DOES FOREIGN DIRECT INVESTMENT ENHANCE LABOR PRODUCTIVITY GROWTH IN CHILE?

A COINTEGRATION ANALYSIS

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INTRODUCTION

During the decade of the nineties, foreign direct investment (FDI) undertaken by transnational corporations (TNCs) became one of the leading factors in promoting the process of economic globalization. Between 1985 and 1990 these flows averaged $142 billion on an annual basis, while during the 1990-99 period alone they averaged $270 billion, or almost twice as much [Economic Commission for Latin America and the Caribbean [ECLAC, 2001]. The acceleration in FDI flows during the 1990s was also characterized by an increasing proportion of these funds directed to the developing nations, including the countries of Latin America and the Caribbean. For example, the share of total FDI channeled to developing countries, particularly Asia and Latin America, rose from 14 percent in 1990 to 24 percent in 1999. Latin America's share of FDI flows to developing countries rose from 29 percent in 1995 to 37 percent in 1999, mainly confined to Argentina, Brazil, Chile and Mexico [ECLAC, 2001].

The increase in FDI flows channeled to these countries, including Chile, has been due to the relatively successful implementation of macroeconomic stabilization measures and structural reform programs. These have taken the form of privatization and debt conversion programs, the liberalization of the tradable sector, and the removal of overly restrictive FDI legislation concerning the repatriation of profits, prior authorization of investments, and sectoral restrictions such as local content and export requirements. The adoption of these outward-oriented, market-friendly policies has reassured both foreign and domestic investors in Latin America's commitment to market-based reforms. Only time will tell if these reforms are sustainable in the long run, particularly in the wake of recent economic and financial crises that have buffeted the region. What is indisputable, however, is that FDI flows will continue to play a strategic role in modernizing Latin America's economy and in providing new income and employment opportunities.

This paper examines the impact of FDI flows on economic growth and labor productivity in one of the more important countries of Latin America: Chile. It was one of

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the earliest countries in the region to adopt and implement neoliberal reforms, albeit at great social and political cost. The country began this process of economic and financial liberalization following the military coup of 1973 and, in recent years, it has further liberalized its FDI regime by modifying Decree Law 600 and its debt capitalization mechanism (Chapter XIX of the Central Bank's Compensation of International Exchange Regulations). FDI flows into Chile have been mainly channeled to traditional sectors such as mining and energy sectors. However, during the nineties, a significant proportion of these funds have been channeled to export-oriented manufacturing operations or to non-traditional sectors using innovative technological processes and managerial techniques. An analysis of FDI flows to Chile during the decade of the nineties should uncover important trends and provide valuable insights into the capacity of FDI to transfer up-to-date technology and managerial know-how, as well as its long-term effect on labor productivity growth.

The layout of the paper is as follows: First, the paper gives an overview of FDI flows to Chile in terms of their magnitude, composition, and sectoral destination. Second, it develops an endogenous growth model that explicitly incorporates FDI's potential impact on private capital formation and labor productivity growth. This section also presents an empirical counterpart to the theoretical model developed in the previous section and discusses the data used in this study. Using cointegration analysis, section IV assesses the impact of changes in the stock of FDI on labor productivity during the 1960-2000 period. The last section summarizes the major arguments and offers some policy prescriptions for attracting FDI into the region and enhancing its positive direct and indirect effects.

OVERVIEW OF FDI FLOWS TO CHILE DURING THE 1990S

Following a poor performance during the decade of the1980s, FDI flows to the countries of Latin American surged during 1990s, from $8.4 billion in 1990 to 93 billion in 1999, or an eleven fold increase [ECLAC, 2001]. The strength of these flows is revealed by the fact that despite the serious economic downturn in Mexico in 1995, and the associated "Tequila effect" which reduced FDI inflows relative to 1994, they staged a remarkable recovery during the following four years, easily surpassing the pre-crisis levels. In absolute terms, the major recipients of FDI flows have been concentrated in a few major countries of the region, in order of importance of the cumulative level of inflows during the 1990-99 period, they are Brazil, Mexico, Argentina, Chile and Venezuela. The major supplier of FDI flows to Latin America during the decade of the nineties (and historically) has been the United States followed, in order of importance, by Great Britain, Japan, Germany, and France [ECLAC, 2001]

In relative terms, the major countries of Latin America, including Chile, have exhibited a consistently strong record of attracting FDI inflows during the decade of the 1990s, never falling below 1.5 percent of their countries' respective GDPs, and beginning in 1994, FDI inflows have averaged 5.4 percent in the case of Chile [ECLAC, 2000]. The importance of these inflows is more fully appreciated by focusing on the evolution of FDI flows relative to Chile's gross fixed capital formation. Table 1 (part A) shows that during the 1990-1995 period FDI flows to Chile represented close to 10 percent of its gross fixed capital formation, and in1996 and 1997, these flows reached more than a quarter of gross fixed capital formation—the highest figure among the major countries of the region, or for that matter, the developing world [ECLAC, 2001].

TABLE 1A
Chile: FDI Flows as a Percentage of Gross Fixed Capital Formation, 1990-2000

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Chile	8.34	7.21	7.50	7.22	14.56	12.11	25.71	27.9	22.9	54.3[a]	22.0

TABLE 1B

Chile: FDI Flows adjusted for the Remittance of Profits and Dividends as a Percentage of Gross Fixed Capital Formation, 1990-2000

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Chile	4.75	-1.66[b]	-2.10	0.75	6.01	10.89	16.71	17.4	17.8	43.8	8.1

Source: United Nations, *World Investment Report, 1999.* New York: United Nations, 1999; and ECLAC, *Statistical Yearbook for Latin America and the Caribbean, 2000.* Santiago, Chile:United Nations, 2001.

a. The unusually high figure is the result of a doubling of FDI inflows and a steep drop in gross fixed capital formation in 1999.

b. Negative value indicates that profits and dividend payments exceeded FDI inflows for that year, thereby diverting resources away from fixed capital formation.

Critics of FDI have long argued that, instead of increasing the investable resources of the host nation, FDI flows represent a net drain on the country's scarce resources because they generate substantial reverse flows in the form of remittances of profits and dividends to the parent companies, as well as through the widespread practice of intra-firm transfer pricing [Cypher and Dietz, 1997; Plasschaert, 1994]. The net contribution of FDI to private capital formation can be computed by deducting from these (gross) inflows the repatriation of profits and dividends to the parent companies. For Latin America as a whole, profit and dividend remittances to the developed countries more than tripled between 1990 and 2000, from $7.0 billion to over $25 billion [ECLAC, 2001]. Chile's remittances of profits and dividends registered more than a sevenfold increase between 1990 and 2000, from $335 million to $2.4 billion.

In relative terms, Chile's remittances of profits and dividends averaged 52 percent of total FDI flows over the 1990-99 period. If we subtract profits and dividends from gross FDI flows and express the net figure as a proportion of fixed capital formation, it is evident from Table 1 (part B) that the net contribution of FDI inflows to gross fixed capital formation to Chile, although increasing in recent years, is far less than that suggested by gross FDI inflows. In fact, Table 1 (part B) shows that it was even negative during the 1992-93 period; that is, it diverted resources away from the financing of fixed capital formation.

Economic theory, however, suggests that rather than focus on the flows of FDI to the countries of Latin America, it is theoretically more appropriate to concentrate on the accumulated stock of FDI, because it is the latter that ultimately determines the marginal productivity of private capital (and labor). The stock of FDI in Latin America (1990 dollars) rose from $175.6 billion in 1990 to $466.9 billion in 2000. This represents almost a doubling in the stock of FDI of these countries, an increase which is far greater than that of the entire "lost decade" of the 1980s. Chile's stock of FDI rose from $12.3 billion in 1990 to an impressive level of $26.8 billion by year-end 1999. Endogenous growth theory suggests that if this accumulation of capital in the form of FDI has generated substantial spillover benefits, both of an indirect and direct nature as explained in the next section, then the long-term positive contribution of this surge in FDI during the decade of the 1990s cannot be adequately measured by focusing solely on flow variables.

Another (indirect) and admittedly crude way of assessing the potential spillover benefits of FDI inflows to Chile is to examine their sectorial distribution during the second half of the 1980s and the decade of the 1990s [Agosin, 1995]. For example, if the sectors receiving the FDI inflows are traditional sectors using highly standardized technology with relatively few forward and backward linkages to the rest of the economy, then one may presume that these spillover effects are minimal, while if FDI flows are channeled to "greenfield" investments or to non-traditional sectors using innovative technological processes and managerial techniques, then one may infer that these positive spillover benefits are on an average greater.

Table 2 below shows that under the Chilean government's 1974 Foreign Investment Statute (known as Decree Law 600), a significant proportion of the surge in FDI to the country during the second half of the 1980s and the decade of the 1990s was directed to traditional sectors such as copper mining. The table also suggests that beginning in 1993 a significant share was channeled to financial services and industrial sectors based on natural resources and oriented toward exports, such as pulp and paper and fish and sea products. Although FDI flows authorized under Decree Law 600 have been, by and large, confined to traditional sectors such as copper mining, Table 2 also shows that those authorized under Chapter XIX of the debt conversion program implemented in 1985 but discontinued after 1991, granted only limited access to the traditional mining sector and were primarily directed to priority sectors in industry with an outward orientation, such as cellulose and paper and non-traditional agricultural and sea products.[1] Despite the Chilean's governments attempt to promote non-traditional sectors by imposing restrictions on investments in the mining sector, the amount of FDI flows channeled through both Chapter XIX and DL 600 during the 1987-95 period were primarily confined to mining and traditional industries such as textiles, leather, and footwear where the country has a comparative advantage based on low unit labor costs and natural resources.[2]

However, Table 2 shows that during the 1996-2000 period there was a marked decline in the proportion of FDI channeled to the mining sector and a concomitant increase in the share allocated to telecommunications, manufacturing, energy, and financial services. The FDI flows destined to the manufacturing sector were primarily in the form of minority shares in leading industrial sectors, such as Coca-Cola's acquisition of a 6 percent share in the country's largest bottling company, *Embotelladora Andina*. By contrast, those flows directed to the financial services sector involved

TABLE 2

Sectorial Distribution of FDI in Chile Under Decree Law 600 and the Chapter XIX Debt Conversion Program (percentage of the total)

Decree Law 600	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996-2000
Agriculture	1.2	0.4	0.6	3.2	3.3	2.2	2.6	2.6	2.0	1.0
Mining	49.7	55.0	79.4	75.4	48.9	59.7	46.1	48.3	47.4	24.0
Industry	19.1	4.5	7.9	9.1	22.5	11.3	31.0	27.1	26.6	45.0
Services	30.0	40.1	12.1	12.3	25.3	26.8	20.3	22.0	24.0	30.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Chapter XIX	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**			
Agriculture	64.2	24.3	19.4	15.4	—	—	—			
Mining	6.8	12.7	13.5	23.9	—	—	—			
Industry	6.4	40.7	39.7	23.4	46.2	—	—			
Services	22.6	22.3	27.4	37.3	53.8	—	—			
Total	100.0	100.0	100.0	100.0	100.0	—	—			

Source: Obtained from Agosin (1995), Table1.3, p.9; and computed from ECLAC (2001), pp. 90-97.

majority acquisitions such as Spain's Banco Santander's 51 percent stake in Banco Osorno for $500 million [ECLAC, 2001]. Whether this represents a permanent break with the past remains to be seen, but the evidence presented above seems to suggest that until 1995 a large portion of the FDI attracted to Chile had been confined to production processes characterized by low value added, which, obviously, does not bode well for the long-term sustainability of the Chilean economic model.

FDI FLOWS, ECONOMIC GROWTH, AND DEVELOPMENT

FDI inflows to developing countries have the potential to increase their stock of capital and technological know-how which, in turn, raises the host country's level of output, labor productivity, and tax revenues. However, FDI flows may have a negative effect on the growth prospects of a country if they give rise to substantial reverse flows in the form of remittances of profits and dividends and/or if the TNCs obtain substantial tax concessions from the host country. These negative effects would be further compounded if the expected positive spillover effects from the transfer of technology are minimized or eliminated altogether because of overly restrictive intellectual property rights and/or the technology that is transferred is inappropriate for the host country's factor proportions (e.g., too capital intensive).

Following the lead of Zhang [2001] and De Mello [1997], the externality (positive or negative) associated with incorporating the stock of FDI can be explicitly modeled via an augmented Cobb-Douglas production function of the following form:

$$Y = Af[L, K_p, E] = AL^{\alpha} K^{\beta} E^{1-\alpha-\beta} \quad (1)$$

where Y is real output, K_p is the private capital stock, L is labor, and E refers to the externality generated by additions to the stock of FDI. α and β are the shares of domestic labor and private capital respectively, and A captures the efficiency of production. It is also assumed that α and β are less than one, such that there are diminishing returns to the labor and capital inputs.

The externality, E, can be represented by a Cobb -Douglas function of the type:

$$E = [L, K_p, K_f^{\gamma}]^{\theta}, \tag{2}$$

where γ and θ are, respectively, the marginal and the intertemporal elasticities of substitution between private and foreign capital. Let $\gamma > 0$, such that a larger stock of FDI generates a positive externality to the economy. If $\theta > 0$, intertemporal complementarity prevails and, if $\theta < 0$, additions to the stock of FDI crowd out private capital over time and diminish the growth potential of the host country.

Combining equations (1) and (2), we obtain,

$$Y = AL^{\alpha+\theta(1-\alpha-\beta)} K_p^{\beta+\theta(1-\alpha-\beta)} K_f^{\gamma\theta(1-\alpha-\beta)} \tag{3}$$

A standard growth accounting equation can be derived by taking logarithms and time derivatives of equation (3) to generate the following dynamic production function:

$$g_y = g_A + [\alpha + \theta(1-\alpha-\beta)]g_L + [\beta + \theta(1-\alpha-\beta)]g_{K_p} + [\gamma\theta(1-\alpha-\beta)]g_{K_f}, \tag{4}$$

where g_i is the growth rate of $i = Y, A, L, K_p, and\ K_f$. Equation (4) states that (provided γ and $\theta > 0$) additions to the stock of FDI will augment the elasticities of output with respect to labor and capital by a factor $\theta(1-\alpha-\beta)$.[3]

EMPIRICAL MODEL

In the estimation of equation (4) above, proxies are often used for variables such as the labor force and/or the stocks of private capital and FDI [Aschauer, 1990; Cardoso, 1993; Green and Villanueva, 1991; Lin, 1994; Nazmi and Ramirez, 1997]. For example, population data is used rather than labor force data, or investment data (as a proportion of GDP) is substituted for capital stock data. However, the use of these proxies imposes unduly restrictive assumptions (e.g., such as a fixed capital-output ratio) or unrealistic assumptions (a constant labor force participation rate) that generate both misspecified relationships and significant measurement errors [Alexander, 1994].

Fortunately, for Chile we have a sufficiently long (and official) time series (annual) data set for private investment, public investment, and FDI flows extending back to 1960 . Using a perpetual inventory method, capital stock data can therefore be generated for the variables in question. Chile's National Institute of Statistics (INE) has also published official data on the labor force for the period under review. This study thus extends previous empirical work by estimating an empirical counterpart of the growth (labor productivity) model in equation (4) for the 1960-2000 period. The most general formulation of the labor productivity function is

$$\Delta y_t = \alpha + \beta_1 \Delta l_{t-1} + \beta_2 \Delta k_{p,t-i} + \beta_3 \Delta k_{f,t-i} + \beta_4 \Delta k_{g,t-i} + \beta_5 D_1 + \beta_6 D_2 + \beta_7 D_3 + \beta_8 \Delta TOT + \varepsilon, \quad (5)$$

where lower case letters denote natural logarithms, Δ is the difference operator, and i denotes the lag lengths; y represents the natural log of real GDP (1977 pesos); l, as indicated above, refers to the natural log of the labor force; k_p, k_f and k_g denote, respectively, the natural log of the stocks of private capital, FDI capital, and public capital (1977 pesos); D_1 is a dummy variable that equals 1 for the crises years of 1973 (military coup), 1975 (major economic recession) and 1982-83 (major economic recession) and 0 otherwise, while D_2 equals 1 for debt-led growth years of 1978-81; D_3 is set equal to 1 for the 1987-97 period (acceleration of real economic growth associated with the Chilean government's decision to pursue vigorously an outward-oriented strategy of economic development beginning in 1986-87); given the historical importance of copper exports in the Chilean economy, the regression also includes a terms of trade variable, ΔTOT, which is defined as the percentage change in the terms of trade. An increase in ΔTOT denotes an improvement in Chile's terms of trade [Ffrench-Davis and Muñoz, 1992].

The model was also estimated with an interactive dummy variable for the post-1995 period, *viz., D*4 multiplied by the lagged FDI growth variable. By estimating this variable interactively with the FDI variable one can (crudely) assess whether the change in the composition of FDI towards operations in manufacturing and services has led to greater output (labor productivity) growth after 1995. A finding that it has would be consistent with the notion that changes in the mix of FDI to higher value-added operations has led to greater positive spillover effects.

The coefficients of equation (5) represent the annual percentage change in real GDP associated with a respective percentage change in the variables in question. The dependent variable in this study was estimated as a labor productivity growth equation by subtracting the percentage change in the labor force from the percentage change in GDP.[4] Defining the dependent variable in this manner reverses the expected sign of the labor variable because of diminishing returns to the labor input. The sign of β_1 is anticipated to be positive in the GDP growth rate formulation while, as indicated above, it is expected to be negative in the labor productivity growth specification. β_2 is expected to be positive, while the signs of β_3 and β_4 can be either positive or negative depending on whether changes in the stocks of foreign and public capital, respectively, complement or substitute for private capital formation. The public capital stock variable was included as an argument because investments in economic infrastructure such as roads, bridges and ports are likely to increase the marginal productivity of both private domestic and foreign capital, thus stimulating economic growth and labor productivity.[5] β_5 is anticipated to have a negative sign for obvious reasons. β_6 is expected to be positive because of the high rates of economic growth associated with the short-lived lending boom of 1978-81. β_7 is also expected to have a positive sign because the average annual growth rate in Chile accelerated with the return of foreign direct investment and the expansion of exports during the 1988-94 period. Finally, β_8 is expected to have a positive sign because an improvement in the TOT variable, *ceteris paribus*, stimulates economic growth in an open economy such as the Chilean one.[6]

Data

Economic (annual) data used in this study were obtained from official government sources such as the *Instituto Nacional de Estadisticas* (various issues), the Banco Central de Chile, *Memoria Anual* (various issues), and OECD, *Economic Surveys: Chile*.[7] Private and public investment data for Chile have been obtained from the International Finance Corporation, *Trends in Private Investment in Developing Countries: Statistics for 1970*-2000 [Table C1, 2001]. The relevant stock data was generated using a standard perpetual inventory model. In this study the initial stocks of private (public) and foreign capital were estimated by aggregating over five years of gross investment (1956-1960), assuming an estimate of the rate of depreciation of 5 percent. To ensure the robustness of the econometric results, other estimates of the rate of depreciation were used (10 percent), as well as different estimates of the initial capital stock (e.g., summing over 4 and 6 years), but the results were not altered significantly.

COINTEGRATION ANALYSIS AND RESULTS.

Macro time series data such as the ones used in this study tend to exhibit either a deterministic and/or stochastic time trend and are therefore non-stationary. Engle and Granger [1987] have shown that regressing a non-stationary series against another one may lead to spurious results because conventional significance tests are likely to suggest that a relationship exists when, in fact, there is none. Unit root (non-stationarity) test were undertaken by using an Augmented Dickey-Fuller test (ADF) [Dickey-Fuller, 1981] with a constant (representing positive or negative drift) and a deterministic trend (representing a non-stationary mean). Table 3 (part A) below presents the results of running ADF test (one lag) on the variables in logarithmic form with a deterministic trend.[8] The results indicate that the null hypothesis of non-stationarity cannot be rejected for any of the variables in level form with a deterministic trend, suggesting that the variables in question do appear to exhibit a non-stationary (time dependent) mean throughout the period under review. In other words, detrending the data by a single trend line will not render the data in question stationary because the trend line itself may be shifting over time [Charemza and Deadman, 1997]. However, most of the variables become stationary in first differences at the five percent level of significance (and in one case at the 10 percent level).

Table 3 (part B) also presents the results of running an ADF test (one lag) for the variables in both level and differenced form under the assumption of a stochastic trend with drift only. It can be readily seen that all the variables in level form are nonstationary; i.e., they appear to follow a stochastic trend with (positive) drift [Nelson and Plosser, 1982].[9] In first differences, however, the null hypothesis of non-stationarity is rejected for all variables (except one) at least at the 5 percent level.[10] Thus, the evidence presented above suggests that the variables in question follow primarily a stochastic trend with (upward) drift as opposed to a deterministic one, although the possibility that for given sub-periods they follow a mixed process cannot be rejected.

TABLE 3A
Chile: Unit Root Tests for Stationarity with Constant and Time Trend
Sample Period 1960-2000

Variables	Levels	First Difference	5% Critical Value[1]	1% Critical Value
ln(Y)	-1.38	-4.04**	-3.53	-4.21
ln(Y/L)	-0.86	-3.98**	-3.54	-4.21
lnL	-0.20	-6.78***	-3.54	-4.21
$\ln K_f$	-1.93	-3.53**	-3.53	-4.21
$\ln K_p$	-2.83	-3.24*	-3.53	-4.21
$\ln K_g$	-2.47	-3.25*	-3.53	-4.21
TOT	-1.71	-5.01***	-3.53	-4.21

1 MacKinnon critical values for rejection of hypothesis of a unit root.
*, **, and *** denote significance at the 10, 5 and 1 percent levels, respectively.

TABLE 3B
Chile: Unit Root Tests for Stationarity with Constant Only
Sample Period 1960-2000

Variables	Levels	First Difference	5% Critical Value[3]	1% Critical Value
ln(Y)	0.26	-3.99***	-2.93	-3.61
ln(Y/L)	-0.80	-3.84***	-2.93	-3.61
lnL	-1.20	-2.95**	-2.93	-3.61
$\ln K_f$	0.98	-2.91*	-2.93	-3.61
$\ln K_p$	0.32	-3.24**	-2.93	-3.61
$\ln K_g$	-0.63	-3.71***	-2.93	-3.61
TOT	-1.64	-4.95***	-2.93	-3.61

3 MacKinnon critical values for rejection of hypothesis of a unit root.
*, **, and *** denote significance at the 10, 5 and 1 percent levels, respectively.

Given that the variables are integrated of order one, I(1), it is necessary to determine whether there exists a stable and non-spurious (cointegrated) relationship among the regressors in level form in each of the relevant specifications. The necessity arises because applying first differences to the logarithms of the variables in question leads to a loss of information regarding the long-run properties of the estimated model; i.e., a model evaluated in difference form is misspecified because it does not have a long-run solution. In order to preserve this important information the cointegration method first proposed by Johansen [1988] and Johansen and Juselius [1990] was employed. The Johansen method was chosen over the one originally proposed by Engle and Granger [1987] because it is capable of determining the number of cointegrating vectors for any given number of non-stationary series (of the same order), its application is appropriate in the presence of more than two variables, and more important, Johansen [1988] has shown that the likelihood ratio tests used in this procedure (unlike the DF and ADF tests) have well-defined limiting distributions[11].

The Johansen cointegration test suggested that the hypothesis of no cointegrating vector can be rejected at least at the one percent level, thus suggesting the presence of at least one cointegrating equation from which residuals (EC terms) can be obtained to measure the respective deviations between the current level of output (labor productivity) and the level based on the long-run relationship.[12] The presence of a cointegrating relationship among the selected variables in level form means that an error correction (EC) model can be estimated; *viz*., a model that combines both the short-run properties of economic relationships in first difference form as in equation (5) above, as well as the long-run information provided by the data in level form. EC models thus enable the researcher to estimate the speed of adjustment back to the long-run (stable) condition among the variables.

The information provided by the Johansen test was used to generate the EC models presented in Table 4 below. To conserve space, the table presents results only for the labor productivity growth rate relationship. They show that the immediate impact of changes in the growth rate of the private capital stock are positive and statistically (and economically) significant, while contemporaneous changes in employment growth have a negative impact on the growth rate in labor productivity. The public capital stock variable also has a positive and statistically significant effect when lagged two to three periods. Turning to the foreign private capital stock variable, it can be seen that this variable has a positive and statistically significant effect when lagged four or five periods. This result as well as the one for the public capital stock — is not surprising because FDI-induced positive externalities in the form of a greater transfer of technology and managerial know-how are likely to impact labor productivity with a considerable lag. More importantly, the estimate for the interaction variable (D4 multiplied by the FDI variable) in equation (5) suggests that the sectorial change in the composition of FDI after 1995 had the effect of further enhancing the impact of FDI growth on labor productivity growth.

The remaining dummy variables in equations (2) -(5) have the anticipated signs and they are statistically significant, while, as expected, the change in the terms of trade effect has a positive and statistically significant effect. The relative fit and efficiency of the EC regressions is quite good and, as the theory predicts, the EC terms are negative and statistically significant, suggesting, as in equation (4), that a deviation from long-run labor productivity growth in a given year is corrected by about 38 percent in the next year. Finally, stability tests were undertaken to determine whether the null hypothesis of no structural break could be rejected. The Chow breakpoint tests (available upon request) suggested that the hypothesis could not be rejected for the crisis years of 1973, 1975, and 1982.

The EC models were also used to track the historical data on labor productivity growth in Chile. Table 5 below presents selected Theil inequality coefficients obtained from the historical simulations of the productivity growth equations. The Theil inequality coefficient measures the root-mean-square (RMS) error in relative terms;

TABLE 4

Chile: Error Correction Model; Dependent Variable is: (ΔlnY_t - ΔlnL_t), 1960-2000.

	OLS Regressions				
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Constant	-6.47	-2.59	-4.38	-5.39	-3.01
	(-1.91)**	(-1.39)*	(-2.57)***	(-3.56)***	(-1.55)*
ΔlnL_t	-0.55	-0.34	-0.28	-0.29	-0.33
	(-2.03)**	(-1.82)**	(-1.75)**	(-1.93)**	(-1.92)**
ΔlnK_{ft-5}	0.19	0.12	0.13	0.15	0.14
	(2.12)**	(1.91)**	(2.30)**	(3.00)**	(2.35)**
DUM4*(ΔlnK_{ft-5})	—	—	—	—	0.18
					(1.71)**
ΔlnK_{pt}	0.76	0.46	0.45	0.44	0.44
	(5.43)***	(4.91)***	(4.68)***	(4.37)***	(4.30)***
ΔlnK_{gt-3}	0.58	0.37	0.47	0.46	0.38
	(1.85)**	(2.04)***	(2.43)***	(3.03)***	(2.05)**
Ect_{t-1}	-0.45	-0.30	-0.31	-0.38	-0.30
	(-2.25)***	(-2.73)**	(-3.18)***	(-2.82)***	(-3.03)***
DUM1	—	-6.15	-5.59	-5.38	-5.94
		(-3.15)**	(-3.02)***	(-2.95)***	(-3.09)***
DUM2	—	—	2.99	3.56	—
			(2.82)***	(3.86)***	
DUM3	—	—	—	2.73	—
				(3.20)***	
TOT	0.17	0.18	0.22	0.19	0.20
	(1.56)*	(2.29)**	(3.05)***	(2.24)**	(2.45)**
Adj R^2	.60	.78	.81	.85	.80
S.E.	4.18	3.08	2.93	2.69	3.05
D.W.	1.74	1.80	1.76	1.84	1.85
AR(1)	0.54*	0.36*	0.42**	0.35*	0.36**
Sample size	41	41	41	41	41

Note: Asterisks are defined as in Table 3. AR(1) refers to a first order auto-regressive specification and t-ratios are in parenthesis.

i.e., it is a measure of the deviation between the simulated values of the variable and its actual value scaled so that it falls between 0 and 1. If the Theil coefficient is 1 then the predictive performance of the model is at its worst, while if it is equal to zero it is perfect. In general, the predictive power of the model is considered to be quite good if the coefficient is below 0.3 [Theil, 1966]. As can be seen from Table 5, the coefficients are well below the threshold value suggested by Theil, e.g., 0.210 and 0.202 for equations (3) and (4), respectively.

The Theil coefficients can also be decomposed into three major components: the bias, variance, and covariance terms. The bias proportion measures the extent to which the average value of the simulated series deviates from its historical value, while the variance and covariance ratios measure, respectively, the capacity of the model to simulate the historical variability in the variable, and its ability to replicate the remaining error after the average deviations have been accounted for. Ideally, the bias and variance components should equal zero, while the covariance proportion should

TABLE 5
Chile: In-Sample Forecast Evaluation for Error Correction Models.

	Equation (3)	Equation (4)
Sample: 1967 2000		
Root Mean Squared Error (RMS)	2.3855	2.2165
Mean Absolute Error (MAE)	1.7691	1.6628
Theil Inequality Coefficient (TIC)	0.2108	0.2015
Bias Proportion (BP)	0.0000	0.0000
Variance Proportion (VP)	0.0011	0.0331
Covariance Proportion (CP)	0.9988	0.9668
Sample: 1967 1995		
RMS	2.7200	2.3504
MAE	2.1189	1.8777
TIC	0.2276	0.2004
BP	0.0002	0.0000
VP	0.0059	0.0339
CP	0.9938	0.9660
Sample: 1970 2000		
RMS	2.1939	1.8973
MAE	2.7171	1.3801
TIC	0.1932	0.1640
BP	0.0058	0.0000
VP	0.0560	0.0295
CP	0.9380	0.9704

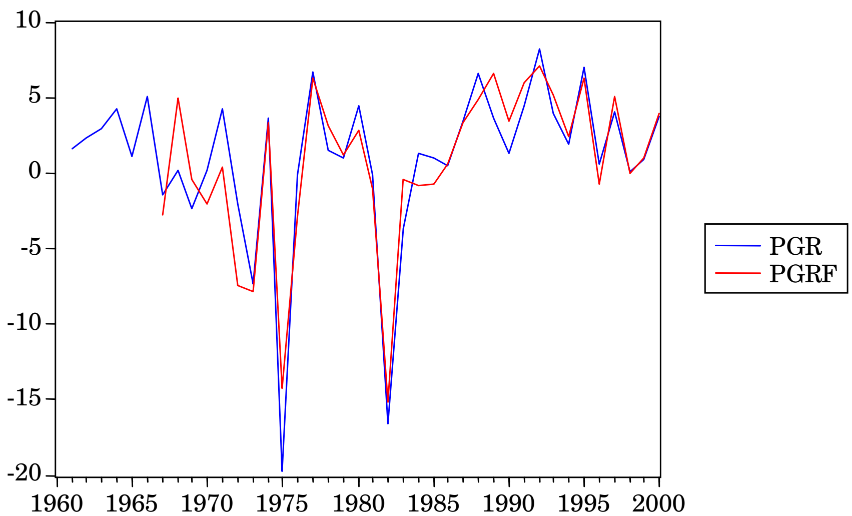
Note: In-Sample Forecast estimates generated with EVIEWS 4.1

equal one. Table 5 shows that all of these ratios are close to their optimum values. Sensitivity analysis on the coefficients also revealed that changes in the initial or ending period did not alter the predictive power of the selected models (or, for that matter, any of the models run in this study). Figure 1, corresponding to equation (4) in Table 4, provides visual evidence of the models' ability to track the turning points in the actual series. (PGR) refers to the actual series and (PGRF) denotes the in-sample fit. It also highlights the Chilean economy's highly variable and, at best, modest increase in labor productivity for the period under review. Part of the explanation for this lackluster performance resides in the country's tumultuous economic and political history, particularly during the seventies and early eighties. However, beginning in 1985 and following the return to civilian rule, there is evidence of a modest upward trend in labor productivity, although it is too early to tell whether this represents a permanent break with the past.

CONCLUSION

This paper analyzed the impact of FDI flows on labor productivity growth in one of the leading countries of Latin America, Chile. Several major findings were presented. First, the evidence for Chile suggests that although FDI flows have been substantial during the second half of the eighties and nineties, particularly in relation to domestic capital formation, a large proportion of these funds has been directed to traditional sectors such as mining and agriculture where value added per worker is relatively low and the technology used is highly standardized and routine in nature. Although Chile has pursued policies to redirect FDI flows to high priority sectors in the tradable sector via the debt conversion program (discontinued in 1991), the evidence suggests that up until 1995 a significant proportion of FDI flows were not being channeled to innovative "greenfield" investments in the manufacturing sector where technological spillover effects are likely to be greater.

FIGURE 1
Chilean Labor Productivity Growth Rate



Second, the econometric results suggest that the variables included in the production function have a stable and non-spurious relationship that keeps them in proportion to one another in the long run, even though each variable in level form has a stochastic trend. The ECM estimates show that FDI flows (lagged) had a positive and significant effect on labor productivity growth during the 1960-2000 period, and the interactive term suggests that the effect is stronger during the 1996-2000. The lagged public investment variable, as well as outward-oriented policies (captured by dummies) were also found to have the expected sign and be statistically significant. The EC terms are negative and statistically significant, suggesting that contemporaneous shocks to the long-run labor productivity relationship are corrected in subsequent periods. Finally, Theil inequality coefficients indicate that the EC models are able to track the historical data on labor productivity growth rather well.

From a policy standpoint, the Chilean economy may have much to gain by attracting FDI flows, particularly if they are channeled to "greenfield" investments were the (long-run) positive "spillover" effects associated with FDI in the form of "intangibles" such as the transfer of technology and managerial know-how are greatest. On the other hand, policies that attract FDI on the basis of overly generous subsidies, lavish tax concessions, and few, if any, restrictions on profit and dividend remittances should be avoided. The evidence showed that TNCs' remittances of profits and dividends from the country have grown substantially since 1991, and that once these reverse flows are subtracted from the gross inflows of FDI, the contribution of FDI to the financing of private capital formation in Chile is reduced significantly.

NOTES

1. Critics of the program, such as Meller [1993] and Ffrench-Davis [1992], contend that between 1985 and 1990 the implicit subsidy of the debt swap mechanism amounted to 46 percent of the total value of the investments undertaken. They also argue that many of these investments would have been made anyway, so that the Chapter XIX discount amounted to no more than a foreign exchange gift to investors.
2. Agosin [1995] presents empirical results for Chile during the 1975-92 period. He finds that the level of real GDP in constant dollars (a proxy for market size) has a positive and statistically significant effect on FDI flows, while the depreciation of the real exchange rate has a positive impact on FDI flows. From an institutional standpoint, he finds that the adoption of the debt conversion program (Chapter XIX), proxied by a dummy variable, had a positive and statistically significant impact on FDI flows.
3. A recent study by Bosworth and Collins [1999] for 58 developing nations during 1978-95 finds that FDI inflows generate a positive and economically significant effect on domestic investment. Interestingly, they report little or no impact of portfolio inflows on domestic investment, and a small but statistically significant effect for bank loans.
4. The regression was not estimated in per worker terms (under the assumption of constant returns) because the estimated elasticities of the dynamic production function will only equal their factor shares if factor markets are perfectly competitive. This is an untenable assumption for a developing country such as the Chilean one. Furthermore, a Wald test suggested that the assumption of constant returns to scale could be rejected in the private inputs.
5. There is now a vast literature that addresses the question of whether public investment enhances private investment and economic growth. The results have been mixed, with some researchers finding support for the complementarity hypothesis while others reject it [Aschauer, 1990; Cardoso,1993; Cruz and Teixeira, 1999; and Ramirez, 2000].
6. The government consumption variable was not included in the estimation because it not only includes human capital investments such as expenditures on health and education (which are likely to enhance labor productivity), but also a substantial portion is devoted to expenditures on public wages and salaries (which are likely to have a negative effect). The available data from the Central Bank of Chile is not sufficiently disaggregated to generate a human capital variable via the perpetual inventory model.
7. Investment data was cross-checked with that found in the International Finance Corporation, Trends in Private Investment in Developing Countries: Statistics for 1970-2000 [2001] and no significant differences were discerned.
8. The order of the lag length was determined by applying both the Akaike Information Criterion (AIC) and the Schwartz Bayesian Criterion (SBC). Lower values for these performance statistics indicate a better fit to the data.
9. A stochastic trend is one where the random component of the series itself, say variable x_t, contributes directly to the long run pattern of the series, either upward or downward. However, in the case of a deterministic trend the deviations from the non-stationary mean are quickly corrected over time [Charemza and Deadman, 1997].
10. This study also performed unit root tests on the relevant variables using the Phillips-Perron (PP) test regression. The results (available upon request) are consistent with those generated by the ADF test. See Phillips and Perron [1988] for further details.
11. Admittedly, the relatively small sample size used in this study (between 35 and 39 observations after adjusting for endpoints) obviates the need to discuss the asymptotic properties of large sample estimators. Still, the sample size is sufficiently large (greater than 30) to allow us to invoke the Central Limit Theorem and use the Johansen likelihood ratio test. In addition, the Johansen method is employed because there are more than two integrated variables of the same order in the various estimated regressions.

11. The likelihood ratio statistic (94.014) exceeded the 1 percent critical value (70.05), thereby rejecting the hypothesis of no cointegration. The long-run estimates of the cointregrating equation (normalized on the labor productivity variable) have their expected signs and are significant at least at the 5 percent level. Results are available upon written request.

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