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IMF lending arrangements in emerging and developing countries – participation and prediction

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ABSTRACT

The literature on determinants of International Monetary Fund (IMF) interventions in emerging and developing countries shows that the IMF's decisions are determined by political and economic causes. This article empirically investigates economic factors, showing that a country's probability to sign an IMF arrangement can be predicted by looking at a core group of macroeconomic variables. Using discriminant analysis we develop a score function that allows us to predict a country's future participation in IMF programmes. The study covers 153 emerging and developing countries, over more than 30 years (1980–2011) and 654 agreements, for both non-concessional and concessional loans. The proposed tools are simple, consistent and relevant and they can be used both to monitor an IMF country and its economic development in real time and to forecast future demand for IMF aid.

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1. Introduction

The recent financial crisis has induced a need for new answers and policy tools for the basic economic and financial problems, both at international and national level. Beyond doubt, International Monetary Fund (IMF) is still one of the most important institutions in the international financial architecture and there are many national governments, specialists and academics who are optimistic about its future. Attempting to reinvent itself after almost 70 years since it was created, the IMF continues to have a central role especially in the emerging economies, both in post-crisis recovery programmes and in pro-growth strategies.

There are two major questions in the scientific literature regarding the IMF's role in the global economy: why countries borrow from the IMF and what the effects of the IMF's interventions are. When it comes to the first research question, the studies show that the determinants of IMF interventions are both economic and political. In this article we argue that despite the political and institutional causes that influence a country's decision to sign an agreement with the IMF, the most important decisions are the economic conditions. In order

to sustain this idea, we use a Z-score model to predict the emerging countries' probability of participating in an IMF lending programme. Using discriminant analysis, we emphasise that a combination of five key macroeconomic variables is sufficient to answer accurately enough to the first question: will the country participate in the IMF lending arrangement?

This article contributes to the literature in two ways: (1) it empirically investigates economic determinants of IMF lending arrangements, using a different methodology than other studies in this field – our score function predicts a request of an IMF loan; (2) it has a practical relevance, because the prediction rate is over 80% it shows that our model could be used to monitor an IMF country and its economic development in real time and to forecast future demand for IMF aid. The research covers 153 emerging and developing countries, over more than 30 years (1980–2011) and 654 agreements, for both non-concessional and concessional loans. Eventually, the aim of the article is to develop a score function that allows us to predict the possibility of a financial agreement with the IMF.

The rest of the article is organised as follows. Section 2 provides a review of the literature on the determinants of the probability that a country receives financing from the IMF. Section 3 describes data series and the methodology developed for constructing the score function to predict the existence of a financial agreement with the IMF and presents the empirical results. The final conclusions are given in section 4.

2. Literature review

The general literature on IMF is focused on a wide range of problems, such as the institutional reform (Rovčanin & Kožarić, 2008) or the effectiveness of IMF programmes (Eke & Kutun, 2009). Analysing the literature on the determinants of the probability of a country receiving financing from the IMF we found a long list of economic variables and a short register of political variables. The main problem is that there is a dissent about which ones really matter.

The fundamental motivation for seeking IMF financial support is to solve the balance of payments problems. However, the first article of Agreement of the IMF stipulates among Fund purposes:

... to give confidence to members by making the general resources of the Fund temporarily available to them under adequate safeguards, thus providing them with opportunity to correct maladjustments in their balance of payments without resorting to measures destructive of national or international prosperity ... to shorten the duration and lessen the degree of disequilibrium in the international balances of payments of members. (IMF, 2011)

More and more emerging and developing countries had considered the option of calling the Fund financial aid. But the eligibility of a country itself is not enough to require a loan from the IMF. Comprehensive summaries of the studies regarding the determinants of IMF credit can be found in Sturm, Berger, and de Haan (2005) for the period 1992–1994, Ghosh, Goretti, Joshi, Thomas, and Zalduendo (Ghosh, Goretti, Joshi, Thomas, & Zalduendo, 2007) covering 1996–2006 and Moser and Sturm (2011) for the 2005–2010 period.

Most of these studies are empirical and they model participation in an IMF programme as a binary choice (logit, probit) or using linear regression (ordinary least squares [OLS]) or extreme bounds analysis, focusing on a various number of economic and/or political factors which determine borrowing from the IMF. Few papers use discriminant analyses and descriptive statistics in order to identify some factors that determine the demand for

an IMF loan. A brief summary of the main contribution to the literature in this particular area, based on the methodology and sample used could be as follows:

- *Logit analysis*: Joyce (1992) – 45 countries, 1980–1984; Bird (1996) – 40 countries, 1980–1985; Veiga (2005) – 10 countries, 1957–1999; Andersen, Harr, and Tarp (2006) – 102 countries, 1995–2000; Pop-Eleches (2009) – Latin American and East European countries, 1982–2001; Dreher, Sturm, and Vreeland (2009) – 197 countries, 1951–2004; Copelovitch (2010) – 47 countries, 1984–2003;
- *Probit analysis*: Conway (1994) – 74 countries, 1976–1986; Knight and Santaella (1997) – 91 developing countries, 1973–1991; Bird and Rowlands (2001) – 95 countries, 1974–1994; Marchesi (2003) – 93 developing countries, 1983–1995; Dreher (2004) – 54 countries, 1976–1997; Barro and Lee (2005) – 130 countries, 1975–1999; Eichengreen, Gupta, and Mody (Eichengreen, Gupta, & Mody, 2006) – 24 emerging countries, 1980–2003; Stone (2007) – all IMF programmes, 1992–2002; Ghosh et al. (2007) – 1974–2005; Cerutti (2007) – 59 countries non-PRGF eligible developing countries, 1982–2005; Marchesi and Sabani (2007) – 53 middle-income countries, 1982–2001; Elekdag (2008) – 169 countries, 1970–2004; Reynaud and Vauday (2009) – 107 emerging and developing countries, 1990–2003; Bal-Gunduz (2009) – 55 low-income countries, 1980–2004; Bird and Rowlands (2009a) – 88 low and middle income countries, 1977–2000; Bird and Rowlands (2009b) – emerging and developing countries, 1973–2000; Breen (2010) – 159 developing and emerging economies, 1983–2006; Presbitero and Zazzaro (2012) – 118 low and middle-income countries, January 2008–June 2010;
- *Discriminant analysis*: Santaella (1995) – 78 developing countries, 1973–1991;
- *Extreme bounds analysis*: Sturm et al. (2005) – 118 countries, 1971–2000; Moser and Sturm (2011) – 165 countries, 1990–2009;
- *Linear probability model* – Nooruddin and Simmons (2006) – 130 countries; 1980–2000;
- *OLS method*: Dreher and Vaubel (2004) – 94 countries, 1975–1997; Dreher (2006) – 98 countries, 1970–2000;
- *Granger causality test*: Ozturk (2009) – 88 developing countries, 1975–2004.

Although a lot of studies have used the logit or probit regression as a statistical method, there are many similarities with the discriminant analysis, thus:

- these are multivariate statistical methods which can be applied for the same research area;
- the functional form of these methods is the same;
- all these methods estimate probabilities and allow the inclusion of a particular value into a group of dependent variables.

The main difference occurs in the estimation of the coefficient. Discriminant analysis produces a score, while regression generates a logit/probit.

Pohar, Blas, and Turk (2004) think that ‘linear discriminant analysis is a more appropriate method when the explanatory variables are normally distributed’ (p. 160). It fails only when the number of categories is below three. The authors underline that ‘the differences between the methods become negligible with a sample size of 50 and more, when the methods differently allocate only about 0.5% of the cases’.

Savić, Brčanov, and Dakić (2008, p. 29) consider discriminant analysis much easier to use and to understand in the case of prediction of group membership, while logit regression

‘requires separate regression models for each of the groups except one, which is determined by subtraction’.

Our choice for discriminant analysis is supported by the following arguments:

- it is a useful tool to identify the variables that allow us to discriminate between different groups and to determine the factors affecting the differentiation between groups;
- discriminant independent variables are assumed to be continuous;
- it gives as a result the probability of a group membership.

3. Data series and methodology. Empirical results

The aim of the empirical research is to develop a score function that allows us to predict the possibility of a financial agreement with the IMF. This function is likely to be applied to the emerging and developing countries according to the IMF classification.

The method used to estimate the score function is discriminant analysis.

The principle of discriminant analysis is to find a boundary between the countries that are in a position to obtain a loan from the IMF and countries with sound macroeconomic situation, which do not need a loan.

Score function is defined as follows:

$$F(x) = \alpha_1(x_1 - p_1) + \alpha_2(x_2 - p_2) + \dots + \alpha_k(x_k - p_k) \quad (1)$$

where:

$\alpha_i(x_i - p_i)$ = the contribution of the ‘i’ indicator to score $F(x)$;

α_i = estimated coefficient;

p_i = pivot point;

$$p_i = \frac{\mu_{Fi} + \mu_{Ni}}{2}$$

μ_{Fi} and μ_{Ni} = averages of the indicator ‘i’ for countries with loan and countries without loan.

This way of writing function has the advantage of indicating the most influential indicators of the value of the score in the diagnosis of a country’s economy. Favourable indicators have a positive contribution, while unfavourable indicators have a negative contribution.

In a preliminary stage of the discriminant analysis, the score function has the following form:

$$Z = (\mu_N - \mu_F)' T^{-1} \left(x_i - \frac{\mu_{Fi} + \mu_{Ni}}{2} \right) \quad (2)$$

where:

μ_{Fi} and μ_{Ni} = averages of the indicator ‘i’ for countries with loan and countries without loan;

$(\mu_N - \mu_F)'$ = transposed matrix of the difference between the averages for selected indicators;

T = variance-covariance matrix;

x_i = indicator ‘i’.

In developing the score function for predicting the need to request a loan agreement with the IMF, we will go through the following stages:

- estimation of the discriminant function;
- selection of the qualitative evaluation intervals;
- examination of the score function predictive ability.

3.1. Estimation of the discriminant function

A first step in developing the function is the choice of a sample of countries that comprise the two groups (countries in need which received loans from the IMF and countries without financial difficulties which do not require loan agreements).

In order to build Z-score we analysed a number of 153 countries classified by the IMF as emerging and developing economies. In our analysis all types of loans are included, both non-concessional and concessional financing agreements: Stand-By Arrangements (SBA), Flexible Credit Line (FCL), Precautionary and Liquidity Line (PLL), Extended Fund Facility (EFF), Extended Credit Facility (ECF), Standby Credit Facility (SCF) and Rapid Credit Facility (RCF), in a total of 654 agreements. For this we used the IMF History of Lending Arrangements database from 1 May 1984 to 31 May 2013 (IMF, 2013a).

Two groups of countries were selected on which will be applied the discriminant analysis:

- 42 countries with IMF financing agreements underway on 1 January 2013 (all countries with a financing agreement);
- 42 countries without IMF financing agreements underway on 1 January 2013 (even if they have benefited from financing agreements in the past), sorted on a random basis. This group was chosen in order to ensure comparability with the group of countries with financing agreements underway.

The next step is the selection of indicators that make the best discrimination for the two groups of countries.

The analysis took into account the period 1980–2011 (the last year with complete data from the IMF) and used an initial number of 56 economic indicators listed in Appendix 1. For each country, the data sources of macroeconomic variables were the IMF – World Economic Outlook database (IMF, 2013b) and the World Bank – World Development Indicators database (World Bank, 2013).

According to the existing studies, the demand for IMF credit is inversely related to GDP growth, investment, current account balance and international reserves holdings. For the selection of the indicators in the score function, we applied the tests of significance, looking for those indicators with a *p-value* less than 0.05. So, we have chosen a total of five indicators, as follows:

- Gross domestic product in constant prices (as percent change) – Annual percentages of constant price GDP are year-on-year changes; the base year is country-specific;
- Gross national savings (as percent of GDP) – expressed as a ratio of gross national savings in current local currency and GDP in current local currency;
- General government revenue (as percent of GDP) – revenue consists of taxes, social contributions, grants receivable, and other revenue;

- Current account balance (as percent of GDP) – current account is all transactions other than those in financial and capital items. The major classifications are goods and services, income and current transfers;
- Foreign direct investment, net inflows (percent of GDP).

Having the selected variables, we return to the form of Z-score (formula 2).

Based on the indicators of the 84 selected countries (highlighted in Appendix 2) and on the methodology explained above, the final form of the score function is:

$$Z = 0.1345x_1 + 0.0221x_2 - 0.0105x_3 + 0.0464x_4 - 0.0129x_5 - 0.1933 \quad (3)$$

where:

- x_1 = Gross domestic product in constant prices (as percent change);
- x_2 = Gross national savings (as percent of GDP);
- x_3 = General government revenue (as percent of GDP);
- x_4 = Current account balance (as percent of GDP);
- x_5 = Foreign direct investment, net inflows (as percent of GDP).

Values of the selected indicators in funding of this score function were used according to the following criteria:

- For countries with IMF financing agreements underway on 1 January 2013, indicators were selected from the previous year of the financing agreement;
- For countries without IMF financing agreements underway on 1 January 2013, indicators were selected for 2011.

The selection of indicators from the previous year (for countries with agreement), respectively 2011 (for countries without agreement) is explained by the fact that the economic situation in the year before the agreement has the highest power of prediction.

3.2 Selection of the qualitative evaluation intervals

Assessment of this score is based on the following classification, which allows a prediction rate of 82.14%.

Inflexion points of the model

Interval Z	Assessment
$Z < 0$	Country receives IMF financing
$Z \geq 0$	Country does not receive IMF financing

3.3 Examination of the score function predictive ability

Considering another sample of countries, we analysed the accuracy of the prediction that performs the function Z previously established. Thus, a sample of countries was selected for which it was tested *posteriori* the final form of the score function (listed in Appendix 3). This sample test was determined by selecting other 69 emerging and developing countries (with and without financing agreement in the past) not included in the initial sample (a priori analysis) for the score function construction.

The reporting year was similarly selected, thus:

- for countries that have benefited from funding agreements in the past, indicators were selected from the previous year of the financing agreement;
- for countries that have not benefited from funding agreements in the past, indicators were selected for 2011.

Given the above information, the prediction's success rate of the sample test is 81.14%. For all observations (153 countries) the success rate prediction is 81.7%, representing a satisfactory level consistent with the results of other studies: Conway (1994) – nearly 90%; Knight and Santaella (1997) – over 80%; Cerutti (2007) – 82% in sample and only 63% of the total observations; Bal-Gunduz (2009) – 84% and 59% respectively in the first and the second model.

3.4 Limits and advantages of the Z-Score

Regarding the limitations of this score, they drift, on the one hand, of the general limits of discriminant analysis method, and on the other hand, of the specific limits of the Z-score.

Within the *limits* of this score we mention:

- Discriminant analysis involves the selection of the most relevant indicators, but they do not lead to the complete discrimination of the countries analysed;
- Regarding the chosen indicators, they cannot totally eliminate the interdependencies between them;
- The score function doesn't integrate the non-financial parameters, such as the social and political determinants. The diagnosis is reduced to a financial expression;
- Although the score function predicts the possibility of IMF financing to balance the macroeconomic situation of the country, the country policymakers may resort to the reforms of funding (not necessarily from the IMF);
- The validity of score function is provided for a given institutional and economic context and the conclusion of agreements with the IMF is often influenced by a number of political, institutional, legal and sociological factors concerning the analysed countries;
- Score highlights the difficulties of countries with a certain delay, being calculated on available data.

But Z-score presents *advantages* arising mainly from scoring method characteristics, thus:

- It is a method that can be applied easily, allowing a fast and relatively reliable assessment of macroeconomic risks of the analysed countries;
- It is useful for forecasting calculations, providing an initial view on health and key elements of the analysed countries;
- The score function manages a prediction with a success rate of over 80% on all observations (153 emerging and developing countries).

4. Conclusion

Analysing the literature on the determinants of the probability that a country receives financing from the IMF we found notable differences regarding the sample of countries, the period, the types of IMF arrangements and the method of analysis.

We focused on 153 countries – classified by the IMF as emerging and developing economies – over the period 1980–2011. One hundred and nineteen economies from the total have received IMF financial support at least once from 1 May 1984 to 31 May 2013. The database used includes all types of IMF loans, both concessional and non-concessional, in a total of 654 agreements.

Most of the studies do not cover the second half of the 2000s and the global crisis time and are likely to lose the vulnerabilities associated with serious global macroeconomic imbalances. Furthermore, these empirical studies model participation in an IMF programme as a binary choice (logit, probit) or using linear regression (OLS) or extreme bounds analysis, focusing on a various number of economic and/or political factors which determine borrowing from the IMF. A few papers use discriminant analyses and descriptive statistics in order identify some factors that determine a demand for IMF loan.

We have chosen discriminant analysis as statistical method to predict the possibility of a financing agreement with the IMF. The goal is to find the accurate line between the countries that are in the position to obtain a loan from the IMF and countries with sound macroeconomic situation, which do not need a loan.

For the elaboration of score function there were selected two groups of countries on which we applied discriminant analysis: 42 countries with IMF financing agreement underway on 1 January 2013; 42 countries without IMF financing agreements underway on 1 January 2013. We analysed the accuracy of the prediction that performs the function Z previously established on the second sample of 69 emerging and developing countries (with and without financing agreement in the past) – not included in the initial sample (a priori analysis) – for which it was tested *posteriori* the final form of the score function.

Consistent with the results of previous studies, the prediction rate is 81.7% for all observations (153 emerging and developing countries). The predictive performance is good, the out-of-sample results ensuring a similar value of 81.1%.

The major purpose of discriminant analysis is to predict, calculating the importance scores of the variables that best discriminate between the groups. Our score function predicts a request of an IMF loan to balance the macroeconomic situation of the country or the participation in an agreement with the IMF.

The results of this study can be used to monitor an IMF country and its economic development in real time and to forecast future demand for IMF credit.

Disclosure statement

No potential conflict of interest was reported by the authors.

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Appendix 1. Economic indicators used in analysis.

Subject Descriptor	Scale
Gross domestic product, constant prices	National currency
Gross domestic product, constant prices	Percent change
Gross domestic product, current prices	National currency
Gross domestic product, current prices	US dollars
Gross domestic product, deflator	Index
Gross domestic product per capita, constant prices	National currency
Gross domestic product per capita, current prices	National currency
Gross domestic product per capita, current prices	US dollars
Output gap in percent of potential GDP	Percent of potential GDP
Gross domestic product based on purchasing-power-parity (PPP) valuation of country GDP	Current international dollar
Gross domestic product based on purchasing-power-parity (PPP) per capita GDP	Current international dollar
Gross domestic product based on purchasing-power-parity (PPP) share of world total	Percent
Implied PPP conversion rate	National currency per current international dollar
Total investment	Percent of GDP
Gross national savings	Percent of GDP
Inflation, average consumer prices	Index
Inflation, average consumer prices	Percent change
Inflation, end of period consumer prices	Index
Inflation, end of period consumer prices	Percent change
Six-month London interbank offered rate (LIBOR)	Percent
Volume of imports of goods and services	Percent change
Volume of Imports of goods	Percent change
Volume of exports of goods and services	Percent change
Volume of exports of goods	Percent change
Value of oil imports	US dollars
Value of oil exports	US dollars
Unemployment rate	Percent of total labour force
Employment	Persons
Population	Persons
General government revenue	National currency
General government revenue	Percent of GDP
General government total expenditure	National currency
General government total expenditure	Percent of GDP
General government net lending/borrowing	National currency
General government net lending/borrowing	Percent of GDP
General government structural balance	National currency
General government structural balance	Percent of potential GDP
General government primary net lending/borrowing	National currency
General government primary net lending/borrowing	Percent of GDP
General government net debt	National currency
General government net debt	Percent of GDP
General government gross debt	National currency
General government gross debt	Percent of GDP
Gross domestic product corresponding to fiscal year, current prices	National currency
Current account balance	US dollars
Current account balance	Percent of GDP
Foreign direct investment, net	Current US dollar
Foreign direct investment, net inflows	Percent of GDP
Foreign direct investment, net inflows	Current US dollar
Total reserves	Percent of total external debt
Total reserves in months of imports	Current US dollar
Total reserves minus gold	Current US dollar
Exports of goods and services	Current US dollar
Imports of goods and services	Current US dollar
Real effective exchange rate	Index (2005 = 100)
Real interest rate	Percent

Appendix 2. Prediction of the score for the sample of countries (84).

Countries with Financing Agreements	Score	Countries without Financing Agreements	Score
Afghanistan	1.48	Algeria	1.17
Antigua and Barbuda	-2.59	Argentina	1.06
Armenia	-2.77	Azerbaijan	1.53
Bangladesh	1.13	Bolivia	0.75
Benin	-0.21	Brazil	0.04
Bosnia and Herzegovina	-0.83	Bulgaria	0.15
Burkina Faso	-0.06	Cambodia	0.44
Burundi	-0.51	Cameroon	0.35
Central African Republic	-0.20	Cape Verde	0.14
Colombia	-0.31	Chad	0.02
Comoros	-0.84	China	2.02
Cote d'Ivoire	-0.28	Croatia	0.21
Gambia	-1.67	Dominica	0.79
Georgia	-0.07	Ecuador	1.03
Grenada	-2.59	Egypt	0.02
Guinea	-1.19	Equatorial Guinea	0.36
Guinea-Bissau	-0.28	Ghana	1.21
Haiti	0.37	Guyana	-0.32
Iraq	-0.04	India	1.18
Jordan	-0.47	Indonesia	1.21
Kenya	0.34	Kazakhstan	1.44
Kosovo	-0.88	Lao PDR	-0.34
Kyrgyz Republic	-0.61	Lithuania	0.41
Lesotho	0.36	Mauritius	0.24
Liberia	-2.08	Nepal	0.80
Macedonia	0.26	Nigeria	1.18
Malawi	-0.01	Panama	0.62
Mali	-0.08	Papua New Guinea	1.38
Mauritania	-0.81	Philippines	0.84
Mexico	0.56	Russia	0.85
Moldova	-1.49	Samoa	-0.55
Morocco	-0.39	Sudan	-0.30
Niger	-0.99	Thailand	0.26
Poland	0.01	Trinidad and Tobago	0.12
Romania	-0.45	Tunisia	-0.75
Sao Tome and Principe	-0.88	Turkey	0.42
Serbia	-0.65	Uganda	0.22
Seychelles	-1.75	Uruguay	0.41
Sierra Leone	-0.22	Uzbekistan	1.54
Solomon Islands	0.74	Venezuela	1.09
St. Kitts and Nevis	-1.24	Vietnam	0.89
Tanzania	0.21	Zimbabwe	-1.43

Source: Authors' calculations.



Appendix 3. Prediction of the situation for the test sample countries (69).

Countries with Financing Arrangements			Countries without Financing Arrangements		
Reporting year	Score	Prediction Right?	Reporting year	Score	Prediction Right?
2005	0.52	NO	2011	0.62	YES
2008	2.17	NO	2011	1.19	YES
1991	-0.96	YES	2011	0.19	YES
2008	-0.72	YES	2011	0.95	YES
1984	-0.03	YES	2011	0.86	YES
1985	0.69	NO	2011	1.02	YES
2008	-0.57	YES	2011	0.66	YES
2007	-1.19	YES	2011	1.47	YES
2008	-0.11	YES	2011	-1.86	NO
2007	-0.70	YES	2011	3.30	YES
2009	-0.01	YES	2011	0.22	YES
2008	-0.40	YES	2011	-8.00	NO
2008	1.30	NO	2011	1.46	YES
2003	-0.81	YES	2011	-1.20	NO
2008	-0.04	YES	2011	-1.52	NO
2009	-0.64	YES	2011	1.19	YES
2007	-1.34	YES	2011	0.64	YES
2009	-1.16	YES	2011	0.36	YES
2007	-0.07	YES	2011	1.77	YES
2005	-0.06	YES	2011	3.79	YES
2008	-0.59	YES	2011	2.63	YES
2009	-0.69	YES	2011	0.17	YES
2008	-0.11	YES	2011	1.01	YES
2006	-0.06	YES	2011	0.99	YES
2007	-0.12	YES	2011	-2.09	NO
2005	-0.27	YES	2011	0.37	YES
2006	1.25	NO	2011	-0.89	NO
2005	1.34	NO	2011	0.19	YES
2008	-0.19	YES	2011	3.02	YES
2008	-0.37	YES	2011	0.49	YES
2008	-0.47	YES	2011	1.53	YES
2007	-0.38	YES	2011	-2.40	NO
2009	-2.40	YES	2011	1.26	YES
2009	-0.34	YES	2011	0.36	YES
2007	0.29	YES			

Source: Authors' calculations.