Determinants of Child Mortality in Africa: A Methodological Discussion

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Abstract

Current literature is ambiguous regarding the significance of public health expenditure in reducing mortality rate among children in cross country studies. In fact, several previous studies found the relationship between these two variables to be insignificant. Such findings indicate the existence of a huge inefficiency in public sector of struggling countries and discourage supports provided by donating entities. This study addresses the disagreement in the literature by pointing out how results are sensitive to the use of non-stationary variables that are used often in the literature. Using a Panel Vector Autoregressive model, no empirical evidence for the role of public health expenditure in reducing child mortality is found when non-stationary variables are used. However, results are significantly different as soon as stationary variables are substituted in the same model. In fact, the elasticity of under five mortality rate with respect to per capita public health expenditure is about -0.22 for African countries in the sample.

Keywords: Under five mortality rate, public health expenditure, female education, panel vector autoregressive, impulse-response analysis.

JEL classification: C33; H51; I18

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I. Introduction

Determinants of mortality in young children have received widespread attention in the public health and epidemiology literature. Although theory suggests that public health expenditure in struggling countries should be one of the main factors that help to prevent mortality in children, current empirical works seems to lack consensus on the impact (Martin et.al. 2008). For example, this lack of consensus can be seen with regards to under five mortality rate (U5MR), as Bokhari, Gai and Gottret (2007) report elasticity of -0.33 for U5MR with respect to public health expenditure, compared to other researchers (e.g. see: Filmer and Pritchett 1999; Rajkumar and Swaroop 2008) who report a very small and statistically insignificant effect for this variable in reducing U5MR.

This ambiguity, or the belief that public health expenditure does not matter, has a very strong policy implication for countries facing this problem, as well as donor agencies. It could signal a catastrophic inefficiency in the public sector of these countries and discourage financial assistance. It also implies that all the efforts that have been put into the process of reducing child mortality through extending the provision of health care to the population in need have not been successful.

Knowing the fact that child mortality has reduced over time, it is then hard to accept that public health expenditure is not a determinant and other variables, such as education among women (e.g. see Filmer and Pritchett 1999), are the significant variables. It is also difficult to believe that inefficiency in these governments would extend to the health sector but would have no effect on the education sector. Conjointly, it is definitely hard to explain how education would have such an outstanding effect on child mortality without consideration to the health sector.

One explanation for this counterintuitive empirical result is potential problematic methodologies used by different authors. Cross sectional studies cannot appropriately control for heterogeneity among countries and most of the previous panel studies failed to account for non-stationary nature of the variables. This study, therefore, revisits the question of relative importance of main determinants of U5MR and demonstrates that the main results are very sensitive to the use of non-stationary variables. In other words, using non-stationary variables, "illiteracy rate in female population" and "per capita GDP (as a measure of income)" are found to be the most important variables with no statistically significant effect for "per capita public health expenditure". However, as soon as stationary variables (the growth rate of above mentioned variables) are used in the models, public health expenditure becomes the most important variable. Similar results are found using impulse-response analysis.

The rest of the paper is organized as follows: Section II provides a brief review of the literature on the determinants of mortality in young children. Section III describes the data that is used in this study. Section IV explains the methodology and section V reports the results while section VI concludes.

II. Determinants of Child Mortality

Child mortality continues its downward trend from about 10 million death in 2000 (Black, Morris and Bryce 2003) to about 7.6 million in 2010, with pneumonia and preterm birth complications being the leading causes of death (Liu et.al. 2012). Contributing factors, such as malnutrition, result in these diseases to be more malignant (Olofin et. al. 2013). Even though this type of study lends itself to the research agenda of epidemiologists, it also has major economic implications. Some economists focus on the child mortality as an important issue itself (e.g. see Filmer and Pritchett 1999) but others use this and similar indicators (e.g. infant mortality rate or

maternal mortality rate) to evaluate and compare the performance of health care systems or, more generally, the quality of governments (e.g. see Herrera and Pang 2005).

The majority of cross-country studies on the relationship between health expenditure and different health outcomes either focus only on the public health expenditure or do not differentiate between public and private expenditures (e.g. see: Evans et. al. 2001; Bokhari, Gai and Gottret 2007; Rajkumar and Swaroop 2008; Anyanwu and Erhijakpor 2009; Darcin 2013). There are, however, some exceptions in both country-specific (e.g. see Crémieux et. al. 2005; Paxson and Schady 2005) and cross-country studies (e.g. see: Herrera and Pang 2005; Issa and Ouattara 2005). Herrera and Pang (2005) study the health care efficiency of 140 countries for the period of 1996 to 2002 and show that lower levels of efficiency is correlated with higher levels of public to private expenditure. Issa and Ouattara (2005) find somewhat different results indicating that public expenditure is the main driver of health performance in countries with lower levels of development and private expenditure in the other countries. These results suggest that any comparison between public sectors should be done with the knowledge of the private sectors. Therefore, this study includes both public and private health expenditures in all the models. It should be noted that from theoretical point of view, researchers have disagreed about whether public and private sectors are substitutes (Rajkumar and Swaroop 2008) or play different roles in the provision of health care (Musgrove 1996; Scott 2001).

The literature is divided on the significance of public health expenditure in reducing child mortality (Martin et.al. 2008). Several previous studies failed to find a significant effect (for example see Filmer and Pritchett 1999; Rajkumar and Swaroop 2008) while some report contradictory results (i.e. very significant effect) (Bokhari, Gai and Gottret 2007). Other examples of this ambiguity can be found in the literature. Johar (2009) studies the effect of a

health program in Indonesia which provides free primary health care for economically disadvantage individuals that was not successful in increasing the use of health care among this group. But in a different setting, Barham and Maluccio (2009) find highly significant effect of cash transfer on vaccination rate among children in Nicaragua. Another example is Wagstaff and Moreno-Serra (2009) who find no significant effect of public health insurance on health outcomes in a panel of 28 countries that experienced the transition from being a communist country. On the other hand, there are many studies who find a significant impact of health insurance on health outcomes, especially in children and more disadvantage groups (for example see Levy and Meltzer (2004), Currie et. al. (2008) and Weathers II and Stegman (2012)).

Beside health expenditure, different socio-economic variables are believed to be influential in determining child mortality (Houweling and Kunst 2010). The main variable in this category is poverty which is found to be highly correlated with mortality rate in children. This relationship is found both in the aggregated (i.e. country) and also disaggregated (i.e. individual) levels (Wang 2003; Anyanwu and Erhijakpor 2009). The other critical factor that has been found is education among female population. Previous studies consider women's education as one of the main preventive factors of mortality among young children (Rutstein 2000; Buor 2003; Houweling and Kunst 2010; Monden and Smits 2013). Different measures of education (e.g. literacy or primary education) have been used and the results indicate that education is one of the channels that public officials can use to reduce child mortality. In this study, per capita GDP as a measure of income and female illiteracy rate as a proxy for education are included to account for these two main determinants of U5MR.

Other influential factors such as living in the urban versus rural area (Wang 2003), access to the clean water (Anyanwu and Erhijakpor 2009), access to the health care (Anand and

Bärnighausen 2004; Rutherford, Mulholland and Hill 2010) and more importantly, HIV/AIDS prevalence (Evans et. al. 2001; Herrera and Pang 2005; Anyanwu and Erhijakpor 2009) are also reported in the literature. This is not an exhaustive list, as researchers have selected different variables to focus on. However, only HIV prevalence is included in this study, as it is a major issue for African countries.

III. Data

In order to determine which one of the main determinants of child mortality in the literature is relatively more important and whether public health expenditure has any role in reducing U5MR, panel data from African countries is utilized. There are two reasons for this choice. First, African countries, specifically sub-Saharan countries, are among the places with the highest rate of child mortality and thus, this problem is of vital concern. (Black, Morris and Bryce 2003). Therefore, it is expected that public health resources are more dedicated to reduce child mortality in these countries. Second, many of the African counties are incorporated in the Millennium Development Goals for reducing the mortality rate in children[3] (Liu et. al. 2012). Thus, considerable attention from policy makers is given to improve these countries' status in this measure. Consequently, it is reasonable to expect that because of this attention from policy makers, more public resources in the health sector have been specifically allocated to reduce mortality among children.

The panel of African countries used in this study includes 30 countries for which the data is available for the period of 1995 to 2011 for all variables.[4] The list of these countries is reported in the appendix A. While there is a legitimate concern over whether the number of countries in

[3] The goal is "to reduce child mortality by two-thirds between 1990 and 2015" (UN 2010)
[4] The only exception is Liberia that doesn't have data for 1995 through 1997 for some of the variables.

the sample would adversely affect the results, the main goal of this study is to demonstrate that the results are sensitive to the use of non-stationary variables, which would be unaffected by the size of the sample. Of course, whether the parameter estimates can be generalized for all of the African countries is up for debate.

The main variables of interest in this study are introduced in Table I. This table also provides information about the sources for these variables. Appendix B reports summary statistics for the main variables of interest (in their level form) for each country separately. Table II, provides a short summary of the countries with the highest and the lowest values for each variable (in the level form).

Table I: Description of variables used in this study

Table II: The range of deviation in each variable across countries

IV. Methodology

Many studies in this area use variables in their level form. However, there is a trend in the literature to use some of these variables in their growth rate form (Verguet and Jamison 2013). Verguet and Jamison (2013) evaluate the health care performance variable in the growth rate form and argue that its levels are not sensitive to the socio-economic and policy changes. This study provides an additional reason to avoid using these variables in their level form from an econometric point of view.

Many macroeconomic variables are found to be non-stationary in their level forms. When non-stationary variables are used in methods like OLS, they produce spurious results (Granger

and Newbold 1974). Several stationary tests have been developed to assess whether a time series is integrated or not. This study utilizes the Augmented Dickey-Fuller (Dickey and Fuller 1979) and Phillips-Perron (Phillips and Perron 1988) unit root tests. The null hypothesis of both tests is that series has unit root (i.e. it is non-stationary). Therefore, rejecting this hypothesis is favorable.

The results of these tests on all of the variables are reported in Appendix C (Table C.1 through Table C.12). It should be noted that both tests are done on each country separately but the results are concentrated together for the sake of comparison. Table IIIA provides a more summarized report of the result of these tests and shows that in most of the countries in the sample, variables are not stationary in their level form. Similar tests are used for variables in the growth rate form and most of variables are proved to be stationary. The detailed results of unit root tests are provided in Appendix C (Table C.13 through Tale C.24) and Table IIIB provides a summary of these results. While there is no country with all six variables being stationary in their level forms, almost all of the countries have stationary variables in their growth rate form. This has an obvious implication: Any study that includes these variables in their level form may produce spurious results.

Table III: Results of unit root tests

As the starting point for modeling, a simple one-way fixed effect model is specified and estimated as it is demonstrated in EQ.1.

EQ.1 $$U5MR_{c,t} = \beta_1 PGH_{c,t} + \beta_2 PPH_{c,t} + \beta_3 PGDP_{c,t} + \beta_4 PPHIV_{c,t} + \beta_5 NSF_{c,t} + f_c + \varepsilon_{c,t}$$

Subscripts c and t stands for "country" and "time" respectively, f_c is the vector of country specific fixed effects and $\varepsilon_{c,t}$ is the error term. EQ.1 uses variables in the non-stationary form but this model can be easily estimated for stationary variables (i.e. switching from X to GX variables, for example, using GU5MR instead of U5MR). The model is estimated once without controlling for PPH (or GPPH) and once with this variable on the right hand side to determine whether estimates are sensitive to the inclusion of this variable.

The above model does not take into account the endogeneity of right hand side variables. For example, Bhargava et.al. (2001) find that health affects the growth of GDP especially in low income countries. One way to solve this problem is to use a model from Vector Autoregressive family which utilize the lag values of variables as instruments. Due to the fact that data is in the panel form, a Panel Vector Autoregressive (Panel-VAR) model is the right choice which is specified in EQ.2[5]:

EQ.2 $$y_{c,t} = AY_{c,t-1} + F_c + \varepsilon_{c,t}$$

$y_{c,t}$ represents a (6×1) vector of variables (i.e. U5MR, PGH, PPH, PGDP, PPHIV and NSF when the model is estimated using non-stationary variables and GU5MR, GPGH, GPPH, GPGDP, GPPHIV and GNSF when stationary variables are used for the estimation) for country "c" at time "t". $Y_{c,t-1}$ is a (6×6) matrix that in each row, the lag values of all variables are used.

[5] This study follows the guidelines provided by Love and Zicchino (2006) on how to estimate such model using Generalized Method of Moments (GMM)

Finally, $\varepsilon_{c,t}$ is a (6×1) vector of white noises and F_c is a (6×30) matrix of country fixed effects. Matrix A is a (6×6) matrix of coefficients that is estimated using GMM. In order to determine whether results are sensitive to the presence of a control for private health expenditure (PPH or GPPH), the model is estimated once without this variable and then with it. It should be noted that country fixed effects are eliminated using a forward-mean-differencing method known as Helmert's transformation (Arellano and Bover 1995). The common mean-differencing method to eliminate these fixed effects is not appropriate due to the fact that instruments are the lag values of the variables and simple mean-differencing makes them endogenous and therefore invalid (Love and Zicchino 2006).

A useful tool that is commonly used with VAR models to evaluate and compare the effect of different variables on a particular variable is the Impulse Response Function (IRF). IRF captures the response of each variable to the shocks in another variable while keeping shocks to the other variables equal to zero. The next section reports the parameter estimates for the above models as well as impulse-response functions.

V. Results and Discussion

Estimated coefficients for the fixed effect models are reported in Table IV. The left side of the table is for the parameter estimates with variables in their level form and the right hand side is the estimates using variables in the growth rate form. Even though the estimations are all subjected to the bias due to the endogeneity of dependent variables, it is still informative to note how parameter estimates and their significance change when variables are switched from non-stationary to stationary. Moreover, while the model has a huge explanatory power when non-stationary variables are used, it loses all of its power by switching to the stationary variables.

Table IV: Results of the fixed effect models

Table V reports the parameter estimates for only one equation of the Panel-VAR model which is more relevant to this study. The parameter estimates and their significance also changes in this model depending on whether stationary or non-stationary variables are used for the estimation. This is also clear from the impulse-response diagrams in Figures I and II.

Since the main variable of interest is U5MR (or GU5MR when all variables are used in the growth rate form), only the response of this variable to the innovation in other variables are presented in Figure I. In each diagram the response of U5MR (in terms of standard deviation) is displayed with respect to one (positive) standard deviation shock to the other variable at period zero. The response of U5MR is presented for up to 6 periods after the initial shock. For example, one standard deviation shock to the PGDP would result in -0.0214 standard deviation response in U5MR in the same period and the effects gets larger and approaches to -0.13 standard deviation in the 6^{th} period after the initial shock. Moreover, in each diagram 90 percent confidence interval is also displayed. In order to construct these confidence intervals, Monte Carlo simulations with 1000 replications were used.

Due to the nature of variables, it was expected to see a positive response of U5MR to shocks in NSF and PPHIV and a negative response to shocks in PGDP, PGH and PPH. The diagrams in Figure I satisfy this prior expectation. It is clear from these diagrams that no-schooling for female population has the largest effect on child mortality. However, what seems odd in most of these diagrams is that a shock at time zero has more effect on later periods. It is very hard to

explain how such effect could happen and it seems to be another problem that is caused because of the estimation using non-stationary variables.

Table V: Results of the Panel-VAR model for U5MR and GU5MR equations.

Figure I: Response of U5MR to the shocks in NSF, PPHIV, PGH, PPH and PGDP.

If the effects of variables and their relative importance found in Figure I were in fact the truth, similar pattern of relative importance should be observed when variables are used in the growth rate form. Figure II reveals that such assumption is not correct; in fact, only public health expenditure is statistically and economically significant in determining mortality among young children. One standard deviation shock to GPPH reduces GU5MR by approximately one-fifth of a standard deviation in the next period. Due to the nature of the variables, (which are both in the form of percentage change) this number can be interpreted as the elasticity of under five mortality rate with respect to per capita public health expenditure which is approximately -0.22 according to figure II.

Another major result is the fact that private health expenditure is insignificant in reducing child mortality regardless of what type of variables are used in the model. This aspect of the results needs further investigation. One possible explanation is provided by theories about the relationship between private and public health expenditure which consider these two variables to

be complements (Musgrove 1996; Scott 2001). However, a separate study is required before such conclusion can be made.

Figure II: Response of GU5MR to the shocks in GNSF, GPPHIV, GPGH, GPPH and GPGDP.

VI. Conclusion

The ambiguity in literature about the effect of public health expenditure on child mortality has strong implications especially if it is interpreted as incapability of the public sector of suffering countries in providing health care. Moreover, the belief in such inefficiency has a discouraging effect for donating agencies. However, this study shows that the above mentioned ambiguity is mainly because of problems in research methodologies. Cross sectional studies cannot appropriately account for individual heterogeneity among countries and previous panel studies mostly used non-stationary variables.

In this study, the determinants of child mortality are revisited in order to show how results are sensitive to the use of non-stationary variables. A panel of 30 African countries for the period of 1995 to 2011 is used and a Panel-VAR model is specified and estimated. Impulse-response analysis is also provided to better quantify the relationship between variables in a dynamic framework.

Using non-stationary variables in the best model, it is shown that public health expenditure has no statistically significant effect on reducing child mortality and that education among female population is the main parameter. This is in line with some of the previous studies that report similar results for the inefficiency of public health sector. However, using the same model

with stationary variables, public health expenditure is found to be the main determinant of child mortality. Impulse-response analysis points out that the elasticity of under five mortality rate with respect to per capita public health expenditure is approximately -0.22 for African countries in the sample. This number is more in line with studies like Bokhari, Gai and Gottret (2007) that have found similar statistically significant effect for public health expenditure.

All of the models in this study are estimated both with and without a control for private health expenditure and the results are mixed. The presence of this variable changes some of the parameter estimates in most of the models. However based on the impulse-response analysis of the best model, private health expenditure does not have a statistically significant effect on child mortality in the countries included in this study. One potential explanation for this result is that private and public health expenditures are complements in the African countries present in the sample but further studies are needed to better explain the relationship between these two variables.

The main conclusion of this study, the sensitivity of estimates to the use of non-stationary variables, can be generalized to the other countries. However, the estimated elasticity cannot be generalized. Two important reasons prevent such generalization. First, this study only looks at a group of African countries so the value of the estimated elasticity would be totally different for other countries who do not share similar socio-economic conditions with African countries. Second, this paper only includes some important determinants of child mortality but not all of the variables that have been suggested in the literature. Future works can provide better estimates of the effect of public health expenditure on preventing death in children by improving the current study in these two dimensions.

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Table I: Description of variables used in this study

Variable	Definition	Source
U5MR	Under five Mortality Rate: Probability per 1,000 that a newborn baby will die before reaching age five	UN-IGME
GU5MR	Growth of U5MR	-
PGH	Per capita public health expenditure (in thousand constant (2005) US$)	WHO
GPGH	Growth of PGH	-
PPH	Per capita Private health expenditure (in thousand constant (2005) US$)	WHO
GPPH	Growth of PPH	
PGDP	Per capita gross domestic product (in thousand constant (2005) US$)	WHO
PGDP	Growth of PGDP	-
PPHIV	Number of people living with HIV/AIDS per 1,000 capita	UN-AIDS
GPPHIV	Growth of PPHIV	-
NSF[6]	Percentage of 15 years or older women with no schooling (illiterate).	Barro-Lee
GNSF	Growth in NSF	-

UN-IGME (2014): United Nation Inter-agency Group for Child Mortality Estimation.
WHO (2014): World Health Organization.
UN-AIDS (2014): Joint United Nations Program on HIV and AIDS.
Barro-Lee (2013): Barro-Lee Educational Attainment Dataset

[6] The source for this variable only reports education attainment in 5 years interval. For the years in between I used a simple linear function to impute the missing values. Since the changes over 5 years are very smooth, the imputed numbers are not very sensitive to the type of function being used.

Table II: The range of deviation in each variable across countries

Variable	Highest Average Value	Lowest Average Value
U5MR	Mali (190.71 in every 1,000 live birth)	Mauritius (17.69 in every 1,000 live birth)
PGH	Botswana ($200.07)	Democratic Republic of the Congo ($1.66).
PPH	South Africa ($246.65)	Democratic Republic of the Congo ($5.53).
PGDP	Gabon ($6636.71)	Democratic Republic of the Congo ($132.89).
PPHIV	Botswana (155.70 in every 1000)	Egypt (0.04 in every 1,000)
NSF	Niger (%86.27 no education)	Lesotho (% 8.31 no education)

Note: 29 countries (listed in Appendix A) for years 1995 to 2011 (and Liberia for 1998 to 2011) are considered to build this table. See Appendix B for country specific summary statistics.

Table III: Results of unit root tests

IIIA: Number of countries with stationary time series for each variable (variables are all in the level form).

Variable / Test	U5MR	PGH	PPH	PGDP	PPHIV	NSF	All Variables
Augmented Dickey-Fuller	6	8	8	7	7	2	0
Phillips-Perron	0	8	9	4	2	1	0

IIIB: Number of countries with stationary time series for each variable (variables are all in the growth form).

Variable / Test	GU5MR	GPGH	GPPH	GPGDP	GPPHIV	GNSF	All Variables
Augmented Dickey-Fuller	30	28[7]	27[8]	30	30	30	25
Phillips-Perron	30	30	30	30	30	30	30

Note 1: Tests are all done using %10 confidence interval.

Note 2: all variables are standardized first for each country separately in their level form (using the mean and standard deviation of the variable for that country) and the growth rate variables are calculated using these standardized variables. Moreover, both unit root tests are performed assuming zero intercept and no time trend.

[7] Exceptions are Mali and Sierra Leone.
[8] Exceptions are Senegal, Tanzania and Togo.

Table IV: Results of the fixed effects models

Panel a. FE models with non-stationary variables			Panel b. FE models with stationary variables		
Independent Variables	Dependent Variable:		Independent Variables	Dependent Variable:	
	U5MR	U5MR		GU5MR	GU5MR
PGH	-0.15***	-0.14***	GPGH	-0.020	-0.020
	(0.03)	(0.03)		(0.04)	(0.04)
PPH	-	-0.08***	GPPH	-	0.000
		(0.03)			(0.001)
PGDP	-0.07**	-0.04	GPGDP	0.002	0.002
	(0.03)	(0.03)		(0.02)	(0.02)
PPHIV	0.14***	0.14***	GPPHIV	-0.005	-0.005
	(0.03)	(0.03)		(0.04)	(0.04)
NSF	0.70***	0.69***	GNSF	-0.053	-0.053
	(0.04)	(0.04)		(0.10)	(0.10)
# of Observations	478[a]	478	# of Observations	478	478
# of Countries	30	30	# of Countries	30	30
Wald test (joint significance of above variables)	1218.3***	1243.2***	Wald test (joint significance of above variables)	0.63	0.62
R-Squared	0.7346	0.7389	R-Squared	0.0600	0.0600

Standard errors are in parentheses and country fixed effects are removed using mean differencing technique.

** and *** represent %5 and %1 significance level respectively.

Note: 29 countries (listed in Appendix A) for years 1996 to 2011 and Liberia for 1998 to 2011 are included. Data for 1995 are disregarded since panel b (which uses growth rate of the variables in panel a) does not have any data for 1995.

Table V: Results of the Panel-VAR model for U5MR and GU5MR equations.

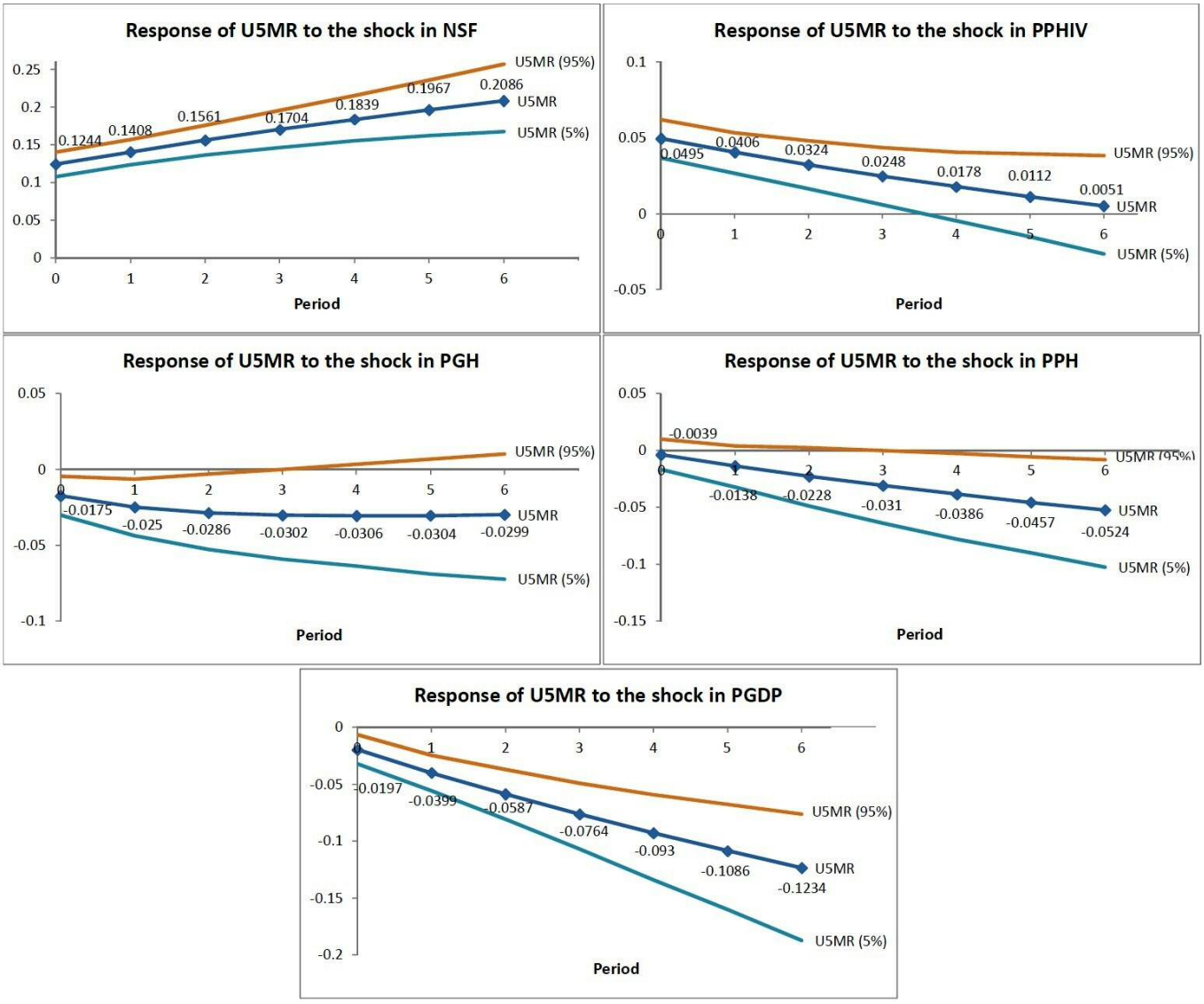
Panel a. Panel VAR models with non-stationary variables			Panel b. Panel VAR models with stationary variables		
	Response of:			Response of:	
Response to:	U5MR (t)	U5MR (t)	Response to:	GU5MR (t)	GU5MR (t)
PGH (t-1)	-0.01 (0.01)	-0.01 (0.01)	GPGH (t-1)	-0.03*** (0.01)	-0.03*** (0.01)
PPH (t-1)	-	-0.02 (0.01)	GPPH (t-1)	-	-0.00001238*** (0.00000515)
PGDP (t-1)	-0.05*** (0.01)	-0.04*** (0.02)	GPGDP (t-1)	0.001 (0.003)	0.001 (0.003)
PPHIV (t-1)	-0.03* (0.02)	-0.03* (0.02)	GPPHIV (t-1)	-0.01 (0.01)	-0.01 (0.01)
NSF (t-1)	0.12*** (0.02)	0.13*** (0.02)	GNSF (t-1)	0.12 (0.12)	0.12 (0.12)
U5MR (t-1)	0.94*** (0.02)	0.94*** (0.02)	GU5MR (t-1)	0.002 (0.01)	0.002 (0.01)
# of Observations	448[a]	448	# of Observations	448	448
# of Countries	30	30	# of Countries	30	30

The Panel-VAR models are estimated by GMM and standard errors are in parentheses. Country fixed effects are removed using Helmert's transformation.

* and *** represent %10 and %1 significance level respectively.

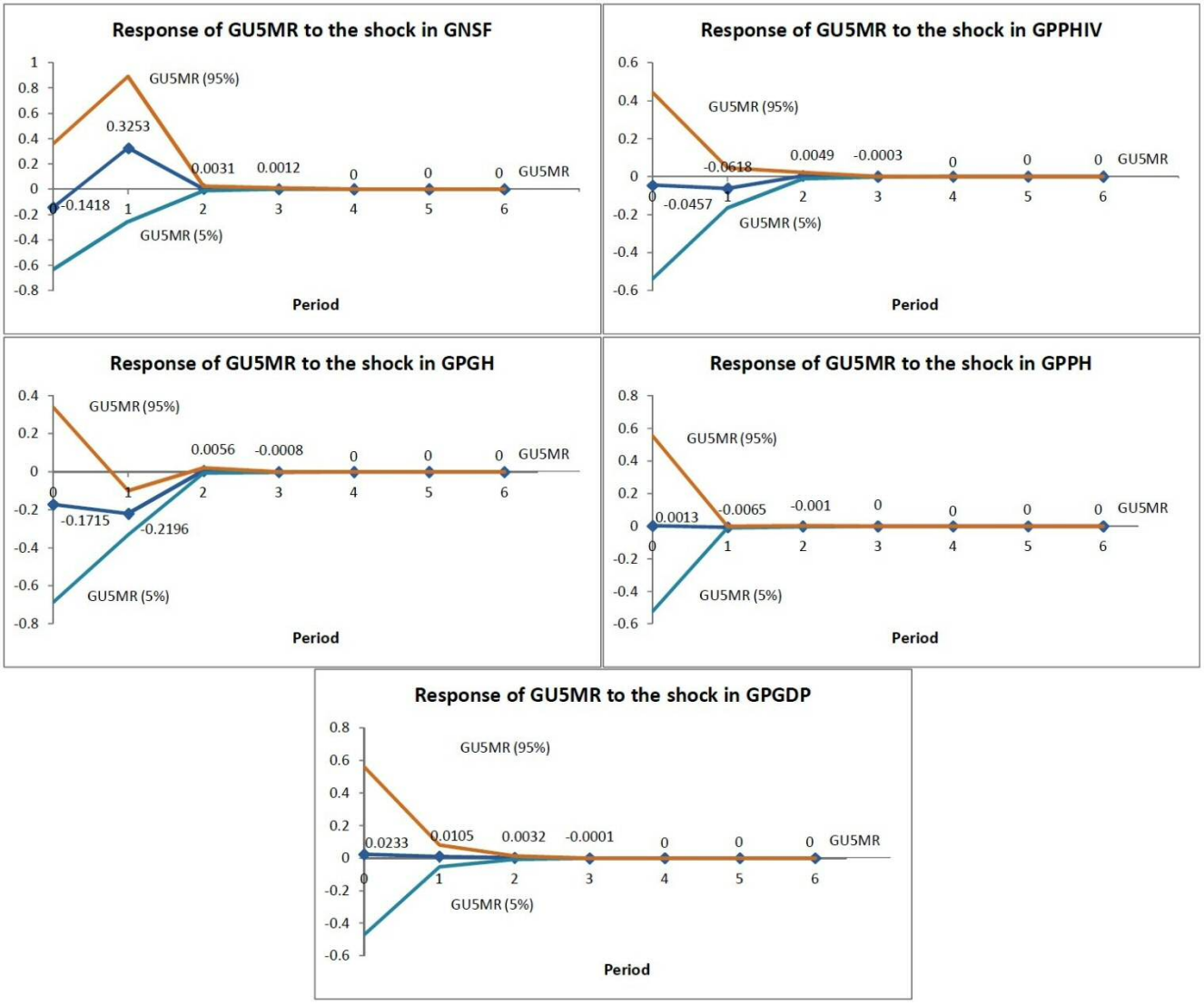
Note: 29 countries (listed in Appendix A) for years 1996 to 2011 and Liberia for 1998 to 2011 are included. Data for 1995 are disregarded since panel b (which uses growth rate of the variables in panel a) does not have any data for 1995. Data for year 2011 cannot be included since the country fixed effects cannot be removed for the last observation using Helmert's transformation.

Figure I: Response of U5MR to the shocks in NSF, PPHIV, PGH, PPH and PGDP.



Note: Confidence intervals are constructed using Monte Carlo simulation with 1000 replications.

Figure II: Response of GU5MR to the shocks in GNSF, GPPHIV, GPGH, GPPH and GPGDP.



Note: Confidence intervals are constructed using Monte Carlo simulation with 1000 replications.

Appendix A: Country list

Table A.1: List of countries used in this study (names in parentheses are the one used in the data set and following appendices)

1	Benin
2	Botswana
3	Burundi
4	Cameroon
5	Congo
6	Côte d'Ivoire (Cote_dIvoire)
7	Democratic Republic of the Congo (DR_Congo)
8	Egypt
9	Gabon
10	Gambia
11	Ghana
12	Kenya
13	Lesotho
14	Liberia
15	Malawi
16	Mali
17	Mauritania
18	Mauritius
19	Mozambique
20	Namibia
21	Niger
22	Rwanda
23	Senegal
24	Sierra Leone (Sierra_Leone)
25	South Africa (South_Africa)
26	Swaziland
27	Tanzania
28	Togo
29	Uganda
30	Zambia

Appendix B: Summary statistics

Table B.1: Summary statistics for individual countries in the sample

Benin					
Variable	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
U5MR	17	129.1176	23.014	92.8	158.2
PGH	17	0.012139	0.001605	0.009406	0.014512
PPH	17	0.013112	0.000473	0.012236	0.013873
PGDP	17	0.560947	0.033843	0.497981	0.605327
PPHIV	17	8.1941	0.956387	5.662573	9.22458
NSF	17	71.92376	4.359713	64.124	78.09
Botswana					
Variable	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
U5MR	17	71.11765	10.73168	56	86.9
PGH	17	0.200068	0.101765	0.072017	0.411205
PPH	17	0.080514	0.017933	0.064198	0.127496
PGDP	17	4.909402	1.009895	3.29512	6.330819
PPHIV	17	155.7013	15.57433	107.2124	168.1192
NSF	17	15.20882	3.269515	10.21	20.9
Burundi					
Variable	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
U5MR	17	137.6235	16.47087	107.8	157.4
PGH	17	0.004097	0.00127	0.002431	0.005977
PPH	17	0.008312	0.002007	0.005784	0.012881
PGDP	17	0.161017	0.005396	0.154054	0.175746
PPHIV	17	17.47173	5.604213	10.61203	26.05753
NSF	17	64.49741	4.98607	56.846	73.03
Cameroon					
Variable	**N**	**Mean**	**Std Dev**	**Minimum**	**Maximum**
U5MR	17	132.1353	20.06386	98.5	155.1
PGH	17	0.010345	0.002893	0.00666	0.016689
PPH	17	0.033409	0.003597	0.023292	0.038847
PGDP	17	0.91802	0.073984	0.786639	1.025764
PPHIV	17	27.77245	4.801674	15.0642	31.08224
NSF	17	29.66165	3.533808	24.668	36.32

Congo

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	111.9824	5.938564	98.9	118.3
PGH	17	0.025713	0.004696	0.019448	0.035513
PPH	17	0.018423	0.002577	0.014356	0.024332
PGDP	17	1.692777	0.125401	1.517573	1.961781
PPHIV	17	25.65984	4.634785	18.35861	31.3154
NSF	17	32.28976	4.469886	26.586	40.54

Cote_dIvoire

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	135.2	13.90948	110.7	152.2
PGH	17	0.011731	0.002427	0.007744	0.01524
PPH	17	0.037811	0.008471	0.022741	0.055137
PGDP	17	0.944404	0.060774	0.844092	1.053463
PPHIV	17	30.88077	5.4107	22.79889	37.9938
NSF	17	57.98447	5.238454	51.056	68.23

DR_Congo

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	167.6647	6.508066	150.4	171.2
PGH	17	0.001658	0.00174	0.000176	0.005283
PPH	17	0.005532	0.000869	0.00447	0.007267
PGDP	17	0.132893	0.014861	0.112078	0.161747
PPHIV	17	8.023085	0.49161	7.084079	8.62924
NSF	17	32.28976	4.469886	26.586	40.54

Egypt

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	38.72941	13.55626	22	64.2
PGH	17	0.025637	0.004574	0.016899	0.03119
PPH	17	0.03743	0.007136	0.019439	0.045026
PGDP	17	1.237365	0.196677	0.940379	1.551454
PPHIV	17	0.037707	0.018505	0.012084	0.071483
NSF	17	46.35471	5.956257	37.58	56.8

Gabon

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	80.00588	7.815647	64.7	88.8
PGH	17	0.083547	0.013549	0.067411	0.107167
PPH	17	0.111787	0.018725	0.088083	0.158446
PGDP	17	6.636706	0.459089	6.143078	7.554808
PPHIV	17	29.70592	6.035789	15.63467	35.70977
NSF	17	19.21447	2.680662	16.026	24.46

Gambia

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	104.8882	20.88884	75.6	141
PGH	17	0.00781	0.003222	0.003416	0.012416
PPH	17	0.008656	0.000677	0.007318	0.009867
PGDP	17	0.41225	0.019656	0.381154	0.45376
PPHIV	17	5.884687	2.398525	1.598319	8.556887
NSF	17	76.89471	3.939839	69.37	80.9

Ghana

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	94.32941	13.13534	74.2	113.3
PGH	17	0.014917	0.003884	0.01011	0.023095
PPH	17	0.011348	0.001703	0.00893	0.015708
PGDP	17	0.489462	0.078662	0.399723	0.675323
PPHIV	17	11.96379	1.375752	9.613144	13.75287
NSF	17	42.196	5.460523	32.482	50.33

Kenya

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	99.65294	12.93837	75.5	113.2
PGH	17	0.009821	0.000844	0.008147	0.011191
PPH	17	0.013458	0.001068	0.01174	0.015331
PGDP	17	0.529695	0.029612	0.496662	0.580104
PPHIV	17	46.07003	5.895509	38.45255	55.27767
NSF	17	30.79565	3.738011	24.246	36.32

Lesotho

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	111.8059	9.749774	91.6	122.9
PGH	17	0.032454	0.017436	0.018478	0.075861
PPH	17	0.020726	0.000961	0.019041	0.022354
PGDP	17	0.662357	0.083627	0.562529	0.835204
PPHIV	17	132.2488	27.39097	61.29735	159.5375
NSF	17	8.310824	1.84619	5.124	10.52

Liberia

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	14	129.9	40.87917	78.4	199.8
PGH	14	0.004529	0.002902	0.001794	0.011795
PPH	14	0.013644	0.007773	0.003863	0.027908
PGDP	14	0.192978	0.041275	0.122883	0.259252
PPHIV	14	9.443377	2.00133	5.570934	11.52297
NSF	14	67.22957	5.970044	56.356	74.242

Malawi

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	143.0647	46.3572	77.1	213.2
PGH	17	0.009184	0.004869	0.002785	0.016331
PPH	17	0.00608	0.001596	0.003721	0.009585
PGDP	17	0.22538	0.017926	0.20466	0.262848
PPHIV	17	86.84762	8.095728	71.51732	97.96277
NSF	17	37.87294	9.739234	23.21	52.72

Mali

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	190.7118	38.41451	132.7	239.9
PGH	17	0.011196	0.002433	0.007169	0.014468
PPH	17	0.014767	0.002009	0.008458	0.016661
PGDP	17	0.398891	0.038711	0.328846	0.451177
PPHIV	17	8.129597	1.115243	6.313316	9.738543
NSF	17	79.88235	5.068326	70.44	86.05

Mauritania

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	104.2588	9.998129	86.5	118.6
PGH	17	0.018298	0.004012	0.011242	0.023789
PPH	17	0.011556	0.001009	0.008923	0.01383
PGDP	17	0.596266	0.034852	0.562536	0.671766
PPHIV	17	3.088223	0.857885	1.265241	4.047866
NSF	17	52.65906	6.502684	41.034	60.99

Mauritius

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	17.68824	2.904282	14.9	22.6
PGH	17	0.103039	0.02737	0.071061	0.16917
PPH	17	0.121365	0.061118	0.058879	0.227687
PGDP	17	4.9282	0.848185	3.590304	6.470797
PPHIV	17	6.073256	1.673763	2.462409	7.742287
NSF	17	11.55918	2.360527	8.076	14.78

Mozambique

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	147.3176	35.73145	96.1	208.4
PGH	17	0.010107	0.002603	0.005113	0.013639
PPH	17	0.007106	0.003762	0.003314	0.016164
PGDP	17	0.290318	0.069263	0.188732	0.409376
PPHIV	17	46.85047	16.68592	15.06265	64.12787
NSF	17	82.72765	3.240727	76.08	86.4

Namibia

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	64.31176	10.88479	41.3	74
PGH	17	0.128398	0.014614	0.103551	0.15231
PPH	17	0.094805	0.035647	0.052176	0.149365
PGDP	17	3.341565	0.407271	2.908421	4.001558
PPHIV	17	81.19395	18.00146	37.54499	94.66413
NSF	17	21.84765	1.505039	19.98	23.6

Niger

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	195.7471	50.88966	119.5	278.9
PGH	17	0.005471	0.001706	0.003222	0.008499
PPH	17	0.005955	0.001025	0.00451	0.007725
PGDP	17	0.260846	0.013496	0.238075	0.283561
PPHIV	17	4.187454	0.791873	2.723734	5.125496
NSF	17	86.26659	2.387958	81.782	89.42

Rwanda

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	141.2294	63.07062	58.9	253.2
PGH	17	0.009908	0.006515	0.003171	0.023148
PPH	17	0.009664	0.005004	0.005001	0.017206
PGDP	17	0.269208	0.0583	0.195046	0.377747
PPHIV	17	27.07777	7.007642	19.19043	39.49585
NSF	17	55.55435	4.551057	47.924	62.96

Senegal

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	111.8588	31.35975	63	147
PGH	17	0.017899	0.007499	0.008663	0.028606
PPH	17	0.020697	0.002594	0.01749	0.027767
PGDP	17	0.758398	0.057132	0.672611	0.829242
PPHIV	17	2.819199	0.830815	1.194868	3.581166
NSF	17	45.43706	5.32031	36.49	53.38

Sierra_Leone

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	221.4941	19.29966	187.2	248.1
PGH	17	0.007643	0.001546	0.005493	0.010917
PPH	17	0.040369	0.005627	0.031862	0.051854
PGDP	17	0.312389	0.040027	0.246651	0.376696
PPHIV	17	7.043633	3.170087	1.616063	10.33476
NSF	17	74.65776	2.496436	70.552	78.61

South_Africa

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	69.09412	9.83104	47.2	80.3
PGH	17	0.175568	0.036213	0.126126	0.245198
PPH	17	0.24665	0.024113	0.193083	0.280737
PGDP	17	5.007319	0.575619	4.309225	5.938879
PPHIV	17	92.16784	29.70605	26.56851	118.9061
NSF	17	12.41682	3.236784	4.7	17.4

Swaziland

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	112.1824	14.75975	84.9	128.5
PGH	17	0.091402	0.031031	0.059455	0.136706
PPH	17	0.053509	0.006871	0.044678	0.067436
PGDP	17	2.284732	0.130599	2.099487	2.459701
PPHIV	17	137.1299	30.18423	67.45601	174.5156
NSF	17	12.752	3.040616	9.384	18.66

Tanzania

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	107.7941	35.39498	57.3	159.6
PGH	17	0.007923	0.0047	0.003399	0.015464
PPH	17	0.008322	0.004631	0.005572	0.020944
PGDP	17	0.344944	0.062011	0.272092	0.454195
PPHIV	17	40.15568	4.519128	32.45455	46.31249
NSF	17	33.27718	6.645561	21.732	43.04

Togo

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	115.7059	10.45093	98.3	132.5
PGH	17	0.008288	0.003388	0.003495	0.016516
PPH	17	0.015776	0.001318	0.012925	0.018204
PGDP	17	0.41883	0.036558	0.385597	0.52209
PPHIV	17	23.63704	3.924353	14.44135	28.36466
NSF	17	52.05082	4.631325	44.574	59.53

Uganda

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	122.8235	32.18234	74	165
PGH	17	0.006207	0.001713	0.003926	0.010251
PPH	17	0.018445	0.007577	0.008904	0.028736
PGDP	17	0.311094	0.057925	0.233449	0.412836
PPHIV	17	43.78226	7.408094	36.33505	62.40676
NSF	17	29.59659	6.751924	18.442	39.93

Zambia

Variable	N	Mean	Std Dev	Minimum	Maximum
U5MR	17	143.5235	32.64078	95	187.8
PGH	17	0.022539	0.003542	0.015787	0.028426
PPH	17	0.016172	0.00278	0.012229	0.021152
PGDP	17	0.62346	0.073089	0.551151	0.776877
PPHIV	17	86.22227	3.986944	78.59319	91.50223
NSF	17	22.05671	2.098639	18.3	24.93

Appendix C: Stationary tests

Note: the hypothesis test in both unit root tests is whether a series has unit root. Therefore the rejection of hypothesis (both p-values being less than 10%) is desirable.

Table C.1: ADF test for U5MR assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	14.3686	0.9999	-3.20	0.0034	Mali	16.2690	0.9999	-6.14	<.0001
Botswana	-20.0243	<.0001	-2.47	0.0171	Mauritania	-0.9375	0.4737	0.43	0.7923
Burundi	3.9173	0.9987	-2.08	0.0389	Mauritius	-10.5446	0.0119	-3.96	0.0006
Cameroon	10.6282	0.9999	-3.82	0.0008	Mozambique	-3.3972	0.1889	-1.09	0.2344
Congo	13.0022	0.9999	-2.24	0.0277	Namibia	8.4284	0.9999	-1.75	0.0747
Cote_dIvoire	4.8296	0.9996	-3.46	0.0019	Niger	-0.6502	0.5267	-0.38	0.5275
DR_Congo	4.4918	0.9994	-2.39	0.0205	Rwanda	0.0973	0.6872	0.08	0.6909
Egypt	-1.1497	0.4370	-2.99	0.0054	Senegal	13.1042	0.9999	-8.39	<.0001
Gabon	1.9593	0.9759	-0.84	0.3364	Sierra_Leone	0.5265	0.7919	-0.58	0.4485
Gambia	-1.2266	0.4243	-1.14	0.2193	South_Africa	31.7078	0.9999	-2.25	0.0271
Ghana	29.0333	0.9999	-1.69	0.0838	Swaziland	-17.5007	0.0004	-1.68	0.0860
Kenya	5.7014	0.9998	-3.66	0.0012	Tanzania	273.9221	0.9999	-5.85	<.0001
Lesotho	-30.7477	<.0001	-1.94	0.0514	Togo	-8.1117	0.0320	2.21	0.9893
Liberia	-3.6567	0.1677	-9.30	<.0001	Uganda	16.0666	0.9999	-8.50	<.0001
Malawi	-30.0688	<.0001	-3.79	0.0009	Zambia	21.0611	0.9999	-2.06	0.0408

Table C.2: Phillips-Perron test for U5MR assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-0.1426	0.6325	-0.13	0.6233	Mali	-0.2700	0.6039	-0.24	0.5829
Botswana	-1.6978	0.3555	-0.75	0.3745	Mauritania	-0.1251	0.6365	-0.11	0.6314
Burundi	0.3514	0.7517	0.26	0.7486	Mauritius	-1.8286	0.3382	-1.24	0.1863
Cameroon	0.4153	0.7673	0.32	0.7644	Mozambique	-1.1882	0.4312	-1.00	0.2675
Congo	1.3350	0.9347	0.65	0.8444	Namibia	1.5025	0.9505	0.88	0.8880
Cote_dIvoire	0.2420	0.7248	0.18	0.7254	Niger	-0.9403	0.4729	-0.79	0.3585
DR_Congo	3.1736	0.9965	1.42	0.9544	Rwanda	-2.0484	0.3111	-1.32	0.1623
Egypt	-1.7918	0.3430	-1.58	0.1043	Senegal	0.0724	0.6833	0.05	0.6842
Gabon	0.7685	0.8470	0.55	0.8238	Sierra_Leone	-0.0051	0.6646	-0.01	0.6629
Gambia	-1.2622	0.4194	-1.08	0.2397	South_Africa	-0.6815	0.5200	-0.27	0.5730
Ghana	-0.5042	0.5546	-0.43	0.5073	Swaziland	-2.6605	0.2474	-1.05	0.2516
Kenya	0.8787	0.8684	0.66	0.8475	Tanzania	-0.6896	0.5184	-0.61	0.4367
Lesotho	-3.6431	0.1735	-1.98	0.0479	Togo	-0.6654	0.5230	-0.53	0.4703
Liberia	-1.5334	0.3757	-1.24	0.1837	Uganda	-0.3021	0.5969	-0.27	0.5726
Malawi	-0.7823	0.5012	-0.69	0.4026	Zambia	-0.4280	0.5702	-0.37	0.5312

Table C.3: Appendix C: ADF test for PGH assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-1.1338	0.4397	-0.67	0.4099	Mali	-2.1214	0.3010	-0.88	0.3162
Botswana	-3.0798	0.2118	-1.42	0.1363	Mauritania	-17.9018	0.0003	-3.13	0.0040
Burundi	-1.6792	0.3562	-0.84	0.3365	Mauritius	-6.8410	0.0524	-1.26	0.1793
Cameroon	-5.5344	0.0862	-0.96	0.2834	Mozambique	-4.6985	0.1177	-2.07	0.0397
Congo	-17.8772	0.0003	-2.45	0.0179	Namibia	-10.5908	0.0117	-2.16	0.0333
Cote_dIvoire	-5.5194	0.0867	-1.35	0.1560	Niger	-4.5386	0.1248	-1.55	0.1090
DR_Congo	-1.4298	0.3923	-0.61	0.4336	Rwanda	0.8584	0.8633	0.37	0.7781
Egypt	-4.2108	0.1407	-1.89	0.0571	Senegal	-0.9504	0.4714	-0.44	0.5023
Gabon	-13.5748	0.0030	-1.90	0.0558	Sierra_Leone	-11.5723	0.0076	-2.10	0.0370
Gambia	-2.6263	0.2497	-1.04	0.2519	South_Africa	-1.0511	0.4538	-0.34	0.5438
Ghana	-4.7959	0.1135	-1.42	0.1372	Swaziland	-0.4210	0.5720	-0.24	0.5813
Kenya	-11.0327	0.0096	-2.25	0.0275	Tanzania	-1.9408	0.3223	-0.86	0.3270
Lesotho	1.9020	0.9735	0.37	0.7783	Togo	1.2445	0.9231	0.35	0.7712
Liberia	-0.3725	0.5789	-0.13	0.6174	Uganda	0.1829	0.7080	0.07	0.6884
Malawi	-1.6474	0.3606	-0.77	0.3641	Zambia	-10.7488	0.0109	-1.81	0.0663

Table C.4: Phillips-Perron test for PGH assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-2.6503	0.2484	-1.09	0.2354	Mali	-3.3132	0.1952	-1.30	0.1700
Botswana	-3.3283	0.1941	-1.56	0.1082	Mauritania	-9.8009	0.0170	-2.54	0.0145
Burundi	-2.8671	0.2294	-1.26	0.1811	Mauritius	-2.0101	0.3156	-0.77	0.3655
Cameroon	-1.2613	0.4196	-0.46	0.4985	Mozambique	-3.4299	0.1872	-1.61	0.0985
Congo	-8.1085	0.0332	-2.02	0.0435	Namibia	-7.4253	0.0432	-2.05	0.0415
Cote_dIvoire	-4.2079	0.1418	-1.30	0.1696	Niger	-3.7625	0.1662	-1.45	0.1303
DR_Congo	-1.4764	0.3868	-0.66	0.4149	Rwanda	0.7662	0.8465	0.46	0.8021
Egypt	-3.3500	0.1926	-1.78	0.0711	Senegal	-0.7505	0.5070	-0.51	0.4769
Gabon	-12.7050	0.0050	-2.85	0.0072	Sierra_Leone	-8.8334	0.0250	-2.20	0.0303
Gambia	-1.6220	0.3659	-0.81	0.3504	South_Africa	0.0072	0.6676	-0.00	0.6660
Ghana	-6.1092	0.0710	-1.90	0.0556	Swaziland	-0.4114	0.5736	-0.29	0.5633
Kenya	-16.6208	0.0007	-3.94	0.0006	Tanzania	-1.7256	0.3517	-0.85	0.3301
Lesotho	2.3332	0.9876	1.11	0.9224	Togo	1.7166	0.9655	0.70	0.8562
Liberia	-0.6583	0.5222	-0.18	0.6017	Uganda	-0.2347	0.6117	-0.09	0.6380
Malawi	-1.0804	0.4490	-0.58	0.4463	Zambia	-6.7883	0.0551	-1.79	0.0692

Table C.5: ADF test for PPH assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-7.3215	0.0435	-1.73	0.0782	Mali	-3.5249	0.1804	-1.20	0.1977
Botswana	0.1474	0.6994	0.03	0.6758	Mauritania	-20.6796	<.0001	-2.86	0.0072
Burundi	-3.2548	0.1989	-1.39	0.1456	Mauritius	-3.0363	0.2151	-0.67	0.4069
Cameroon	-0.2508	0.6076	-0.16	0.6121	Mozambique	1.4935	0.9484	0.89	0.8890
Congo	-22.9661	<.0001	-3.08	0.0045	Namibia	-2.1394	0.2990	-0.99	0.2685
Cote_dIvoire	-14.1906	0.0022	-2.56	0.0140	Niger	-6.1041	0.0695	-1.66	0.0884
DR_Congo	-2.5901	0.2530	-0.69	0.3982	Rwanda	-0.7880	0.5008	-0.37	0.5333
Egypt	-4.7764	0.1143	-1.71	0.0802	Senegal	-9.3388	0.0196	-2.23	0.0283
Gabon	-12.2071	0.0057	-2.31	0.0240	Sierra_Leone	0.1346	0.6963	0.06	0.6868
Gambia	-3.8884	0.1582	-1.37	0.1491	South_Africa	-3.9133	0.1568	-1.35	0.1536
Ghana	0.6901	0.8290	0.20	0.7310	Swaziland	-3.3579	0.1916	-1.03	0.2583
Kenya	0.0283	0.6708	0.01	0.6702	Tanzania	-2.2762	0.2841	-0.29	0.5626
Lesotho	-4.4935	0.1269	-1.23	0.1898	Togo	-8.3100	0.0295	-2.06	0.0409
Liberia	-0.2622	0.6020	-0.11	0.6237	Uganda	-2.7344	0.2400	-0.99	0.2719
Malawi	-6.4453	0.0610	-1.76	0.0731	Zambia	-4.8310	0.1120	-1.64	0.0927

Table C.6: Phillips-Perron test for PPH assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-4.4154	0.1316	-1.48	0.1231	Mali	-14.2596	0.0024	-4.60	0.0001
Botswana	0.8832	0.8692	0.28	0.7544	Mauritania	-11.1540	0.0097	-2.66	0.0110
Burundi	-2.8017	0.2349	-1.28	0.1745	Mauritius	0.2379	0.7238	0.16	0.7173
Cameroon	-11.0345	0.0102	-3.74	0.0009	Mozambique	1.9656	0.9773	1.00	0.9080
Congo	-13.6023	0.0033	-3.25	0.0029	Namibia	-1.6088	0.3678	-0.93	0.2979
Cote_dIvoire	-4.5860	0.1238	-1.51	0.1173	Niger	-5.6522	0.0841	-1.80	0.0682
DR_Congo	-3.6839	0.1709	-1.08	0.2392	Rwanda	-0.5785	0.5398	-0.33	0.5497
Egypt	-4.4817	0.1285	-2.87	0.0070	Senegal	-7.6976	0.0389	-2.29	0.0249
Gabon	-10.0748	0.0152	-2.65	0.0112	Sierra_Leone	-1.4323	0.3933	-0.51	0.4773
Gambia	-5.5252	0.0881	-1.77	0.0722	South_Africa	-6.1085	0.0710	-2.45	0.0175
Ghana	0.4357	0.7722	0.16	0.7184	Swaziland	-3.5161	0.1815	-1.38	0.1473
Kenya	-2.3943	0.2731	-1.03	0.2593	Tanzania	0.2395	0.7242	0.06	0.6872
Lesotho	-3.3918	0.1898	-1.28	0.1756	Togo	-10.2431	0.0142	-2.90	0.0064
Liberia	-0.6159	0.5303	-0.28	0.5619	Uganda	-0.5344	0.5485	-0.42	0.5132
Malawi	-4.2117	0.1416	-1.49	0.1207	Zambia	-4.5445	0.1257	-1.79	0.0689

Table C.7: ADF test for PGDP assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-4.3465	0.1339	-1.74	0.0761	Mali	-3.2530	0.1990	-1.58	0.1026
Botswana	-1.6685	0.3577	-0.85	0.3312	Mauritania	-6.4460	0.0610	-1.66	0.0882
Burundi	-4.5717	0.1233	-1.09	0.2365	Mauritius	-0.2563	0.6064	-0.08	0.6382
Cameroon	-1.2417	0.4219	-0.79	0.3550	Mozambique	-0.5833	0.5397	-0.13	0.6229
Congo	0.3191	0.7416	0.10	0.7001	Namibia	-0.3910	0.5781	-0.20	0.5975
Cote_dIvoire	-3.2912	0.1963	-0.85	0.3294	Niger	-19.1233	0.0001	-2.52	0.0152
DR_Congo	-10.2906	0.0132	-2.17	0.0323	Rwanda	1.0822	0.9012	0.38	0.7795
Egypt	-7.6814	0.0378	-1.48	0.1234	Senegal	-2.0515	0.3090	-1.13	0.2210
Gabon	-6.3569	0.0631	-1.94	0.0516	Sierra_Leone	-0.3460	0.5874	-0.17	0.6065
Gambia	-8.7931	0.0244	-2.19	0.0313	South_Africa	-0.2640	0.6048	-0.10	0.6326
Ghana	-15.2438	0.0013	1.09	0.9197	Swaziland	-4.0474	0.1494	-1.34	0.1571
Kenya	-1.1876	0.4307	-0.43	0.5093	Tanzania	6.1013	0.9999	-1.08	0.2388
Lesotho	0.7634	0.8445	0.24	0.7409	Togo	-3.8442	0.1608	-1.56	0.1062
Liberia	-9.5989	0.0147	-1.96	0.0500	Uganda	0.4883	0.7828	0.14	0.7107
Malawi	-5.0258	0.1042	-0.89	0.3154	Zambia	1.7737	0.9673	0.45	0.7976

Table C.8: Phillips-Perron test for PGDP assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-2.1832	0.2956	-1.66	0.0885	Mali	-3.4318	0.1871	-1.60	0.0988
Botswana	-1.3194	0.4105	-0.93	0.2971	Mauritania	-5.7723	0.0804	-1.79	0.0695
Burundi	-13.3516	0.0037	-3.77	0.0009	Mauritius	-0.4812	0.5593	-0.34	0.5451
Cameroon	-1.5704	0.3732	-1.13	0.2205	Mozambique	-0.3132	0.5945	-0.25	0.5798
Congo	0.3534	0.7522	0.15	0.7146	Namibia	-0.1347	0.6343	-0.10	0.6346
Cote_dIvoire	-1.3451	0.4065	-0.55	0.4624	Niger	-10.0342	0.0155	-2.32	0.0234
DR_Congo	-3.8801	0.1594	-1.81	0.0674	Rwanda	0.2040	0.7155	0.13	0.7104
Egypt	-0.6998	0.5165	-0.53	0.4698	Senegal	-1.1560	0.4365	-0.87	0.3244
Gabon	-4.1032	0.1472	-1.65	0.0906	Sierra_Leone	-1.1392	0.4392	-0.50	0.4815
Gambia	-5.6766	0.0833	-2.01	0.0447	South_Africa	-0.2099	0.6172	-0.16	0.6120
Ghana	1.6348	0.9604	0.90	0.8926	Swaziland	-1.1959	0.4300	-0.94	0.2914
Kenya	-0.3872	0.5787	-0.20	0.5960	Tanzania	0.3117	0.7420	0.24	0.7419
Lesotho	0.7619	0.8456	0.48	0.8068	Togo	-4.2604	0.1391	-1.71	0.0806
Liberia	-6.0042	0.0700	-1.95	0.0508	Uganda	-0.0294	0.6589	-0.03	0.6569
Malawi	-0.9830	0.4655	-0.38	0.5301	Zambia	1.1370	0.9104	0.70	0.8555

Table C.9: ADF test for PPHIV assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-7.2772	0.0443	-3.63	0.0013	Mali	-1.6030	0.3669	-0.54	0.4625
Botswana	-4.4518	0.1288	-1.81	0.0673	Mauritania	-5.2788	0.0948	-2.22	0.0293
Burundi	-3.6523	0.1723	-1.75	0.0748	Mauritius	-1.9230	0.3245	-1.34	0.1574
Cameroon	-2.9343	0.2232	-1.73	0.0773	Mozambique	-2.5235	0.2592	-1.35	0.1553
Congo	256.7470	0.9999	-2.48	0.0168	Namibia	-3.5991	0.1757	-1.42	0.1378
Cote_dIvoire	-12.3569	0.0054	-3.99	0.0006	Niger	-9.4785	0.0185	-2.39	0.0204
DR_Congo	-9.5525	0.0179	-1.15	0.2144	Rwanda	-2.5602	0.2558	-0.94	0.2914
Egypt	2.1503	0.9823	0.30	0.7571	Senegal	-4.5374	0.1249	-2.12	0.0358
Gabon	-6.8201	0.0528	-2.70	0.0103	Sierra_Leone	-7.0577	0.0482	-3.14	0.0039
Gambia	-3.2384	0.2000	-1.52	0.1160	South_Africa	-1.9931	0.3159	-1.01	0.2634
Ghana	-1.1703	0.4336	-0.37	0.5328	Swaziland	-1.6879	0.3550	-0.70	0.3951
Kenya	-2.4336	0.2680	-1.31	0.1644	Tanzania	-0.2730	0.6029	-0.16	0.6107
Lesotho	-1.5901	0.3687	-0.64	0.4222	Togo	-5.2268	0.0967	-1.80	0.0684
Liberia	15.4478	0.9999	-1.95	0.0507	Uganda	-3.5845	0.1766	-1.88	0.0579
Malawi	0.3085	0.7389	0.14	0.7113	Zambia	-1.4475	0.3896	-0.66	0.4116

Table C.10: Phillips-Perron test for PPHIV assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-5.7034	0.0825	-3.24	0.0029	Mali	-1.1301	0.4407	-0.52	0.4733
Botswana	-7.2039	0.0470	-5.05	<.0001	Mauritania	-3.3577	0.1921	-2.55	0.0142
Burundi	-0.8021	0.4975	-0.66	0.4157	Mauritius	-2.7774	0.2370	-2.48	0.0165
Cameroon	-4.7208	0.1180	-3.95	0.0006	Mozambique	-2.1595	0.2983	-1.92	0.0536
Congo	0.0734	0.6835	0.05	0.6845	Namibia	-3.8732	0.1598	-3.14	0.0038
Cote_dIvoire	-0.9824	0.4656	-0.49	0.4855	Niger	-3.3187	0.1948	-1.49	0.1227
DR_Congo	-1.0455	0.4548	-0.46	0.4987	Rwanda	-1.6774	0.3583	-1.49	0.1213
Egypt	0.0578	0.6797	0.03	0.6787	Senegal	-2.4563	0.2669	-2.24	0.0275
Gabon	-4.0997	0.1474	-2.79	0.0083	Sierra_Leone	-1.8092	0.3407	-1.66	0.0892
Gambia	-1.9873	0.3184	-1.78	0.0703	South_Africa	-2.9673	0.2212	-2.63	0.0119
Ghana	-2.5138	0.2612	-1.01	0.2659	Swaziland	-3.1662	0.2058	-2.42	0.0189
Kenya	-0.7609	0.5051	-0.41	0.5163	Tanzania	0.5501	0.7993	0.40	0.7852
Lesotho	-4.3348	0.1355	-3.34	0.0024	Togo	-4.5275	0.1265	-2.61	0.0125
Liberia	0.8768	0.8625	0.45	0.7964	Uganda	-4.6107	0.1227	-3.47	0.0018
Malawi	0.8127	0.8558	0.46	0.8026	Zambia	-1.7683	0.3460	-0.79	0.3587

Table C.11: ADF test for NSF assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	0.1539	0.7010	-0.04	0.6531	Mali	2.4796	0.9895	-0.82	0.3443
Botswana	2.0413	0.9789	0.51	0.8130	Mauritania	2.6673	0.9921	-0.89	0.3146
Burundi	2.1240	0.9815	0.54	0.8213	Mauritius	-10.5899	0.0117	-1.09	0.2358
Cameroon	0.3596	0.7515	0.12	0.7046	Mozambique	2.5778	0.9910	-0.44	0.5045
Congo	-1.4819	0.3845	-0.70	0.3945	Namibia	-5.6629	0.0821	-1.41	0.1386
Cote_dIvoire	-0.4506	0.5660	-0.17	0.6071	Niger	0.9555	0.8808	-0.22	0.5876
DR_Congo	-1.4819	0.3845	-0.70	0.3945	Rwanda	12.4237	0.9999	0.60	0.8346
Egypt	0.7748	0.8468	0.28	0.7517	Senegal	0.2151	0.7159	-0.07	0.6407
Gabon	-1.5510	0.3743	-0.75	0.3758	Sierra_Leone	-13.0328	0.0039	0.64	0.8425
Gambia	4.2642	0.9991	-1.15	0.2127	South_Africa	-9.4374	0.0188	-2.82	0.0080
Ghana	-2.9104	0.2252	0.32	0.7652	Swaziland	-2.2209	0.2900	-1.12	0.2261
Kenya	-1.2697	0.4173	0.24	0.7405	Tanzania	-0.4905	0.5579	0.12	0.7055
Lesotho	6.8336	0.9999	-1.09	0.2352	Togo	14.9422	0.9999	0.72	0.8580
Liberia	3.5086	0.9968	-1.02	0.2557	Uganda	-0.5618	0.5439	0.17	0.7219
Malawi	-12.9052	0.0042	-0.93	0.2956	Zambia	-10.3005	0.0132	-1.88	0.0578

Table C.12: Phillips-Perron test for NSF assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-0.0659	0.6503	-0.06	0.6472	Mali	0.4334	0.7716	0.32	0.7647
Botswana	-1.1622	0.4355	-0.94	0.2942	Mauritania	0.1899	0.7120	0.14	0.7119
Burundi	-1.0794	0.4491	-0.88	0.3204	Mauritius	-0.4789	0.5597	-0.41	0.5163
Cameroon	-1.6632	0.3602	-1.35	0.1555	Mozambique	0.9119	0.8745	0.61	0.8369
Congo	-1.6757	0.3585	-1.46	0.1289	Namibia	-0.5993	0.5358	-0.46	0.4982
Cote_dIvoire	-1.9410	0.3240	-1.60	0.0990	Niger	0.2642	0.7303	0.18	0.7260
DR_Congo	-1.6757	0.3585	-1.46	0.1289	Rwanda	-0.7144	0.5138	-0.55	0.4590
Egypt	-1.2504	0.4213	-1.03	0.2573	Senegal	-0.3865	0.5788	-0.31	0.5543
Gabon	-2.0423	0.3118	-1.78	0.0708	Sierra_Leone	-0.6394	0.5280	-0.51	0.4757
Gambia	0.8135	0.8560	0.60	0.8347	South_Africa	-5.4365	0.0910	-2.62	0.0122
Ghana	-0.2512	0.6080	-0.20	0.5983	Swaziland	-2.0735	0.3081	-1.85	0.0616
Kenya	-0.2580	0.6065	-0.21	0.5950	Tanzania	-0.2581	0.6065	-0.21	0.5942
Lesotho	0.2057	0.7159	0.15	0.7170	Togo	-0.7515	0.5068	-0.61	0.4373
Liberia	0.2558	0.7230	0.16	0.7143	Uganda	-0.5086	0.5537	-0.41	0.5157
Malawi	-0.6983	0.5168	-0.60	0.4406	Zambia	-3.4607	0.1851	-1.47	0.1267

Table C.13: ADF test for GU5MR assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-17.6585	0.0003	-2.75	0.0095	Mali	-15.0259	0.0012	-2.54	0.0150
Botswana	-21.0432	<.0001	-3.47	0.0020	Mauritania	-14.0895	0.0020	-2.46	0.0179
Burundi	-15.5973	0.0009	-2.58	0.0136	Mauritius	-20.8619	<.0001	-2.99	0.0056
Cameroon	-16.8174	0.0004	-2.68	0.0111	Mozambique	-14.2844	0.0018	-2.48	0.0171
Congo	-13.4610	0.0028	-2.53	0.0151	Namibia	-18.5249	0.0001	-2.80	0.0085
Cote_dIvoire	-14.6413	0.0015	-2.50	0.0162	Niger	-13.9975	0.0021	-2.45	0.0181
DR_Congo	-14.7717	0.0014	-2.51	0.0158	Rwanda	-17.8859	0.0002	-2.79	0.0088
Egypt	-13.8514	0.0023	-2.44	0.0186	Senegal	-16.9971	0.0004	-2.70	0.0107
Gabon	-15.7992	0.0008	-2.59	0.0134	Sierra_Leone	-14.5878	0.0016	-2.49	0.0166
Gambia	-15.6884	0.0008	-2.60	0.0132	South_Africa	-13.9520	0.0022	-2.44	0.0183
Ghana	-14.0158	0.0021	-2.45	0.0180	Swaziland	-18.0516	0.0002	-2.65	0.0117
Kenya	-16.1040	0.0007	-2.62	0.0125	Tanzania	-15.9558	0.0007	-2.61	0.0127
Lesotho	-14.2239	0.0019	-1.80	0.0680	Togo	-14.0017	0.0021	-2.45	0.0181
Liberia	-11.3142	0.0056	-2.15	0.0344	Uganda	-14.6292	0.0015	-2.50	0.0162
Malawi	-16.1769	0.0006	-2.63	0.0122	Zambia	-14.1115	0.0020	-2.46	0.0177

Table C.14: Phillips-Perron test for GU5MR assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-16.1152	0.0008	-4.04	0.0005	Mali	-15.3934	0.0012	-3.84	0.0008
Botswana	-15.3964	0.0012	-4.06	0.0005	Mauritania	-15.0008	0.0015	-3.74	0.0010
Burundi	-15.4976	0.0011	-3.87	0.0008	Mauritius	-16.6358	0.0006	-4.22	0.0003
Cameroon	-16.1375	0.0008	-4.05	0.0005	Mozambique	-15.1470	0.0014	-3.78	0.0009
Congo	-15.8421	0.0009	-3.89	0.0007	Namibia	-15.5673	0.0011	-3.89	0.0007
Cote_dIvoire	-15.4356	0.0012	-3.85	0.0008	Niger	-14.9932	0.0015	-3.74	0.0010
DR_Congo	-15.2002	0.0013	-3.79	0.0009	Rwanda	-16.2663	0.0007	-4.09	0.0005
Egypt	-14.9170	0.0015	-3.72	0.0011	Senegal	-15.9681	0.0009	-4.00	0.0006
Gabon	-14.7985	0.0016	-3.69	0.0011	Sierra_Leone	-15.1490	0.0014	-3.78	0.0009
Gambia	-15.7506	0.0010	-3.94	0.0006	South_Africa	-14.8381	0.0016	-3.70	0.0011
Ghana	-15.0055	0.0015	-3.74	0.0010	Swaziland	-17.3739	0.0004	-4.41	0.0002
Kenya	-15.7280	0.0010	-3.93	0.0007	Tanzania	-15.6461	0.0010	-3.91	0.0007
Lesotho	-17.3183	0.0004	-4.15	0.0004	Togo	-15.0061	0.0015	-3.74	0.0010
Liberia	-12.1029	0.0042	-3.35	0.0029	Uganda	-15.2067	0.0013	-3.79	0.0009
Malawi	-15.7231	0.0010	-3.93	0.0007	Zambia	-15.0295	0.0014	-3.75	0.0010

Table C.15: ADF test for GPGH assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-14.8794	0.0013	-2.51	0.0160	Mali	-5.1380	0.0986	-1.54	0.1114
Botswana	-15.7101	0.0008	-2.59	0.0133	Mauritania	-16.3191	0.0006	-2.66	0.0114
Burundi	-63.1941	<.0001	-5.45	<.0001	Mauritius	-15.5912	0.0009	-2.58	0.0137
Cameroon	-17.1583	0.0003	-2.71	0.0104	Mozambique	-18.8867	0.0001	-2.68	0.0109
Congo	-10.8073	0.0099	-2.01	0.0450	Namibia	-15.9790	0.0007	-3.26	0.0031
Cote_dIvoire	-15.0543	0.0012	-2.57	0.0140	Niger	-23.7786	<.0001	-2.73	0.0099
DR_Congo	-30.7864	<.0001	-3.59	0.0015	Rwanda	-16.1394	0.0006	-2.63	0.0123
Egypt	-11.3942	0.0076	-2.21	0.0299	Senegal	-11.6297	0.0068	-2.23	0.0286
Gabon	-8.7240	0.0241	-2.11	0.0367	Sierra_Leone	-6.0867	0.0688	-0.50	0.4797
Gambia	-15.7286	0.0008	-2.60	0.0133	South_Africa	-20.2700	<.0001	-2.95	0.0062
Ghana	-17.5358	0.0003	-2.72	0.0101	Swaziland	-10.9475	0.0093	-2.17	0.0327
Kenya	-11.3856	0.0076	-2.32	0.0239	Tanzania	-14.4001	0.0017	-2.48	0.0168
Lesotho	-26.6744	<.0001	-3.32	0.0027	Togo	-18.9924	0.0001	-2.84	0.0078
Liberia	-202.556	0.0001	-3.56	0.0020	Uganda	-12.6231	0.0043	-2.32	0.0240
Malawi	-17.7180	0.0002	-2.76	0.0094	Zambia	-14.7170	0.0014	-2.51	0.0158

Table C.16: Phillips-Perron test for GPGH assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-13.6228	0.0029	-3.36	0.0024	Mali	-9.7561	0.0165	-2.63	0.0121
Botswana	-15.2005	0.0013	-3.79	0.0009	Mauritania	-13.6985	0.0028	-3.46	0.0019
Burundi	-16.3707	0.0007	-4.24	0.0003	Mauritius	-17.1359	0.0004	-4.31	0.0003
Cameroon	-18.3432	0.0002	-4.69	0.0001	Mozambique	-15.4845	0.0011	-3.87	0.0008
Congo	-14.3121	0.0021	-3.26	0.0029	Namibia	-15.7686	0.0010	-7.15	<.0001
Cote_dIvoire	-16.2307	0.0007	-4.25	0.0003	Niger	-18.2822	0.0002	-3.81	0.0009
DR_Congo	-15.7227	0.0010	-3.91	0.0007	Rwanda	-17.0444	0.0005	-4.29	0.0003
Egypt	-14.5164	0.0019	-3.63	0.0013	Senegal	-14.8217	0.0016	-3.70	0.0011
Gabon	-13.4293	0.0032	-3.54	0.0016	Sierra_Leone	-15.0312	0.0014	-3.75	0.0010
Gambia	-18.9808	0.0001	-4.87	<.0001	South_Africa	-15.5560	0.0011	-3.90	0.0007
Ghana	-17.6100	0.0003	-4.47	0.0002	Swaziland	-14.0307	0.0024	-3.52	0.0017
Kenya	-13.2623	0.0035	-3.78	0.0009	Tanzania	-13.9616	0.0025	-3.49	0.0018
Lesotho	-15.1364	0.0014	-3.76	0.0010	Togo	-10.2072	0.0137	-2.58	0.0135
Liberia	-16.9909	0.0002	-3.56	0.0019	Uganda	-13.8807	0.0026	-3.46	0.0019
Malawi	-16.8357	0.0005	-4.25	0.0003	Zambia	-15.1423	0.0014	-3.78	0.0009

Table C.17: ADF test for GPPH assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-16.0398	0.0007	-2.62	0.0125	Mali	-16.3340	0.0006	-2.66	0.0114
Botswana	-16.2278	0.0006	-2.46	0.0179	Mauritania	-14.8046	0.0014	-3.05	0.0049
Burundi	-15.7702	0.0008	-2.60	0.0131	Mauritius	-13.9917	0.0021	-2.45	0.0181
Cameroon	-12.4520	0.0046	-4.73	0.0001	Mozambique	-15.1505	0.0011	-2.55	0.0147
Congo	-26.6898	<.0001	-3.36	0.0025	Namibia	-22.9697	<.0001	-3.14	0.0041
Cote_dIvoire	-16.7843	0.0004	-3.27	0.0031	Niger	-11.3289	0.0078	-1.65	0.0902
DR_Congo	-17.0656	0.0004	-2.71	0.0104	Rwanda	-14.1391	0.0020	-2.46	0.0176
Egypt	-12.1150	0.0054	-2.28	0.0257	Senegal	0.8397	0.8575	0.35	0.7706
Gabon	-15.9728	0.0007	-2.59	0.0135	Sierra_Leone	-13.7344	0.0024	-2.43	0.0190
Gambia	-13.2211	0.0032	-2.38	0.0211	South_Africa	-16.1349	0.0006	-2.63	0.0123
Ghana	-32.4458	<.0001	-3.59	0.0015	Swaziland	-15.3686	0.0010	-2.57	0.0141
Kenya	-11.6535	0.0068	-2.24	0.0283	Tanzania	14.0910	0.9999	-0.44	0.5009
Lesotho	-13.6169	0.0026	-2.41	0.0195	Togo	-15.0262	0.0012	-0.98	0.2751
Liberia	-13.7005	0.0013	-2.37	0.0224	Uganda	-14.0535	0.0021	-2.45	0.0179
Malawi	-17.8222	0.0002	-2.77	0.0092	Zambia	-14.3199	0.0018	-2.48	0.0171

Table C.18: Phillips-Perron test for GPPH assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-15.9318	0.0009	-3.99	0.0006	Mali	-15.3335	0.0012	-3.89	0.0007
Botswana	-14.7738	0.0016	-3.68	0.0011	Mauritania	-16.1529	0.0008	-4.52	0.0002
Burundi	-14.9590	0.0015	-3.74	0.0010	Mauritius	-15.0004	0.0015	-3.74	0.0010
Cameroon	-9.5005	0.0183	-2.77	0.0088	Mozambique	-15.4533	0.0011	-3.85	0.0008
Congo	-15.5946	0.0011	-3.89	0.0007	Namibia	-16.0318	0.0008	-4.04	0.0005
Cote_dIvoire	-16.2228	0.0008	-7.70	<.0001	Niger	-12.6745	0.0046	-2.59	0.0130
DR_Congo	-15.6188	0.0010	-3.92	0.0007	Rwanda	-14.6290	0.0018	-3.65	0.0012
Egypt	-15.2254	0.0013	-3.80	0.0009	Senegal	-13.0055	0.0040	-3.34	0.0025
Gabon	-15.6930	0.0010	-3.92	0.0007	Sierra_Leone	-15.4221	0.0012	-3.85	0.0008
Gambia	-13.7188	0.0028	-3.53	0.0016	South_Africa	-15.9179	0.0009	-3.98	0.0006
Ghana	-12.1087	0.0060	-2.89	0.0067	Swaziland	-11.1120	0.0093	-2.81	0.0080
Kenya	-13.5126	0.0031	-3.41	0.0021	Tanzania	-15.0011	0.0015	-3.74	0.0010
Lesotho	-14.5806	0.0018	-3.64	0.0013	Togo	-16.2471	0.0007	-4.06	0.0005
Liberia	-10.9203	0.0078	-3.01	0.0059	Uganda	-15.0327	0.0014	-3.75	0.0010
Malawi	-16.5177	0.0006	-4.18	0.0004	Zambia	-14.9872	0.0015	-3.74	0.0010

Table C.19: ADF test for GPGDP assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-18.6580	0.0001	-2.84	0.0078	Mali	-16.4451	0.0005	-2.66	0.0117
Botswana	-14.5652	0.0016	-2.45	0.0181	Mauritania	-13.6181	0.0026	-2.89	0.0070
Burundi	-13.4594	0.0028	-2.39	0.0203	Mauritius	-13.8877	0.0023	-2.44	0.0185
Cameroon	-12.0867	0.0055	-2.28	0.0260	Mozambique	-15.1850	0.0011	-2.54	0.0149
Congo	-6.5041	0.0585	-1.68	0.0848	Namibia	-25.2070	<.0001	-3.23	0.0033
Cote_dIvoire	-17.7203	0.0002	-3.10	0.0044	Niger	-46.6955	<.0001	-4.44	0.0002
DR_Congo	-14.5157	0.0016	-2.49	0.0165	Rwanda	-18.4254	0.0002	-2.81	0.0083
Egypt	-18.8766	0.0001	-2.85	0.0077	Senegal	-18.5174	0.0001	-2.82	0.0082
Gabon	-28.4366	<.0001	-3.17	0.0038	Sierra_Leone	-17.3471	0.0003	-2.73	0.0099
Gambia	-19.8918	<.0001	-2.92	0.0066	South_Africa	-17.4319	0.0003	-2.73	0.0099
Ghana	-21.9912	<.0001	-3.00	0.0055	Swaziland	-17.1636	0.0003	-2.72	0.0102
Kenya	-14.5704	0.0016	-2.53	0.0152	Tanzania	-14.5741	0.0016	-2.49	0.0164
Lesotho	-13.9707	0.0022	-2.45	0.0182	Togo	-15.8034	0.0008	-2.60	0.0132
Liberia	-15.5611	0.0004	-2.53	0.0163	Uganda	-21.6828	<.0001	-3.05	0.0050
Malawi	-16.6819	0.0005	-2.68	0.0110	Zambia	-14.5886	0.0016	-2.50	0.0163

Table C.20: Phillips-Perron test for GPGDP assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-16.0004	0.0008	-4.02	0.0005	Mali	-15.9798	0.0009	-4.00	0.0006
Botswana	-17.1780	0.0004	-4.30	0.0003	Mauritania	-12.5012	0.0050	-3.29	0.0028
Burundi	-14.4759	0.0019	-3.61	0.0013	Mauritius	-15.3331	0.0012	-3.83	0.0008
Cameroon	-15.1452	0.0014	-3.78	0.0009	Mozambique	-17.0535	0.0005	-4.28	0.0003
Congo	-17.0191	0.0005	-4.17	0.0004	Namibia	-12.6713	0.0046	-3.10	0.0042
Cote_dIvoire	-15.5941	0.0011	-4.99	<.0001	Niger	-15.9513	0.0009	-4.07	0.0005
DR_Congo	-14.5783	0.0018	-3.64	0.0013	Rwanda	-16.0755	0.0008	-4.05	0.0005
Egypt	-16.9255	0.0005	-4.29	0.0003	Senegal	-15.6345	0.0010	-3.91	0.0007
Gabon	-12.7283	0.0045	-2.93	0.0063	Sierra_Leone	-15.1862	0.0013	-3.79	0.0009
Gambia	-17.2265	0.0004	-4.38	0.0002	South_Africa	-15.8563	0.0009	-3.97	0.0006
Ghana	-10.3876	0.0127	-2.57	0.0137	Swaziland	-14.5939	0.0018	-3.64	0.0013
Kenya	-17.1055	0.0005	-4.28	0.0003	Tanzania	-15.5753	0.0011	-3.89	0.0007
Lesotho	-14.9929	0.0015	-3.74	0.0010	Togo	-15.5136	0.0011	-3.85	0.0008
Liberia	-15.0971	0.0007	-4.36	0.0004	Uganda	-18.3279	0.0002	-4.77	0.0001
Malawi	-18.7167	0.0002	-4.82	<.0001	Zambia	-15.1807	0.0013	-3.79	0.0009

Table C.21: ADF test for GPPHIV assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-13.1152	0.0033	-2.37	0.0214	Mali	-14.1410	0.0020	-10.92	<.0001
Botswana	-11.3267	0.0079	-2.24	0.0280	Mauritania	-13.3161	0.0030	-2.33	0.0232
Burundi	-18.0589	0.0002	-2.78	0.0088	Mauritius	-13.3429	0.0030	-2.39	0.0204
Cameroon	-16.0650	0.0007	-2.64	0.0119	Mozambique	-14.2080	0.0019	-2.47	0.0173
Congo	-16.9499	0.0004	-2.69	0.0108	Namibia	-14.4462	0.0017	-2.52	0.0156
Cote_dIvoire	-13.5302	0.0027	-4.91	<.0001	Niger	-13.9491	0.0022	-2.45	0.0182
DR_Congo	-14.2854	0.0018	-2.50	0.0162	Rwanda	-15.2602	0.0011	-2.56	0.0143
Egypt	-14.8895	0.0013	-2.52	0.0155	Senegal	-14.4228	0.0017	-2.49	0.0167
Gabon	-25.6152	<.0001	-2.49	0.0165	Sierra_Leone	-14.5185	0.0016	-2.49	0.0164
Gambia	-20.8982	<.0001	-3.00	0.0056	South_Africa	-17.2839	0.0003	-2.74	0.0098
Ghana	-25.8384	<.0001	-3.96	0.0007	Swaziland	-15.7228	0.0008	-2.60	0.0132
Kenya	-13.3890	0.0029	-2.92	0.0065	Tanzania	-15.2254	0.0011	-2.56	0.0143
Lesotho	-14.4379	0.0017	-2.49	0.0167	Togo	-13.9654	0.0022	-2.40	0.0200
Liberia	-13.1607	0.0019	-2.45	0.0192	Uganda	-12.8458	0.0038	-2.12	0.0361
Malawi	-17.4407	0.0003	-2.92	0.0066	Zambia	-17.6339	0.0003	-2.92	0.0066

Table C.22: Phillips-Perron test for GPPHIV assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-14.6093	0.0018	-3.65	0.0012	Mali	-14.9564	0.0015	-3.75	0.0010
Botswana	-14.1199	0.0023	-3.57	0.0015	Mauritania	-14.0139	0.0024	-3.47	0.0019
Burundi	-12.6892	0.0046	-3.16	0.0037	Mauritius	-14.6747	0.0017	-3.66	0.0012
Cameroon	-15.0905	0.0014	-3.79	0.0009	Mozambique	-18.1091	0.0002	-4.58	0.0002
Congo	-15.7589	0.0010	-3.94	0.0006	Namibia	-14.2452	0.0022	-3.57	0.0015
Cote_dIvoire	-16.1144	0.0008	-3.90	0.0007	Niger	-14.9364	0.0015	-3.73	0.0010
DR_Congo	-15.5859	0.0011	-3.91	0.0007	Rwanda	-17.3585	0.0004	-4.38	0.0002
Egypt	-15.8650	0.0009	-3.96	0.0006	Senegal	-15.1671	0.0013	-3.79	0.0009
Gabon	-21.1934	<.0001	-3.39	0.0022	Sierra_Leone	-15.1230	0.0014	-3.77	0.0009
Gambia	-14.9379	0.0015	-3.73	0.0010	South_Africa	-17.2142	0.0004	-4.37	0.0002
Ghana	-15.0435	0.0014	-4.02	0.0005	Swaziland	-15.4044	0.0012	-3.85	0.0008
Kenya	-13.9890	0.0025	-5.68	<.0001	Tanzania	-16.0200	0.0008	-4.06	0.0005
Lesotho	-15.1494	0.0014	-3.78	0.0009	Togo	-14.9752	0.0015	-3.74	0.0010
Liberia	-12.4053	0.0036	-3.67	0.0015	Uganda	-14.7940	0.0016	-3.52	0.0017
Malawi	-15.4968	0.0011	-4.33	0.0003	Zambia	-17.8755	0.0003	-5.85	<.0001

Table C.23: ADF test for GNSF assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-13.1859	0.0032	-2.37	0.0212	Mali	-15.0806	0.0012	-2.54	0.0149
Botswana	-13.9963	0.0021	-2.45	0.0181	Mauritania	-13.9259	0.0022	-2.44	0.0185
Burundi	-14.1788	0.0019	-2.47	0.0175	Mauritius	-14.1652	0.0020	-2.46	0.0176
Cameroon	-14.0395	0.0021	-2.45	0.0179	Mozambique	-15.7839	0.0008	-2.59	0.0133
Congo	-14.3332	0.0018	-2.48	0.0170	Namibia	-15.6006	0.0009	-2.59	0.0135
Cote_dIvoire	-14.0220	0.0021	-2.45	0.0180	Niger	-18.3282	0.0002	-2.80	0.0085
DR_Congo	-14.3332	0.0018	-2.48	0.0170	Rwanda	-15.2226	0.0011	-2.55	0.0145
Egypt	-15.1516	0.0011	-2.55	0.0146	Senegal	-15.1847	0.0011	-2.55	0.0147
Gabon	-14.5556	0.0016	-2.50	0.0162	Sierra_Leone	-14.6067	0.0015	-2.50	0.0162
Gambia	-17.6484	0.0003	-2.74	0.0097	South_Africa	-13.4464	0.0028	-2.40	0.0201
Ghana	-13.0182	0.0035	-2.36	0.0219	Swaziland	-14.9378	0.0013	-2.53	0.0151
Kenya	-14.0859	0.0020	-2.45	0.0180	Tanzania	-14.6323	0.0015	-2.50	0.0163
Lesotho	-16.1190	0.0007	-2.62	0.0126	Togo	-14.1305	0.0020	-2.46	0.0177
Liberia	-12.8333	0.0023	-2.27	0.0271	Uganda	-14.7518	0.0014	-2.51	0.0158
Malawi	-14.6486	0.0015	-2.51	0.0161	Zambia	-16.0584	0.0007	-2.63	0.0124

Table C.24: Phillips-Perron test for GNSF assuming zero intercept and no time trend

Country	Rho	Pr < Rho	Tau	Pr < Tau	Country	Rho	Pr < Rho	Tau	Pr < Tau
Benin	-13.6252	0.0029	-3.41	0.0021	Mali	-15.6794	0.0010	-3.92	0.0007
Botswana	-15.0652	0.0014	-3.76	0.0010	Mauritania	-14.4613	0.0019	-3.61	0.0014
Burundi	-15.0956	0.0014	-3.77	0.0009	Mauritius	-15.0064	0.0015	-3.74	0.0010
Cameroon	-15.0147	0.0015	-3.75	0.0010	Mozambique	-15.9541	0.0009	-3.99	0.0006
Congo	-15.0932	0.0014	-3.77	0.0010	Namibia	-15.1624	0.0013	-3.78	0.0009
Cote_dIvoire	-15.0116	0.0015	-3.75	0.0010	Niger	-17.1172	0.0004	-4.34	0.0003
DR_Congo	-15.0932	0.0014	-3.77	0.0010	Rwanda	-14.6800	0.0017	-3.66	0.0012
Egypt	-15.3056	0.0012	-3.83	0.0008	Senegal	-14.9867	0.0015	-3.74	0.0010
Gabon	-15.1727	0.0013	-3.79	0.0009	Sierra_Leone	-14.9865	0.0015	-3.74	0.0010
Gambia	-16.5840	0.0006	-4.17	0.0004	South_Africa	-15.0342	0.0014	-3.75	0.0010
Ghana	-13.0719	0.0038	-3.28	0.0028	Swaziland	-15.2710	0.0013	-3.82	0.0009
Kenya	-13.7414	0.0028	-3.43	0.0020	Tanzania	-14.1762	0.0022	-3.54	0.0016
Lesotho	-15.7269	0.0010	-3.93	0.0007	Togo	-15.0014	0.0015	-3.74	0.0010
Liberia	-13.0271	0.0025	-3.61	0.0017	Uganda	-15.0459	0.0014	-3.75	0.0010
Malawi	-15.0888	0.0014	-3.76	0.0010	Zambia	-15.2834	0.0013	-3.82	0.0008