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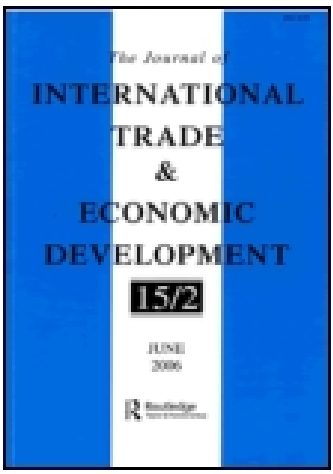

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Foreign aid and export diversification in developing countries

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Foreign aid and export diversification in developing countries

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This paper analyzes the effect of foreign aid on export diversification for a sample of developing countries while controlling for the effects of other factors that determine export diversification. We find that foreign aid not exceeding 20% of a country's GDP significantly promotes export diversification, while foreign aid in excess of 20% of GDP significantly impedes export diversification. The latter result corroborates evidence from related literature, which has shown that foreign aid can have an anti-export bias due to a Dutch disease effect. However, our results show that aid as a percent of GDP is below 20% in most low-income countries. This implies that in many low-income countries, varying amounts of additional aid can be used to enhance export diversification without causing a Dutch disease effect. As in the previous literature, we find that the level of development, infrastructure, transactions costs, and natural resources significantly affect export diversification. Our results are robust to the use of two different export diversification measures and different sub-samples.

Keywords: foreign aid; export diversification; developing countries

JEL Classifications: F35; O35

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1. Introduction

Foreign aid can harm the export performance of a country by causing an appreciation of the real exchange rate. Because foreign aid raises the domestic demand for goods and services, it drives up prices in the non-traded sector and causes the real exchange rate to appreciate – a 'Dutch disease' effect, which causes aid to reduce the amount of exports. A number of studies have shown that aid inflows indirectly eroded the export competitiveness of developing countries by causing real exchange rate appreciation (Van Wijnbergen 1986; Younger 1992; White and Wignaraja 1992; Elbadawi 1999). Recently Munemo, Bandyopadhyay and Basistha (2007), and Rajan and Subramanian (2005a, 2005b) have also pointed out

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this channel as a potential reason for the quantitatively small effect of foreign aid on economic performance of a country.

There is evidence that the Dutch disease can also undermine export performance by negatively affecting export diversification, i.e. by reducing the number of products in the export basket (Collier 2007; Osakwe 2007; Rajan and Subramanian 2005a). This paper seeks to examine this hypothesis of a negative effect of foreign aid on export diversification. There are two possible types of export diversification – vertical export diversification and horizontal export diversification. Vertical export diversification takes place by moving up the value chain to produce manufactured products, as in China and Malaysia, for example. Horizontal export diversification is achieved by producing non-traditional dynamic exports. Examples of these non-traditional dynamic exports include cut flowers in Kenya, fresh fruit, wine, and salmon in Chile, and tuna and frozen shrimps in Thailand.[1] Export diversification is important for enhancing export performance because it overcomes the problem of terms of trade volatility and inelastic and declining global demand associated with traditional primary exports. If the domestic market is also small (which is the case in many developing countries such as those in Sub-Saharan Africa (SSA)), export diversification can be an important channel of development by opening up new export markets.

We use panel data from 69 developing countries to estimate the effect of foreign aid on export diversification while controlling for the effects of other factors that influence export diversification. A number of studies have looked at why SSA has been unable to diversify and export manufactured products as other developing countries have done. Wood and Mayer (2001) find that natural resources and infrastructure are important factors in explaining the low share of manufactured exports in SSA. In Africa, natural resources are the abundant factor, which explains why it has no comparative advantage in manufacturing. Collier and Gunning (1999) add that high transactions costs also make it difficult to produce manufactured exports in Africa. Recently, Habiyaremye and Ziesemer (2006) have confirmed the earlier results of Wood and Mayor (2001) in their analysis of SSA and other developing countries. We should note, however, that SSA can still benefit by initially diversifying horizontally and producing non-traditional products in which it has a comparative advantage. Then, as its economies develop, diversification into manufactured products may eventually become economically profitable.

Diversification is also closely related to the level of development. Empirical evidence presented by Imbs and Wacziarg (2003) shows that economic diversification (measured using employment and value-added data) follows a robust U-shaped pattern in relation to per-capita income. They find that initially diversification increases as per-capita income increases, up to a certain point. Thereafter, economic concentration sets

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in. Their results show that developing countries are in the diversification stage, while developed countries are in the concentration stage. This behavior of diversification along the development path is explained by non-homothetic preferences and factors related to economic geography (see for example Krugman 1991; and Imbs and Wacziarg 2003). Recently Klinger and Lederman (2006) have found a similar pattern of diversification using export data.

Our empirical results show that foreign aid not exceeding 20% of a country's GDP significantly promotes export diversification, while foreign aid in excess of 20% of GDP significantly impedes export diversification. The latter result corroborates evidence from related literature, which has shown that foreign aid can have an anti-export bias due to a Dutch disease effect. However, our results show that aid as a percentage of GDP is below 20% in most low-income countries. This implies that in many low-income countries, varying amounts of additional aid can be used to enhance export diversification without causing a Dutch disease effect. As in the previous literature, we find that the level of development, infrastructure, transactions costs, and natural resources significantly affect export diversification. Our results are also robust to the use of two different export diversification measures and different sub-samples.

The rest of the paper is organized as follows: Section 2 describes the specification of the model to be estimated, discusses estimation issues and data used, and presents summary statistics of the data. Results from the estimation are discussed in Section 3, and the conclusions of the paper are presented in Section 4.

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2. Empirical model, data, and estimation issues

2.1. Empirical model

We analyze the relationship between aid and export diversification by estimating the following two equations.[2]

$$\begin{aligned}\log(HI)_{it} = {} & \beta_0 + \beta_i + \beta_1{}^*(Aid/GDP)_{it} + \beta_2{}^*(Aid/GDP)_{it}^2 \\ & + \beta_3{}^* \log(\text{Re}al\,GDP/POP)_{it} + \beta_4{}^* \log(Teledensity)_{it} \\ & + \beta_5{}^*(Arable\ Land/POP)_{it} + \beta_6{}^*(Political\,Risk) + \varepsilon_{it} \end{aligned} \quad (1)$$

$$\begin{aligned}\log(ME/GDP)_{it} = {} & \alpha_0 + \alpha_i + \alpha_1{}^*(Aid/GDP)_{it} + \alpha_2{}^*(Aid/GDP)_{it}^2 \\ & + \alpha_3{}^* \log(\text{Re}al\,GDP/POP)_{it} + \alpha_4{}^* \log(Teledensity)_{it} \\ & + \alpha_5{}^*(Arable\ Land/POP)_{it} + \alpha_6{}^*(Political\,Risk) + \varepsilon_{it} \end{aligned} \quad (2)$$

In the above equations, we use two measures of export diversification employed by other studies – the Herfindahl index (*HI*) and the share of

manufactured exports in GDP (ME/GDP). We allow for country (indexed by i) fixed effects. The country fixed effects capture country heterogeneity biases like geographical location (landlocked versus coastal), distance to the coast, country size, etc.[3] Apart from foreign aid (Aid/GDP), we have also included other explanatory variables that the previous literature has identified to be important, i.e. real per-capita income (measured by real GDP/POP), infrastructure (measured by teledensity), natural resources (measured by arable land area per capita), and transactions costs (measured by political risk). These measures are discussed in more detail below.

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2.2. Data

Using the same approach as Imbs and Wacziarg (2003) and Klinger and Lederman (2006), we construct a measure of export diversification using the Herfindahl index (HI), which is equal to the sum of squared shares of export products.[4] Export data at the four-digit SITC level from the COMTRADE database were used to construct the Herfindahl index. Exports of manufactured goods have also been used as a measure of export diversification by Elbadawi (1999), Wood and Mayer (2001), and others. Data on manufactured exports are from COMTRADE as well.

Foreign aid is defined as total net official development assistance (ODA). Data on total net ODA were obtained from the OECD-DAC database. We divided the aid figure for each country by the country's GDP to obtain the standard aid measure used by most studies of foreign aid. The real per capita income is PPP based (constant 2000 dollars). Infrastructure is measured by teledensity, which is defined as fixed line and mobile phones per 1000 people. This is the measure also used in the previous literature. Data on other measures of infrastructure, such as road and rail infrastructure were not available for many countries in our sample. It is also difficult to obtain data on natural resource availability. Wood and Mayer (2001) use total land area as their measure of natural resources available in a country. However, this measure is unsatisfactory since it fails to take into account variations in the quality of land (a weakness that Wood and Mayer 2001 acknowledge). We use arable land area instead, which we found to be the best measure compared with other alternatives.[5]

Transactions costs are measured by political risk ratings. The political risk ratings are derived from governance indicators that influence transactions costs such as corruption, law and order, democratic accountability, and bureaucracy quality.[6] The higher the political risk rating, the lower the risk. Data on real per capita income, teledensity, arable land area, and total population were obtained from the World Bank's World Development Indicators (WDI) database. Data on political risk ratings were obtained from the PRS Group.

We have annual data for a sample of 69 developing countries covering the period 1983–2003. The sample includes 32 low-income countries and 37 middle income countries (Table 1). Summary statistics of the data are shown in Table 2. On average, export concentration is higher in low-income

Table 1. Countries included in the estimation.

Least developed countries (LDCs)	Other low-income non-LDC countries (per capita GNI <$825 in 2004)	Middle-income developing countries (per capita GNI $826–$10,065 in 2004)
		Algeria
Angola*	Cameroon*	Argentina
Bangladesh	Congo, Rep.*	Bolivia
Burkina Faso*	Cote d'Ivoire*	Brazil
Congo, Dem. Rep*	Ghana*	Chile
Gambia, The*	India	China
Guinea*	Kenya*	Colombia
Guinea-Bissau*	Nicaragua	Costa Rica
Haiti	Nigeria*	Dominican Republic
Madagascar*	Pakistan	Ecuador
Malawi*	Papua New Guinea	Egypt, Arab Rep.
Mali*	Vietnam	El Salvador
Mozambique*	Zimbabwe*	Gabon*
Niger*		Guatemala
Senegal*		Guyana
Sierra Leone*		Honduras
Sudan*		Indonesia
Tanzania*		Iran
Togo*		Jamaica
Uganda*		Jordan
Zambia*		Lebanon
		Malaysia
		Mexico
		Morocco
		Oman
		Panama
		Paraguay
		Peru
		Philippines
		Sri Lanka
		Syrian Arab Republic
		Thailand
		Trinidad and Tobago
		Tunisia
		Turkey
		Uruguay
		Venezuela

Notes: Based on DAC list of ODA Recipients, effective from 2006. *Countries in Sub-Saharan Africa.

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Table 2. Summary statistics of key variables.

Variable	Mean	Median	Std. Dev.	Maximum	Minimum
			Based on all 69 developing countries		
Herfindahl index	0.22	0.14	0.22	0.92	0.01
Manufactured exports/GDP	0.08	0.03	0.11	1.01	0.00
AID/GDP	0.07	0.03	0.09	0.62	0.00
Real income per capita	3368.47	2701.21	2564.09	13489.74	477.83
Teledensity	65.60	22.71	101.94	653.05	0.43
Arable land area per capita	0.25	0.20	0.21	1.45	0.02
Political risk rating	55.04	56.50	11.94	80.33	15.67
			Based on 32 low-income countries		
Herfindahl index	0.29	0.21	0.24	0.91	0.03
Manufactured exports/GDP	0.05	0.03	0.06	0.34	0.00
AID/GDP	0.12	0.09	0.11	0.62	0.00
Real income per capita	1356.49	1264.88	635.66	3938.26	477.83
Teledensity	10.71	5.84	14.78	84.12	0.43
Arable land area per capita	0.28	0.22	0.23	1.45	0.04
Political risk rating	50.70	51.33	10.53	70.67	15.67
			Based on 26 Sub-Saharan African countries		
Herfindahl index	0.35	0.28	0.24	0.91	0.05
Manufactured exports/GDP	0.04	0.02	0.05	0.34	0.00
AID/GDP	0.13	0.11	0.12	0.62	0.00
Real income per capita	1396.88	1056.73	1149.84	7392.39	477.83
Teledensity	11.44	5.35	22.47	242.27	0.43
Arable land area per capita	0.31	0.24	0.24	1.45	0.11
Political risk rating	51.20	52.33	10.22	70.67	15.67

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countries, and Sub-Saharan Africa has the least diversified exports. Exports in Sub-Saharan Africa are dominated by a few primary products, such as crude petroleum, cotton, ores, cocoa, etc, and, in 22 countries, just three products account for more than half of total exports (Table 3).

2.3. Estimation issues

There are two estimation issues that are worth discussing at this point. The first relates to the sample of developing countries in the panel data for the period 1983–2003. The use of panel data makes it possible to account for fixed effects in the model. The data are averaged into three-year periods for each country.[7]

The second relates to a potential endogenous relationship between aid and export performance.[8] We tackle the potential endogeneity problem of foreign aid by using the instrumental variables (IV) estimation technique. The literature has shown that the political or strategic interests of donors are the key determinants of foreign aid allocation (Boone 1996; Burnside and Dollar 2000; Alesina and Dollar 2000; Bandyopadhyay and Wall 2006).

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Table 3. SSA sample: Three largest exports as a share of total merchandise exports for each country (2006).

Country	1st export product	%	2nd export product	%	3rd export product	%	% share of top 3 exports
Angola	crude petroleum	96.0	precious stones	2.2	refined petroleum	1.1	99.3
Nigeria	crude petroleum	93.1	refined petroleum	3.0	gas,natural	2.6	98.7
Gabon	crude petroleum	74.7	wood,rough	12.1	ores and metal	10.1	96.9
Burkina Faso	cotton	92.1	gold,non-monetary	2.0	fruit & nuts	1.3	95.5
Congo, Rep.	crude petroleum	90.2	refined petroleum	3.4	wood, rough	1.7	95.4
Sudan	crude petroleum	89.6	oil seeds	2.7	gold,non-monetary	2.7	95.0
Niger	refined petroleum	59.7	radio-active material	28.3	works of art	2.8	90.8
Mali	cotton	83.6	oil seeds	4.7	works of art	2.1	90.5
Guinea	ores and metal	75.3	crude petroleum	7.4	precious stones	6.2	88.9
Sierra Leone	diamonds	56.9	ores and metal	18.2	cocoa	8.7	83.8
Zambia	copper	67.4	ores and metal	7.0	tobacco,unmanuf.	5.7	80.2
Cote d'Ivoire	cocoa	49.5	crude petroleum	22.8	fruit & nuts	6.7	79.1
Guinea-Bissau	fish,fresh,chilled	69.5	coal,lignite and peat	5.8	precious stones	3.4	78.7
Mozambique	aluminium	62.9	refined petroleum	8.8	tobacco,unmanuf.	6.0	77.7
Congo, DR	diamonds	36.0	ores and metal	30.2	crude petroleum	9.9	76.1
Malawi	tobacco,raw	61.3	tea	7.6	sugar	6.5	75.4
Uganda	fish,fresh,chilled	30.8	coffee	29.5	tobacco,unmanuf.	8.8	69.2
Ghana	cocoa	49.5	ores and metal	11.7	wood,simply worked	6.7	68.0
Togo	cocoa	36.7	lime,cement	16.7	cotton	9.5	62.9
Cameroon	crude petroleum	38.3	fruit & nuts	10.6	wood,simply worked	10.3	59.2
Zimbabwe	ores and metal	29.7	nickel	15.3	tobacco,unmanuf.	13.1	58.0
Madagascar	outer garments	28.1	outer garments,women's	18.8	outer garments,men's	11.0	57.9
Gambia, The	organic chemicals	24.3	non-ferrous metal waste	11.1	fish,dried,salted	7.2	42.6
Senegal	fish,fresh,chilled	18.6	vegetable oils	10.5	cotton	9.5	38.5
Tanzania	ores and metal	13.9	Tobacco,unmanuf.	10.7	copper	10.0	34.6
Kenya	tea and mate	14.2	outer garments,women's	8.9	refined petroleum	8.9	32.1

Source: Author's calculations using Comtrade Data (SITC rev. 2).

Rajan and Subramanian (2005a, 2005b) show that these types of strategic factors are unrelated to economic performance and can be used as instruments for aid in IV estimation. The significance of political and strategic considerations in aid allocation decisions of major donors is shown by the fact that more US aid is provided to important allies such as Egypt and Israel, while the UK and France allocate most of their aid to former colonies. We use three political/strategic dummy variables as instruments: Friend of UK, Friend of France, and Friend of US. Following Boone (1996) and Rodrik (1995), these dummies are set to one if a recipient country receives more than 1% of the donor's total aid budget allocated to developing countries.

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3. Empirical results

3.1. Estimation results from the full sample of developing countries

We begin with a preliminary analysis of the relationship between export diversification and aid. Figure 1 plots the relationship between the Herfindahl index (in logs) and Aid/GDP. There appears to be no clear relationship between Aid/GDP and export concentration. In Figure 2, we plot the relationship between Aid/GDP and the log of (manufactured exports/GDP), and do not observe a clear relationship as well. We should note, however, that the scatter plots do not really tell us much about causality, and they do not take into account the effects of other variables on export diversification. Therefore, in order to shed more light on the nature of the relationship between aid and export diversification, we report results from panel data regressions below. Table 4 reports results from fixed effects

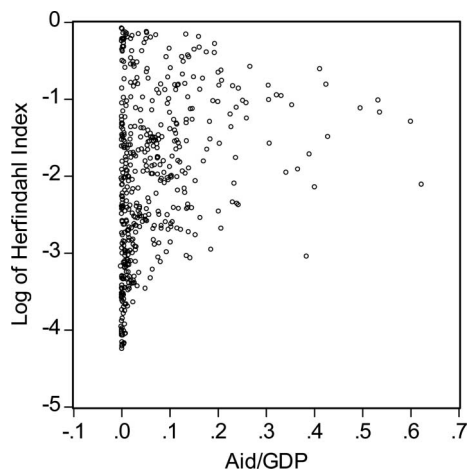

Figure 1. Scatter plot – log of Herfindahl Index and Aid/GDP.

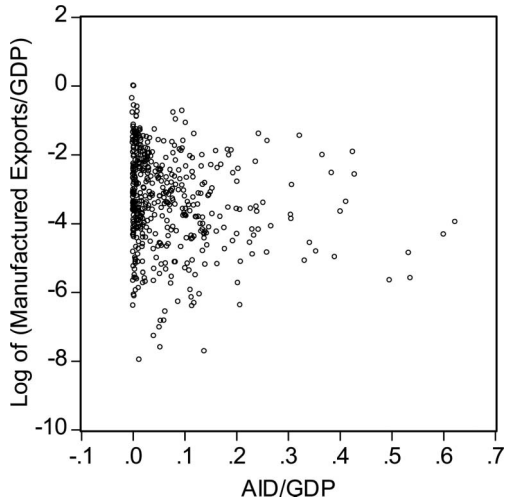

Figure 2. Scatter plot– log of (Manufactured Exports/GDP) and Aid/GDP.

Table 4. Regression results for the full sample of developing countries.

483 observations, 69 countries		
Explanatory variables	FE	FE-IV
Dependent variable: log of Herfindahl index		
Aid/GDP	−0.319 (1.122)	−12.399*** (4.248)
AID/GDP squared	0.679 (2.165)	30.380*** (10.734)
Log of real per-capita income	−0.377*** (0.082)	−0.428** (0.180)
Log of teledensity	−0.057 (0.042)	−0.115*** (0.026)
Arable land area per capita	1.000*** (0.324)	0.459 (0.510)
Political risk rating	−0.009*** (0.002)	−0.007*** (0.001)
Constant	1.374* (0.707)	2.419* (1.435)
R-squared adjusted	0.87	0.77
Dependent variable: log of (manufactured exports/GDP)		
Aid/GDP	6.795*** (2.157)	6.795*** (2.157)
AID/GDP squared	−9.212*** (3.094)	−9.212*** (3.094)
Log of real per-capita income	−0.025 (0.245)	−0.025 (0.245)
Log of teledensity	0.332*** (0.108)	0.332*** (0.108)
Arable land area per capita	−3.529*** (0.359)	−3.529*** (0.359)
Political risk rating	0.015*** (0.003)	0.015*** (0.003)
Constant	−4.423** (1.764)	−4.423** (1.764)
R-squared adjusted	0.82	0.82

Notes: White cross-section standard errors are in parentheses. *implies the coefficient is significant at the 10% level. **implies the coefficient is significant at the 5% level. ***implies the coefficient is significant at the 1% level.

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(FE) regression and fixed effects-instrumental variables (FE-IV) regression using the full sample of 69 developing countries.

3.1.1. *Fixed effects regression results*

Under FE estimation, shown in the second column, we find that aid has a negative effect on the Herfindahl index, while the effect of aid squared on the Herfindahl index is positive (top panel). This implies that foreign aid initially improves export diversification. However, after a certain point, an increase in foreign aid will reduce export diversification (this follows from the fact that diversification increases as the Herfindahl index gets smaller as explained in the previous section). Both results are insignificant. In the bottom panel, aid has a positive and significant effect on manufactured exports/GDP, while the effect of aid squared is negative and significant. This also implies that foreign aid initially improves export diversification. However, after a certain point, an increase in foreign aid will reduce export diversification (in this case, diversification increases when the ratio of manufactured exports to GDP increases).

As in the previous literature, we find that an increase in development (measured by per-capita income), better infrastructure (measured by teledensity), and lower transactions costs (measured by political risk rating) contribute to export diversification by reducing the Herfindahl index. The results are significant for per-capita income and political risk rating. In the bottom panel, teledensity, and political risk rating are significant, and they both increase manufactured/GDP. Per-capita income is inversely related to manufactured exports/GDP since an increase in GDP per capita requires an increase in GDP, which in turn reduces the ratio of manufactured exports to GDP. Our results also confirm the finding by past studies that an abundance of natural resources (measured by arable land area per capita) significantly impedes export diversification – arable land per capita has a positive effect on the Herfindahl index and a negative effect on manufactured exports/GDP.

3.1.2. *Fixed effects-instrumental variables regression results*

We re-estimate the model using the FE-IV technique and report the results in the third column. We instrument for both aid and aid squared using the strategic dummies as instruments.[9] The effects of aid and aid squared on the Herfindahl index continue to be negative and positive respectively. Similarly, the effects of aid and aid squared on manufactured exports/GDP remain unchanged. More importantly, the effects of aid and aid squared are statistically significant in both estimations, implying that up to a certain point, an increase in aid significantly promotes export diversification. Thereafter, increased dependency on foreign aid significantly impedes export diversification.

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In the top panel, the coefficients of per-capita income and political risk rating continue to be negative and significant. The coefficient of teledensity remains negative and is now significant. Arable land area per capita is no longer significant, but its effect on the Herfindahl index remains unchanged. In the bottom panel, the effect and significance of per-capita income remains the same. The effects of teledensity and political risk on manufactured exports/GDP are unchanged, and they are all significant. The estimated coefficient on arable land area per capita is negative and significant as before.

3.2. Countries in which aid is most likely to increase export diversification and countries in which it is most likely to increase export concentration

Our results imply that there exists a range of aid over which export diversification is increasing, and another range of aid over which export concentration is increasing. Using the FE-IV results and equation (1), the estimated turnaround value of Aid/GDP is about 20.4%. This implies that additional aid inflows will increase export diversification in countries where aid is below 20% of GDP, and harm export diversification in countries that have more than 20% of aid in their GDP. From Table 2, Aid/GDP is about 12% in the average low-income country, and 13% in SSA. Only four low-income countries have average aid figures above 20% of GDP – Gambia (22%), Malawi (23%), Mozambique (31%), and Guinea-Bissau (47%). This therefore means that for the majority of low-income countries, an increase in aid can actually increase export diversification.

Clearly, some countries benefit from relatively large aid increases, while for some countries this is not the case. There are six countries with average aid ratios much closer to the turnaround point – Niger (15%), Tanzania (16%), Mali (18%), Nicaragua (18%), Sierra Leone (18%), and Zambia (19%). These countries should not seek very large aid amounts. However, countries that have average aid ratios of 5% or less are in greater need of increased aid flows. These countries are as follows: India (1%), Nigeria (1%), Pakistan (2%), Vietnam (3%), Angola (4%), Zimbabwe (4%), Cameroon (4%), Bangladesh (5%), Sudan (5%), and Côte d'Ivoire (5%). In between these two extremes are countries with average aid ratios ranging from 6% to 14% – Congo Republic (6%), Kenya (7%), Papua New Guinea (9%), Haiti (9%), Ghana (9%), Guinea (9%), Congo, Democratic Republic (10%), Togo (11%), Madagascar (11%), Uganda (12%), Senegal (12%), and Burkina Faso (14%). These countries require varying amounts of extra aid in order to reach the target of 20% required to achieve full diversification benefits.

Using the FE-IV results and equation (2), the estimated turnaround value of Aid/GDP is much higher and is about 37%. This implies that an increase in aid reduces manufactured exports in countries with aid above

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37% of GDP, and expands manufactured exports in those countries whose aid is below 37% of GDP. There is only one low-income country that stands to lose from receiving additional aid increases in this case, namely Guinea-Bissau, whose average aid is 47% of GDP. From Table 2, the average share of manufactured exports in GDP in low-income countries and SSA is very low – 5% and 4% respectively. The reason is that many low-income countries have a comparative advantage in agricultural products and other commodities, and consequently these dominate their export baskets. Horizontal export diversification is therefore much more important in the short to medium term than vertical export diversification for the development of many low-income countries. The Herfindahl index takes into account horizontal export diversification. Therefore, the effect of aid on the Herfindahl index is relatively more important than the effect of aid on manufactured exports in the majority of low-income countries.

3.3. Estimation results from sub-samples of low-income developing countries and Sub-Saharan Africa

In this sub-section, we consider two sub-samples in order to evaluate the robustness of the main results obtained from the full sample. The first is the sub-sample of 32 low-income countries, the majority of which are least developed countries. The second is the sub-sample of 26 countries in Sub-Saharan Africa.

3.3.1. Low-income countries

For low-income countries (Table 5), the FE estimation results show a similar non-linear relationship between aid and the two measures of export diversification. The estimated aid coefficients however only have significant effects on manufactured exports/GDP. An increase in per-capita income, improvements in infrastructure, and a reduction in political risk significantly reduce the Herfindahl index. Natural resources are significant and they increase the Herfindahl index. Better infrastructure and lower political risk are also associated with a significant increase in manufactured exports/GDP, while higher arable land area per capita is associated with a significantly lower manufactured exports/GDP ratio. An increase in per-capita income reduces manufactured exports/GDP, but it is not significant.

In the FE-IV estimation reported in the third column, the non-linear effect of aid on export diversification is unchanged, but is now significant in both regressions. In the top panel, the remaining variables continue to have similar and significant effects, except for political risk rating, which is now positive and insignificant. In the bottom panel, the non-aid variables also have the same effects as before, and only per-capita income is not significant. Except for political risk rating, our FE-IV results show that the other

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Table 5. Regression results for low-income countries.

224 observations, 32 countries		
Explanatory variables	FE	FE-IV
Dependent variable: log of Herfindahl index		
Aid/GDP	−0.984 (1.022)	−7.888** (3.412)
AID/GDP squared	1.789 (1.968)	19.172** (8.902)
Log of real per-capita income	−0.286*** (0.091)	−0.301** (0.142)
Log of teledensity	−0.032** (0.014)	−0.079** (0.034)
Arable land area per capita	1.523*** (0.371)	1.127** (0.547)
Political risk rating	−0.005*** (0.001)	0.002 (0.005)
Constant	0.369 (0.663)	0.695 (1.024)
R-squared adjusted	0.84	0.74
Dependent variable: log of (manufactured exports/GDP)		
Aid/GDP	6.667** (2.727)	16.084** (6.838)
AID/GDP squared	−8.713** (3.842)	−32.213** (13.860)
Log of real per-capita income	−0.139 (0.340)	−0.111 (0.225)
Log of teledensity	0.324*** (0.122)	0.388*** (0.110)
Arable land area per capita	−2.474*** (0.632)	−1.934** (0.926)
Political risk rating	0.025*** (0.006)	0.016* (0.008)
Constant	−4.566** (2.072)	−5.064*** (1.925)
R-squared adjusted	0.73	0.66

Notes: White cross-section standard errors are in parentheses.*implies the coefficient is significant at the 10% level. **implies the coefficient is significant at the 5% level. ***implies the coefficient is significant at the 1% level.

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variables have robust effects on the Herfindahl index. In both samples, aid, aid-squared, per-capita income, and infrastructure are significant. In the bottom panel, the FE-IV results show that all variables are robust, both in terms of their effects on manufactured exports/GDP, as well as significance.

3.3.2. Sub-Saharan Africa

Table 6 reports our estimation results for SSA. Under FE estimation shown in the second column, aid increases the Herfindahl index and aid squared reduces it. Aid has the usual non-linear effect on manufactured exports/GDP. The estimated aid coefficients are, however, not significant in both regressions.

Per-capita income and teledensity both have the expected effects on the Herfindahl index and manufactured exports/GDP, but they are only significant in the latter estimation. The abundance of natural resources in SSA significantly reduces export diversification in both estimations, and reducing transactions costs significantly improves export diversification in the two estimations.

We re-estimate the equations using the FE-IV method and report the results in column three. In the top panel, the effects of aid and aid squared

Table 6. Regression results for SSA countries.

182 observations, 26 countries		
Explanatory variables	FE	FE-IV
Dependent variable: log of Herfindahl index		
Aid/GDP	0.675 (1.236)	−7.889** (3.948)
AID/GDP squared	−0.552 (2.351)	19.957* (10.453)
Log of real per-capita income	−0.107 (0.104)	−0.126 (0.238)
Log of teledensity	−0.007 (0.009)	−0.085** (0.0413)
Arable land area per capita	1.803*** (0.402)	1.019 (0.679)
Political risk rating	−0.005*** (0.002)	0.003 (0.006)
Constant	−0.910 (0.757)	−0.328 (1.441)
R-squared adjusted	0.79	0.59
Dependent variable: log of (manufactured exports/GDP)		
Aid/GDP	3.348 (2.655)	9.630 (6.898)
AID/GDP squared	−4.065 (3.681)	−19.169 (13.126)
Log of real per-capita income	−0.924*** (0.302)	−0.912*** (0.202)
Log of teledensity	0.156** (0.077)	0.213** (0.084)
Arable land area per capita	−3.002*** (0.544)	−2.426*** (0.803)
Political risk rating	0.028*** (0.006)	0.022** (0.009)
Constant	1.495 (1.817)	1.084 (1.796)
R-squared adjusted	0.74	0.70

Notes: White cross-section standard errors are in parentheses.*implies the coefficient is significant at the 10% level. **implies the coefficient is significant at the 5% level. ***implies the coefficient is significant at the 1% level.

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are now negative and positive respectively as before, and both are now significant as well. In the bottom panel, the effects of aid and aid squared on manufactured exports/GDP are unchanged, but they are now insignificant. In addition, the infrastructure variable is now significant and it reduces the Herfindahl index, while transactions costs no longer have a significant effect on the Herfindahl index. In the bottom panel, we find that improvements in infrastructure and a reduction in transactions costs significantly enhance export diversification. Natural resource abundance on the other hand is detrimental to export diversification. In the top panel (FE-IV estimation), the effects of most variables are robust (only political risk rating has no robust effect), and we see that aid, aid-squared, and infrastructure are robust in both samples. In the bottom panel, all variables have robust effects on manufactured exports/GDP. The significance of the political risk variable in the bottom panel reinforces the Collier and Gunning (1999) conclusion that transactions costs in SSA negatively affect manufactured exports. The results in the bottom panel also strongly support Wood and Mayer (2001) who found that the abundance of natural resources is a significant impediment to expanding manufactured exports in SSA.

4. Conclusion

This paper analyzes the effect of foreign aid on export diversification for a sample of developing countries while controlling for the effects of other factors that determine export diversification. We find that foreign aid not exceeding 20% of a country's GDP significantly promotes export diversification, while foreign aid in excess of 20% of GDP significantly impedes export diversification. The latter result corroborates evidence from related literature, which has shown that foreign aid can have an anti-export bias due to a Dutch disease effect. However, our results show that aid as a percentage of GDP is below 20% in most low-income countries. This implies that in many low-income countries, varying amounts of additional aid can be used to enhance export diversification without causing a Dutch disease effect. As in the previous literature, we find that the level of development, infrastructure, transactions costs, and natural resources significantly affect export diversification. Our results are robust to the use of two different export diversification measures and different sub-samples.

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Notes

1. See for example Andersson et al. (2005) and Bonaglia and Fukasaku (2003).
2. Aid/GDP could not be measured in logs because there are some negative aid numbers in our dataset. The decision to use log or level forms for the remaining independent variables was based on the form that yielded the most significant results. The dependent variable in each equation is measured in logs because this is the approach used by other studies in the literature. We also experimented with functional forms in which all the independent variables are in levels, but the results were not significant.
3. We also experimented with time fixed effects to capture global biases such as implementation of global trade agreements, but these did not improve our results, and were not used in our final estimation.
4. $\mathrm{HI} = \Sigma_{i=1}^{n}\left(x/\Sigma_{i=1}^{n}x\right)^2$ where x_i is export of good i, and n is the total number of export products. When exports are evenly distributed over a large number of products, HI approaches zero; and when there is a single export product, HI is one. Thus, the more diversified the composition of exports, the smaller is the value of the Herfindahl index.
5. We also tried other measures of natural resource abundance such as dummies for oil exporters and resource rich countries, but the results were not significant.
6. Elbadawi (1999) for example uses a corruption index to measure transactions costs.

7. Given the small size of our sample, we were unable to perform time series analysis with the panel data.
8. The extent of export diversification can also affect aid. For example, in 2005, the WTO in partnership with the World Bank and IMF launched the aid for trade initiative, which was designed to provide aid that will accelerate export growth and diversification in poor countries.
9. All the instruments we use are significant in explaining aid.

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