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Fiscal Effects of Aid in Ethiopia:

Evidence from CVAR applications

by

Giulia Mascagni and Emilija Timmis

Abstract

This paper explores the fiscal effects of aid in Ethiopia, using national data from 1960 to 2009, which is a longer series than most studies in this literature. This data includes the measure of aid that is flowing through the budget as measured by the recipient. We use the Cointegrated VAR methodology to model complex long run and short run dynamics amongst the following variables: aid grants, aid loans, tax revenue, non-tax revenue, and public expenditure. We also estimate an alternative model, where expenditure is disaggregated into capital and recurrent components (with aggregated domestic revenues to preserve degrees of freedom) in order to explore aid-spending relationships. The CVAR analysis is complemented by an in-depth qualitative understanding of the Ethiopian context, which ensures sound model specification and sensible interpretation of estimated results. Taking into account the major political regime changes, the data suggests three main conclusions regarding long run equilibrium relationships: government long-term spending plans are based on domestic sources, treating aid as an additional source of revenue; aid is positively associated with, and adjusts to, spending, with a particularly strong relation between capital expenditure and grants; and both grants and loans are positively related to tax revenue, both in the long and in the short-run.

Keywords: CVAR, Ethiopia, fiscal effects, aid, revenue.

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1. Introduction

This paper explores fiscal dynamics in Ethiopia and specifically the fiscal effects of aid, an understanding of which can be seen as a prerequisite to the analysis of the macroeconomic effectiveness of aid (see McGillivray and Morrissey, 2000). We estimate a Cointegrated Vector Auto-Regressive (CVAR) model including the following variables: government expenditure, disaggregated into recurrent and capital spending components, tax revenue, non-tax revenue, and aid, disaggregated into grants and loans. The CVAR model is highly demanding of the data. Therefore, we estimate two models with a maximum of five variables at a time. Since our key interest is in whether aid has any adverse effects on tax revenue, the primary focus is on a model with disaggregated aid and revenue variables, and aggregated government spending. The alternative system then looks in more detail at the relationship between aid and public expenditure by disaggregating the latter into the capital and recurrent components, but aggregating government revenue. This alternative system thus aims at shedding light on what is aid actually funding.

The key advantage of this study over similar CVAR applications for Africa lies in our unique data. We use annual observations from 1960 to 2009 compiled by the Ethiopian Ministry of Finance and Economic Development (MOFED). Not only is the series longer than those used in existing studies in the literature[1], but it is also obtained from a single national source. By using national data we are able to capture the recipient's measure of aid: the amount that is effectively disbursed through the budget and that the government is fully aware of. For these reasons, it is the component and the measure of aid that is most relevant for the analysis of its fiscal effects.

Our findings are three-fold. First, our results provide evidence for the existence of a *domestic* budget equilibrium that does not include aid: government spending decisions are driven by domestic revenue in the long run, and this is consistently true across the three political regimes covered in our sample. Second, aid is

1 This is true for studies using annual observations, while studies using quarterly data naturally have a larger sample (for example Martins, 2010).

positively associated with tax revenue[2], thus failing to provide evidence for a disincentive or substitution effect. Interestingly, both grants and loans are positively associated with tax, despite the conventional expectation that grants should crowd out tax while loans should stimulate revenue mobilisation due to the need for future repayment (Gupta et al., 2004, Benedek et al., 2012). Third, both grants and loans are positively associated with public expenditure. The system with disaggregated spending components shows that this effect is mainly driven by the strong positive association between aid grants and capital expenditure. We are also able to identify a donor disbursement behaviour whereby donors back proven commitment to increased expenditure with additional funding, particularly grants. These results are robust to alternative aggregation/disaggregation strategies and the inclusion/exclusion of dummies, which is especially valuable in the CVAR context where results are often model-specific.

The paper is structured as follows: section 2 introduces the fiscal effects of aid and reviews the relevant literature to date. Section 3 provides a review of the literature on fiscal response using CVAR. Section 4 introduces the Ethiopian data and some relevant aspects of Ethiopian fiscal history to provide some qualitative context. Section 5 describes the CVAR methodology, and summarises the misspecification tests and the determination of the cointegration rank. In section 6, the long run structure is identified. Section 7 discusses the long run and short run results, and the common driving trends in the model. The results for the alternative system specification, where total expenditure is disaggregated into recurrent and capital, are provided in section 8. Section 9 concludes.

2. Fiscal effects of aid: framework and hypotheses

The last few decades of research on the fiscal effects of aid often relied on the seminal work of Heller (1975), which defined the framework of fiscal response models. The framework is based on the maximisation of the government's utility function, represented by deviations of actual fiscal aggregates from target levels. Criticisms of this framework (see for example Binh and McGillivray, 1993, and

2 Note that we use a measure of tax in (log) levels rather than as a percentage of GDP, and therefore we cannot draw explicit conclusions on the effects of aid on tax *effort*.

White, 1994) include both theoretical and empirical issues, such as equal treatment of overshooting and undershooting the government targets, or unavailability of the actual data on government targets.

With the aim of overcoming the problems inherent in Heller's framework and single equation models (tax effort models), the Cointegrated Vector Auto – Regressive (CVAR) framework has attracted increased attention in the analysis of fiscal dynamics. CVAR offers several advantages. Firstly, it does not require a strict theoretical economic structure but rather 'allows data to speak freely', to discriminate between competing hypotheses or theories. Secondly, it does not impose *a priori* assumptions and restrictions, most notably on variable exogeneity, but allows the researcher to test for these in the dynamic multiple equation setting. However, since the estimation of simultaneous long and short–run equations involves a large number of parameters, the CVAR model ideally requires large samples, and this poses a challenge in the analysis of fiscal dynamics in developing countries. Indeed, the CVAR method is very demanding on the data, and therefore the number of variables should be as limited as possible to allow estimation and inference, particularly in small samples.[3] Moreover, the results can be sensitive to specification choices (Lloyd et al., 2009). To address these concerns, we formulate two distinct models: one to focus on the tax–aid relationship, and one to examine which components of government spending are most affected by aid, as well as performing numerous robustness checks.

Given the lack of economic theory in the CVAR framework, we use a simple government budget identity to equip ourselves with a set of hypotheses of the fiscal effects of aid to be tested in the parsimonious CVAR model. The basic accounting identity of the budget simply states that all revenues and borrowing must equal all expenditures:

$$TAX + NTAX + LOANS + GRANTS + BORROW = CAPEXP + RECEXP \quad (1)$$

3 Also note that the CVAR lends itself to the "build-up of type I errors in a general-to-specific modelling strategy" (Lloyd et al., 2009).

where *TAX* denotes tax revenue, *NTAX* is non-tax revenue, *LOANS* are foreign aid loans, *GRANTS* denote foreign aid grants, *BORROW* is domestic (and foreign non-concessional) borrowing, and *CAPEXP* and *RECEXP* represent respectively the central government's capital and recurrent expenditures.

Together with the assumption of some government targets, the early fiscal response literature assumed that aid is exogenous, although aid endogeneity was later introduced by Franco-Rodriguez et al. (1998). Other types of studies in related literature, such as tax effort models and fungibility studies often assume the exogeneity of aid, without being able to properly test for it. In this context, the CVAR framework has the clear advantage of not requiring any of these assumptions. The mechanism for the budget process does not have to be specified *a priori*, rather it is inferred from analysis of the data to uncover the dynamics that drive the process, discriminating between competing potential mechanisms, and testing for the exogeneity of variables.

Given the concessional nature of aid loans, (domestic) borrowing could be considered as the 'borrowing of last resort'[4]. Following such reasoning, equation 1 can be rewritten as:

$$(TEXP) - (DOMREV + AID) = BORROW \quad (2)$$

where, for simplicity, we aggregate all variables into total domestic revenue (*DOMREV*), total government expenditure (*TEXP*), and aid (*AID*). Viewing borrowing as a residual decision allows us to regard it as a potentially stationary process, which is supported by the Ethiopian data, and therefore focus our hypothesis-testing on interactions between the remaining variables.

Equation 2 suggests three main potential effects of aid. Firstly, we can expect a positive relation with expenditure – aid should be spent. Given the limited availability of data and contentious issue of what is a 'good' way to spend aid

4 This, of course, is debatable if one accepts that both commitment and disbursement of aid loans take time.

money, we will not delve into discussion of the fungibility of aid (see McGillivray and Morrissey (2000) for an overview of the debate). Our focus is to test which variable – aid or government expenditure – adjusts to the other if they form a long-run equilibrium, and which spending component bears a stronger association with aid.

Secondly, aid can influence tax revenue. Several competing hypotheses can be formed about this potential relationship. Foreign aid may provide a politically cheaper source of revenue than taxation, and therefore discourage tax effort. This argument, in theory, is stronger for grants than for aid loans, because the latter requires future repayments. On the other hand, aid may have a positive effect on tax revenue through its effect on income: by expanding the tax base, strengthening tax administration, or improving tax policies[5]. If aid has a positive rather than a negative effect on tax revenue, we would expect aid and tax to exhibit a positive long-run association.

Finally, aid may not all be spent as additional public expenditure, but also be used to decrease borrowing. Since aid relaxes domestic budget constraints (i.e. the budget identity excluding aid variables), the government could achieve the same level of expenditure with less borrowing. However, as we do not have the full series on domestic borrowing (see section 4), we are unable to test for this potential fiscal effect of aid.

In addition to these three possible effects of aid, we explore empirically the specification of the budget equilibrium equation (such as equation 1). In particular, we investigate whether such equilibrium includes only domestic variables or if it requires aid to achieve balance in the long run. The existence of a domestic equilibrium would imply that the government makes long-term plans based on domestic resources, with aid as an addition to this pre-existing long run relation. The question of whether aid is part of the budget process or if it is rather an external source of financing that relaxes an existing domestic budget constraint is also closely related to the issue of exogeneity, which is discussed throughout the

5 Part of this effect will not be modelled directly as the recipient's measure of aid will exclude any non-cash aid components, such as donor staff (expertise, consulting), and aid projects implemented fully by the donor.

paper. This issue is also relevant in the context of aid volatility and predictability, which make it harder for governments to take aid into account in their spending plans and therefore to make it part of the long-run budget equilibrium.

In view of these hypotheses and debates, this paper aims to explore the following research questions:

- Does the budget identity hold as an equilibrium relation in the long run?
- If so, is aid part of that long run equilibrium relation?
- Does aid discourage tax revenue?
- Does aid increase spending?
- Which components of spending are most affected by aid?
- Does aid heterogeneity (i.e. grants and loans) matter, and what are the differences in the behaviour caused by the two aid components?

3. Literature review

Given the inconclusiveness of cross-country evaluations of the fiscal effects of aid, and as country-level data improves, case-study approaches have been increasingly seen as a way to overcome the limits inherent to the cross-country literature (Carter, 2013). This section reviews particularly the case studies from the fiscal response literature that use the CVAR methodology in developing countries. However, it should be noted that related streams of literature exist on issues such as fiscal response (not using the CVAR method), tax effort, and aid fungibility.

A number of authors have used the CVAR analysis to investigate the fiscal effects of aid. Table 1 summarises the studies of the fiscal literature that use CVAR and reports some details about the variables and data used for each. Other studies have used CVAR on developing country data, but are excluded from this detailed review because they do not focus on fiscal dynamics. These are for example: Mavrotas (2002), which looks at the effect of aid on growth; M'Amanja and Morrissey (2006), which investigates aid, investment and growth in Kenya; and Juselius et al. (2011), which explores the effect of aid on key macroeconomic variables in a set of African countries. The latter includes Ethiopia and it does not find any adverse macroeconomic effects of aid there, although it does not consider

fiscal variables. Since a substantial part of aid flows into the public budget, an analysis of the fiscal effects of aid can be seen as a prerequisite to understanding the macroeconomic effectiveness of aid (McGillivray and Morrissey, 2000; Lloyd et al., 2009). In this sense, by focusing on the fiscal variables, we are taking a step back with respect to the literature on the macroeconomic effects of aid.

The common features in the existing literature are that data are usually obtained from a mix of national and international sources, and the time-series dimension is rather short. Variables can be included either in levels or in logs, with the former being prevalent in the studies reported in Table 1. In the broader CVAR literature however, the log transformation is quite common and it is used, for example, in Juselius et al. (2011) and M'Amanja and Morrissey (2006). In either case, variables are always deflated to reflect constant rather than current values.

Additionally, given the high data requirements in CVAR, the number of variables included in the models tends to be low, with a maximum of five. A notable exception is Martins (2010), who uses quarterly data (60 observations) from Ethiopia to model a system of six fiscal variables. We favour annual data for two reasons. Firstly, quarterly data for Ethiopia is available but not as reliable as it was only compiled rigorously after the introduction of the Protection of Basic Services (PBS) project in 2005, when donors became more careful about monitoring and reporting. Secondly, budget decisions are taken annually and intra-year dynamics do not necessarily add relevant information. Therefore, while we take the Martins (2010) paper as a reference point because it analyses Ethiopia, we depart from it both by using annual data and by exploiting deeper qualitative information about the country context.

The set of studies by the Overseas Development Institute (ODI) on Malawi, Uganda and Zambia are largely inspired by an earlier version of Osei et al. (2005). They all adopt the same approach of estimating a set of different models based on the CVAR methodology, including different sets of variables. In Fagernas and Roberts (2004b), all variables were found to be stationary and only a simple VAR was implemented. Therefore, we focus on the other two studies. For Uganda and Malawi, Fagernas and Roberts (2004, 2004a) find that both grants and loans have the expected positive effect on total expenditure, with grants having a stronger

positive impact on the development rather than on the current component of expenditure. They find no solid evidence that aid discourages tax effort in Malawi, and identify a positive long run effect of aid on domestic revenue in Uganda. The effect of aid on borrowing is negligible in Uganda, while some evidence of an adverse effect could be provided for Malawi.

Table 1. Summary of fiscal response literature using CVAR

Paper	Country	Obs.	Variables	Data source
Fagernas and Roberts (2004a)	Uganda	26	Loans, grants, ODA, domestic borrowing, domestic revenue, development expenditure, recurrent expenditure, total expenditure	National, IMF
Fagernas and Roberts (2004b)	Zambia	27	Loans, grants, ODA, domestic borrowing, domestic revenue, development expenditure, recurrent expenditure	WDI, IMF-IFS, OECD-DAC
Fagernas and Schurich (2004)	Malawi	31	Loans, grants, ODA, domestic borrowing, domestic revenue, development expenditure, recurrent expenditure	National, WDI, IMF
Osei et al. (2005)	Ghana	33	Expenditure (capital and recurrent), tax, aid, domestic borrowing	IMF, OECD-DAC
Bwire (2013)	Uganda	37	Expenditure, aid, tax, domestic borrowing	National, OECD-DAC
M'Amanja et al. (2005)	Kenya	39	Expenditure, tax, aid (grants and loans), growth	National
Lloyd et al. (2009)	Developing countries	30	Foreign financing, capital expenditure, recurrent expenditure, tax revenue, domestic borrowing	WDI
Martins (2010)	Ethiopia	60*	Development expenditure, current expenditure, domestic revenue, grants, loans, domestic borrowing	National

Note: '' denotes quarterly observations.*

Osei et al. (2005) focus on the impact of aid on fiscal policy in Ghana using two models: first, a measure of aggregate expenditure, and second, one further disaggregated into capital and recurrent expenditure. In both cases they provide support for exogeneity of foreign aid. Aid in Ghana is associated with beneficial policy responses: increased tax effort and decreased domestic borrowing, resulting in increased public spending. Results from the disaggregated model suggest that aid in Ghana is more strongly associated with current rather than capital

expenditure, contrary to the evidence from Uganda and Malawi (Fagernas and Roberts, 2004a; Fagernas and Schurich, 2004).

M'Amanja et al. (2005) relate fiscal variables to growth in Kenya using a measure of aid disaggregated into grants and loans. While grants are positively associated with growth in the long run, loans are used to finance fiscal deficits. Consequently, loans were found to have negative effects on growth in the long run. With the weak significance of the effects of grants, the authors find that "loans substitute for domestic tax effort to finance a fiscal deficit". They conclude that in the case of Kenya, this is a potential obstacle to aid effectiveness, and that grants seem to be a preferable aid modality than loans.

Martins (2010) models fiscal dynamics in Ethiopia using disaggregated measures of expenditure and aid, but leaves domestic revenue aggregated (containing both tax and non-tax revenue). His framework also includes domestic borrowing, but excludes a number of residual items[6]. For the period 1993-2008, he finds aid to be positively related to development expenditure, with aid adjusting to variations in expenditure, suggesting that donors follow the government's expenditure decisions by financing increased expenditure. Domestic borrowing was found to be the most adjusting item, thus compensating for variations in both aid and other revenues. Martins (2010) finds that the government finances its expenditure in the following order: domestic revenue, aid, and borrowing. He found no evidence that aid discourages tax revenue. While Martins' use of quarterly data allows for an increased sample size and conveniently considers only a period of relative political stability while preserving the number of observations, we use annual data because we believe budget decisions are taken annually and intra-year dynamics do not necessarily add relevant information.

Finally, the most recent CVAR analysis on fiscal dynamics is included in Bwire's PhD thesis (2013) on Uganda. The author finds that aid in Uganda is associated with beneficial policy responses and particularly with increased spending and tax revenue and decreased borrowing. The thesis finds that tax revenue is the main driver of spending plans, thus being the main driving force in the system. Contrary

6 All papers exclude one or more variables from the analysis, most commonly domestic borrowing and/or non-tax revenue, to avoid estimating an identity.

to Osei et al. (2005), the exogeneity of aid cannot be empirically supported in the case of Uganda. The order of preference for resources to finance the budget is in line with the results from Martins (2010).

These studies do not find much evidence for 'negative' fiscal effects of aid, but demonstrate that the underlying fiscal mechanisms differ across countries, and therefore justify a case-study approach. A general element emerging throughout CVAR applications is the importance of considering the country context, particularly when the number of observations is small. Knowledge of the historical and political context can help in designing the deterministic components of the CVAR, such as dummies and mean shifts related to country specific events, and can also help explain large residuals. The next sections summarise our data, its advantages, and how exploring the qualitative context contributes to the analysis of the quantitative results.

4. The Ethiopian data and context

4.1 Data

Data availability and reliability represent a severe obstacle in African countries, especially in regard to the time-series dimension. Many African countries became independent in the 1960s, and only then started to build national institutions, including statistical offices. The Ethiopian case is different because the country never experienced colonisation, but only a six-year invasion by Italian forces from 1935-1941. Upon his return in 1941, Emperor Haile Selassie embarked on a reform process with fiscal policy at its core, as public revenues were much needed for reconstruction and development. By the time the Central Statistical Office was created in 1961, Ethiopia had a well-established tradition of data collection, with fiscal records dating back to 1949, and in fact, today – together with South Africa – Ethiopia has the highest Statistical Capacity Rating in Africa (African Economic Outlook, 2010). This is of particular importance for the CVAR analysis, as this approach is highly reliant on the data.

Our dataset of 50 annual observations for the period of 1960 – 2009[7] was compiled in Ethiopia on the basis of data from the Ministry of Finance and Economic Development (MOFED) of Ethiopia. MOFED compiles National Accounts that may then be transferred to international institutions to apply the necessary modifications that make the data comparable across countries. Our choice to use national data has several advantages: firstly, the data series are consistent as they come from a single source, and thus avoid introducing any conversions or adjustments. Secondly, it is the one used for government decision-making and is therefore relevant from a policy perspective. Finally – and crucially – it includes a measure of aid that represent the actual portion going through the government's budget (other aid channels being through non-governmental organisations or delivered in the form of technical or in-kind assistance to name a few)[8]. Note that our measure of budget aid includes not only budget support, but also other sources of aid that flow through the budget. Budget support was withdrawn in 2005 due to post-election tensions and has not been restored since. However, other types of aid were introduced, most notably a project called Protection of Basic Services (PBS). While PBS is a project, it flows through the budget and fully uses the country systems, thus exhibiting some similarities with general budget support.

While only budget aid is considered, we are still able to further disaggregate it into grants and loans. Such disaggregation is motivated by the expectation that these two types of aid would exhibit different effects because of the repayment requirement associated with loans (Gupta et al., 2004; Benedek et al., 2012). Furthermore, whilst grants are largely donor-determined, loans may be sought out by the recipient, especially when deficits are high.

When disaggregating public expenditure into its capital and recurrent components, we maintain the government's original classification without any further manipulation. Whilst the distinction between development expenditure and pure government consumption along the lines of Martins (2010) is theoretically

7 Data records follow Ethiopian fiscal years, following the Ethiopian Ge'ez calendar.

8 We acknowledge that by omitting the off-budget aid, we ignore its potential indirect effects on government decisions.

appealing, it is very difficult to credibly impute single expenditure items to either of the categories. An obvious example is public sector salaries: some components may be considered a developmental expenditure (e.g. wages in health and education), but the wage bill is classified under recurrent spending.

Finally, we disaggregate domestic revenue into tax and non-tax revenue, and we show that they display different behaviour in Ethiopian fiscal dynamics. Unfortunately, we have to exclude domestic borrowing because a full series for this variable is only available from 1974. Furthermore, given several negative values, its inclusion would be extremely difficult given the log transformation applied to the data.

In the CVAR applications discussed above, variables are either analysed in levels (Bwire, 2013, Martins, 2010, Osei et al., 2003) or in logarithmic transformations (Juselius et al., 2011, M'Amanja et al., 2005). We explored both options and settled on data in logs because it was superior in terms of model fit, with benefits such as no autocorrelation and normality in the residuals (discussed in section 5). The log transformation requires all variables to be strictly positive. Since the first three years in the grants series are reported to be effectively zero, we discard first three years of observations, reducing the sample to the period of 1963 – 2009[9].

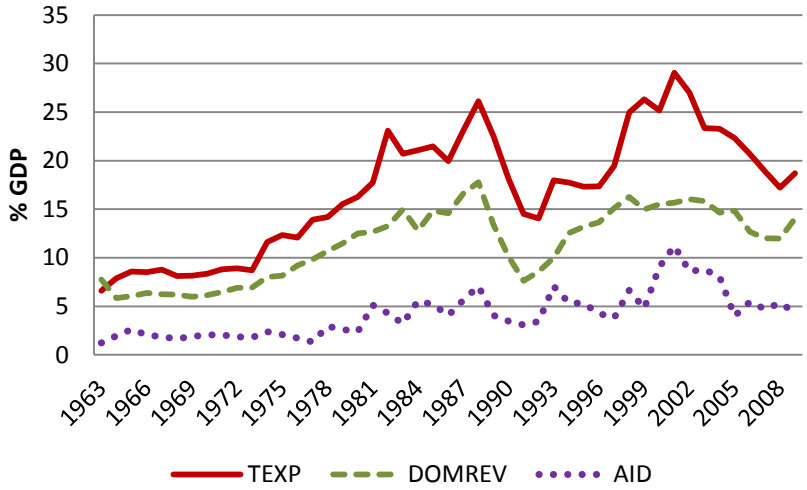
4.2 Descriptive statistics and Ethiopian context

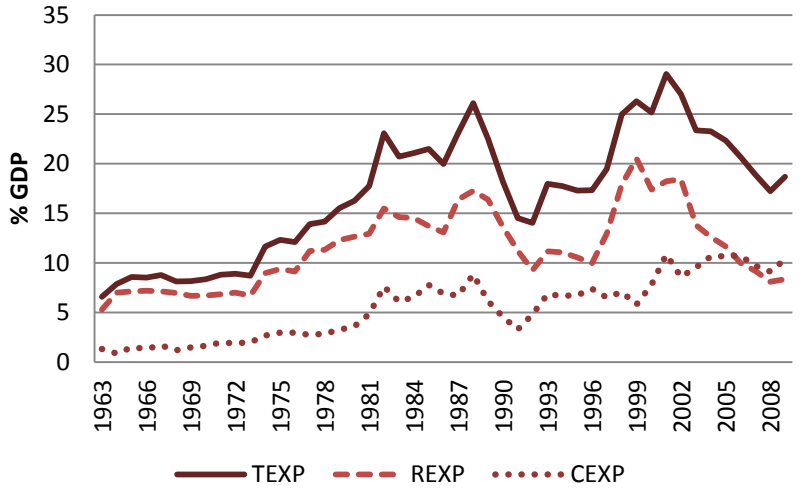
Consulting fiscal history, as well as having a good understanding of the main economic and political factors during the period, complements the econometric exercise by ensuring that the interpretation of quantitative results is realistic and by shedding light on the sources of econometric problems such as structural breaks. This section, rather than offering a full account of the fiscal history[10] over the period considered, highlights the main facts that are directly relevant for the CVAR analysis.

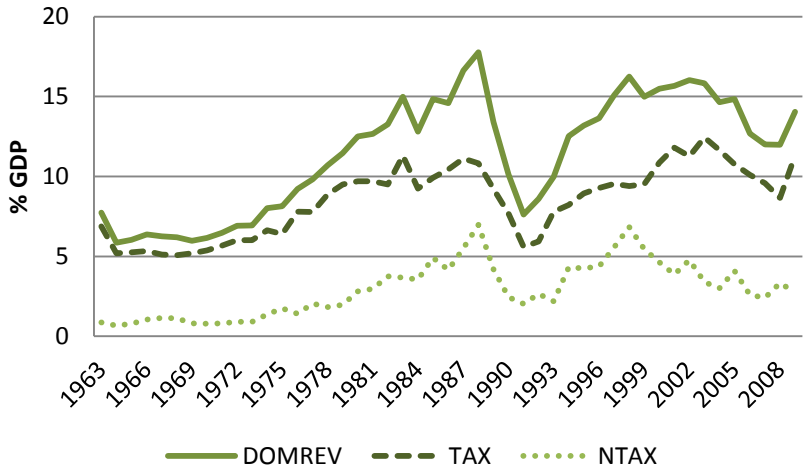
9 We specifically do not express the variables as proportion of the GDP. Whilst it would allow to facilitate the interpretation (both statistic and economic), as well as international comparisons, it may introduce more measurement error, given the difficulties related to GDP accounting (see, for instance, Jerven, 2013).

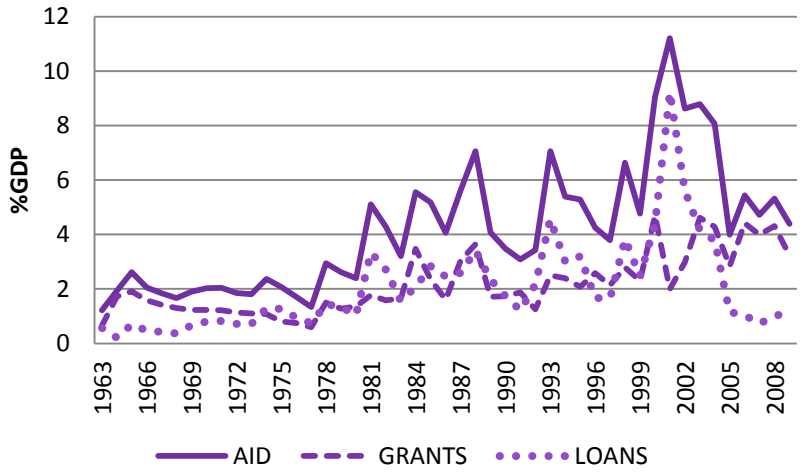
10 A more detailed description of the key events and policies is available on request and a full historical account can be found in Mascagni (2014) PhD thesis at the University of Sussex.

Figure 1 : Data of key aggregated and disaggregated variables









The key variables are depicted in Figure 1. For presentation purposes, the data are expressed as proportion of GDP. During the sample period, Ethiopia experienced several important events, including two major political regime changes that are clearly visible in the data. In the beginning of our sample, Ethiopia was under the Imperial rule of Haile Selassie, who had ruled the country since 1930, with a six–year interruption due to the Italian invasion in 1935. During the 1974 revolution, a socialist military junta, known as Derg, overthrew the Emperor and established a socialist regime. In 1991, the Derg was defeated by the Ethiopian People's Revolutionary Democratic Front, (EPRDF) which is still in power today.

The first eleven years of data depict the feudal structure of imperial rule. With underdeveloped "modern" sectors and little revenue obtained in rural areas through direct taxation (mainly due to widespread tax evasion), the Imperial regime relied heavily on trade and indirect taxation. Sustained revenue mobilisation during this period was mainly driven by two elements of government spending: expansion of the military and civilian bureaucracies. A large army (the largest military force in black Africa by 1960) was needed to address the tensions over borders, primarily with Eritrea (fully annexed by Ethiopia in 1962), but also with Somalia over the Ogaden region. The bureaucratic apparatus expanded to meet increasing administrative and economic functions. Development planning, a central issue in the international debate in 1950s, included a succession of five-year development plans. Partly due to Ethiopia's unique independence from colonial power, aid flows were comparatively low, with loans and grants contributing about a fifth of total expenditure on average. Although the US was the key ally and donor, Ethiopia could also turn for assistance to the Federal Republic of Germany, Sweden, Czechoslovakia, Yugoslavia, and even the Soviet Union, as well as multilateral organisations such as the World Bank and the UN. Already in the Imperial period Ethiopia was receiving advice on taxation thanks to missions from the UN, the World Bank and the US, amongst others.

After the 1974 socialist revolution and the establishment of the socialist military junta (Derg), state expenditure grew increasingly imbalanced with the growth of the economy. Public expenditures consistently shifted away from development and services (capital expenditure) towards control functions, including military expenditure (recurrent spending). The continuity with the Imperial regime became increasingly clear, at least in

terms of a strong state, repressive political apparatus and lack of independent institutions. Domestic revenue mobilisation remained a priority. Tax policy during the Derg era mainly relied on direct taxation with high marginal rates[11] (on personal incomes and commercial profits, including those from state-owned enterprises), agricultural taxation (income and land use), and trade taxes (dominated by the revenues from taxes on exports). Although initially increasing, the tax revenue eventually declined, mainly due to the shrinking tax base and widespread avoidance and evasion. Non-tax revenues also increased, initially due to expropriations and nationalisation, then thanks to the profits from state enterprises (that were already heavily taxed), and, towards the end of the regime, transfers from National Bank of Ethiopia, as it had a large amount of unused accumulated reserves of domestic currency. American aid was fully withdrawn from Ethiopia by 1977, except its humanitarian component, mainly due to the uncompensated expropriation of American private assets and concerns over violations of human rights under the new regime. The USSR became the most influential foreign actor, while Western donors had little political leverage in the country. Nevertheless, Ethiopia mostly traded with the Western partners (Europe, the US, and Japan). For example, Ethiopia was part of the Lomé agreement signed in 1975 with the European community, and thus a substantial fraction of aid was still Western. The last years of the Derg regime (the period from 1989-1991) was characterised by a deteriorating economic, military[12], and political situation in the country, as a decade of poor economic policies – increasing war effort, overextension of the state, the lack of investment, and weakening terms of trade - resulted in economic crisis, accompanied by a fiscal collapse that appears clearly in Figure 1.

Coming to power in 1991 after 16 years of armed struggle, the EPRDF embarked upon comprehensive liberalisation and privatisation programmes with the support of the International Financial Institutions (IFI). The fiscal situation improved quickly after the fiscal collapse under the Derg, with revenues increasing and the deficit decreasing. These significant improvements in fiscal policy were partly due to the very low level of tax collections in the last years of the Derg, which was relatively easily reversed with the start of the new regime, as well as the fact that by the early 1990s, the EPRDF already had effective control of many regions in Ethiopia where the Derg's authority no longer

11 The marginal rate under the Derg was as high as 89 % for personal income taxes.

12 By 1990, reportedly, "the conflicts in the north were consuming more than two-thirds of Ethiopia's annual budget" (Keller, 1992)

reached. Moreover, the dismantlement of the massive Derg military apparatus decreased expenditures substantially, contributing to decreasing deficit. Western donors supported these efforts, especially through Structural Adjustment Programmes (SAPs) in the 1990s[13]. Budget aid to Ethiopia increased substantially and consistently during the EPRDF period, with Ethiopia now being considered an 'aid darling'. However, general budget support was withdrawn in the aftermath of the 2005 election, which led to increasing tensions between donors and the government. Despite these tensions, aid started flowing again shortly after its withdrawal through the Protection of Basic Services project, which is also channelled through the budget. Both grants and loans each averaged about 3% of GDP during the period, and aid dependency (expressed as total budget aid as a proportion of government expenditure) increased to about 28%. However, aid remains a more volatile source of revenue than taxation (Figure 1).

Despite the EPRDF's major improvements in revenue performance, the capacity for tax reform was limited in the 1990s. A major tax reform was eventually carried out in 2002, representing the start of increased efforts in revenue mobilisation, which was falling short of the needs stemming from the administrative reforms, decentralisation and the re-militarisation of the late 1990s. The IMF, along with other donors, played a crucial role in supporting the tax reform. Despite expectations of an annual tax growth rate of 24% on average (against the predicted GDP growth rate of 11%), important limitations remain in tax revenue mobilisation, such as low income and the large share of the agricultural sector (40% GDP), with further capacity and compliance constraints.

As far as GDP growth is concerned, the emergence of the idea of developmental state and the ambitious development plans[14] supported large increases in (per capita) GDP, which recovered from the stagnation and deterioration experienced under the Derg regime. In fact, the 2000s (Figure 1) are characterised by fast GDP growth rates. Perhaps encouraged by the strong economic performance, aid grants have consistently increased under the EPRDF apart from the period of the war with Eritrea around the turn of the century. Ethiopia also received debt relief under HIPC initiative, which contributes to explaining the decrease in loans in the 2000s.

13 Although these were interrupted by the peace conditionality during the armed conflict with Eritrea (1998-2001, the latter year also coinciding with a drought).

14 Particularly the Plan for Accelerated and Sustained Development to End Poverty (PASDEP) in 2005 and the Growth and Transformation Plan (GTP) in 2010.

5. Econometric Framework

5.1 The Cointegrated VAR

Using the data described in section 4, we model a five-dimensional vector auto-regressive model that includes the central government's total expenditure (*texp*), domestic revenue, disaggregated into the tax and non-tax revenue components (*tax* and *non-tax*, respectively), and budget aid disaggregated into *grants* and *loans*. Lower case denotes logarithmic transformation.

In the VAR framework, each variable is modelled as endogenous, and is expressed as a function of past own values, as well as past realisations of other variables (and deterministic components). The vector error-correction model (VECM) representation of the VAR includes both the stationary first differences of variables in x_t (Δx_t), and their value in levels (x_t), thus preserving both the long run and short run information in the data. The error correction form of the VAR (VECM) is represented by the following equation:

$$\Delta x_t = \Pi x_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Phi D_t + \varepsilon_t$$

$$x_t = texp_t, tax_t, nontax_t, grants_t, loans_t$$

where x_t is a $p \times 1$ vector of endogenous variables described above, so that p is the number of variables included in the system; D_t is a vector of deterministic components (such as constant, deterministic trend, and dummy variables) with a vector of coefficients Φ; k denotes the selected lag length; and ε_t is a $p \times 1$ vector of unobservable error terms, that are assumed to be $\varepsilon_t \sim IN(0, \Omega)$. VECM allows a clear separation between the long-run coefficients in Π and the short-run coefficients in Γ_i.

The VECM representation illustrates that if variables are found to be I(1) – and macroeconomic variables usually are – stationary variables (Δx_t) are regressed on unit-root processes (x_{t-1}). In such cases, the estimated coefficients would be spurious. However, if some variables in the system are driven by the same persistent shocks, there may exist linear combinations of these variables that are integrated of the lower order than the variables themselves (i.e. I(0)). These linear combinations would represent

cointegrated relations, $\beta' x_t$, and could be interpreted as the long run steady-state relationships. When cointegration exists, Π has reduced rank $r < p$ and is defined as:

$$\Pi = \alpha\beta'$$

where α and β are $p \times r$ matrices (with $r < p$), $\beta' x_t$ defines the stationary long-run cointegrating relationships $(r \times 1)$, and α denotes the adjustment coefficients to the equilibrium error. Intuitively, if all $x_t \sim I(1)$ and $\Delta x_t \sim I(0)$, then a full rank in Π would be logically inconsistent as it would imply that x_t must be stationary[15]. On the other hand $r = 0$ implies that each variable in x_t is non-stationary and is driven by its own individual stochastic trend and therefore no cointegration exists. In this case, a simple VAR model with the variables in first differences would not imply any loss in long run information.

5.2 Model specification

The results of lag-length determination tests are summarised in Table 2. The Schwarz information criterion suggests *k*=1, whist Hannan-Quinn proposes *k*=3. The Lagrange Multiplier (LM) tests suggest some leftover residual autocorrelation at *k*=1, which could potentially violate the model assumptions and confound inference. The choice of lag-length for our specified model is $k = 2$, which is usually considered to be sufficient to model a rich dynamic structure of macroeconomic variables (Juselius, 2006:72).

Table 2: Lag length selection

Model	k	T	Regr.	Log-lik.	SC	H-Q	LM(1)	LM(k)
VAR(5)	5	42	30	513.591	-11.11	-15.04	0.149	0.579
VAR(4)	4	42	25	470.985	-11.30	-14.58	0.678	0.161
VAR(3)	3	42	20	451.589	-12.61	-15.23	0.315	0.483
VAR(2)	2	42	15	414.521	-13.07	-15.03	0.268	0.143
VAR(1)	1	42	10	383.947	-13.83	-15.14	0.055	0.055

Note: SC denotes the Schwarz information criterion; H-Q the Hannan-Quinn criterion; LM(k) is LM-test for autocorrelation of order k, with H_0 = no autocorrelation.

15 The VECM representation of the VAR with full rank in Π and $x_t \sim$I(1) would imply that a stationary variable $\mathbf{\Delta} x_t$ equals a non-stationary variable x_{t-1}, lagged stationary variables $\mathbf{\Delta} x_{t-1}$ and a stationary error term. Since a stationary variable cannot equal a non-stationary variable, either $\mathbf{\Pi} = 0$ or it would have a reduced rank.

The model includes an unrestricted constant, thus allowing for a non-zero mean in the cointegrating space and trends in levels of variables (but not in cointegrating relationships)[16]. The political regime changes are modelled as shift dummies, allowing for mean changes in equilibrium relationships[17].

The specified model seems to fit the data well and to satisfy the necessary conditions to proceed in the CVAR, as shown in Table 3. The residuals from the unrestricted VAR model do not seem to suffer from residual autocorrelation or heteroskedasticity. The assumption of multivariate (and univariate) normality cannot be rejected, with a p-value of 0.111. The goodness of fit of the model, summarised by the trace correlation, is also acceptable (0.518).

Table 3: Misspecification tests

Residual normality *(p-values)*						
	Multivariate	**Univariate**				
		texp	*tax*	*non-tax*	*grants*	*loans*
	0.111	0.496	0.103	0.856	0.277	0.741
Residual autocorrelation and ARCH effects *(p-values)*						
		LM(1)	LM(2)	LM(3)	LM(4)	
Residual autocorrelation		0.190	0.225	0.156	0.864	
ARCH		0.606	0.131	0.340	1.000	
Trace correlation	0.518					

Note: normality tests test the null of normally distributed errors; in the residual autocorrelation test, H0 is no autocorrelation; for the ARCH test, H0=homoskedastic errors. All values reported in the table are p-values.

5.3 Determination of cointegration rank

The determination of cointegration rank, *r,* is crucial in the CVAR analysis, as it influences the subsequent econometric analysis by dividing the data into r pulling and $p-r$ pushing forces, corresponding respectively to equilibrium relations and common

16 We tested a model allowing for a trend in cointegrating relationships, but the tests suggested it can be excluded.

17 Whilst the 1991 shift dummy is 'required' by the data as an outlier, the 1974 one is not. However, we model it for consistency with the qualitative data. Results do not hinge on the exclusion/inclusion of this dummy.

driving trends. In other words, the testing procedure aims to discriminate between the stationary (equilibrium) and the non-stationary relations.

The choice of cointegration rank is usually a difficult decision in practice, and in the context of developing countries it is aggravated by small samples. It is therefore preferable to consider additional information in addition to the formal testing procedure (Juselius 2006:131). In the next paragraphs we consider all the available information for determining the cointegration rank.

The Johansen test, also called the trace test, is the formal test procedure. It is based on the concentrated form of the VAR model (or R-form), where all short-run dynamics and deterministic components are concentrated out using the Frisch-Waugh theorem[18]. The procedure is to test the hypothesis $H_r: rank = r$, which implies that there are at least $p - r$ unit roots and r cointegrating relations. If the test statistic (reported in Table 4) exceeds the critical value, we reject the hypothesis of $p - r$ unit roots and r cointegrating relations, and conclude that there are fewer unit roots and more cointegrating relations in the model.

The distribution of this likelihood-ratio test is non-standard, and it depends on the deterministic components of the VAR model. It therefore has to be simulated using our specified model (to account for the step dummies) in order to obtain critical values. In addition, Juselius (2006:140-141) argues that in small samples the asymptotic distributions are generally a poor approximation to the true distributions, and can therefore result in substantial size and power distortions. Therefore, we consider the small sample Bartlett corrections to the trace statistic (see Johansen, 2002), which ensures a correct test size.

The uncorrected trace statistic allows accepting the hypothesis that there are two unit roots $(p - r)$ and three stationary relations (r), thus suggesting a rank of three (r=3). The Bartlett-corrected values may suggest three unit roots $(p - r)$ and two cointegrating relations (r), thus a rank of two (r=2). However, it is only possible to accept this hypothesis with a borderline p-value of 0.062. Juselius (2006:145) suggests that in small

18 For more details see Juselius (2006:116-117, 131-145).

samples it is better to avoid choosing the rank based on small p-values close to the 5% threshold, so we chose *r*=3 as the safer option.

Table 4: Rank test

p-r	r	Eig. Value	Trace	Trace*	Frac95	P-value	P-value*
5	0	0.561	102.992	89.83	75.45	0.000	0.003
4	1	0.459	65.973	57.49	54.15	0.003	0.025
3	2	0.364	38.306	34.60	35.87	0.026	0.062
2	3	0.265	17.927	15.41	19.08	0.075	0.155
1	4	0.087	4.095	3.55	5.86	0.123	0.163

*Note: the deterministic specification includes an unrestricted constant and 2 level shifts in 1974 and 1991; * denotes Bartlett corrections.*

Juselius (2006:48-52, 131-145) suggests considering four additional pieces of information when deciding the cointegration rank: the characteristic roots of the model, the *t*-values of the α coefficients of unrestricted VAR, the recursive graphs of the trace statistic, and the graphs of the cointegrating relations, as well as the economic interpretability of the results. Such information (reported in the Appendix) seems to support the choice of $r = 3$. With a lower rank, as it may be (borderline) suggested in the rank test with Bartlett correction, important long run information may be lost: the α coefficients of the third cointegrating relation are significant in the unrestricted VAR, and all other additional information supports the inclusion of a third cointegrating relation. We are therefore confident that $r = 3$ fits the data well. This choice is also confirmed by the parameter constancy tests of the model with $r = 3$, which do not signal any problems (Juselius, 2006:145).

In addition to the statistical tests to determine the rank of Π, it is crucial to ensure that the resulting equilibrium relations are economically interpretable. In view of Ethiopia's historical context (section 4.2), the broader literature (section 3), and the hypotheses formulated in section 2, we may expect to find the following three equilibrium relations:

1. A domestic budget equilibrium**,** where the government makes its spending decisions consistent with the planned domestic revenue. Whether aid is part of this equilibrium can and will be tested.

2. A relationship between government spending and aid, which we can expect to be positive. Formulating an equilibrium relation between these variables would also allow us to test hypotheses about aid spending and to identify the adjusting variables. In particular, it is interesting to test whether it is government expenditure or aid that adjusts to deviations from such an equilibrium relationship.
3. A relation between aid variables and tax revenue. If such a long run relation exists, it is possible to test whether there exists a disincentive effect of aid on tax. In addition, by disaggregating grants and loans, we can test whether aid heterogeneity matters.

In the following sections, we assess the empirical validity of these hypotheses and estimate the respective coefficients.

6. Long run identification

We conduct a battery of long-run identification procedures to gain initial insight into the dynamics of the system. Namely, we test[19] whether the variables are long-run excludable, stationary, weakly exogenous, or purely adjusting. Table 5 summarises these results for the selected rank (r=3).

Table 5: Long-run identification tests

	texp	*tax*	*non-tax*	*grants*	*loans*	D1991	D1974
Long run exclusion	0.000	0.002	0.008	0.001	0.014	0.055	0.001
Stationarity	0.003	0.003	0.003	0.002	0.011	**Excluded**	
Stationarity	0.085	0.021	0.647	0.059	0.371	**Included**	
Weak exogeneity	0.007	0.096	0.002	0.020	0.073		
Unit vectors in alpha	0.194	0.061	0.040	0.007	0.054		

Note: all tests are likelihood ratio tests for r=3 and all values reported in the table are p-values; the first row tests H_0 of a zero row restriction in beta; the second and third rows test H_0= stationarity; in the fourth row H_0 is a zero row restriction in alpha and therefore weak exogeneity; in the last row H_0 is a unit vector in alpha.

A variable is said to be long run excludable if its long-run coefficient (β) can be accepted to be zero across all cointegrating vectors. For a system with three cointegrating relationships, none of the variables of interest can be excluded (with a mild suggestion

19 All tests in this section are likelihood ratio tests.

that the 1991 mean shift dummy may be excludable). The stationarity tests determine whether any variable is stationary by imposing zero restrictions on all other variables in one cointegrating vector, leaving other *r-1* vectors of long run parameters unrestricted. If the mean shift dummies are excluded, none of the variables can be accepted as stationary. However, if the dummies are included, the stationarity of non-tax and loans cannot be rejected. This is likely due to the 'slicing' of an already small sample. The Dickey-Fuller GLS tests largely support the hypothesis that variables are I(1) processes with a drift, with the exception of loans.

Weak exogeneity tests identify which variables do not adjust to the long run equilibrium by imposing a zero row in α vector, without imposing any restrictions on β vectors. If the null hypothesis is accepted, a variable with a zero row in alpha can be considered weakly exogenous and it defines a common driving trend. Tax revenue and loans are potentially weakly exogenous, but only at the 10% confidence level. This evidence is not strong enough to justify a partial model, and weak exogeneity will be tested again once the long run structure is identified. Finally, mirroring the weak exogeneity test, the unit vector in alpha test determines whether a variable can be accepted as purely adjusting to the equilibrium error, thus being purely endogenous. Only government spending can be confidently seen as purely adjusting. Interestingly, while we cannot assert with confidence that the aid variables are exogenous, the tests do not support the idea that they are purely endogenous to the system.

6.1 Testing restrictions on beta

Testing restrictions on the beta vectors is useful to obtain indications on the stationarity of possible combinations of variables and therefore their possible inclusion in the long run system as equilibrium relations. The procedure involves imposing zero restrictions on some variables in a given beta vector, allowing the remaining parameters to be estimated while keeping the other two cointegrating relationships unrestricted. The null hypothesis is then the stationarity of a particular relation which, if accepted, suggests that the tested relation is a possible candidate for inclusion amongst the three cointegrating relations in the final long run structure. For each tested relation we impose at least one normalization and two restrictions, which are needed for long run identification. However, with r=3, when only two restrictions (and one normalisation) are imposed, the relation is just-

identified and therefore the p-value is 1 by construction (i.e. restrictions are not testable, see Juselius, 2006:189). Table 6 tests a number of possible relations and the last column reports the p-value for the null of stationarity. In addition to testing stationarity, the table allows us to assess the reducibility of relations, or if it is possible to drop one additional variable from the relation while preserving stationarity.

Table 6 is organized around the expected relations formulated in section 5.3, namely: budget equilibrium, aid and expenditure, and aid and tax. The first possible cointegrating (CI) relation is explored in rows H1-H11 and captures the domestic budget equilibrium. This relationship between government expenditure and revenue is clearly stationary and the coefficients are quite stable in all reported specifications. The testing procedure shows that aid variables do not need to be included and that therefore there exists an "irreducible" domestic fiscal equilibrium. This domestic equilibrium is valid over the whole sample, as mean shifts can be excluded. The second possible CI relation (H12-H17) summarizes the relationship between total expenditure and the aid variables. This relationship needs the 1991 dummy to be stationary and therefore the exclusion of the 1974 dummy can be considered as an over-identifying restriction. Although statistical testing would allow considering a further restriction on grants, the economic interpretability of results would benefit by its inclusion, given that aid is the main variable of interest here. The third relation (H18-H23) shows a positive association between tax revenue and the aid variables in the long run. As for the previous relation, the 1991 dummy is needed to achieve stationarity and therefore the only other restriction that may be considered is on the 1974 shift.

Table 6. Hypothesis testing on beta

HP	texp	tax	ntax	grants	loans	D1991	D1974	p-value
	Budget equilibrium							
H1	1	-0.703	-0.275	-0.013	-0.051	0	0	1 -
H2	1	-0.696	-0.338	0.001	0	0	0	0.391
H3	1	-0.719	-0.281	0	-0.045	0	0	0.765
H4	1	-0.731	-0.189	0	0	-0.177	-0.156	1 -
H5	1	-0.694	-0.33	0	0	-0.021	0	0.426
H6	1	-0.689	-0.347	0	0	0	0.016	0.409
H7	**1**	**-0.695**	**-0.338**	**0**	**0**	**0**	**0**	**0.692**
	Irreducibility of the budget equilibrium relation							
H8	1	-10.875	0	0	0	0	0	0.001
H9	1	-0.785	0	0	0	-0.385	-0.361	0.63
H10	1	0	-0.738	0	0	0	0	0.003
H11	1	0	-2.958	0	0	2.933	2.881	0.461
	Aid and expenditure							
H12	**1**	**0**	**0**	**-0.761**	**-0.452**	**0.784**	**-0.145**	**1 -**
H13	**1**	**0**	**0**	**-0.807**	**-0.558**	**0.993**	**0**	**0.869**
H14	1	0	0	-0.607	-0.012	0	-0.715	0.020
H15	1	0	0	-0.325	-0.873	0	0	0.003
H16	1	0	0	-0.494	0	-0.258	-0.744	0.058
H17	1	0	0	0	1.342	-2.794	-2.491	0.385
	Aid and taxation							
H18	**0**	**1**	**0**	**-0.91**	**-0.712**	**1.709**	**0.449**	**1 -**
H19	**0**	**1**	**0**	**-0.884**	**-0.393**	**1.135**	**0**	**0.628**
H20	0	1	0	-0.686	0.308	0	-0.856	0.017
H21	0	1	0	-4.428	10.636	0	0	0.002
H22	0	1	0	-0.559	0	0	0	0.002
H23	0	1	0	0	-2.101	0	0	0.005
	Grants and loans							
H24	0	0	0	1	2.056	-4.337	-2.728	0.479
H25	0	0	0	1	-2.567	0	0	0.005

Note: zeroes are imposed (as restrictions) – not estimated. P-value refers to H0 of stationarity. Rows in bold indicate possible valid specifications for the long-run relations.

7. Results: long run and short run

7.1 Long run structure

Based on the testing procedure in section 6.1 and with the aim of answering the economic questions, we impose the following restrictions on the long-run (β) coefficients. To test whether there exists an internal budget equilibrium in the very long run, we exclude aid and dummy variables from β_1, corresponding to H7 in Table 6. To identify the relationship between aid and spending, we exclude the domestic revenue variables from β_2, corresponding to H12. To explore the equilibrium between aid and tax, we exclude government spending and non-tax revenue from β_3, corresponding to relation H19 (note that ordering of the β vectors does not affect the results**)**. The results for the long run part of the CVAR are reported in table 7. As discussed in section 5, the β coefficients describe the stationary long-run equilibrium relations, while the corresponding α coefficients describe the adjustment behaviour of the variables (α coefficient needs to be of opposite sign to its corresponding β coefficient to be equilibrium correcting). Normalisation of the β vectors is always done on a significant variable. In addition to this statistical criterion, normalisation is also decided to ease economic interpretability [20]. Note, however, that the results of the normalised beta should still be read as a vector and not as causal effects.

Table 7: Long-run results

	texp	***tax***	***nontax***	***grants***	***loans***	1991	1974	
Beta1	**1**	**-0.69** (-11.23)	**-0.34** (-8.56)	-	-	-	-	~I(0)
Beta2	**1**	-	-	**-0.72** (-9.50)	**-0.29** (-5.15)	**0.53** (4.91)	**-0.36** (-8.72)	~I(0)
Beta3	-	**1**	-	**-0.91** (-5.82)	**-0.38** (-3.35)	**1.16** (5.23)	-	~I(0)
Alpha1	**-0.42 (-3.06)**	**0.39 (2.25)**	0.52 (1.41)	-0.45 (-0.87)	-1.07 (-1.45)	-	-	
Alpha2	-0.22 (-1.52)	0.065 (-0.35)	**-1.89 (-4.81)**	**1.718 (3.15)**	**1.69 (2.18)**	-	-	
Alpha3	**0.24 (3.20)**	0.08 (0.89)	**1.05 (5.17)**	**-0.46 (-1.63)**	-0.33 (-0.81)	-	-	
Normality	p-value = 0.068							
Stationarity	p-value = 0.849							

Note: t-values are reported in parentheses; the null hypotheses for the test at the bottom of the table are respectively normality and stationarity.

20 Contrary to a regression model, a change in the normalization will not change the ratio between the coefficients (Juselius, 2006:120).

The first equilibrium relationship confirms the 'internal domestic equilibrium' hypothesis: expenditure and revenues are positively related, and in the very long run government spending plans are based on domestic resources. Although the logarithmic transformation infringes the interpretation of the coefficients as the homogeneity condition (i.e. expenditure is equal to the sum of domestic revenues), the equilibrium can be interpreted as a long-run budgetary process equating public expenditure to domestic revenue. It also suggests continuity of statehood across the regimes, as the mean shift dummies are excluded, and thus the relationship holds across the political regimes. As suggested by the coefficients in the α_1, expenditure exhibits the strongest and most significant adjustment behaviour, although the coefficient on tax is of a similar magnitude, implying that in the long run tax is also adjusting to equilibrium error. This is in line with a sensible expectation that expenditure decisions are more sensitive to planned revenue, which is not as easily adjusted in the short-to-medium term.

The second identified equilibrium relationship reveals a positive association between both aid components and government spending. Crucially, the vector α_2 indicates that aid – and not expenditure – adjusts to departures from this equilibrium. Such behaviour suggests the hypothesis that donors may follow some 'disbursement rule' based on government spending (or that Ethiopia seeks out aid loans to finance the deficit), whilst government spending behaviour does not seem to be conditional on disbursement of aid[21]. The coefficients show that, for example, a 1% increase in grants is associated with a 0.72% increase in total expenditure. Given that the nominal amount of grants is substantially smaller than expenditure, these figures suggest that expenditure increased by more than the amount of grants. Importantly, this is consistent with a positive association between aid and tax. For example, at 2010 values, an increase in grants of 124 million ETB is associated with a 501 million ETB increase in total expenditure.

Finally, the identified long run relationship between aid and taxation reveals no adverse effects of aid: both grants and loans are positively associated with tax revenue. Whilst expenditure and non-tax revenue exhibit some adjustment, grants can be seen as the most adjusting variable to departures from the equilibrium. This is consistent with the notion that donors support tax reforms by disbursing grants (potentially to relax some capacity

21 Note that this result is consistent with the results in Martins (2010).

constraints), with a significant change in 1991[22]. The significance of the mean shift dummies when aid variables are included (i.e. in β_2 and β_3) indicates that aid behaviour and its relation with fiscal variables change across the different political regimes.

The joint stationarity of the over-identified system is accepted with a p-value of 0.849, and all the individual vectors appear stationary as well. The Doornik-Hansen test suggests that the assumption of multivariate normality cannot be rejected (p-value=0.068).

Keeping the identified long run structure fixed, it is possible to test whether any variables are weakly exogenous. Aid loans could be accepted as weakly exogenous (p-value=0.131) confirming previous results (see Table 5), whilst weak exogeneity of tax is rejected (p-value=0.049). The remaining analysis is conducted without imposing any weak exogeneity conditions.

7.2 Short run structure

While the cointegrating relations in our model are $r = 3$ long run equilibrium relations between endogenous variables with the same time index, the short-run equations are $p = 5$ relations between p current variables (Δx_t); $\left(\mathrm{p} \times (\mathrm{k} - 1)\right)$ lagged variables Δx_{t-1} $(i = 1, \dots, k-1)$; and r lagged equilibrium errors, $\beta(x_{t-1})$, from the identified long run structure. Identification of the short-run structure requires $(p-1)$ restrictions on each of the simultaneous equations.

Two other important differences exist with respect to the long run identification. Firstly, the distinction between endogenous and exogenous variables may change short run identification, whereas it did not change the long run structure. Secondly, identification of the short run structure requires uncorrelated residuals, whereas no such requirement exists in the long run structure. Therefore, the residual covariance matrix plays an important role here. In particular, uncorrelated residuals of a short run structural model may be interpreted as estimated shocks, whilst large off-diagonal elements of the covariance matrix can be a signal of significant contemporaneous effects between the system variables (Juselius, 2006:230). Indeed, "the VAR model can be considered a reduced-form model in the short run dynamics in the sense that potentially important

22 Note that the 1974 dummy was insignificant and thus excluded from β_3.

current (simultaneous) effects are not explicitly modelled but are left in the residuals" (Juselius, 2006:230). The high correlation coefficients in the residual covariance matrix may also be due to the omission of relevant variables, but in our system it most likely reflects contemporaneous effects between the fiscal variables. Table 8 indicates sensible contemporaneous effects between domestic fiscal variables as well as between expenditure and aid loans.

Table 8: Residual correlation matrix

	Δtexp	***Δtax***	***Δnon-tax***	***Δgrants***	***Δloans***
Δtexp	0.089				
Δtax	**0.356**	0.100			
Δnon-tax	**0.410**	-0.162	0.248		
Δgrants	-0.039	0.104	-0.010	0.321	
Δloans	**0.410**	0.171	-0.043	0.122	0.420

As the identified short run structure is heavily over-parameterised, with many insignificant coefficients, in this section we report a parsimonious system, following Juselius (2006, Chapter 13), where the estimated coefficients with small *t*-statistics[23] are set to zero. Since there are some non-negligible correlation coefficients in the residual covariance matrix (Table 8), the interpretation of the short-run equations as causal relationships, or reactions to structural shocks, should be taken with caution. The results are shown in the equations summarised in Table 9. The thirty over-identifying restrictions were accepted with a p-value of 0.5.

The government expenditure equation shows a positive association with the past changes of foreign grants and loans, albeit with limited magnitude. This may reflect government smoothing decisions in the face of volatile aid flows[24]. The tax equation indicates that even in the short run, aid is not inducing a reduction in tax revenue. This could well indicate a positive 'income effect' of aid on tax in the short run, as aid also seems to be positively associated with non-tax revenue. Grants do not seem react to any of the shocks

23 Those with P-value < 0.1.

24 Or, since the data is in logs, just reflect that a percentage change in each aid component, which together amount to about a fifth of government spending, corresponds to about a fifth of the percentage increase in government spending, indicating that received aid is actually spent in one period.

in the short run, consistent with the qualitative suggestion that aid may be issued for strategic considerations, or that donors take time to react to Ethiopia's fiscal decisions. Finally, loans seem to be reduced in the face of higher tax (but not non-tax) revenues, which is plausible, as government's need to borrow is reduced in periods of growing revenues.

Table 9: Short run equations

	$\Delta texp_{t-1}$	Δtax_{t-1}	$\Delta non\text{-}tax_{t-1}$	$\Delta grants_{t-1}$	$\Delta loans_{t-1}$	$CI1_{t-1}$	$CI2_{t-1}$	$CI3_{t-1}$	D91	D74
$\Delta texp_t$ =				0.16 (4.3)	0.11 (4.5)	-0.58 (-5.6)	0.25 (6.0)			0.16 (2.0)
Δtax_t =			0.2 (3.6)	0.08 (1.8)	0.46 (2.8)		-0.17 (-2.5)	0.17 (3.3)	-0.26 (-2.6)	
$\Delta nontax_t$ =				0.24 (2.4)	0.16 (2.2)			0.19 (2.2)		0.42 (1.7)
$\Delta grants_t$ =								0.46 (4.0)		
$\Delta loans_t$ =		-1.14 (-2.6)	0.48 (2.8)			-1.74 (-3.5)	0.74 (3.7)			

Note: numbers in parentheses are t-values. CI1 refers to Beta 1, CI2 to Beta 2, CI3 to Beta 3.

7.3 Common driving trends

The accompanying moving average (MA) representation of the VAR illustrates how the process can be described in terms of pulling and pushing forces. The steady state to which the process is pulled to is defined by the long-run relations $\beta' x_t - \beta_0 = 0$. The forces α represent adjustment and they activate as soon as the process is out of a steady state, i.e. when $\beta' x_t - \beta_0 \neq 0$[25]. The MA representation describes the non-stationary movement of the variables according to the common driving trends that represent the cumulated sum of the shocks to the system. "In this sense, the AR and MA representations are two sides of the same coin: the pulling and the pushing forces of the system" (Juselius, 2006:88). The inverted model can be summarised as:

25 This section relies heavily on Juselius (2006:88-89).

$$x_t = C\sum_{i=1}^{t}(\varepsilon_i + \Phi D_i) + C^*(L)(\varepsilon_i + \Phi D_i) + X_o$$

where $C = \beta_\perp(\alpha'_\perp(I - \Gamma_1)\beta_\perp)^{-1}\alpha'_\perp$ is the long run impact matrix of rank *p-r*, with $\alpha'_\perp\varepsilon_t$ describing the common driving trends; $C^*(L)$ is a stationary lag polynomial, and X_o depends on the initial values.

Unlike the identification of the stationary long run relationships, the identification[26] of the MA is not invariant to the information set. Furthermore, given that some of the residual cross correlations are non-negligible, the residuals cannot be strictly interpreted as structural shocks. Finally, we did not find enough evidence to substantiate the imposition of weak exogeneity restrictions, or identify variables that are purely adjusting to the identified long run structure. Therefore, the results in this section should be taken with caution and they should be taken as indicative at most.

Table 10: Composition and loadings of the Common Trends

	texp	***tax***	***non-tax***	***grants***	***loans***
The composition of common trends (CT) $[\alpha'_\perp]$					
CT(1)	0.8	1	-0.46	-0.44	-
	(1.16)		(-1.16)	(-1.91)	
CT(2)	-1.29	-	0.197	-0.93	1
	(-0.83)		(0.30)	(-1.85)	
The effect of the common trends on other variables $[\beta_\perp(\alpha'_\perp(I - \Gamma_1)\beta_\perp)^{-1}]$					
CT(1)	0.54	0.69	0.20	0.62	0.33
	(2.85)	(2.84)	(2.89)	(2.30)	(0.60)
CT(2)	-0.03	-0.04	-0.02	-0.30	0.62
	(-1.10)	(-0.98)	(-1.92)	(-6.8)	(6.88)

Note: t-statistics reported in the parentheses.

Broadly, the first common trend seems to be mostly constructed from the unanticipated shocks to tax revenue, with a potential contribution from grants (other coefficients being insignificant). Shocks seem to most strongly affect the domestic fiscal variables, notably, expenditure and tax revenue, but also grants, indicating support for potential donor

26 Note that (p-r-1) restrictions are required to just-identify each common trend.

response to tax mobilisation reforms. The second common trend is composed from shocks to aid variables (loans), and loading to aid variables themselves, consistent to aid policy fairly independent of fiscal dynamics.

Below, in Table 11, the C matrix columns illustrate the impact of unanticipated shocks[27] on each variable in the system more broadly. A significant coefficient indicates permanent effect. Otherwise, the effect is transitory at most. Likewise, the rows indicate how each variable is affected by such shocks.

Table 11: Long-run impact (C) matrix

	texp	*tax*	*non-tax*	*grants*	*loans*
texp	0.49	0.54	-0.26	-0.21	-0.03
	(1.85)	(2.85)	(-2.00)	(-2.20)	(-1.10)
tax	0.61	0.69	-0.32	-0.26	-0.04
	(1.83)	(2.84)	(-2.00)	(-2.23)	(-0.98)
non-tax	0.19	0.20	-0.09	-0.07	-0.02
	(2.00)	(2.89)	(-2.07)	(-1.99)	(-1.92)
grants	0.89	0.62	-0.34	0.01	-0.30
	(2.39)	(2.30)	(-1.90)	(0.05)	(-6.76)
loans	-0.53	0.33	-0.03	-0.72	0.62
	(-0.70)	(0.60)	(-0.08)	(-2.68)	(6.88)

Note: t-values are reported in parentheses.

Shocks to government expenditure can be expected to have a persistent positive impact on expenditure itself, tax (and non-tax) revenue, and, grants especially. The effect on loans can be expected to be negative, and temporary at most. This may indicate that increments in the government expenditure that are sustained are eventually funded from domestic resources, or aid grants. Unanticipated shocks to tax revenue would have positive permanent effects on all domestic fiscal variables and grant aid. Shocks to non-tax revenue seem to affect all variables negatively, and, loans aside, permanently. This could indicate detrimental policies of expropriation or transfer of funds from the central bank. The effects of cumulated shocks to grants are more difficult to interpret, as they seem to negatively affect both expenditure and tax, whilst a permanent negative effect on loans could indicate that grants and loans are substitutes, perhaps from the donor

27 The interpretation of these shocks is limited due to presence of residual correlation.

perspective. Loans, on the other hand, do not seem to have permanent effects on the domestic fiscal variables, but they seem to negatively affect grants (again, consistent with the substitution between the aid types), and have a positive effect on loans themselves, possibly signalling repayment or servicing difficulties. Note again, that these results are indicative at most.

8. Alternative system: disaggregated expenditure

To get more insight into what aid might actually be funding, or, alternatively, which spending decisions it seems to adjust to, we specify an alternative system: keeping the aid flows disaggregated as before, we aggregate the domestic revenue variables (given that they did not exhibit highly contrasting long run behaviour) and disaggregate government expenditure into its capital and recurrent components. The total number of variables in the system is still p=5. The structure of the deterministic terms is identical to that of the model above to ensure full comparability. The selected lag length is k=2, and the choice of cointegration rank is r=3. For brevity, we focus on the long run results only, as the fit of the system is slightly inferior[28] to our main model, making the short run specification weaker. Results are summarised in Table 12.

Table 12: Long-run results (alternative system)

	cexp	***rexp***	***domrev.***	***grants***	***loans***	1991	1974	
Beta1a	**-0.60** (-14.09)	**-0.13** (-1.84)	**1**	-	-	-	-	~I(0)
Beta2a	**1**	-	-	**-0.89** (-15.03)	**-0.18** (-3.10)	**0.17** (2.06)	**-0.71** (-6.88)	~I(0)
Beta3a	-	**1**	-	**-0.36** (-7.82)	**-0.20** (-4.62)	-0.05 (-0.74)	**-0.472** (-6.13)	~I(0)
Alpha1a	-0.21 (0.53)	**0.84** (4.98)	-0.16 (-0.73)	0.08 (0.13)	0.42 (0.44)	-	-	
Alpha2a	-0.22 (-1.17)	**0.33** (4.14)	0.08 (0.77)	**0.75** (2.64)	-0.21 (-0.47)	-	-	
Alpha3a	-0.11 (-0.42)	**-0.59** (-5.13)	*-0.25 (-1.64)*	0.56 (1.37)	0.53 (0.83)	-	-	
Normality	p-value = 0.068							
Stationarity	p-value = 0.564							

Note: t-values are reported in parentheses; the null hypotheses for the test at the bottom of the table are respectively normality and stationarity.

28 In terms of multivariate normality in the UVAR (p-value = 0.012), but, crucially, not in terms of residual autocorrelation. Full results available from the authors on request.

The first cointegrating vector mimics the previously identified domestic budget equilibrium: domestic revenue is positively associated with both components of government expenditure. Interestingly, the relationship is stronger with capital expenditure, possibly indicating that the periods with 'good' government policies targeting the collection of revenue tend to be reflected in more capital ('development') spending. Recurrent spending is the single most adjusting variable to departures from this equilibrium. Vectors Beta2a and Beta3a roughly correspond to the second equilibrium in the previous model, with aid variables now related separately to capital and recurrent expenditure in order to identify any potentially differing effects. Both aid variables seem to be positively related to both components of government spending.

Grants seem to be more strongly associated with capital expenditure than loans. Grants is the most adjusting variable in this equilibrium relation (β_{2a}), potentially signalling a donor disbursement behaviour rewarding increments in "developmental" spending. Given that donors and the government are in accordance on financing priorities, donors back the commitment to increased domestic capital expenditures with more grants, rather than applying aid conditionality. Finally, the third equilibrium relationship (β_{3a}) indicates a positive association between recurrent expenditure and loans and grants. While some would argue this may point to 'fungibility' issues, our view is that some aid is indeed intended to fund recurrent spending components (such as health and education, see Gomanee et al., 2005).

The strong positive relation between grants and capital expenditure is consistent with other findings in the literature (Fagernas and Roberts, 2004a; Fagernas and Schurich, 2004; Martins, 2010). On the one hand, this result may seem counter-intuitive. Indeed, it may be reasonable for loans to be more closely related to the more "productive" capital expenditure, since they have to be repaid in the future. In practice, however, loans to Ethiopia are largely concessional, making repayment a rather distant issue in time that therefore might not have direct policy implications. On the other hand, grants may come with more conditionality, in the form of pressure to spend on "productive" capital rather than recurrent ("consumption") expenditures, precisely because they do not require repayment. The idea that capital spending is preferable to recurrent expenditure may be slowly fading in the international debate. However, in historical perspective, this distinction may be behind the result of grants being mostly associated with capital

expenditure. This suggests that donors back a commitment to increased domestic capital expenditure with grants.

9. Conclusions

This paper presents an in-depth analysis of fiscal dynamics in Ethiopia using the CVAR methodology. By doing this, we are able to draw three main conclusions.

Firstly, we provide evidence for the existence of a domestic budget equilibrium that includes domestic revenues and government expenditure, but excludes aid. The domestic budget equilibrium is confirmed in the two systems estimated in this paper as well as in the alternative systems used for checking robustness. This relation holds regardless of the political regime changes, across the whole period considered. By looking at adjustment coefficients, we also find that spending plans are mainly driven by tax revenue, while expenditure is the most adjusting variable.

Secondly, and crucially, we find no evidence of an adverse effect of aid on tax revenue, which implies that the government of Ethiopia is not substituting taxes with aid, nor has it been discouraged in its tax revenue collection. On the contrary, we find a positive and robust relation between tax revenue and both grants and loans in the long run. This finding is also largely confirmed in the short run structure. This relation may be explained by a beneficial effect of aid in improving tax policies and strengthening the tax administration. Indeed, throughout the whole period the government of Ethiopia has received foreign advice on tax matters, and this remains one of the policy areas of highest agreement between the government and donors today. Moreover, Ethiopia's history of independence from colonial powers has profoundly shaped the national character and pride, making financial independence a core priority of the current government. As a consequence, the case for a substitution or tax displacement effect of aid is particularly ill-grounded in Ethiopia, as confirmed by this analysis.

Thirdly, both aid variables are found to have a positive and robust relation with public expenditure. This relation is stronger between capital expenditure and grants, as shown in the alternative system using disaggregated expenditure data. This finding is consistent with the results in the literature and with the idea that donors may have a preference for grants to be spent on more productive capital expenditure rather than on "consumption"

recurrent expenditure. We are also able to identify a donor disbursement behaviour whereby donors back proven commitment to increased expenditure with additional funding, particularly grants.

All the results presented here are robust to different variations in the system, which is particularly valuable in the CVAR context where results are often model-specific. We are able to test and confirm all the underlying statistical assumptions of the CVAR model (more so in our main system than in the alternative one), thus supporting the validity of our results. Using exclusively national data sources, we are able to avoid problems related to the different international measures of aid and capture exactly the component that is most relevant for the analysis of its fiscal effects. Our dataset also presents an advantage in terms of the length of the time series available, which is the longest in the CVAR fiscal literature so far. Last but not least, the findings of this paper are largely rooted and consistent with the Ethiopian context and with the qualitative evidence on the political economy of the country.

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Appendix

Additional information to determine r

There are in particular four additional pieces of information that can be used to determine *r* and namely: the characteristic roots of the model, the *t*-values of the α coefficients from unrestricted VAR, the recursive graphs of the trace statistic, and the graphs of the cointegrating relations[29].

First, the characteristic roots of the model with $r = 3$ are illustrated in the figure below. If the third cointegrating vector is non-stationary and therefore wrongly included in the model, then the largest characteristic root will be close to the unit circle. With $r = 3$, the modulus of the largest characteristic root is 0.690 as reported in the output table below. Although in small samples it is difficult to make a sharp distinction between unit roots, near unit roots, and 'very stationary' roots (Juselius, 2006: 145), we believe that the largest root in our case is far enough from the unit circle not to be considered a unit root[30].

The Roots of the COMPANION MATRIX // Model: H(3)

	Real	Imaginary	Modulus	Argument
Root1	1.000	0.000	1.000	0.000
Root2	1.000	0.000	1.000	0.000
Root3	0.690	-0.000	0.690	0.000
Root4	-0.291	0.481	0.562	2.115
Root5	-0.291	-0.481	0.562	-2.115
Root6	0.340	0.400	0.525	0.866
Root7	0.340	-0.400	0.525	-0.866
Root8	0.395	-0.000	0.395	0.000
Root9	-0.272	0.260	0.376	2.379
Root10	-0.272	-0.260	0.376	-2.379

Secondly, we look at the t-values of the alpha coefficients of the UVAR. The idea behind this is that ideally we want to lose as little information in Π as possible when choosing *r*. If all of the *t*-values of the α coefficients in the r^{th} relation are small, say less than 2.6, then one would not gain a lot by including the r^{th} vector as a cointegrating relation in the model (Juselius, 2006:142). The higher critical value is needed because in the UVAR we

29 For more details see Juselius (2006:48-52, 131-145).

30 Note that the modulus of the largest characteristic root for a model with r=2 is 0.584.

have not yet established which ($\hat{\beta}x_t$) vectors are stationary. Since the *t*-values for the α coefficients corresponding to a non-stationary ($\hat{\beta}x_t$) are not distributed as a Students' *t*, it is more appropriate to consider a value between Students' t and Dickey-Fuller's τ (Juselius, 2006:122).

The output table below shows the α coefficients from our basic UVAR. In Alpha(3) almost all coefficients are significant and thus show adjustment. Instead in Alpha(4) only one coefficient may be considered significant. This results show that by choosing $r = 2$, thus excluding Alpha(3), we would lose important information. The choice of $r = 3$ seems, therefore, preferable.

ALPHA

	Alpha(1)	Alpha(2)	Alpha(3)	Alpha(4)	Alpha(5)
DL_TEX	-0.023	-0.044	-0.033	-0.000	-0.004
	(-2.267)	(-4.303)	(-3.197)	(-0.014)	(-0.356)
DL_TAX	0.018	0.010	-0.046	0.016	-0.016
	(1.427)	(0.764)	(-3.564)	(1.276)	(-1.235)
DL_NTA	-0.119	0.024	-0.077	0.015	0.033
	(-4.340)	(0.877)	(-2.812)	(0.536)	(1.185)
DL_GRA	0.122	-0.090	-0.073	0.075	0.039
	(3.282)	(-2.416)	(-1.966)	(2.004)	(1.060)
DL_LOA	0.114	-0.123	-0.144	-0.131	0.017
	(2.257)	(-2.430)	(-2.851)	(-2.597)	(0.327)

Thirdly, we look at the recursive graphs (available on request) of the trace statistic, noting that the recursively calculated components of the trace statistic should grow linearly for all stationary relations (r) but stay constant for the unit root processes ($p - r$). The graph contains a unit root rejection line at 1. However, for small samples, and accounting for the Bartlett correction, this line should be shifted to approximately 1.25 (Juselius, 2006:145). This confirms that there are three stationary relations, and thus it supports $r = 3$.

As a fourth source of information we look at the graphs of the possible cointegrating relations from the UVAR (available on request). In particular, if the graph of a supposedly stationary relation shows clear signs of non-stationarity, it may be necessary to reconsider the choice of *r* or try to re-specify the model. The graphs for the first three Beta relations do not provide strong evidence against a choice of $r = 3$ although Beta(3) is more difficult to judge around 1991.