The Changing Nature of US Investment Abroad in Manufacturing

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Abstract

This paper assesses the sensitivity of U.S. Direct Investment Abroad to factors that represent host country demand, factor endowments and other determinants of cost, and trade and tax policy variables. It is based on several indicators of the activity of multinational companies (MNC): real gross product originating; employment; total compensation; property, plant and equipment; and sales. The basic framework explains the first three variables most successfully, but gives a less complete explanation for the latter two variables. The estimates confirm that MNC activity has increased in countries with big increases in GDP per capita, and where trade barriers and taxes have declined. The results also indicate the importance of technological development and exchange rate stability, but they suggest some differences for OECD versus non-OECD countries, particularly in terms of the technological development of neighbors, corporate tax rates, and exchange rate volatility.

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Introduction

The activity of U.S. multinationals abroad has increased, but at an irregular pace, over the past two decades. Figure 1 based on affiliate output gives one picture. During the 1980s, production in developing countries grew much less rapidly than in developed countries. In the early 1990s this pattern was reversed, with very strong growth in production in developing countries. Over the latter part of the 1990s, however, both groups expanded, but developing countries again fell behind developed countries. For the two decades as a whole, affiliate output in the OECD countries grew more rapidly, in spite of its more irregular pattern. Figure 2, based on the stock of property, plant and equipment, however, gives a rather different picture. Developing countries experienced a decline in the capital stock over the 1980s, but in the 1990s it grew at an accelerating rate. The record for developed countries was one of much more regular expansion of the capital stock, but markedly slower growth than in developing countries. Further complexity can be demonstrated from examining the record with respect to employment, employee compensation and affiliate sales.

These varying patterns suggest that any assessment of U.S. direct investment abroad may be sensitive to the measure of activity used and to the time period chosen. Because each of the measures of MNC activity mentioned above has its drawbacks, a major aim of this study is to assess how robust the importance of various explanatory variables is, regardless of the dependent variable chosen. Also, one strand of this literature initially dealt with the evidence from a cross-section of countries in a single year (Grubert and Mutti 1991, Hines and Rice 1993), and subsequently considered changes across years (Altshuler, et al, 2001, Mutti 2003). The recent release of the 1999 benchmark survey of

US investment abroad makes it possible to explore further the way the determinants of FDI may be changing over time or across different groups of countries. For example, some studies suggest that such investment has become more sensitive to tax policy in recent years (Altshuler, et al, 2001). Others report greater sensitivity to taxation in developing countries than developed countries (Mutti and Grubert, 2004), or more generally demonstrate that there are systematic differences in coefficient values for OECD versus non-OECD countries (Blonigen and Wang, 2004).

The theoretical framework of the study is based on the gravity model, a common approach in previous studies. The analysis is limited to majority-owned US affiliates in manufacturing, because the reported activity more likely reflects real production for them than for financial affiliates. Also, the Bureau of Economic Analysis presents information on real value added (gross product originating) only in this sector. The study introduces proxies for technology and additional explanatory variables in the analysis, especially with respect to supply conditions in alternative locations. Given the marked differences in GDP growth rates for developed versus developing countries over different periods within the past two decades, the study also focuses on the role of demand in the host country market and the stability of those parameter values. Finally, the study considers contrasting model specifications for variables that are determined by shorter-run versus longer-run factors, a potentially important distinction in the case of gross product originating versus property, plant and equipment.

Methodology

The theoretical model of the study is based on the gravity model. Frankel (1997) provides a popular formulation of the model: the amount of the trade between two countries is a function of their populations, income per capita, distance, adjacency and

common language. Bergstrand (1985, 1989) and Deardorff (1998) present a theoretical justification of the model and a rationale for the use of the lognormal specification. A similar approach can be applied in the context of MNC activity abroad.[1] What follows is a short summary of such a model.

Based on a firm's demand and cost conditions, the demand for the products of an MNC in a given host country A is determined, as follows:

$$\ln Q_{AA} = \alpha_0 + \alpha_1 \ln Pop_A + \alpha_2 \ln(GDP/Pop)_A + \alpha_3 \ln W_A + \alpha_4 \ln W_B + \alpha_5 \ln\left(\frac{R}{1-T_A}\right) + \alpha_6 \ln\left(\frac{R}{1-T_B}\right), \quad (1)$$

where Q_{AA} is the output of the MNC affiliate produced and sold in country A, Pop_A and $(GDP/Pop)_A$ determine the size of the local market in country A, W is the wage and approximates the labor costs of production in country A and in a potential substitute location B, and R/(1-T) is the before-tax cost of capital, based on the corporate tax rate, T, in each country and R, the common after-tax return that the MNC expects to earn in all locations.[2]

To account for the production of an MNC in host country A that is exported to country B, the following specification applies:

$$\ln Q_{AB} = \beta_0 + \beta_1 \ln Pop_B + \beta_2 \ln(GDP/Pop)_B + \beta_3 \ln W_A + \beta_4 \ln W_B + \beta_5 \ln\left(\frac{R}{1-T_A}\right) + \beta_6 \ln\left(\frac{R}{1-T_B}\right), \quad (2)$$

[1] See, for example, Mutti and Grubert (2004) and the literature cited there. For a more complete demonstration of this relationship in a general equilibrium setting that allows for both international trade and multinational investment, see Bergstrand and Egger (2004).

[2] There is no consensus among economist about the proper functional form of the tax variable. Some past studies use the inverse of the tax rate, and others use the tax rate and the tax rate squared. The formulation in eq. (1) allows the most straightforward interpretation, that the coefficient represents the percentage change in MNC activity in response to a tax policy change that reduces the cost of capital by one percent.

The present study is based on measures of affiliate activity in a given host country, which are aggregates that include the portion devoted to the host country market in Country A as well as the portion sold abroad in all countries of type B. Given the empirically plausible restriction that the lognormal specification is most appropriate in this situation,[3] the coefficients in the equation for the total output of the MNC in country A equal the weighted averages of equation (1) and all equations of type (2).

Other plausible explanatory variables that affect relevant supply or demand conditions include trade barriers, infrastructure, technology, and host country institutions. Given the unresolved controversy over the horizontal, vertical, and knowledge-capital models of MNC activity, the interpretation of some of those coefficients is ambiguous.[4] Assuming the horizontal integration model, one may conclude that signs of trade barriers should be positive. That is, the more difficult it is to export products to a certain country, the greater is the incentive for an MNC to establish an affiliate to serve the local market. Assuming the vertical model, however, one concludes that these two variables should have a negative sign as the coordination of the production process becomes more costly.

The role of host-country infrastructure in allowing countries to produce more efficiently is important in accurately estimating the effect of other variables. For example, if a country with better infrastructure also has greater GDP per capita, including only the latter variable means that GDP per capita will have a positive coefficient that includes the influence of greater demand at a given price but also a lower cost of production. Likewise, if better technology and infrastructure make it possible for a

[3] For further details, review the results of the Davidson – McKinnon test in the study by Mutti and Grubert (2004).
[4] See Carr, Markusen and Maskus (2003) and Blonigen, Davies, and Head (2003) for recent contributions to this literature.

country to pay higher wages, entering the wage variable alone may result in a positive coefficient estimate.

Data

The data set contains information for 50 countries from the benchmark surveys of direct investment abroad in 1982, 1989, 1994, and 1999.

Dependent Variables

Real gross product originating (GPO) is a particularly attractive indicator of MNC activity in a country. In contrast to affiliate sales, which may include many imported components, GPO measures the economic activity or value added within an affiliate. Given the rising prominence of export-led growth strategies based on export processing zones that assemble imported components and sell the output abroad, this distinction is likely to be especially important in studies that include developing countries. The BEA has used a rigorous and systematic procedure to deflate nominal GPO expressed in the host country currency, where the deflator is calculated from a weighted average of the deflators of the seven major manufacturing categories in the host country (Mataloni, 1997). Unfortunately, such detailed information is only available for OECD members. For the developing countries included in this study, the nominal dollar values for non-OECD countries are deflated using the US producer price index (PPI). Such a procedure is most comparable to the BEA's treatment of OECD countries if purchasing power parity holds, a condition that may not be met during periods of economic crisis when large capital outflows from a country occur. A potential drawback of the real GPO

measure is that the reported amount of value added may reflect transfer-pricing practices, which shift profits to low-tax countries and out of high-tax countries.[5]

To assess whether other measures of MNC activity yield similar insights, this study includes two measures of labor input that are less likely to be affected by transfer pricing incentives: the number of workers employed and the total compensation paid by US affiliates. The number of workers poses no problem with respect to price deflators or exchange rates, and employers have little reason to understate or overstate the number of employees. However, the number of hours worked is not reported, and that value may vary over the business cycle, or it may vary across countries due to differences in the importance of part-time workers. Also, if there are differences in the industrial mix that imply differences in the labor and skill intensity of the production processes, the number of workers may not be a good indicator of the real value of output created. Total compensation may give a better indication of the value created by more skilled workers, but it ignores other important factor inputs, and issues of appropriate deflators and exchange rates still arise. The study also includes affiliate sales to provide a point of comparison to prior estimates in the literature.[6]

A conceptually different measure of MNC economic activity is the output potential of fixed capital, as indicated by the affiliate's property, plant, and equipment (PPE). This variable presumably should reflect the expected profitability of future operations, which may well differ from currently observed sales or employment. A possible drawback of

[5] The potential size of this effect is not clear from recent work (Swenson 2001, Clausing 2003). Grubert (2003) finds that the allocation of debt among subsidiaries and the shifting of R&D based intangible income account for virtually all the observed difference in profitability between high and low tax countries.
[6] To be expressed in units comparable to BEA's real GPO measure, current dollar values for total compensation and sales are converted into local currency units, deflated using the local GDP deflator, converted back into U.S. dollars using the 1995 exchange rate, and finally adjusted by a constant purchasing power parity value. This procedure parallels the methodology for real GPO followed by Mataloni (1997).

this variable is that it is measured in historic prices at the time of purchase. In an inflationary environment, PPE will appear higher in countries where more of the investment has occurred recently. Also, PPE will overstate the value of output in countries where more capital-intensive industries operate.

Countries and Their Classification

The geographic breakdown of the country dataset includes 17 European, 13 Asian, 2 North American, 12 Latin American, and 6 listed as "Others" countries. An alternative break down of the countries is based on long-run GDP per capita, used as a proxy for income per capita. Countries with GDP per capita greater than $11,000 in 1993 are classified as "high income," countries with GDP per capita between $11,000 and $2,000 in 1993 as "middle income," and countries with GDP per capital less than $2000 as "low income."[7]

The two alternative classifications are used to create regional and income group dummy variables. The set of dummy variables is intended to capture any region or income group-specific effects, and such variables can be interacted with other variables to determine whether the latter's influence differs across regions or income levels. In addition, benchmark year dummies are introduced to differentiate among observations over time.

Explanatory variables

[7] According to this classification, the high income countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, United Kingdom; the middle countries are Argentina, Brazil, Chile, Costa Rica, Greece, Malaysia, Mexico, Panama, Peru, South Africa, South Korea, Taiwan, Thailand, Turkey, Venezuela; and the low income countries are China, Colombia,

Market Size

Host country population and GDP per capita are obtained from the *World Development Indicators 2004* (*WDI 2004*) and the *Taiwan Statistical Yearbook 2003*. These two variables indicate the potential size of the host market. Rather than forcing them to make the same contribution, as when GDP alone is considered, entering them separately allows distinctions to be drawn between the relative importance of these two different sources of growth. To be consistent with Mataloni's measure of real GPO, the GDP per capita measured in constant local currency units is converted into international purchasing units using the PPP conversion value for 1993.

Potential GDP

To explain MNC activity that is motivated by a longer-run perspective, such as the PPE that the affiliate maintains, the study distinguishes between the observed value of nominal GDP at time *t* and its short and long-run components:

$$GDP_t^{observed} = GDP_t^{LR} + GDP_t^{SR},$$

where GDP_t^{LR} indicates the unobserved long-run equilibrium value of GDP, and GDP_t^{SR} indicates the unobserved fluctuations around the long run equilibrium level at time t. The most popular tool to determine these components of output is the Hodrick–Prescott (HP) filter (Hodrick and Prescott, 1997). The procedure is based on the estimation

$$\min \sum_{t=1}^{\tau} (y_t - y_t^*)^2 + \lambda \sum_{t=2}^{\tau-1} [(y_{t+1}^* - y_t^*) - (y_t^* - y_{t-1}^*)]^2,$$

where τ indicates the time span, y_t is the observed value of GDP at time t, y_t^* is the smoothed component which gives the estimate of potential GDP at time t, and λ is the

Dominican Republic, Ecuador, Egypt, Guatemala, Honduras, India, Indonesia, Jamaica, Nigeria, and the Philippines. This categorization is similar to one utilized by the World Bank.

smoothing factor which is usually estimated at 100 for annual potential GDP estimates. The HP filter minimizes simultaneously the distance between the actual values and the trend line, on one hand, and the change in the trend line, on the other[8].

Trade Barriers

Trade barriers are based on an openness index published in 1987 by the World Bank (*WDR*, 1987) and updated here for subsequent years. The original study assigned developing countries to one of four categories that demonstrated progressively less openness. Dummy variables are used to represent the three grouping that are less open. Assignment to these categories can change over time, based on changes in trade flows (exports and imports) as a percentage of GDP, as explained in the data appendix.

Corporate Taxes

The host country tax policy is approximated by the average effective corporate tax rate. The values are based on data reported by US controlled foreign manufacturing corporations to the US Treasury Department on Form 5471. The use of the average effective corporate tax rate is preferable to the use of statutory rates, because the former includes the effect of tax incentives offered to the MNC. It may reflect some endogenous determination of the tax rate, if greater investment allows a company to qualify for a lower rate. This potential problem has not been a serious one in previous work (Altshuler, et al, 2001). In order to minimize random noise in the tax data, the values for 1982 and 1994 are based on the average of the current year tax rate and the tax rate two year ago. The corresponding rates for 1989 and 1999 are based on the average of the tax rates three years before, one year before and one year after the corresponding benchmark year. This measure of taxation ignores the residual taxes paid in the United States, because that

[8] A more detailed discussion of the reasons for choosing the H-P filter can be found in the Data Appendix.

liability can be deferred and the actual amounts paid are a small portion of the total tax burden for MNCs (Grubert and Mutti, 2001).

Another representation of tax policy included in the study is the logarithm of the absolute value of the host country tax rate minus 0.25, the average value for the whole sample over the entire period. Grubert (2003) uses such a tax spread variable to indicate an incentive for greater transactions with related parties. A low host country tax rate not surprisingly is attractive to U.S. MNCs, but this variable also implies that a high host country tax rate may be less of a deterrent to investment. That possibility arises if the taxes paid in the high-tax country can shield the firm from additional U.S. tax due on earnings in low tax countries. Also, the parent may be able to easily shift profits from the high-tax affiliate to the low-tax affiliate, through transfer pricing or the form of financing adopted, which reduces the penalty of a high host-country tax rate.

Manufacturing Real Wages

Manufacturing real wages in host countries are included in the data set as proxies for the labor costs incurred by MNC. The wage data have been retrieved from *LABORSTA*, supported by the International Labor Organization (ILO), and from the Bureau of Labor Statistics (BLS). The real manufacturing wage has been calculated from the nominal wage using the host country GDP deflator. Potential real manufacturing wages are used in the long-run explanation of PPE. They are approximated using the HP filter. Both the actual and potential real wage estimates have been adjusted for PPP, which corresponds to the adjustment made to the GPO, total labor compensation and sales measures.[9]

[9] While real wages for the economy as a whole are likely to be independent of the level of investment by U.S. parents, in some small economies the two variables may be endogenously determined. Some authors have addressed that possibility with instrumental variable estimates, but the general equilibrium

Other Variables

Besides the tax and trade variables discussed above, another indication of relevant policy is short-run exchange rate volatility. Greater volatility is hypothesized to have a negative impact on the MNC choice to allocate resources and sales to that host country. This variable is calculated as the variance of the monthly percentage changes in the exchange rate of local currency units per US dollar over the last five years before the corresponding benchmark surveys. Most of the data originate from the IFS database.

A proxy for host country infrastructure is the average number of telephones per 1,000 workers. This variable is most directly relevant to the country's capabilities in communications and information technology. It may also be a useful proxy for the overall technological development of a country and the productivity of its resources in the economy, because the demand for infrastructure and information technology increases as the economic structure of the country becomes more complex. The data for this variable are from the International Telecommunications Union, as reported in WDI and from the *Taiwan Statistical Yearbook 2003.*

Empirical Results

The empirical analysis is based on panel data estimation of an equation that represents the weighted average of equations (1) and (2). Both random and fixed effects estimates are made, but in all cases other than the dependent variable as real GPO, a Hausman test

formulations mentioned earlier instead introduce relative factor endowments, particularly the availability of skilled labor. Carr, Markusen and Maskus (2001) suggest that the larger the host country's relative endowment of skilled labor, the greater affiliate sales will be. A comparable variable was not statistically significant in the present study.

finds systematic differences between them.[10] Therefore, the comments that follow focus on the fixed effects estimates reported in Table 1.

Real Gross Product Originating

The coefficient of the population variable is 0.16, and while it is not statistically significant, it indicates that as the population increases by 1%, GPO increases by 0.16%. Although the coefficient estimate is small compared to the random effects estimate, it still suggests that large countries in general attract more investment and warrant more production than small countries. A larger population for a given level of economic development suggests a larger domestic market, which allows economies of scale to be achieved; the fact that the coefficient is less than one may be due to the fact that not all MNC output is sold in the given local market. Additionally, a larger population may indicate a larger available pool of inflexibly supplied labor (Eaton and Tamura, 1996), and may promote production when scale economies are important, regardless of where the output is sold. The coefficient of GDP per capita is much larger, 1.22, and statistically significant, implying a greater attraction of investment to high-income countries or those where income grew rapidly. Such an effect presumably reflects demand conditions, where MNCs produce goods that have high income elasticities of demand that sell well in high income countries.

The size of this estimated scale effect is sensitive to whether GDP per capita also receives credit for supply considerations that favor production in high-income countries, such as more productive workers or better infrastructure. When such supply side variables are omitted, the estimated GDP per capita coefficient is even larger. Table 1

[10] If the model is misspecified and omitted variables are correlated with the error term in the random effects estimates, the latter approach will give biased estimates and the fixed effect estimates instead should be used.

demonstrates the case where the density of the telephone network serves as a proxy for the overall economic infrastructure of the host country. This technology variable is interacted with separate dummy variables for high (OECD) income, medium income, and low-income countries. The technology variables are not so strongly correlated with GDP per capita that including both yields estimates with many insignificant coefficients. In fact, all three of these interaction terms are positive and of similar magnitude, which indicates that in general higher technological development has a positive impact on MNC activity. A strong role for technological considerations is consistent with the findings of Markusen and Maskus (1999).

The Table 1 estimates include two additional technology variables, which represent the state of technology in potentially competing locations. Omitting such variables results in biased coefficient estimates of the host country effects, unless the two sets of variables are unrelated. Although the formulation with only two countries A and B is straightforward, when many alternative locations exist, how to allow for this potential competition is far from clear.[11] This study considers two alternative avenues of international competition among host countries: first, a host country may compete with countries of comparable average income per capita; and second, a host country may compete with countries in the same region. Group values for the cost variables are created as weighted averages of the country values, where the weights are affiliate GPO

[11] One study of FDI uses various measures of distance as the proper metric to determine the relevant value for a set of neighboring countries (Blonigen, et al, 2004), although this approach yields plausible results only when the sample is limited to foreign direct investment in Europe. An insightful study of U.S. state-local public expenditures finds that the proportion of the population that is black is a more successful measure of potential neighbors, as judged by the formulation that leads to the largest increase in the log likelihood function in their maximum likelihood estimates (Case, et al, 1994). Blonigen, et al, find that explicit attention to spatial autoregression matters much less than potential bias from omitted variables. However, their measure of competition with neighbors is the amount of FDI located there, a potentially endogenous variable. Case, et al, treat the issue of endogeneity much more carefully.

activity in the country. If better technology in Country A increases MNC activity in Country B, the two sites are complements. A negative coefficient suggests they are substitutes. Vertically integrated production across countries is more likely to demonstrate complementarity. As shown in Table 1, both coefficients are negative, but neither is statistically significant, an indication of a probable tendency for substitution with production elsewhere to dominate any complementarity.[12]

The coefficient of the tax variable indicates that a change in taxation that reduces the cost of capital by one percent will increase GPO by 1.7 percent. The nature of competition within a region or within an income group is mixed, however. The alternative tax variable based on regions appears significant and positive, 0.96, but the alternative tax variable based on income groups appears significant and negative, -1.61. The negative sign in this case suggests that as taxes decline in alternative locations, the appeal of a given host country to MNCs is likely to decline. The overall effect of the two tax competition variables appears to be negative.

The dummy variable for a closed economy is negative, and the coefficient estimate implies that such a country will account for 72 percent less production than one that is completely open. The dummy variables for less restrictive trade policies also are negative, but not significantly different from those economies judged to be open, and they are not included in the regression results reported in Table 1. In addition, the

[12] Equations (1) and (2) suggest that including the population and GDP per capita scale variables for other markets in which Country A production might be sold also is appropriate. To the extent that the value of these scale variables elsewhere reflects only this demand element, their coefficients will be positive. To the extent that these variables also represent a country that has more skilled or productive workers and is more likely to exhaust scale economies, their coefficients will be negative. If other variables that more closely represent such a supply side productivity effect are included in the equation to be estimated, such as the technology proxy, then the corresponding coefficient for the scale variables elsewhere are more likely to be positive. Because none of the latter coefficients were large in magnitude or statistically significant, those variables are not included in the estimated equation reported in Table 1.

interaction term of this trade policy variable and the tax term is negative, indicating that closed economies gain much less from a favorable tax environment.

A final observation with respect to the tax terms is that the positive coefficient on the tax spread coefficient is positive and significant. This pattern suggests that potential profit shifting raises the attractiveness of both low-tax and high-tax locations relative to the responsiveness implied by the log (1-t) specification.[13]

The wage variable has an unexpectedly positive sign. A higher wage may be associated with greater output, however, if the specification has not adequately controlled for differences in productivity across countries. Employers in a country may be able to pay higher wages and still be competitive if output per worker is sufficiently higher, and the technology proxy introduced above may not adequately reflect those differences.

Workers and Employee Compensation

When the number of workers is the dependent variable, the estimated relationship is quite similar to that reported for GPO. Variables that reflect the cost of capital are likely to appear less important if, for example, a lower tax rate results in some substitution of capital for labor as well as an incentive for greater output in the host country. In that situation, the estimated coefficient provides a lower bound relative to the magnitudes reported for GPO. However, as shown in Table 1 the role of technology, taxes, and trade policy appears quite comparable, in terms of the corresponding coefficient values and precision of the estimates. The coefficient for wages now is negative, although insignificant. The sharpest distinction arises in the case of GDP per capita, whose

[13] To address the possibility that this effect is primarily attributable to additional response to a low tax rate, and not to any particular benefit from operating where high host country taxes are imposed, this measure was separated into a variable for countries with below-average tax rates, $t - 0.25<0$, and one for countries with above average tax rates, $t - 0.25>0$. The coefficients for these two terms were both positive and significantly different from zero but not from each other.

coefficient is small and insignificant, as well as the negative coefficient on population. The apparent decline in the role of demand factors may particularly arise if MNC activity in some countries is concentrated in labor-intensive sectors such as electronics assembly that are destined for the export market; the distribution of workers and total compensation may differ from real GPO, and supply considerations may be more important than the size of the domestic market or the skill level of domestic workers.

In the case of total compensation, the role of GDP per capita is more similar to the positive and significant value reported for GPO. A better educated and more productive labor force suited to production of MNC goods that require its services more intensively generally exists where GDP per capita is higher, although the latter figure can be high due to resource rents or large returns to capital. Again, the technology, tax and trade coefficients are comparable in magnitude and significance to the GPO estimates.

Property, Plant and Equipment

The estimates for PPE use the smoothed measures of potential GDP and wages, not the actual values of those variables in a given year. In fact, that distinction did not prove to make a major difference for these years and countries, because the actual values yielded very similar results. In both cases, however, the role of population is surprisingly large, with a coefficient of 2.47 that is of borderline significance, a contrast to the fixed effects estimates for the three prior variables. Perhaps the more rapid growth of population in developing countries and the surge in affiliate capital in these countries over the 1990s, as noted in Figure 1, accounts for this distinction. Also in contrast to the prior cases, the role of technology variables is not nearly as precisely estimated. While the host country tax and trade coefficients are comparable to prior columns, the values for taxes in alternative locations are not significant. Thus, the basic model still appears

applicable to the case of PPE, but several of the coefficient values obtained are less convincing. One interpretation of the results is that more careful attention must be paid to the way expected values of future demand and cost variables are formed when the dependent variable implies a long-run decision.

Sales

To use affiliate sales as the dependent variable results in the loss of over a quarter of the observations, a situation that may explain the less precise estimates obtained for many coefficients. Similar to PPE, the coefficient for population is large, 1.47, and significant at the 10 percent level. The technology variables are significant, but the coefficient values vary markedly across income groups, with the measure appearing most important for high-income countries. The tax coefficient is smaller and only significant at the 10 percent level, and the various interactions effects explained above make little difference here. The negative effect of trade restrictions, however, still is quite important.

To assess the disadvantage of the smaller sample in this case, the earlier models were estimated for this same smaller sample. Indeed, the distinction turns out to be important, as the restricted sample for GPO shows that technology makes a considerably larger difference for high-income countries and that the various tax interaction effects no longer are significant.

More Complete Specifications

While the basic model presented above is particularly appropriate for explaining measures of affiliate GPO, workers, and employee compensation, some of the issues raised at the outset of the paper, regarding the stability of estimates over time and for different subgroups of countries, are not addressed in that formulation. Table 2 includes estimates that allow for both of these possibilities. The results are reported only for GPO

as the dependent variable, although estimates for the other cases also are discussed. Nevertheless, greater attention to the GPO results seems warranted, because the PPE measure appears to give a rather divergent picture of how MNC activity is changing over time, and the sales variable forces a large sacrifice in the sample size.

Of the possible extensions to explore, one important one is the potential importance of 1999 as a year when affiliate activity became more sensitive to either demand or cost conditions in host markets. Another is the potential difference in the response of affiliates in OECD countries compared to non-OECD countries. To determine whether the coefficients of the variables in the basic model have changed over time, dummy variables for the year 1999 and membership in the OECD are interacted with the basic set of variables. When such an interaction term is statistically significant, it is retained in the estimated equation reported here.

The impact of two variables has changed significantly over the 1994-99 period: GDP per capita and exchange rate volatility. Rapid growth in the host economy appears more important during the recent period in attracting more MNC activity. That result may be influenced by the more rapid growth in real GPO for OECD countries and the fact the income was growing more rapidly in OECD countries compared to the previous five-year period but less rapidly in non-OECD countries compared to the previous five-year period. That slowdown in non-OECD growth can be attributed to financial crises in several developing countries. The potential role of financial crises and exchange rate volatility is explored by including a variable that represents the standard deviation of the exchange rate in the most recent five-year period. Countries with predictable exchange rates appeared to attract more economic activity than countries with high volatility in their exchange rates, particularly during the most recent period. In contrast to the

expectation that more aggressive tax planning strategies adopted by many MNCs over the latter time period might cause GPO to be more sensitive to tax rates, that outcome does not appear to be the case for manufacturing affiliates.

With respect to the possibility suggested by Blonigen and Wang (2004) that there may be significant differences in the coefficient values that explain MNC activity in OECD versus non-OECD countries, the current analysis suggests the greatest distinctions arise when GPO is the dependent variable, which is shown in Table 2. The Hausman test again rejects any significant difference between the random and fixed effects coefficients, but in the case of non-OECD countries the coefficient for population in one estimate is positive and significant (random effects) and in one is negative but insignificant (fixed effects). For OECD countries, there is less difference between the two estimates.

The distinction among income levels is most important with respect to the responsiveness of MNCs to host country taxation. For non-OECD countries the tax coefficient increases from approximately 1.7 to 2.5, an indication that MNC activity is more sensitive to changes in tax policy for those countries that maintain few trade barriers. The negative interaction between the closed economy variable and the tax variable rises in magnitude and significance, which indicates that MNC activity in developing countries with closed markets is not particularly sensitive to tax considerations. The interaction between the tax variable and the OECD dummy is highly significant, negative, and of similar magnitude to the tax variable reported above. Within OECD countries, therefore, the overall impact of corporate taxes on real GPO appears to be quite small. Also, the interaction between the tax spread and the OECD dummy has a negative and significant coefficient, in contrast to the positive and significant coefficient for that variable in non-OECD countries.

With respect to technology in the host country and alternative locations in the region, those variables play little role in OECD countries, but are quite significant for non-OECD countries. In contrast to the more basic formulation in Table 1, now the contribution of the technology proxy in high-income countries is no longer comparable to the value for other countries and it is no longer significant. With respect to technology in other countries, if a non-OECD country falls behind others in the region, then MNC activity is likely to decline. For OECD countries, MNC activity appears to be insensitive to international technological competition and may even increase when neighboring countries improve their level of technological development.

As noted at the outset, however, using the real GPO figures raises questions over their sensitivity to transfer pricing strategies or to the application of appropriate price deflators. Particularly in the case of OECD versus non-OECD countries, any differences may be statistical artifacts that cannot be replicated with other dependent variables, because of the difference in deflators applied to the two groups.

For this more detailed formulation, both workers and total compensation appear similar to the GPO estimates with respect to the greater importance of GDP growth in 1999. Distinctions between OECD and non-OECD countries still appear over the role of the technology proxy in the host country and in the competing countries in the region, with both variables being important only in non-OECD countries. The greater sensitivity to taxation in non-OECD countries still appears, but the difference from OECD countries no longer is statistically significant. Also, exchange rate volatility does not have a significant influence on these employment measures, not a surprising result if that volatility has its most direct effect on reported profitability.

For PPE, introducing separate interaction effects with the OECD dummy does not yield any significant differences across countries with respect to taxation. Rather, the tax effects identified in the basic model of Table 1 no longer appear significant. It is plausible that fixed capital investment is less sensitive to fluctuations in current tax policy than the MNC's short-run output decisions. The level of technology in alternative regional locations again is important for non-OECD countries.

Conclusions

The basic empirical model applied in this study generally yields consistent results for different measures of MNC activity, different time horizons, and different representations of the explanatory variables. Consistent with earlier literature, the study indicates the importance of market size, corporate taxes, and international tax competition. It also supports the view that MNC sensitivity to changes in corporate taxes depends on the degree of openness of the host economy and the level of economic development of the host country.

Some evidence of profit shifting appears, as indicated by the greater tax sensitivity of real GPO than the other measures of MNC activity. However, that comparison does not suggest that the pattern of profit shifting has changed significantly in the most recent period when MNCs' tax avoidance strategies have been most aggressive. During that most recent period, the relative importance of the host market, labor costs, and technology remained the same, and possibly increased. Distinctions between OECD and non-OECD countries appear most convincingly in the case of attention to technological developments elsewhere in the region for non-OECD countries. MNC activity in OECD countries appears to be more dependent upon the attraction of host country demand and

complementarities in terms of technological development. MNC activity in non-OECD countries appears more driven by competitive cost conditions, such as taxes and technology. Those factors are important in the vertical integration of production for external markets, and this pattern is not observed for OECD countries.

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Table 1. Basic Model, Standard errors in brackets	Specification (1), GPO		Specification (1), Total Compensation		Specification (1), Workers		Specification (1), PPE		Specification (1), Total Sales	
Variables:	1982-99, re	1982-99, fe	1982-99, re	1982-99, re	1982-99, re	1982-99, fe	1982-99, re	1982-99, fe	1982-99, re	1982-99, fe
ln Population	0.95 (0.11)	0.16 (0.77)	0.86 (0.10)	-0.00 (0.67)	0.81 (0.10)	-0.08 (0.66)	1.00 (0.11)	2.47 (1.33)	1.09 (0.10)	1.49 (0.81)
ln GDP/Pop	1.41 (0.26)	1.22 (0.29)	0.92 (0.22)	0.68 (0.25)	0.48 (0.22)	0.22 (0.25)	1.31 (0.42)	1.23 (0.59)	1.53 (0.28)	0.86 (0.33)
Technology, low income	0.52 (0.15)	0.73 (0.17)	0.60 (0.14)	0.79 (0.15)	0.70 (0.14)	0.88 (0.15)	0.46 (0.22)	0.97 (0.30)	0.11 (0.18)	0.49 (0.25)
Technology, medium income	0.42 (0.17)	0.59 (0.22)	0.47 (0.15)	0.59 (0.19)	0.66 (0.15)	0.74 (0.18)	0.19 (0.25)	0.54 (0.38)	-0.06 (0.20)	0.65 (0.30)
Technology, high income	0.44 (0.20)	0.94 (0.36)	0.43 (0.18)	0.68 (0.30)	0.73 (0.18)	0.99 (0.29)	-0.06 (0.31)	0.89 (0.62)	-0.24 (0.24)	1.34 (0.46)
Technology, region	-0.44 (0.19)	-0.45 (0.26)	-0.45 (0.17)	-0.45 (0.22)	-0.33 (0.17)	-0.35 (0.22)	-0.31 (0.24)	-0.35 (0.43)	-0.53 (0.19)	-1.08 (0.30)
Technology, income	-0.10 (0.23)	-0.06 (0.31)	0.05 (0.20)	0.07 (0.27)	-0.43 (0.20)	-0.36 (0.26)	0.77 (0.35)	0.00 (0.52)	0.78 (0.26)	0.63 (0.37)
Ln (1-Tax)	1.64 (0.42)	1.73 (0.45)	1.27 (0.36)	1.38 (0.38)	1.51 (0.35)	1.56 (0.37)	1.79 (0.63)	1.77 (0.74)	1.41 (0.48)	0.95 (0.56)
Ln(1-Tax), region	1.03 (0.40)	0.96 (0.48)	0.73 (0.35)	0.93 (0.42)	0.80 (0.34)	1.00 (0.41)	0.20 (0.64)	-0.17 (0.82)	0.50 (0.40)	0.02 (0.49)
Ln(1-Tax), income	-1.50 (0.70)	-1.61 (0.76)	-2.41 (0.63)	-2.16 (0.67)	-2.30 (0.63)	-2.10 (0.65)	-2.04 (1.19)	-1.90 (1.34)	-1.15 (0.84)	-1.18 (0.92)
Ln (Wage)	0.32 (0.16)	0.33 (0.17)	0.13 (0.14)	0.10 (0.15)	-0.08 (0.13)	-0.08 (0.14)	-0.04 (0.29)	-0.77 (0.41)	0.38 (0.18)	0.15 (0.21)
Tax Spread	0.13 (0.04)	0.15 (0.04)	0.08 (0.04)	0.10 (0.04)	0.09 (0.03)	0.11 (0.04)	0.09 (0.07)	0.13 (0.07)	0.05 (0.04)	0.07 (0.05)
Closed Economy	-1.41 (0.35)	-1.28 (0.38)	-1.37 (0.31)	-1.35 (0.34)	-1.73 (0.30)	-1.68 (0.33)	-1.41 (0.50)	-1.66 (0.63)	-1.53 (0.40)	-1.41 (0.49)
ln(1-tax)* (Closed Economy)	-2.12 (0.72)	-1.91 (0.76)	-1.76 (0.62)	-1.83 (0.65)	-2.59 (0.61)	-2.61 (0.64)	-2.10 (1.17)	-3.32 (1.31)	-3.39 (1.20)	-2.15 (1.32)
Hausman Test Stat, $\chi 2$ with d.f. = variables	16.87 P>0.05		88.24 P<0.01		37.50 P<0.01		30.21 P<0.01		147.52 P<0.01	
R^2	0.75	0.76	0.68	0.69	0.60	0.61	0.53	0.57	0.77	0.80

Table 2. GPO specifications, Standard errors in brackets;	Specification (1), Without technology		Specification (2), Basic Model		Specification (3), 1999 distinctions		Specification (5), OECD vs. non-OECD And 1999 distinctions	
real GPO	1982-99, re	1982-99, fe	1982-99, re	1982-99, fe	1982-99, re	1982-99, fe	1982-99, re	1982-99, fe
ln Population	0.85 (0.10)	0.44 (0.61)	0.95 (0.11)	0.16 (0.77)	0.99 (0.11)	-0.38 (0.72)	1.12 (0.13)	-0.22 (1.00)
ln GDP/Pop	1.72 (0.16)	1.95 (0.23)	1.41 (0.26)	1.22 (0.29)	1.16 (0.25)	0.95 (0.28)	1.10 (0.25)	0.81 (0.28)
Technology, low income			0.52 (0.15)	0.73 (0.17)	0.68 (0.15)	0.95 (0.17)	0.73 (0.15)	0.95 (0.17)
Technology, medium income			0.42 (0.17)	0.59 (0.22)	0.60 (0.17)	0.76 (0.21)	0.66 (0.18)	0.70 (0.23)
Technology, high income			0.44 (0.20)	0.94 (0.36)	0.70 (0.20)	0.77 (0.34)	-0.10 (0.37)	0.07 (0.39)
Technology, region			-0.44 (0.19)	-0.45 (0.26)	-0.71 (0.20)	-0.82 (0.27)	-0.95 (0.22)	-1.24 (0.28)
Technology, income			-0.10 (0.23)	-0.06 (0.31)	-0.28 (0.24)	-0.26 (0.34)	-0.32 (0.28)	-0.03 (0.37)
Ln (1-Tax)	1.58 (0.43)	1.71 (0.46)	1.64 (0.42)	1.73 (0.45)	1.60 (0.39)	1.76 (0.42)	2.13 (0.52)	2.82 (0.56)
Ln (1-Tax), region	1.18 (0.41)	1.12 (0.47)	1.03 (0.40)	0.96 (0.48)	0.94 (0.38)	1.34 (0.47)	0.69 (0.42)	0.81 (0.57)
Ln (1-Tax), income	-1.49 (0.58)	-1.47 (0.75)	-1.50 (0.70)	-1.61 (0.76)	-1.09 (0.70)	-0.59 (0.78)	-0.63 (0.73)	-0.17 (0.77)
Ln (Wage)	0.23 (0.15)	0.15 (0.17)	0.32 (0.16)	0.33 (0.17)	0.36 (0.15)	0.42 (0.16)	0.38 (0.15)	0.46 (0.15)
Tax Spread	0.11 (0.04)	0.11 (0.04)	0.13 (0.04)	0.15 (0.04)	0.14 (0.04)	0.15 (0.04)	0.20 (0.05)	0.23 (0.05)
Closed Economy	-1.70 (0.34)	-1.85 (0.38)	-1.41 (0.35)	-1.28 (0.38)	-1.19 (0.34)	-0.87 (0.38)	-1.31 (0.35)	-1.10 (0.38)
ln(1-tax)* (Closed Economy)	-1.89 (0.75)	-1.87 (0.77)	-2.12 (0.72)	-1.91 (0.76)	-1.93 (0.68)	-1.86 (0.71)	-2.30 (0.72)	-2.58 (0.74)
XR-Volatility					-0.69 (0.44)	-0.77 (0.44)	-0.84 (0.43)	-1.01 (0.42)
Ln (GDP/Pop) * 1999					0.03 (0.01)	0.04 (0.01)	0.04 (0.01)	0.04 (0.01)
XR-Volatility * 1999					-2.98 (1.46)	-4.07 (1.52)	-2.92 (1.43)	-4.12 (1.45)
Ln (Population)*OECD							-0.30 (0.14)	0.33 (1.32)
Tech_Reg*OECD							1.58 (0.52)	1.70 (0.61)
Ln (1-Tax) * OECD							-1.90 (0.77)	-3.10 (0.87)
Spread_Tax*OECD							-0.15 (0.07)	-0.20 (0.07)
Hausman Test Stat, $\chi 2$ with d.f. = variables	7.96 P>0.05		16.87 P>0.05		117.32		299.42	
R^2	0.71	0.75	0.76	0.76	0.78	0.79	0.81	0.82

Data Appendix

GDP Deflator and PPP adjustment of GDP, Wages, and PPE

The implicit host country GDP deflators for a particular year are calculated, as follows:

- The host country GDP evaluated in current local currency units ($GDP_{current}^{LCU}$) is divided by the host country GDP evaluated in 1995 local currency units (GDP_{1995}^{LCU}); this operation gives a host country GDP deflator in terms of local currency units with 1995 as a base year;
- Then, the host country GDP deflator in local currency units with 1995 as a base year is converted into a deflator with 1993 as a base year. The latter year is characterized by fewer extremes in exchange rates across countries, and as explained below a purchasing power parity adjustment is made for the values observed in that year. The conversion of the deflator is accomplished by multiplying the ratio discussed under the first bullet point by the ratio of host country GDP measured in 1995 prices (GDP_{1995}^{LCU}) in local currency units and its counterpart measured in 1993 prices (GDP_{1993}^{USD});
- The procedure is summarized by the following formula:

$$Deflator_{GDP}^{LCU} = \frac{GDP_{current}^{LCU}}{GDP_{1995}^{LCU}} * \frac{GDP_{1995}^{LCU}}{GDP_{1993}^{LCU}}$$

The host country real GDP estimates in local currency units with 1993 as a base year ($realGDP_{lcu}$) are estimated using:

$$realGDP_{lcu} = nomGDP_{lcu} / Deflator_{GDP}^{LCU}$$

Then, the host country GDP in local currency units with 1993 as a base year is converted into 1993 USD ($realGDP_{usd}$). Since real GDP estimates are intended to indicate the real

economic activity taking place in a certain country for a given period, one needs to use purchasing power parity to adjust for the discrepancy between the nominal and real exchange rates. The purchasing power parity adjustment coefficients used in this research are taken from the annual *World Development Report 1995*. They represent an adjustment factor with a base year 1993 ($PPP^{USD}_{const\_1993USD}$), which is assumed to remain constant over time. The GDP estimates used in the research are obtained by multiplying host country real GDP in local currency units by the corresponding PPP coefficient:

$$GDP^{1993USD}_{ppp\_const} = realGDP_{usd} * PPP^{USD}_{const\_1993USD}$$

The GDP deflator and the PPP adjustment coefficients are also employed in the calculation of real manufacturing wages, potential manufacturing wage, and real PPE.

Hodrick - Prescott Filter

The discussion below indicates in some detail the reasons for choosing the Hodrick-Prescott filter instead of one of the alternatives.

One possible problem related to the Hodrick-Prescott filter is that its reliability decreases towards the end of finite sample series. This problem is overcome by including GDP forecasts based on an AR (1) process of the rate of change of real GDP. However, in the context of this study, the end-of-sample problem will not be important because the last HP estimates used in the actual research are for 1999.

Additional problems are related to the underlying *a priori* assumption that the series are I(2). Furthermore, the HP filter performs optimally if the residuals are white noise, but in reality the residuals very often exhibit autoregressive properties, sometimes with a high level of persistency (King and Rebello, 1993). However, these problems are

common for both detrending and filter estimation techniques (French, 2001). What follows is a discussion of the alternatives and their drawbacks.

Baxter and King propose a filter based on spectral analysis (Baxter and King, 1999). They argue that business cycles usually last between 6 and 32 months, so they attribute any fluctuations of shorter length to random components of the series, while any fluctuations longer than 32 months are attributed to long run changes in the underlying time series. The authors also argue that the band pass filter performs better than the HP filter towards the end of finite samples. However, as pointed out earlier, the end-of-sample issue does not appear to be important in this particular study.

Finally, the Kalman or state-space filter uses historical data to estimate the share of the variance to assign to trend rather than cycle. The filter, however, has an important drawback: practically, its variance estimates are biased towards zero when the true variance is small but nonzero, as demonstrated by Stock and Watson (1998). Specifically, they show that the filter is unable to identify shifts in the growth rate of trend productivity.

As obvious from the above discussion, all established estimation techniques have their theoretical drawbacks. Practically, French and Doepke evaluate the performance of the estimators in the context of the US and Germany, correspondingly. Both of them conclude that the estimators are poor predictors of turning points in the business cycle, which is fortunately not the major focus of the present research. Furthermore, both French and Doepke conclude that end-of-sample problems lead to the relatively poor performance of all techniques as forecasting tools. In general, both of them agree that the filters perform better than the simple detrending procedure, but it is impossible to determine whether one of them should be preferred.

Thus, the database includes potential GDP estimates based on the most widely used and accepted method, the HP filter. In order to mitigate the end-of-sample problems, the HP filter is applied to observable GDP time series for the 54 countries over a time span starting from 1973 and finishing in 2002: the potential GDP estimates employed in the research are only the within-sample years 1982, 1989, 1994, and 1999.

Trade Openness Index

With respect to the procedure used to update the trade openness index, a country gains or loses a point if it meets the following tests:

- Its relative position with respect to the other countries has changed by more than 50%. All countries are distributed on a scale determined by the lowest and highest observed ratios of international trade to GDP, using the formula:

$$rank_A = \frac{(ratio_{\max} - ratio_A)}{(ratio_{\max} - ratio_{\min})},$$

  where $rank_A$ can vary between 0 and 1. This measure of the relative position of country A rests on a scale determined by the maximum and minimum observed ratios of trade flows/GDP, shown as $ratio_{\max}$ and $ratio_{\min}$.

- The country has experienced a 5 percentage point absolute change in total international trade relative to GDP.

Both tests have been applied in order to avoid giving undue credit to closed economies that have marginally liberalized their trade policy (in this case, the country will pass the first test, but not the second.).

Tax Rate of Competitors

Along with the country specific tax rates, the data set contains estimates of the tax competition faced by a country in terms of statutory and average effective corporate tax rates. The competition is assumed to take place on regional level and within the group of countries with comparable average income per capita. The tax rates of each country have been weighted by the GPO of US affiliates. The formulas used to estimate the regional and income group average effective and statutory rates are:

$$tax_{gpo\_weights} = \sum_{i=1}^{n} \frac{GPO_i}{\sum_{j=1}^{n} GPO_j} * tax_i ,$$

where n is the total number of countries and tax_i indicates either the statutory or average effective rate for country i.

Exchange rate source

The exchange rate data for the New Taiwan Dollar comes from the *Taiwan Statistical Yearbook 2003* and the data for the Greek Drahma between 1977 and 1983 come from the *Monthly International Financial Statistics*.

Wages

The wage data has been converted into wage per hour for manufacturing production workers. The BLS estimates are reported in this format, but in some cases the ILO provides monthly and weekly wages. The adjustment procedure in these cases is based on

the "hours worked" series included in LABORSTA, whenever available. When "hours worked" data are not available for the whole sample period, the average of the reported observations has been used. Finally, in the cases in which hours worked are not available at all, the adjustment has been made by using the average hours worked for the corresponding income group of countries.

LABORSTA does not report all annual manufacturing wage estimates for the following countries: Argentina (1997-1999), Brazil (1978-1982), Colombia (1978-1989), Egypt (1980-1981, 1983-1984, 1996-1999), Philippines 1997-1999, Russia (prior to 1996, 1998), Thailand (1978-1989), Turkey (1985-1987, 1995), Indonesia (1978-1995), Nigeria (all years), Venezuela (all years, except 1997), and Jamaica (1992-2002). Two distinct procedures have been used to estimate the missing values. The first one is growth trend forecasting on the basis of past wage estimates since the last major long run economic shock. The second procedure has two stages. The first one involves detrending of the existing wage data and collection of the stationary residuals, which indicate short run fluctuations in wages. Simple linear detrending has been preferred in this case because of two major reasons: first, wages are expected to follow a growth path, approximated by the following process:

$$wage_t = \alpha * \exp(\beta * t + u_t),$$

where *t* picks up any productivity changes in the long run and u_t represents short run fluctuations in wages. The detrending allows for the collection of the residuals, which exhibit significant level of persistency and have mean value of 0. In the second stage, the residuals are regressed on the first lagged value of the residual. The residuals appear to be well approximated by an AR(1) process with a white noise residual. The persistency coefficient is then used to approximate the deviation of the missing wage values from the

long run trend. The advantage of the first approach is that it allows the HP filter to approximate all true values without the introduction of any artificial noise in the series, while avoiding problems associated with the missing values (discussed in more detail below). Thus, it is especially suitable for a study of wages in the long run. The second approach is geared towards the study of wages in the short run.

In the case of Indonesia, Nigeria, and Jamaica, the limited number of observations has warranted some additional estimation. Economic theory suggests that in the long run growth in productivity leads to a commensurate growth in wages. Thus, the growth of labor productivity, defined as the change in production per worker on an annual basis, can be used as a proxy for the growth in real wages. In the case of Nigeria, the original wage of departure in 1977 is set equal to that of India, for the two economies had comparable labor market characteristics in the 1970s.

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