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A Mean-Variance Explanation of FDI Flows to Developing Countries*

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Abstract

An important feature of the world economy is the close global and regional integration due to strong trade and investment relations among countries. The high degree of integration between countries is likely to give rise to business cycle synchronisation in which case shocks will spillover from one country to another. This will have implications for the way investors evaluate the return and risk of investing abroad. This paper utilises a simple mean-variance optimisation framework where global and regional factors capture the interdependence between countries. The model implies that FDI is driven by the risk-adjusted rate of return as well as global and regional spillovers. The preditions of the model are confirmed in a sample of 60 countries over the period 1970-2000.

Keywords: Foreign direct investment, risk, portfolio, business cycles
JEL clasifications: F21, G11, R11, E32

1 Introduction

While a large part of the empirical literature on FDI has focussed mainly on the traditional low-return explanation of limited FDI inflows to certain developing

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countries, more recent studies have attempted to control for the risk of investing abroad. The importance of risk stems from the fact that, in the face of the uncertainty connected to foreign investments, the objective of investors is to maximise the expected return on their investment in which case the variance of returns becomes a critical element in the locational choice of foreign investors. While empirical FDI analyses remain focused on deriving proxies for *local* return and risk, an important feature of the world economy is the close global and regional integration due to strong trade and investment relations among countries. The high degree of integration between countries is likely to give rise to business cycle synchronisation in which case shocks will spillover from one country to another. This will have implications for the way foreign investors evaluate return and risk.

This paper offers a theoretical framework for FDI that takes both return and risk into account, and where global and regional factors capture the interdependence between countries. This framework allows us to decompose total risk into covariance risk and idiosyncratic risk. *Covariance risk* is defined in Cochrane (2001, Ch. 7) as the variance in a country's return that is caused by common global and regional factors.[1] The global factor captures movements in the underlying forces that drive the economies, i.e. oil price shocks, productivity shocks and interest rate shocks. On the other hand, shocks that affect adjacent countries owing to similarities in production, export and trade structures would be captured by the regional factor. *Idiosyncratic risk*, on the other hand, is (unsystematic) country-specific risk and captures, among other things, changes in macroeconomic policy, internal conflicts or structural changes affecting return in a particular country.

Our theoretical model predicts that FDI flows are driven by the *risk-adjusted rate of return*. Moreover, once we take the interdependence between countries into account, care should be taken in defining both return and risk. First, return should include the spillovers from the global and regional investment climate due to business cycle synchronisation. Second, country risk should be adjusted for covariance risk in order to get a more precise measure of idiosyncratic risk since ignoring such

[1] Systematic risk and undiversifiable risk have both been used in the literature as synonyms for covariance risk. However, these terms rely on the existence of costless diversification opportunities and on the existence of a large market portfolio. The definition of covariance risk applied in this paper does not, and it continues to be relevant even when the investor invests only in a few countries and where there are certain entrance costs.

systematic comovements in returns exaggerates the measure of country risk.

We test the implications of our theoretical model on the net flow of FDI into a cross-section of 60 developing countries. We find that the strong relationship between FDI inflows and the risk adjusted rate of return can only be observed in the empirical model when a precise measure of idiosyncratic risk is obtained; that is once we control for both global and regional covariance risk. We also find that there is a relatively large and positive net effect from global integration. On the regional level, there is a positive net effect of being located in Asia and (to a lesser extent) in Africa. In Latin America, on the other hand, the regional return component is exactly balanced by the risk premium required to compensate for regional covariance risk, and there is thus no net effect of being located in this region. The results are robust to correcting for possible endogeneity problems.

The paper proceeds as follows. Section 2 summarises the theoretical arguments for global and regional business cycle synchronisation. Section 3 solves the investor's optimisation problem using a mean-variance optimisation framework under three different scenarios of interdependence between alternative FDI locations: no correlation (the traditional view), the presence of a global factor in a country's return (global business cycle) and, lastly, the coexistence of a global and regional component in returns (global and regional business cycles). Section 4 sets out the econometric modelling of the FDI relation and tests the implications of the theoretical model based on the risk measures derived in Sunesen (2006). Finally, Section 5 summarises and concludes.

2 Global and Regional Business Cycles

The phenomenon of globalisation, the close economic and financial integration of the world economy, is likely to give rise to comovements in economic aggregates and thus to business cycle effects. The leading explanation for business-cycle synchronisation is trade, which captures the flow of technological transmission and the extent to which a country is exposed to global shocks.[2]

[2] Another frequently referenced explanation is financial integration but in light of the poorly developed financial markets in most developing countries we focus on the trade mechanism. We refer to Baxter and Kouparitsas (2004) for further references on the many potential explanations

However, as pointed out by Frankel and Rose (1998) and Heathcote and Perri (2002), among others, one could also expect increased trade to result in increased sectoral specialisation (through returns to scale, etc.). If the primary business cycle shocks are sector-specific, then countries with greater similarity in sectoral structures and exports would tend to have more correlated business cycles, other things equal. This means that if adjacent countries have more similar industrial structures, export good compositions or initial endowments (human capital, physical capital, arable land, etc.) one might expect regional business cycle comovement.

Figure 1-3 in the Appendix suggest that there are regional similarities in the distribution of wealth (important to the income-generating process), in the composition of natural capital (suggestive of initial endowments) and in the distribution of economic activity (related to industrial structures) that might give rise to regional business cycle synchronisation due to asymmetric shocks to world prices - fluctuations in the prices of primary, capital and intermediate goods - and in the world real interest rate.[3]

Figure 1 shows the regional distribution of wealth divided into natural capital, produced capital and intangible capital. Wealth in African countries stems mainly from natural capital whereas intangible capital adds up to more than half of total wealth in Latin America and Asia. Figure 2 shows the composition of natural capital wealth. The non-renewable subsoil resources are particularly important in Latin America but weigh less heavily in Africa and Asia. Forested areas account for a large share of natural capital in Africa while dependency on land is strongest in Asia. Finally, Figure 3 depicts the distribution of economic activity. While more than a quarter of the income generated in Africa and Asia stems from agriculture, hunting, forestry and fishing, the number is only 15% in Latin America. Finally, while the three regions have comparable levels of economic activity in the mining, construction and transport sectors, the African manufacturing sector is largely underdeveloped compared with Latin America and Asia.

Together the data presented here suggest that we should expect both global and regional business cycle synchronisation. This is supported by a vast amount of

of business cycle comovement.

[3]Interest rate disturbances might cause significant business cycle fluctuations in highly indebted countries, the so-called HIPC countries, most of which are located in Sub-Saharan Africa and Latin America.

empirical evidence a few of which are summarised here. Kose, Otrok and Whiteman (2003) find that there is a distinct global business cycle that accounts for a large fraction of business-cycle variability in developed countries, whereas regional and idiosyncratic factors are more important in developing economies. The finding of a global business cycle is supported by Albuquerque, Loayza and Servén (2002), while Baxter and Kouparitsas (2004) and IMF (2005, Chapter 2) find evidence of regional business cycle comovement.

3 A Theoretical Model of Risk and Return

The presence of common global and regional factors in local returns means that there will be some systematic pattern in the covariance of returns that the investor can exploit in order to get a more precise measure of return and risk. The theoretical model builds on the mean-variance portfolio model associated particularly with Tobin (1958, 1965) and Markowitz (1952). The model assumes that multinational enterprises (MNEs) estimate the expected profitability of choices among risky assets by looking at the mean and variance provided by combinations of those assets.[4]

3.1 The Optimisation Problem

We make two simplifying assumptions that make the portfolio model suitable for the investment decision of MNEs. First, direct investors typically have a relatively long investment horizon, where the entry decision comes first and where the investor adjusts the size of his investment according to the expected profitability of investment in the particular country. Empirically, this means that FDI inflows in some periods might become negative, which will happen if dividend payments from the host country to the source country are higher than the investments made in that year. In financial terms this means that we allow for "short sales". This assumption also ensures that all countries are in the portfolio; some will be held

[4] This only leads to expected utility maximisation if investor's utility function depends only on the means and the variance of wealth (quadratic utility function) and if returns are normally distributed.

long (receive positive amounts of net FDI) and others will be held short (receive negative amounts of net FDI).

Second, we assume that there is riskless lending and borrowing. The majority of foreign investors are large-scale MNEs that come from industrialised countries with highly developed capital markets. Relative to investing in developing countries where the risk of investment is so much higher, assuming that the home market offers riskless lending and borrowing at the world interest rate is probably not a bad approximation.

Under the assumption of risk-less lending and borrowing, Sharpe (1963) finds that the optimal portfolio is the portfolio with the greatest ratio of excess return (expected return minus the risk-free rate) to standard deviation that satisfies that the sum of the proportions invested in the country equals 1. Substituting the constraint into the objective function means that we can solve the investor's optimisation problem by maximising the Sharpe Ratio (SR)

$$\max_{x} SR = \frac{\sum_{i=1}^{N} x_i(\bar{R}_i - R_f)}{[\sum_{i=1}^{N} x_i^2\sigma_i^2 + \sum_{i=1}^{N} \sum_{j=1,j\neq i}^{N} x_i x_j \sigma_{ij}]^{\frac{1}{2}}}, \tag{1}$$

where x_i is the share of FDI going to country i, $\bar{R}_i$ is the expected rate of return to investment in country i, R_f is the riskless rate of return (the world interest rate), σ_i^2 is the variance of return to investment in country i, and σ_{ij} is the covariance between returns in country i and country j. Setting the derivative with respect to x_m equal to zero and rearranging yields

$$\frac{dSR}{dx_m} = -[\lambda x_m \sigma_m^2 + \sum_{j=1,j\neq m}^{N} \lambda x_j \sigma_{mj})] + (\bar{R}_i - R_f) = 0, \tag{2}$$

where

$$\lambda = \frac{\sum_{i=1}^{N} x_i(\bar{R}_i - R_f)}{\sum_{i=1}^{N} x_i^2\sigma_i^2 + \sum_{i=1}^{N}\sum_{j=i}^{N} x_i x_j \sigma_{ij}} = \frac{\bar{R}_p - R_f}{\sigma^2(R_p)}, \qquad (3)$$

and $\bar{R}_p$ is the expected return on the portfolio and $\sigma^2(R_p)$ is the variance of R_p. Defining $Z_m = \lambda x_m$ and substituting it for λx_m yields a system of N simultaneous equations for N unknown variables (Z_m):

$$\bar{R}_i - R_f = Z_m\sigma_m^2 + \sum_{j=1, j\neq m}^{N} Z_j\sigma_{mj}, \qquad m = 1, ..., N. \qquad (4)$$

3.2 Adjusting for Global and Regional Interdependence

In an optimisation model of N countries the analyst must provide estimates of N expected returns, N variances of returns and $N(N-1)/2$ covariances of return. To simplify the problem, we utilise the empirical observation of global and regional interdependence summarised in the previous section to formulate index models that will provide a structural solution of the model.[5] We show here the derivations for the multi-index model since the single-index model follows directly. To our knowledge this paper is the first to offer an explicit solution of a multi-index model. In constructing the global and regional indices we make the identifying assumption that countries are small relative to the world (regional) economy, which implies that local factors may have a global (regional) component but that the reverse is not true.

The *multi-index model* assumes that country returns move together partly because of economy wide changes and partly because of countries belonging to regional subgroups. Let ω be an index of global market performance defined as $\omega = \alpha_\omega + \varepsilon_\omega$ where α_ω is the global rate of return and ε_ω captures global shocks. By symmetry, let τ_k be the index of regional market performance defined as $\tau_k = \alpha_{\tau_k} + \varepsilon_{\tau_k}$, where α_{τ_k} is the regional return and ε_{τ_k} captures regional shocks

[5] Index models have frequently been used to simplify the nature of interdependence between countries; see among others Rajan and Friedman (1997), Kose, Otrok and Whiteman (2003), and Albuquerque, Loayza and Servén (2002).

in region k, $k \in K$ where K is the set of regions. We can now define the rate of return to investment in country i as

$$R_i = \alpha_i + \beta_{i\omega}\omega + \sum_{k=1}^{K} \beta_{i\tau_k} I_{ik}\tau_k + u_i, \tag{5}$$

where α_i is the country-specific rate of return, and $\beta_{i\omega}$ is the degree of global integration, $\beta_{i\tau_k}$ is the degree of regional integration, and I_{ik} is an indicator of regional belonging that takes the value one if country i belongs to region k and zero otherwise. u_i captures idiosyncratic (country-specific) shocks.

While a multi-index model of this kind can be employed directly, the model would have some very convenient mathematical properties if the indexes were orthogonal, $E(\omega-\alpha_\omega)(\tau_k-\alpha_{\tau_k}) = E[\varepsilon_\omega \varepsilon_{\tau_k}] = 0$, and if the residual was uncorrelated with two indexes, $E[u_i(\omega-\alpha_\omega)] = E[u_i\varepsilon_\omega] = 0$ and $E[u_i(\tau_k-\alpha_{\tau_k})] = E[u_i\varepsilon_{\tau_k}] = 0$.[6] Under these assumptions total risk can be expressed as

$$\sigma_i^2 = \beta_{i\omega}^2\sigma_\omega^2 + \sum_{k=1}^{K} \beta_{i\tau_k}^2 I_{ik}\sigma_{\tau_k}^2 + \sigma_{u_i}^2, \tag{6}$$

where σ_ω^2 is the variance of global return, and $\sigma_{\tau_k}^2$ is the variance of return in region k. This formulation ensures that total risk can be decomposed into global and regional covariance risk, $\beta_{i\omega}^2\sigma_\omega^2$ and $\beta_{i\tau_k}^2\sigma_{\tau_k}^2$, as well as idiosyncratic risk, $\sigma_{u_i}^2$.

Substituting for $\sigma_i^2 = \beta_{i\omega}^2\sigma_\omega^2 + \sum_{k=1}^{K} \beta_{i\tau_k}^2 I_{ik}\sigma_{\tau_k}^2 + \sigma_{u_i}^2$ and $\sigma_{ij} = \beta_{i\omega}\beta_{j\omega}\sigma_\omega^2 + \sum_{k=1}^{K} \beta_{i\tau_k}\beta_{j\tau_k} I_{ik} I_{jk}\sigma_{\tau_k}^2$ in (4) and solving for x_i yields

$$x_i = \frac{1}{\lambda\sigma_{u_i}^2}[(\bar{R}_i - R_f) - \beta_{i\omega}C_\omega^* - \sum_{k=1}^{K} \beta_{i\tau_k} I_{ik} C_{\tau_k}^*], \tag{7}$$

where $C_\omega^* = \sigma_\omega^2 \sum_{j=1}^{N} Z_j\beta_{j\omega}$ and $C_{\tau_k}^* = \sum_{j=1}^{N} Z_j\beta_{j\tau_k}\sigma_{\tau_k}^2$.[7]

[6] In the Cohen and Pogue (1967) notation, this means that we apply the multi-index model in its diagonal form.

[7] λ is the risk-adjusted excess return on the portfolio. Since it is the same for all the countries in the portfolio, it will be ignored in the remaining part of the paper.

3.3 Implications

Scenario 1. If there is no correlation between countries ($\beta_{i\omega} = \beta_{i\tau_k} = 0, \forall\, k \in K$), the share of FDI going to country i, x_i, will be given by

$$x_i = \frac{1}{\sigma^2_{\varepsilon_i}}[\bar{R}_i - R_f].$$

The term $\bar{R}_i - R_f$ reflects the excess return over the risk-free rate of return, and it can therefore be interpreted as the risk premium imposed on country i. Since our empirical analysis will be based on a cross-section of countries we can set the risk-free rate equal to zero without loss of generality. We can then simplify the expression

$$x_i = \frac{1}{\sigma^2_{\varepsilon_i}}\bar{R}_i = \frac{\alpha_i}{\sigma^2_{\varepsilon_i}}, \tag{8}$$

where α_i is the expected rate of return to investment in country i, and $\sigma^2_{\varepsilon_i}$ is the total risk of investing in country i ($\sigma^2_{\varepsilon_i} = \sigma^2_i$). In effect, this implies that all FDI should flow to the country with the highest risk-adjusted rate of return. This approach is clearly too simplistic and such a corner solution never manifests itself.

Scenario 2. In the presence of a common movement in returns due to a global business cycle ($\beta_{i\tau_k} = 0\ \forall,\ k \in K$), the single index model gives

$$x_i = \frac{1}{\sigma^2_{e_i}}[\bar{R}_i - R_f - \beta_{i\omega} C^*_\omega].$$

For a country to be held long, $x_i > 0$, we must require that $C^*_\omega < (\bar{R}_i - R_f)/\beta_{i\omega}$. $(\bar{R}_i - R_f)/\beta_{i\omega}$ is the standardised global risk premium; i.e. the risk premium relative to country i's contribution to global covariance risk (also called excess return to beta). We can therefore interpret C^*_ω as the global cut-off point: only countries with a standardised global risk premium beyond the global cutt-off point will receive positive amounts of FDI. Again, we can rewrite the expression to get a more intuitive interpretation:

$$x_i = \frac{\alpha_i}{\sigma^2_{e_i}} + (\alpha_\omega - C^*_\omega)\frac{\beta_{i\omega}}{\sigma^2_{e_i}}, \tag{9}$$

where α_ω is the global return, $\sigma_{e_i}^2$ is the risk of investing in country i adjusted for global covariance risk ($\sigma_{e_i}^2 = \sigma_i^2 - \beta_{i\omega}^2\sigma_\omega^2$), and $\beta_{i\omega}$ is the degree of global spillovers. The first term is the risk-adjusted rate of return familiar from Scenario 1. The second term reflects the country-specific net effect of global integration, which will depend on the combined sign of $(\alpha_\omega - C_\omega^*)$ and $\beta_{i\omega}$. If the global return is higher than the global cut-off point, $\alpha_\omega > C_\omega^*$, there is a net benefit of global integration and the country therefore gains from being positively correlated with the global business cycle, $\beta_{i\omega} > 0$.

Since the portfolio includes both countries that are positively and negatively correlated with the world economy the investor gains from diversifying across countries. However, since countries are not perfectly correlated and since there is a finite number of developing countries (each MNE is typically only present in a small number of countries) investors cannot diversify away all covariance risk.

Scenario 3. In the presence of both global and regional business cycle effects, the relevant regression is

$$x_i = \frac{\alpha_i}{\sigma_{u_i}^2} + (\alpha_\omega - C_\omega^*)\frac{\beta_{i\omega}}{\sigma_{u_i}^2} + \sum_{k=1}^{K}(\alpha_{\tau_k} - C_{\tau_k}^*)I_{ik}\frac{\beta_{i\tau_k}}{\sigma_{u_i}^2}, \qquad (10)$$

where $\beta_{i\tau_k}$ is the degree of regional spillovers, $C_{\tau_k}^*$ is the regional risk premium, and $\sigma_{u_i}^2$ is total risk adjusted for both global and regional risk components ($\sigma_{u_i}^2 = \sigma_i^2 - \beta_{i\omega}^2\sigma_\omega^2 - \sum_{k=1}^{K}\beta_{i\tau_k}^2 I_{ik}\sigma_{\tau_k}^2$). By symmetry, if the regional return outweighs the regional covariance risk ($\alpha_{i\tau_k} - C_{\tau_k}^* > 0$), a country that is positively correlated with the regional business cycle will benefit from its regional location.

The investor now experiences a second diversification gain by investing in countries that are positively as well as negatively correlated with the regional economy. Since the regional return components are assumed to be uncorrelated once we control for the common comovement due to the global business cycle, there is no additional diversification benefit from diversifying across regions.

4 Empirical Estimation

In this section we take the structural model of FDI to the data. To estimate the model we need proxies for local returns, global and regional spill-overs as well as various risk measures. In the most elaborated case where countries are affected both by global and regional spillovers, equation (5) decomposes return according to

$$R_{it} = \alpha_{it} + \beta_{i\omega}\omega_t + \sum_{k=1}^{K} \beta_{i\tau_k} I_{ik}\tau_{kt} + u_{it}.$$

Since direct measures of the return to FDI in developing countries are not available, we follow the methodology in Sunesen (2006) to obtain the country-specific return (α_{it}), the global and regional rates of return (ω_t and τ_{kt}), and the degrees of global and regional integration ($\beta_{i\omega}$ and $\beta_{i\tau_k}$). The main steps of the procedure are shortly schetched here.

First, we proxy return by growth in GDP per capita, g_{it}, and apply annual data for a sample of 126 developed and developing countries to estimate

$$g_{it} = x'_{it}\delta + \varepsilon_{it}, \qquad \varepsilon_{it} \sim IID(0, \sigma^2_{\varepsilon_i}) \tag{11}$$

where x_{it} is a vector of slowly-moving growth determinants and ε_{it} is the growth residual. The country-specific return, α_i, can then be proxied by averaging $x'_{it}\hat{\delta}$ over time, and $\sigma^2_{\varepsilon_i}$ is interpreted as conditional risk (total risk adjusted for economic fundamentals). To take out the global return component we decompose further

$$\hat{\varepsilon}_{it} = \beta_{i\omega}\omega_t + e_{it}, \qquad e_{it} \sim IID(0, \sigma^2_{e_i}) \tag{12}$$

where $\hat{\omega}_t$ can be identified as the first principal component from a principal components analysis (PCA) of $\hat{\varepsilon}_{it}$, and $\beta_{i\omega}$ is the factor loading. $\sigma^2_{e_i}$ is conditional risk adjusted for global covariance risk. Averaging ω_t over time gives the global return component, ω. By symmetry, we adjust for regional spillovers by undertaking a PCA of $\hat{e}_{it}$ for each region individually and estimate

$$\hat{e}_{it} = \sum_{k=1}^{K} \beta_{i\tau_k} I_{ik}\tau_{kt} + u_{it}, \qquad u_{it} \sim IID(0, \sigma^2_{u_i}) \tag{13}$$

where τ_{kt} is the first principal component and $\beta_{i\tau_k}$ is the factor loading from the PCA of region k.

The great advantage of undertaking the PCA in two steps is the precise interpretation and identification of the principal components as capturing global and regional spillovers. In addition, the methodology ensures that the crucial assumptions of the multi-index model are satisfied: the covariance between the two indexes is zero, the residual is uncorrelated with each index, and the covariance between the residual i and the two indexes is zero.

4.1 Results

We now turn to the regression analysis and we estimate the three cross-section equations using Ordinary Least Square (OLS) for the sample of 60 countries[8]

$$\textbf{Scenario 1.} \quad x_i = c_0 \frac{\hat{\alpha}_i}{\hat{\sigma}^2_{\varepsilon_i}} + \varepsilon_i$$

$$\textbf{Scenario 2.} \quad x_i = c_0 \frac{\hat{\alpha}_i}{\hat{\sigma}^2_{e_i}} + c_1 \frac{\hat{\beta}_{i\omega}}{\hat{\sigma}^2_{e_i}} + e_i$$

$$\textbf{Scenario 3.} \quad x_i = c_0 \frac{\hat{\alpha}_i}{\hat{\sigma}^2_{u_i}} + c_1 \frac{\hat{\beta}_{i\omega}}{\hat{\sigma}^2_{u_i}} + c_2 AFR \frac{\hat{\beta}_{i\tau_{AFR}}}{\hat{\sigma}^2_{u_i}} + c_3 ASIA \frac{\hat{\beta}_{i\tau_{ASIA}}}{\hat{\sigma}^2_{u_i}} + c_4 LAC \frac{\hat{\beta}_{i\tau_{LAC}}}{\hat{\sigma}^2_{u_i}} + u_i$$

While c_0 reflects the importance of the risk-adjusted rate of return (where the definition of risk varies between the three scenarios), c_1 reflects the net benefit of global integration ($\alpha_\omega - C^*_\omega$), and c_2 to c_4 reflect the net benefit of regional belonging ($\alpha_{\tau_k} - C^*_{\tau_k}$, where $k = AFR, ASIA, LAC$). Results using standard errors adjusted for cluster-correlations are reported in Table 1.

The first column shows the regression results based on the traditional view that FDI inflows are driven by returns, α_i, and that countries are completely independent. Country returns enter positively but insignificant and the explanatory power is very low. In Scenario 1, countries are completely independent and the

[8] As in the majority of empirical FDI studies, China has been excluded from the sample due to its dominant share of FDI into developing countries and Asia in particular. Not only has this status been achieved in a relatively short period of time, see UNCTAD (1994), but concerns have also been raised about the reported magnitude of FDI inflows into China. The World Bank (1996) reports that the overestimation may be more than 25% of annual FDI flows. In addition, Brazil and Mexico are huge FDI recipients compared with other Latin American countries, and their outlier status is confirmed by the test for multiple outliers in multivariate data in Hadi (1992, 1994).

Table 1: FDI Regressions (OLS estimation)

	Traditional	Scenario 1	Scenario 2	Scenario 3
Return	2.89	0.027	0.027	0.020**
	[13]	[0.03]	[0.02]	[0.008]
Global integration			0.11**	0.098**
			[0.05]	[0.04]
Asian integration				0.057***
				[0.007]
Latin American integration				-0.024
				[0.02]
African integration				0.020*
				[0.01]
Constant	0.60***	0.57***	0.42***	0.34***
	[0.1]	[0.1]	[0.1]	[0.1]
R-squared	0	0.07	0.18	0.51

Note: OLS regression including 60 countries (excluding China, Brazil and Mexico). The dependent variable is average net FDI inflows from 1970-2000. Heteroscedastic consistent standard errors adjusted for cluster-correlations are in brackets. *** p<0.01, ** p<0.05, * p<0.1

only determinant of FDI is the risk-adjusted rate of return. This variable turns out to be positive and insignificant and the explanatory power remains very low. In Scenario 2 we adjust for global interdependence and we find that there is a positive net benefit of global integration

In Scenario 3 we see that the more precise definition of idiosyncratic risk once we adjust for global and regional covariance risk means that the risk-adjusted rate of return is clearly identified and significant. In addition to a positive net benefit of global integration, we find that there is a strong positive net gain of being located in Asia whereas the African spillover effect is lower and less significant. The Latin American return factor, on the other hand, is exactly matched by the risk premium required to compensate for regional covariance risk.

4.2 Endogeneity Problems

The methodology in Sunesen (2006) is based on the premise that GDP growth is closely related to the return to investment and thus that growth is a main driver of FDI. However, one needs to face the question of causality since FDI has the potential to transfer knowledge and technology that might spur growth. If this is the case, all variables in the regression are potentially endogenous since they are based either on predicted growth or on the growth residual. Although Hansen and Rand (2004) present empirical evidence of a bidirectional relationship between FDI and growth in the short run only and support for a causal link from growth to FDI in the long run, we wish to make sure that our results are robust against possible endogeneity problems.

We therefore use the two-stage least square (2SLS) estimator based on a set of instruments that we expect to be highly correlated with the explanatory variables but uncorrelated with the error term. The set of instruments include: the Fearon (2003) ethnic fractionalisation index, the land area in square kilometers from the World Development Indicator (2005), the 1966 malaria index from Gallup and Sachs (1999), the Alesina et al. (2003) linguistic fractionalisation index, the dummy for landlockness from Gallup and Sachs (1999), the Barro and Lee (1994) war dummy and the proportion of a country's land area within 100 km of the ocean from Gallup and Sachs (1999). Data availability means that we end up with a sample of 56 developing countries. Results are reported in Table 2.

The Sargan Hansen test of weak instruments indicates that our instruments are valid, and the Anderson canonical correlation test and the Cragg Donald F-test confirm that we have no problem with weak instruments. The Anderson-Rubin test shows that explanatory variables are jointly significant in the regressions. However, the Durbin-Wu-Hausman test confirms the Hansen and Rand (2004) finding that growth drives FDI and not the opposite. Hence, we can treat all variables as exogenous in the regression and rely on the results in Table 1.

5 Summary and Conclusions

This paper applies a simplified version of the mean-variance portfolio model that explicitly takes the interdependence of alternative investment locations into account. The model predicts that FDI inflows are driven by the *risk-adjusted rate of return* but that one should be very careful in the applied definition of both return and risk. First, return should include the spillovers from the global and regional investment climate due to business cycle synchronisation. Second, country risk should be adjusted for covariance risk in order to get a more precise measure of idiosyncratic risk since ignoring such systematic comovements in returns exagger-

Table 2: FDI Regressions (2SLS estimation)

	Scenario 1	Scenario 2	Scenario 3
Return	0.041	0.046**	0.019**
	[0.03]	[0.02]	[0.01]
Global integration		0.24***	0.19***
		[0.08]	[0.07]
Asian integration			0.050***
			[0.02]
Latin American integration			-0.065*
			[0.04]
African integration			0.023
			[0.04]
Constant	0.58***	0.28**	0.33**
	[0.1]	[0.1]	[0.1]
Number of countries	56	56	56
R-squared	0.04	0.05	0.45
Test statistics (p-values)			
Sargan test of overidentification	0.12	0.083	0.35
Anderson test of weak instruments	0.0000	0.0000	0.0017
Cragg Donald test of underidentification	0.0000	0.0000	0.0006
Anderson-Rubin test of joint significance	0.0000	0.0000	0.000
Durbin-Wu-Hausman test of endogeneity	1.00	0.62	0.59
First stage F-statistics			
Return	48.61	42.38	25.38
Global integration		37.23	55.35
Asian integration			10.69
Latin American integration			18.59
African integration			29.88
Joint significance		12.91	12.25

Note: 2SLS regression where all variables are instrumented by ethnic fractionalisation, land area, the malaria index, linguistic fractionalisation, landlockness, war dummy and the proportion of land close to the ocean. The dependent variable is average net FDI inflows from 1970-2000. Heteroscedastic consistent standard errors adjusted for cluster-correlations are in brackets. *** p<0.01, ** p<0.05, * p<0.1

ates the measure of country risk. In the most extended model, we find that the investor diversifies his portfolio in two ways: by investing in countries that are positively as well as negatively correlated with the global business cycle, and by investing in countries that are positively as well as negatively correlated with the regional economy.

We test the implications of our theoretical model on the net flow of FDI into 60 developing countries. We find that FDI inflows are determined by the risk-adjusted rate of return once we adjust for global and regional covariance risk, and that there is a positive net benefit of global integration. Also, we find that there is a strong positive net gain of being located in Asia whereas the African spillover effect is lower and less significant. The Latin American return factor, on the other hand, is exactly matched by the risk premium required to compensate for regional covariance risk.

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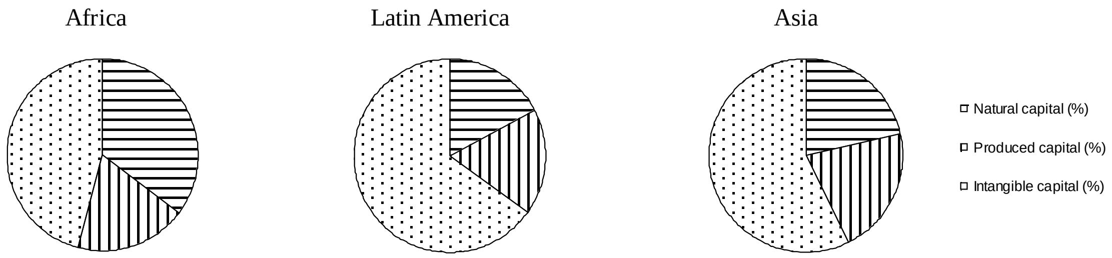
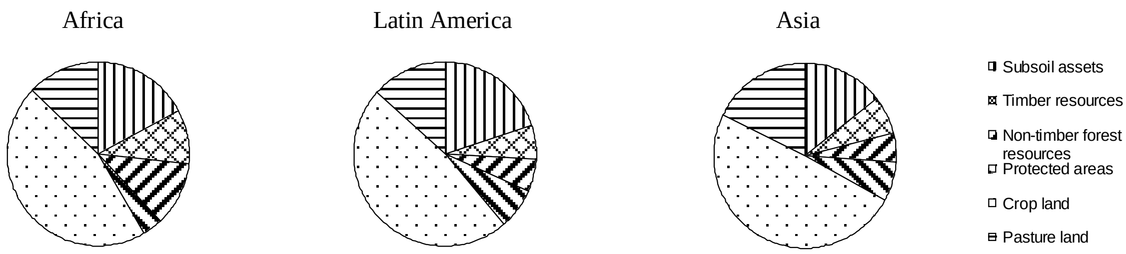
Appendix

Figure 1. Distribution of Wealth



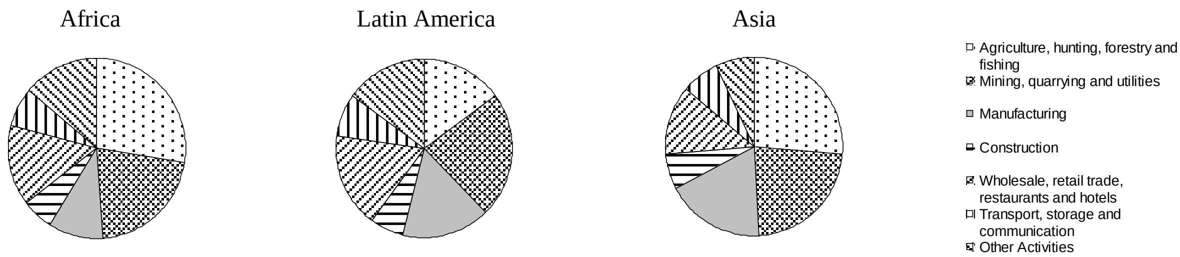
Source: World Bank (2005). Data is in per cent of total wealth. Natural capital is the sum of non-renewable subsoil resources, forested areas and land areas. Produced capital is the sum of equipment and machinery, structures and urban land. Intangible capital is calculated as the residual wealth and includes mainly human capital, institutional quality and social capital.

Figure 2. Composition of Natural Capital Wealth



Source: World Bank (2005). Data is in per cent of total wealth. Subsoil assets include oil, natural gas, coal and mineral resources.

Figure 3. Distribution of Economic Activity



Source: Data is from the National Accounts Main Aggregates Database. Data is in per cent of natural capital wealth.