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# Technology Capital and the U.S. Current Account*

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ABSTRACT

The U.S. Bureau of Economic Analysis (BEA) estimates the return on investments of foreign subsidiaries of U.S. multinational companies over the period 1982–2006 averaged 9.4 percent annually after taxes; U.S. subsidiaries of foreign multinationals averaged only 3.2 percent. Two factors distort BEA returns: *technology capital* and *plant-specific intangible capital*. Technology capital is accumulated know-how from intangible investments in R&D, brands, and organizations that can be used in foreign *and* domestic locations. Used abroad, it generates profits for foreign subsidiaries with no foreign direct investment (FDI). Plant-specific intangible capital in foreign subsidiaries is expensed abroad, lowering current profits on FDI and increasing future profits. We develop a multicountry general equilibrium model with an essential role for FDI and apply the BEA's methodology to construct economic statistics for the model economy. We estimate that mismeasurement of intangible investments accounts for over 60 percent of the difference in BEA returns.

*Appendices, data, and codes are available at our website http://www.minneapolisfed.org/research/sr/sr406.html. We thank three anonymous referees and the Editor for their helpful comments and the NSF for research support. The views expressed herein are those of the authors and not necessarily those of the Federal Reserve Bank of Minneapolis or the Federal Reserve System.

# 1. Introduction

The U.S. Bureau of Economic Analysis estimates the return on investments of foreign subsidiaries of U.S. multinational companies over the period 1982–2006 averaged 9.4 percent annually after taxes, whereas returns on investments of U.S. subsidiaries of foreign multinationals averaged only 3.2 percent. These series are displayed in Figure 1.[1] The figure shows that the differences in these returns are not only high on average but are persistently high. Furthermore, when compared with estimates of returns of U.S. businesses on domestic operations, returns on investments abroad are 4 to 5 percentage points higher, and returns on investments made by foreign companies in the United States are 1 to 2 percentage points lower. Since one-third of U.S. C-corporation profits come from their foreign subsidiaries, understanding why their foreign operations appear to be doing so much better than their domestic operations is both interesting and important.

In this paper, we estimate the importance of *unmeasured* intangible investments that distort *measured* returns on foreign direct investment. We do this by developing a multi-country general equilibrium model that includes intangible capital. The main theoretical innovation is the inclusion of two distinct types of intangible capital: *technology capital* that can be used at multiple locations and intangible capital that is *plant-specific*. Examples of technology capital include accumulated know-how from investments in research and development (R&D), brands, and organizations that is not specific to a plant. Technology capital used abroad generates rents for foreign subsidiaries with no foreign direct investment. Thus, given technology capital, foreign subsidiaries play an essential role.

We apply the same methodology as the BEA to construct economic statistics for our model economy. We emphasize that the names for the BEA statistics are not appropriate in our model world. In the model world, which has no uncertainty, the after-tax returns on all investments are equal. Consequently, all differences in returns that are constructed with the BEA methodology are due to differences in the timing and magnitude of foreign intangible investment and income.

We find that abstracting from either technology capital or plant-specific intangible

[1] The U.S. return is *direct investment receipts* from Table 1 of the U.S. International Transactions divided by the *U.S. direct investment position at current cost* from Table 2 of the U.S. International Investment Yearend Positions. The foreign return is analogous: direct investment payments divided by the foreign direct investment position at current cost.

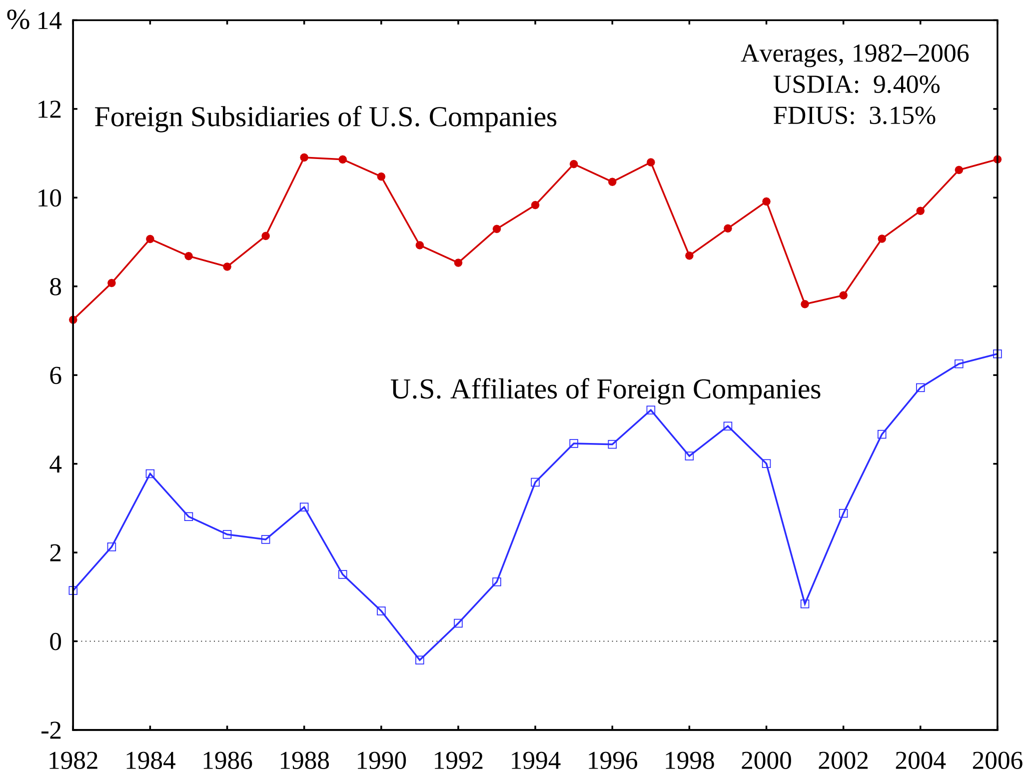


Figure 1. BEA Rates of Return on Foreign Subsidiary Capital

capital has large consequences for the BEA-measured rates of return on U.S. foreign subsidiaries and U.S. affiliates of foreign companies. We estimate that the mismeasurement of intangible investments leads to a 4 percentage point difference in FDI returns for the period 1982–2006, with the return on foreign FDI in the United States very close to what theory predicts and the return on U.S. FDI higher than predicted.

Our finding rests critically on differences in the timing and magnitude of inward and outward FDI in the United States.[2] After World War II, foreign direct investments in the United States were negligible and did not begin to rise significantly until the late 1970s. If foreign companies make large expensed investments in plant-specific intangible capital when setting up operations, profits of foreign affiliates will appear low relative to those

[2] Appendix A provides a brief history of U.S. policies that impact the timing and magnitude of inward and outward FDI.

of domestic companies.[3] This is the case for U.S. affiliates of foreign companies. On the other hand, if significant intangible investments have already been made, then accounting profits will appear high because they include the rents from this intangible capital. This is the case for U.S. companies that have had large direct investment incomes throughout the post-World War II period.

To estimate the return differentials for inward and outward FDI, we use secular trends for the period 1960–2006 in U.S. current account series—namely, net factor incomes and net exports—to tie down the paths of the key exogenous parameters of our model. We then use these inputs to make predictions for paths of asset holdings and returns. The key parameters are countries' *degree of openness* to foreign multinationals' technology capital, technology capital's share of income, and the *relative size* of the United States vis-à-vis foreign countries.

The degree of openness is the degree to which foreign multinationals' technology capital is allowed to be used in production by foreign multinationals. In a country that is closed, only domestic firms operate; there is no FDI income, and FDI returns are zero. As a country opens up, it gains because foreign companies have technologies that can be operated in the country through their FDI and at any location within the country. As countries open, productivity increases because more multinationals have more locations in which they can use their technology capital. The extent of the increase depends on the income share of technology capital. We find that the degree of openness and the share of income to technology capital are important determinants for FDI incomes.

The relative size of a country is a function of both its population and its total factor productivity relative to that of other countries. We find that the path of the relative size of the United States vis-à-vis foreign countries is an important determinant for the path of U.S. net exports. In particular, we find that the recent slowdown in population growth in countries hosting U.S. FDI accounts for much of the recent decline in the U.S. trade balance.

As an external check, we compare the model's predictions to both macro-evidence

[3] High startup costs of new FDI by foreign affiliates in the United States is one explanation that the BEA gives for comparatively low returns on foreign direct investment in the United States.

and micro-evidence. At the macro-level, we find that the model's predictions for the rising U.S. consumption share of GDP and the falling ratio of U.S. GDP to world GDP are consistent with data from U.S. national accounts and the Conference Board and Groningen Growth and Development Center (GGDC). At the firm- and industry-level, we find that the model's predictions are consistent with evidence on accounting rates of return. Our theory predicts that accounting rates of return increase with R&D and advertising intensities of firms, and it predicts that accounting rates of return of foreign affiliates increase with parents' R&D intensity and with age.

The model that we develop has efficient domestic and international goods and asset markets. Multinationals are price-takers using different technologies in competitive markets to produce a single composite good that is freely shipped anywhere in the world. All investments, whether at home or abroad, earn the same rate of return. We abstract from financial market and trade barriers to isolate the impact of mismeasuring intangible investments.[4] We also assume that U.S. and foreign technologies are symmetric, with neither having a comparative advantage in production of technology capital. An open issue is whether extending the theory to include financial frictions or asymmetric technologies can account for the remaining gap in the FDI return differential.

Our paper is related to the empirical literature concerned with improving measures of cross-border asset returns and external positions.[5] This literature has been engaged in a lively debate about whether there are indeed significant cross-border rate of return differentials on portfolio assets and direct investment assets. Most agree that there are return differentials in FDI, and the focus of research—both inside and outside the BEA—has been on improving estimates of the market value of foreign subsidiaries. Market values include the value of intangible assets and, if used when constructing FDI returns, could potentially eliminate the puzzling differential between returns on U.S. foreign operations and returns on foreign operations in the United States. Unfortunately, these researchers face two difficult problems: market values of subsidiaries and parents are not separately

[4] Caballero, Farhi, and Gourinchas (2008) and Mendoza, Quadrini, and Ríos-Rull (2006) develop general equilibrium models with financial frictions to estimate the effects on the current accounts of unanticipated capital liberalizations. Fogli and Perri (2006) estimate the impact of lower U.S. business cycle volatility on the U.S. trade balance due to lower precautionary savings. None of these papers consider the impact of unmeasured investments.

[5] See, for example, Gourinchas and Rey (2007) and Curcuru, Dvorak, and Warnock (2008).

available, and current estimates of direct investment at market value are not meaningful if firms have capital that can be used simultaneously at home and abroad. In this paper, we take a different approach to this difficult measurement problem: we allow for the fact that actual and measured returns may differ and use theory to infer the differential in *measured* returns. When comparing data and model, we use direct investment position at current cost, which is the empirical counterpart to foreign subsidiary (tangible) reproducible costs in our theory. Once we have estimates for stocks of technology capital and plant-specific intangible capital, we can then use the model to predict the paths of direct investment positions at market value.

More closely related to our work are two recent papers that use the neoclassical growth model, augmented to include intangible capital, to study U.S. foreign direct investment. Bridgman (2007) uses a model with plant-specific intangible capital and evidence on R&D expenditures by multinationals to adjust reported rates of return on FDI. He adjusts reported rates by the ratio of tangible to total capital. He finds that the adjusted return differential is considerably smaller than the reported return differential and attributes this finding to cross-country differences in tangible to intangible capital ratios in foreign subsidiaries. Kapicka (2008) uses the model of McGrattan and Prescott (2007) that includes technology capital to estimate the welfare gains of a fully open United States.

The paper is organized as follows. Section 2 describes the theory we use. We first derive the aggregate production function for a closed economy with technology capital and then extend the derivation to the multicountry case. We then use the aggregate production functions in a multicountry general equilibrium model. In Section 3, we choose parameters based on U.S. data and compare equilibrium paths of our model with trends in U.S. time series. Section 4 relates our findings to the current account literature. Conclusions are found in Section 5.

## 2. Theory

In this section, we describe a multicountry general equilibrium model that builds on McGrattan and Prescott (2007). We begin by describing the technologies available to multinationals. We then describe the problems faced by citizens in the different countries. Finally, we describe how BEA accountants would record transactions with the data from our model economy.

### 2.1. Technologies

We model a country as a measure of locations where multinationals can set up operations. Multinationals own *technology capital*, which is their know-how accumulated from investing in R&D, brands, and organization capital. Technology capital can be used—with inputs of tangible capital, plant-specific intangible capital, and labor—in many locations simultaneously. A unit of technology capital is, in a technical sense, a set of technologies, one for each location. The stock of technology capital in a country is the number (or measure) of technologies owned by its multinationals, and the number of locations in a country is assumed to be proportional to its population.

The number of locations is a characteristic of a country. We interpret large countries as having a large number of locations. In larger countries, multinationals produce more because they have more opportunities to use their technology capital. These locations are not factors of production and, therefore, do not earn rents. With both technology capital and locations, we have a tractable way to introduce nonrival technologies into an otherwise standard growth model with price-taking firms.

We start by describing production in a closed country and then extend the analysis below to a multicountry world.

*Production in a Closed Country*

Firms choose locations in which to set up operations and use their technology capital. Production also requires inputs of labor, tangible capital, and plant-specific intangible capital. For simplicity, assume that $z$ is a composite of these three factors of production. One unit of technology capital and $z$ units of the composite input at a given location produce $y = g(z)$. Consider the case of brand equity with units of technology capital indexed by $m$. For ease of exposition, assume for now that $m$ is discrete and that $m = 1$ is the Wal-Mart brand, $m = 2$ is the Home Depot brand, and so on. Wal-Mart chooses the locations in which to set up stores and use its brand. It may be the case that both Wal-Mart and Home Depot have stores at the same location. It may be the case that the

Wal-Mart corporation owns two units of technology capital and decides on the locations for each.

We want to derive the total output for a country with locations $N$, technology capital stock $M$, and composite input $Z$. Now, we treat the number of locations and the number of technologies as real variables and choose $z : [0, N] \times [0, M] \rightarrow I\!R_+$ to solve

$$Y = F(N, M, Z) = \max_{z} \int g(z(n, m))\, dn\, dm \qquad \text{subject to} \int z(n, m)\, dn\, dm \leq Z.$$

We put conditions on $g(\cdot)$ so that there is an optimal plant size and limits to any organization's span of control. Specifically, we assume that it is increasing and strictly concave.

If there is an optimal plant size, the fact that we limit the number of units of technology in any location to one is not essential. Having multiple small plants in the same location using the same unit of technology is equivalent to having one large plant.

Given the properties of $g(\cdot)$, the maximal production allocation requires that all brands be operated in all locations, with an equal amount of the composite input in each of the $NM$ production units. Thus, the aggregate production function is $F(N, M, Z) = NMg(Z/(NM))$. Suppose that $g(z) = Az^{1-\phi}$, where $A$ is a parameter determining the level of technology and $\phi \geq 0$. The aggregate production function in this case is

$$Y = F(N, M, Z; A) = A(NM)^{\phi} Z^{1-\phi}. \tag{2.1}$$

Below we assume that $A$ may vary by country, and the size of a country will depend on both $A$ and $N$.

The aggregate product $F$ displays constant returns in the two factors of production $M$ and $Z$: $F(N, \lambda M, \lambda Z) = \lambda F(N, M, Z)$. Notice, if $\phi = 0$, then (2.1) nests the standard specification, which is linear in $Z$.

The technologies we use capture the ideas that plant rents provide the incentive to make the costly investment in developing a unit of technology capital and that there are limits to the span of control of an organization.

*Production in a Multicountry World*

In the multicountry case, the only factor that can be used both at home and abroad is technology capital (e.g., brands). Let $i$ index the country where production is occurring, and let $j$ index the country of origin of the multinational. The number of locations of country $i$ is $N_i$. The technology capital used by multinationals from $j$ is $M^j$. The composite capital-labor input in country $i$ used to produce output with technology capital of multinationals from $j$ is $Z_i^j$. With these inputs, we write total output in country $i$ as

$$\begin{aligned} Y_i &= \sum\nolimits_j F\left(N_i, M^j, Z_i^j; A_i, \sigma_i\right) \\ &= A_i \left(N_i M^i\right)^{\phi} \left(Z_i^i\right)^{1-\phi} + \sum\nolimits_{j \neq i} A_i \sigma_i \left(N_i M^j\right)^{\phi} \left(Z_i^j\right)^{1-\phi}, \end{aligned} \tag{2.2}$$

which is the sum of outputs of all multinationals, where $A_i$ is the technology parameter for multinationals from $i$ operating in country $i$, and $A_i \sigma_i$ is the technology parameter for foreign multinationals operating in $i$ with $\sigma_i \leq 1$. If we maximized (2.2) subject to the constraint that the sum of composite inputs does not exceed the total in country $i$, $\sum_j Z_i^j \leq Z_i$, then the total (maximal) output is

$$Y_i = A_i \left[N_i \left(M^i + \sigma_i^{\frac{1}{\phi}} \sum\nolimits_{j \neq i} M^j\right)\right]^{\phi} Z_i^{1-\phi}. \tag{2.3}$$

This expression facilitates comparison to the closed economy case. If $\sigma_i = 0$, (2.3) is equivalent to (2.1).

*Degree of Openness*

As before, we include the technology parameter $A_i$, which is common to all production units. In the multicountry case, there is an additional parameter in the specification of the production technology in (2.2), namely $\sigma_i$. The parameter $\sigma_i$ is a measure of *the degree of openness of country* $i$. A value of 1 implies that a country is totally open—so domestic and foreign firms have the same opportunities in country $i$. A value of less than 1 implies that domestic and foreign firms are not treated equally. In particular, there are costs to foreign firms, and these costs have the same effect as if they had lower total factor productivity (TFP) than domestic firms.[6]

Another interpretation of openness is possible if we set $\omega_i = \sigma_i^{1/\phi}$ and rewrite (2.3) as follows:

$$Y_i = A_i \left[N_i \left(M^i + \omega_i \sum\nolimits_{j \neq i} M^j\right)\right]^{\phi} Z_i^{1-\phi}. \tag{2.4}$$

[6] A natural extension of this model would include industries, some of which are permitted to operate and some of which are blocked.

Here, $\omega_i$ can be interpreted as the fraction of foreign technology capital permitted to be brought in and used by foreign multinationals. If $\omega_i$ is equal to zero, costs are infinite and no foreign firms are permitted. This is the closed-economy case. As we noted before, in this case, country $i$ has constant returns in technology capital and the composite input $Z$. If $\omega_i$ is greater than 0, the sum of output across the open countries is greater than the sum of output for the same countries if they were closed. It is *as if* there were increasing returns when in fact there are none.

This scale effect is more evident if we rewrite (2.4) in terms of *effective technology capital*. Let $M_i$ be the effective capital *used* in country $i$, that is, $M_i = M^i + \omega_i \sum_{j \neq i} M^j$. Substituting this into (2.4) yields the same expression as (2.1). The difference is that the effective capital stock is larger when countries are open.

*Composite Input*

The composite capital-labor input in country $i$ is modeled as a Cobb-Douglas technology,

$$Z_i^j = \left(K_{T,i}^j\right)^{\alpha_T} \left(K_{I,i}^j\right)^{\alpha_I} \left(L_i^j\right)^{1-\alpha_T-\alpha_I} \tag{2.5}$$

with inputs of tangible capital, $K_{T,i}^j$, plant-specific intangible capital, $K_{I,i}^j$, and labor $L_i^j$.

Multinationals own the technologies that we have described above. Households own equity of these multinationals. We turn next to a description of the problems solved by each.

### 2.1.1. Multinationals

The stand-in multinational from $j$ maximizes the present value of the stream of dividends:

$$\max \sum\nolimits_t p_t \left(1 - \tau_{dt}\right) D_t^j, \tag{2.6}$$

where dividends are the sum of dividends across all operations in all countries indexed by $i$ and are given by $D_t^j = \sum_i D_{it}^j$ with

$$D_{it}^j = \left(1 - \tau_{p,it}\right) \left(Y_{it}^j - W_{it} L_{it}^j - \delta_T K_{T,it}^j - X_{I,it}^j - \chi_i^j X_{M,t}^j\right) - K_{T,i,t+1}^j + K_{T,it}^j, \tag{2.7}$$

$\chi_i^j = 1$ if $i = j$ and 0 otherwise, $X_{I,i}^j$ is investment in plant-specific capital which is split among locations in country $i$ that $j$ operates, and $X_M^j$ is the technology capital investment of multinational $j$ used in all locations in which $j$ operates. The output produced by $j$ in country $i$ is given by $Y_i^j = F(N_i, M^j, Z_i^j; A_i, \sigma_i)$, where $F$ is defined (2.1) with $Z_i^j$ defined in (2.5). The wage rate in country $i$ is $W_i$ and is the same rate paid by all multinationals operating in $i$.

Dividends for $j$ are equal to worldwide after-tax profits less net investment of tangible capital, $\sum_i (K_{T,i,t+1}^j - K_{T,it}^j)$. (The latter is called *undistributed profits* in the U.S. National Income and Product Accounts (NIPA) and *reinvested earnings* in the U.S. International Transactions Accounts (ITA).) Taxable profits are equal to sales less expenses, where the expenses are wage payments, tangible depreciation, and expensed investments on plant-specific intangible capital and technology capital. Taxable profits in country $i$ are taxed at rate $\tau_{p,i}$. We assume that multinationals do not engage in transfer pricing to avoid taxation.[7]

The capital stocks of the multinational next period are given by

$$\begin{aligned} K_{T,i,t+1}^j &= (1-\delta_T)\, K_{T,it}^j + X_{T,it}^j \\ K_{I,i,t+1}^j &= (1-\delta_I)\, K_{I,it}^j + X_{I,it}^j \\ M_{t+1}^j &= (1-\delta_M)\, M_t^j + X_{M,t}^j. \end{aligned}$$

Here, we assume that depreciation rates can differ for the three types of capital.

### 2.1.2. Households

The stand-in household in country $i$ chooses consumption, hours of work, and next period asset holdings to solve

$$\max \sum_t \beta^t U\left(C_{it}/N_{it}, L_{it}/N_{it} + \bar{L}_{nb,it}/N_{it}\right) N_{it}$$

$$\text{subject to} \quad \sum_t p_t \left[ (1+\tau_{ci})\, C_{it} + \sum_j V_t^j \left(S_{i,t+1}^j - S_{it}^j\right) + B_{i,t+1} - B_{it} \right]$$

$$\leq \sum_t p_t \left[ (1-\tau_{li})\, W_{it} L_{it} + (1-\tau_{dt}) \sum_j S_{it}^j D_t^j + r_{bt} B_{it} + \kappa_{it} \right],$$

[7] Evidence of Bernard, Jensen, and Schott (2006) and estimates of the U.S. Department of the Treasury (1999) suggest that corporate tax revenues lost to transfer pricing are small—on the order of 1 to 2 percent of corporate tax liabilities.

where $C_i$ is total consumption of households in $i$, $N_i$ is the total population in $i$, $L_i$ is the labor input in the business sector, $\bar{L}_{nb,i}$ is the labor input in the nonbusiness sector, $S_i^j$ is holdings of equities from $j$ which have a price $V^j$ and dividend $D^j$ per share, $B_i$ is holdings of debt which earns interest at rate $r_b$, and subscript $t$ indexes time. Taxes are levied on consumption at rate $\tau_{ci}$, labor at rate $\tau_{li}$, and dividends at rate $\tau_d$.[8] Transfers plus nonbusiness income less nonbusiness investment is summarized by $\kappa_i$.[9]

We assume that the number of locations in country $i$ is proportional to the population of $i$. In other words, we assume that a foreign multinational can set up more operations in a country like the United States that has many consumers than a country like Belgium with few. Without loss of generality, we use a proportionality constant of 1 and therefore use $N_i$ to denote *both* the number of locations and the number of people in $i$.

We abstract from uncertain events, since we are interested in secular trends. Thus, the returns on household assets are equal in equilibrium, and the composition of their portfolio is not uniquely determined. When choosing parameters, we preset debt holdings and foreign share holdings and let equilibrium conditions determine the total net worth of households.

The equity value for multinationals from $j$ is given by

$$V_t^j = (1 - \tau_{dt}) \Big( \sum_i K_{T,i,t+1}^j + \sum_i (1 - \tau_{p,it})\, K_{I,i,t+1}^j + (1 - \tau_{p,jt})\, M_{t+1}^j \Big), \tag{2.8}$$

which is a sum of the values of its capital stocks at home and abroad. The prices of each type of capital depend on tax rates. (See McGrattan and Prescott (2009) for the derivation of (2.8).)

## 2.2. Comparison of BEA and Model Accounts

We want to compare the time series for our model world economy with those published by the BEA. To do so, we have to construct variables comparable to those that are reported in the BEA national and international accounts.

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[8] The dividend tax rate does not depend on $i$. If it did, we would need to allow for clientele effects.

[9] Activity in the nonbusiness sector is added (and treated exogenously) in order to ensure that the NIPA aggregates are comparable in magnitude in the model and data.

We start with the national accounts—in particular, GDP. GDP for country $i$ at date $t$ is given by

$$\text{GDP}_{it} = C_{it} + \sum\nolimits_j X^j_{T,it} + \bar{X}_{nb,it} + NX_{it}, \tag{2.9}$$

where $NX_i$ is net exports of goods and services by country $i$. Here, we are assuming that $C$ includes both private and public consumption expenditures and $\bar{X}_{nb}$ includes all non-business investment expenditures of households, nonprofit institutions, and governments. Another way to calculate GDP is by adding up all domestic incomes. Specifically, if we sum up compensation of households ($W_i L_i$), total before-tax profits of businesses operating in $i$, ($Y_i - W_i L_i - \sum_j (\delta_T K^j_{T,i} + X^j_{I,i}) - X^i_M$), tangible depreciation ($\sum_j \delta_T K^j_{T,i}$), and total nonbusiness value added ($\bar{Y}_{nb,i}$), we have GDP from the income side:

$$\text{GDP}_{it} = Y_{it} + \bar{Y}_{nb,it} - X^i_{M,t} - \sum\nolimits_j X^j_{I,it}. \tag{2.10}$$

This has to be equal to product in (2.9). From (2.9) and (2.10), it is easy to calculate net exports as total output—business plus nonbusiness—produced in country $i$ less the sum of consumption and all investments.

Given that we are interested in measurement, it is worth noting that GDP for country $i$, as defined in (2.10), is *not* a measure of production of country $i$ in the model economy. In the model economy, total production in country $i$ is $Y_i + \bar{Y}_{nb,i}$. GDP is lower because some investments are expensed.

Next, consider adding flows from and to other countries. The BEA's measure of gross national product (GNP) is the sum of GDP plus net factor income from abroad.[10] Net factor receipts (NFR) are the sum of FDI income of multinationals and portfolio equity and debt income of households:[11]

$$\text{NFR}_{it} = \sum_{l \neq i} \{D^i_{lt} + K^i_{T,l,t+1} - K^i_{T,lt}\} + \sum_{l \neq i} S^l_{it} D^l_t + \max\left(r_{bt} B_{it}, 0\right). \tag{2.11}$$

Analogously, net factor payments (NFP) from $i$ to the rest of the world are the sum of FDI income of foreign affiliates in $i$ sent back to foreign parents, and portfolio incomes from

[10] Here, we abstract from wage compensation from abroad because it is negligible in the U.S. accounts.

[11] Equity holdings are categorized by the BEA as direct investment when the ownership exceeds 10 percent. Otherwise they are categorized as portfolio income.

stocks and bonds of country $i$ that are sent to investors outside of $i$:

$$\text{NFP}_{it} = \sum_{l \neq i} \{D_{it}^{l} + K_{T,i,t+1}^{l} - K_{T,it}^{l}\} + \sum_{l \neq i} S_{lt}^{i} D_{t}^{i} + \max\left(-r_{bt} B_{it}, 0\right). \tag{2.12}$$

Adding net factor income to net exports and to GDP, we have the current account (CA) and GNP, respectively:

$$\text{CA}_{it} = NX_{it} + \text{NFR}_{it} - \text{NFP}_{it}$$

$$\text{GNP}_{it} = \text{GDP}_{it} + \text{NFR}_{it} - \text{NFP}_{it}.$$

The net factor income flows (in (2.11) and (2.12)) are used by the BEA to construct rates of return on capital in foreign subsidiaries. There are several problems with these measures of income, however. First, a substantial part of net investment (reinvested earnings) is not included. In the case of income from foreign direct investment, only net investment in tangible capital is included. In the case of portfolio income, no net investment is included. Second, even if all net investment were to be included, income from *the same investment* of technology capital is made in different geographic locations.

To illustrate the problem, we construct returns on foreign direct investment using the BEA methodology for the following simple example with two "countries": the United States indexed by $u$ and the rest of world indexed by $r$. In this case, the *actual* returns that U.S. multinationals earn on their three types of investments are:

$$r_{Tt} = \left(1 - \tau_{p,rt}\right)\left(\alpha_T \left(1 - \phi\right) Y_{rt}^{u} / K_{T,rt}^{u} - \delta_T\right)$$

$$r_{It} = \alpha_I \left(1 - \phi\right) Y_{rt}^{u} / K_{I,rt}^{u} - \delta_I$$

$$r_{Mt} = \phi \left(Y_{ut}^{u} + Y_{rt}^{u}\right) / M_{t}^{u} - \delta_M,$$

which follows from the maximization problem in (2.6). Since these returns are equated in equilibrium, we can write $r_t = r_{Tt} = r_{It} = r_{Mt}$, where $r_t$ is the common rate of return on all investments in the model's world economy.

*Reported* returns of U.S. subsidiaries from the rest of the world are equal to the FDI income (dividends plus reinvested earnings) divided by the tangible capital stock of

U.S. multinationals abroad:

$$\begin{aligned} r_{\text{FDI},t} &= (1-\tau_{p,rt}) \left(Y^u_{rt} - W_{rt} L^u_{rt} - \delta_T K^u_{T,rt} - X^u_{I,rt}\right) / K^u_{T,rt} \\ &= r_t + (1-\tau_{p,rt}) \left[\phi + (1-\phi)\,\alpha_I\right] \frac{Y^u_{rt}}{K^u_{T,rt}} - (1-\tau_{p,rt}) \frac{X^u_{I,rt}}{K^u_{T,rt}}, \end{aligned} \tag{2.13}$$

which is not equal to $r_t$ when either technology capital or plant-specific intangible capital is nonnegligible. Interestingly, the reported return *can be higher or lower* than the actual return. It is higher if investment of U.S. foreign subsidiaries in plant-specific intangible capital, $X^u_{I,rt}$, is not too large. It is lower otherwise.

In Appendix B, we present firm- and industry-level evidence that is consistent with our model's predictions for accounting rates of return. First, we present micro-evidence that shows accounting rates of return increase with R&D and advertising intensities. Our theory predicts a positive relationship because intangible investments are expensed. Second, we present micro-evidence that accounting rates of return of foreign affiliates increase with parents' R&D intensity. Our theory predicts a positive relationship because most R&D is technology capital that adds positively to returns but the capital is not included with the measured stock. Finally, we present micro-evidence that accounting rates of return of foreign affiliates increase with age. Our theory predicts an age effect if firms make large initial intangible investments which imply lower accounting rates of return.

The question we address in the next section is, How large is the impact of this mismeasurement when the model is parameterized to generate time series consistent with the U.S. national and international accounts?

## 3. Quantitative Predictions for the United States

In this section, we parameterize our model for the United States and the *rest of world* so that the secular trends in the model current accounts line up with counterparts in the U.S. international accounts compiled by the BEA. We then use the model to make predictions about measured returns and asset holdings of foreign subsidiaries.

In Appendix C, we provide information about the sources of our data, which are primarily from the U.S. national and international accounts. Prior to constructing any statistics, we adjust measures of U.S. GDP and U.S. GNP to exclude consumption taxes and intermediate financial services and to include depreciation of consumer durables and capital services of consumer durables and government fixed capital. When we use the terms GDP and GNP, we mean the adjusted series. The adjustments imply average measures of GDP and GNP that are about 3.8 percent higher than the BEA's published series. (See McGrattan and Prescott (2009) for further details.)

For the rest of world, we use data on transactions with the United States and measures of population and GDP from the GGDC. In computing total GDP, we restrict the rest of world to regions doing nonnegligible trade and FDI with the United States. The list of these regions and the countries within is provided in Appendix C.

In McGrattan and Prescott (2009), we check the sensitivity of our analysis to changes in the model's parameters. We briefly summarize the findings at the end of this section.

### 3.1. Model Inputs

Table 1 summarizes the parameters held constant when computing the equilibrium paths of our model. Table 2 summarizes all time-varying parameters. The series are smoothed to allow us to focus on trends. Table 3 summarizes the initial capital stocks.

Populations and total factor productivities are assumed to grow over time at rates $\gamma_N$ and $\gamma_A$, respectively. Trend growth rates are assumed to be the same for both the United States and rest of world. Trend growth in population is set at 1 percent per year and trend growth in total factor productivity at 1.2 percent per year. These rates, along with income shares in Table 1, imply a growth rate of 3 percent per year for output,

$$\gamma_Y = (1+\gamma_N)^{\frac{1-(1-\phi)(\alpha_T+\alpha_I)}{(1-\phi)(1-\alpha_T-\alpha_I)}}\,(1+\gamma_A)^{\frac{1}{(1-\phi)(1-\alpha_T-\alpha_I)}} - 1,$$

on a balanced growth path. We do allow for deviations from trend through variations in the populations and TFP of the rest of world relative to the United States, which we describe below.

Utility is logarithmic, and the weight on leisure, equal to 1.32, ensures that the time to work is consistent with U.S. aggregate hours. The discount factor is chosen so that the average annual real interest rate is slightly above 4 percent.

Parameters of the nonbusiness sector were set at U.S. levels. These include the fraction of time to nonbusiness activity at 6 percent, the nonbusiness investment share of GDP at 15.4 percent, and nonbusiness value added as a share of GDP at 31.2 percent.

In choosing tax rates, we fixed the two that have little impact on capital returns, namely, $\tau_c$ and $\tau_l$, and set them equal to average rates for the United States. For the consumption tax, we take the ratio of sales and excise taxes to total consumption, implying $\tau_c = 0.073$. For the labor tax rate, we use the methodology of Prescott (2002), implying $\tau_l = 0.29$. Although some countries, such as those in Europe, have higher consumption tax rates than labor tax rates, what is relevant is the intratemporal tax wedge, $1 - (1 - \tau_l)/(1 + \tau_c)$. For our parameter choices, this wedge is equal to 34 percent.

The key constants for our analysis are depreciation rates and income shares, since they determine the magnitudes of the stocks of capital. In the case of tangible capital, we have measures from the BEA. We set the depreciation rate for tangible investment $\delta_T$ at 6 percent per year to be consistent with BEA tangible investments and fixed capital stocks. Given a rate of depreciation, we then set $\alpha_T$ equal to 0.23 so that the model's business tangible investment is consistent with U.S. business investment.

In the case of the two types of intangible capital, we have direct measures of only some intangible expenditures. Furthermore, there is an added complication in our model with technology capital: the size of the technology capital stock also depends on the countries' degrees of openness. What we do, therefore, is to use measures of expenditures on R&D and national advertising and estimates of expenditures on organizational capital to provide a plausible range for investment in technology capital. In addition, we use measures of U.S. equity values to indirectly infer the magnitude of the remaining plant-specific intangible investment. In McGrattan and Prescott (2009), we do sensitivity analysis and show how the results change as we change the depreciation rates and income shares for these intangible capitals.

The National Science Foundation (2007) reports U.S. R&D expenditures over the period 1960–2006 that averaged 2.4 percent of GNP. The U.S. Bureau of the Census (1960–2008) and Universal McCann (2005–2007) report estimates of national advertising expenditures that are on average equal to 1.2 percent of GNP for the period 1960–2006.

Together, these imply an investment share of 3.6 percent; we view this as a plausible lower bound if we abstract from organizational know-how which is more difficult to measure. Corrado, Hulten, and Sichel (2005) have estimates of investment in organizational capital for the period 1988–2000 and conclude that it is in the range of 2.2 to 3.1 percent of GDP. Since part of the organizational capital is plant-specific, we chose 5 to 6 percent of GNP as a plausible range for total investment in technology capital.

For market values, we use the Federal Reserve Board's *Flow of Funds Accounts* (1945–2006), which reports market values for corporate and noncorporate equity. Since there are very large movements in corporate equity values, ranging from 0.4 times GDP to 1.8 times GDP over our sample, we set parameters so that the model and data are consistent in the 1960s.[12] During this decade, the value was relatively stable and averaged 1.5 times GNP.

With these targets for technology capital investment and market value, we set the benchmark shares and annual depreciation rates for intangible capital as follows: $\phi = .07$, $\alpha_I = .07$, $\delta_M = .08$, and $\delta_I = .0$. A value of $\delta_M = .08$, which is intermediate to estimates for depreciation of R&D and organizational capital. In our sensitivity analysis, we show that the main results are unaffected if we double $\delta_M$ or set it equal to 0.[13] With $\delta_M = .08$, a value of $\phi = .07$ yields an average share of technology capital investment to GNP of 5.3 percent and an average ratio of technology capital stock to GNP of 0.53 over the sample period 1960–2006.

For plant-specific intangible capital, we started with a depreciation rate for plant-specific capital $\delta_I$ equal to zero and set $\alpha_I$ so that the predicted market value of U.S. businesses is about 1.5 times GNP over the period 1960–1969. If we set the depreciation rate higher and adjust $\alpha_I$ to keep the stock of intangible unchanged, then our results are unaffected. For our benchmark parameterization, the average plant-specific intangible investment is 3.9 percent of GNP, and the average ratio of plant-specific intangible capital to GNP is 1.2 over the sample period 1960–2006.

[12] In McGrattan and Prescott (2005), we show that changes in taxes and regulations played a quantitatively important role in the secular movements of corporate equities, but the theory used there and extended here is not well suited to modeling transitions after tax reforms.

[13] When we check sensitivity of our results to changes in constants, we also adjust the paths of openness parameters and relative size to ensure consistency of the U.S. and model current accounts. This is described below.

Table 2 reports all time-varying parameters used to compute the model's equilibrium paths. Since we are matching the secular trends in the model and in the data, we do our computations on a 5-year basis (with all relevant constants appropriately adjusted). We smooth the time series and report the smoothed series at 5-year intervals.

The second column shows the trend in the ratio of the rest of world population to that of the United States. Data are from Conference Board and Groningen Growth and Development Centre (2008), and the countries in rest of world are listed in Appendix C. In 1960, the rest of the world's population was about 8.2 times larger than that of the United States. The population ratio rose to 9.4 by 1990 and then fell back to 9 by 2006. For the benchmark parameterization, we assume the decline in population continues. However, in McGrattan and Prescott (2009), we show that this assumption does not affect our main findings.

The third and fourth columns in Table 2 show effective U.S. tax rates on dividends and profits. The source of the dividend tax rate is McGrattan and Prescott (2003, Figure 1). The tax rate on profits is equal to the tax liability of corporations divided by corporate profits (with the Federal Reserve Bank profits subtracted from both the numerator and denominator). We assume the same rates apply to both corporate and noncorporate business income. Because the United States taxes worldwide incomes, the relevant tax rates for both U.S. FDI abroad and FDI in the United States are the U.S. rates.

The last five columns of Table 2 contain time-varying inputs that are set so as to generate model current accounts with trends that are similar to the U.S. current accounts. The first two of these inputs are the openness parameters $\{\sigma_{rt}\}$ and $\{\sigma_{ut}\}$ that determine how open the rest of world is to U.S. multinationals and how open the United States is to foreign multinationals, respectively.

The openness parameters are crucial for determining the level of incomes of foreign direct investment. If they are equal to zero in all periods, the model predicts no FDI income at all. To generate the patterns of U.S. time series, with U.S. FDI receipts higher than FDI payments, it is necessary to set $\sigma_{rt} > \sigma_{ut}$ for all years considered. We also chose a path for $\sigma_{ut}$ that was increasing faster than $\sigma_{rt}$ during the second half of our sample to capture the faster growth in income of U.S. affiliates of foreign companies which occurred in the late 1970s.[14] These choices for the openness paths are, in our view, reasonable given the history of U.S. policies discouraging inward FDI reviewed in Appendix A.

The next input, which is listed in column 7 of Table 2, is the total factor productivity of the rest of the world relative to that of the United States. Without loss of generality, we scale U.S. TFP in such a way as to have U.S. GDP in 1960 equal to 1. Both relative TFPs and relative populations affect the *relative size* of the rest of world to the United States:

$$\text{Relative size} = \left(\frac{A_{rt}}{A_{ut}}\right)^{\frac{1}{1-(1-\phi)(\alpha_T+\alpha_I)}} \left(\frac{N_{rt}}{N_{ut}}\right). \tag{3.1}$$

Size is a measure of effective persons. In McGrattan and Prescott (2007), we show that the size of a country is what is relevant for output and productivity. In models without technology capital, only relative TFPs matter.

In terms of the exercise of fitting the current accounts, the path of relative size is most important for the trade balance, since variations in population or TFP require shipments (or loans) to equate capital-output ratios. In McGrattan and Prescott (2009), we show that the slowdown in rest of world population relative to the United States has been an important contributor to the recent large decline in the U.S. trade balance. If technology capital is not included in the model ($\phi = 0$), the predicted decline in the trade balance is much smaller because the change in relative populations plays no role in that case.[15]

The last two columns in Table 2 are per capita U.S. debt $B_{ut}/N_{ut}$ and the U.S. holding of foreign shares $S_{ut}^r$. Technically, these are not exogenous parameters. However, because households are indifferent to the composition of their portfolios, we need to preset two of the three asset holdings and allow the third to be endogenously determined. We do this in such a way as to match the secular movements in interest net income and total portfolio net income.[16]

[14] To simplify the fixed point problem of matching the U.S. and model current account series, which is done for the benchmark model and for all alternative specifications considered in McGrattan and Prescott (2008), we restricted the paths as follows: $\sigma_{rt} = a_r + b_r t$ and $\sigma_{ut} = a_u(1 + b_u \tanh(c_u + d_u t))$ and chose values for the coefficients $\{a_r, b_r, a_u, b_u, c_u, d_u\}$.

[15] In McGrattan and Prescott (2009), we compare theoretical and quantitative predictions for productivity and net exports in models with and without technology capital.

[16] To match portfolio equity incomes, we need an implausibly large drop in foreign share holdings in 2000. In McGrattan and Prescott (2009), we show that our choice of $S_{ut}^r$ has almost no effect on the paper's main findings.

The last set of inputs needed to compute equilibrium paths are the initial capital stocks. The values we use are summarized in Table 3 and are found as follows. We use the fact that the ratio of plant-specific intangible capital to tangible capital is equated across countries and technologies on the equilibrium path and assume this is true in the initial period. We also restrict the initial capital stocks by assuming that there are no jumps in initial investment growth rates. The initial stocks are set so that the growth rates for all investments are equated in the first and second period. To pin down the ten initial stocks, one more restriction is needed. The last restriction that we impose is that U.S. GDP is 31 percent of world GDP in 1960.

### 3.2. The United States, 1960–2006

We now use our parameterized model economy to study the U.S. international accounts over the period 1960–2006. We first show that the model incomes and products exhibit the same level and trends as in U.S. domestic and international data. Then we compare the capital stocks in foreign subsidiaries and returns on these stocks with BEA estimates using their methodology. We find that the BEA mismeasurement of intangible earnings and stocks accounts for over 60 percent of the 6.25 percent average difference in reported rates of return on FDI.

#### 3.2.1. Incomes

Averages over the period 1960–2006 for the broad categories of GNP for the actual and predicted U.S. accounts are displayed in Table 4. This table verifies that our choices of parameters yield good agreement between the average U.S. and model components of gross national product. In both theory and data, consumption is about 74 percent of GNP on average over the sample. Business tangible investment is between 11 and 12 percent of GNP. The share of nonbusiness investment in the model is set so that it is 15 percent of GDP (which is close in magnitude to GNP throughout the sample). The ratio of net exports to GNP is about $-1.1$ percent on average.

On the income side, the model generates the observed split between business and nonbusiness income. We can further break down business income into capital and labor income if we know how much of intangible investments are expensed by owners of business and how much by shareholders. In previous work, we assumed that half was expensed by each. If we assume the same split here, then the model's average business labor income is 67 percent of business income, just as it is in the United States.

The final component of U.S. GNP is net factor income from the rest of world. Here again, there is good agreement between average U.S. levels and the model's predictions because we chose parameters for openness and relative size to match the trends in the data. Net portfolio income, which is non-FDI equity and interest receipts less payments, is −0.2 percent of GNP for both the United States and the model. We do not report the subcategories of portfolio income because household portfolio composition is not determined in theory.[17] The foreign direct investments, on the other hand, are, and we show both receipts and payments. U.S. receipts have averaged 1.1 percent of GNP, whereas payments have averaged 0.2 percent of GNP, which is what our model predicts. Adding up domestic income and net income from the rest of world gives us gross national income in the last row of Table 4. In the case of the actual accounts, there is an additional statistical discrepancy of 0.6 percent of GNP.

Figure 2 shows the model predictions for U.S. FDI receipts from their subsidiaries, U.S. FDI payments from U.S. affiliates to their parents, and the U.S. trade balance. These fit the secular trends by construction, since we chose the inputs in Table 2 to generate comparable trends.[18] Most noteworthy is that the model can replicate the trends in the U.S. current account flows. The essential elements of the model that make this possible are technology capital and locations.

The top panel of Figure 3 shows the portfolio net income component of the U.S. current accounts. This includes both dividends from foreign equities and interest on external debt. In the lower panel, we show the interest income to highlight the fact that the model matches both the debt and equity components of income.

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[17] There has been recent progress on developing methods to compute endogenous portfolio choices in stochastic open-economy models. See, for example, Devereux and Sutherland (2006).

[18] In doing so, we did not try to match the U.S. FDI receipts at the end of the sample, which were temporarily high due to a one-time-only tax rate reduction allowed by the American Jobs Creation Act (AJCA) of 2004. Faust, Gleckman, and Barrett (2004) estimated that $300 billion would be repatriated under section 965 of the Internal Revenue Code, which was added by the AJCA.

Figure 4 is an external check on the model fit. In the top panel, we show the share of consumption in GDP for the United States. The consumption share is around 72 percent in 1960 for both the model and the data. Over the sample, the rise in the model's share is consistent with the U.S. trend. In McGrattan and Prescott (2009), we show that the magnitude of the increase depends crucially on the inclusion of technology capital (that is, $\phi > 0$). The model without technology capital predicts little change in the consumption share over the period 1960–2006. The model with technology capital (and $\phi = .07$) predicts a rise of roughly 5 percentage points. Many have interpreted this rise as a sign that U.S. households are "saving too little." This is not the case in the model, since nothing prevents households from smoothing consumption optimally. Furthermore, there is a lot of new investment occurring as the world opens to foreign direct investment. Some of this new investment is not counted in U.S. or rest of world GDP.

In the bottom panel of Figure 4, we show the model's prediction for the U.S. share of world GDP and the share calculated from the GGDC (2008) dataset. The model shows a decline in U.S. GDP relative to that of the world, consistent with observations up to 2000. The GGDC data display a larger decline after 2000. As in the case of net exports and the consumption share of GDP, the pattern of relative GDPs for the model depends importantly on patterns in relative TFPs and populations.

In summary, technology capital is an important factor in accounting for trends in U.S. data. With technology capital included, the model generates trends in domestic and international incomes and products that are close to those observed in the United States. We therefore regard the model as a useful framework to assess the puzzling patterns in U.S. foreign capital stocks and returns. We turn to this next.

### 3.2.2. Assets and Returns

Figure 5 shows the time series for direct investment positions at current cost. The theoretical counterparts are tangible capital stocks.[19] Panel A displays the BEA data. Panel B displays the model's equilibrium paths. We see from the BEA data that stocks of U.S. foreign subsidiaries were about 6 percent of U.S. GNP in 1960, whereas the stocks

[19] Part of the direct investment position is due to accumulated debt from intercompany loans, but this is small relative to the value of tangible capital stocks.

of U.S. affiliates were less than 2 percent of U.S. GNP. Stocks of affiliates remained low until the second half of the 1970s and then rose rapidly, nearly to the level of U.S. foreign subsidiaries by 2006. As a result, the net position first rises and then falls roughly in half.[20]

The model is able to capture the rise and fall in the net asset position, but the level of the capital stock in U.S. subsidiaries is higher than predicted. Thus, if we compare the BEA returns and the model returns, we find that the U.S. rate of return on direct investment abroad is lower than the BEA estimate. In Figure 6, we display the same returns as earlier (see Figure 1), along with the predictions of the model. The BEA reports an average return on U.S. subsidiary capital of 9.40 percent. The model estimate is 7.08 percent on average, 2.32 percentage points below the BEA's. Notice, however, that the model does well in fitting the returns on foreign capital in the United States. The average return for U.S. affiliates is 3.15 percent, whereas the model predicts 3.12 percent. Our estimates imply that the mismeasurement of intangible incomes and stocks accounts for about 63 percent of the return differential reported by the BEA (that is, 3.96/6.25).

The average actual rate of return on foreign direct investment in the model economies—both the United States and rest of world—is 4.6 percent over the 1982–2006 period. The BEA methodology applied to the model yields an estimate of 7.1 percent for U.S. capital because multinationals are earning rents on their technology capital. But foreign multinationals are also earning rents on technology capital. So why is there a large difference in predicted FDI returns? The main difference is the expensing of plant-specific capital. Foreign direct investment—both tangible and intangible—is negligible for foreign companies at the beginning of our sample and then increases rapidly. The expensing of intangible capital lowers the subsidiary profits of foreign companies and implies a lower return than U.S. capital abroad. In terms of equation (2.13), the net investment term $X^u_{I,rt}$ that is subtracted from income is large.

In McGrattan and Prescott (2009) we do extensive sensitivity analysis. The key parameters for the implied return differential in Figure 6 are income shares and depreciation

[20] In McGrattan and Prescott (2005), we capitalized the income of U.S. foreign subsidiaries in order to estimate the fundamental value of U.S. operations abroad. We estimated the value of the stock of foreign subsidiaries—net of foreign stocks in the United States—at close to 0.3 times GDP for the 1990s. Similar calculations were made by Hausmann and Sturzenegger (2007). The inconsistency between our estimate of the net asset position and the BEA's was a motivating factor for the current study.

rates for the two types of intangible capital. We find that if these parameters are chosen to be consistent with observed market values, observed tangible investment rates, and estimated intangible investment rates, then the model predicts a sizable gap in measured FDI returns even though there is no actual gap.[21] However, if we choose parameters that imply a low value for the plant-specific intangible capital, regardless of the implications for market values and other stocks, we find that the model predicts a smaller gap in measured FDI returns. For example, if we set $\delta_I$ equal to 6 percent rather than 0 percent without changing $\alpha_I$, and adjust openness parameters and relative size to match the current account series, we find that the ratio of plant-specific intangible capital to GNP is half of the benchmark value. In this case, the return differential is 2.7 percentage points rather than 4. The smaller gap follows from the fact that the model predicts low returns for foreign subsidiaries in the United States when their expensed investment in plant-specific intangible capital is large.

The income share on technology capital $\phi$ is the key parameter in determining the high rate of return on U.S. foreign subsidiaries. If we decrease $\phi$ from 7 percent to 6 percent, the model predicts an average rate of return for U.S. FDI of 6.6 percent, down from 7.1 percent in the benchmark economy. The implied technology capital stock of foreign affiliates in the United States is also lower, the lower $\phi$. If $\phi$ is 6 percent, we predict a return of 2.3 percent for foreign subsidiaries in the United States and the implied differential is 4.3 percentage points. Thus, interestingly, the smaller the share on technology capital, the larger the implied gap in returns because plant-specific intangible capital plays a larger role as we decrease $\phi$.

For all parameterizations that we consider, the return differential eventually disappears as the growth rate of foreign investment in the United States approaches the growth rate of U.S. investment abroad. When this happens, we find that all FDI returns appear to be too high because technology capital is earning rents even when there has been no foreign direct investment.

[21] See, for example, Nakamura (2003) and Corrado et al. (2005) for estimates of intangible investment rates.

### 3.2.3. Predictions for Direct Investment Positions at Market Value

When comparing the model's direct investment positions with data from the BEA, we have used current cost measures. We have done so because a meaningful comparison is possible. The same is not true for market value measures which depend on accurately measuring the value of intangible capital of parents and subsidiaries, a task that is difficult if not impossible given there are so few transactions involving direct investment equity. Furthermore, in a world with technology capital, part of the intangible capital stock is not categorizable as "domestic" or "foreign" on one side of the net asset position. Technology capital is global by nature, and it is large.

The empirical difficulties do not preclude us from using our theoretical model to make predictions about how market values have evolved since 1982 (which is when the BEA started reporting their market value measures). Of course, to do this, we do need to make some assumption about how to apportion the stock of technology capital to home and abroad. More specifically, we need to decompose the value in (2.8) into a "domestic" and "foreign" component.

In Figure 7, we plot direct investment positions at market value assuming that the fraction of a firm's technology capital counted as "domestic" capital is equal to the ratio of domestic tangible capital to total tangible capital and "foreign" capital is equal to the remainder. Figure 7 shows that the predicted market value of U.S. subsidiaries rises from 20 percent of U.S. GNP in 1982 to 37 percent in 2006. Over the same period, the predicted market value of U.S. affiliates of foreign multinationals rises from 5 percent to 27 percent.[22] About 55 percent of the market value for both the U.S. subsidiaries and the U.S. affiliates is the value of their tangible capital.

If we compare our predictions to the market value measures of the BEA, we find that the main discrepancy is in the initial values for subsidiaries of U.S. multinationals. In 1982, our model predicts this value is 20 percent of U.S. GNP, whereas the BEA estimates it is 7 percent of GNP. By 2006, the BEA estimate rises to 32 percent, so part of the gap between our model prediction and their estimate is closed over the sample. There is less of

[22] The procedure of Hausmann and Sturzenegger (2007) of estimating market values of FDI by dividing foreign incomes with a constant rate of return does not uncover the true market values in our environment.

a discrepancy for the foreign affiliates. The BEA estimates show that the market value of U.S. affiliates of foreign multinationals rises from 4 percent in 1982 to 23 percent in 2006. Thus the gap widens but, given the difficulties in directly measuring these market values, is not large.

## 4. Technology Capital and the Current Account

The time series of our model are consistent with the observed large declines in the U.S. current account balance and the U.S. net asset position even though goods and asset markets are perfectly efficient. Thus, as Backus et al. (2006) have emphasized, if current account imbalances are an indication of capital markets working well, there is nothing to worry about.[23]

The fact that the model does remarkably well in generating a trade balance and a current account balance consistent with U.S. data is attributable to our incorporating technology capital (that is, $\phi > 0$) into an otherwise standard two-country growth model. In a standard model without technology capital, the level of borrowing and lending across countries depends only on countries' relative TFPs. When we include technology capital, we find that relative populations and the degree of countries' openness also matter. Populations matter because they affect the number of locations and the scale of operations. Degrees of openness matter because, like TFP, they determine the relative productivity in the two countries. In McGrattan and Prescott (2009), we provide analytical results for environments with and without technology capital to examine the mechanism more closely. We also demonstrate that the equilibrium paths for the model with $\phi = 0$ and the model with $\phi = .07$ are very different qualitatively and quantitatively.

## 5. Conclusion

We develop and use a multicountry model to show that abstracting from intangible investments has large consequences for measured rates of return on U.S. foreign subsidiaries and

[23] Obstfeld and Rogoff (2006) worry that the unwinding of the U.S. current account will be accompanied by a collapse of the dollar. We have no way to assess this prediction, since our model values are real and the real exchange rate is equal to one.

U.S. affiliates of foreign companies. We estimate a return differential of 4 percent per year between returns *on* direct investment of the United States and returns on direct investment *in* the United States. This difference is due to the accounting of intangible investments.

Our paper considers only mismeasurement as leading to differences in domestic and foreign rates of return. Other factors that we abstract from may also have played a role. These include transfer pricing by multinationals to avoid U.S. taxation, different risk characteristics of U.S. and foreign projects, and financial market frictions in foreign countries. We also may have built in too much symmetry in our modeling of the United States and the rest of world. If there are differences in technology-capital intensities between countries, we would expect larger differences in returns.

# A. History of U.S. Policies Related to FDI

The findings of our quantitative analysis depend critically on the timing and magnitude of inward and outward FDI in the United States, which in turn depends on how we model the relative degree of openness to foreign technology capital in the United States and elsewhere. Our theory of FDI is consistent with U.S. current account facts if we model the United States after World War II as initially less open to inward FDI than the rest of the world was to U.S. outward FDI, with a rapid change occurring during the 1970s. In this section, we review key policies that discouraged inward FDI during the postwar period. These policies lead us to conclude that our modeling of U.S. openness is reasonable.

### A.1. Bretton Woods System of Fixed Exchange Rates

In compliance with the Foreign Investment Study Act of 1974, the U.S. Secretary of Commerce was asked to report on foreign direct investment in the United States. Appendix G, entitled "Investment Motivation," outlines reasons why foreign companies invested or did not invest in the United States. According to the report, "Currency undervaluation acted as a strong disincentive to foreign direct investment in the United States, both because it placed an artificially high price on dollar-denominated assets, and because it gave foreign producers an inherent cost advantage in selling in U.S. markets through exports" (U.S. Department of Commerce 1976, p. G-40).

The United States suspended convertibility from dollars to gold in August 1971. Between 1971 and 1973, the dollar depreciated 35 percent relative to the German mark, 26 percent relative to the Japanese yen, 27 percent relative to the French franc, 28 percent relative to the Dutch guilder, and 35 percent relative to the Swiss franc.

In February 1973, the Bretton Woods currency exchange market closed.

### A.2. Interest Equalization Tax

Another disincentive for foreign multinationals considering investing in the United States was the high cost of financing under the interest equalization tax (IET) (U.S. Department of Commerce 1976, p. G-58). The IET, which was effective in 1963, was a tax of 15 percent on interest received from foreign borrowers. The intent of the tax was to eliminate the deficit in the balance of payments. The effect was to close U.S. capital markets to foreign affiliates in the United States.

The interest equalization tax was removed in 1974.

### A.3. Extraterritorial Application of U.S. Laws

According to Damm (1970), foreign companies considering investment in the United States were concerned with a "growing trend toward extraterritorial application of U.S. laws and regulations" (p. 41). Ellis (1970) provides many examples of extraterritorial application of U.S. antitrust law, including cases where the economic activities took place outside the United States.

Although there was no formal dissolution of extraterritorial application of U.S. antitrust law, some foreign governments reacted to orders of the U.S. courts by making it illegal for their companies to comply with them. For example, the Watkins report (Watkins 1968) recommended that the Canadian government "enact legislation to prohibit compliance with foreign antitrust orders, decrees, or judgments."

### A.4. National Security Acts

During World War I, national security concerns were the impetus for FDI restrictions in certain industries and for the Trading with the Enemy Act (TWEA) of 1917.

The TWEA allowed the president to "investigate, regulate, direct and compel, nullify, void, prevent or prohibit, any acquisition, holding, withholding, use, transfer, withdrawal, transportation, importation or exportation of, or dealing in, or exercising any right, power, or privilege with respect to, or transactions involving, any property in which any foreign country or a national thereof has any interest." President Wilson invoked the TWEA during the war to seize all U.S. assets of German companies. He also seized all foreign-owned radio stations, including those owned by British companies. President Roosevelt invoked the TWEA during World War II to seize German and Japanese assets in the United States.

According to Graham and Marchick (2006), uncertainty about whether the U.S. government would seize foreign assets in an international emergency was resolved in 1976 when the TWEA was supplanted by the International Emergency Economic Powers Act (IEEPA). The IEEPA stipulated conditions of an international emergency and took away the right to transfer title of foreign assets to the United States in such an emergency.

Until the IEEPA in 1976, the TWEA was the primary regulation concerned with the impact of foreign direct investment on national security.

## B. Firm- and Industry-Level Evidence on Rates of Returns

Our theory predicts the following three patterns involving accounting rates of return: (1) they increase with R&D and advertising intensities; (2) rates of return of foreign affiliates increase with parents' R&D intensity; and (3) rates of return of foreign affiliates increase with age. There is an abundance of firm- and industry-level evidence supporting these predictions. Here, we briefly summarize the evidence. In McGrattan and Prescott (2009), we provide further details.

### B.1. Rates of Return Increase with Advertising and R&D Intensities

Empirical studies of the relationship between rates of return and advertising and R&D intensity have consistently found a strong positive relationship.[24] This is of interest because our theory predicts that accounting profits are higher than true profits if firms invest in intangible assets. Because these investments are expensed, measured income includes a return on past intangible capital investments, but measured capital excludes the R&D capital and brand equity.

Many of the early studies attributed the positive relation between rates of return and advertising or R&D intensities to the existence of market power. Once researchers corrected the accounting rates of return to appropriately count R&D and advertising expenditures as investments, they found that the high accounting returns of R&D or advertising-intensive firms were significantly reduced. In the case of consumer goods firms making significant advertising expenditures, the high returns were largely eliminated once these expenditures were treated as an investment. (See Bloch (1974), Ayanian (1975), and Demsetz (1979).) In the case of producer goods firms making significant R&D expenditures, the high returns to R&D-intensive firms were significantly reduced. (See Grabowski and Mueller (1978).)

In summary, researchers studying the relationship between rates of return and advertising and R&D intensities have found a strong positive relation that is largely eliminated or significantly reduced if expenditures are treated as an investment rather than an expense.

### B.2. Rates of Return of Foreign Affiliates

We turn next to specific evidence on rates of return of foreign affiliates of U.S. corporations. The evidence sheds some light on the role of parents' intangible capital and affiliates' age for the profitability of foreign affiliates.

[24] See Comanor and Wilson (1967), Bloch (1974), Ayanian (1975), Demsetz (1979), Grabowski and Mueller (1978), and a recent survey of the literature by Ali Shah and Akbar (2008).

Table B.1. Regressions of Rates of Return of Majority-Owned Foreign Affiliates on R&D Intensity of U.S. Parents for Major Industries

Regression: $r = \alpha + \beta x$

$r$ = avg. ratio of net income to total assets of foreign affiliates, 1999–2005

$x$ = avg. ratio of R&D expenditures to value added of U.S. parents, 1999–2005

| | Samples, $m$ = maximum missing years per industry | | | |
|---|---|---|---|---|
| Coefficient | $m = 0$, $x \geq 0\%$ | $m = 2$, $x \geq 0\%$ | $m = 2$, $x \geq 1\%$ | $m = 2$, 3 dropped[a] |
| $\alpha$ | 3.21 | 3.34 | 3.81 | 2.43 |
| | (.71) | (.75) | (.54) | (.68) |
| $\beta$ | .145 | .142 | .114 | .193 |
| | (.055) | (.079) | (.046) | (.069) |
| No. of Industries | 17 | 34 | 22 | 31 |

[a] This sample excludes oil and gas extraction, beverages and tobacco products, and motion picture and sound recording.

### B.2.1. Increase with R&D Intensity of Parents

Our theory says that accounting rates of return of foreign affiliates should increase with expensed investments made by their parents. From the BEA annual survey of U.S. direct investment abroad (USDIA), we have data to construct rates of return for foreign affiliates of U.S. multinationals and data on R&D expenditures of their parents using industry data based on the NAIC classification. We find that there is a strong positive relationship.

Table B.1 shows the results of regressing rates of return of majority-owned foreign affiliates on the R&D intensity of U.S. nonbank parents. The accounting rate of return for affiliates is net income to total assets. For each major industry (using NAIC classifications), we average the rates of return over the period 1999–2005. The R&D intensity is defined to be the ratio of R&D expenditures to value added of the U.S. parents. In some cases, data are missing because they are suppressed for confidentiality reasons or because the industry classification changed. Thus, we also consider samples with at most two years of missing data in rates of returns or in R&D intensities, averaging the years that are available.

The regression results in Table B.1 show that there is a statistically significant and positive relationship between foreign affiliate returns and the R&D intensity of parents.

The results also show that the differences in rates of return for low R&D-intensive industries and high R&D-intensive industries is economically significant. The intercept $\alpha$ tells us that the rate of return is a little under 4 percent for the very low R&D-intensive industries. For high R&D-intensive industries, like computers and electronic products or chemicals, the R&D intensity of the parents is around 30 percent, and therefore the rates of return of affiliates are around 8 percent.

The results are also robust to the set of affiliates and the industry categorization. The affiliates' rates of return used in the regressions reported in Table B.1 are based on data of majority-owned affiliates that are categorized according to their own industry. Results are not significantly altered if we use all affiliates or categorize affiliates by their parents' primary industry.

In summary, we find a strong positive relationship between affiliates rates of return and parents' R&D intensities.

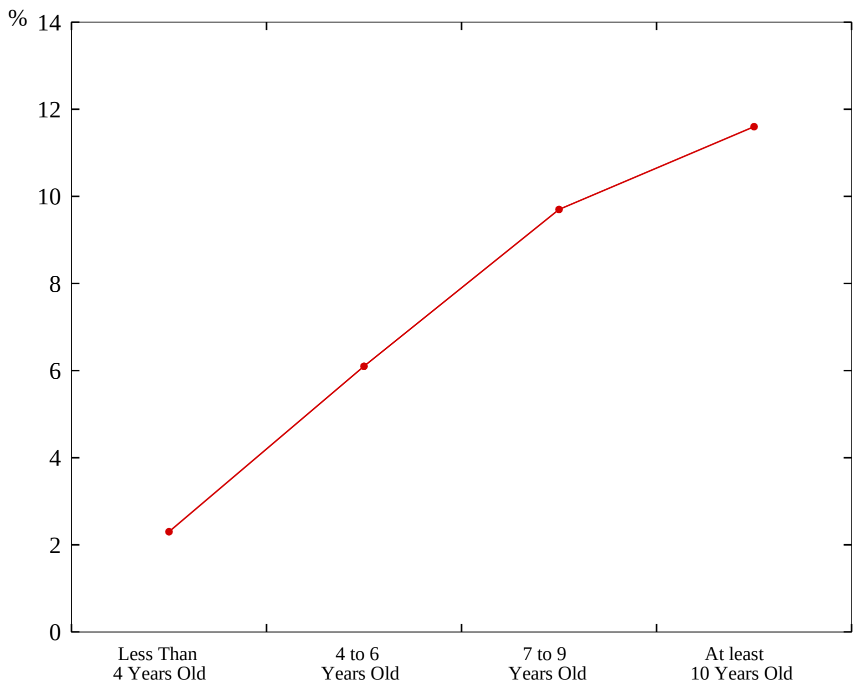
### B.2.2. Increase with Age

Our theory says that accounting rates of return of foreign affiliates should increase with the age of the affiliate, starting out below rates of return for the parents and eventually rising to levels above the rates of return for the parents. In McGrattan and Prescott (2009) we present results from several studies based on BEA surveys of U.S. multinationals abroad and foreign subsidiaries in the United States and IRS compilations of financial data reported on corporate tax returns of U.S. multinationals. All confirm that there is a strong positive relationship between affiliates' rates of return and their age. Here, we focus our discussion on one important study of Lupo, Gilbert, and Liliestedt (1978) and refer readers to our survey of the other studies in McGrattan and Prescott (2009).

Lupo et al. (1978) investigate the relationship between age and rate of return for 4,507 foreign manufacturing affiliates of U.S. manufacturing parent companies participating in the BEA benchmark survey of 1966. For the 1966 survey, 10 age categories are available for U.S. affiliates. Age is defined as the number of years that the U.S. parent has owned the affiliate. For their study, Lupo et al. condensed these age categories into four: under 4 years, 4 to 6 years, 7 to 9 years, and 10 years and older. They also split the sample by industry and area to make sure that the relationship was, in their words, "genuine" and not a result of where or what the affiliates were producing.

Figure B.1 shows the rates of return for the total sample by age. The range of returns is 2.3 percent for affiliates less than 4 years old and 11.6 percent for those at least 10 years old. They also present results by industry and by area. With a few exceptions, the rates of return are all monotonically increasing with age.

Figure B.1. Rates of Return of Foreign Manufacturing Affiliates of U.S. Manufacturing Parents, by Age of Affiliate




Source: Lupo, Gilbert, and Liliestedt (1978)

Lupo et al. (1978) check the robustness of their results in two ways. First, they recalculated returns with after-tax net income rather than before-tax net income. The main conclusions are not altered. A second check shows that the relationship between age and an affiliate's rate of return is not due to secular inflation. It is possible that inflation could bias Lupo et al.'s results given that values on the accounts are book values. Older assets are understated if secular inflation is high. This understatement implies that older affiliates would have higher returns than younger affiliates simply because inflation is positive (and not necessarily because of large expensed investments incurred with setting up new operations). They decompose the return into an "inflation-sensitive" and an "inflation insensitive" component and show that the latter rises significantly with age.

The other studies that we survey confirm Lupo et al.'s findings that there is significant age effect for rates of return on foreign affiliate rates of return.

## C. Data Sources

The data sources for this study are listed below. After each source we note the specific tables that we use and where we use them. For more details, see McGrattan and Prescott (2009) and the accompanying materials at our website (http://www.minneapolisfed.org).

*National Income and Product Accounts*, 1960–2006

- Tables 1.1.5, 2.5.5, 3.1, 3.5. Gross domestic product and components are used to construct averages in the top panel of Table 4. Adjustments are made so that the income and product measures are comparable in the theory and data. Specifically, consumption taxes and intermediate financial services are excluded from value added and all expenditures on fixed assets are treated as investment. See McGrattan and Prescott (2009) for details.
- Table 1.7.5. Gross national product (adjusted in the same way as GDP) is used when constructing all averages in Table 4 and in Figures 2–3 and Figure 5.
- Table 1.13. National income by sector is used to construct business and nonbusiness income in the middle panel of Table 4. In the nonbusiness sector, we include households, nonprofits, general government, and government enterprises.
- Tables 1.14, 3.2. Gross value added of domestic corporations is used to construct the tax rate on profits (with the Federal Reserve profits excluded) in Table 2.
- Table 4.1. Net exports and net factor incomes are used to construct averages of the current account components in Table 4. The net exports series is also shown in Figure 2.
- Table 5.7.5. Private inventories are added to fixed assets for estimating tangible capital stocks and their depreciation rates.

*Fixed Assets*, 1960–2006

- Tables 1.1, 6.1. Current-cost net stocks by owner and by sector are used to adjust measures of consumption and investment in Table 4 and to estimate tangible capital stocks and their depreciation rates.

*International Transactions Accounts*, 1960–2006

- Tables 1, 6. U.S. direct investment receipts and payments are plotted in Figure 2 and used to construct the rates of return in Figures 1 and 6. Portfolio incomes plotted in Figure 3 are determined residually by subtracting direct investment incomes from net factor incomes in NIPA.

*Flow of Funds Accounts for the United States*, 1960–2006

- Table F6. Investment expenditures of households, nonprofit institutions, and governments are counted as nonbusiness investment in Table 4.
- Table F10. Consumer durable depreciation is added to depreciation because we include durable consumption with tangible investment.
- Tables L213, B100. Corporate and noncorporate equity values are used to estimate business market value.
- Table L107. Direct investment positions at current cost are plotted in Figure 5 and used to construct the rates of return in Figures 1 and 6.

*GGDC Total Economy Database*, 1960–2006

- GDP in constant 1990 dollars is used to construct U.S. share of world GDP in Figure 4 using the list of countries below as rest of world.

*Rest of world regions and countries*

- Canada
- *Western Europe*: Austria, Belgium, Cyprus, Denmark, Finland, France, all Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom
- *Eastern Europe*: Albania, Bulgaria, Czechoslovakia, Hungary, Poland, Romania, Yugoslavia
- *Latin America and Other Western Hemisphere*: Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Guatemala, Jamaica, Mexico, Peru, Puerto Rico, St. Lucia, Trinidad and Tobago, Uruguay, Venezuela
- *Asia*: China, Hong Kong, Japan, Singapore, S. Korea, Taiwan
- *Oceania*: Australia, New Zealand

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TABLE 1. Model Constants at Annual Rates

| Parameter | Expression | Value |
|---|---|---|
| Growth Rates (%) | | |
| Population | $\gamma_N$ | 1.0 |
| Technology | $\gamma_A$ | 1.2 |
| Preferences | | |
| Discount factor | $\beta$ | .98 |
| Leisure weight | $\psi$ | 1.32 |
| Nonbusiness Sector (%) | | |
| Fraction of time at work, $i = u, r$ | $\bar{L}_{nb,i}/N_i$ | 6.0 |
| Nonbusiness investment, $i = u, r$ | $\bar{X}_{nb,i}/\text{GDP}_i$ | 15.4 |
| Nonbusiness value-added, $i = u, r$ | $\bar{Y}_{nb,i}/\text{GDP}_i$ | 31.2 |
| Fixed Tax Rates (%) | | |
| Tax rates on labor $i = u, r$ | $\tau_{l,i}$ | 29.0 |
| Tax rate on consumption, $i = u, r$ | $\tau_{c,i}$ | 7.3 |
| Income Shares (%) | | |
| Technology capital | $\phi$ | 7.0 |
| Tangible capital | $(1-\phi)\alpha_T$ | 21.4 |
| Plant-specific intangible capital | $(1-\phi)\alpha_I$ | 6.5 |
| Labor | $(1-\phi)(1-\alpha_T-\alpha_I)$ | 65.1 |
| Depreciation Rates (%) | | |
| Technology capital | $\delta_M$ | 8.0 |
| Tangible capital | $\delta_T$ | 6.0 |
| Plant-specific intangible capital | $\delta_I$ | 0 |

TABLE 2. Model Time-Varying Inputs

| Year | Relative[a] Populations | Tax Rates: Dividends | Tax Rates: Profits | Openness: ROW | Openness: U.S. | Relative[a] TFPs | Per Capita U.S. Debt | U.S. Foreign Shares |
|---|---|---|---|---|---|---|---|---|
| 1960 | 8.20 | .400 | .408 | .8350 | .6900 | .3730 | 0 | .010 |
| 1965 | 8.42 | .400 | .403 | .8397 | .6942 | .3727 | 0 | .032 |
| 1970 | 8.64 | .400 | .396 | .8443 | .7003 | .3725 | 0 | .050 |
| 1975 | 8.86 | .397 | .386 | .8490 | .7090 | .3722 | 0 | .070 |
| 1980 | 9.08 | .370 | .375 | .8537 | .7207 | .3719 | 0 | .113 |
| 1985 | 9.30 | .246 | .361 | .8583 | .7357 | .3714 | −.049 | .178 |
| 1990 | 9.37 | .164 | .348 | .8630 | .7531 | .3717 | −.098 | .220 |
| 1995 | 9.28 | .153 | .336 | .8677 | .7718 | .3731 | −.146 | .260 |
| 2000 | 9.16 | .152 | .327 | .8723 | .7899 | .3743 | −.195 | .300 |
| 2005 | 9.04 | .152 | .320 | .8770 | .8058 | .3751 | −.244 | −.050 |
| 2010 | 8.91 | .152 | .315 | .8817 | .8186 | .3743 | −.270 | .000 |
| 2015 | 8.79 | .152 | .312 | .8863 | .8283 | .3732 | −.293 | .000 |
| 2020 | 8.67 | .152 | .310 | .8910 | .8352 | .3723 | −.293 | .000 |
| 2025 | 8.55 | .152 | .309 | .8957 | .8399 | .3721 | −.293 | .000 |
| 2030 | 8.42 | .152 | .308 | .9003 | .8431 | .3731 | −.293 | .000 |
| 2035 | 8.30 | .152 | .307 | .9050 | .8452 | .3745 | −.293 | .000 |

[a] "Relative" implies rest of world relative to the United States.

TABLE 3. Model Initial Capital Stocks Relative to Initial U.S. GDP[a]

| Parameter | Expression | Value |
|---|---|---|
| Technology capital stocks | | |
| U.S. companies | $K^u_{M,0}$ | .523 |
| ROW companies | $K^r_{M,0}$ | 1.06 |
| Tangible capital stocks | | |
| U.S. companies at home | $K^u_{T,u,0}$ | 1.28 |
| U.S. companies abroad | $K^u_{T,r,0}$ | .105 |
| ROW companies at home | $K^r_{T,r,0}$ | 2.81 |
| ROW companies abroad | $K^r_{T,u,0}$ | .014 |
| Plant-specific intangible capital stocks | | |
| U.S. companies at home | $K^u_{I,u,0}$ | 1.16 |
| U.S. companies abroad | $K^u_{I,r,0}$ | .095 |
| ROW companies at home | $K^r_{I,r,0}$ | 2.53 |
| ROW companies abroad | $K^r_{I,u,0}$ | .012 |

[a] Initial U.S. GDP is normalized to 1, and initial ROW GDP is normalized to 2.2.

TABLE 4. U.S. and Model Components of U.S. GNP, 1960–2006
(Averages, All Relative to GNP)

| Variable | Data | Model |
|---|---|---|
| Domestic Product | | |
| Consumption | .740 | .735 |
| Investment | .266 | .268 |
| Business tangible | .113 | .116 |
| Nonbusiness | .153 | .153 |
| Net Exports | −.012 | −.011 |
| Gross Domestic Product | .994 | .993 |
| Domestic Income | | |
| Business income | .678 | .683 |
| Nonbusiness income | .310 | .310 |
| Gross Domestic Income | .988 | .993 |
| Net Income from Rest of World | | |
| Portfolio income (net) | −.002 | −.002 |
| Direct investment receipts | .011 | .011 |
| Less: Direct investment payments | −.002 | −.002 |
| Net Factor Income | .006 | .007 |
| Statistical Discrepancy | .006 | — |
| Gross National Income | 1.000 | 1.000 |

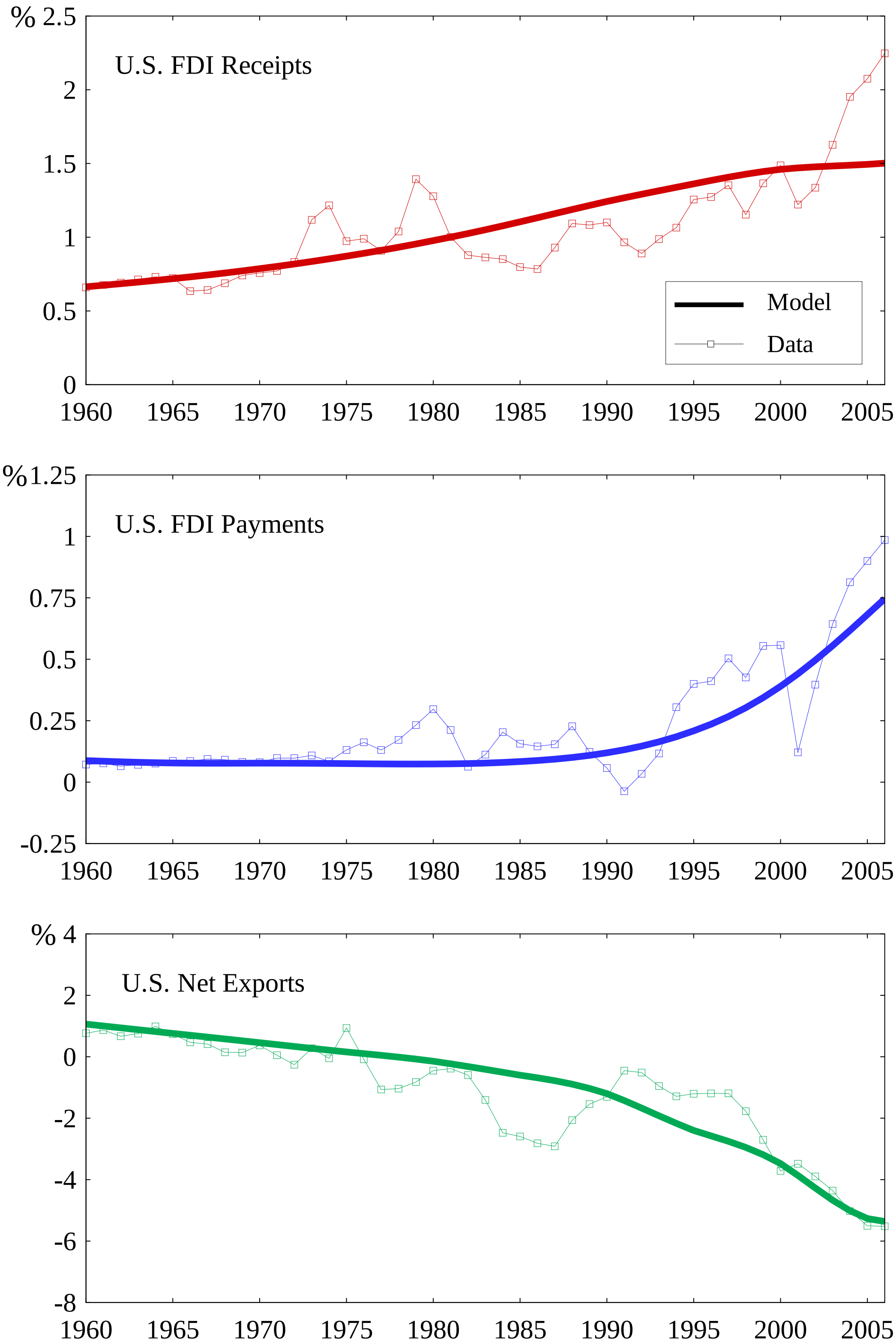



Figure 2. BEA and Model Components of the U.S. Current Accounts (as a Percentage of U.S. GNP)

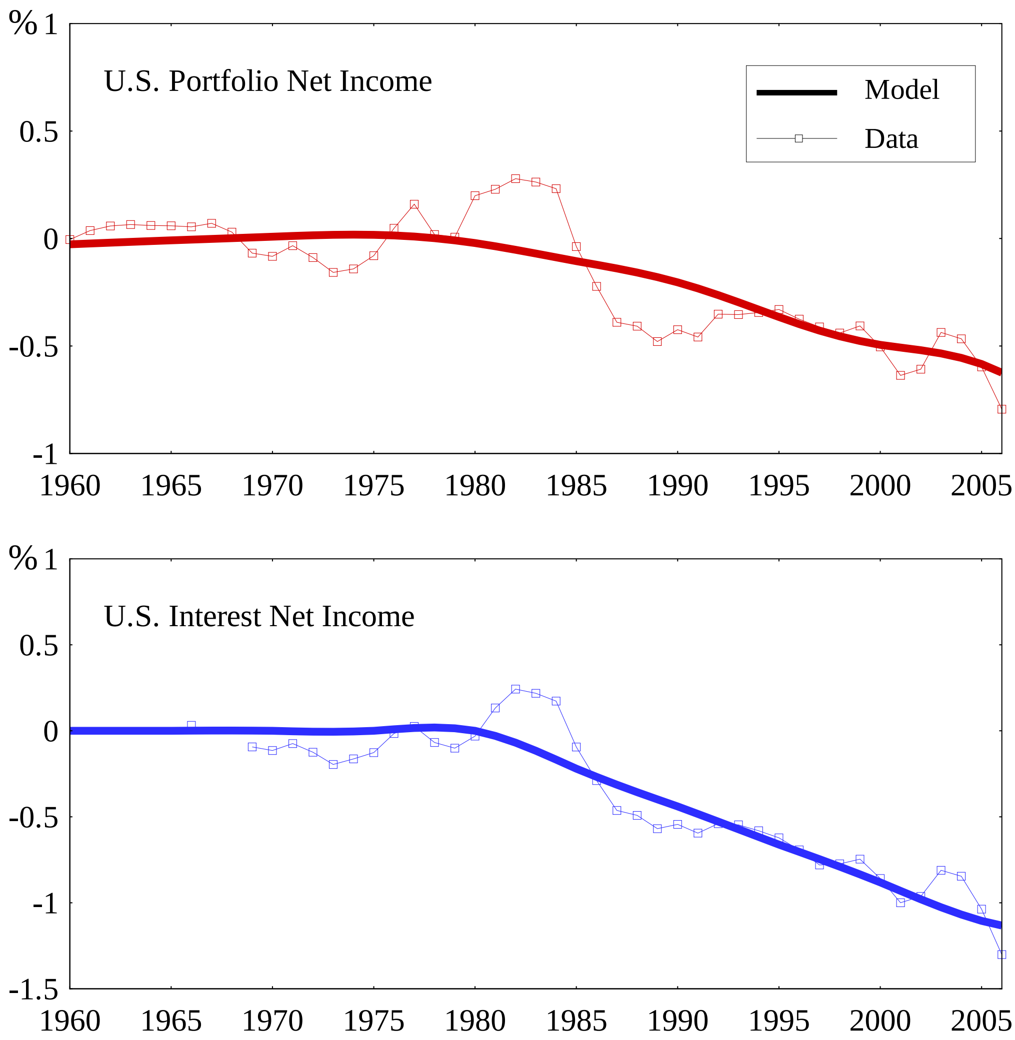



FIGURE 3. BEA AND MODEL PORTFOLIO INCOME OF THE U.S. CURRENT ACCOUNTS (TOTAL AND INTEREST COMPONENT, AS A PERCENTAGE OF U.S. GNP)

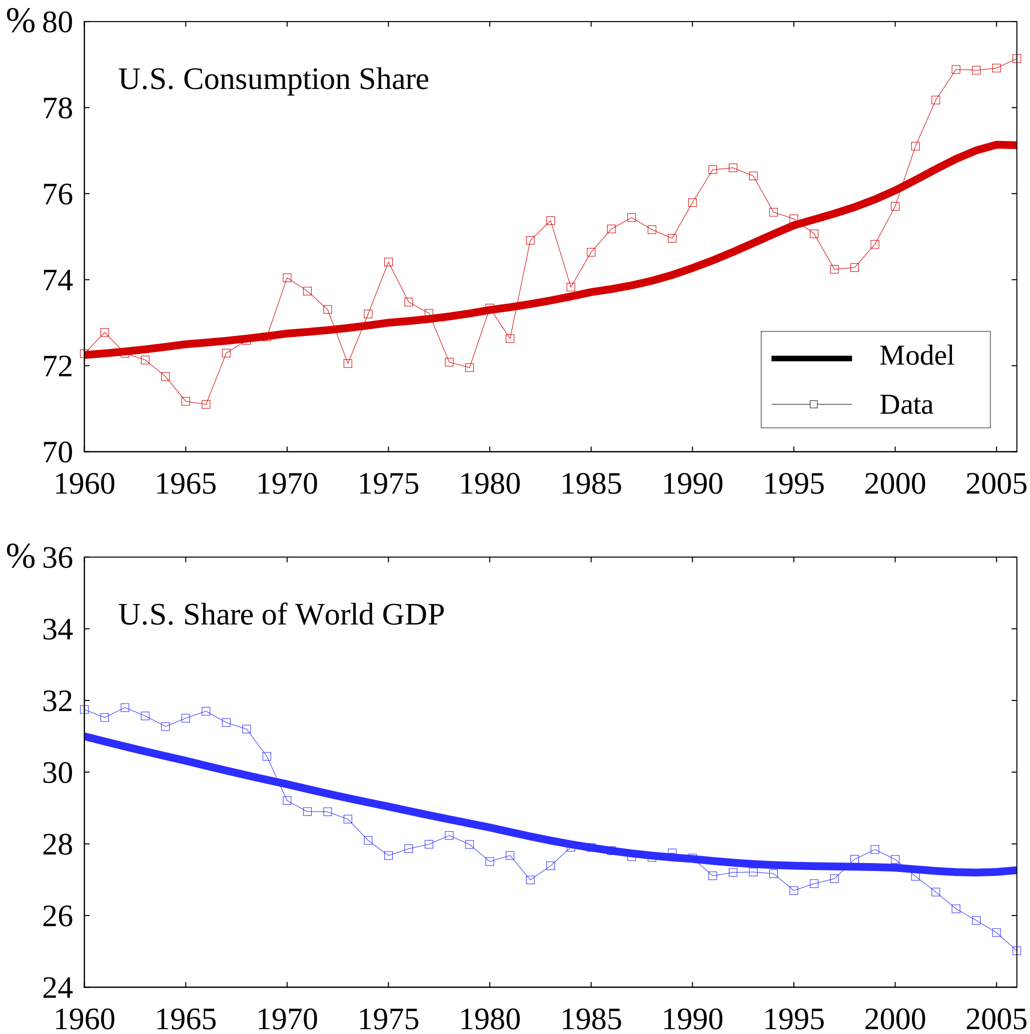
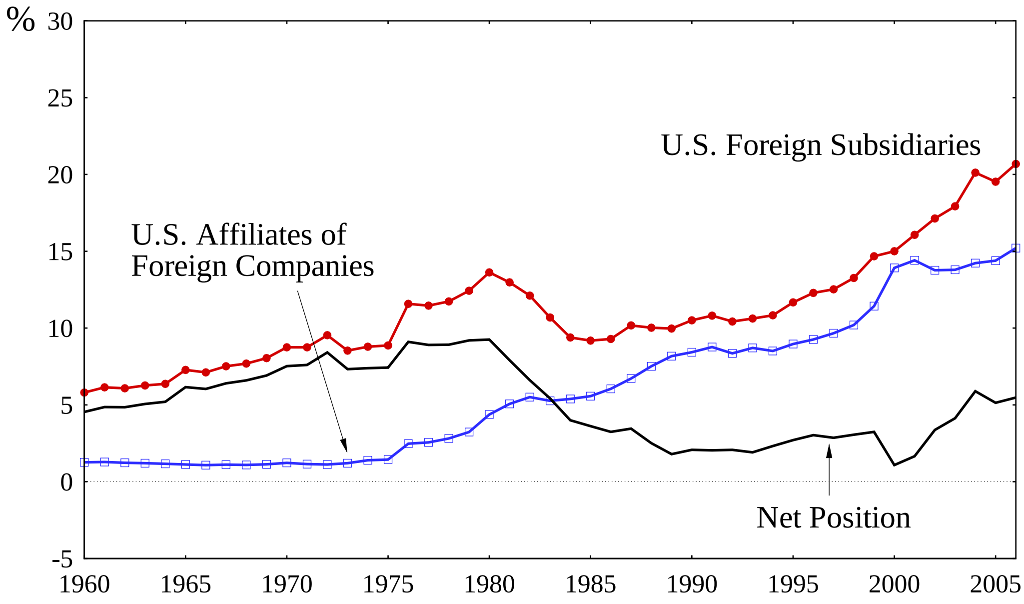
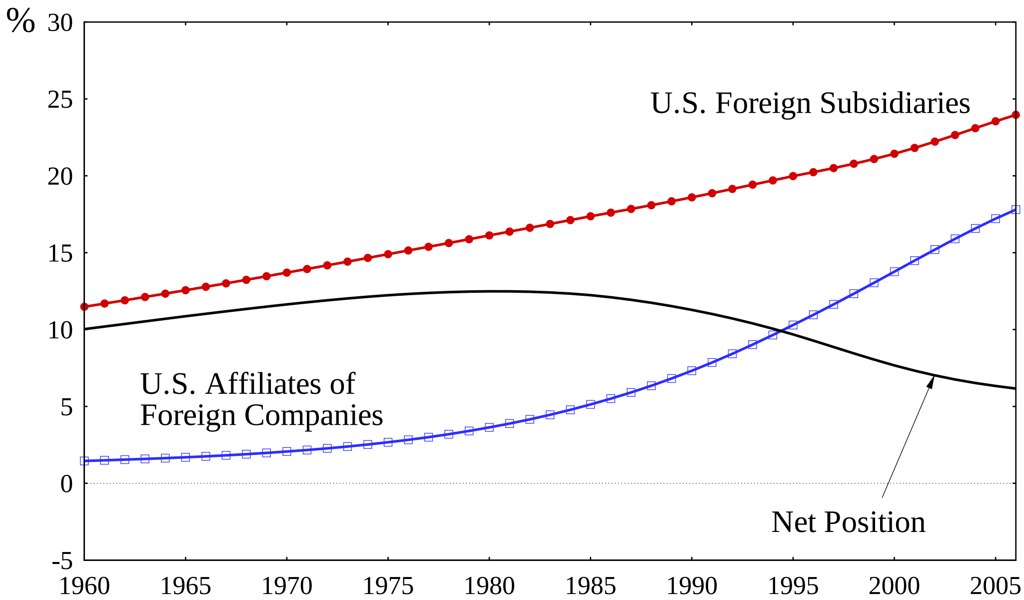



Figure 4. BEA and Model Ratios of U.S. Consumption to GDP and U.S. GDP to World GDP




A. BEA




B. Model

FIGURE 5. TANGIBLE CAPITAL STOCKS IN SUBSIDIARIES,
(AS A PERCENTAGE OF U.S. GNP)

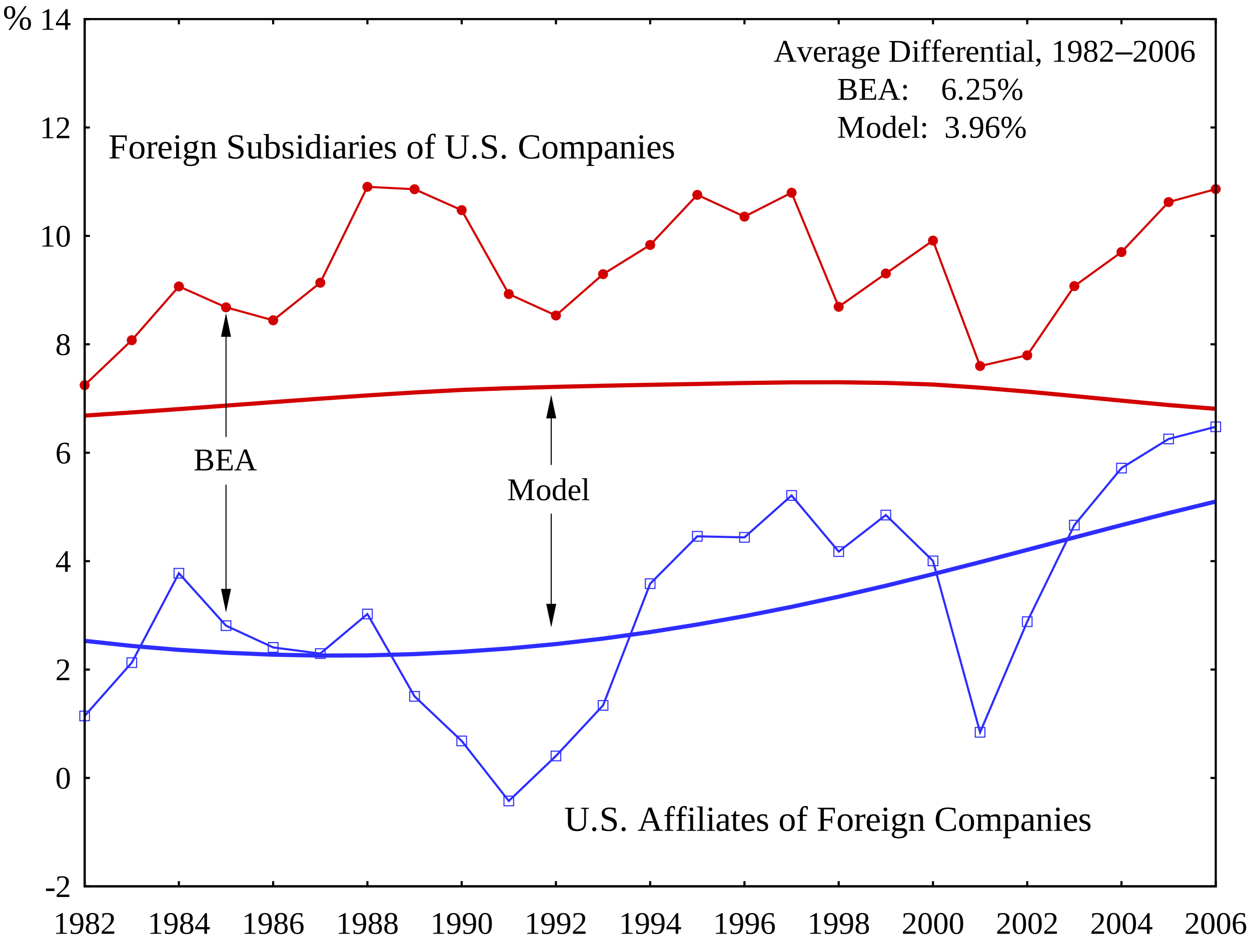



Figure 6. BEA and Model Rates of Return on Subsidiary Capital

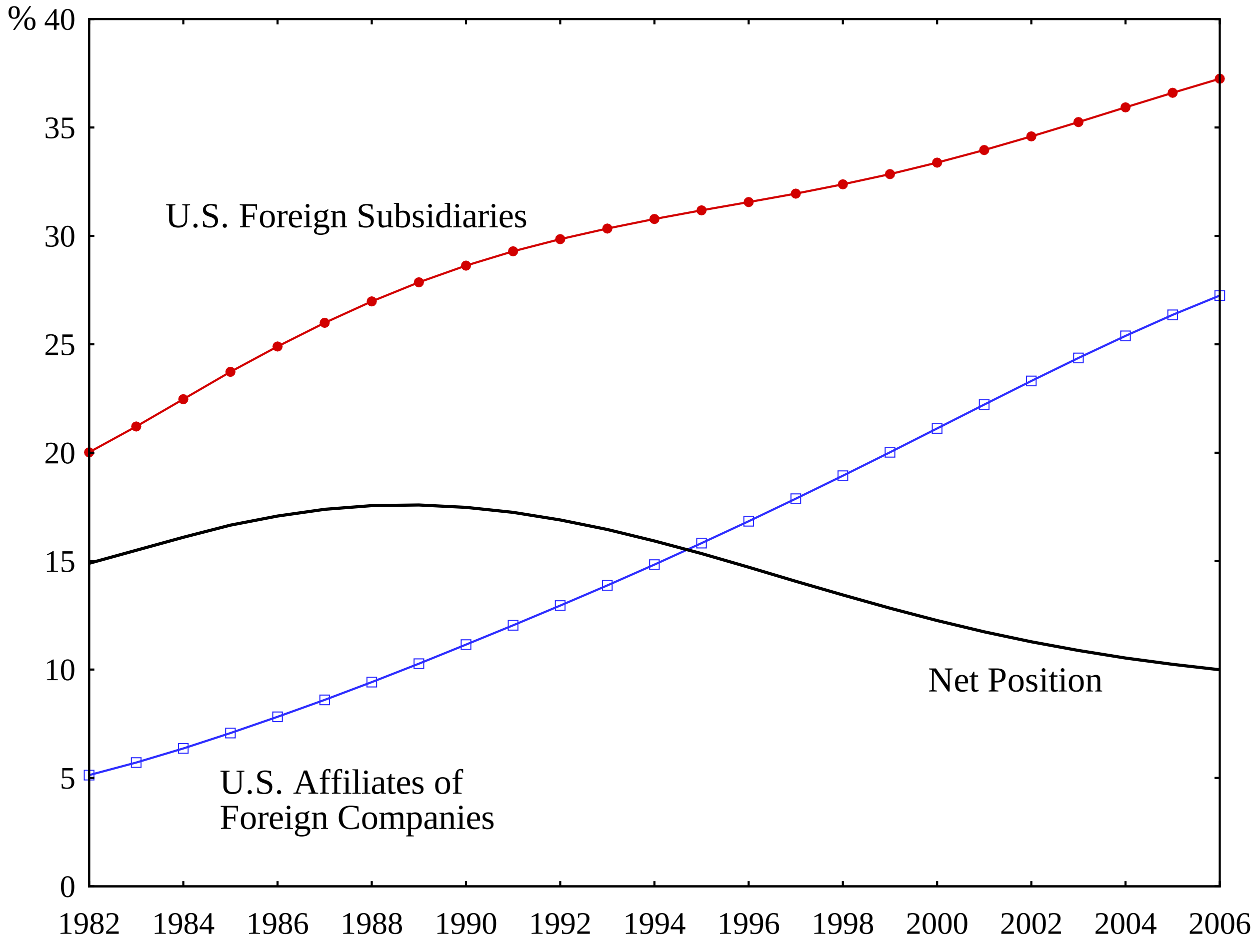



Figure 7. Model Predictions of Direct Investment Positions at Market Values (as a Percentage of U.S. GNP)