On the Conditional Effect of IMF Program Participation on Economic Growth

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Abstract

The empirical evidence currently available in the literature regarding the effects of a country's IMF program participation on its output growth is rather mixed. To shed new evidence on this issue, in this paper we specify a panel data model accounting in particular for sample selection, aspects of endogeneity, and the potential conditionality of output growth effects of IMF program participation on a country's degree of program implementation and "soft factors" such as educational attainment, health indicators, internal stability, and quality of governance. We adduce evidence that the effects of IMF program participation on output growth vary systematically with the degree of program implementation and our index of "soft factors", and are positive only if the IMF program is implemented to a sufficient degree and the program participation is coupled with sufficient progress in improving institutional quality.

Keywords: IMF Program Participation, Output Growth, Panel Sample Selection Models, Conditional Pooling.

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1 Introduction

The International Monetary Fund (IMF) began its operations in 1945, and was conceived as an independent international organisation helping to promote macroeconomic and financial stability as well as growth of the world economy. In the 1970s the IMF expanded its role towards providing on a conditional basis development assistance to countries that as a prerequisite for loan approval had to initiate economic and structural reforms as outlined by the IMF.[1] The IMF has often been criticized for failures in carrying out such development policy. This paper re-considers the effect of a country's participation in IMF loan programs on its output growth, when taking account of conditionality of these growth effects on the degree of program implementation and the country's institutional quality as measured by factors such as educational attainment, health indicators, internal stability, and quality of governance.

The empirical evidence regarding the effect of a country's participation in IMF loan programs on its economic growth is rather mixed. Using political economy variables as instruments, Barro and Lee (2005) find that IMF program participation has a negative effect on output growth. In addition, Barro and Lee (2005) find negative effects of IMF program participation on the rule of law. Vreeland (2003), using counterfactual analysis, also finds evidence that program participation leads to a reduction of growth, at least for the period during which a country is participating in the program. In contrast, Nsouli, Atoyan, and Mourmouras (2005), giving special attention to the degree of IMF program implementation, argue that countries that to a stronger degree abide with IMF programs experience more favorable macroeconomic outcomes.

In this paper we provide new insights regarding the effects of a country's IMF program participation on its economic growth by constructing and estimating a panel data model accounting in particular for sample selection issues, for endogeneity of program participation, and for the potential conditionality of the output growth effects of IMF program participation on a country's degree of program implementation and its institutional quality as measured by factors such as educational attainment, health indicators, internal stability, and quality of governance. We argue that capturing sample

[1] For a more detailed exposition, see Fritz-Krockow and Ramlogan (2007).

selection, aspects of endogeneity, and conditionality of effects is critical for properly measuring the effects of a country's IMF program participation on output growth. To cope with sample selection issues, we work with an equation system composed both of a program selection and an output growth equation, as well as accounting for the endogeneity of the program participation measure in the output growth equation. We capture country-specific effects under the two alternatives of a random effects model and a fixed effects model. For the fixed-effects model we propose a new estimation and inference approach. To account for the conditionality of the growth effects of IMF program participation, we use semi-parametric conditional pooling techniques to condition the effects of participation in IMF programs on a country's degree of program implementation and its institutional quality as measured by our "soft factors".

Using this econometric framework and a sample of annual data for 94 countries over the time period 1975 to 2005, we provide evidence that the effects of IMF program participation on output growth vary systematically with the degree of program implementation and our index of conditioning factors, and are positive only if IMF program participation is at a sufficiently advanced stage, and if it is coupled with sufficient progress in improving institutional quality.

The remainder of this paper is structured as follows: Section 2 provides a review of the previous literature. Section 3 outlines the panel data framework that allows us to cope with sample selection bias and endogeneity. Section 4 describes our approach to taking into account conditionality of the effects of IMF program participation. Section 5 presents our empirical results. Finally, Section 6 concludes. Further details regarding our econometric modelling framework and inference approach, as well as the database we collected for this paper, are described in several appendices.

2 Review of Previous Literature

There are a number of important contributions to the literature concerned with measuring the effect of a country's IMF program participation on economic growth. Most of the contributions can be characterized as following one of three approaches: (i) the "before-after"-approach, (ii) the "with-

without"-approach, and (iii) regression-based approaches.[2]

The "before-after"-approach is based on the idea that, *ceteris paribus*, economic growth that a country experiences before/after entering a loan program may be compared with economic growth it experiences during participation in an IMF loan program. For example, Evrensel (2002) investigates the effect of IMF loan programs for a sample of 109 countries over the time period from 1971 to 1997 using lags of up to three years before and after program participation to conduct a "before-after" analysis. With respect to the growth effects of program participation, she argues that the evidence is inconclusive. The main problem with the "before-after" approach, in any case, is that in practice it is not feasible under this approach to properly account for country-specific features that influence the output growth effects of program participation.

The "with-without" approach rests on the assumption that the core features of countries that participate in IMF loan programs are the same as those of countries not participating in IMF loan programs. For example, using matching methods, Hutchison (2004) analyzes the differences in economic growth between countries participating and those not participating in IMF loan programs, for a panel of 25 countries over the time period from 1975 to 1997. Hutchison's (2004) results suggest that, once sample selection is controlled for using observable variables only,[3] participation in IMF loan programs has no adverse effects on output growth. However, Hutchison's (2004) matching methods do not take into account any selection based on unobservable variables, and so his results may still be subject to sample selection bias.

The majority of contributions to the empirical literature on the effects of IMF program participation on economic growth employ regression-based approaches. Dicks-Mireaux, Mecagni, and Schadler (2000) perform a counterfactual analysis using a panel data set for 74 countries over the time period from 1986 to 1991. Taking into account sample selection issues, Dicks-Mireaux, Mecagni, and Schadler (2000) find significant, positive effects of IMF program participation on output growth. In contrast, Vreeland (2003) using a similar methodology for a panel of 79 countries over the time

[2]See also Vreeland (2003) and Dreher (2006) for a similar categorization of the literature.

[3]See, for example, Heckman, Ichimura, and Todd (1998) for a distinction between selection based on observed variables versus selection based on unobserved variables.

period from 1970 to 1990 finds a negative impact of IMF program participation on output growth. Finally, Barro and Lee (2005), using a set of political economy variables as instruments to correct for endogeneity problems in a panel comprising 86 countries over the time period from 1975 to 2000 for their output growth equation based model, find that participation in IMF programs has a significantly negative effect on output growth.

3 Panel Data Models with Sample Selection and Censored Endogenous Variables

When estimating the effect of IMF program participation on a country's output growth, two issues that are of importance are (i) endogeneity of the program participation measure in the output growth equation and (ii) sample selection. The first issue arises when explaining economic growth with, *inter alia*, a country's participation in IMF loan programs, as one will need to distinguish whether a country's economic performance is causal for IMF program participation, or vice versa. The second issue arises when using non-randomly selected samples for model estimation, as then the fact that the growth performance of countries that participate in IMF programs may systematically differ from that of those countries that do not participate needs to be addressed.[4] Countries tend to participate in IMF loan programs when they encounter economic problems, which on its own implies that they are likely to experience a growth process different from that of countries that do not turn to the IMF for assistance. It is then sensible to analyze the growth process of participating countries separately from the growth process of non-participating countries, which in turn necessitates to correct for sample selection.

As noted by Vella (1998), while sample selection has been commonly confronted in purely cross-sectional analyses, it is less frequently considered to be a concern in estimation of a panel model. This may in part be due to the perception that a panel model incorporating random or fixed effects will eliminate most forms of unobserved heterogeneity. However, consistency of the fixed effects estimator of a default fixed effects model not explicitly capturing the selection mechanism requires that the selection operates

[4] As is well known, the investigation of such sample selection effects was pioneered by Heckman (1979).

purely through the time-invariant country-specific terms, which appears to be rather unlikely. Consistency of the random effects estimator of the default random effects panel model requires the additional condition that the time-invariant country-specific effect and the model's disturbance term are uncorrelated.

3.1 Random Effects Panel Model with Sample Selection and Endogeneity

In the following we will first outline a random effects model to correct for sample selection as well as endogeneity of the IMF program participation measure in the output growth equation. Our exposition of this random effects model draws strongly upon Vella (1998) and Vella and Verbeek (1999).[5] Consider the following random effects panel data model with sample selection and endogeneity:

$$y_{it}^{*} = \mu_i + d_{it}\theta + \boldsymbol{x}_{it}'\boldsymbol{\beta} + e_{it}, \tag{1}$$

$$d_{it}^{*} = \alpha_i + \boldsymbol{z}_{it}'\boldsymbol{\gamma} + v_{it}, \tag{2}$$

$$d_{it} = \begin{cases} d_{it}^{*} \text{ if } d_{it}^{*} > 0, \\ 0 \text{ otherwise}, \end{cases} \tag{3}$$

$$y_{it} = \begin{cases} y_{it}^{*} \text{ if } d_{it} > 0, \\ \text{unobserved otherwise}, \end{cases} \tag{4}$$

where y_{it}^{*} and d_{it}^{*} are latent endogenous variables for country i and time period t with observed counterparts y_{it} (output growth) and d_{it} (IMF loan-quota ratio); $\boldsymbol{x}_{it}$ is a subset of $\boldsymbol{z}_{it}$, and throughout our exposition in this section $\boldsymbol{z}_{it}$ will be taken to be strictly exogenous. The selection rule in equations (3) and (4) reflects that y_{it} is only observed under program participation, that is, $d_{it} > 0$.

Let us write the unobserved component of each equation as the sum of the country-specific random effect (μ_i in Equation (1) and α_i in Equation (2)) and the time-specific idiosyncratic error term (e_{it} in Equation (1) and

[5] Vella and Verbeek (1999) discuss a model that *inter alia* allows for a broader range of functional forms than we wish to consider in this paper. Our model specification also differs from theirs in that we wish to allow for a larger number of regressors in the sample selection equation than in the output growth equation.

v_{it} in Equation (2)):

$$\epsilon_{it} = \mu_i + e_{it}, \tag{5}$$

and

$$u_{it} = \alpha_i + \upsilon_{it}. \tag{6}$$

Defining $\boldsymbol{u}_i$ as the stacked $(T_i \times 1)$ vector of u_{it}'s for country i, $\boldsymbol{X}_i = (\boldsymbol{x}_{i1}, \boldsymbol{x}_{i2}, ..., \boldsymbol{x}_{iT_i})'$, and $\boldsymbol{Z}_i = (\boldsymbol{z}_{i1}, \boldsymbol{z}_{i2}, ..., \boldsymbol{z}_{iT_i})'$, we assume that

$$\boldsymbol{u}_i | \boldsymbol{Z}_i \overset{iid}{\sim} N(0, \sigma_\alpha^2 \boldsymbol{\iota}\boldsymbol{\iota}' + \sigma_v^2 \boldsymbol{I}), \tag{7}$$

with $\boldsymbol{\iota}$ being a $T_i \times 1$ vector of ones. Equation (7) restricts α_i and v_{it} to be independent across i, and v_{it} is restricted to be intertemporally uncorrelated and homoskedastic. We also assume that

$$E(\epsilon_{it} | \boldsymbol{Z}_i, \boldsymbol{u}_i) = \tau_1 u_{it} + \tau_2 \bar{u}_i, \tag{8}$$

where $\bar{u}_i = T_i^{-1} \sum_{t=1}^{T_i} u_{it}$, and τ_1 and τ_2 are parameters. Note that Equation (8) allows for d_{it} and ϵ_{it} to be correlated, capturing endogeneity of the IMF loan-quota ratio in the output growth equation as arising through the program participation selection mechanism specified in Equation (2). Also, through $\tau_2 \neq 0$ Equation (8) allows e_{it} to be intertemporally correlated and heteroskedastic.

Conditioning Equation (1) on the selection outcomes, $\boldsymbol{d}_i$, as well as the regressors in $\boldsymbol{X}_i$, and observing Equation (8) yields

$$\begin{aligned} E(y_{it}^* | \boldsymbol{Z}_i, \boldsymbol{d}_i) &= d_{it}\theta + \boldsymbol{x}_{it}'\boldsymbol{\beta} + E(\epsilon_{it} | \boldsymbol{Z}_i, \boldsymbol{d}_i) \\ &= d_{it}\theta + \boldsymbol{x}_{it}'\boldsymbol{\beta} + \tau_1 u_{it} + \tau_2 \bar{u}_i. \end{aligned} \tag{9}$$

To obtain the sample selection correction terms in u_{it} and $\bar{u}_i$ on the right-hand side of Equation (9), Vella and Verbeek propose to compute

$$E[u_{it} | \boldsymbol{Z}_i, \boldsymbol{d}_i] = \int [\alpha_i + E(v_{it} | \boldsymbol{Z}_i, \boldsymbol{d}_i, \alpha_i)] f(\alpha_i | \boldsymbol{Z}_i, \boldsymbol{d}_i) d\alpha_i, \tag{10}$$

where $f(\alpha_i | \boldsymbol{Z}_i, \boldsymbol{d}_i)$ denotes the conditional density of α_i, and v_{it} in terms of its expectation conditional on $\boldsymbol{Z}_i, \boldsymbol{d}_i$, and α_i is the generalized residual

from estimation of the panel Tobit model in Equation (2).[6] The conditional density of α_i can be obtained from

$$f(\alpha_i|\boldsymbol{Z}_i, \boldsymbol{d}_i) = \frac{f(\boldsymbol{d}_i|\boldsymbol{Z}_i, \alpha_i)f(\alpha_i)}{f(\boldsymbol{d}_i|\boldsymbol{Z}_i)}, \tag{11}$$

with f generically denoting density functions, and where

$$f(\boldsymbol{d}_i|\boldsymbol{Z}_i) = \int \prod_{t=1}^{T_i} f(d_{it}|\boldsymbol{Z}_i, \alpha_i)f(\alpha_i)d\alpha_i. \tag{12}$$

After obtaining the conditional expectation of u_{it} in Equation (10), the output growth equation in (1) can be estimated, including u_{it} and $\bar{u}_i$ as additional variables to correct for sample selection while also allowing for endogeneity of d_{it}. The functional form of Equation (10) as well as details concerning the computation of the standard errors for the estimates of $\theta, \boldsymbol{\beta}, \tau_1$, and τ_2 can be found in Appendix A.

If e_{it} is to be restricted to be intertemporally uncorrelated, then Equation (8) reduces to

$$E(\epsilon_{it}|\boldsymbol{Z}_i, \boldsymbol{u}_i) = \tau_1 u_{it}, \tag{13}$$

implying that Equation (10) simplifies to

$$E[u_{it}|\boldsymbol{Z}_i, d_{it}] = \int [\alpha_i + E(v_{it}|\boldsymbol{Z}_i, d_{it}, \alpha_i)]f(\alpha_i|\boldsymbol{Z}_i, d_{it})d\alpha_i. \tag{14}$$

3.2 Fixed Effects Panel Model with Sample Selection and Endogeneity

Semykina and Wooldridge (2005) propose a fixed effects specification of a panel data model closely related to Equations (1) to (4). In what follows we will invoke Semykina and Wooldridge's (2005) modelling of the fixed effects, decomposing the fixed effects into a systematic component driven by observables (the instruments in $\boldsymbol{Z}_i$) as well as a random unobserved component, and then embed the resultant model within the estimation and inference procedure discussed in Sub-Section 3.1.[7]

[6] See Gourieroux, Monfort, Renault, and Trognon (1987) for a definition of the generalized residuals we work with here.

[7] Semykina and Wooldridge (2005) provide a different two-step estimation and inference

Following Semykina and Wooldridge (2005), let us thus invoke a Mundlak (1978) type decomposition of the country-specific fixed effect in Equation (2):

$$\alpha_i \quad = \quad \zeta + \bar{\boldsymbol{z}}_i' \boldsymbol{\kappa} + r_i, \tag{15}$$

where r_i is a random effect; defining

$$\tilde{u}_{it} = r_i + v_{it}, \tag{16}$$

we assume in analogy to Equation (7) that

$$\tilde{\boldsymbol{u}}_i | \boldsymbol{Z}_i \overset{iid}{\sim} N(0, \sigma_r^2 \boldsymbol{\iota}\boldsymbol{\iota}' + \sigma_v^2 \boldsymbol{I}). \tag{17}$$

Clearly, the Mundlak (1978) and Semykina and Wooldridge (2005) fixed effects specification restricts the systematic variation of the country-specific effect to only arise through the vector of observables $\bar{\boldsymbol{z}}_i$. This is a more restrictive specification of the fixed effect than often adopted in other panel data models, for example in the linear dynamic panel data literature.[8]

Let us use a similar decomposition as specified in Equation (15) for the country-specific effect in the selection equation also for the country-specific effect in the output growth equation (that is, Equation (1)):

$$\mu_i \quad = \quad \psi + \bar{\boldsymbol{z}}_i' \boldsymbol{\kappa} + \chi_i, \tag{18}$$

where χ_i is a random effect; defining

$$\tilde{\epsilon}_{it} = \chi_i + e_{it}, \tag{19}$$

we now also assume in analogy to Equation (8) that

$$E(\tilde{\epsilon}_{it} | \boldsymbol{Z}_i, \tilde{\boldsymbol{u}}_i) = \tilde{\tau}_1 \tilde{u}_{it} + \tilde{\tau}_2 \bar{\tilde{u}}_i. \tag{20}$$

procedure for a panel model with a Probit specification of the selection mechanism than we propose in this sub section for a panel model with a Tobit specification of the selection mechanism. For our data set, the procedure we outline here appears to be more robust to the selection of instruments in $\boldsymbol{Z}_i$ than the Semykina and Wooldridge (2005) procedure. A systematic comparison of our procedure with that of Semykina and Wooldridge (2005) would be interesting to pursue but is beyond the scope of this paper.

[8] See, for example, Binder, Hsiao, and Pesaran (2005) for an unrestricted formulation of fixed effects within a linear dynamic panel data model.

Under Equations (15) to (20), we therefore allow for a less restrictive specification of the country-specific effects than in Vella and Verbeek (1999), and capture a fixed effects specification in the spirit of Mundlak (1978) and Semykina and Wooldridge (2005), augmenting both the program selection equation, Equation (2), and the output growth equation, Equation (1), with the regressors in $\bar{\boldsymbol{z}}_i$, but otherwise pursuing the estimation and inference procedure of Sub-Section 3.1. We will discuss the choice of elements in $\bar{\boldsymbol{z}}_i$ in Section 6.

Finally, the null of the random effects specification of Sub-Section 3.1 can be tested against the fixed effects specification of this sub-section by investigating whether $\boldsymbol{\kappa} = \mathbf{0}$ and $\boldsymbol{\phi} = \mathbf{0}$.

4 Conditioning the Effect of IMF Loan Program Participation

The fixed effects model of Section 3 still involves the restriction that the systematic differences in the output growth processes across countries can be captured through the country-specific effects and different realizations of the regressors in d_{it} and $\boldsymbol{x}_{it}$. This is a rather strong assumption. To analyze the effects of IMF program participation, it clearly seems desirable to allow for systematic differences in these effects themselves across countries. To do so in a parsimonious form that also allows us to learn about the sources of the variations of the effects across countries, we consider here the conditional pooling approach of Binder and Offermanns (2008). This approach allows us to model the conditionality of the growth effects of IMF loan programs on a country's degree of program implementation or on its institutional quality with a minimal set of assumptions regarding the functional form of this conditionality.[9] The approach consists of modelling the dependency with flexible functional form polynomials, as a homogeneous function of the relevant conditioning variable, denoted by $w_{i,t-1}$: $\theta(w_{i,t-1})$. Binder and Offermanns (2008) propose to specify $\theta(w_{i,t-1})$ using a parametric function of flexible form, and in particular choose Chebyshev polynomials as one

[9] In this paper, we do not consider multivariate conditional pooling. See Binder, Georgiadis, and Sharma (2009) for an extension of the conditional pooling approach to a bivariate setting.

specification of orthogonal polynomials:

$$\theta(w_{i,t-1}) = \sum_{s=0}^{\tau} \gamma_s^{(\theta)} c_s(w_{i,t-1}), \tag{21}$$

with the Chebyshev polynomials $c_s(w_{i,t-1})$ recursively defined as $c_{s+1}(w_{i,t-1}) = 2w_{i,t-1}c_s(w_{i,t-1}) - c_{s-1}(w_{i,t-1})$, $s = 1, 2, ..., \tau$, $c_0(w_{i,t-1}) = 1$, $c_1(w_{i,t-1}) = w_{i,t-1}$, and where $\gamma_s^{(\theta)}$, $s = 0, 1, ..., \tau$, are coefficients that are homogeneous across countries.[10]

To condition an independent variable's effect, that variable may be multiplied with the Chebyshev polynomial bases $c_s(w_{it})$, $s = 0, 1, ..., \tau$, and estimation can then be carried out as usual with the resultant augmented set of variables. The calculation of standard errors for the Chebyshev polynomial is discussed in Appendix B.

5 Conditioning Variables

Under the conditional pooling approach (some of) the model coefficients are a function of a conditioning variable. According to the IMF, "[c]onditionality refers to policies and actions that a borrowing member agrees to carry out as a condition for the use of IMF resources. The purpose of conditionality is to ensure assistance to members [...] in a manner that [...] establishes adequate safeguards for the temporary use of the IMF's resources."[11] In practice, the IMF only disburses installments of funds agreed to in the loan program if the country initiates specific reforms, that is, complies with conditionality of the loan program. Hence, one way to model compliance with conditionality is to consider the ratio of loans actually drawn relative to loans originally agreed upon. Provided that the IMF consistently disburses funds only to countries that are sufficiently successful in advancing reforms, the loans-drawn-to-agreed-ratio should be a useful proxy as to whether a country is successful in implementing the economic reforms advocated by the IMF.

We also consider a more direct measure of structural conditionality, that according to the IMF since the 1980's has involved changes in policy processes, legislation, and institutional reforms.[12] To capture the effect

[10] Chebyshev polynomials belong to the class of orthogonal polynomials, and thus can address collinearity problems that could arise under $\tau > 1$.

[11] See Fritz-Krockow and Ramlogan (2007), p. 25.

[12] See International Monetary Fund (2005).

of structural conditionality, we construct an index incorporating measures of educational attainment, life expectancy, government stability, bureaucracy quality, corruption, law and order, ethnic tensions, and internal conflicts, as described in what follows.[13] The index is constructed on the basis of the mean of the j-th country's index elements relative to the mean of the same index elements for a base-country year (for example, the United States in 2000):

$$index_{it} = \frac{\sum_{s=1}^{m} \ s\text{-}th \ variable_{it}}{\sum_{s=1}^{m} \ s\text{-}th \ variable_{base-country,\, base-year}}, \tag{22}$$

where m denotes the number of variables that enter into the construction of the index. To be able to calculate this index, we replace missing observations using interpolated values. If for, say, country i a time series is missing entirely, we proxy it via a "rank-matching" procedure: For each time period for country i, first a preliminary index is calculated on the basis of Equation (22) involving only those variables that are actually available for country i. We then also calculate the same preliminary index for all other countries for time period t, excluding those variables that are completely missing for country i. Using these preliminary indices, we then calculate the period t relative rank (that is, $\frac{rank_{it}}{number \ of \ countries_t}$) of the preliminary index value of country i among the set of all countries that can be considered for the preliminary index values in period t. Finally for this procedure, we then proxy for time period t the variable in country i that is entirely missing with the value of that variable for which the period t relative rank is closest to the relative rank calculated for country i's preliminary index for period t.

We impute those variables for which there are no observations either at the beginning or at the end of the series backward or forward, respectively, using the percentage changes of the preliminary index. At this point we then have for each country a balanced set of variables that can be used to calculate the index as outlined in Equation (22).

Our approach to index calculation ensures that there are no mean-shifts in the index if for a country the time series for some variable begins later or ends earlier than the time series for some other variables for that country. Our approach furthermore preserves all the information about the variation

[13] A listing including a detailed description of all variables used for construction of our index is given in Appendix C.

in the time series we exploit. It should be noted that due to the imputation procedure it is possible that an index value may become larger than one.

6 Empirical Results

Table 1 displays our estimation results when estimating the random effects (RE) panel model using the growth rate of real GDP per capita as the dependent variable and a representative set of explanatory variables, including the IMF loan-quota ratio, that have been used in previous studies on the growth effects of IMF program participation. Note that these estimation results involve no correction yet for potential sample selection bias and/or endogeneity.

Table 1: Growth Equation: RE Panel Model

Independent Variables	**Coefficients**
Openness	−0.009 [−1.25]
Government Share	−0.030 [−1.05]
Investment Share	0.127** [3.77]
Inflation	−0.003** [−2.34]
Democracy	0.307** [2.45]
Loan-Quota Ratio	−0.003 [−1.60]
Number of Observations:	745

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

To summarize briefly, the estimated coefficients in Table 1, Column 2 (country-years with participation in IMF loan programs), on both the investment share and the democracy variable are significantly positive. The estimated coefficient on inflation is significantly negative. The coefficient on the loan-quota is negative but not significant. An increase of the investment share by one percentage point increases a country's growth rate of real GDP per capita by 0.134 percentage points, and an increase of the democracy index by one unit increases a country's growth rate of real GDP

per capita by 0.286 percentage points. An increase in the inflation rate by one percentage point leads to a reduction of real per capita GDP growth rate by 0.003 percentage points.

Note that the regression of Table 1 features three potential sources of bias, namely a sample selection bias, an endogeneity bias, and a heterogeneity bias.

In a first step towards resolution of these bias problems, we will take into account sample selection and endogeneity by means of considering the random effects panel model outlined in Sub-Section 3.1. The selection equation, Equation (2) is a random effects Tobit model, as the loan-quota ratio is left-censored at zero. Table 2 displays our estimation results when using a representative set of explanatory variables that has been used in previous studies, and using the IMF loan-quota ratio as the dependent variable.

Table 2: Selection Equation: RE Tobit Model

Independent Variables	**Coefficients**
Total Reserves in Months of Imports	0.031 [1.061]
OECD	−0.717 [−1.549]
Log(Quotashare)	−0.497 [−1.555]
Investment Share	0.090** [−5.619]
Government Share	0.014 [1.129]
Openness	−0.003 [−0.893]
Inflation	−0.002** [−3.710]
Democracy Index	0.045 [1.412]
Number of Observations for the selection equation:	2256

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

As can be seen from Table 2, the estimated coefficient on the lagged growth rate of real GDP per capita is significantly negative. If the growth rate of real GDP per capita declines by one percentage point, then the ratio of IMF lending to a country's quota increases by 0.087 percentage

points.[14] The estimated coefficient of OECD membership is significantly positive. A change of the dummy from 0 to 1 increases the ratio of IMF lending to a country's quota by 1.359 percentage points. The estimated coefficient of years under IMF program participation is also significantly positive. If the number of years under IMF program participation increases by one, then the ratio of IMF lending to a country's quota increases by 0.03 percentage points. The estimated coefficient of real GDP per capita squared is significantly negative. An increase in this variable by one unit decreases the ratio of IMF lending to the country's quota by 0.012 percentage points.

The residual from the selection equation can now be used to generate correction terms that, as described in Sub-Section 3.1, correct for sample selection and endogeneity when estimating the effect of changes in the loan-quota ratio on the output growth of countries participating in IMF loan programs. Table 3 displays our estimation results when considering the same regressions as displayed in Table 1, but augmented by the correction terms for sample selection bias (with coefficients τ_1 and τ_2).[15]

Three issues are worth noting: First, due to the estimation of the sample selection equation, the number of observations has slightly diminished from 807 to 745. Second, τ_1 is marginally significant (at the 10% significance level) for country-years participating in IMF loan programs, providing some evidence that there is correlation between the error terms of the selection and the output growth equations. Third, the coefficient on the loan-quota ratio is still negative but not significant.

To address the issue of heterogeneity bias, in our next step of analysis we condition the effect of the loan-quota ratio on output growth on the loans-drawn-to-agreed-ratio, which, as discussed in Section 5, may serve as a useful proxy for measuring conditionality of effects. The conditioning may also on its own contribute to alleviating the endogeneity problem: One

[14]Note that differentiating the latent variable (denoted here generically as y^*, with respect to the independent variable (denoted here generically as x, entering into the Tobit model with a coefficient of β), we of course have

$$\frac{\partial E(y^*|x)}{\partial x} = \beta.$$

The marginal effect for the observed dependent variable needs to correct for censoring, multiplying β with the probability that the loan-quota ratio is strictly positive.

[15]The standard errors reported in Tables 3 to 8 are corrected for first-step sampling uncertainty affecting second-step inference. See also Appendix A.

Table 3: Growth Equation: RE Panel Model

Independent Variables	**Coefficients**
Openness	-0.009 [-0.914]
Government Share	-0.004 [-0.090]
Investment Share	0.016 [0.134]
Inflation	-0.005^{*} [-2.093]
Democracy	0.339^{**} [2.472]
Loan-Quota Ratio	-0.001 [-1.095]
τ_1	0.726 [0.651]
τ_2	0.464 [1.644]
Number of Observations:	745

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

may expect that a higher degree of compliance with conditionality causes higher (lower) growth if the reforms implemented do promote higher (lower) growth. However, growth should have a negligable effect on compliance with conditionality. It appears sensible to conjecture that lower growth raises a country's willingness to accept painful economic reforms. In this case, lower growth should be associated with a higher degree of compliance. In any case, the loan quota-ratio and real GDP per capita growth only feature a correlation of 0.01 in the sample of all participating countries. Table 4 displays our results when using Chebyshev polynomials of order one and the loans-drawn-to-agreed-ratio as the conditioning variable.

Conditioning the effect of the loan-quota ratio on this proxy for IMF conditionality has a considerable effect on the estimation results: If a participating country does not comply with conditionality at all, the effect of program participation on output growth is negative: An increase in the loan-quota ratio by 1% lowers the growth rate of real per capita GDP by 0.012 percentage points. However, the higher the compliance ratio, the smaller in absolute terms the negative effect of the loan-quota ratio. If the compli-

Table 4: Growth Equation: RE Panel Model

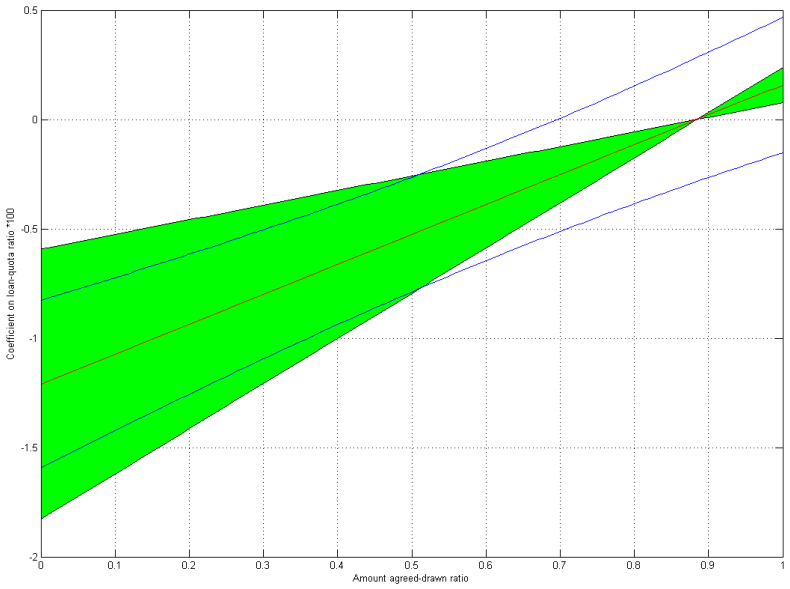
Independent Variables	**Coefficients**
Openness	-0.010 [-1.020]
Government Share	0.002 [0.048]
Investment Share	-0.003 [-0.027]
Inflation	-0.005^{*} [-2.199]
Democracy	0.355^{**} [2.552]
Loan-Quota Ratio	-0.002^{*} [-2.050]
*Loan-Quota Ratio * Drawn Ratio*	0.001^{**} [3.242]
τ_1	0.845 [0.765]
τ_2	0.462 [1.617]
Number of Observations:	745

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

ance ratio is larger than 88%, the effect of IMF program participation turns positive. If all funds originally agreed upon are drawn, that is, there is full compliance with conditionality, then an increase of the loan-quota ratio by 1% leads to an increase of real per capita GDP growth by 0.002 percentage points.

For countries that do not comply with conditionality, the coefficient on the loan-quota ratio is negative. If these countries do not receive funds from the IMF, because they do not set in effect the reforms proposed by the IMF, the effect would, of course, at worst be zero. However, when countries comply with conditionality, our regression results suggest a positive output growth effect. These results are in line with IMF arguments stressing that compliance with conditionality is important for the success of IMF loan programs. Figure 1 plots the coefficient on the loan-quota ratio conditional on the loans-drawn-to-agreed-ratio. The red line displays the value of the coefficient depending on the magnitude of the loans-drawn-to-agreed-ratio. The blue lines represent one standard-deviation error bands and the green

Figure 1: Effect of IMF Loan Size Conditional on Actual Degree of Program Participation, Annual Data, 1975 - 2005, 94 Countries.



surface displays the maximal standard error when allowing for a significance level of 5%. Hence the coefficient value is significant at least at a 5% level if the blue lines are on the green surface. As can be seen from Figure 1, we find the coeffient to be significant for loans-drawn-to-agreed-ratios of up to 0.5.

To investigate the influence of conditionality of the effect of IMF program participation on a country's institutional quality directly, we use our index of institutional quality described in Section 5. Since structural conditionality is measured in changes by the IMF, we include the index of institutional quality in percentage changes as our conditioning variable.

Table 5 displays results when using Chebyshev polynomials of order one and the growth rate of the index of institutional quality as the conditioning variable.

Table 5: Growth Equation: RE Panel Model

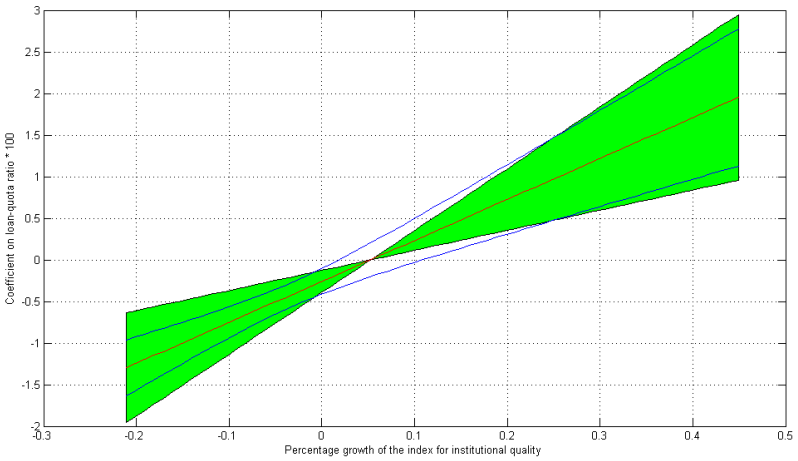
Independent Variables	**Coefficients**
Openness	-0.008 [-0.849]
Government Share	-0.002 [-0.063]
Investment Share	0.004 [0.036]
Inflation	-0.005^{*} [-2.224]
Democracy	0.343^{**} [2.507]
Loan-Quota Ratio	-1.191 [-0.001]
*Loan-Quota Ratio * Index Growth*	0.005^{**} [2.871]
τ_1	0.831 [0.764]
τ_2	0.461 [1.662]
Number of Observations:	745

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Conditioning the effect of the loan-quota ratio on the growth rate of a country's institutional quality yields significant results: If a country cannot improve its institutional quality, the effect of program participation on out-

put growth is negative: An increase of the loan-quota ratio by 1% lowers the growth rate of real GDP per capita by 0.002 percentage points. At the same time, this coefficient estimate increases systematically with the growth of the institutional index. If the growth rate of the index for institutional quality exceeds 0.04%, the effect of IMF loan program participation on output growth turns positive. Our results provide support for IMF statements pointing out that compliance with conditionality is important for the success of IMF loan programs. Figure 2 displays the coefficient on the loan-quota ratio conditional on the percentage growth of the index of institutional quality.

Figure 2: Coefficient of Loan-Quota Ratio Conditioned on a Country's Growth of Institutional Quality , Annual Data, 1975 - 2005, 94 Countries.



To ensure that the growth of the institutional index does not just capture business cycle dynamics, it is sensible to run the regression displayed in Table 5 with quinquennial data. Table 6 displays these regression results for the sample period from 1975 to 2005. Qualitatively, the estimation results do not change much. However, the interaction term of the loan-quota ratio and the percentage growth of the institutional index is now only marginally significant (at the 10% significance level). Figure 3 displays the coefficient of the loan-quota ratio conditional on the growth rate of the institutional quality index for the sample of quinquennial data. Table 7 displays the same regression as Table 4, but with the sample restricted to begin in 1985.

Table 6: Growth Equation: RE Panel Model

Independent Variables	**Coefficients**
Openness	-0.002 [-0.498]
Government Share	-0.008 [-0.241]
Investment Share	0.108 [1.639]
Inflation	-0.002^{**} [-3.133]
Democracy	0.263^{*} [2.085]
Loan-Quota Ratio	-0.004 [-0.562]
*Loan-Quota Ratio * Index Growth*	0.01 [1.327]
τ_1	0.024 [-0.037]
τ_2	0.429 [1.161]
Number of Observations:	253

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses quinquennial data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Qualitatively the results again do not change much. Figure 4 displays the coefficient of the loan-quota ratio conditional on the growth rate of the institutional index for the shortened sample. To again investigate whether the significance of the conditioning variable may just reflect business cycle dynamics rather than growth dynamics, the regression is re-estimated with quinquennial data. Table 8 displays the results for the sample period from 1985 to 2005, using quinquennial data. Once more, qualitatively the results do not change much. Figure 5 displays the coefficient of the loan-quota ratio conditional on the growth rate of the institutional quality index for the shortened sample with quinquennial data.

7 Conclusion

[To be added.]

Figure 3: Coefficient of Loan-Quota Ratio Conditioned on a Country's Growth of Institutional Quality, Quinquennial Data, 1975 - 2005, 94 Countries.

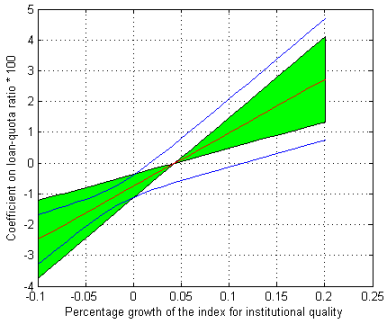


Figure 4: Coefficient of Loan-Quota Ratio Conditioned on a Country's Growth of Institutional Quality, Annual Data, 1985 - 2005, 94 Countries.

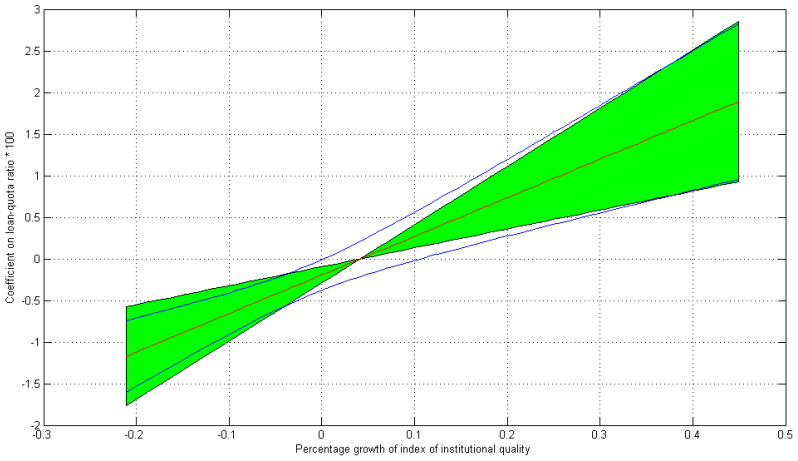


Table 7: Growth Equation: RE Panel Model

Independent Variables	**Coefficients**
Openness	-0.024 [-1.623]
Government Share	0.018 [0.370]
Investment Share	-0.046 [-0.372]
Inflation	-0.005^{**} [-2.507]
Democracy	0.315 [1.309]
Loan-Quota Ratio	-0.013 [-1.196]
*Loan-Quota Ratio * Index Growth*	4.847 [2.457]
τ_1	1.033 [0.972]
τ_2	0.198 [0.641]
Number of Observations:	542

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 8: Growth Equation: RE Panel Model

Independent Variables	**Coefficients**
Openness	-0.013 [-1.651]
Government Share	0.014 [0.328]
Investment Share	0.095 [1.300]
Inflation	-0.002^{**} [-2.342]
Democracy	0.327 [1.772]
Loan-Quota Ratio	-0.022 [-2.100]
*Loan-Quota Ratio * Index Growth*	0.021 [2.068]
τ_1	0.912 [1.146]
τ_2	0.065 [0.156]
Number of Observations:	178

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses quinquennial data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Figure 5: Coefficient of Loan-Quota Ratio Conditioned on a Country's Growth of Institutional Quality, Quinquennial Data, 1985 - 2005, 94 Countries.

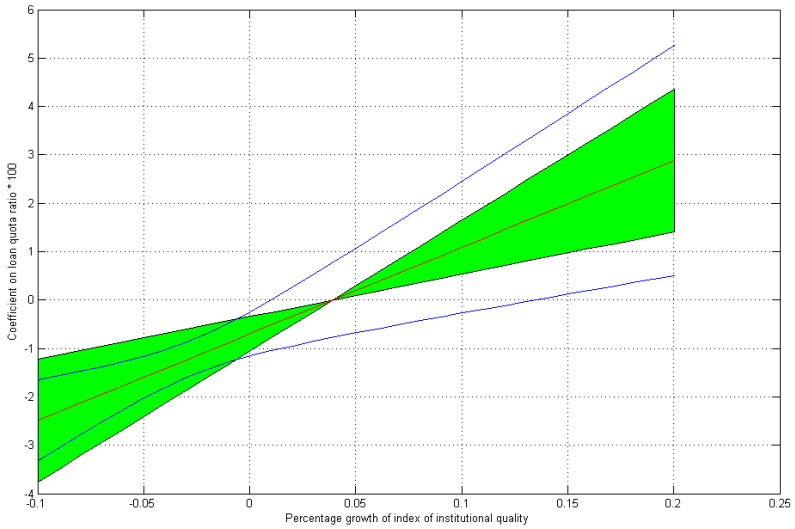


Table 9: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	−0.019 [−1.07]
Government Share	−0.096 [−1.34]
Investment Share	0.329** [4.07]
Inflation	−0.003* [−2.28]
Democracy	0.292* [2.09]
Loan-Quota Ratio	−0.002 [−1.39]
Mean of Total Reserves in Months of Imports	0.122 [0.90]
Mean of Real GDP per Capita	−0.304 [−1.501]
Mean of Real GDP per Capita Squared	0.014 [1.069]
Mean Years Under Program	0.096** [2.892]
Mean of OECD	−1.468 [−0.676]
Mean of Log(Quotashare)	0.774 [1.411]
Mean of Growth Rate of Real GDP per Capita Lagged	0.665** [5.248]
Number of Observations:	745

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 10: Selection Equation: FE Tobit Model

Independent Variables	**Coefficients**
Growth Rate of Real GDP per cap. Lagged	-0.031^{**} [−3.311]
Total Reserves in Months of Imports	0.003 [0.09]
Real GDP per Cap.	−0.150 [−1.005]
Real GDP per Cap. Squared	−0.009 [−1.278]
Years Under Program	0.128^{**} [7.036]
Oecd	2.243^{**} [3.448]
Log(Quotashare)	7.360^{**} [5.098]
Mean of Total Reserves in Months of Imports	−0.062 [−0.911]
Mean of Real GDP per Capita	0.155 [1.038]
Mean of Real GDP per Capita Squared	−0.002 [−0.402]
Mean Years Under Program	−0.019 [−0.747]
Mean of OECD	-2.292^{**} [−2.452]
Mean of Log(Quotashare)	-7.169^{**} [−4.779]
Mean of Growth Rate of Real GDP per Capita Lagged	−0.017 [−0.247]
Number of Observations for the selection equation:	2256

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 11: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	-0.006 [-0.640]
Government Share	-0.008 [-0.2585]
Investment Share	0.088 [1.526]
Inflation	-0.003^{*} [-2.246]
Democracy	0.269^{*} [2.270]
Loan-Quota Ratio	0.8345 [0.835]
Mean of Total Reserves in Months of Imports	0.003 [0.022]
Mean of Real GDP per Capita	-0.213 [-1.309]
Mean of Real GDP per Capita Squared	0.012 [1.164]
Mean Years Under Program	0.036 [0.610]
Mean of OECD	-1.328 [-0.865]
Mean of Log(Quotashare)	0.767 [1.491]
Mean of Growth Rate of Real GDP per Capita Lagged	0.674^{**} [5.187]
τ_1	-0.674 [-1.813]
τ_2	0.553^{**} [2.472]
Number of Observations:	745

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 12: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	−0.006 [−0.668]
Government Share	−0.003 [−0.101]
Investment Share	0.074 [1.315]
Inflation	−0.003** [−2.370]
Democracy	0.269* [2.270]
Loan-Quota Ratio	−0.698 [−1.219]
*Loan-Quota Ratio * Amount-Drawn-Amount-Agreed Ratio*	1.256** [2.939]
Mean of Total Reserves in Months of Imports	−0.004 [−0.031]
Mean of Real GDP per Capita	−0.169 [−1.048]
Mean of Real GDP per Capita Squared	0.008 [0.801]
Mean Years Under Program	0.051 [0.840]
Mean of OECD	−1.473 [−0.957]
Mean of Log(Quotashare)	0.954* [1.969]
Mean of Growth Rate of Real GDP per Capita Lagged	0.637** [4.807]
τ_1	−0.606 [−1.353]
τ_2	0.494* [2.185]
Number of Observations:	745

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 13: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	−0.005 [−0.560]
Government Share	−0.009 [−0.309]
Investment Share	0.082 [1.458]
Inflation	−0.003* [−2.194]
Democracy	0.251* [2.181]
Loan-Quota Ratio	0.467 [1.158]
*Loan-Quota Ratio * Growth of Index of Institutional Quality*	5.179** [3.020]
Mean of Total Reserves in Months of Imports	0.989 [0.497]
Mean of Real GDP per Capita	0.006 [0.045]
Mean of Real GDP per Capita Squared	−0.173 [−1.076]
Mean Years Under Program	0.371 [0.022]
Mean of OECD	−1.235 [−0.799]
Mean of Log(Quotashare)	0.699 [1.390]
Mean of Growth Rate of Real GDP per Capita Lagged	0.686** [5.309]
τ_1	−0.901* [−2.072]
τ_2	0.576** [2.606]
Number of Observations:	745

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 14: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	-0.026 [-1.740]
Government Share	0.033 [0.739]
Investment Share	0.048 [0.511]
Inflation	-0.003^{**} [-3.309]
Democracy	0.307 [1.580]
Loan-Quota Ratio	-0.475 [-0.675]
*Loan-Quota Ratio * Amount-Drawn-Amount-Agreed-Ratio*	1.460^{*} [2.605]
Mean of Total Reserves in Months of Imports	-0.057 [-0.285]
Mean of Real GDP per Capita	-0.024 [-0.066]
Mean of Real GDP per Capita Squared	0.009 [0.286]
Mean Years Under Program	0.003 [0.055]
Mean of OECD	-0.824 [-0.411]
Mean of Log(Quotashare)	0.520 [0.711]
Mean of Growth Rate of Real GDP per Capita Lagged	0.639^{**} [4.482]
τ_1	-1.019 [-1.926]
τ_2	0.325 [1.078]
Number of Observations:	542

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1985 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 15: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	−0.023 [−1.556]
Government Share	0.029 [0.643]
Investment Share	0.055 [0.639]
Inflation	0.003** [−2.887]
Democracy	0.306 [1.569]
Loan-Quota Ratio	0.795 [1.770]
*Loan-Quota Ratio * Growth of Index of Institutional Quality*	5.180** [2.764]
Mean of Total Reserves in Months of Imports	−0.088 [−0.458]
Mean of Real GDP per Capita	−0.213 [−0.590]
Mean of Real GDP per Capita Squared	0.030 [0.973]
Mean Years Under Program	−0.020 [−0.324]
Mean of OECD	0.739 [0.372]
Mean of Log(Quotashare)	0.306 [0.416]
Mean of Growth Rate of Real GDP per Capita Lagged	0.681** [5.193]
τ_1	−1.233* [−2.264]
τ_2	0.290 [0.977]
Number of Observations:	542

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses annual data, the sample extends from 1985 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 16: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	0.009^{**} [4.122]
Government Share	0.205 [0.205]
Investment Share	-0.013 [-0.676]
Inflation	-0.000^{*} [-2.248]
Democracy	0.214^{**} [2.472]
Loan-Quota Ratio	-3.243^{**} [-3.200]
*Loan-Quota Ratio * Growth of Index of Institutional Quality*	0.935 [0.112]
Mean of Total Reserves in Months of Imports	-0.031 [-0.382]
Mean of Real GDP per Capita	-0.244^{**} [-2.398]
Mean of Real GDP per Capita Squared	-0.173 [0.274]
Mean Years Under Program	0.211^{**} [3.617]
Mean of OECD	-0.917 [-0.852]
Mean of Log(Quotashare)	1.429^{**} [4.379]
Mean of Growth Rate of Real GDP per Capita Lagged	0.838^{**} [10.213]
τ_1	3.261^{**} [3.052]
τ_2	-0.014 [-0.057]
Number of Observations:	253

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses quinquennial data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 17: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	0.009^{**} [4.016]
Government Share	0.002 [0.141]
Investment Share	-0.006 [-0.284]
Inflation	0.000^{**} [-2.497]
Democracy	0.220^{*} [2.560]
Loan-Quota Ratio	-4.022^{**} [-3.917]
*Loan-Quota Ratio * Amount-Drawn-Amount-Agreed-Ratio*	1.547^{*} [2.316]
Mean of Total Reserves in Months of Imports	-0.028 [-0.348]
Mean of Real GDP per Capita	-0.220^{*} [-2.149]
Mean of Real GDP per Capita Squared	0.000 [-0.017]
Mean Years Under Program	0.210^{**} [3.859]
Mean of OECD	-0.795 [-0.675]
Mean of Log(Quotashare)	1.453^{**} [4.727]
Mean of Growth Rate of Real GDP per Capita Lagged	0.837^{**} [10.408]
τ_1	3.221^{**} [3.218]
τ_2	-0.018 [-0.082]
Number of Observations:	253

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses quinquennial data, the sample extends from 1975 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 18: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	0.003 [0.730]
Government Share	0.008 [0.375]
Investment Share	−0.004 [−0.168]
Inflation	−0.001** [−3.072]
Democracy	0.337** [2.566]
Loan-Quota Ratio	−2.518** [−3.002]
*Loan-Quota Ratio * Growth of Index of Institutional Quality*	2.563 [0.299]
Mean of Total Reserves in Months of Imports	0.086 [1.315]
Mean of Real GDP per Capita	−0.129 [−0.391]
Mean of Real GDP per Capita Squared	−0.009 [−0.275]
Mean Years Under Program	0.136** [2.756]
Mean of OECD	0.544 [0.675]
Mean of Log(Quotashare)	0.754 [1.470]
Mean of Growth Rate of Real GDP per Capita Lagged	0.869** [5.143]
τ_1	2.508** [2.746]
τ_2	0.079 [0.178]
Number of Observations:	178

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses quinquennial data, the sample extends from 1985 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Table 19: Growth Equation: FE Panel Model

Independent Variables	**Coefficients**
Openness	0.003 [0.756]
Government Share	0.008 [0.358]
Investment Share	−0.002 [−0.097]
Inflation	−0.001** [−2.726]
Democracy	0.339** [2.712]
Loan-Quota Ratio	−2.967** [−3.967]
*Loan-Quota Ratio * Amount-Drawn-Amount-Agreed-Ratio*	0.936 [1.199]
Mean of Total Reserves in Months of Imports	0.097 [1.392]
Mean of Real GDP per Capita	−0.149 [−0.426]
Mean of Real GDP per Capita Squared	−0.006 [−0.182]
Mean Years Under Program	0.135** [2.860]
Mean of OECD	0.860 [0.953]
Mean of Log(Quotashare)	0.777 [1.493]
Mean of Growth Rate of Real GDP per Capita Lagged	0.860** [5.016]
τ_1	2.848** [2.813]
τ_2	0.036 [0.075]
Number of Observations:	178

Note: The dependent variable is real GDP growth per capita. t-statistics are displayed in square brackets underneath the coefficient estimates. A "*" indicates significance at the 5% level and a "**" indicates significance at the 1% level. The regression uses quinquennial data, the sample extends from 1985 to 2005 and the number of countries considered is 94. A description of all variables used is provided in Appendix C.

Appendix A: Computation of Conditional Expectations and of Standard Errors

In this appendix we first discuss the computation of the conditional expectation in Equation (10) needed to correct the output growth equation, that is Equation (1), under the random effects specification for sample selection bias, while also allowing for endogeneity of d_{it}.[16] The conditional expectation of v_{it} given $\boldsymbol{Z}_i, \boldsymbol{d}_i$, and α_i on the right hand side of Equation (2) is calculated as follows:

$$E(v_{it}|\boldsymbol{Z}_i, \boldsymbol{d}_i, \alpha_i) = \left[d_{it} - (\alpha_i + \boldsymbol{z}'_{it}\boldsymbol{\gamma})\right] 1_{(d_{it}>0)} - \left(\sigma_\upsilon \frac{\phi(\frac{\alpha_i + \boldsymbol{z}'_{it}\boldsymbol{\gamma}}{\sigma_\upsilon})}{\Phi(\frac{-\alpha_i - \boldsymbol{z}'_{it}\boldsymbol{\gamma}}{\sigma_\upsilon})} \right) 1_{(d_{it}=0)}, \quad (23)$$

where ϕ and Φ denote the standard normal probability and cumulative density functions, respectively, and $1(\cdot)$ denotes the indicator function.

Using this expression, the conditional expectation of u_{it} given $\boldsymbol{Z}_i$ and $\boldsymbol{d}_i$, Equation (10), can be obtained as:

$$E[u_{it}|\boldsymbol{Z}_i, \boldsymbol{d}_i] = \int \left\{ \alpha_i + \left[d_{it} - (\alpha_i + \boldsymbol{z}'_{it}\boldsymbol{\gamma})\right] 1_{(d_{it}>0)} - \sigma_\upsilon \frac{\phi(\frac{\alpha_i + \boldsymbol{z}'_{it}\boldsymbol{\gamma}}{\sigma_\upsilon})}{\Phi(\frac{-\alpha_i - \boldsymbol{z}'_{it}\boldsymbol{\gamma}}{\sigma_\upsilon})} 1_{(d_{it}=0)} \right\}$$
$$\cdot \frac{\left[\prod_{t=1}^{T} \Phi(\frac{-\alpha_i - \boldsymbol{z}'_{it}\boldsymbol{\gamma}}{\sigma_\upsilon}) 1_{(d_{it}=0)} \frac{1}{\sigma_\upsilon} \phi(\frac{d_{it} - \alpha_i - \boldsymbol{z}'_{it}\boldsymbol{\gamma}}{\sigma_\upsilon}) 1_{(d_{it}>0)}\right] \frac{1}{\sigma_\alpha} \phi(\frac{\alpha_i}{\sigma_\alpha})}{\int \left[\prod_{t=1}^{T} \Phi(\frac{-\alpha_i - \boldsymbol{z}'_{it}\boldsymbol{\gamma}}{\sigma_\upsilon}) 1_{(d_{it}=0)} \frac{1}{\sigma_\upsilon} \phi(\frac{d_{it} - \alpha_i - \boldsymbol{z}'_{it}\boldsymbol{\gamma}}{\sigma_\upsilon}) 1_{(d_{it}>0)}\right] \frac{1}{\sigma_\alpha} \phi(\frac{\alpha_i}{\sigma_\alpha}) d\alpha_i} d\alpha_i. \quad (24)$$

When obtaining standard errors for the estimates of the parameters of the output growth equation under the two-step procedure of Section 3, the sampling uncertainty that has entered the construction of the correction factors $\hat{u}_{it}$ and $\hat{\bar{u}}_i$ needs to be observed. The following estimator of the variance-covariance matrix of $\boldsymbol{\pi} = (\theta \; \boldsymbol{\beta}' \; \tau_1 \; \tau_2)'$ reflects this sampling uncertainty:

$$\hat{Var}_N = \frac{1}{N} \hat{\boldsymbol{G}}_N^{-1} \left(\hat{\boldsymbol{V}}_N + \hat{\boldsymbol{D}}_N \hat{\boldsymbol{W}}_N \hat{\boldsymbol{D}}'_N \right) \hat{\boldsymbol{G}}_N^{-1}, \quad (25)$$

[16] Note that the conditional expectation $E(\tilde{u}_{it}|\boldsymbol{Z}_i, \boldsymbol{d}_i)$ arising under the fixed effects specification can be computed in analogous fashion, and thus need not be considered separately.

where $\hat{\boldsymbol{W}}_N = \hat{Var}_N(\hat{\boldsymbol{\gamma}})$,

$$\hat{\boldsymbol{G}}_N = \frac{1}{N}\sum_{i=1}^{N} \boldsymbol{R}_i' \boldsymbol{R}_i, \tag{26}$$

$$\hat{\boldsymbol{V}}_N = \frac{1}{N}\sum_{i=1}^{N} \boldsymbol{R}_i' \hat{\boldsymbol{e}}_i \hat{\boldsymbol{e}}_i' \boldsymbol{R}_i, \tag{27}$$

$$\hat{\boldsymbol{D}}_N = \frac{1}{N}\sum_{i=1}^{N} \boldsymbol{R}_i' \frac{\partial \left[(\hat{\boldsymbol{u}}_i \ \hat{\bar{u}}_i \boldsymbol{\iota}) \ \hat{\boldsymbol{\tau}} \right]}{\partial \boldsymbol{\gamma}} \Big|_{\boldsymbol{\gamma}=\hat{\boldsymbol{\gamma}}}, \tag{28}$$

with

$$\boldsymbol{R}_i = \left(\boldsymbol{d}_i \ \boldsymbol{x}_i' \ \hat{\boldsymbol{u}}_i \ \hat{\bar{u}}_i \boldsymbol{\iota} \right), \tag{29}$$

$$\boldsymbol{\tau} = (\tau_1 \ \tau_2)', \tag{30}$$

and $\boldsymbol{\iota}$ is again a vector of ones of size T_i. Note that if $\tau_2 = 0$ is imposed in the estimation, then it appears sensible to also impose that $\hat{\boldsymbol{e}}_i \hat{\boldsymbol{e}}_i'$ is a diagonal matrix (reflecting that e_{it} is restricted to be intertemporally uncorrelated).

Computation of the standard errors of the growth equation parameter estimates under the fixed effects specification can proceed in analogy to Equations (25) and (30).

Appendix B: Calculating Standard Errors for the Chebyshev Polynomial

[To be added.]

Appendix C: Description of Variables

Variables	Source
Real GDP per capita: International Dollar in 2000 Constant Prices, thousand dollars.	Penn World Tables 6.2
Openness in constant prices: Percent in 2000 constant prices.	Penn World Tables 6.2
Government share of real GDP: Percent in 2000 Constant prices.	Penn World Tables 6.2
Investment share of real GDP: Percent in 2000 Constant prices.	Penn World Tables 6.2
Growth rate of real GDP per capita: Percent in 2000 constant prices.	Penn World Tables 6.2
Total reserves in months of imports: Total reserves comprise holdings of monetary gold, special drawing rights, reserves of IMF members held by the IMF, and holdings of foreign exchange under the control of monetary authorities. The gold component of these reserves is valued at year-end (December 31) London prices. This item shows reserves expressed in terms of the number of months of imports of goods and services which could be paid for.	World Development Indicators 2006 CD-ROM
GDP per capita: GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 2000 U.S. dollars.	World Development Indicators 2006 CD-ROM
Inflation: Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a fixed basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used.	World Development Indicators 2006 CD-ROM
Life expectancy at birth: Life expectancy at birth indicates the number of years a newborn infant would live if prevailing patterns of mortality at the time of its birth were to stay the same throughout its life.	World Development Indicators 2006 CD-ROM
General government final consumption expenditure: General government final consumption expenditure includes all government current expenditures for purchases of goods and services (including compensation of employees). It also includes most expenditures on national defense and security, but excludes government military expenditures that are part of government capital formation.	World Development Indicators 2006 CD-ROM
OECD dummy: dummy equals one for all time periods for which the country is in the OECD. One exception is Turkey which is dropped from the OECD economies..	OECD[17]
Net financial flows, IMF concessional: Net financial flows are disbursements of loans and credits less repayments of principal. IMF is the International Monetary Fund. Concessional assistance is provided through concessional lending facilities. Data are in current U.S. dollars.	World Development Indicators 2006 CD-ROM
Dummy for program participation: based on monthly data. A dummy is only set to one if at least during five months for a year the program took place.	International Financial Statistics and own calculations
Democracy index: Legal Index of Electoral Competitiveness (LIEC): Codified with 1 if it has a value of 6 or larger which is the threshold for democratic systems.	World Bank Political Institutions Dataset
Quota: Countries' quota in millions of standard drawing rights (SDR).	International Financial Statistics
Loan-quota ratio: sum of all loan programs/quota.	International Financial Statistics and own calculation
Amount agreed-drawn ratio: ratio between amount agreed in an IMF loan program and the undrawn balance in t.	International Financial Statistics and own calculations
Government Stability: this is an assessment both of the government's ability to carry out its declared program(s), and its ability to stay in office. The risk rating assigned is the sum of three subcomponents, each with a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to very low risk and a score of 0 points to very high risk. The subcomponents are: government unity, legislative strength and popular support.	International Country Risk Guide
Investment Profile: this is an assessment of factors affecting the risk to investment that are not covered by other political, economic and financial risk components. The risk rating assigned is the sum of three subcomponents, each with a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to very low risk and a score of 0 points to very high risk. The subcomponents are: contract viability/expropriation, profits repatriation, payment delays.	International Country Risk Guide
Internal Conflict: this is an assessment of political violence in the country and its actual or potential impact on governance. The highest rating is given to those countries where there is no armed or civil opposition to the government and the government does not indulge in arbitrary violence, direct or indirect, against its own people. The lowest rating is given to a country embroiled in an on-going civil war. The risk rating assigned is the sum of three subcomponents, each with a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to very low risk and a score of 0 points to very high risk. The subcomponents are: civil war/coup threat, terrorism/political violence and civil disorder.	International Country Risk Guide

[17] See http://www.oecd.org/document/58/0,3343,en_2649_201185_1889402_1_1_1_1,00.html

External Conflict: the external conflict measure is an assessment both of the risk to the incumbent government from foreign action, ranging from non-violent external pressure (diplomatic pressures, withholding of aid, trade restrictions, territorial disputes, sanctions, etc) to violent external pressure (cross-border conflicts to all-out war). External conflicts can adversely affect foreign business in many ways, ranging from restrictions on operations, to trade and investment sanctions, to distortions in the allocation of economic resources, to violent change in the structure of society. The risk rating assigned is the sum of three subcomponents, each with a maximum score of four points and a minimum score of 0 points. A score of 4 points equates to very low risk and a score of 0 points to very high risk. The subcomponents are: war, cross-border conflict and foreign pressures.	International Country Risk Guide
Corruption: this is an assessment of corruption within the political system. Such corruption is a threat to foreign investment for several reasons: it distorts the economic and financial environment; it reduces the efficiency of government and business by enabling people to assume positions of power through patronage rather than ability; and, last but not least, introduces an inherent instability into the political process. The most common form of corruption met directly by business is financial corruption in the form of demands for special payments and bribes connected with import and export licenses, exchange controls, tax assessments, police protection, or loans. Such corruption can make it difficult to conduct business effectively, and in some cases my force the withdrawal or withholding of an investment. Although our measure takes such corruption into account, it is more concerned with actual or potential corruption in the form of excessive patronage, nepotism, job reservations, favor-for-favors and secret party fund.	International Country Risk Guide
Military in Politics: the military is not elected by anyone. Therefore, its involvement in politics, even at a peripheral level, is a diminution of democratic accountability. However, it also has other significant implications. The military might, for example, become involved in government because of an actual or created internal or external threat. Such a situation would imply the distortion of government policy in order to meet this threat, for example by increasing the defense budget at the expense of other budget allocations. In some countries, the threat of military take-over can force an elected government to change policy or cause its replacement by another government more amenable to the military's wishes. A military takeover or threat of a takeover may also represent a high risk if it is an indication that the government is unable to function effectively and that the country therefore has an uneasy environment for foreign businesses. A full-scale military regime poses the greatest risk.	International Country Risk Guide
Religion in Politics: religious tensions may stem from the domination of society and/or governance by a single religious group that seeks to replace civil law by religious law and to exclude other religions from the political and/or social process; the desire of a single religious group to dominate governance; the suppression of religious freedom; the desire of a religious group to express its own identity, separate from the country as a whole. The risk involved in these situations range from inexperienced people imposing inappropriate policies through civil dissent to civil war.	International Country Risk Guide
Law and Order: law and order are assessed separately, with each sub-component comprising zero to three points. The Law sub-component is an assessment of the strength and impartiality of the legal system, while the Order sub-component is an assessment of popular observance of the law. Thus, a country can enjoy a high rating 3 in terms of its judicial system, but a low rating 1 if it suffers from a very high crime rate of if the law is routinely ignored without effective sanction (for example, widespread illegal strikes).	International Country Risk Guide
Ethnic Tensions: this component is an assessment of the degree of tension within a country attributable to racial, nationality, or language divisions. Lower ratings are given to countries where racial and nationality tensions are high because opposing groups are intolerant and unwilling to compromise. Higher ratings are given to countries where tensions are minimal, even though such differences may still exist.	International Country Risk Guide
Democratic Accountability: this is a measure of how responsive government is to its people, on the basis that the less responsive it is, the more likely it is that the government will fall, peacefully in a democratic society, but possibly violently in a non-democratic one.	International Country Risk Guide
Bureaucracy Quality: The institutional strength and quality of the bureaucracy is another shock absorber that tends to minimize revisions of policy when governments change. Therefore, high points are given to countries where the bureaucracy has the strength and expertise to govern without drastic changes in policy or interruptions in government services. In these low risk countries, the bureaucracy tends to be somewhat autonomous from political pressure and to have an established mechanism for recruitment and training. Countries that lack the cushioning effect of a strong bureaucracy receive low points because a change in government tends to be traumatic in terms of policy formulation and day-to-day administrative functions.	International Country Risk Guide
Educational attainment: total population aged 15 and over average years of school.	Worldbank
Institutional Index: set up from the variables educational attainment, life expectancy, government stability, bureaucracy quality, law and order, ethnic tensions and internal conflict	International Country Risk Guide and own calculations

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Appendix D: Countries Contained in Data Set[18]

Algeria	El Salvador	Liberia	Sierra Leone
Angola	Finland	Libya	Singapore
Argentina	France	Madagascar	Somalia
Australia	Gambia, The	Malawi	South Africa
Austria	Germany	Malaysia	Spain
Bangladesh	Ghana	Mali	Sri Lanka
Belgium	Greece	Mexico	Sudan
Bolivia	Guatemala	Morocco	Sweden
Botswana	Guinea	Mozambique	Switzerland
Brazil	Guinea-Bissau	Namibia	Syrian Arab Republic
Burkina Faso	Guyana	Netherlands	Thailand
Cameroon	Haiti	New Zealand	Togo
Canada	Honduras	Nicaragua	Trinidad and Tobago
Chile	India	Niger	Tunisia
Colombia	Indonesia	Nigeria	Turkey
Congo, Dem. Rep.	Ireland	Norway	Uganda
Congo, Rep.	Israel	Pakistan	United Kingdom
Costa Rica	Italy	Panama	United States
Cote d'Ivoire	Jamaica	Papua New Guinea	Uruguay
Cyprus	Japan	Paraguay	Venezuela, RB
Denmark	Jordan	Peru	Zambia
Dominican Republic	Kenya	Philippines	Zimbabwe
Ecuador	Korea, Rep.	Portugal	
Egypt, Arab Rep.	Lebanon	Senegal	

[18]Major oil exporting countries and centrally planned economies have been excluded.

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