The Contribution of Foreign Capital to U.S. Productivity Growth

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Abstract

U.S. Bureau of Labor Statistics productivity data show output growth per worker since 1995 approximately doubling the rate achieved over the preceding two decades. A rapid inflow of foreign investment paralleled the growth in productivity, suggesting a positive link between U.S. productivity and foreign capital. The goal of this study is to examine the relative contribution of foreign capital to the productivity gains. Applying a Cobb-Douglas production function to data from 1988 to 1999, it is found that foreign capital made important contributions to U.S. productivity growth. While it is concluded that foreign capital had little impact on productivity growth from 1988 to 1994, estimates indicate that it accounted for roughly twenty-six percent of U.S. productivity gains from 1995 to 1999.

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Introduction

During the latter half of the 1990s, the U.S. experienced exceptional productivity gains. During this same period, foreign capital stocks in the U.S. also increased dramatically. Not only did the U.S. foreign capital stock grow at a rapid pace, its share of the nation's overall capital stock grew dramatically. Figure 1 shows foreign capital as a percent of total capital from 1980 to 1999. As presented, this percentage has increased from 2.9 percent in 1980 to 5.6 percent in 1999. However, foreign capital's share of total capital varied significantly. For example, foreign capital's share of total capital increased dramatically during the latter half of the 1980s and peaked in 1991. During the latter half of the 1990s, foreign capital's share remained relatively steady at approximately 5.5 percent.

The relationship between foreign capital and U.S. productivity from 1980 to 1999 is depicted in Figure 2. The figure shows several consecutive years of productivity growth coupled with growth in foreign capital stocks. In particular, during the latter half of the 1990s, the growth in foreign capital stocks in the U.S. paralleled the productivity gains during the period.

Figure 3 compares growth rates of foreign and domestic capital from 1980 to 1999. Both follow the same general trend over the period, but since foreign capital is much smaller in absolute terms, it exhibits much more variation than domestic capital. The standard deviation of foreign capital's growth rate is 9.3 percent while it is only 1.0 percent for domestic capital. Note also that foreign capital's yearly growth rate falls considerably after the recessions of 1981-82 and 1991, but sometime after each downturn.

Not surprisingly, detailed industry data demonstrate this same degree of volatility for both foreign and domestic capital. Table 1 lists growth rates for foreign capital, domestic capital,

and GDP by industry from 1988 to 1999.[1] As presented, the standard deviation of foreign capital across industries is six times higher than that for domestic capital. Furthermore, the correlation coefficient between foreign capital and domestic capital calculated from the data in Table 1 is –0.13. The negative sign on the correlation coefficient suggests that foreign capital may have displaced domestic capital in the production process during this period. However, this negative sign could also be attributed to foreign firms purchasing domestic firms, such as the 1998 Daimler-Benz purchase of Chrysler, causing capital formerly classified as domestic to be re-classified as foreign. The next section provides a discussion of foreign capital and domestic capital.

Productivity Differences: Foreign Capital versus Domestic Capital

The rising level of foreign direct investment (FDI) in the U.S. has stimulated many studies examining the differences between foreign and domestic capital in the production process. Importantly, research has suggested five factors that potentially account for differential productivity rates between foreign and domestic capital.

First, foreign capital has been concentrated in manufacturing where productivity growth has generally exceeded that of non-manufacturing. Figure 4 displays the percent of both foreign and domestic capital in manufacturing. During the period 1987 to 1999, approximately ten percent of domestic capital was in manufacturing. At the same time, the amount of foreign capital in manufacturing industries ranged between 33 and 46 percent. Furthermore, from 1995 to 1999, the period of significant productivity growth, the share of foreign capital in manufacturing rose from 36 to 46 percent.

[1] Data on foreign capital disaggregated by industry are not available before 1988. In some cases, aggregation was necessary.

Second, U. S. economic conditions influence foreign investment differently than domestic investment. As presented in Figure 3, the two U.S. recessions over the past two decades portray vastly different impacts on capital stock. In each case, there was a significant drop in the growth rate of foreign capital the year after the recession began. This suggests that economic slowdowns in the U.S. have a delayed impact on foreign capital in the U.S. and in that respect are pro-cyclical.

Third, foreign firms that locate in the U.S. may attract other foreign firms in their supply chain. For instance, Florida and Kenney (1994) found that Japanese investment in research and development in the U.S. tended to cluster in technologically advanced areas and in the Midwest automotive region. In addition, Zhang (2001) found foreign investment clustered along coastal regions because of advantages in wage rates and infrastructure. Figure 5 displays foreign capital as a percentage of gross state product (GSP) by state for 1999. An examination of the figure provides some evidence of clustering of foreign capital. There are clusters in the Northwest, in the Mountain States, and in the Mid-West stretching from Kansas to Virginia.

Fourth, exchange rate fluctuations affect profit rates and investment costs for foreign firms more than domestic firms. Researchers have found much evidence linking exchange rates to the investment activity of foreign firms. Specifically, Lin et al. (2001) and Liou (1993) found that exchange rates were one of the factors determining overseas investment decisions. Additionally, Amuedo-Dorantes and Pozo (2001) found that as exchange rate uncertainty increases, FDI decreases in the short run. Love and Lage-Hidalgo (2000) similarly found that exchange rates affected the timing of U.S. direct investment in Mexico and Balcao Reis (2001) showed that foreign investment may decrease national welfare due to the transfer of capital

returns to foreigners. The next section identifies the linkage between foreign capital and economic growth.

Foreign Capital and Economic Growth

The confluence of foreign capital expansion and strong productivity growth encouraged economists and policymakers to view foreign capital as a vital component of economic growth. The earliest studies examining the impact of FDI in the U.S. were initiated in the late nineteenth century. This was a period marked by significant U.S. restrictions on investment by non-U.S. residents and citizens. During the 1950s and 1970s, research focused on U.S. investment abroad, virtually ignoring FDI in the U.S. Arpan, et al. (1981) noted the lack of research examining the impact of FDI on U.S. economic activity during the 1970s. In this study, the authors examined the inflow of foreign investment to the U.S. and identified several factors that account for the rising level of FDI in the U.S. These included the growth in global firms, rising foreign wage rates relative to U.S. wages, the response of other nations to the incursion of the U.S. into their economies, and the desire of foreign firms to gain access to U.S. technology. The authors concluded that there was a need for additional research examining the impact (local, state, and regional) of inward FDI.

There have been many studies investigating the impact of U.S. FDI on the economies of other countries (see Meredith and Maki, 1992). Chamarbagwala, et al. (2000) used a Cobb-Douglas production function to empirically test the relative output elasticity with respect to foreign and domestic capital in a pooled cross-sectional time-series model of seven Asian economies. The authors concluded that the elasticity for foreign capital was larger than that for domestic capital (also see Green and Levine (1970) and Weitzman (1979)).

Most of the literature on inward FDI flows into the U.S. concentrated on narrow categories of research, such as geographic orientation, industry orientation, employment impacts,

and legal issues. A large volume of work has concentrated on the location of FDI. For example, Coughlin, et al. (1991) examined the location decision. Their results based on 1981 to 1983 data indicated that states with higher per capita incomes and higher densities of manufacturing activity attracted relatively more FDI.

Furthermore, existing literature seldom relates FDI to economic development directly. Instead, research has focused on what impact FDI had on manufacturing sectors and on employment. An example of this is the work by Shelburne and Bednarzik (1993) that investigated the relationship between employment and FDI location decisions in trade-sensitive industries. Leichenko and Erickson (1997) found that inward flows of FDI were statistically significant and positively related to exports by the U.S., and they speculated that the increased export activity U.S. was due to increased productivity caused by FDI. Their review of the relevant literature indicated that there were sound theoretical arguments to support the proposition that increased levels of FDI enhanced international competitiveness lead to an increase in export activity. While the researchers established a linkage between FDI and exports, the missing nexus was between FDI and productivity. In the end, the authors concluded that thus far there were no compelling conclusions regarding the impact of rising FDI on U.S. productivity growth.

It is puzzling that no studies, to the authors' knowledge, have specifically examined the relationship between inward FDI and U.S. productivity. In an effort to fill this research gap, this study investigates the extent to which foreign capital contributed to U.S. productivity growth between 1988 and 1999. It focuses on the following three specific research issues:

- *First, the study determines the extent to which foreign capital contributed to U.S. productivity between 1988 and 1999.*

- *Second, the study examines how foreign capital's contribution to productivity growth differed between 1988-94 and 1995-99.*
- *Third, the study investigates the extent to which foreign capital tended to crowd out domestic capital.*

The remainder of this study disentangles the productivity impacts of foreign capital from that of domestic capital, to the extent possible, by controlling for each in a regression framework described later. In order to provide more reliable estimates of the impact of foreign capital on productivity growth, the present effort pools times series and cross-sectional two-digit in a production function framework. The next section outlines the methodology.

Methodology

The following analysis treats foreign capital as an input in the production function as presented in Equation (1) below. Time and industry subscripts are omitted for presentation simplicity.

$$Q = f(L, K_D, K_F, LQ) \quad (1)$$

where Q is output, L is Labor, K_D is domestic capital stock, K_F is foreign capital stock, and LQ represents labor quality. Assuming a generalized Cobb-Douglas form yields a more specific relationship between inputs and outputs as presented in Equation (2) ("A" represents the constant).

$$Q = A\, L^{\beta}\, K_D^{\alpha}\, K_F^{\lambda} LQ^{\rho} \quad (2)$$

And output per unit of labor is:

$$Q / L = A\, L^{\beta-1}\, K_D^{\alpha} K_F^{\lambda} LQ^{\rho} \quad (3)$$

Re-writing Equation (3) in natural logarithm form produces Equation (4).

$$\ln Q - \ln L = \ln A + (\beta-1) \ln L + \alpha \ln K_D + \lambda \ln K_F + \rho \ln LQ \quad (4)$$

A more flexible function form allows for the estimation of substitution and complementary relationships between the inputs. Dewan's translog production function in Equation (5) meets this condition (Dewan and Min, 1997):

$$\ln Q = \ln A + \beta_0 \ln L + \alpha_0 \ln K_D + \lambda_0 \ln K_F + \beta_1 (\ln L)^2 + \alpha_1 (\ln K_d)^2 + \lambda_1 (\ln K_F)^2 +$$

$$\delta_1 (\ln L)(\ln K_F) + \delta_2 (\ln L)(\ln K_D) + \delta_3 (\ln K_F)(\ln K_D) + \rho \ln LQ \qquad (5)$$

The empirical estimations of Equations (4) and (5) use pooled industry output, labor, capital, and labor quality data for the period 1988 to 1999. The percent of the industry workforce that is college educated and the average age of the industry workforce are used to proxy labor quality (LQ). Definitions and mean values of all variables used in the estimation of Equations (4) and (5) are listed in Table 2.

The next section provides an overview of the data used in empirical tests.

Data

Data used to test hypotheses come from three different sources. The U.S. Bureau of Economic Analysis publishes output and capital stock data, while the U.S. Bureau of Labor Statistics generates labor hour estimates. Age and education data, labor quality, come from the *Current Population Survey* (*CPS*), a monthly survey of approximately 50,000 households conducted by the U.S. Bureau of the Census for more than 50 years. The *CPS* is the primary source of information on the U.S. labor force and includes the most robust measures of labor market activity for the civilian, non-institutional population.

The Bureau of Economic Analysis (BEA) publishes foreign capital stock data annually in *Foreign Direct Investment in the United States: Operations of U.S. Affiliates of Foreign Companies*. The BEA defines a foreign affiliate as any company in the U.S. that has at least ten percent foreign ownership, or any new business in the U.S. established by a foreign company.

Every five years the BEA publishes its *Benchmark Survey* of all foreign affiliates and, in interim years, it collects sample data to estimate values for the entire population.

This net capital stock is the total real property, plant, and equipment of foreign affiliates less real depreciation. This paper examines the relationships between these variables across industries for the years 1988 to 1999. However, the industries used in this paper do not conform to either SIC or NAICS industries because the Census classifies pre-1996 data using SIC codes and post-1995 data using NAICS conventions. Thus, this methodology aggregated or dropped industry groups to produce the twenty-eight consistent industries listed in Table 1.[2] The next section presents the empirical results.

Empirical Results

Results from the estimation of Equation (4) for the full sample are presented in Table 3. Columns (1), (2), and (3) list the results for the periods 1988-99, 1988-94, and 1995-99 respectively.[3] Each of the labor and capital stock variables has the expected sign and is statistically significant except for foreign capital, which is only statistically significant for the period 1995-99. Basu and Fernald (1997) found that production function estimates based on two-digit industries, as in this study, appear to exhibit constant, or slightly decreasing returns to

[2]The industries that have been aggregated are Lumber and Wood Products & Furniture and Fixtures; Electronic and Other Equipment & Instruments and Related Products; Food and Kindred Products & Tobacco Products; Textile Mill Products & Apparel and Other Textile Products & Leather and Leather Products; Communications & Public Utilities; Depository Institutions & Nondepository Institutions & Security and Commodity Brokers & Holding and Other Investment Offices; and Insurance Carriers & Insurance Agents, Brokers, and Service. The industries that have been dropped are Agriculture, Forestry, and Fishing; Personal Services; Auto Repair; Services; Parking; Miscellaneous Repair Services; Amusement and Recreation Services; Legal Services; Educational Services; Social Services; Membership Organizations; Other Services; and Government.

[3]The estimated covariance matrix of coefficients is calculated using Equation 12.39 in Kmenta (1986, page 623). The estimated matrix, Φ, is the variance-covariance matrix of the disturbance terms and it is of the order N(T-1) x N(T-1). In general, the parameter estimates contained in all of our pooling regressions possess the asymptotic properties of Aiken's estimator. Aiken's generalized estimator is the same as the best-linear unbiased estimator derived for the regression model with autoregressive disturbances. Some econometricians believe that this matrix should be multiplied by the overall estimates of σ^2. Results using this latter technique were virtually identical to those presented.

scale. In this case, the sums of the elasticities are 1.04, 1.07, and 1.12 for the periods 1988-99, 1988-94, and 1995-99 respectively.[4] Thus, all regressions produce estimates with increasing, but close to constant, returns to scale.

Several other important findings emerge from the estimates. First, foreign capital's impact is much lower during the period marked by the U.S. recession (-0.0111 versus 0.0727) while domestic capital's impact differs little between periods (0.2990 versus 0.3148). Second, even in the 1995-99 period, domestic capital's elasticity is more than four times that of foreign capital.

Based on parameter estimates from Table 3, foreign capital's estimated contributions to productivity growth are derived and listed in Table 4 for the two periods, 1988-94 and 1995-99. As indicated for the period 1995-99, foreign capital contributed 0.019 to labor productivity and domestic capital added 0.038 to labor productivity during the period of rapid productivity growth. Thus, foreign capital and domestic capital accounted for 27.0 percent and 54.2 percent, respectively, of total labor productivity growth over the period. For the years 1988-94, foreign capital made no contribution to labor productivity growth. However, domestic capital contributed 0.06 to labor productivity growth, which represents 36.8 percent of total labor productivity growth for the period. Thus during the period including a recession, foreign capital made no contribution to productivity growth.

Data in Table 4 suggests that foreign capital's impact varies significantly according to the U.S. business cycle. Table 5 lists annual growth rates for output, productivity, foreign capital and domestic capital. As presented, foreign capital tends to be more counter-cyclical. In this case during the slower output and productivity growth period 1988-94, foreign capital's growth

[4] Since the coefficient calculated for labor is ß–1 in Equation (4), labor's elasticity is the calculated coefficient plus one.

rate was much higher than during the higher output and productivity growth period 1995-99. Domestic capital tends exhibit the opposite trend. That is, domestic capital's growth tends to be higher during periods of high output and productivity growth. The correlation coefficients between growth rates for foreign capital and GDP were -.43 and +.89 for 1988-94 and 1995-99 respectively. On the other hand, the correlation coefficients between growth rates for domestic capital and GDP were +.95 and +.66 for 1988-94 and 1995-99 respectively.

Results for the estimation of Equation (5), the translog production function, are presented in Table 6. In this case, the dependent variable is GDP rather than GDP per hour worked. Estimates in Table 6 allow one to determine the extent to which inputs are substitutes or complements. As indicated by coefficient estimates, foreign capital and domestic capital are substitutes, while foreign capital and labor are complements. The counter-cyclical nature of foreign capital, at least relative to domestic capital, has potentially important public policy implications. It indicates that government policies promoting foreign capital formation are very important at times when the U.S. experiences a recession. Government capital formation policies include lower taxes on capital gains and dividend income, tax rebates, tax cuts, tax credits, etc. It also suggests that the lag in government actions and their impact on the U.S. economy may coincide with a decline of FDI in the U.S.

Furthermore, since overall economic activity increases are usually accompanied by rising interest rates, these findings suggest that U.S. companies get crowded out of the credit markets. Because the hurdle rates for positive net present value capital expenditures increase with rising interest rates, FDI is able to take advantage of the U.S. capital market change, accounting for the increase in FDI flows to the U.S. The increase of FDI in expansionary periods leads to increased productivity and fuels more rapid economic growth. Further research is needed to determine its

impact the U.S. money supply, money reserves, money velocity, inflation, and Federal Reserve policy. Advocate of the "new economy" hail very strong economic performance between 1995 and 1999 as evidence of a sustainable increase in the underlying growth potential of the U.S. Whether these gains ultimately prove permanent or transitory remains uncertain, but it is certain that substantial inflows of private foreign capital have encouraged them.

Summary

Using U.S. Census data on foreign capital, along with more advanced statistical techniques, this study more fully examined the impact of foreign capital on output and productivity growth. It found that foreign capital was a positive and statistically significant factor stimulating productivity growth during the latter half of the 1990s, a period marked by rapid productivity growth. Given current low investment rates of foreign capital, there appears to be significant room for enhancing productivity growth via expanding foreign capital. Results from this study indicate that any large expansion in FDI in the U.S. will mean productivity gains for the economy. While the productivity enhancing power of the foreign capital has not been "mind boggling," it has been significant with quite promising results for the future. Furthermore, findings from this study suggest that foreign capital provides counter-cyclical support for the overall U.S. economy. This latter proposition should stimulate greater research in this area.

Figure 1: Foreign Capital as a Percentage of Total Capital, 1980-99

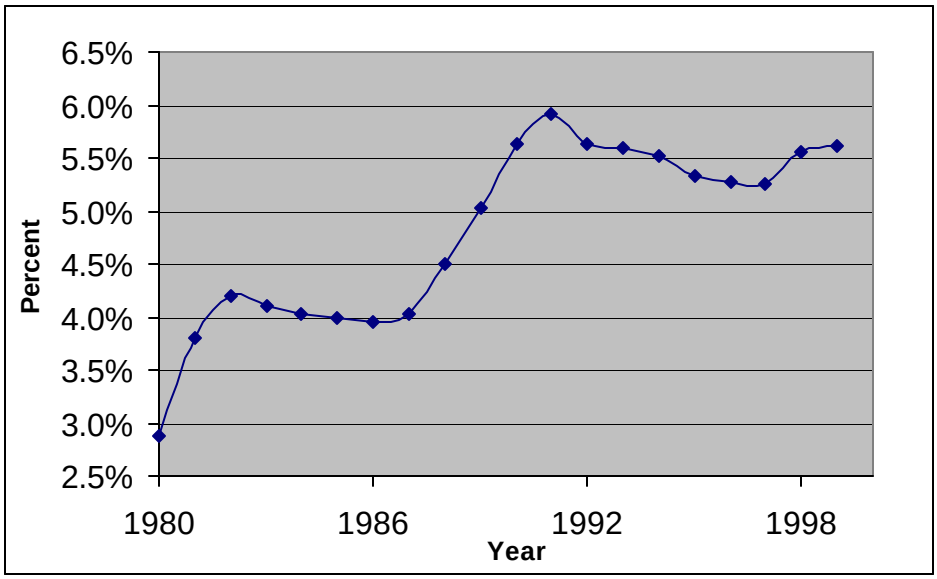

Figure 2: Annual Gains in U.S. Productivity and Annual Increases in Foreign Capital Stock, 1980-99

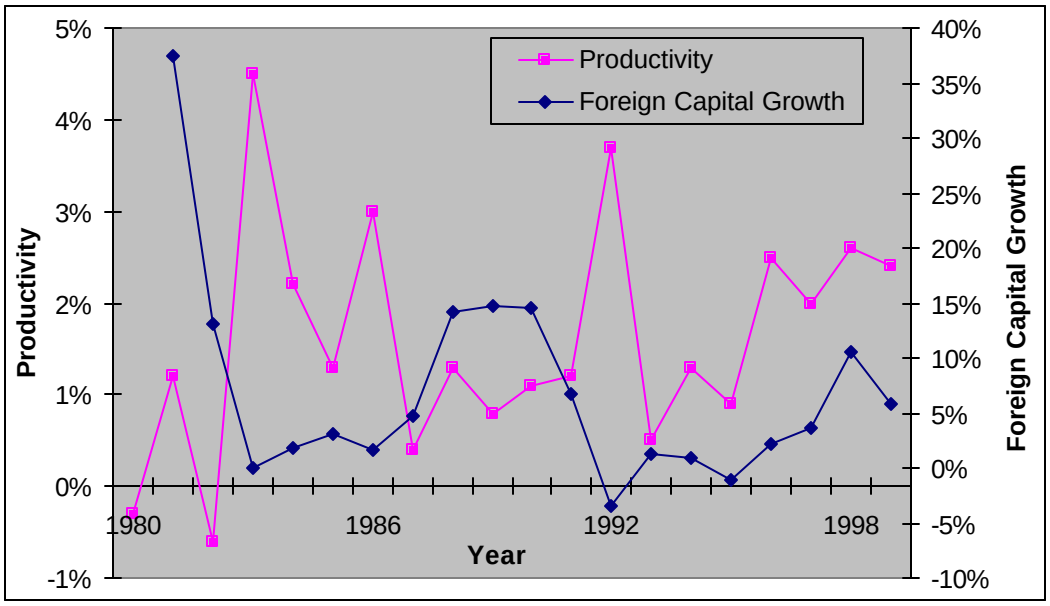

Figure 3: Growth Rates of Foreign and Domestic Capital, 1980-99

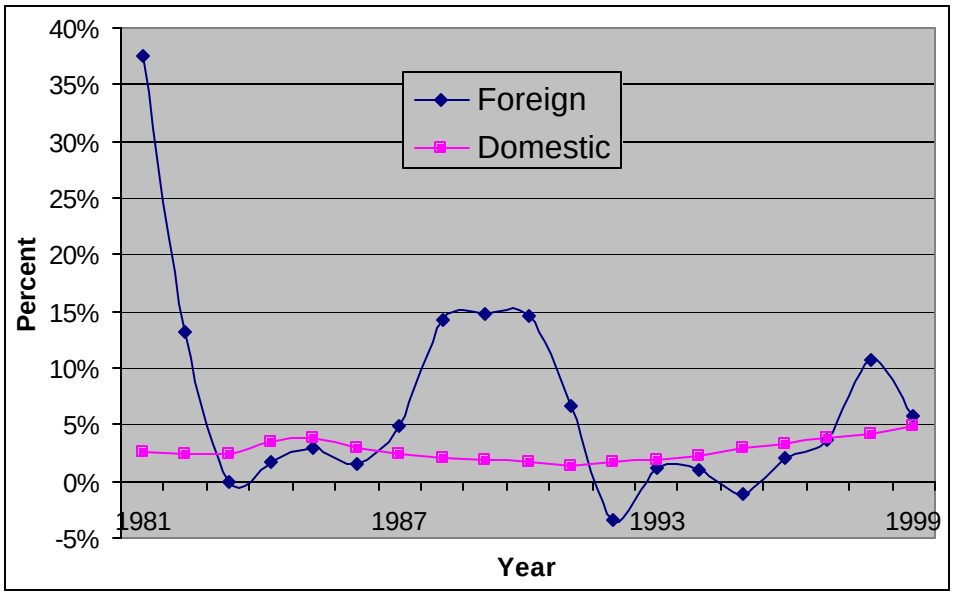

Table 1: Growth Rates by Industry, 1988-99			
	Growth Rate		
Industry	**Foreign Capital**	**Domestic Capital**	**GDP**
Communication and Utilities	1341.14%	23.68%	51.70%
Motor Vehicles and Equipment	1117.23%	-54.23%	20.69%
Insurance	620.18%	85.68%	2.34%
Health Services	225.02%	71.48%	17.44%
Business Services	223.32%	151.76%	120.37%
Wholesale Trade	220.43%	58.23%	84.35%
Mining	171.12%	-8.13%	5.78%
Finance	170.89%	86.22%	64.57%
Other Transportation Equipment	153.23%	6.96%	-24.42%
Construction	146.40%	47.44%	23.07%
Rubber and Miscellaneous Plastics Products	141.37%	46.83%	74.97%
Electronics	119.06%	48.86%	105.78%
Paper and Allied Products	112.52%	12.11%	5.35%
Printing and Publishing	106.49%	22.32%	-20.49%
Miscellaneous Manufacturing	86.78%	-29.61%	17.19%
Hotels and Other Lodging Places	59.22%	35.18%	26.57%
Primary Metal Industries	57.48%	-12.40%	38.86%
Industrial Machinery and Equipment	46.36%	25.84%	144.81%
Stone, Clay, and Glass Products	45.88%	-6.50%	33.44%
Transportation	41.00%	11.81%	60.87%
Food, Beverages, and Tobacco	31.18%	22.01%	-51.05%
Retail Trade	24.21%	49.24%	58.91%
Motion Pictures	23.11%	190.46%	41.54%
Chemicals and Allied Products	16.20%	50.72%	38.85%
Fabricated Metal Products	10.62%	15.10%	17.32%
Real Estate	4.10%	30.26%	32.25%
Textiles, Apparel, and Leather	-0.97%	1.27%	-7.48%
Lumber and wood products & Furniture and fixtures	-10.15%	12.58%	-2.51%
Standard deviation	320%	50%	44%

Figure 4: Percent of Capital in Manufacturing Industries, 1987-99

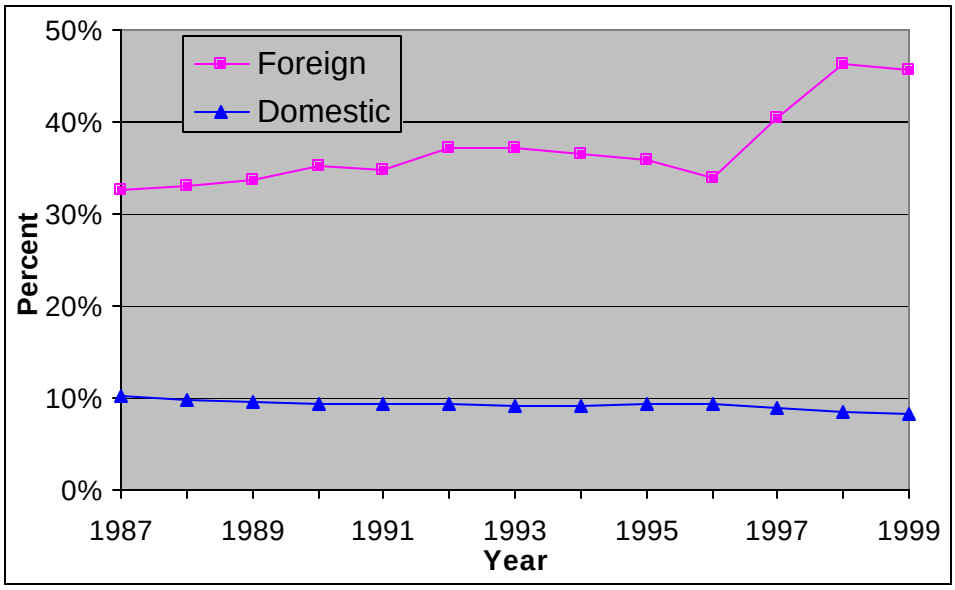

Figure 5: States' Foreign Capital as a Percentage of GSP, 1999

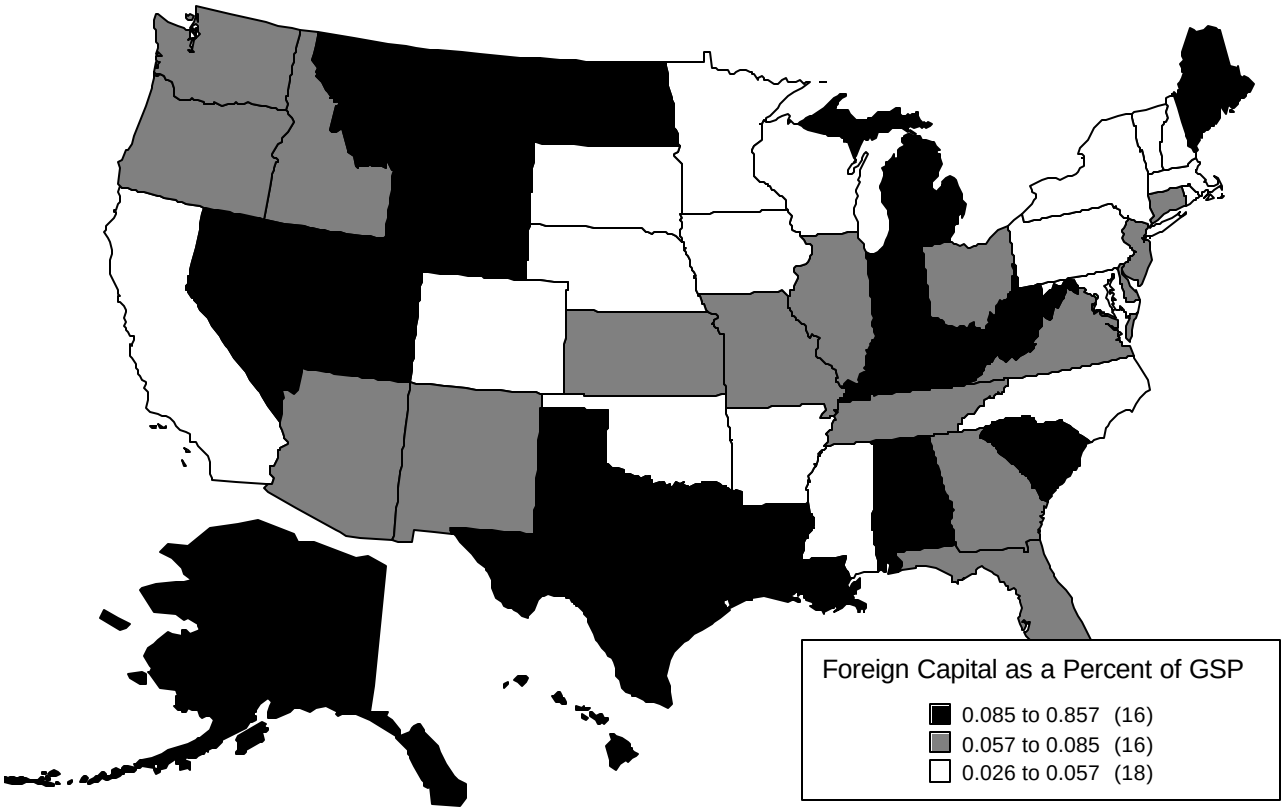

Table 2: Mean Values of data: 1988 and 1999		
	1988	**1999**
GDP–Industry average in millions (LGDP)	$173.39734	$245.9091
Labor hours (Lhours)	4,950,078,306	5,939,582,239
Foreign capital (Lforeign_Cap)	$11,742.65	$24,859.17
Domestic capital (Ldomestic_Cap)	$217,781.46	$286,271.47
Age (Lage)	39.2	40.1
Percent college educated (Led)	17.3%	19.7%

Table 3: Impact of Factors on Labor Productivity, 1988-99			
	1988-99	**1988-94**	**1995-99**
Lhours	-0.2063 [a] (-5.9380)	-0.2162 [a] (-5.3130)	-0.2654 [a] (-6.3920)
Lforeign_Cap	0.0122 (1.4730)	-0.0111 (-1.2520)	0.0727 [a] (7.5040)
Ldomestic_Cap	0.2319 [a] (8.2570)	0.2990 [a] (9.9360)	0.3148 [a] (10.0800)
Lage	0.1836 (0.9911)	0.7905 [a] (2.0060)	0.0828 (0.5255)
Led	0.0182 (1.0630)	0.0571 [a] (2.4260)	0.0828 (-0.9028)
Constant	-16.1070 [a] (-17.1500)	-18.5730 [a] (-10.4300)	-16.0380 [a] (-16.7000)
R^2	0.1932	0.6144	0.5279
Number of Observations	336	196	140
[a] Coefficient is statistically different from zero at the 95% level of confidence			

Table 4: Capital's Estimated Impact on Productivity Growth		
	1988-94	**1995-99**
Domestic Capital:		
Contribution to Productivity Growth	0.061	0.038
Percent of Total Productivity Growth	36.8%	54.2%
Foreign Capital:		
Contribution to Productivity Growth	0	0.019
Percent of Total Productivity Growth	0	27.0%

Table 5: Annual growth rates output, productivity and capital by time period		
	Annual Growth Rates	
	1988-94	1995-99
GDP	2.2%	5.3%
Productivity	1.0%	2.5%
Foreign Capital	10.2%	8.0%
Domestic Capital	1.6%	4.1%

Table 6: The Impact of Factors on GDP		
	Coefficient	**t-Value**
Lhours	-1.838	-1.786
Ldomestic_Cap	2.240[a]	3.911
Lforeign_Cap	-1.000 [a]	-3.834
Lhours*Ldomestic_Cap	-0.226 [a]	-6.007
Lhours* Lforeign_Cap	0.033 [a]	2.788
Ldomestic_Cap*Lforeign_Cap	-0.023 [a]	-2.258
$Lhours^2$	0.111 [a]	3.802
$Ldomestic\_Cap^2$	0.138 [a]	7.897
$Lforeign\_Cap^2$	0.029 [a]	4.840
Led	0.020	1.309
Lage	0.327	1.821
Constant	5.786	0.593
R^2	.916	
Number of Observations	336	
[a] Coefficient is statistically different from zero at the 95% level of confidence		

References

Amuedo-Dorantes, Catalina and Susan Pozo. "Foreign Exchange Rates and Foreign Direct Investment in the United States." *International Trade Journal*, 15 (3), Fall 2001, 323-343.

Arpan, J.S. Edward B. Flowers, and David A. Ricks. "Foreign direct investment in the United States: the state of knowledge in research," *Journal of International Business Studies*, vol. 12, Issue 1, Special Issue, Spring – Summer 1981, 137 – 154.

Balcao Reis, Ana. "On the Welfare Effects of Foreign Investment." *Journal of International Economics*, 54 (2), August 2001, 411-427.

Basu, Susanto, and John G. Fernald. "Returns to scale in U.S. production: estimates and implications," *Journal of Political Economy*, 105 (2), 1997, 249-283.

Chamarbagwala, Rubiana, Sunder Ramaswamy, and Phanindra V. Wunnava. "The role of foreign capital in domestic manufacturing productivity: empirical evidence from Asian economies," *Applied Economics*, 32, 2000, 393 – 398.

Coughlin, Cletus C., Joseph V. Terza, and Vachira Arromdee. "State characteristics and the location of foreign direct investment within the United States," *Review of Economics and Statistics*, 73 (4), November 1991, 675 – 683.

Dewan, Sanjeev and Chung-ki Min. "The Substitution of Information Technology for Other Factors of Production: A Firm Level Analysis," *Management Science*, 43(12), Dec. 1997, pp. 1660-1675.

Florida, Richard and Martin Kenney. "The Globalization of Japanese R&D: The Economic Geography of Japanese R&D Investment in the United States." *Economic Geography*, 70 (4), October 1994, 344-369.

Green, D., and H. Levine. "Implications of technology transfers for the USSR." NATO: East-West Technology Cooperation, Brussels: NATO Economic Directorate, 1976.

Leichenko, Robin M., and Rodney A. Erickson. "Foreign direct investment and state export performance," *Journal of Regional Science*, 37 (2), 1997, 307 – 329.

Lin, Yingshing, Michael Szenberg, and Thomas J Webster. "Determinants of Foreign Direct Investment: Taiwan, 1965-1993." *Journal of Applied Business Research*, 17 (2), Spring 2001, 51-63.

Liou, Kuo-Tsai. "Foreign Direct Investment in the United States: Trends, Motives, and the State Experience." *American Review of Public Administration*, 23 (1), March 1993, 1-17.

Litan, R.E., and Alice M. Rivlin. "Projecting the Economic Impact of the Internet," *American Economic Review*, May 2001, Vol. 91 (2), 313-317.

Love, James H. and Francisco Lage-Hidalgo. "Analysing the Determinants of US Direct Investment in Mexico." *Applied Economics*, 32 (10), August 2000, 1259-1267.

Meredith, Lindsay N., and Dennis R. Maki. "The United States export and foreign direct investment linkage in Canadian manufacturing industries," *Journal of Business Research*, 24, 1992, 73-88.

McGuckin, R. H., and K. J. Stiroh. "Do computers make output harder to measure?" Federal Reserve Bank of New York, April 6, 2000, paper presentation.

Shelburne, Robert C., and Robert W. Bednarzik. "Geographic concentration of trade-sensitive employment," *Monthly Labor Review*, 1993.

Weitzman, M. "Technology transfer to the USSR: an econometric analysis, *Journal of Comparative Economics*, 3, 1979, 167 – 177.

Zhang, Wei. "Rethinking Regional Disparity in China." *Economics of Planning*, 34 (1-2), 2001, 113-138.