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**The Effect of Population Health on Foreign Direct Investment Inflows to Low- and Middle-Income Countries**

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**Summary.** — This paper investigates the effect of population health on gross inflows of foreign direct investment (FDI). We conduct a panel data analysis of 74 industrialized and developing countries over 1980–2000. Our main finding is that gross inflows of FDI are strongly and positively influenced by population health in low- and middle-income countries. Our estimates suggest that raising life expectancy by one year increases gross FDI inflows by 9%, after controlling for other relevant variables. These findings are consistent with the view that health is an integral component of human capital for developing countries.

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**Key words** — population health, foreign direct investment, human capital, low- and middle-income countries

1. INTRODUCTION

The World Health Organization’s Report of the Commission on Macroeconomics and Health (CMH, 2001) asserts: “a healthy workforce is important when attracting foreign direct investment (FDI).” Many international agencies have made similar statements regarding the effect of health on FDI inflows. Such claims have bolstered the position of health on the global development agenda. To date, however, a relationship between population health and FDI has not been established in the empirical literature. The aim of this paper is to investigate whether population health encourages inflows of FDI after controlling for other relevant variables. This study is important for two main reasons. First, developing countries continue to face severe resource constraints. Placing budgetary priority on health interventions at the expense of competing claims merits a strong evidence-based foundation. Second, the expanding role of FDI in the global economy has made understanding its determinants a priority for both researchers and policy makers.

There are several reasons for why population health might be important for attracting FDI. A growing body of evidence has shown that health is an integral component of human capital that raises worker productivity and spurs economic growth. High levels of human capital in the workforce are likely, other things being equal, to make a country more attractive to foreign investors. On the other hand, high rates of absenteeism or worker turnover due to morbidity and mortality can raise production costs and deter FDI. A large burden of infectious diseases might also dampen FDI inflows to a given locale if investors fear for their own health or that of their staff.

To investigate if health status of a population affects FDI inflows, we conduct a panel data analysis of 74 industrialized and developing countries over the period 1980–2000. Our main finding is that FDI inflows are strongly and positively influenced by population health among the sample of low- and middle-income countries. Our estimates suggest that raising life expectancy by one year increases FDI inflows by 9% in these countries, after controlling for

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other relevant factors. These findings are consistent with the view that health is an integral component of human capital for developing countries.

The remainder of the paper is organized as follows: Section 2 presents stylized facts regarding FDI and its relationship to developing countries and human capital; Section 3 reviews empirical evidence and theoretical arguments for considering health as a form of human capital; Section 4 describes the theory of FDI inflows and the empirical model used in the analysis; Section 5 details the data used and our sources; Section 6 presents our empirical results; and Section 7 concludes. To the best of our knowledge, this represents the first empirical investigation evaluating whether health directly affects FDI, ceteris paribus.

2. FDI TRENDS AND HUMAN CAPITAL

FDI has become an increasingly important source of financing worldwide. During the past two decades, global inflows of FDI have soared: from $59 billion in 1982 to $651 billion in 2002 (UNCTAD, 2003). Attracting FDI is important for countries at all stages of development. It has been argued, however, that inducing greater FDI inflows is of more importance to developing countries given their lower savings rates and income levels. Indeed, FDI now represents the largest component of net resource flows to developing countries, surpassing official development assistance (ODA), portfolio investments, and bank loans (Miyamoto, 2003).

In addition to providing much needed capital, FDI has other attributes of particular relevance for developing economies. These attributes include expanding access of domestic firms to global markets and facilitating the transfer of technology. FDI may also increase tax revenue for the host economy and enhance the competitiveness of the domestic market through spillover effects (Loungani & Razin, 2001; UNCTAD, 2004a). These potential benefits of FDI have been widely publicized. Leaders gathered at the International Conference on Financing for Development (ICFD), held in Mexico in 2002, characterized FDI as an engine for economic growth and an integral component of poverty alleviation. The Monterrey Consensus, adopted at the ICFD, stated, “A central challenge, therefore, is to create the necessary domestic and international conditions to facilitate direct investment flows...to developing countries” (United Nations, 2002).

This challenge has not yet been met. Global FDI inflows are not distributed evenly. Industrialized economies are the most likely destination for FDI; and some developing countries receive much greater inflows than others. African countries in particular have struggled to attract foreign investors (see Morisset, 2002). In 2002, Africa attracted only $11 billion in foreign investment; far less than Central Europe ($28.7 billion), Latin America ($56 billion), or Asia ($95.1 billion) (UNCTAD, 2003). Asiedu (2002), empirically investigating the determinants of FDI to developing countries, found that sub-Saharan African (SSA) countries were less likely to attract investors than non-SSA countries, despite the fact that US investment into SSA had a higher rate of return than investment in other developing regions. Furthermore, factors proven to promote FDI to non-SSA countries (such as infrastructure and return on capital investment) did not have a clear impact on FDI to SSA countries. A survey conducted by the United Nations Conference on Trade and Development (UNCTAD) of the leading multinational enterprises supported Asiedu’s results. Only one out of every five respondents expected higher inflows to African countries over the next two years, and two-thirds believed that the current level of flows would remain unchanged (UNCTAD, 2004b).

Under standard neoclassical assumptions (where output is produced by capital and labor), capital is predicted to flow from wealthy to poor countries until capital–labor ratios equalize across countries. The observed pattern of FDI, with most capital flowing from one wealthy country to another, is thus an apparent paradox. Lucas (1990) argues that differences in human capital could explain this paradoxical pattern. Recently, there has been renewed interest in the idea that human capital might play a role in encouraging foreign investment. To the extent that physical capital and skills are complementary inputs, the presence of a healthy and more highly educated workforce can increase the productivity of capital. This is driven in part by economic activity shifting first from the primary goods to manufacturing sectors and then toward services, which are successively more knowledge intensive. For example, in the early 1970s, the services sector accounted for only 25% of the world FDI stock. By 2002, services had risen to about 60% of the total...
stock (UNCTAD, 2004a). FDI geared to knowledge- and skill-intensive industries may imply that countries with higher levels of human capital are more attractive to investors (Blomström & Kokko, 2003; Miyamoto, 2003; Noorbakhsh, Paloni, & Youssef, 2001). Most cross-country studies investigating this idea identify human capital narrowly with education, ignoring strong reasons for considering health as an integral component of human capital. Therefore, in a natural extension of the literature, we investigate whether the health status of the population encourages inflows of FDI. In Section 3, we review empirical evidence establishing health as a form of human capital and summarize circumstantial evidence suggesting a link between health and FDI.

3. HEALTH, HUMAN CAPITAL, AND FDI

In addition to the importance of health as a consumption good, health can also be viewed as a form of human capital that enhances economic performance both for the individual and at the level of the macroeconomy (Bloom, Canning, & Jamison, 2004). A substantial body of evidence has demonstrated that population health is a robust predictor of growth in per capita income (Barro, 1991; Barro & Sala-i-Martin, 1995; Bhargava, Jamison, Lau, & Murray, 2001; Bloom, Canning, & Sevilla, 2004). However, countries may benefit to different degrees from health. Bhargava et al. (2001) argue that economic growth resulting from health improvements is more pronounced in developing countries than in industrial countries.

Health can affect economic performance through direct and indirect mechanisms. Health has a direct effect on the productivity of workers. Healthy workers are generally more physically and mentally robust than those afflicted with disease or disability. Furthermore, they are less likely to be absent from work, or suffer low productivity in work, due to personal or household illness. Poor health can lead to low wages, which in turn keeps health and nutrition levels low, thereby creating a poverty trap.

Microeconomic analyses using anthropometric measures (such as the onset of menarche, nutritional status, and stature) and indices of morbidity (such as work days lost due to illness) have consistently shown that health affects worker productivity (Knaul, 1999; Ribero, 1999; Savedoff & Schultz, 2000; Schultz & Tansel, 1997; Strauss & Thomas, 1998).

Health can also affect economic performance through indirect mechanisms; for example, improved health can increase the return to education and worker experience. Healthier children have enhanced cognitive function and higher school attendance, allowing them to become better educated, higher earning adults (Bhargava, 2001; Bloom, 2005). Healthier workers, who have lower rates of absenteeism and longer life expectancies, acquire more job experience. Better health also improves the prospective life-span of workers. In countries with low life expectancies, the prospect of retiring is remote. Once better health becomes more common, retirement seems more attainable. Increased longevity, therefore, can generate the need for retirement income and set off a savings and investment boom (Bloom, Canning, & Graham, 2003). Health improvements may also affect the age structure of populations. Initially, such improvements tend to reduce mortality rates among infants and children, since interventions to reduce childhood mortality are usually neither costly nor complex. As parents come to expect more of their children to survive to adulthood, fertility rates fall. This change produces a baby boom generation. The fall in birth rates, coming as it does after a fall in mortality rates, means that the large baby boom generation is unique, with much smaller cohorts before and after it. As this generation enters the workforce, it may provide a boost to productivity leading to economic growth (Bloom & Canning, 2000).

Health, viewed as a form of human capital, could affect FDI through several mechanisms. As the CMH report suggested, a healthy workforce could enhance worker productivity and attract FDI inflows. However, health may also encourage FDI via other mechanisms. Firm profitability may suffer if health-related costs are high. Companies operating in countries where health infrastructure and personnel are lacking may need to develop or significantly subsidize a health care system for their employees. Sick leave, funeral costs, and low workforce morale represent additional burdens for investing firms. In addition, for fear of endangering their own health and that of their expatriate staff, foreign investors may shun areas where disease is rampant and where access to health care is limited. Foreign investors and their managerial staff may lack resistance to disease, either acquired or inherited, that the host country population enjoys. For example, a significant portion of the population in Africa
carries the sickle cell trait. This condition confers protection from severe malaria and is much less common among European descendants (Pasvol, Weatherall, & Wilson, 1978). A similar reduction in disease severity has been observed with certain types of thalassemia (Clegg & Weatherall, 1999). Indeed, these inherited hemoglobinopathies are thought to persist among certain African and Asian populations because natural selection favors alleles offering protection against malarial illness.

A classic instance of disease interfering with investment occurred during the building of the Panama Canal. Yellow fever and other pathogens claimed the lives of 10,000–20,000 workers during 1882–1888, forcing Ferdinand de Lesseps and the French to abandon the construction project (Jones, 1990). More recently, the outbreak of Severe Acute Respiratory Syndrome (SARS) has highlighted fears that new infectious disease outbreaks could undermine global integration and deter foreign investment. Preliminary evidence seems to support this view. A global business survey on HIV/AIDS sponsored by the World Economic Forum (Bloom, Bloom, Steven, & Weston, 2003) found that half of all business leaders in low-income countries believe that HIV affects their country’s access to FDI.

As well as affecting the costs of production, health may also affect the level of demand. Healthy populations are more productive, earning higher incomes and creating a larger market for goods. In addition to this effect on aggregate demand, health may also have consequences on the pattern of demand, with direct effects on the demand for health services and more indirect effects on sectors such as tourism.

Even though circumstantial evidence suggests a link between health and FDI, empirical findings are noticeably absent. The gap in the literature is not without consequence. As competition for ODA rises and questions about the effectiveness of foreign aid are raised, developing countries are increasingly looking to FDI to promote technology transfers and economic growth. We now turn to the model.

4. THE MODEL

Firms invest in foreign countries, instead of exporting to them or licensing to a local company, to satisfy one of two strategic objectives. They may seek to better serve the local market, producing locally to avoid transportation costs, trade barriers, or production delays and speed information flow. This is market-seeking or horizontal FDI. Alternatively, they may seek to produce for the global market but select this location to minimize production costs through lower-cost inputs. This is export-oriented or vertical FDI (Shatz & Venables, 2000). In principle, health can affect both vertical and horizontal FDI.

Local production allows a firm to avoid transportation costs and import duties; but this is only attractive if the domestic market is sufficiently large to cover the fixed costs of setting up production and any country-specific cost disadvantages. Asiedu (2002) and Blonigen and Wang (2004) conjecture, reasonably, that horizontal FDI will be driven largely by domestic demand (market size). Along the same lines, other investigators have traditionally found that host market size, usually measured in terms of real gross domestic product (GDP) per capita and population size, is a positive determinant of FDI inflows (Chakrabarti, 2001; Schneider & Frey, 1985; Wheeler & Mody, 1992). By contrast, ceteris paribus, vertical FDI will flow to countries that possess cheap, productive inputs and have the fewest restrictions on trade. The presence of highly educated, healthy workers, available at low wages, may be a large inducement for vertical FDI.

We can formalize this. Let us begin with a model of export-oriented or vertical FDI. Assuming constant returns to scale, profit maximization, and competitive markets, the profits earned by a unit of FDI can be expressed in the form of a profit function given by

$$\pi = f(p^0_x, p_k, p_x, z),$$

where $p^0_x$ is the world price of the output produced, $p_k$ is the local cost of capital, $p_x$ is the local cost of an input (in general, there will be many inputs into production), and $z$ represents the per unit costs due to factors such as transportation, tariffs, and corruption in the host economy. In this model, all FDI will flow to the country with the highest profit rate. Now suppose that the cost of investment rises as the volume of FDI (which we denote by $I$) expands depending on $S$, the absorptive capacity of the country with a quadratic adjustment cost would be according to

$$C(I) = p^0_k \left( I + \frac{\sigma I^2}{2S} \right).$$
The idea is that as aggregate FDI increases some resources become scarce, increasing the cost of investing. Note that this model applies to gross inflows of FDI, since it is the gross inflows and not the net balance of FDI flows that has to be absorbed. The price of capital facing an individual company undertaking FDI depends on the aggregate volume of FDI and is

\[ p_k = C'(I) = p_k^0 \left( 1 + \alpha \frac{I}{S} \right). \]

Investment of FDI in each country will take place up to the point where the profitability of investment is equalized across countries \( \pi^0 = f(p_k^0, p_k(I), p_k^0, z) \). Solving this as an implicit function for \( I \) gives

\[ I = g(\pi^0, p_k^0, p_k^0, S, p_k^0, z). \]

The terms with the superscript 0 refer to worldwide variables that are the same for each country (though they may vary over time), while the other variables are country specific. We proxy \( S \), the absorptive capacity of the economy for FDI, by population size and income per capita. We do not have local prices for each input in our model.

The profit function \( f \) of the firms involved in FDI implies an underlying production function. However, the aggregate production function of the economies these firms are investing in may be quite different. Suppose the aggregate production function for the domestic economy is Cobb–Douglas and is given by

\[ Y = AK^\alpha X^\beta L^{1-\alpha-\beta}, \]

where \( Y \) is output, \( K \) is capital, \( L \) is labor, \( X \) is some other input (e.g., health), \( \alpha \) and \( \beta \) is total factor productivity. Profit-maximizing firms will choose input levels for \( X \) so that the marginal product of \( X \) equals its real price (in output units) \( p_x \). This implies that

\[ \frac{dY}{dX} = \beta AX^{\beta-1}K^{\alpha-\beta}L^{1-\alpha-\beta} = \beta \frac{Y}{L} \frac{X}{L} = p_x, \]

and hence,

\[ p_x = \beta \frac{Y}{L} \left( \frac{X}{L} \right)^{-1}. \]

It follows that we can regard the per-worker level of an input that is available in an economy (for a given level of income per capita) as a proxy for its price, with higher levels of an input per worker associated with lower input prices and lower input levels associated with higher prices. The level of output per worker is also a proxy for the general level of input prices. We can control this by including the level of income per capita in the regression. In this framework, countries with a high level of income per capita are likely to have high factor prices which will deter investment, while countries with high levels of a particular input per capita, given their income level, will have low prices for that input, which will encourage investment. We also include a number of variables, such as corruption and distance to major markets, that may add to costs of production.

Note that the production function for firms undertaking FDI implicit in the profit function \( f \) (Eqn. (1)) may be quite different from the existing aggregate production function for the economy (Eqn. (5)) that determines the link between domestic factor availability and factor prices. This allows for the possibility that FDI firms have different technology from the existing firms in the economy. Our model does not, however, allow for the possibility that FDI firms are interested only in some specialized factors of production that are not captured accurately by broad aggregates. However, using national averages makes the empirical investigation tractable, since data on the availability and cost of inputs at the local level are not readily available for many developing countries.

The model set out here is one of export-oriented or vertical FDI. For most low- and middle-income countries, we think this is the appropriate model. To construct a model of horizontal FDI, the appropriate price level of output is the local price of the good, not the world price. While input prices have the same effect for horizontal FDI as for vertical FDI, the coefficients on factors that produce trade barriers may now change. Trade barriers such as import tariffs, distance to major markets, or lack of access to the sea may act as a deterrent to export-oriented FDI but may actually attract horizontal FDI, since many features that reduce the competitiveness of imports may give FDI that produces for the host economy an advantage. This implies that the coefficients on these variables must again be interpreted with care, since they may be the result of two competing forces. However, for most low- and middle-income countries we expect that FDI will be predominantly export-oriented and that the deterrent effect of trade barriers dominates.
In our empirical work, we model the gross level of FDI inflows at time \( t \) in country \( i \) as follows:

\[
\log I_{it} = a + \alpha \log \text{Pop}_{it} + \beta \log \text{GDP per capita}_{it} \\
+ \theta \text{Health}_{it} + \mu \log \text{Edu}_{it} + \gamma X_{it} + \delta Z_{it} \\
+ D_i + \varepsilon_{it},
\]

where the subscript \( i \) refers to a country, while \( t \) refers to the time period. We include log population (Pop) and log GDP per capita as scale variables. Following our theory, we also include measures for worker health and education levels as productive components of human capital. Further input per capita measures are included in the vector \( X \), while vector \( Z \) represents barriers to trade that may deter FDI. We include time dummies, \( D_i \), to capture changes in the volume of global international investment flows over time (due to changes in the world price or rate of profit), and \( \varepsilon \) represents the error term.

We predict that higher levels of health and education inputs are (after controlling for income per capita) associated with lower input costs, \( p_x \), according to (7) above. Note that GDP per capita now has two effects in our model. It can not only be considered as a scale variable that captures market size and capacity to absorb FDI, but can also act as a proxy for the overall level of input costs (assuming the Cobb–Douglas specification above). The two effects of income per capita on FDI can be thought of as generating a coefficient \( \beta = (\beta_1 + \beta_2) \) on income per capita in our regressions where \( \beta_1 \) represents its scale effect on absorptive capacity and \( \beta_2 \) represents its effect on average input prices. Provided the model is correctly specified, there is no problem in estimating the total effect of income per capita \( (\beta_1 + \beta_2) \) though we cannot identify the individual parts of this effect. While this will not affect the validity of our estimation, the coefficient on GDP per capita should be interpreted with caution because it may reflect both the market size and the cost effect that tend to move in opposite directions. Note that the market size effect is usually associated with horizontal FDI, while in our model a positive effect of market size on vertical FDI may be due to the economies’ ability to absorb FDI inflows without pushing up the price of capital. Although our theory is a model of vertical FDI, in practice the estimation is more general and some of the scale effects we detect may reflect horizontal FDI.

Our estimation approach measures the effect of health on FDI conditional on a number of other factors, such as the scale of the economy and education levels. We therefore estimate only the direct effect of health. There may also be indirect effect. For example, if high levels of population health raise income levels, and reduce mortality, then both income and population numbers will rise. Health may also encourage school attendance and education. However, these indirect effects will already be captured by the relevant variables in the model and are not attributed to our health variable.

Our FDI measure is gross inflows. Many researchers use other measures, for example, net inflows, but we prefer gross inflows for three reasons. First, this measure seems more appropriate for investigating what characteristics of a particular country attract investors. Second, from Eqn. (2), a capacity constraint on FDI will raise the price of investment as gross inflows increase and some inputs become scarce. Third, in terms of knowledge spillovers, which may be a central benefit of FDI, it is the gross inflows that matter and not the net inflows.

The literature commonly normalizes FDI flows by dividing by some scale variable, for example, population or GDP. We prefer not to impose a particular normalization or scale factor, instead estimating a relationship. Our log formulation allows for normalization by population or GDP as special cases. For example, in the case of population we can transform our equation as follows:

\[
\log(I/\text{Pop})_{it} = a + (\alpha - 1) \log \text{Pop}_{it} \\
+ \beta \log \text{GDP per capita}_{it} \\
+ \theta \text{Health}_{it} + \mu \log \text{Edu}_{it} \\
+ \gamma X_{it} + \delta Z_{it} + D_i + \varepsilon_{it}.
\]

It follows that we can test if normalizing by population is a valid method of measuring the scale effect by estimating the original equation and testing the restriction that \( \alpha = 1 \). Similarly, normalizing FDI by total GDP gives

\[
\log(I/\text{GDP})_{it} = a + (\alpha - 1) \log \text{Pop}_{it} \\
+ (\beta - 1) \log \text{GDP per capita}_{it} \\
+ \theta \text{Health}_{it} + \mu \log \text{Edu}_{it} \\
+ \gamma X_{it} + \delta Z_{it} + D_i + \varepsilon_{it}.
\]
It follows that our estimated coefficients on health are unchanged by such normalizations. We use life expectancy at birth to proxy the health of a country’s population. 7 We would prefer a measure of health that explicitly accounts not only for mortality rates, but also for the morbidity effects of ill-health. However, Murray and Lopez (1996) demonstrate that higher life expectancy is associated with lower morbidity and overall better health status. Furthermore, Shastry and Weil (2002) report that the survival rate of adult males is linearly related to adult male height, which is often used as a measure of health human capital in microeconomic studies (e.g., Savedoff & Schultz, 2000; Schultz, 2002). These findings establish a relationship between mortality and morbidity measurements. However, health is a multidimensional concept and it is likely that our life expectancy measure does not capture the full complexity of population health. Different dimensions of health may have differing economic consequences (e.g., Gallup & Sachs, 2001, show that endemic malaria affects economic growth, even after accounting for life expectancy). We leave the study of the effects of different components of population health on FDI to future research.

We use as our educational stock measure the log of the percentage of the population aged 25 or above who have completed secondary schooling (Cohen & Soto, 2001). We follow the literature with respect to the inclusion of other control variables, including openness of the economy, infrastructure, quality of governance, and distance to major world markets. Openness of the economy to trade is especially important for firms seeking to export products from the host country to the global market, as tariffs, quotas, and other forms of capital controls will diminish firms’ profits (Asiedu & Lien, 2004). Openness is required not only with respect to exports, but also for imports, because many FDI ventures may require the purchase of intermediate inputs from abroad. We employ the ratio of trade (imports + exports) to GDP as our measure of openness.

Governance is increasingly being identified as a key factor that firms evaluate when choosing to invest abroad (Gastanaga, Nugent, & Pashamova, 1998; MIGA & Deloitte & Touche, 2002). In particular, the quality of bureaucratic institutions affects FDI inflows (Globerman & Shapiro, 2002; Stein & Daude, 2001). Wei (2000) finds that corruption has a strong negative impact on the location of FDI. We use Knack and Keefer (1995) indexes of bureaucratic quality and corruption in government. Note that in both cases a higher value of the index is “better,” in particular, a high value of the index indicates less corruption.

Good infrastructure in the form of transportation and communication networks can increase firm productivity and help attract foreign investment. We employ telephone mainlines per 1,000 population as a proxy for host country infrastructure. However, this measure has its limitations, as it only accounts for the availability and not the reliability of the infrastructure. This could be particularly problematic in poor countries where support for infrastructure may be lacking (Asiedu, 2002). Furthermore, telephone mainlines are quickly being replaced by mobile networks. Although mobile networks were not sufficiently developed over our study period (1980–2000) to be significant, there is evidence to suggest that this is quickly changing (Williams, 2005). 8 Rapid technological changes of this type mean that studies like ours based on historical data need to be treated with caution for policy purposes.

We also investigate whether geography affects the distribution of FDI inflows. Transportation costs and distance from the home country are commonly included in gravity models of international investment and may affect a firm’s decision about where to locate abroad (Brainard, 1997; Yigang, 2003). Although Hausmann and Fernández-Arias (2000) find that distance to major markets is not a robust FDI determinant, we include air distance from major markets as a possible control variable in our analysis. 9 In addition, Gallup, Sachs, and Mellinger (1999) argue that the economies of coastal regions, with their easy access to international trade through sea lanes, should outperform the economies of inland areas. While inland areas can access markets through rail or road links, these are often much more expensive forms of transportation. Thus, we include a dummy variable for whether a country is landlocked with the stipulation that the country is not located in Western or Central Europe (countries in Western and Central Europe have close proximity to a major market and the absence of sea routes may not matter). We also include a variable for the proportion of population within 100 km of the coast or an ocean-navigable waterway as an alternative to having access to the sea.
A weakness of the cross-country approach that we employ is that it relies on national averages. For large countries with major difference across states or provinces, such as India or China, FDI inflows may be responding to local, not national, conditions. In other instances, analysis at the regional level might be more appropriate. For example, parts of Southern Africa demonstrate a distinctive disease epidemiology partly due to shared ecological and historical characteristics (Bloom & Sachs, 1998). Our results therefore carry the qualification that the cross-country approach we employ may need to be supplemented by more detailed local or regional studies to obtain a fuller understanding of the determinants of FDI inflows.

5. DATA

The empirical analysis employs panel data for a set of 74 countries observed over the last two decades. A list of countries included in the analysis is provided in Appendix A. A summary of data sources and variable descriptions is provided in Appendix B. We use all countries for which data are available, but exclude major petroleum exporters, because for these countries our measure of openness (trade flows) may not reflect a lack of trade barriers and GDP per capita is unlikely to proxy labor costs (UNCTAD, 2005).

The dependent variable, gross FDI inflows, is based on annual data averaged over each decade. We constructed gross FDI inflows using data from the World Development Indicators (World Bank, 2003). The World Development Indicators does not include data on gross inflows directly, but does provide data on total gross flows (the sum of gross inflows and gross outflows) and on net inflows (gross inflows minus gross outflows), from which gross inflows can be derived. We calculated gross FDI inflows using the following two relationships:

\[
\text{Gross FDI (}\%\text{GDP}) = \text{Gross inflows FDI (}\%\text{GDP}) + \text{Gross outflows FDI (}\%\text{GDP})
\]

and

\[
\text{Net inflows FDI (}\%\text{GDP}) = \text{Gross inflows FDI (}\%\text{GDP}) - \text{Gross outflows FDI (}\%\text{GDP}).
\]

Hence,

\[
\text{Gross FDI inflows (}\%\text{GDP}) = \text{[Gross outflows FDI (}\%\text{GDP}) + \text{Net inflows FDI (}\%\text{GDP})]/2.
\]

We multiply this by GDP (constant 1995 US$) to obtain gross FDI inflows.

All explanatory variables are taken at the beginning of the relevant time period. Summary statistics for the full sample of 74 countries are presented in Table 1. The correlation coefficients for the full sample of 74 countries are presented in Table 2. Life expectancy ranks second only to GDP per capita in strength of raw correlation to log gross FDI inflows.

| Variable                          | Mean   | Standard deviation | Minimum   | Maximum   |
|-----------------------------------|--------|--------------------|-----------|-----------|
| Log gross FDI inflows             | 24.453 | 2.833              | 17.859    | 30.371    |
| Log total population              | 16.381 | 1.387              | 13.323    | 20.850    |
| Log GDP per capita                | 8.415  | 1.145              | 6.168     | 10.192    |
| Openness of economy              | 60.165 | 39.450             | 11.546    | 361.179   |
| Bureaucratic quality             | 3.415  | 1.977              | 0         | 6         |
| Corruption in government         | 3.613  | 1.872              | 0         | 6         |
| Life expectancy                  | 64.577 | 11.104             | 35.196    | 78.837    |
| Log education                    | −2.561 | 1.316              | −6.624    | −0.580    |
| Telephones per 1,000 capita      | 149.455| 184.731            | 0.700     | 680.800   |
| Distance to major markets        | 3.890  | 2.774              | 0.140     | 9.280     |
| Population coastal (%)           | 61.940 | 34.091             | 0         | 100       |
| Landlocked                       | 0.135  | 0.343              | 0         | 1         |

Sources for data are listed in Appendix B.
Table 2. Correlation matrix for the full sample (74 countries)

|                          | Log gross FDI inflows | Log total population | Log GDP per capita | Openness of economy | Bureaucratic quality | Corruption government | Life expectancy | Log education | Telephones per 1,000 capita | Distance to major markets | Population coastal (%) | Landlocked |
|--------------------------|-----------------------|----------------------|-------------------|--------------------|---------------------|----------------------|-------------------|--------------|-----------------------------|--------------------------|------------------------|-------------|
| Log gross FDI inflows    | 1                     |                      |                   |                    |                     |                      |                   |              |                             |                          |                       |             |
| Log total population     | 0.398                 | 1                    |                   |                    |                     |                      |                   |              |                             |                          |                       |             |
| Log GDP per capita       | 0.813                 | 0.029                | 1                 |                    |                     |                      |                   |              |                             |                          |                       |             |
| Openness                 | 0.105                 | -0.448               | 0.177             | 1                  |                     |                      |                   |              |                             |                          |                       |             |
| Bureaucratic quality     | 0.718                 | 0.169                | 0.743             | 0.165              | 1                   |                      |                   |              |                             |                          |                       |             |
| Corruption government    | 0.592                 | 0.055                | 0.644             | 0.227              | 0.864               | 1                    |                   |              |                             |                          |                       |             |
| Life expectancy          | 0.811                 | 0.096                | 0.901             | 0.207              | 0.598               | 0.572               | 1                 |              |                             |                          |                       |             |
| Log education            | 0.720                 | 0.104                | 0.797             | 0.111              | 0.554               | 0.463               | 0.785             | 1             |                             |                          |                       |             |
| Telephones per 1,000 capita | 0.731               | 0.052                | 0.834             | 0.137              | 0.786               | 0.733               | 0.703             | 0.691         | 1                           |                          |                       |             |
| Air distance 1,000 km    | -0.510                | -0.154               | -0.571            | -0.147             | -0.413              | -0.325              | -0.527            | -0.470        | -0.540                      | 1                        |                       |             |
| Population coastal (%)   | 0.467                 | -0.117               | 0.619             | 0.291              | 0.374               | 0.333               | 0.637             | 0.500         | 0.445                       | -0.518                    | 1                      |             |
| Landlocked               | -0.436                | -0.179               | -0.457            | -0.077             | -0.337              | -0.231              | -0.512            | -0.405        | -0.294                      | 0.361                     | -0.637                 | 1            |
Table 2 shows that life expectancy is highly correlated with income per capita (a correlation coefficient of just above 0.9). However, while this correlation tends to increase the size of the estimated standard errors in our regressions, it does not undermine the consistency of the estimates or the validity of the inference we can draw assuming that the functional form of our model is specified correctly.

6. ESTIMATION AND RESULTS

Table 3 reports our panel data estimates for the full sample of 74 countries with up to two observations per country, one for 1980–90 and one for 1990–2000. All reported regressions passed Ramsey’s Regression Specification Error Test (RESET) for model misspecification. We estimate using heteroskedasticity-consistent standard errors.

Column (1) of Table 3 reports results for an ordinary least squares specification that is representative of the FDI literature. The coefficients on income per capita and total population, our indicators of market size, are positive and strongly significant, and this remains true for all our specifications. The coefficients on each are usually not significantly different from unity in our regressions, indicating that in practice normalizing FDI flows by total GDP is valid.

Corruption is not significantly different from zero in our specifications, yet the other gover-

| Table 3. Full sample (74 countries) dependent variable: log gross FDI inflows |
|-----------------|-----------------|-----------------|-----------------|
| (1)             | (2)             | (3)             | (4)             |
| Constant        | −5.057**        | −2.492          | −1.187          | −1.132          |
|                 | (1.991)         | (1.783)         | (2.314)         | (3.330)         |
| Log total population in base year | 0.840***        | 0.761***        | 0.756***        | 0.774***        |
|                 | (0.116)         | (0.095)         | (0.093)         | (0.128)         |
| Log GDP per capita in base year | 1.655***        | 0.970***        | 0.898***        | 0.777***        |
|                 | (0.126)         | (0.235)         | (0.249)         | (0.318)         |
| Openness of economy in base year | 0.009*          | 0.007**         | 0.007**         | 0.008           |
|                 | (0.005)         | (0.003)         | (0.003)         | (0.006)         |
| Bureaucratic quality | 0.196*          | 0.324***        | 0.319***        | 0.383***        |
|                 | (0.103)         | (0.105)         | (0.106)         | (0.116)         |
| Corruption in government | 0.015           | −0.057          | −0.044          | −0.171          |
|                 | (0.106)         | (0.100)         | (0.099)         | (0.118)         |
| Life expectancy | 0.070***        | 0.065***        | 0.075***        |
|                 | (0.022)         | (0.022)         | (0.027)         |
| Log education   | 0.120           | 0.110           | 0.110           |
|                 | (0.154)         | (0.164)         |                 |
| Telephones per 1,000 capita | 0.001           | 0.001           | 0.001           |
|                 |                 |                 | (0.001)         |
| Distance to major markets | 0.021           | 0.021           | 0.021           |
|                 |                 |                 | (0.021)         |
| Population coastal (%) | 0.001           | 0.001           | 0.001           |
|                 |                 |                 | (0.005)         |
| Landlocked      | 0.293           | 0.293           | 0.293           |
|                 |                 |                 | (0.538)         |
| Dummy 1990–2000 | 1.027***        | 0.921***        | 0.903***        | 0.752***        |
|                 | (0.206)         | (0.198)         | (0.206)         | (0.214)         |
| Observations    | 137             | 137             | 137             | 130             |
| Adjusted $R^2$  | 0.85            | 0.86            | 0.86            | 0.86            |

Note: Heteroskedastic-consistent (White) standard errors are in parentheses.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.
nance measure, quality of bureaucratic institutions, is both significant and positive in the model. Adding life expectancy in column (2) demonstrates that health is a statistically significant predictor of gross FDI inflows at the 1% level and is robust to adding education in column (3). The results indicate that every additional year of life expectancy increases FDI inflows by about 7% among the full sample of countries.

The other component of human capital, education, has a positive coefficient, but is not statistically significant. This finding is consistent with the conflicting evidence on the importance of education in determining the inflows of FDI. Root and Ahmed (1979), as well as Schneider and Frey (1985), report that education does not significantly affect FDI flows to developing countries. More recently, however, Noorbakhsh et al. (2001) and Globerman and Shapiro (2002) argue that education does have a positive and significant impact on foreign investment and that its effect has been increasing over time. The reason for the poorly determined coefficient on secondary schooling in our model could be measurement error in the data on education that biases the estimated coefficient toward zero (see Krueger & Lindahl, 2001). We also tried other measures of education, such as the number of accumulated years of education in the population aged 15–64 and school enrollment rates, but did not find any measure that produced a statistically significant effect.

We further test for robustness by adding infrastructure and geographic variables that are also postulated to be determinants of FDI inflows. The results reported in column (4) indicate that the coefficient on life expectancy is robust to these alternate specifications, though many of the controls do not themselves appear to be statistically significant.

Recent evidence suggests that pooling data from industrial and developing countries in empirical FDI studies may yield misleading coefficient estimates (Blonigen & Wang, 2004). We might expect that developing countries are more dependent on export-oriented FDI, while industrial countries are more attractive for market-seeking FDI (Shatz & Venables, 2000). Of particular relevance to the current study, we noted a gap in average life expectancy between income groups: 75.2 years for high-income countries versus 59.4 years for low- and middle-income countries. Diminishing returns to health might well make it a more important investment in low-income countries. We therefore analyze the model using two restricted samples, one of low- and middle-income countries and one of high-income countries selected on the basis of the World Bank’s income classification.

The results for low- and middle-income countries are reported in Table 4. The model being estimated in Table 4 is identical to that reported in Table 3, the only difference being the sample. The results are broadly similar to those listed in Table 3. The coefficient on openness is somewhat larger than before, which is consistent with foreign investment to developing countries being mainly export-oriented. Life expectancy once again has a positive and statistically significant effect on FDI. The large decrease in the coefficient on GDP per capita when we add life expectancy to the model indicates that when health is excluded from the model, GDP per capita is, to some extent, serving as a proxy for health in low- and middle-income countries.

The effect of population health on FDI inflows is robust to adding education and other control variables. Our results suggest that every additional year of life expectancy is associated with a 9% increase in gross FDI flows to low- and middle-income countries.

The index of corruption is now significant, but of the “wrong” sign. The results suggest that higher levels of corruption are associated with higher levels of FDI in low- and middle-income countries. This finding, although perhaps surprising, agrees with Stein and Daude’s (2001) and Wheeler and Mody’s (1992) results. It is also consistent with Alesina and Weder (1999), who argue that the relationship between corruption and economic performance is complicated. Some types of corruption may allow the relatively efficient provision of services to foreign firms, its main effect being on the distribution of domestic economic gains, with little distortion of productive activities.

Table 5 uses the same specifications as Table 3 for a sample restricted to high-income countries. The sample size now becomes quite small and may lead to some variables becoming statistically insignificant simply because of a lack of power; therefore, these results should be treated with caution. Unlike the results reported from the previous two samples; openness, GDP per capita, and bureaucratic quality are not statistically significant. The lack of
significance of openness is consistent with the idea that FDI going to industrial countries is mainly to access their markets rather than to export.

Even though GDP per capita does not have a significant association with FDI inflows, the other proxy for market size, total population, is highly significant at the 1% level. The lack of significance of GDP per capita could be due to a balancing of the market size effect with the cost of production effect, which should work in the opposite directions. Reduced corruption does appear to have a positive and significant impact on FDI in this sample; indicating that the type of corruption, or the way it affects the economy, may differ between industrial and developing countries. Health is not statistically significant in any specification among high-income countries. This is consistent with the idea that the worker productivity effects of health differentials appear mainly in developing countries; however, we hesitate to emphasize such an interpretation due to the small sample size.

Our results are consistent with those of Blonigen and Wang (2004), who argue that the underlying factors that determine the level of FDI activity vary systematically across countries at different stages of development. This split of the sample is supported by the fact that we can reject parameter equality between the two sub-samples in some specifications. For example, taking regression 1, the F-test (distributed as a $\chi^2(7,121)$) yields a statistic of 2.18. This leads us to reject the hypothesis that the coefficients reported in

### Table 4. Low- and middle-income country sample (51 countries) dependent variable: log gross FDI inflows

|                      | (1)       | (2)       | (3)       | (4)       |
|----------------------|-----------|-----------|-----------|-----------|
| Constant             | -6.385**  | -0.078    | 0.590     | -2.288    |
|                      | (3.017)   | (3.017)   | (3.280)   | (3.913)   |
| Log total population | 0.912***  | 0.685***  | 0.682***  | 0.749***  |
| in base year         | (0.176)   | (0.148)   | (0.148)   | (0.165)   |
| Log GDP per capita   | 1.654***  | 0.663**   | 0.643*    | 0.784     |
| in base year         | (0.162)   | (0.329)   | (0.332)   | (0.457)   |
| Openness of economy  | 0.015**   | 0.009     | 0.009     | 0.014**   |
| in base year         | (0.007)   | (0.007)   | (0.006)   | (0.006)   |
| Bureaucratic quality | 0.311*    | 0.553***  | 0.538***  | 0.549***  |
|                      | (0.167)   | (0.146)   | (0.153)   | (0.183)   |
| Corruption in        | -0.149    | -0.343**  | -0.320**  | -0.366**  |
| government           | (0.151)   | (0.130)   | (0.146)   | (0.190)   |
| Life expectancy      | 0.093***  | 0.089***  | 0.091**   |           |
|                      | (0.027)   | (0.029)   | (0.035)   |           |
| Log education        |           | 0.067     | 0.017     |           |
|                      |           | (0.191)   | (0.209)   |           |
| Telephones per 1,000 | -0.002    |           |           |           |
| capita               |           | (0.007)   |           |           |
| Distance to          |           | 0.041     |           |           |
| major markets        |           | (0.086)   |           |           |
| Population coastal   | 0.001     |           |           |           |
| (%)                  |           | (0.009)   |           |           |
| Landlocked           | 0.353     |           |           | (0.651)   |
| Dummy 1990–2000      | 1.133***  | 0.949***  | 0.936***  | 0.865***  |
|                      | (0.301)   | (0.276)   | (0.289)   | (0.335)   |
| Observations         | 90        | 90        | 90        | 86        |
| Adjusted $R^2$       | 0.71      | 0.74      | 0.73      | 0.72      |

* Significant at the 10% level.  
** Significant at the 5% level.  
*** Significant at the 1% level.

Note: Heteroskedastic-consistent (White) standard errors are in parentheses.
the two sub-samples are the same at the 5% significance level. We also reject the commonality of coefficients in regression specification 2. Although we fail to reject the null hypothesis of equality for regression specifications 3 and 4, it seems preferable to consider the two sub-samples separately.

7. CONCLUSION

This paper provides empirical evidence that health is indeed a positive and statistically significant determinant of gross FDI inflows to low- and middle-income countries. Our results remain robust to adding many control variables, such as education, governance, infrastructure, and income per capita. Although we have tried to ensure that our results are robust, there is always the possibility that some hidden variable is the real determinant of FDI. The positive coefficient on life expectancy may be due to factors correlated with health that we could not control for in the model. Future studies should confirm the robustness of our findings and attempt to disaggregate the health effect we have identified. It may be that certain diseases have a greater impact on FDI inflows than others. For example, diseases that afflict the working-age population (e.g., HIV/AIDS) or are easily transmittable (e.g., tuberculosis) may deter FDI inflows more than chronic, non-communicable diseases. Perhaps diseases with a high morbidity affect FDI differently than those with a high mortality. It is difficult to carry out this type of detailed

| Table 5. High-income country sample (23 countries) dependent variable: log gross FDI inflows |
|----------------------------------------|----------------|
|                                       | (1)           | (2)           | (3)           | (4)           |
| Constant                              | 1.298         | 0.378         | −2.744        | −2.688        |
|                                       | (6.173)       | (9.971)       | (11.346)      | (12.167)      |
| Log total population in base year     | 0.821***      | 0.822***      | 0.791***      | 0.834**       |
|                                       | (0.094)       | (0.099)       | (0.106)       | (0.316)       |
| Log GDP per capita in base year       | 0.952         | 0.921         | 1.238         | 1.665         |
|                                       | (0.700)       | (0.749)       | (1.093)       | (1.198)       |
| Openness of economy in base year      | 0.005         | 0.005         | 0.005         | 0.004         |
|                                       | (0.004)       | (0.004)       | (0.004)       | (0.017)       |
| Bureaucratic quality                  | 0.180         | 0.196         | 0.174         | 0.089         |
|                                       | (0.204)       | (0.260)       | (0.249)       | (0.277)       |
| Corruption in government              | 0.235*        | 0.230         | 0.258         | 0.339**       |
|                                       | (0.137)       | (0.151)       | (0.161)       | (0.162)       |
| Life expectancy                       | 0.015         | 0.019         | −0.070        |               |
|                                       | (0.124)       | (0.124)       | (0.124)       | (0.124)       |
| Log education                         | −0.202        | −0.573        |               |               |
|                                       | (0.303)       | (0.385)       |               |               |
| Telephones per 1,000 capita           |               | 0.003         |               |               |
|                                       |               | (0.002)       |               |               |
| Distance to major markets             |               | 0.021         |               |               |
|                                       |               | (0.105)       |               |               |
| Population coastal (%)                |               | 0.004         |               |               |
|                                       |               | (0.014)       |               |               |
| Landlocked                            | 0             |               |               |               |
| Dummy 1990–2000                       | 0.856***      | 0.832***      | 0.802***      | 0.691*        |
|                                       | (0.233)       | (0.252)       | (0.256)       | (0.350)       |
| Observations                          | 45            | 45            | 45            | 43            |
| Adjusted $R^2$                        | 0.84          | 0.84          | 0.84          | 0.80          |

Note: Heteroskedastic-consistent (White) standard errors are in parentheses.
* Significant at the 10% level.
** Significant at the 5% level.
*** Significant at the 1% level.
analysis at the cross-country level, but it may be possible in more local settings.

Despite these qualifications, our main result is that a one-year improvement in life expectancy is associated with a 9% increase in gross FDI inflows to low- and middle-income countries, and this result seems fairly robust. These findings are consistent with the view that health is an integral component of human capital for developing countries and suggest that the payoff to improved population health is also likely to include an elevated rate of FDI inflows.

NOTES

1. Globerman and Shapiro (2002) do regress FDI on the human development index (HDI), which is a composite of GDP per capita, educational literacy and enrollment, and life expectancy at birth. We directly investigate the effect of health on FDI.

2. In 2001, the five highest FDI-receiving countries attracted 62% of the total inflows to the developing world (Cho, 2004).

3. For example, Debswana, Anglo American, and Coca-Cola are a few companies now subsidizing HIV medicines (anti-retroviral therapy) in southern African countries (The Economist, 2002).

4. More generally, Acemoglu, Robinson, and Johnson (2001) show that historically infectious disease burdens have had a profound impact on the pattern of colonial settlement while Glaeser, La Porta, Lopez-de-Silanes, and Shleifer (2003) emphasize that one effect of such settlement was the transfer of human as well as physical capital.

5. The profit function assumes that all factor inputs are chosen to maximize profits given the price vector. In our case we examine the profits earned by a unit of FDI, allowing all other inputs to be chosen optimally.

6. Adding multiple inputs in the same Cobb–Douglas function does not change any of the results.

7. The estimates of life expectancy are based on age-specific mortality rates for high-income countries but are usually constructed from life tables based on infant mortality rates from national demographic and health surveys in developing countries (see Bos, Vu, & Stephens, 2002).

8. Williams (2005) finds that mobile phone penetration rates are a significant and positive predictor of net FDI inflows to developing countries. However, these results are only observed for the period 2000–02. A similar relationship is not found if data from 1993 to 1999 are included in the analysis. Williams interprets these findings as evidence that mobile networks were not sufficiently developed during the earlier period to affect FDI.

9. The sea distance may be a better indicator than air distance to major markets for trade purposes, though this leaves open the issue of how to deal with landlocked countries.

10. The 20 major petroleum producers are Algeria, Angola, Bahrain, Brunei Darussalam, Republic of Congo, Gabon, Indonesia, Islamic Republic of Iran, Iraq, Kuwait, Libyan Arab Jamahiriya, Nigeria, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Trinidad and Tobago, United Arab Emirates, Venezuela, and Yemen (based on the classification by the United Nations Conference on Trade and Development—see http://www.unctad.org/Templates/WebFlyer.asp?intItemID=2162&lang=1).

11. Because data are not available for 1980, we used the earliest available data (during 1983–87) for the index of corruption and quality of bureaucratic institutions over both time periods. The data for the variable, “percent of population 100 kilometers from the coast or an ocean-navigable waterway,” are estimated using geographic information system (GIS) technology, which does not date back to 1980. Despite this limitation, the variable was included in the model as a determinant of trade costs. We also tried other geographic variables (e.g., land area in the tropics) but none were significant.

12. Neither the share of the population near the coast nor being landlocked were significant if entered separately.

13. In the World Bank (2003) categorization, the low- and middle-income group (all developing economies) includes those countries in which the 2001 gross national income per capita was US$9,205 or less, as measured in current US dollars. The high-income economies are those in which the 2001 gross national income per capita was US$9,206 or more.
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## APPENDIX A. LIST OF COUNTRIES

| High-income countries | Low- and middle-income countries |
|------------------------|----------------------------------|
| Australia              | Argentina                        | Madagascar |
| Austria                | Bangladesh                        | Malawi     |
| Belgium                | Bolivia                           | Malaysia   |
| Canada                 | Brazil                            | Mali       |
| Cyprus                 | Bulgaria                          | Mexico     |
| Denmark                | Burkina Faso                      | Morocco    |
| Finland                | Cameroon                          | Mozambique |
| France                 | Chile                             | Nicaragua  |
| Germany                | China                             | Niger      |
| Greece                 | Colombia                          | Panama     |
| Ireland                | Costa Rica                        | Paraguay   |
| Italy                  | Dominican Republic                | Peru       |
| Japan                  | Ecuador                           | Philippines|
| The Netherlands        | El Salvador                       | Romania    |
| New Zealand            | Ethiopia                          | Senegal    |
| Norway                 | Ghana                             | Sierra Leone|
| Portugal               | Guatemala                         | South Africa|
| Singapore              | Guyana                            | Sudan      |
| Spain                  | Haiti                             | Tanzania   |
| Sweden                 | Honduras                          | Thailand   |
| Switzerland            | Hungary                           | Tunisia    |
| United Kingdom         | India                             | Turkey     |
| United States          | Jamaica                           | Uganda     |
|                       | Jordan                            | Uruguay    |
|                       | Kenya                             | Zambia     |
|                       |                                    | Zimbabwe   |

Country classifications according to World Bank (2003) categorization.

## APPENDIX B. VARIABLE DEFINITIONS AND SOURCES

| Variable                | Definition                                                                 | Source                    |
|-------------------------|---------------------------------------------------------------------------|---------------------------|
| Log gross FDI inflows   | Calculated from gross FDI (percentage of GDP), FDI, net inflows (percentage of GDP) and GDP (constant 1995 US$); see text for details | World Bank (2003)         |
| Log total population    | Population, total                                                        | World Bank (2003)         |
| Log GDP per capita      | GDP per capita, purchasing power parity (constant 1995 international $)   | World Bank (2004)         |
| Openness of economy     | Sum of imports of goods and services (percentage of GDP) and exports of goods and services (percentage of GDP) | World Bank (2003)         |
| Bureaucratic quality    | Index with 0–6 range, with higher values indicating “better” ratings     | Knack and Keefer (1995)   |
| Corruption in government| Index with 0–6 range, with higher values indicating “better” ratings     | Knack and Keefer (1995)   |
| Life expectancy         | Life expectancy at birth, total (years)                                  | World Bank (2003)         |
| Log education           | Percentage of population aged 25 or over who have completed secondary education | Cohen and Soto (2001)     |

(continued next page)
## APPENDIX B—continued

| Variable                  | Definition                                                                 | Source                        |
|---------------------------|---------------------------------------------------------------------------|-------------------------------|
| Telephones per 1,000 capita | Telephone mainlines per 1,000 population                                   | World Bank (2003)             |
| Distance to major markets | The minimum great-circle (air) distance in 1,000 km from the country’s capital city to the closest major port: New York, Rotterdam, or Tokyo | Gallup et al. (1999)          |
| Population coastal        | Percent of population within 100 km of coastline or ocean-navigable river, excluding coastline above the winter extent of sea ice and the rivers that flow to this coastline | Gallup et al. (1999)          |
| Landlocked                | Indicator for landlocked country (1 if landlocked, 0 otherwise), excluding countries in Western and Central Europe (Austria, the Czech Republic, Hungary, the Former Yugoslav Republic of Macedonia, Slovakia, and Switzerland) | Gallup et al. (1999)          |