Kiel
Working Papers

Kiel Institute
for the World Economy

FDI and Health in Developed Economies: A Panel Cointegration Analysis

by Dierk Herzer
Peter Nunnenkamp

No. 1756 | February 2012

Web: www.ifw-kiel.de

Kiel Institute for the World Economy, Hindenburgufer 66, 24105 Kiel, Germany

Kiel Working Paper No. 1756 | February 2012

FDI and Health in Developed Economies: A Panel Cointegration Analysis

Dierk Herzer and Peter Nunnenkamp

Abstract:
This paper examines the long-run effect of FDI on health in developed countries. Using panel cointegration techniques, we find a significant and negative long-run effect.

Keywords: FDI, health, panel cointegration.

JEL classification: I10; F21; C23

Dierck Herzer
Helmut-Schmidt-University Hamburg,
Holstenhofweg 85
D-22043 Hamburg, Germany
phone: +49-40-6541-2775
Fax: +49-40-6541-2118
E-mail: herzer@hsu-hh.de

Peter Nunnenkamp
Kiel Institute for the World Economy
Hindenburgufer 66
D-24105 Kiel, Germany
phone: +49-431-8814-209
Fax: +49-431-8814-500
E-mail: peter.nunnenkamp@ifw-kiel.de

1. Motivation and background

The empirical literature on the effects of foreign direct investment (FDI) has focused almost exclusively on the benefits that host economies may reap in terms of higher growth and wages. While this literature "seems to have run out of steam," the effects of FDI on important dimensions of the quality of life such as health conditions are among the wide array of neglected issues (Blonigen and O'Fallon 2011: 4). If at all, the link between FDI and health is addressed by listing a healthy workforce among the determinants of the location choices of foreign investors (Alsan et al. 2006; Azémar and Desbordes 2009).

FDI could help improve health conditions in the host economies if foreign firms not only paid higher wages than domestic firms but also provided their employees with better social services and safer workplaces. In addition to such direct effects within firms, economy-wide indirect effects on health could follow from FDI-induced growth to the extent that higher average incomes result in more demand for health services. Waldmann (1992) argues that health care is a superior good. Nevertheless, positive health effects via this route cannot be taken for granted. First, it is disputed that FDI generally leads to higher growth. Second, it is open to question whether more expensive health care translates into higher life expectancy (Deaton 2003).

Ambiguity also prevails with regard to the potentially adverse effects of FDI on health. FDI represents a major driving force of economic globalization which has been associated with widening income gaps in various countries. Unequal societies are characterized by "relative deprivation," and chronic stress is considered to be the main pathway through which inequality impairs health (Wilkinson 2000). However, the evidence available for this channel is inconclusive. FDI does not necessarily result in wider income gaps in the host countries (e.g., Chintrakarn et al. 2012). Furthermore, "there are serious questions about whether the correlation between income inequality and mortality is robust through time, and whether it comes from the effects of income inequality or some other factor that is correlated with it" (Deaton 2003: 143).

FDI may also affect health conditions by increasing competitive pressure in the host economies. Workers could suffer higher levels of stress and uncertainty, especially when FDI takes the form of mergers and acquisitions which often result in lay-offs and streamlining of production. In addition, global financial integration and the worldwide competition for FDI inflows are widely believed to constrain governments in delivering public goods. Host-country governments may even be tempted to lure foreign investors by providing subsidized infrastructure and tax privileges, while cutting, at least in relative terms, social spending on items such as public health services. Whether FDI contributes to races to the bottom in terms of public spending on health depends, inter alia, on the degree of political myopia – considering that the country's attractiveness to FDI might suffer in the longer run from impaired health of the workforce.

2. Empirical analysis

2.1. Model and data

We estimate a bivariate model of the form

$$H_{it} = a_i + \delta_i t + bFDI_{it} + \varepsilon_{it} \,, \tag{1}$$

where a_i are country fixed effects, $\delta_i t$ are country-specific time trends, H_{it} is a measure of the health status of country i's population in year t, and FDI_{it} stands for foreign direct investment in country i at time t. Following the standard literature, we proxy population health by life expectancy at birth, while for our FDI variable, we use net FDI inflows as a percentage of GDP.

Equation (1) assumes a long-run bivariate relationship between permanent movements in life expectancy at birth and permanent movements in FDI (relative to GDP). Necessary conditions for this assumption to hold are that the individual time series for both life expectancy and the FDI variable are nonstationary (or integrated) and that H_{it} and FDI_{it} form a cointegrating vector. A regression containing all the variables of a cointegrating vector has a stationary error term, ε_{it}, implying that no relevant integrated variables are omitted; any omitted nonstationary variable that is part of the cointegrating vector would enter the error term, thereby producing nonstationary residuals and thus leading to a failure to detect cointegration. If there is cointegration between the (two) variables, then the same cointegrating relationship also exists in an extended variable space (Johansen 2000). Thus, an important implication of finding cointegration is that no relevant integrated variables are omitted in the cointegrating regression. Cointegration estimators are therefore robust to the omission of nonstationary variables that do not form part of the cointegrating relationship (Pedroni 2007).

Another assumption inherent in Equation (1) is that health is endogenous in the sense that changes in FDI cause changes in population health. The results of Alsan et al. (2006), however, suggest that health is a positive determinant of FDI. The empirical implication is that it is not only crucial to examine the time-series properties of the variables and to test whether the variables are cointegrated, but it is also important to deal with this endogeneity problem.

A final econometric issue is the potential cross-sectional dependence in the data through common time effects. For example, the data may be partly driven by common global business cycles or global health influences, such as major influenza epidemics, the introduction of new vaccines, and the diffusion of antibiotics and contraceptives. Given that standard panel unit root and cointegration tests may be biased in the presence of such cross-sectional dependence, we also use recent advances in panel data econometrics to account for this issue.

The data on life expectancy at birth and FDI are from the World Development Indicators 2011 database and cover the period 1970-2009. We include all developed countries for which complete data are available, leading to a sample of 14 countries: Austria, Canada, Denmark, Finland, France, Israel, Italy, Netherlands, New Zealand, Norway, Spain, Sweden, the United Kingdom, and the United States.

2.2. Panel unit roots and cointegration tests

In order to determine if the series have unit roots, we use the standard Im, Pesaran, and Shin (2003) (IPS) test. However, this test may suffer from severe size distortions in the presence of cross-sectional dependence. This is why we also employ the cross-sectionally augmented ADF (CADF) panel unit root test proposed by Pesaran (2007). This test is based on the common correlated effects (CCE) approach introduced by Pesaran (2006) and filters out the cross-sectional dependence by augmenting the individual country ADF regressions with the cross-section averages of lagged levels and first-differences of the individual series. As can be seen from Table 1, both the IPS and the CADF tests are unable to reject the null hypothesis that H_{it} and FDI_{it} have a unit root in levels. Since the null hypothesis of a unit root in first differences is rejected, we conclude that the series are integrated of order 1.

In order to test for cointegration, we use the standard panel and group ADF and PP test statistics suggested by Pedroni (1999). A potential problem with the Pedroni approach is that it does not allow for cross-sectional dependence. To test for cointegration in the presence of possible cross-sectional dependence we also use the error correction model (ECM) cointegration tests recently developed by Gengenbach et al. (2008). Following the CCE approach, this test involves estimating separate conditional ECMs for each country using the cross-section averages of the dependent and independent variables (as proxies for the unobserved common time effects). Gengenbach et al. propose two test statistics to test the null hypothesis of no cointegration: the average t-statistic associated with the coefficient of the lagged dependent variable and the average Wald chi-square test statistic of the hypothesis that all coefficients of the lagged levels are zero. The results of these tests are presented in Table 2. They indicate that the null hypothesis of no cointegration can be rejected at least at the 5% level.

2.3. Long-run relationship

In order to estimate the long-run effect of FDI on health, we use the dynamic ordinary least squares (DOLS) estimator. This estimator is asymptotically unbiased and normally distributed, even in the presence of endogenous regressors, thus allowing us to control for the potential endogeneity of FDI. The within-dimension-based DOLS model used in this paper and following Kao and Chiang (2000) is:

$$H_{it} = a_i + \delta_i t + bFDI_{it} + \sum_{j=-k}^{k} \Phi_{ij} \Delta FDI_{it-j} + \varepsilon_{it}, \qquad (2)$$

where Φ_{ij} are coefficients of current, lead, and lag differences, which account for possible serial correlation and endogeneity of the regressor(s), thus yielding unbiased estimates.

We apply the DOLS procedure to both our raw data and to cross-sectionally demeaned data. The latter serves to extract common time effects from the data to account for the likely cross-sectional dependence. However, the demeaning approach assumes that the cross-sectional dependence is due to a single common source and that the response to the common factor is the same for all countries (Pedroni 2007). To allow for cross-sectional dependencies that potentially arise from multiple unobserved common factors and to permit the individual responses to these factors to differ across countries, we also compute the CCE estimator. Specifically, we run a DOLS regression of LE_{it} on FDI_{it}, cross-section specific leads and lags of ΔFDI_{it}, and the cross-section averages of the dependent variable and the regressors; the averages are interacted with country-dummies to allow for country-specific parameters.

The results of these estimation procedures are presented in Table 3. All regressions show a statistically significant and negative relationship between FDI and health. According to the DOLS regression with cross-section averages (CCE), an increase in the FDI-to-GDP ratio by one percentage point leads to a decrease in life expectancy of 0.028 years. In quantitative terms, the impact implied by this estimate is fairly small. The FDI-to-GDP ratio increased, on average, by about 0.022 percentage points per year in the period 1970-2009, so that life expectancy decreased, on average, by about 2.65 hours per year due to the increase in this ratio.

3. Conclusion

In this study, we examined the long-run relationship between FDI and population health for developed countries, a relationship that has not yet been explored in the literature. From our results it can be concluded that FDI has, in general, a negative effect on health in developed economies.

References

Alsan, M., Bloom, D.E., Canning, D., 2006. The effect of population health on foreign direct investment inflows to low- and middle-income countries. *World Development* 34, 613-630.

Azémar, C., Desbordes, R., 2009. Public governance, health and foreign direct investment in sub-Saharan Africa. *Journal of African Economies* 18, 667-709.

Blonigen, B., O'Fallon, C., 2011. Foreign firms and local communities. NBER Working Paper 17282. Cambridge, MA.

Chintrakarn, P., Herzer, D., Nunnenkamp, P., 2012. FDI and income inequality: evidence from a panel of US states. *Economic Inquiry*, forthcoming.

Deaton, A., 2003. Health, inequality, and economic development. *Journal of Economic Literature* 41, 113-158.

Gengenbach, C., Urbain, J.-P., Westerlund, J., 2008. Panel error correction testing in panels with global stochastic trends. Working paper Meteor RM/08/051, Maastricht University.

Im, K.S., Pesaran, M.H., Shin, Y., 2003. Testing for unit roots in heterogeneous panels. *Journal of Econometrics* 115, 53-74.

Johansen, S., 2000. Modelling of cointegration in the vector autoregressive model. *Economic Modelling* 17, 359-373.

Kao, C., Chiang, M., 2000. On the estimation and inference of a cointegrated regression in panel data. *Advances in Econometrics* 15, 179-222.

Pedroni, P., 1999. Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics* 61, 653-670.

Pedroni, P., 2007. Social capital, barriers to production and capital shares: implications for the importance of parameter heterogeneity from a nonstationary panel approach. *Journal of Applied Econometrics* 22, 429-451.

Pesaran, M.H., 2006. Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica* 74, 967-1012.

Pesaran, M.H., 2007. A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics* 22, 265-312.

Waldmann, R. J., 1992. Income distribution and infant mortality. *Quarterly Journal of Economics* 107, 1283-1302.

Wilkinson, R. G., 2000. *Mind the Gap: Hierarchies, Health, and Human Evolution*. London (Weidenfeld and Nicolson).

Table 1: Panel unit root tests

Variables	Deterministic terms	IPS	CADF
Levels			
H_{it}	constant, trend	-1.24	-2.28
FDI_{it}	constant, trend	1.96	-2.12
First differences			
H_{it}	Constant	-4.89**	-2.55**
FDI_{it}	Constant	-4.57**	-2.31*

** (*) indicate rejection of the null hypothesis of a unit root at the 1% (5%) level. The number of lags was determined by the Schwarz criterion. The IPS statistics are distributed as standard normal. The 1% (5%) critical value for the CADF statistics is -2.96 (-2.67) with an intercept and a linear trend, and -2.45 (-2.25) with an intercept (Pesaran 2007).

Table 2: Panel cointegration tests

Pedroni (1999)	
Panel PP t-statistic	-3.21**
Panel ADF t-statistic	-3.17**
Group PP t-statistic	-4.65**
Group ADF t-statistic	-4.21**
Gengenbach et al. (2008)	
ECM t-statistic	-3.50*
ECM Wald statistic	24.05**

** (*) indicate rejection of the null hypothesis of no cointegration at the 1% (5%) level. The number of lags was determined by the Schwarz criterion. The Pedroni statistics are distributed as standard normal. The 5% critical value for the ECM t-statistic is -3.441; the 1% critical value for the corresponding Wald statistic is 18.702 (Gengenbach et al. 2008).

Table 3: DOLS estimates of the long-run effect of FDI on health

Raw data	Demeaned data	CCE
-0.039**	-0.036**	-0.028*
(-3.10)	(-4.91)	(-2.38)

t-statistics are in parenthesis. ** (*) indicate significance at the 1% (5%) level. The DOLS regressions were estimated with one lead and one lag.