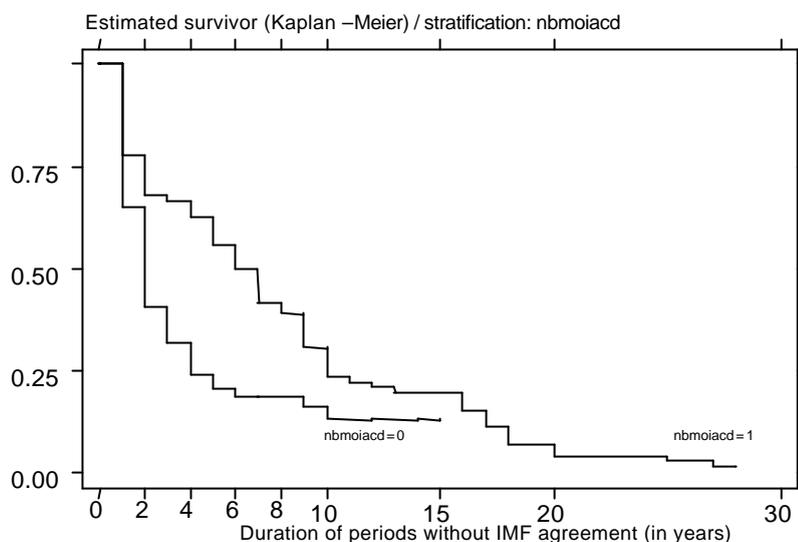
Graph 9.2 shows that those countries which had a longer period with an agreement also start a new agreement more quickly. The countries, which have experienced two years without IMF agreement, while having spent more than 32 months with an arrangement previously, have a cumulated probability of 69% to sign an agreement during the third year. This probability is only 34% if they have spent less than 32 months on an agreement previously. These figures suggest that there is an inertia effect or "learning by doing" effect, as described by Conway (1994) and Knight and Santaella (1997). Countries that have had Fund arrangements in the past are more likely to enter into an arrangement in a subsequent period. The reason might be that the authorities of a country are familiar with the Fund's operating procedures because they have previously negotiated and implemented an arrangement.

According to Bird (1995), it is also possible that some sort of "borrower's threshold" exists. While they remain on one side of the threshold, countries will strongly resist borrowing from the Fund and will pursue a range of policies to avoid it. Once circumstances have caused them to enter into a Fund arrangement and they have crossed that threshold, the resistance to future borrowing is considerably reduced. With the political price of using the Fund being paid, the cost of future use is significantly reduced. It is also possible that there are other characteristics which both make a country more likely to have a long arrangement in the first place and more likely to sign a new arrangement more quickly.

This latter hypothesis is examined by looking at a potential characteristic that may explain both factors. The second criterion used to split the sample is related to the structure of the society and more precisely to the ethnic diversity. Easterly and Levine (1997) used this characteristic to explain the weak economic performances of the African continent. They noticed that 14 of the countries with the highest diversity are located in Africa and that "Ethnic diversity may increase polarization and thereby impede agreement about the provision of public goods and create positive incentives for growth-reducing policies". Alesina and Drazen (1991) argued that society's polarization and the degree of social conflict are key factors underlying policy decisions and therefore make it difficult to reach a political consensus about a program of reforms, when the population is very divided ethnically. The indicator of ethnic homogeneity chosen for our analysis is the index of ethno-linguistic fractionalization (ETH). This index has been built by Tailor and Hudson (1972)[5] and measures the probability that two randomly selected individuals in a country belong to different ethno-linguistic groups. Therefore, the scale of this index goes from 0 to 1, and the sample is split by creating a dummy ETH5 equal to 1, if the ETH index is lower than 0.5.

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[5] Derived from Soviet data collected in the early 1960s for the "Atlas Narodov Mira" (1964).

Graph 3.3
Probability to remain without IMF agreement and ethno-linguistic fractionalization

Estimated survivor (Kaplan-Meier) / stratification: eth5
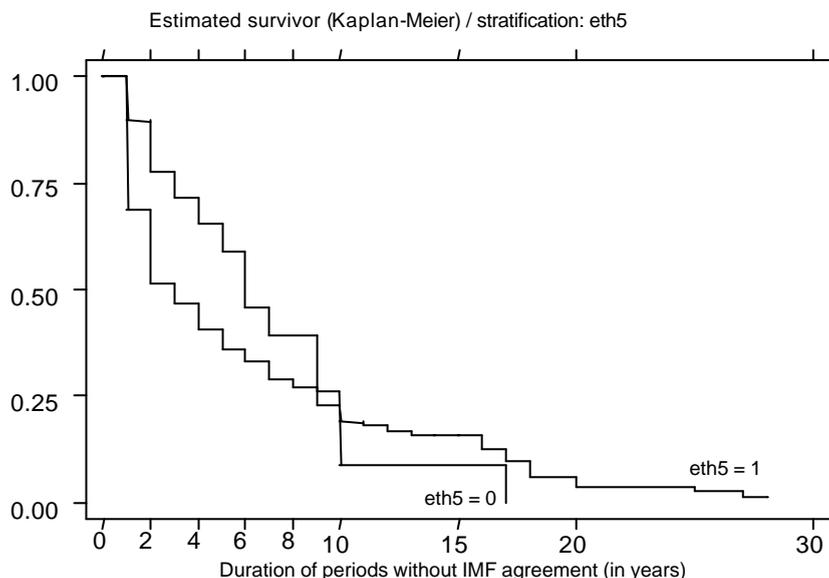
Graph 3.3 shows a cumulated survivor probability significantly lower for less ethically divided countries. Countries with an ethno-linguistic fractionalization index lower than 0.5, and with two years without IMF agreement, have a cumulated probability of 54% to sign a financial arrangement with the IMF during the third year. This probability is only 29% for the countries with a fractionalization rate over 0.5. However, after nine years without agreement, the ethno-linguistic fractionalization is no longer a significant factor for explaining periods without agreement.

Those results give a first idea about the impact of some variables on the duration without IMF agreement. However, these results have to be qualified, because the estimation method used above doesn't take into account the interdependence between the different variables. More elaborated models, such as parametric models, will allow the evaluation of the simultaneous impact of several exogenous variables.

III.2. Parametric analysis

Non-parametric estimations provide a first analysis of the duration of periods without agreement with the IMF. However, they are limited to a succinct examination of these durations, since they do not control for the countries' observable heterogeneity. The empirical work which has been done on this subject (Bird and Orme, 1981; Goldstein and Montiel, 1986; Cornelius, 1987; Joyce, 1992; Conway, 1994; Bird, 1995; Knight and Santaella, 1997) concludes that exogenous variables do have a significant impact on a country's decision to request IMF assistance, and therefore should not be left out. This section aims at examining the determinants of the duration of periods without IMF agreement.

III.2.a. Methodological specifications

The estimated models can be written as:

$$-a \log t = bX + e \qquad \text{if specified as a proportional hazards model}$$
$$\text{and} \quad \log t = b^* X + \log t_0 \qquad \text{if specified as an accelerated lifetime model.}$$

The estimated coefficients are b and b^*. In the case of a proportional hazards model, estimated with Cox's method, the endogenous variable is $-a \log t$; a positive value for b means a higher exit probability and thus a shorter duration. On the other hand, in the case of an accelerated lifetime model, a positive value for the parameter b^* implies a longer duration (i.e. a lower exit probability). The estimation is performed by using the method of maximum likelihood, with specification of the likely distribution of the survival time: Weibull, Log-Normal, or Log-Logistic.

The introduction of exogenous variables with changing values during the observation period adds a complication to the estimation of a duration model. So far the independent variables were assumed to measure constant characteristics over the observation period. Kiefer (1988) notes regarding the introduction of time varying explanatory variables, that no simple interpretation of coefficients is possible in this case: "Identification is tricky, in that the effect of trending regressors is difficult to separate from possible duration dependence". Thus for estimates to be precise, the time paths of regressors must vary substantially across individuals.

Yet in the case of this study, many variables with potential influence on the decision to request an IMF arrangement have a value that changes on an annual basis. To bypass this practical problem of estimation and interpretation, the average value of these exogenous variables over the period without agreement has been introduced. Therefore, the coefficients of the variables will have to be interpreted as the coefficients of proxies of these variables (Petersen, 1986).

For each country there are one or more observations (periods with no IMF agreement between 1971 and 1998) constituting the endogenous variable, each observation being considered independent. For each endogenous observation, there is one observation for each exogenous variable.

III.2.b. Exogenous variables

The variables[6] introduced to explain the duration of periods of no agreement between the IMF and Sub-Saharan African countries will take into account three categories of determinants: the behavior of interest groups, the circumstances for a country to request an arrangement with the IMF, and the conditions for the IMF to supply financial assistance to this country.

The behavior of interest groups. When negotiations between the IMF and a government are announced, it is not rare to observe demonstrations of interest groups against the financial arrangement due to their concern of its impact on domestic distribution of income (Sidell,

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[6] If not otherwise specified, data come from the World Bank's *African Development Indicators* 2000.

1988). The objective of the estimation of this duration model is to measure the extent of interest groups' role in the process of concluding an agreement. Can interest groups delay a government from signing an agreement with the IMF and therefore extend the periods without agreement? The behavior of interest groups can have a double impact: a direct impact through lobbying the government and an indirect impact through supply and demand variables. Organized groups can, for instance, refuse to pay their fiscal liabilities. This will have an impact on the government's fiscal revenue and therefore on the fiscal deficit, the reduction of which is a typical element of IMF's *ex ante* conditions.

There is no direct measure of the extent of rent-seeking activities. To take into account the influence of interest groups and their impact on the government's choice, the factors which make their existence likely have been introduced. Two of those factors have been selected:[7] the ethno-linguistic fractionalization index (ETH) and the share of illiterate population in the total population.

The impact of ETH on the duration of periods with no IMF agreement is *a priori* ambiguous. The effect can be positive insofar as the domestic consensus necessary to implement an IMF reform program is more difficult to reach when the population is divided into groups with opposite interests. On the other hand, the fragmentation can reduce the duration of periods with no agreement if the government anticipates that the intervention of an external actor will provide the impetus necessary to implement reforms. The IMF has the capacity to "impose" reforms externally due to the conditions attached to its financial assistance.

The variable "share of the illiterate population in the total population"[8] takes into account the capacity to mobilize the population to action. The assumption is that illiterate populations are easier for interest groups to mobilize against programs of reforms than educated populations.

The variables of demand. Three kinds of variables for the circumstances for a country to request an arrangement with the IMF have been distinguished. The first category is the structural characteristics: GDP per capita, reflecting the level of development of the country; the size of the population (in logarithm) to take into account the size of the country; and the variation of the real effective exchange rate[9] between the beginning and the end of the period without agreement. The second category is the financial situation: the disbursements from the private sector (in percentage of GDP); the external debt service in percentage of exports of goods and services; and the foreign currency reserves measured in months of imports. The third category is related to the country's prior experience with the IMF: the number of months spent with an IMF agreement before each period without an agreement. This last variable aims at verifying the existence of an inertia effect or of a borrower's threshold observed in the non-parametric analysis, and by Conway (1994), Knight and Santaella (1997), and Bird (1995).

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[7] Other factors could have been used for this analysis. Svensson (2000), for instance, used an index of corruption as a proxy of rent-seeking activities. We were not able to do the same thing because of the lack of data over the 1971-98 period, for the countries of our sample (Sub-Saharan African countries only). Other factors are highly correlated with high rent-seeking activities, but they all create problems with the other explanatory variables. The index "rule of law" has the same temporal and geographical limits as the index of corruption. Exports of primary commodities (except agricultural products) are highly correlated with foreign currency reserves, which is one variable among the variables of demand introduced in the duration model.

[8] The share of illiterate population has been chosen rather than the average number of years of education, because the latter is available only for a small number of Sub-Saharan African countries over the period 1971-1998.

[9] Units of local currency per US$. An increase of the REER means a real depreciation of the local currency.

The variables of supply. Two sets of variables are used to take into account the determinants of supply of an arrangement by the IMF, i.e. the factors leading the IMF to conclude an agreement with a country and to agree to provide financial assistance.

The first set of variables concerns the specific measures taken by the country. The decision-making process inside the IMF consists mainly in assessing the government's commitment to reform its economic policy in order to achieve fiscal and/or external equilibrium. The IMF has two means for this evaluation: the country's promises expressed in the letter of intent presented to the IMF Board and the measures taken by the government prior to the financial arrangement being accepted by the IMF. In the framework of a duration model, it is difficult to take into account the promises. On the other hand, it is possible to measure some of the actions required by the IMF before the conclusion of an agreement. Among these actions, two have been selected: (i) the country's fiscal policy, measured by the level of fiscal revenues in percentage of GDP for the last year of the period with no agreement[10] and (ii) the country's exchange rate policy, measured by the variation of the nominal exchange rate[11] over the three months preceding the end of the period with no agreement. This last variable is a dummy equal to one, if the depreciation is above 15%. This threshold takes into account that devaluations were often one of the conditions imposed by the IMF before the signature of an arrangement for Sub-Saharan African countries.

The second set of variables of supply is related to the political and institutional environment. The theoretical and empirical work done on this issue has mainly focused on : (i) the consequences of IMF programs on the political stability and on the evolution of the political regimes (Sidell, 1988; Bienen and Gersovitz, 1985; Herbst, 1990; Bathily, 1989) and (ii) the impact of the instability and the nature of political regimes on the performances of the country in implementing IMF programs (Haggard and Kaufman, 1989; Kaufman, 1986; Callaghy, 1990). The alternative approach of this study is to test the assumption that countries with certain institutional and political characteristics have a higher probability to conclude an agreement with the IMF than other countries. These characteristics are included in the model with two variables:

   (i)   The nature of the political regime coming from the data set POLITY IV[12], which proposes an annual codification of the nature of the political authority. The indicator chosen is a composite indicator computed by subtracting an indicator of autocracy to an indicator of democracy.[13] The resulting unified polity scale ranges from +10 (strongly democratic) to -10 (strongly autocratic).

   (ii)   The level of political instability coming from the data set "Political Instability" built by CERDI[14] and updated in 1999. This indicator measures the instability of

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[10] Or the average of annual ratios if the period is right-censored.

[11] Units of local currency per US$. An increase of the nominal exchange rate means a depreciation of the local currency. (Source: *International Financial Statistics*, IMF)

[12] Polity IV, Integrated Network for Societal Conflict Research (INSCR) Program, University of Maryland.

[13] An autocracy is defined as a regime that sharply restricts or suppresses competitive political participation. Its chief executives are chosen in a regularized process of selection within the political elite, and once in office, they exercise power with few institutional constraints. Democracy is conceived as three essential, interdependent elements. One is the presence of institutions and procedures through which citizens can express effective preferences about alternative policies and leaders. Second is the existence of institutionalized constraints on the exercise of power by executive. Third is the guarantee of civil liberties to all citizens (Source: Polity IV, Dataset Users manual).

[14] Centre d'Etudes et de Recherches sur le Développement International, University of Clermont-Ferrand, France.

the executive power of the country. It enumerates and adds the events corresponding to legal political changes (elections, change of the executive chief) and illegal political changes (successful coups). The instability of the executive branch can *a priori* have two opposite effects. It can delay the signature of an agreement because the IMF does not have a stable authorized negotiator or it can ease the conclusion of such an agreement if the change of regime offers a reopening of negotiations (Remmer, 1986).

For these two variables, the values for the last year of the period with no agreement are included.[15] The objective is to verify whether a country has a higher probability to sign an agreement with the IMF, depending on whether its regime is more democratic or more autocratic and whether this country is experiencing political instability during the negotiations with the IMF.

III.2.c. Results of estimations

Table 3.2 presents the different estimations of the duration model with the three categories of explanatory variables. Given the constraint of the available data, the size of the sample has shrunk from 146 observations for the non-parametric analysis to 69 for the parametric analysis (See Annex 1 for the composition of the sample). The results of the regressions confirm the significant influence of certain characteristics of the countries. The variable of political instability is the only one to be systematically insignificant. Moreover, depending on the probability distribution chosen, some variables are not significant: (i) the level of foreign reserves, the size of the population, the political regime and a multiplicative variable (fractionalization index * illiteracy rate) when the Cox semi-parametric estimation is used; (ii) the variation of the nominal exchange rate when the Weibull distribution is used; and (iii) the illiteracy rate when Weibull or Log-Normal are used. Excluding those differences of significance, the four models are relatively homogenous in estimating the effects of the exogenous variables.

In order to evaluate the quality of these models, a Ramsey-Reset test was performed. This test provided information about whether some major explanatory variables are missing. Annex 2 describes the procedure of the test and gives the results. According to the estimations, the assumption of missing explanatory variables can be rejected. As for the possible non-observable heterogeneity, this eventuality was corrected by using the Gamma distribution[16]. (See Annex 3). The econometric results show that the parameter signaling the presence of this kind of heterogeneity *(q)* is not significant. This indicates that models without control of unobservable heterogeneity can be used.

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[15] or the annual average if the period is right-censored

[16] To correct this bias, the usual method is to assume that the individual densities depend on a heterogeneous element (which has a specific distribution) introduced among the explanatory variables. The distribution commonly used is the Gamma distribution:

$$f(v) = \frac{k}{G(k)} e^{-kv} v^{k-1} \quad \text{with} \quad \Gamma(k) = \int_0^\infty x^{k-1} e^{-x} dx$$

Table 3.2 - Regression of duration models, 1971-98

Regression N°	1	2	3	4
	Cox[1]	Weibull	Log Normal	Log Logistic
Dependent variable	Duration of periods with no IMF agreement			
1. <u>Variables of behavior of interest groups</u>				
Index of ethno-linguistic fractionalization	1.687	-1.576	-1.746	-1.445
	(2.79)**	(-5.01)**	(-6.38)**	(-4.02)**
Share of illiterate population	-0.009	0.005	0.006	0.009
	(-2.15)**	(1.00)	(1.51)	(2.36)**
Index of fractionalization x illiterate population	-0.00007	0.0001	0.0001	0.0001
	(-0.88)	(1.98)**	(1.95)**	(2.01)**
2. <u>Variables of demand of agreement by the country</u>				
• *Structural Characteristics*				
GDP per capita	-0.0006	0.0003	0.0003	0.0003
	(-4.06)**	(3.32)**	(3.18)**	(4.32)**
Log of population	-0.213	0.171	0.181	0.172
	(-1.49)	(1.92)*	(2.13)**	(2.04)**
Variation of the Real Effective Exchange Rate[2]	-0.041	0.031	0.031	0.031
	(-6.10)**	(11.67)**	(11.40)**	(11.39)**
• *Financial situation*				
Disbursements from the private sector in % of GDP	-11.991	10.570	9.573	10.31
	(-4.29)**	(4.65)**	(4.78)**	(4.90)**
External debt service in % of exports	0.019	-0.020	-0.019	-0.015
	(1.83)*	(-3.196)**	(-2.91)**	(-2.44)**
Level of foreign reserves in months of imports	-0.075	0.069	0.072	0.071
	(-1.29)	(1.65)*	(1.67)*	(1.96)**
• *Experience with IMF*				
Number of months with an agreement before the period without agreement	2.822	-1.444	-1.505	-1.564
	(6.23)**	(-6.65)**	(-6.71)**	(-6.98)**
3. *<u>Variables of supply of agreement by the IMF</u>*				
• *Specific measures taken by the country*				
Fiscal revenues in % of GDP[3]	0.008	-0.010	-0.009	-0.010
	(1.89)*	(-3.35)**	(-3.40)**	(-4.04))**
Variation of the nominal exchange rate over the 3 months preceding the end of the period without agreement[4]	0.555	-0.466	-0.549	-0.381
	(2.26)**	(-1.44)	(1.69)*	(-1.88)*
• *Institutional factors*				
Political regime[5]	0.038	-0.029	-0.030	-0.026
	(1.58)	(-1.81)*	(-1.91)*	(-1.72)*
Political instability	0.181	-0.027	-0.070	-0.094
	(1.16)	(-0.20)	(-0.55)	(-0.85)
Constant		-0.964	-1.368	-1.734
		(-0.63)	(-1.02)	(-1.38)
Observations	69	69	69	69
Log of likelihood	-181.1	-55.6	-51.9	-50.8
P		1.30	1.24	2.21
AIC: Akaike criterion	394	144	136	134

T Student in brackets (after White's correction)   * significant at 10%   ** significant at 5%

1 The coefficients show the effect on the exit probability out of the status of country without agreement. The signs of the coefficient inversed compared to the signs of the other equations.

2 Variation rate between the starting date and the ending date of the period without agreement.

Units of local currency per US$.

3 Index for the last year of the period without agreement and average of annual indices if the period is right-censored.

4 Dummy = 1, if variation > 15%

5 Index POLITY 98: scale ranging from +10 (strongly democratic) to –10 (strongly autocratic).

III.2.d. Interpretation of the results

Generally, the coefficient of the variables has the expected sign. The influence of interest groups taken into account with the variable of ethno-linguistic fractionalization (ETH) is a strongly significant negative determinant of the duration of periods without agreement. This confirms the hypothesis that a multitude of ethno-linguistic groups makes it difficult to reach a political consensus to implement a program of economic policy reforms (Alesina and Drazen, 1991). In such circumstances, the government has an incentive to request assistance from the IMF, not only to obtain financial support, but also to have the reforms imposed externally (Remmer, 1986; Putnam, 1988; Stein, 1992; Edwards and Santaella, 1993; and Bjork, 1995). For example, a government wishing to lower public spending, but facing strong opposition of the domestic constituencies, may enter into an IMF arrangement to tie the budget proposal to the conditions imposed by the IMF. This move raises the cost for the domestic constituencies of rejecting the proposed budget because a rejection of the government is also a rejection of the IMF arrangement. A rejection of the IMF will send a negative signal to creditors and investors which is costly to both the government and the domestic constituencies. By tying their hands with IMF conditionality, governments can increase their bargaining leverage with domestic interest groups opposed to economic reform (Vreeland, 1999; Pauly, 1997).

Arcand, Guillaumont, and Guillaumont-Jeanneney (1999) assumed that it is ethnic polarization rather than ethnic fragmentation that is an obstacle to reform. Polarization is the case when there are two ethnic groups of equal size. It is also the case when there is one dominant group and several smaller groups likely to form a coalition that is capable of opposing the dominant group. An operational definition of polarization would be that it corresponds to a situation where the probability of confrontation between ethnic groups is high. This implies that the impact of ETH on the duration of periods with no agreement is not linear, but is an inverted U-shape. To test this hypothesis, ETH squared was introduced, but did not appear with a significant sign and thus was not kept in the final estimation.

The illiteracy rate has the opposite impact of ETH. Its coefficient is significantly[17] positive, meaning that its effect on the duration of periods without agreement is positive (after controlling for GDP). Moreover, when associated with the illiteracy rate in a multiplicative variable, the impact of ETH changes and becomes positive as well. These results confirm the intuition that interest groups can more easily mobilize largely illiterate populations against reform programs because the rationale for these reforms is more difficult to explain to such populations. The utility of intervention of an external actor is considerably reduced when the official language of a country is understood by only a small share of the population (common in African countries with high illiteracy), aggravating the problems of communication.

The variables of demand are very significant in explaining the duration of periods without agreement. The level of development, size of the country, disbursements from the private sector, level of foreign reserves, and depreciation of the real exchange rate have a positive impact, whereas the external debt service ratio has a negative impact. The larger and more developed a country, the easier it is to ride out external shocks and the less external support it needs from the IMF. The same argument applies to countries which (i) have a low debt service compared to their revenue from exports of goods and services, (ii) have a relatively high level of foreign reserves measured in months of imports, and (iii) experience a

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[17] Except in the case of estimation with Weibull and Log-Normal distributions.

depreciation of their real effective exchange rate. The capacity to meet external obligations (debt service and imports) due to available foreign currencies is a positive factor in lengthening the period without agreement with the IMF.

There is no evidence in the data to support that IMF lending has a catalytic effect on private financial flows.[18] The results suggest that African countries do not request IMF credits as long as they receive sufficient private financial flows. These results can be interpreted in two ways. The countries turn to the IMF either: (i) to substitute public financial flows for private ones when they can no longer borrow on international financial markets; or (ii) to regain credibility and be able to borrow on international financial markets. In the case of Sub-Saharan African countries, the facts indicate that public financings, especially from concessional sources, were substituted for private flows when the risk of insolvency of African countries became too high during the 1980s and 1990s (OECD, 1988).

The study also attempted to verify the existence of an IMF catalytic effect on other official financial flows (bilateral, World Bank, and other regional development banks). In order to be able to disburse external aid flows, most of these donors require the recipient countries to have an agreement with the IMF. The amount of undisbursed debt[19] from official creditors during the year preceding an agreement[20] was introduced in the regressions and was not found to be significant. This suggests that the existence of undisbursed financial commitments from other official donors is not a decisive incentive for a government to conclude an agreement with the IMF, after the impact of other factors has been taken into account.

Furthermore, the estimated model shows that the phenomenon of "learning by doing", or borrower's threshold, is an important element to estimate the duration of periods without IMF agreement. In the non-parametric analysis, it was suggested that this effect may be due to other characteristics. After controlling for them, it is still there. The variable "number of months with an agreement before the period without agreement" appears with a strongly significant negative sign. This result indicates that the more time a country has spent with an IMF agreement, the shorter are subsequent periods without agreement. Therefore, signing an agreement with the IMF is easier for a country if previous agreements have been concluded. However, this conclusion has to be tempered, because this variable may also reflects the fact that for most countries the initial period was in the 1970s before the oil shock and before the Fund developed its lending program for developing countries.

Other variables representing factors of demand were introduced in this estimation, but were not significant. In the case of the deficit of current accounts, the literature indicates that this variable is significant for samples consisting of all the developing countries (Bird and Orme, 1981; Joyce, 1992; Conway, 1994; and Bird, 1995), but insignificant for samples including only Sub-Saharan African countries (Cornelius, 1987). The level of inflation, investment rate, and variation of terms of trade were not found to be significant either.

The variables of supply, i.e. the elements taken into consideration by the IMF in approving an arrangement, have significant effects. The study finds that a country's increase in fiscal

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[18] The studies conducted on this issue propose different conclusions. Bird and Orme (1981) and Bird (1995) show that IMF lending and private lending are complementary. This supports the hypothesis that IMF lending has a catalytic effect on private financial flows. On the other hand, Cornelius (1987) shows that these two sources of lending are substitutable in the case of Sub-Saharan African countries.

[19] Source: *Global Development Finance*, the World Bank.

[20] And the average of these amounts over the period if the observation is right-censored.

revenues in addition to a nominal depreciation of its currency during a one-year period of no IMF agreement are strong indicators of entering into an agreement in the near future. The increase of revenues to decrease the fiscal deficit and the devaluation to improve the country's export competitiveness are common IMF prior-actions for an arrangement. They are decisive elements for the approval of a program by the Fund's Board.

Institutional and political characteristics do not appear to be major determinants of the duration of periods without agreement. The variable of instability of the executive power is not significant. The variable of political regime is positive and slightly significant, suggesting that the more democratic a country, the higher its probability of concluding an agreement with the IMF. This weak link between institutional characteristics of a country and its probability of signing an agreement with the IMF has already been identified by Moore and Scaritt (1990) in the case of African countries. However, many other studies (among them Kaufman, 1986; Haggard and Kaufman, 1989) have shown that autocratic regimes are more likely to conclude and successfully implement an IMF program than democratic regimes. According to its statutes, the IMF is not allowed to intervene in its members' domestic politics. However, the IMF sometimes suspends programs when events change the nature of the political regime and this is seen to have important negative economic consequences, as was the case with Côte d'Ivoire in 1999 after the coup.

IV. CONCLUSION

The parametric and non-parametric analyses of the duration of periods without agreement between the IMF and Sub-Saharan African countries provide information about the determinants of IMF financial arrangements. The economic characteristics of the countries are decisive. A country is less likely to request an IMF agreement and therefore is more likely to have longer periods without agreement if the country: (i) is relatively less exposed to external shocks because of its size and/or level of development, and (ii) is able to meet external obligations (imports and external debt service).

The role of IMF pre-arrangement conditions has also been identified in this study. Countries which increase their fiscal revenue and devalue their currency during the last year of the period without agreement have a higher probability of concluding an arrangement with the IMF. In order to grant financial support, the Fund's Board takes into account the countries' first efforts to reform fiscal policy and exchange rate policy.

Finally, the role of interest groups, especially ethno-linguistic groups, appeared clearly in the results of the econometric analyses. Their incapacity to reach a political consensus regarding a reform program accelerates the IMF intervention. As an external actor, the IMF is able to initiate and support such reforms with high political costs that a weak government could not implement alone. However, this IMF intervention is feasible only when the rationale is understood by the population, which supposes that the illiteracy rate is not high.

Annex 1:

**Composition of the sample
of the parametric study**

	Country	Code	Date of the periods with No agreement
1.	Afrique du Sud	ZAF	jan84-?
2.	Benin	BEN	1971-may89
3.	Benin	BEN	jul92-dec92
4.	Botswana	BWA	1971-98
5.	Burkina Faso	BFA	1971-fev91
6.	Burundi	BDI	apr77-jul86
7.	Burundi	BDI	dec94-?
8.	Burundi	BDI	sep89-oct91
9.	Cameroun	CMR	1971-aug88
10.	Cameroun	CMR	jul90-nov91
11.	Cameroun	CMR	oct92-fev94
12.	Cameroun	CMR	oct96-jul97
13.	Congo	COG	jun92-apr94
14.	Congo	COG	jun95-may96
15.	Congo	COG	may80-jul86
16.	Congo	COG	may88-jul90
17.	Côte d'Ivoire	CIV	jan87-jan88
18.	Côte d'Ivoire	CIV	jul97-fev98
19.	Côte d'Ivoire	CIV	oct92-fev94
20.	Ethiopie	ETH	jul82-sep92
21.	Ethiopie	ETH	nov95-sep96
22.	Gambie	GMB	1971-apr77
23.	Gambie	GMB	dec80-jan82
24.	Gambie	GMB	dec91-mai98
25.	Gambie	GMB	jan85-aug86
26.	Gambie	GMB	jun78-oct79
27.	Gambie	GMB	mar83-mar84
28.	Ghana	GHA	avr92-mai95
29.	Ghana	GHA	jan86-sep86
30.	Kenya	KEN	apr93-nov93
31.	Kenya	KEN	jan95-mar96
32.	Kenya	KEN	mar86-jan88
33.	Lesotho	LSO	1971-may88
34.	Lesotho	LSO	oct97-?
35.	Madagascar	MDG	avr92-oct96
36.	Malawi	MWI	1971-sep79
37.	Malawi	MWI	avr94-oct94
38.	Malawi	MWI	dec85-fev88
39.	Mali	MLI	avr87-jul88
40.	Mali	MLI	sep91-jul92
41.	Maurice	MUS	sep86-?
42.	Mauritanie	MRT	fev98-jun99
43.	Mozambique	MOZ	1971-may87
44.	Niger	NER	avr95-mai96
45.	Niger	NER	jan92-fev94
46.	Nigeria	NGA	1971-dec86
47.	Nigeria	NGA	fev88-jan89

```
48.         Nigeria          NGA    mai90-dec90
49.         Nigeria          NGA       mai92-?
50.         Ouganda          UGA    oct84-mai87
51.            RCA           CAF    avr95-jun98
52.            RCA           CAF    jun90-fev94
53.         Senegal          SEN     1971-fev79
54.         Senegal          SEN    jan81-aug81
55.         Senegal          SEN    jan83-aug83
56.         Senegal          SEN    jul92-fev94
57.         Tanzanie         TZA    aug94-oct96
58.         Tanzanie         TZA    nov90-jun91
59.          Tchad           TCD     1971-sep87
60.          Tchad           TCD    nov90-fev94
61.           Togo           TGO       jul98-?
62.           Togo           TGO    mar93-aug94
63.           Togo           TGO    nov86-fev88
64.          Zambie          ZMB    jan85-jan86
65.          Zambie          ZMB    jun87-nov95
66.         Zimbabwe         ZWE     1971-mar81
67.         Zimbabwe         ZWE    mai82-fev83
68.         Zimbabwe         ZWE    oct84-dec91
69.         Zimbabwe         ZWE    oct95-mai98
```

Annex 2:

Ramsey-Reset Test

The objective of the Ramsey-Reset test is to verify whether variables are missing. It evaluates the quality of specification of the estimated models.

The statistic is calculated in three stages:
1. Estimation of the model to get the estimated value of the endogenous variable
2. Computation of the square of this estimated value
3. Introduction of this variable in the initial estimation.

H_0 : There is no missing variable
H_1 : There is missing variable(s)

The statistic is:

$$R = \frac{|SCR_0 - SCR_1|(N - K_1)}{SCR_1(K_1 - K_0)} \rightarrow F(K_1 - K_0, N - K_1)$$

with SCR_0 = sum of squared residuals of the initial regression
SCR_1 = sum of squared residuals of the second regression
N = number of observations
K_0 = number of regressors in the initial equation
K_1 = number of regressors in the second equation

If $F_C > F_T$, H_0 is rejected and some missing variables exist.

On Stata 6, this test can be performed with the command "linktest". This procedure has been used to obtain the following results. The assumption H_0 is rejected if the squared endogenous variable, named *hatsq,* is significantly different from zero.

- Model 1

Cox regression   Number of obs = 69

```
Log likelihood = -209.92563

-------------------------------------------------
duration |     Coef.          t
---------+---------------------------------------
   _hat |   .0400622        0.054
 _hatsq |  -.0809176       -1.140

-------------------------------------------------
```

- Model 2

Log-normal regression   Number of obs = 69

```
Log likelihood = -65.554574

----------------------------------------------------
duration |     Coef.          t
---------+------------------------------------------
   _hat  |   .8610387       3.343
  _hatsq |   .0012105       0.015
----------------------------------------------------
```

- Model 3

Log-logistic regression   Number of obs = 69

```
Log likelihood = -62.16789

----------------------------------------------------
duration |     Coef.          t
---------+------------------------------------------
   _hat  |   .8334206       3.842
  _hatsq |   .0262254       0.390
----------------------------------------------------
```

- Model 4

Weibull regression   Number of obs = 69

```
Log likelihood = -63.192386

----------------------------------------------------
duration |     Coef.          t
---------+------------------------------------------
   _hat  |   1.117728       5.813
  _hatsq |   -.060874      -1.056
----------------------------------------------------
```

Annex 3:

Test of absence of non-observable heterogeneity

The differences in duration of periods without agreement might be caused by elements not captured by quantitative and qualitative variables. To take this eventuality into account, a random element representing this non-observable heterogeneity between individuals, is included. This random element is supposed to have a gamma distribution. The results obtained with this correction for the model 2 of table 2 are the following:

```
+----------------------------------------------+
| Loglinear survival model: WEIBULL            |
| Maximum Likelihood Estimates                 |
| Dependent variable            LDURATIO       |
| Weighting variable                 ONE       |
| Number of observations              69       |
| Iterations completed                51       |
| Log likelihood function      -57.31098       |
| Censoring status variable is DEAD98          |
| Weibull Model with Gamma Heterogeneity       |
+----------------------------------------------+
+--------+-------------+---------------+-------+--------+----------+
|Variable | Coefficient | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+--------+-------------+---------------+-------+--------+----------+
          RHS of hazard model
 NBMOIACC  2.363256071     .23876530        9.898   .0000  63.227848
 GDPCAP    .2058368549E-04 .70008297E-04    3.294   .0000  1370.3238
 DBTSPRIV  9.621292276    2.9252515         4.554   .0000  .17148909E-01
 DETSERV  -.5828126300E-01 .14634429E-02   -1.898   .0564  19.451055
 RESERV    .5860281316E-02 .42833373E-01    1.777   .0658  2.2881933
 LPOP      .9306346558E-01 .61752720E-01    1.807   .0513  15.540663
 TCER      .0220298531     .00497750        8.443   .0000  1.6133396
 RECFISC2 -.5876449879E-01 .11845418E-02   -3.496   .0000  21.607398
 TXCHMEND -.1047579025     .50102683       -1.709   .0758  .47862483
 POLITY   -.1283074064E-01 .12964830E-01    -.990   .3223 -2.2468354
 INSTAB   -.4679000578E-01 .10633535        -.440   .6599  .51618445
 ETH      -1.171957182     .33367470       -4.286   .0000  .69620253
 ILLIT2    .2255256039E-02 .69971422E-02    1.322   .1472  53.560497
 ETHIL2DE  .7533241129E-04 .10751197E-04    1.701   .0784  1546.2060
 Constant -1.28421092     1.1456528        -1.121   .2623

        Ancillary parameters for survival
 Theta     10.17048878    10.319971          .586   .4644
 Sigma     .6368114651E-01 .61490080E
```

Theta is not significant, meaning non-observable heterogeneity does not exist. Therefore the correction is not necessary.

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