Foreign direct investment in a small open economy

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Published online: 14 Aug 2013.

To cite this article: Helga Kristjansdottir (2013) Foreign direct investment in a small open economy, Applied Economics Letters, 20:15, 1423-1425, DOI: 10.1080/13504851.2013.815306

To link to this article: http://dx.doi.org/10.1080/13504851.2013.815306
Think of a small open economy interestingly positioned between the trade blocs of the NAFTA and the EU, with FDI in recent years resembling the pattern before the economic crash, making a pre-crash data set useful for exploring potential long-term trends. In this research, investment is explained by geographic location and country size, using a gravity model to account for the country’s exceptional remoteness and sparseness. A unique extension of the gravity model applies the inverse hyperbolic sine (IHS) function. The IHS functional form is estimated together with fixed difference between investment sectors and trade blocs being estimated simultaneously, an analysis that is rarely possible. Results indicate that under these conditions, investment appears to be more driven by wealth than market size effects.

**Keywords:** foreign direct investment; IHS function; gravity model; trade blocs; investment sectors

**JEL Classification:** F1; F2; F4

1. **Introduction**

Picture a small open economy, located midway between America and Europe, in between the powerhouses of the EU and NAFTA trade blocs. The country in question is Iceland. Larger countries generally have a long history of FDI already, which can make for a more convoluted case when it comes to studying the factors that influence investment. Iceland is a fully developed country, but due to political changes, it is a relatively new target for FDI. The research focus is, therefore, on a country with an exciting and unusual blank slate where we can see the nascent forces of FDI at work, with the majority of FDI as a greenfield investment (Nocke and Yeaple, 2008). The investment pattern analysed is similar to how FDI might have been before in the larger countries, already having a history of foreign investments (Parlour and Walden, 2011). Iceland is well fitted for gravity model analysis (Bergstrand, 1985) since it is remarkably small and distant from its investing countries. Or as Krugman (2011) phrased it ‘this is a very small economy, and thinking about some things like exports, you really need to bear in mind how undiversified it really is’. Therefore, the investment data analysed is running over sectors, blocs and years. This is panel data estimation for FDI (Hanna, 2010). All combined, these characterizing factors seem like they will have interesting effects on the gravity model, and stress the model capabilities to its limits.

Some model extensions are applied to capture the nature of the driving forces of FDI in this unique situation. The research applies a unique transformation of the gravity model, by the inverse hyperbolic sine (IHS) procedure applied in this situation for the first time. The IHS procedure transforms the gravity model, but maintains its features so that it is treated as by the logarithm function for positive values; however, unlike the logarithm function, it also treats zeros and negative values. This accountancy for zeros and negatives adds value to the analysis, because when decomposing FDI in Iceland by sectors, it is...
sometimes so low that there are occasional zeros in the data set. This transformation has been previously used on a different model in a different setting, when analysing household wealth, which is a similarly marginal case (Burbidge et al., 1988).

Owing to the manner in which the case country is interestingly positioned between the trade blocs of NAFTA and the EU, the data dimensions allow for model enlargements, to account for the difference between investment sector and investment blocs simultaneously, an analysis that is rarely possible. Therefore, an expanded version of the conventional gravity model (Bergstrand, 1985) is estimated to account for the IHS function, making it possible to control for both fixed sector and bloc effects at the same time, which is truly unique for this model type.

The questions to be answered are the following: How does the model work when expanded in this way? How does it work under the conditions of substantial size difference between the source and the recipient country of investment? Previous research on FDI is extensive (Næry, 2009), but has not covered this situation. Furthermore, when it comes to FDI in Iceland, the circumstances today are similar to those before the economic boom and crash. Pre-crash, the bulk of FDI was associated with the power-intensive sector in renewable energy sources (Harstad, 2012), a trend that is repeating itself today.

The data applied can, therefore, help to explain the current economic forces and predict future trends, as the power-intensive sector continues to be of great importance in the modern international economy. In the case country Iceland, factors tend to be drawn to the power-intensive industry. This is along the lines of the Heckscher–Ohlin model, implying that allocation of factors to industries is in accordance to their abundance (Topalova, 2010). The case country is even more interesting in today’s market because it has an abundance of energy that can’t be exported directly, and it is of the most valuable type, renewable and completely environmentally friendly. The research can potentially be meaningful for source countries looking for investment opportunities in relatively small economies in general.

II. Model Set-up and Regression Results

The research proceeds by simultaneously taking into account sources and allocation of FDI. The analysis will start by providing decomposition of investment into the main investment sectors and country membership into various trade blocs. This is done for the purpose of determining whether it is possible to determine fixed difference between individual sectors on one hand, and individual trade blocs on the other hand. These effects will be estimated simultaneously. First, the least restricted version of the equation is investigated, after considering the basic specification including the variables most commonly applied in the gravity model. The results for estimating Equation 1 are presented in Table 1.

\[
\sinh^{-1}(\text{FDI}_{i,s}) = \beta_0 + \beta_1 \ln(Y_{i,t}) + \beta_2 \ln(Y_t) + \beta_3 \ln(N_{i,t}) + \beta_4 \ln(N_t) + \beta_5 \ln(D_t) + \gamma_{k} \text{Sector}_k + \pi_n \text{Bloc}_n + \nu_{i,s,t}
\]

In Equation 1, the fixed-effects technique is applied once more. The sector dummy Sector$_k$ runs over sectors $k = 1, 2, \ldots, 4$, and a trade bloc dummy runs over trade blocs where $n = 1, 2, \ldots, 4$ with Bloc$_n$.

The fixed term can, therefore, be presented as being $\beta_0 + \gamma_k + \pi_n$ and the error term as being $\nu_{i,s,t}$. Here $\pi_n$ is a constant, accounting for trade-bloc-specific effects, as before Sector$_k$ is a constant accounting for sector-specific effects, and $\nu_{i,s,t}$ randomly distributed. There are three possibilities available when the results for Equation 1 are analysed. First, it is possible to set $\beta_0 = 0$ and $\pi_n = 0$, and second to set $\beta_0 = 0$ and $\gamma_k = 0$. Third, it is possible to set $\pi_n = 0$ and $\gamma_k = 0$. Here, it is presumed that $\gamma_3 = 0$ (coefficient for Sector three, Telecom & Transport or T&T) and $\pi_4 = 0$ (EU bloc). Therefore, the regression results obtained for the dummy variables combined can be interpreted as the ‘deviation’ from the T&T sector and the EU bloc.

**Table 1. Fixed sector and trade bloc effects**

<table>
<thead>
<tr>
<th>Regressors</th>
<th>IHS Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\ln(Y_{i,t})$ Host country GDP</td>
<td>2.189* (2.44)</td>
</tr>
<tr>
<td>$\ln(Y_t)$ Source country GDP</td>
<td>1.053*** (5.54)</td>
</tr>
<tr>
<td>$\ln(N_{i,t})$ Host country population</td>
<td>$-2.127$ (–0.84)</td>
</tr>
<tr>
<td>$\ln(N_t)$ Source country population</td>
<td>$-0.892$*** (–5.13)</td>
</tr>
<tr>
<td>$\ln(D_t)$ Distance</td>
<td>$-0.068$ (–0.24)</td>
</tr>
<tr>
<td>Sector$_1$ Power-intensive Ind.</td>
<td>0.575** (5.29)</td>
</tr>
<tr>
<td>Sector$_2$ Comm. and fin. ind.</td>
<td>0.649*** (6.58)</td>
</tr>
<tr>
<td>Sector$_4$ Other industries</td>
<td>0.435*** (5.32)</td>
</tr>
<tr>
<td>Bloc$_1$ EFTA</td>
<td>0.484*** (3.57)</td>
</tr>
<tr>
<td>Bloc$_2$ NAFTA</td>
<td>0.357** (1.99)</td>
</tr>
<tr>
<td>Bloc$_4$ Nonbloc members</td>
<td>$-0.236$ (–0.45)</td>
</tr>
<tr>
<td>Constant</td>
<td>10.949*** (3.34)</td>
</tr>
<tr>
<td>Observations</td>
<td>740</td>
</tr>
<tr>
<td>Log-likelihood</td>
<td>$-1091.20$</td>
</tr>
<tr>
<td>Degrees of freedom</td>
<td>11</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.1814</td>
</tr>
</tbody>
</table>

**Notes:** *** Significant at the 1% level.
** Significant at the 5% level.
Taken together, the results indicate that both the host and source countries’ total wealth (measured as GDPs) is estimated to have significant and positive effects on FDI. However, the population variables continue to have signs different from what is typically found, with the source country population having a significant value.

When both sector- and bloc-fixed effects are estimated simultaneously, the sector dummy captures difference between that particular sector and the T&T sector, regardless of bloc. Similarly, the bloc coefficient indicates the average of FDI from a bloc across all sectors. The sector effect estimates indicate that all the sectors are estimated to have a significantly higher share of FDI than the T&T sector. Moreover, when keeping the EU trade bloc fixed, the EFTA and NAFTA blocs are estimated to be positively and significantly different from the EU.

III. Conclusions

In this research, the gravity model for international trade is applied to analyse FDI in a small open economy, since it is particularly suitable to a rare slate data set of the unusual case country, Iceland.

The gravity model is uniquely extended to incorporate the IHS function, rather than the conventional logarithm function, and the data dimensions allow for model enlargement to account for difference between investment sectors and trade blocs simultaneously, an analysis that is rarely possible. This procedure makes it possible to control for both fixed sector and bloc effects at the same time, providing opportunity for more exceptional in-depth analysis.

Application of the IHS procedure, together with estimating investment sector and trade bloc effects simultaneously makes this research truly unique, since this has never been done before.

FDI is found to be negatively affected by the population of the host and source country; however, positively affected by their GDPs. Such opposite sign estimates for GDPs and population indicate FDI to be affected by distance and wealth, rather than market size. In other words, geographical location and income per capita wealth of the nations appear to be more important in this situation than size of the nations.

The fact that the result of this gravity model analysis indicates that FDI tends to be driven by wealth rather than market size effects, may have some implications for other relatively small open economies wanting to receive FDI from larger ones, as well as for the larger countries considering their FDI options.

Acknowledgement

I wish to thank Elisa Contraryman Stead, Martin Browning, Mette Ejrnæs, Gudbjörn Freyr Jónsson and Helgi Tomasson for their helpful comments. This article was written during my stay at the Centre for Applied Microeconometrics (CAM) at the University of Copenhagen. The hospitality of CAM is gratefully acknowledged.

References


