Substitutability Between Foreign Direct Investment and Aid

Helga Kristjánsdóttir†
University of Iceland

May 2006 - Preliminary Draft - Not for citation

Abstract

The objective of this paper is to examine the substitution between aid flows and the flows of foreign direct investment (FDI) between in some Heavily indebted poor countries. I use data running over 34 years from 1970 to 2004. I analyse this by means of simultaneous equations system, allowing me to determine the substitutability between foreign direct investment and aid. Due to the small scale of flows, the model is analyzed with an inverse hyperbolic sine function rather than a logarithmic function. Findings indicate that as the HIPC countries income grows, there is a shift from complementary to substitutional effects between aid flows and FDI.

Keywords: Foreign Direct Investment, Aid
JEL Classifications Codes: F21, F23

*I wish to thank for helpful comments by Ronald B. Davies, Thorvaldur Gylfason, Gian Maria Milesi-Ferretti and Carl-Johan Dalgaard.

†Address for correspondence: Helga Kristjánsdóttir, Faculty of Economics, University of Iceland, 101 Reykjavík, Iceland. Phone: +354 525 4531, fax: +354 552 6806, E-mail: helgakr@hi.is
1 Introduction

Recent studies have shown that the majority of FDI has taken place between the wealthy countries, so that flow of capital has been between the east and west rather than from north to south, Markusen (2002). In other words, the flow of FDI has not been primarily from the developed to the developing countries, but rather among the developed ones. The limited FDI inflow to some of the developing countries is hard to estimate, which is the purpose of this paper, to provide some techniques to estimate FDI inflows in correspondance to aid inflow.

The purpose of my paper is to determine to which degree foreign direct investment may substitute for foreign aid in the Heavily indebted poor countries (HIPC) receiving aid from the International Development Association (IDA), which has the role of supporting anti-poverty programs in the poorest developing countries with long-term, no interest loans.

The research focus in on the substitutability between FDI and aid flows in the HIPC countries. My objective is to determine the substitutability between FDI and aid in a sample of HIPC countries, and also to look specifically at one of the HIPC countries.

The story to be considered is whether the HIPC countries, depending on aid from IDA, are likely to become more attractive to multinationals after receiving IDA aid over a period of time. With affective aid provision they could be expected to be shifted to a higher equilibrium after a period of time, with higher economic stability, making these countries more attractive for foreign investors to enter into foreign direct investment.

Incentives for foreign direct investment into the developing countries often are of different nature than those in the developed countries, and these are more likely to be green field rather than brownfield investments nature. In other words FDI is less likely to be in the form of mergers and acquisitions (M&As). Therefore aggregate FDI flow data therefore is can be applied directly, but needs not to be proxied by affiliate sales figures like in previous research by Brainard (1997), Ekholm et al.
(2003) or Markusen (2002). This use of aggregate data are somewhat similar to the case of Kristjánsdóttir (2005), where the aggregate FDI is applied. Here the aggregate FDI World Bank (2006B) data is used together with IDA aid flow data from the World Bank (2006B).

In order to capture the substitutability effects, I use the so-called simultaneous equations approach, with allows us to simultaneously to determine to what extent FDI and aid are functions of each other, simultaneously. I run these regressions for some individual HIPC countries specifically. These are Malawi and Mozambique on one hand, and Ghana on the other. Ghana has been relatively trouble free during the period estimated.

When choosing variables for the regressions, I use some of the variables used by Dalgaard et al. (2002) which they used in estimating the connection between aid and growth. Since some of the sample data turn out being negative, these are transformed by the inverse hyperbolic sine (IHS) procedure, allowing for negatives in the sample.

The paper is organized as follows. Section 2 sets out brief details on the literature. Section 3 explains the modelling strategy used here and description of the data. In Section 4 regression results are presented and discussed. Finally, Section 5 provides concluding remarks.
2 Literature

The available literature on FDI in the developing countries often tends to consider the contribution of FDI to growth. These would be papers by De Mello (1997), Balasubramanyam et al. (1996) and Borensztein et al. (1998) the latter finding that the host country of FDI needs to have a minimum threshold of human capital to experience a higher productivity of FDI. Some papers have looked at how FDI affects domestic firms in the local market, these would be like Aitken and Harrison (1999), and Aitken et al. (1997). Also, paper by Edwards (1990) looks at Debt-Equity Swaps in the Developing Countries.

Also, when considering aid flows and their effect, as to shift the economy into a higher equilibrium, a paper by Dalgaard et al. (2004) provides some interesting insights on the how growth in impacted by aid flows, when considering some Burns and Dollar papers. The variables selected in my paper somewhat correspond to the Dalgaard et al. (2004) paper.

Since the proxing of FDI can be a difficult task, some researchers have chosen to look specifically into that, and in a paper by Lane and Milesi-Ferretti (2003), the consideration is set on the composition of FDI and possible ways of correcting for M&As in the sample when estimating FDI.

In most of the recent literature, affiliate sales have been used as the most common proxy for foreign direct investment in a particular host country. In a well known paper, Brainard (1997) proxies outward and inward FDI separately as the share of affiliate sales in total exports. Another more recent example of a share measure can be found in a paper by Slaughter (2000), where he constructs an investment share variable as the share which accounts for an FDI proxy (measured as majority owned affiliates) in overall multinational investment. Brainard (1997) investigates multinational enterprises (MNEs) in order to capture the trade-off between MNE affiliate sales and trade. She seeks to capture inward and outward FDI proxies separately, by estimating shares of total foreign sales. Brainard applies data on MNEs in the U.S. and its trading countries, and estimates the incentive multina-
tionals have for exporting rather than undertaking FDI, when corrected for several factors such as trade, investment costs, and economies of scale. Brainard uses the share of exports in total sales as her dependent variable, which is meant to be an inverse indicator for foreign affiliate sales in total sales (FDI). She finds that MNEs have more incentive to undertake overseas production (FDI) rather than exporting to the foreign market when transport costs and trade barriers increase, and with a decrease in investment barriers as well as relative weight of plant to firm scale economics. In her paper, Brainard applies ’’the share of affiliate sales accounted for by exports’’. that is the. ’’share of exports in total sales’’. This corresponds to capturing the share of non-affiliate sales in total sales. Brainard is thereby able to use an inverse proxy for the share of FDI in foreign MNEs activities.

Slaughter (2000) constructs an investment share variable as the share of ”majority owned affiliates” in overall multinational investment. An example using capital stock share to construct the dependent variable can be seen in Slaughter (2002).

Slaughter (2002 calculates the share of MOFAs (majority-owned affiliates) in overall MNEs investment. He places the share of skilled labor on the left hand side of the equation, and the share of capital stock on the right hand side. The dependent share variable used by Slaughter is based on the skilled labor share in the total wage bill. More specifically, he captures the share of skilled labor in the overall labor force by dividing the wage of nonproduction workers (referred to as skilled labor) by the total wage bill to production and nonproduction workers.
3 Model and Data

A simultaneous equations model is applied here, which allows me to simultaneously estimate aid as function of foreign direct investment and investment as function of aid. More specifically this procedure allows me to avoid the possible simultaneity which might exist among explanatory variables. I base the choice of variables somewhat on a paper by Dalgaard et al. (2004). In their paper Dalgaard et al. (2004) use GDP, population, fraction of land in tropic and budget surplus among other variables when estimating the interaction of aid and growth.

The basic equation, Equation (1) goes as follows:

\[ IDA_{inflow_{i,t}} = \alpha_0 + \alpha_1 FDI_{inflow_{i,t}} + \alpha_2 POP_{i,t} \]
\[ + \alpha_3 GDP_{i,t} + \epsilon_{1,i,t} \]  
\[ FDI_{inflow_{i,t}} = \alpha_4 + \alpha_5 IDA_{inflow_{i,t}} + \alpha_6 CROP_{i,t} \]
\[ + \alpha_7 CA_{balance_{i,t}} + \epsilon_{2,i,t} \]

In Equation (1) the endogenous variables aid and FDI are functions of each other, as well as being function of other relevant variables for aid and FDI. The recipient country of FDI or aid, is denoted with (i), with the recipient countries being Ghana, Malawi and Mozambique.

Since I prefer to estimate the equation in a linear format, and change the notation, I now present it in a log-linear format as show in Equation (2). The model specification for the three-stage estimation for systems of simultaneous equations, for a linear regression format, can be presented as follows:

\[ \sinh^{-1}(AID_{inflow_{i,t}}) = \beta_0 + \beta_1 \sinh^{-1}(FDI_{inflow_{i,t}}) \]
\[ + \beta_2 \ln(POP_{i,t}) + \beta_3 \ln(GDP_{i,t}) + \zeta_{1,i,t} \]
\[ \sinh^{-1}(FDI_{inflow_{i,t}}) = \beta_4 \sinh^{-1}(AID_{inflow_{i,t}}) + \beta_5 + \beta_6 \ln(CROP_{i,t}) \]
\[ + \beta_7 \sinh^{-1}(CA_{balance_{i,t}}) + \zeta_{2i,t} \]
The simultaneous equation system presents IDA inflow to the sample countries over time \((t)\) by \((IDA_{inflow_{i,t}})\) in Equation (2a), and FDI inflow over time \((t)\) by \((FDI_{inflow_{i,t}})\) in Equation (2b).

IDA financial flows into individual countries are defined by the World Bank (2006B) as Net financial flows, IDA (current US$). World Bank (2006B) defines net financial flows as the disbursements of loans and credits less repayments of principal.

Foreign Direct Investment is obtained from the World Bank (2006B), and these are foreign direct investment data net inflows (BoP, current US$).

During the period estimated, FDI flows, aid flows and the current account occasionally turn negative, within particular years. This can happen if dividend payment from the host country to the source country is higher than the investments made in a particular year.

As to deal with these cases of zeros and negatives, the dependent variables of FDI and aid are estimated by using the so-called inverse hyperbolic sine (IHS) procedure, rather than a logarithm transformation\(^1\).

The other variables are defined by the World Bank (2006B) as follows: GDP (current US$), Population, total, Land under cereal production (hectares), Current account balance (BoP, current US$), Crop production index \((1999-2001 = 100)\). I use data running over 34 years from 1970 to 2004.

I use World Bank data for all the variables estimated, all estimates are received using STATA 8.0.

---

\(^1\)The difference between the two functional forms is shown in Appendix B.
4 Estimation Results

The regression results from estimating Equations (2a) and (2b) simultaneously for aid and FDI, are presented in Table 1. The results from estimating Equation (2a) are first presented with aid flow to the sample countries (Malawi, Mozambique and Ghana) as function of FDI inflow, Population and GDP. Then the results from estimating Equation (2b) are presented with FDI inflow as function of aid inflow, crop production and the current account balance.

Table 1. Empirical Findings for the Basic Model Specification

<table>
<thead>
<tr>
<th>Regressors</th>
<th>Ghana</th>
<th>Ghana, Moz., Malawi</th>
</tr>
</thead>
<tbody>
<tr>
<td>$AID_{inflow_{i,t}}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$FDI_{inflow_{i,t}}$</td>
<td>-.202</td>
<td>.120</td>
</tr>
<tr>
<td></td>
<td>(-.64)</td>
<td>(.91)</td>
</tr>
<tr>
<td>$POP_{i,t}$</td>
<td>9.954</td>
<td>6.049**</td>
</tr>
<tr>
<td></td>
<td>(1.49)</td>
<td>(1.96)</td>
</tr>
<tr>
<td>$GDP_{i,t}$</td>
<td>.034**</td>
<td>.010**</td>
</tr>
<tr>
<td></td>
<td>(3.07)</td>
<td>(2.25)</td>
</tr>
<tr>
<td>Obs.</td>
<td>30</td>
<td>77</td>
</tr>
<tr>
<td>R-Sq.</td>
<td>0.7018</td>
<td>0.4897</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>72.75</td>
<td>77.98</td>
</tr>
<tr>
<td>$FDI_{inflow_{i,t}}$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$AID_{inflow_{i,t}}$</td>
<td>-.176</td>
<td>.393**</td>
</tr>
<tr>
<td></td>
<td>(-1.08)</td>
<td>(2.15)</td>
</tr>
<tr>
<td>$CROP_{i,t}$</td>
<td>204106***</td>
<td>1363558***</td>
</tr>
<tr>
<td></td>
<td>(4.95)</td>
<td>(3.43)</td>
</tr>
<tr>
<td>$CA_{balance_{i,t}}$</td>
<td>-.1088126**</td>
<td>-.154***</td>
</tr>
<tr>
<td></td>
<td>(-2.79)</td>
<td>(-5.30)</td>
</tr>
<tr>
<td>Obs.</td>
<td>30</td>
<td>77</td>
</tr>
<tr>
<td>R-Sq.</td>
<td>0.6298</td>
<td>0.5968</td>
</tr>
<tr>
<td>$\chi^2$</td>
<td>57.06</td>
<td>126.48</td>
</tr>
</tbody>
</table>

Note: t-statistics are in parentheses below the coefficients. ***, ** and * denote significance levels of 1%, 5% and 10%, respectively.

The estimates for level data are reported here, regression was also run for the inverse hyperbolic sine and logarithm functions although not reported here. Both
the results from estimating Equations (2a) and (2b) in a simultaneous equations system are somewhat as could be expected.

Taken together, in the case of Ghana, FDI and aid are not found to support each other, that is they are found to be substitutes rather than complements. However, when the more trouble some countries (Mozambique and Malawi) are also included in the sample, FDI flows and aid flows are found to complement each other. These results can be found to support the theory that when the HIPC countries experience a higher income per capita, as is the case for Ghana in comparison with Malawi and Mozambique\(^2\), the complementary effects diminish, the while supplementary effect increase with FDI inflows increasingly substituting for aid flows.

Furthermore, as the estimates reported in Table 1 show, aid inflow is estimated to be positively affected by population and GDP increase. FDI is estimated to be positively affected by crop production, however negatively affected by the current account balance.

The results obtain when Equation (2) is estimated, using an inverse hyperbolic sine and logarithm functions, back up most of the level estimates. The only difference is that GDP is not found to significantly effect aid flows, and the current account is not found to significantly effect FDI.

---

\(^2\)In 1990 Ghana had GDP 211, Malawi 131 and Mozambique 163, and in 2000 Ghana had GDP 251, Malawi 151 and Mozambique 211, these are GDPs (constant 2000 US$), World Bank (2006B).
5 Conclusions

The objective of this paper is to determine whether aid flows and FDI inflows in some of the HIPC countries can be found to be supplements or complements for each other. And an important issue of concern is whether there is a shift from aid flows to FDI flows, when the economies move to a higher equilibrium as reflected in higher income per capita.

Estimates are obtained for the HIPC countries Ghana, Malawi and Mozambique, these are estimated together in one sample and Ghana is also estimated individually as to provide a comparison to the other two countries. One of the important issues to be dealt with is the fact that data for these countries are sometimes not obtainable and flows may turn negative or zeros. Therefore and application of an inverse hyperbolic sine function is provided as to deal with these countries since, it allows for estimation of negative flows and zeros.

Taken together, in the case of Ghana, FDI and aid are not found to support each other, that is they are found to be substitutes rather than complements. However, when the more trouble some countries Mozambique and Malawi are included in the sample, FDI flows and aid flows are found to complement each other. These results can be found to support the theory that when the HIPC countries experience a higher income per capita, as is the case for Ghana in comparison with Malawi and Mozambique, complementary effects diminish at the cost of supplementary effects, with FDI inflows increasingly substituting for aid flows.
6 Appendix A

I use the definition by World Bank (2006A) on the Heavily indebted poor countries (HIPC) countries\textsuperscript{3}.

\textsuperscript{3}The economies included are:
- Benin
- Bolivia
- Burkina Faso
- Burundi
- Cameroon
- Central African Republic
- Chad
- Comoros
- Congo, Rep.
- Côte d’Ivoire
- Ethiopia
- Gambia, The
- Ghana
- Guinea
- Guinea-Bissau
- Guyana
- Honduras
- Lao PDR
- Liberia
- Madagascar
- Malawi
- Mali
- Mauritania
- Mozambique
- Myanmar
- Nicaragua
- Niger
- Rwanda
- São Tomé and Príncipe
- Senegal
- Sierra Leone
- Somalia
- Sudan
- Tanzania
- Togo
- Uganda
- Zambia
7 Appendix B

I apply so-called "Inverse Hyperbolic Sine Function" to the dependent variable, rather than applying the natural logarithm function to some of the regressions. The procedure is preferred because of the need for transformation that does not truncate or eliminate low values of the dependent variable. This way of imposing the inverse hyperbolic sine (IHS) function to the dependent variable while imposing natural logarithm on the dependent variables, has been used in studies on household wealth. The procedure was proposed by Johnston (1949) and suggested as a suitable transformation for household wealth data by Burbidge et al. (1988), since some households hold zero or negative net worth as explained by Carroll et al. (1999). Figure 1 provides a graphical description of the natural logarithm function \( \ln(x) \) (thick line) and the inverse hyperbolic sine function\(^4\) \( \sinh^{-1}(x) \) (thin line).

![Figure 1: The Inverse Hyperbolic Sine Function](image)

Source: Author’s computations.

\(^4\)More specifically, the Inverse Hyperbolic Sine Function can be presented as \( \sinh^{-1}(x) = \ln(x + (1 + x^2)^{0.5}) \)
Figure 2: Inverse Hyperbolic Sine and Natural Logarithm Functions

Source: Author’s computations.
References


