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

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ABSTRACT

We develop a general equilibrium multicountry model and use it to evaluate concerns of high U.S. current account deficits and a declining net U.S. investment position. We introduce *technology capital* which can be used by multinationals in some or all of their domestic and foreign operations. Prime examples are brand equity and patents. This capital is intangible and is therefore expensed rather than capitalized. The expensing of the investment implies that there are differences in reported and actual balance of payments and net asset positions. Although our model economy has efficient domestic and international capital markets, the predicted equilibrium paths for the reported series exhibit similar behavior to the observed U.S. time series. Thus, on the basis of our model's quantitative predictions, we conclude that there is no prima facie evidence that the large current account deficits are a harbinger of a future crisis.

*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

Since 1991, the U.S. current account deficits have been rising and its net foreign asset position has been falling. As of mid-year 2006, the net position was 0.25 times gross national income (GNI). The fall in the net asset position is puzzling because net factor income has been positive and roughly constant for the last twenty years, averaging 0.5 percent of GNI. A closer examination of the international statistics shows (*i*) a modest positive and falling net equity position and growing net equity income and (*ii*) growing net indebtedness and growing net interest payments. These observations suggest that there is a problem in the measurement of the net equity asset position and/or income and not with the measurement of net indebtedness or net interest income.

Most of the U.S. net equity income from abroad is from foreign direct investment (FDI). In McGrattan and Prescott (2005), we capitalized the income of U.S. foreign subsidiaries in order to estimate the fundamental value of U.S. corporations including their operations abroad.[1] Using this approach, we estimated that the value of U.S. FDI, net of foreign investment in the United States, had increased dramatically between the 1960s and the 1990s, from about 0.1 times GNI to almost 0.3 times GNI. These estimates are in sharp contrast to the reported figures of the Bureau of Economic Analysis (BEA) that report a fall from 0.06 times GNI in the 1960s to about 0.02 times GNI in the 1990s.

A problem with the reported statistics is that the national accounts do not include the large intangible capital investments made by corporations. Intangible capital investments are expensed and, therefore, are not part of accounting profits. They are also excluded from the international accounts which reports net factor income from abroad. Even if a small amount of income is unreported per year, the cumulative effect on net asset positions could be large.

[1] See also recent calculations by Haussmann and Sturzenengger, 2006.

In this paper, we quantify the importance of this underreporting by developing a multicountry general equilibrium model with multinational companies. In the standard macroeconomic model, there is no reason for foreign direct investment, and the only gain to economic integration is due to differences in factor endowments, which do not seem to be an important factor for trade between the advanced industrial countries. In the model we develop, there is a gain to FDI because companies have technologies that can be operated in any country and at any location within a country. The country's stock of *technology capital* is the number, or measure, of technologies owned by its multinational companies. A good example is brands. A cup of Starbucks coffee cannot be exported from Seattle to Beijing; but Starbucks can set up operations in Beijing. Investments in technology capital such as advertising or R&D are expensed. These investments, along with plant-specific intangible investments, are the investments we are interested in quantifying.

The model that we develop has efficient domestic and international capital and goods markets.[2] Multinationals are price-takers using different technologies in competitive markets to produce a single composite good that is freely shipped anywhere in the world. Factor inputs for these technologies are labor and tangible capital services indexed by the country of operation and operation-specific intangible capital. There are no increasing returns at the aggregate world level, yet summing the convex cone production sets of a set of countries results in a larger aggregate technology set than those being aggregated.

We use the model economy to show that abstracting from intangible investments can have large consequences for the current account balance and net asset position. Using a two-country example, we first show that a neutral portfolio shift can have a large effect on *reported* international transactions data. By neutral, we mean that the United States increases its borrowing abroad and uses the proceeds to purchase foreign equities,

[2] Caballero et al. (2005) and Mendoza et al. (2006) develop general equilibrium models with financial frictions to estimate the effects on the current account of unanticipated capital liberalizations. Fogli and Perri (2006) estimate the impact of lower U.S. business cycle volatility. None of these papers consider the impact of unmeasured investments.

with no consequences for the allocation of resources. We then use the model economy to evaluate nonneutral changes motivated by recent events in the United States and other industrial nations that do impact the allocation of resources. Specifically, we introduce a policy change inducing an investment boom in the U.S. nonbusiness sector, and we introduce a population decline abroad. These experiments have large consequences for net exports, the reported and actual current account balance, and the reported and actual net asset positions. We also show that small mismeasurements in income accumulate to large mismeasurements of asset positions.

The main lesson of the experiments we conduct is that care must be taken when drawing inference from the current accounts concerning a country's actual net asset position.

The paper is organized as follows. In section 2, we review the U.S. international transactions. In section 3, we introduce a model and demonstrate that the actual and reported current account is different. In section 4, we use three experiments to demonstrate that recent movements in the current account are consistent with capital markets working efficiently. Conclusions are in section 5.

## 2. The U.S. Current Account and Net Asset Position

We describe the large changes that have occurred in the U.S. international accounts since 1950 and establish that these changes are puzzling for standard growth theory. All series are displayed relative to U.S. gross national income (GNI).

Figure 1 displays the current account balance and net exports.[3] There have been dramatic shifts in the current account balance since 1975. During the 1980s, the current account balance fell to −3 percent of GNI. More recently, it has fallen to −6 percent of

[3] We use the balance on current account reported in the U.S. NIPA accounts which is equal to exports of goods and services plus income receipts less imports of goods and services, income payments, and current taxes and transfer payments to the rest of the world (net).

GNI, a fact that has motivated much debate about the possibility of a future financial crisis. Movements in net exports have tracked the current account balance implying that the sum of net factor income and current transfers has been roughly zero relative to GNI.

Figure 2 displays total net factor income along with two main subcategories over the period 1950–2005. The figure shows that there has been little or no trend in the total, but large trends relative to GNI in the subcategories. Net factor income is the sum of net wage and salary income and income on asset holdings, namely interest, dividends, and undistributed profits on direct investment (or 'reinvested earnings' as it is called in the international accounts). The subcategories shown in Figure 2 are net interest and net equity income (dividends plus undistributed profits).[4]

Net interest income was negligible until the mid-1980s and then became negative. In recent years, interest payments to the rest of the world have been close to 1.5 percent of GNI. Very little of this is related to intercompany debt on foreign direct investment.

Net income on equity has been positive and rising for most of the 1950–2005 period. The equity income includes both dividend income for foreign equity holdings and total earnings (dividends plus undistributed profits) on FDI. Prior to 1980, virtually all of the income was from FDI. More recently there has been an increase in direct portfolio income from equity but it is still under 25 percent of the total.[5] In recent years, the income from equity abroad has been only slightly higher than the payments on foreign debt.

Figures 3 through 5 display the U.S. net asset positions for debt at market value, equity in portfolios at market value, and direct investment at current cost.[6] Figure 3 shows that in 1976 the net debt position was at about zero. By 2005, the debt net position

[4] Net wage and salary income is negligible and not shown.

[5] Equity holdings are categorized as direct investment when the ownership exceeds 10 percent. Otherwise it is categorized as portfolio income.

[6] The BEA's methodology for measuring the market value of direct investment is not consistent with our theoretical measures of market value. Thus, we make comparisons with their current cost measures.

relative to U.S. GNI fell to −34 percent. This is consistent with the fact that interest payments have been rising.

Figure 4 shows the market value of equity in portfolios. This has been small for most of the post World War II period. Recently there has been a small increase in both equity income and the asset position, but portfolio equity is still a much smaller component of overall equity income and asset holdings than foreign direct investment.

The direct investment net asset position shown in Figure 5 steadily increased relative to U.S. GNI until 1980 when it reached 10 percent. Since then, there has been a steady increase in foreign direct investment in the United States, which has lead to a fall in the net position by more than a factor of 2. The equity net asset position shown in Figure 4 was slightly negative relative to U.S. GNI until 1993. Between 1993 and 2005, the ratio averaged 3 percent. Thus, taking into account both the direct investment and the portfolio assets, the equity asset position is positive but low, especially given the income stream from equity holdings.[7]

It is also low relative to estimates of McGrattan and Prescott (2005). We estimated the capital in foreign subsidiaries by capitalizing the foreign profits. Specifically, we assumed that the ratio of domestic after-tax profits to the domestic capital stock was equal to the ratio of foreign after-tax profits (net) to the net stock in foreign subsidiaries. The ratio of foreign to domestic after-tax profits was 0.11 for the 1960s and 0.29 for the 1990s. The stock of corporate tangible capital (including inventories and land) in both periods was about one times U.S. GDP. Given GDP and GNI are not very different, we would have predicted a rise in the net direct investment position from about 11 percent of GNI in the 1960s to about 29 percent of GNI in the 1990s. But the asset position reported by the BEA, and shown in Figure 5, is very different. The BEA estimates are about 6 percent of GNI in the 1960s and about 2 percent of GNI in the 1990s. More recently, the reported

[7] The current cost measure and market value measure are not the same so we do not show the sum.

position has risen but it is still below 5 percent of GNI.

If we analyze these data with standard theory, these data are puzzling. In particular, the asset positions from FDI fell despite the fact that net income from FDI has been increasing over the entire period 1950–2005. This suggests that there is a possible problem with the income measures or the stock measures or both.

In the next section, we explore one important factor that can potentially account for the deviation from theory: unmeasured investment in intangible capital.[8] In order to quantify it, we will need to develop some new theory.

## 3. Theory

In this section, we develop a multicountry general equilibrium model that builds on our earlier work in McGrattan and Prescott (2005, 2006). The main extension is the introduction of technology capital.

### 3.1. A Theory of Technology Capital

Here, we develop a theory of technology capital in a model economy with more than one country. A country's stock of *technology capital* is the number (or measure) of technologies owned by its multinationals. A *technology* is a production unit that can be operated in any country and at any location within a country. An example of such a technology is a company brand or patent that can be used—with inputs of tangible capital, plant-specific intangible capital, and labor—in many locations simultaneously. The number of locations in a country is proportional to its population.

We begin by describing the technologies available to multinationals. We then describe

[8] Another source of mismeasurement is transfer pricing by multinationals. Evidence of Bernard et al. (2006) and estimates done by the Internal Revenue Service suggest that this is small in comparison to mismeasurement due to not counting intangible investments.

the problems faced by citizens in the different countries. Finally, we describe how BEA accountants would record transactions if placed in our model economy.

### 3.1.1. Technologies

We start by describing production in one country and then extend the analysis to below to a multi-country world.

Let $N$ be the number of production locations in the country. At each location, companies can use different types of technology capital to produce output. For expositional purposes, we assume here that technology capital is brand equity (e.g., Coca Cola). There are a total of $K$ brands available for producing output at any location.[9] Production also requires inputs of labor, tangible capital, and plant-specific intangible capital. For simplicity assume that $Z$ is the aggregate quantity of a composite of these three factors of production.

We are interested in deriving the aggregate production function that maximizes total output from all plants. A plant operated at a location displays decreasing returns to scale of its operation. Specifically, output at the plant level is given by $y = g(z)$ where $g(0) = 0$, $g$ is increasing, differentiable, and concave. Total output, given aggregate inputs $(N, K, Z)$, is then given by

$$F(N, K, Z) = \max_{\{x_{kz} \geq 0\}} \sum_{k,z} x_{kz} g(z)$$

$$\text{subject to } \sum_{k,z} x_{kz} z \leq Z$$

$$\sum_{z} x_{kz} \leq N \text{ for all } k \in 1, \dots K$$

where $x_{kz}$ is the number of plants of type $(k, z)$ operated. Given the properties of $g(\cdot)$, the maximal production allocation requires that all brands be operated in all locations, with

9 It is straight-forward to extend the analysis to a continuum of brands.

an equal amount of the composite input in each of the $NK$ production units. Thus, the aggregate production function is $F(N, K, Z) = NKg\left(Z/(NK)\right)$.

Suppose $g(z) = Az^{\phi}$ where $A$ is a parameter determining the level of technology and $\theta < 1$. Then the aggregate production function in this case is

$$F(N, K, Z; A) = AZ^{\phi}(NK)^{1-\phi}$$

where we have included $A$ as an argument for convenience. Below we assume that $A$ may vary by country and by technology capital. In general, we assume that the plant-level production technology is such that $F$ has the following properties:

$$F(N, \lambda K, \lambda Z) = \lambda F(N, K, Z)$$
$$F(\lambda N, K, \lambda Z) = \lambda F(N, K, Z).$$

Thus, there are constant returns to the composite input and the number of production units. Doubling the possible production units, either by doubling the number of locations or doubling the brands, implies a doubling of the output.

In the multi-country case, we assume that the only factor that can be used both at home and abroad is technology capital (e.g., brands). Let $i$ index the countries. Total output in country $i$ is given by

$$Y^i = \sum_j F(N^i, K_j, Z^i_j; A^i_j) \tag{3.1}$$

where $j$ indexes the country of origin of brands $K_j$, $Z^i_j$ is the composite capital-labor input in country $i$ used to produce output with brands $K_j$, and $N^i$ is the size of country $i$. The parameters $\{A^i_j\}$ are indexed by both $i$ and $j$. There are common factors, like access to R&D in a country where companies produce, that affect $A$ of domestic and foreign multinationals the same way. There are also factors, like regulations on foreign competitors, that imply a different $A$ for domestic and foreign multinationals.

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

$$Z_j^i = (K_{m,j}^i)^{\theta_m} (K_{u,j}^i)^{\theta_u} (L_j^i)^{1-\theta_m-\theta_u}$$

with inputs of *measured* tangible capital, $K_{m,j}^i$, *unmeasured* plant-specific intangible capital, $K_{u,j}^i$, and labor $L_j^i$. In order to distinguish the capital stocks, we will index the technology capital in (3.1) with $T$ when using it to define the optimization problem of the multinational.

### 3.1.2. Multinationals

The stand-in multinational $j$ solves

$$\max \sum_t p_t (1-\tau_d) D_{j,t}$$

subject to

$$\begin{aligned}
D_{j,t} = \sum_i \{ &(1-\tau_{p,t}^i)(Y_{j,t}^i - W_t^i L_{j,t}^i - \delta_m K_{m,j,t}^i \\
&\qquad - X_{u,j,t}^i - \chi_j^i X_{T,j,t}) - (K_{m,j,t+1}^i - K_{m,j,t}^i)\} \\
K_{m,j,t+1}^i &= (1-\delta_m) K_{m,j,t}^i + X_{m,j,t}^i \\
K_{u,j,t+1}^i &= (1-\delta_u) K_{u,j,t}^i + X_{u,j,t}^i \\
K_{T,j,t+1} &= (1-\delta_T) K_{T,j,t} + X_{T,j,t}
\end{aligned}$$

and the production technologies described above. The variable $\chi_j^i$ is the fraction of investment in technology $j$ that is expensed in country $i$. Thus, $\sum_i \chi_j^i = 1$. Multinationals pay tax on profits at rate $\tau_p^i$ and can expense investments in firm-specific intangible and technology capital.

### 3.2. Households

Households solve the following problem

$$\max \sum_t \beta^t U(C_t^i/N_t^i, L_t^i/N_t^i + \bar{L}_{nb,t}^i/N_t^i)N_t^i$$

$$\text{subj. to} \quad \sum_t p_t[(1+\tau_c^i)C_t^i + \sum_j V_{j,t}(S_{j,t+1}^i - S_{j,t}^i) + B_{t+1}^i - B_t^i]$$
$$\leq \sum_t p_t[(1-\tau_l^i)W_t^i L_t^i + (1-\tau_d)\sum_j S_{j,t}^i D_{j,t} + r_{b,t}B_t^i + \kappa_t^i]$$

with $r_{b,t}$ equal to the after-tax return on lending/borrowing. We assume that country $i$ has a population of size $N_0^i(1+\eta)^t$, with growth rate $\eta$ which is assumed for now to be common. The stand-in household in country $i$ consumes $C_t^i$ and provides labor of $L_t^i$ to multinationals and $\bar{L}_{nb,t}^i$ to nonbusiness activities.[10] Purchases of consumption are taxed at rate $\tau_c^i$ and labor income is taxed at rate $\tau_l^i$. Households also hold and trade equity shares of multinationals and borrow or lend between countries. The share holding for $i$ of $j$ is $S_{j,t}^i$ and the total bond holding is $B^i$. Total shares outstanding are normalized to 1 and bond holdings are in zero net supply. Income earned on the assets are equity distributions, taxed at rate $\tau_d$ in all countries, and interest income. Transfers from the government and income less investment from nonbusiness activity (assumed to be exogenously determined) is summarized by the term $\kappa_t^i$.

### 3.3. Reported and Actual Accounts

Because investments in plant-specific intangible capital and technology capital are expensed, the domestic and international data collected and published by government agencies would not coincide with the actual accounts for items such as investment and retained earnings. Here, we briefly describe the differences. (See Appendix B for more details.)

Because intangible capital is expensed, government accounts do not include intangible

[10] We have included nonbusiness hours (exogenously) in total hours and will include nonbusiness income less investment in $\kappa^i$. The nonbusiness sector is added in order to ensure that the NIPA aggregates are of the right order of magnitude.

depreciation or undistributed profits. This affects both the domestic accounts and the net factor income. It does not affect net exports. Thus, any differences in the reported and actual current account balance is due to differences in reported and actual net factor income.

Some of the net factor income is portfolio income and some is foreign direct investment. They are not treated symmetrically. In the accounts, income on equity portfolios only includes dividends. Income on FDI includes both dividends and part of undistributed profits.

## 4. Quantitative Predictions for the United States

In this section we conduct experiments in the context of our model economy with two initially symmetric 'countries': the United States and the rest of the world. The first experiment is a neutral experiment: starting in 1985, U.S. investors hold more foreign equity and less debt but no real economic activity changes. The second set of experiments have nonneutral changes that cause a decline in net exports: (a) a policy change that induces an increase in nonbusiness expenditures on residential construction and the war in Iraq starting in the late 1990s and (b) a population decline in other industrial nations after 1990. These experiments are motivated by events in the United States during the last several decades.

### 4.1. Parameters

Table 1 summarizes the parameters that are held fixed in all experiments. Most are taken from McGrattan and Prescott (2006).

Initial growth rates are assumed to be the same for both countries with populations growing at 1 percent per year and technology growing at 2 percent per year. Utility is logarithmic with the weight on leisure equal to 1.32. The discount factor is chosen so that the interest rates is slightly above 4 percent.

The income shares imply that capital earns 33 percent and labor earns 67 percent. The shares of intangible capital—plant-specific and technology—imply that roughly one-third is specific to the location and two-thirds is not. This is consistent with estimates of Corrado et al. (2006). Depreciation rates for plant-specific capital and technology capital are taken to be 0 and 10 percent, respectively. There are no good estimates on these rates but we'll assume that brand equity and patents have a greater rate of decay than organizational capital. For tangible capital, we use 5 percent.

The technology parameters $A_j^i$ are set so that there is only a slight cost of operating abroad, with $A_j^i = 1$ for $i = j$ and 0.98 for $i \neq j$. This choice yields a unique symmetric balanced growth path.[11]

Tax rates are based on U.S. rates as in McGrattan and Prescott (2006). Because we are modeling multinationals in industrial nations with comparable tax rates, we set them equal across countries. We set the expense rates such that technology capital is expensed at home (that is, in the country of incorporation). We set initial debt owed at zero and initial ownership of shares such that U.S. households own 95 percent of U.S. companies and similarly for foreigners.

The steady state (balanced growth path) for these parameters is given in Tables 2 and 3, panels A and B. (See Appendix B for details on how these were computed.) In Table 2A, we report the domestic and national accounts as they would be recorded in government accounts. In Table 2B, we report the accounts including the investments and incomes not recorded in government accounts. Tables 3A and 3B are the corresponding tables with stock values.

[11] If all $A$'s the same, there a multiple steady states.

Table 4 summarizes the time series inputs for numerical experiments described next.

### 4.2. Experiments

We can now use our parameterized model economy to study the United States current account and net asset positions. We are particularly interested in seeing how quantitatively important are the discrepancies between reported and actual accounts and moreover whether these discrepancies can help us account for the puzzling features of the data in the last several decades.

In all of the experiments, we assume that the United States increases its foreign borrowing starting around 1985. Prior to 1985, U.S. interest payments to the rest of the world were very small and the net debt position roughly zero. After that time, the U.S. became net debtors with interest payments (net) now at around 1.5 percent of GNI. Figure 6 shows the input for $B$ relative to the trend growth $(1+g) = (1+\gamma)(1+\eta)$. U.S. borrowing is assumed to rise at a rate consistent with U.S. observations.

#### 4.2.1. Neutral Changes

At the same time that foreign borrowing was increasing, the United States increased net equity holdings abroad. This pattern motivates our first experiment: a swap of debt for equity. In Figure 7A, we show the share of foreign equity. The path of foreign equity holdings is chosen so that there is no real change relative to the balanced growth trend. Essentially, the households are indifferent to their portfolio composition. All assets earn the same rate of return and there is no home bias.

Figure 7B shows the reported and actual current account balance. The reported balance falls significantly and stays negative permanently, while the actual balance rises significantly and stays positive permanently. The difference is payments to equity that do not show up in the reported accounts. In this experiment, net FDI earnings are not affected. Thus, the missing earnings are undistributed profits on equity portfolios.

Interestingly, although the real consumption and hours—and therefore welfare—of U.S. households and foreign households remain unchanged, the shift in asset ownership implies that U.S. households own more of the world technology capital. Figure 7C displays the market values of U.S.-owned and foreign-owned technology capital.

The main lesson from this examples is that the current account and net asset positions as reported are missing both equity income and capital. Thus, any change affecting the portfolio composition, even if it does not affect the welfare of households, can have an effect on the reported international accounts.

#### 4.2.2. Nonneutral Changes

With neutral changes, there is no change of net exports. In the United States, however, the current account and net exports have been moving together. We consider two reasons for the drop in net exports and their consequences for the reported and actual international accounts: a policy change inducing a boom in nonbusiness investment in the United States and a decline in population growth rates abroad.

Figure 8A is a stylized change in the share of U.S. nonbusiness investment motivated by recent increases in residential investment and government defense spending for the war in Iraq. These two increases together were on the order of 3 to 4 percent of GDP between 2000 and 2005 and may well increase another percent. Thus, we input a 5 percentage point shift in $X_{nb,t}^{us}$ relative to U.S. GDP. Along with this change, we assume that debt levels change as in Figure 6.

The increase in U.S. investment results in a large decline in net exports. This decline is the same for the government accounts and the actual accounts. However, the change in net factor income is not the same. Figure 8B displays the reported international net flows, and Figure 8C displays the actual international net flows. The reported net current account balance starts to decline as early as 1985 because of the increased U.S. borrowing and thus increase net interest payments abroad. The actual accounts show an increase in the net current account balance for the same reasons as before: equity income from abroad is rising. Thus, the lessons of this experiment are similar to the first experiment: details of the portfolio composition matter. This is true whether or not there is a shift in net exports.

In Figure 8D, we display the market values of technology capital owned by U.S. households and by foreign households. As before, there is a shift in ownership as the U.S. equity holdings rise. The net position starts at zero percent of GNI and rises to over 6 percent.

The second nonneutral experiment that we conduct assumes differential population growth rates in the two countries. This experiment is motivated by the fact that growth in European nations has slowed significantly in the last two decades. Differential growth has large consequences for net exports and net factor incomes.

Figure 9A displays the inputs for this experiment. The two countries start out the same size, and in 1990 the foreign population growth rate falls. As before, U.S. debt levels relative to trend fall as in Figure 6.

With smaller population abroad, production and investment shifts to the United States. Figure 9B displays net exports, reported net factor income, and the reported current account balance. Net exports start to fall until 2000 and then recover to a level permanently below trend. Reported net factor income, on the other hand, rises and stays permanently close to 1/2 percent of GNI per year. Figure 9C displays the actual net factor income—which includes all retained earnings—and the picture is quite different than reported. Actual net factor income first rises and then drops back to 1/2 percent of GNI per year. In Figure 9D, we display the market values of technology capital owned by U.S. households and by foreign households. The shift in ownership is larger than the earlier experiments given that more production is shifting to the United States. In this case, the net position rises to almost 10 percent of GNI.

In Figures 9E and 9F we show how the net positions for the capital used in foreign subsidiaries, at current cost, change as the foreign population changes. Figure 9E is the reported and actual net direct investment positions, excluding any technology capital. The difference between these is the intangible capital that is plant-specific. By the end of the simulation, the difference is close to 20 percent of U.S. GNI. Figure 9F shows the technology capital of U.S. and foreign companies. This capital is used in all operations so it should be treated differently than capital that is specific to a location. Here, we show how much has been accumulated by U.S. companies and how much by foreign companies. The difference is greater than 20 percent of U.S. GNI. Of course there is an issue best about how to assign technology capital to 'domestic' and 'foreign' activities. But, however, the assignment is made, the lessons learned from these experiments is the same. Abstracting from intangible capital has important quantitative consequences for the U.S. current account balance and net investment position.

## 5. Conclusion

Over the past decade, the U.S. current account deficit has risen from one percent of gross national income to over six percent of GNI. This has lead many economists to conclude that the United States has a problem that policymakers should address.[12] In this paper, we show that some caution should be used when analyzing the data given the government data does not include intangible investments. We develop and use a multicountry model

[12] Prominent examples are Obstfeld and Rogoff (2006) and Stiglitz (2006). See Backus et al. (2006) for the opposing view.

to show that abstracting from intangible investments can have large consequences for the current account balance and net asset position which understate equity income and capital stocks. On the basis of or model's quantitative predictions, we find no prima facie evidence that there is a problem to address.

# A. Data Appendix

Figure 1. National Income and Product Accounts Table 4.1, 1929–2005

- Balance on current account
- Net exports of goods and services

Figure 2. National Income and Product Accounts Table 4.1, 1929–2005

- Income receipts less payments
- Income receipts less payments, dividends plus reinvested earnings on direct investment
- Income receipts less payments, interest

Figure 3. International Investment Position of the U.S. at Yearend, 1976–2005

- U.S.-owned assets abroad, excluding direct investment and corporate equities
- Foreign-owned assets in the United States, excluding direct investment and corporate equities

Figure 4. Flow of Funds Accounts for the United States, Table L-107, 1946–2006

- U.S. direct investment abroad valued at current cost
- Foreign direct investment in U.S. valued at current cost

Figure 5. Flow of Funds Accounts for the United States, Table L-107, 1946–2006

- U.S. corporate equities held by rest of the world
- Foreign corporate equities held by U.S. residents

All Figures. National Income and Product Accounts Table 1.7.5, 1929–2005

- Gross national income

## B. Model Accounts

In this appendix, we summarize the national and international accounts for country $i$ in our model economy. Some valuations are in current cost (cc) and some in market value (mv). A tilde ($\sim$) over a capital stock indicates an end of period value. A delta ($\Delta$) before a capital stock indicates change over the period.

### B.1. Government Accounts

| | |
|---|---|
| *Gross Domestic Income* | |
| Depreciation | $\delta_m \sum_j K^i_{m,j}$ |
| Compensation | $W^i L^i$ |
| Profits | |
| Undistributed | $\sum_j (\Delta K^i_{m,j})$ |
| Net dividends | $\sum_j (Y^i_j - X^i_{u,j} - X^i_{m,j} - \chi^i_j X_{T,j}) - W^i L^i -$ Tax liability |
| Tax liability | $\tau^i_p \{\sum_j (Y^i_j - X^i_{u,j} - \chi^i_j X_{T,j} - \delta_m K^i_{m,j}) - W^i L^i\}$ |
| *Gross Domestic Product* | |
| Consumption | $C^i$ |
| Investment | $\sum_j X^i_{m,j} + \bar{X}^i_{nb}$ |
| Net exports | $\sum_j (Y^i_j - X^i_{m,j} - X^i_{u,j} - \chi^i_j X_{T,j}) + \bar{Y}^i_{nb} - C^i - \bar{X}^i_{nb}$ |
| *Net factor receipts* | |
| FDI dividends | $\sum_{\ell \neq i} (1-\tau^\ell_p)\{Y^\ell_i - W^\ell L^\ell_i - \delta_m K^\ell_{m,i} - X^\ell_{u,i} - \chi^\ell_i X_{T,i}\} - \Delta K^\ell_{m,i}$ |
| FDI undistributed | $\sum_{\ell \neq i} \Delta K^\ell_{m,i}$ |
| Portfolio income | $\sum_{j \neq i} S^i_j D_j + \max(r_b B^i, 0)$ |
| *Net factor payments* | |
| FDI dividends | $\sum_{j \neq i} (1-\tau^i_p)\{Y^i_j - W^i L^i_j - \delta_m K^i_{m,j} - X^i_{u,j} - \chi^i_j X_{T,j}\} - \Delta K^i_{m,j}$ |
| FDI undistributed | $\sum_{j \neq i} \Delta K^i_{m,j}$ |
| Portfolio income | $\sum_{\ell \neq i} S^\ell_i D_i + \max(-r_b B^i, 0)$ |
| *Current Account* | Net exports + Net factor receipts less payments |
| *Net Asset Positions* | |
| FDI (cc) | $\sum_{\ell \neq i} \tilde{K}^\ell_{m,i} - \sum_{j \neq i} \tilde{K}^i_{m,j}$ |
| Portfolio (mv) | $\sum_{j \neq i} S^i_j V_j - \sum_{\ell \neq i} S^\ell_i V_i + B^i$ |

### B.2. Actual Accounts

| | |
|---|---|
| *Gross Domestic Income* | |
| Depreciation | reported $+\sum_j(\delta_u K^i_{u,j} + \delta_T \chi^i_j K_{T,j})$ |
| Compensation | reported |
| Profits | |
| Undistributed | reported$+ \sum_j \Delta(K^i_{u,j} + \chi^i_j K_{T,j})$ |
| Net dividends | reported |
| Tax liability | reported |
| *Gross Domestic Product* | |
| Consumption | reported |
| Investment | reported $+\sum_j(X^i_{u,j} + \chi^i_j X_{T,j})$ |
| Net exports | reported |
| *Net factor receipts* | |
| FDI dividends | reported |
| FDI undistributed | reported $+ \sum_{\ell\neq i} \Delta(K^\ell_{u,i} + \chi^\ell_i K_{T,i})$ |
| Portfolio income | reported $+ \sum_{j\neq i} S^i_j[\sum_\ell \Delta K^\ell_{m,j} + \Delta K^\ell_{u,j}) + \chi^i_j X_{T,j} - \delta_T K_{T,j}]$ |
| *Net factor payments* | |
| FDI dividends | reported |
| FDI undistributed | reported $+ \sum_{j\neq i} \Delta(K^i_{u,j} + \chi^i_j K_{T,j})$ |
| Portfolio income | reported $+ \sum_{\ell\neq i} S^\ell_i[\sum_\ell \Delta K^\ell_{m,i} + \Delta K^\ell_{u,i}) + \chi^\ell_i X_{T,i} - \delta_T K_{T,i}]$ |
| *Current Account* | Net exports + Actual net factor receipts less payments |
| *Net Asset Positions* | |
| FDI (cc) | reported $+ \sum_{\ell\neq i} \tilde{K}^\ell_{u,i} - \sum_{j\neq i} \tilde{K}^i_{u,j}$ |
| FDI (mv) | $(1-\tau_d)\{\sum_{\ell\neq i}(\tilde{K}^\ell_{m,i} + (1-\tau^\ell_p)\tilde{K}^\ell_{u,i}) - \sum_{j\neq i}(\tilde{K}^i_{m,j} - (1-\tau^i_p)\tilde{K}^i_{u,j})\}$ |
| Technology capital (mv) | |
| by country of inc. | $(1-\tau_d)\{(\sum_\ell \chi^\ell_i(1-\tau^\ell_p))\tilde{K}_{T,i} - (\sum_{j\neq i}\sum_\ell \chi^\ell_j(1-\tau^j_p))\tilde{K}_{T,j}\}$ |
| by ownership | $\sum_j[S^i_j - \sum_{\ell\neq i} S^\ell_j](1-\tau_d)(\sum_\ell \chi^\ell_j(1-\tau^\ell_p))\tilde{K}_{T,j}$ |
| Portfolio (mv) | reported |

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TABLE 1. Model Parameters

| Parameter | Expression | Value |
|---|---|---|
| Growth Rates | | |
| Population | $\eta$ | .01 |
| Technology | $\gamma$ | .02 |
| Preferences | | |
| Discount factor | $\beta$ | .98 |
| Leisure weight | $\psi$ | 1.32 |
| Income Shares | | |
| Tangible capital | $\phi\theta_m$ | .23 |
| Plant-specific intangible capital | $\phi\theta_u$ | .04 |
| Labor | $\phi(1-\theta_m-\theta_u)$ | .67 |
| Technology capital | $1-\phi$ | .06 |
| Technology Levels | | |
| At home, $i = 1, 2$ | $A_i^i$ | 1.0 |
| Abroad, $i \neq j$ | $A_j^i$ | .98 |
| Plant-specific intangible capital | $\delta_u$ | 0 |
| Technology capital | $\delta_T$ | .10 |
| Depreciation Rates | | |
| Tangible capital | $\delta_m$ | .05 |
| Plant-specific intangible capital | $\delta_u$ | 0 |
| Technology capital | $\delta_T$ | .10 |
| Tax Rates | | |
| Tax rates on profits, $i = 1, 2$ | $\tau_p^i$ | .35 |
| Tax rates on labor $i = 1, 2$ | $\tau_l^i$ | .31 |
| Tax rate on consumptions, $i = 1, 2$ | $\tau_c^i$ | .066 |
| Tax rate on distributions | $\tau_d$ | .15 |
| Expense Rates | | |
| Technology capital expensed at home, $i = 1, 2$ | $\chi_i^i$ | 1 |
| Initial Assets | | |
| Debt | $B_0$ | 0 |
| Equity shares, $i = 1, 2$ | $S_{i,0}^i$ | .95 |

TABLE 2A. Steady State Flow Values for Government Accounts

| Variable | Value |
|---|---|
| **Domestic Product** | |
| Consumption | .755 |
| Investment | .245 |
| Measured | .115 |
| Nonbusiness | .130 |
| Net Exports | .000 |
| Gross Domestic Product | 1.000 |
| **Domestic Income** | |
| Compensation | .487 |
| Depreciation | .072 |
| Domestic Profits | .101 |
| Tax liability | .035 |
| Undistributed | .043 |
| Dividends | .022 |
| Nonbusiness income | .340 |
| Gross Domestic Income | 1.000 |
| **Income Receipts on Assets Abroad** | |
| Direct Investment Earnings | .038 |
| Dividends | .020 |
| Undistributed profits | .018 |
| Portfolio Income | .001 |
| Dividends | .001 |
| Interest | .000 |
| Total Income Receipts on Assets Abroad | .039 |
| **Income Payments Assets Abroad** | |
| Direct Investment Earnings | .038 |
| Dividends | .020 |
| Undistributed profits | .018 |
| Portfolio Income | .001 |
| Dividends | .001 |
| Interest | .000 |
| Total Income Payments on Assets Abroad | .039 |
| Net Factor Income | .000 |
| Gross National Income | 1.000 |

TABLE 2B. Steady State Values for Actual Accounts

| Variable | Value |
|---|---|
| **Domestic Product** | |
| Consumption | .755 |
| Investment | .305 |
| Tangible | .115 |
| Plant-specific intangible | .020 |
| Technology intangible | .040 |
| Nonbusiness | .130 |
| Net Exports | .000 |
| Gross Domestic Product | 1.000 |
| **Domestic Income** | |
| Compensation | .487 |
| Depreciation | .103 |
| Domestic Profits | .130 |
| Tax liability | .035 |
| Undistributed | .073 |
| Dividends | .022 |
| Nonbusiness income | .340 |
| Gross Domestic Income | 1.060 |
| **Income Receipts on Assets Abroad** | |
| Direct Investment Earnings | .046 |
| Dividends | .020 |
| Undistributed profits | .026 |
| Portfolio Income | .005 |
| Dividends | .005 |
| Interest | .000 |
| Total Income Receipts on Assets Abroad | .051 |
| **Income Payments Assets Abroad** | |
| Direct Investment Earnings | .046 |
| Dividends | .020 |
| Undistributed profits | .026 |
| Portfolio Income | .005 |
| Dividends | .005 |
| Interest | .000 |
| Total Income Payments on Assets Abroad | .051 |
| Net Factor Income | .000 |
| Gross National Income | 1.060 |

TABLE 3A. Steady State Stock Values for Government Accounts

| Variable | Value |
|---|---|
| U.S. Assets Abroad | |
| Direct investment at current cost | .600 |
| Foreign equities at market value | .088 |
| Foreign net debt at market value | .000 |
| Foreign Assets in the U.S. | |
| Direct investment at current cost | .600 |
| Foreign equities at market value | .088 |
| Foreign net debt at market value | .000 |
| Net Position | .000 |

TABLE 3B. Steady State Stock Values for Actual Accounts

| Variable | Value |
|---|---|
| U.S. Assets Abroad | |
| Direct investment at current cost | .876 |
| Foreign equities at market value | .088 |
| Foreign net debt at market value | .000 |
| Foreign Assets in the U.S. | |
| Direct investment at current cost | .876 |
| Foreign equities at market value | .088 |
| Foreign net debt at market value | .000 |
| Net Position | .000 |
| Technology Capital at Market Value | |
| U.S. households | .169 |
| Foreign households | .169 |

TABLE 4. Time Series for Numerical Experiments

| Year | All Examples | Neutral Change | Nonneutral Changes | |
|---|---|---|---|---|
| $t$ | $B_t/(1+g)^t$ | $S^{us}_{row,t}$ | $X^{us}_{nb,t}/\text{GDP}^{us}_t$ | $\dot{N}_{row,t}$ |
| 1975 | 0 | 1.5 | 13.0 | 1.0 |
| 1976 | 0 | 1.5 | 13.0 | 1.0 |
| 1977 | 0 | 1.5 | 13.0 | 1.0 |
| 1978 | 0 | 1.5 | 13.0 | 1.0 |
| 1979 | 0 | 1.5 | 13.0 | 1.0 |
| 1980 | 0 | 1.5 | 13.0 | 1.0 |
| 1981 | 0 | 1.5 | 13.0 | 1.0 |
| 1982 | 0 | 1.5 | 13.0 | 1.0 |
| 1983 | 0 | 1.5 | 13.0 | 1.0 |
| 1984 | 0 | 1.5 | 13.0 | 1.0 |
| 1985 | 0 | 1.5 | 13.0 | 1.0 |
| 1986 | -1.8 | 2.4 | 13.0 | 1.0 |
| 1987 | -3.6 | 3.4 | 13.0 | .99 |
| 1988 | -5.4 | 4.3 | 13.0 | .99 |
| 1989 | -7.2 | 5.3 | 13.0 | .98 |
| 1990 | -9.0 | 6.2 | 13.0 | .96 |
| 1991 | -10.8 | 7.1 | 13.0 | .92 |
| 1992 | -12.6 | 8.1 | 13.0 | .87 |
| 1993 | -14.4 | 9.0 | 13.0 | .78 |
| 1994 | -16.2 | 10.0 | 13.0 | .68 |
| 1995 | -18.0 | 10.9 | 13.1 | .54 |
| 1996 | -19.8 | 11.8 | 13.1 | .40 |
| 1997 | -21.6 | 12.8 | 13.2 | .25 |
| 1998 | -23.4 | 13.7 | 13.4 | .12 |
| 1999 | -25.2 | 14.7 | 13.7 | .03 |
| 2000 | -27.0 | 15.6 | 14.1 | .00 |
| 2001 | -28.8 | 16.5 | 14.7 | .03 |
| 2002 | -30.6 | 17.5 | 15.4 | .12 |
| 2003 | -32.4 | 18.4 | 16.1 | .25 |
| 2004 | -34.2 | 19.4 | 16.9 | .40 |
| 2005 | -36.0 | 20.3 | 17.6 | .54 |
| 2006 | -37.8 | 21.2 | 18.0 | .68 |
| 2007 | -39.6 | 22.2 | 18.2 | .78 |
| 2008 | -41.4 | 23.1 | 18.0 | .87 |
| 2009 | -43.2 | 24.1 | 17.6 | .92 |
| 2010 | -45.0 | 25.0 | 16.9 | .96 |
| 2011 | -45.0 | 25.0 | 16.0 | .98 |
| 2012 | -45.0 | 25.0 | 15.4 | .99 |

Figures 1–2

Examining the U.S. Current Account
Annually, 1950–2005, Relative to Gross National Income

Figure 1
U.S. Current Account Balance and Net Exports

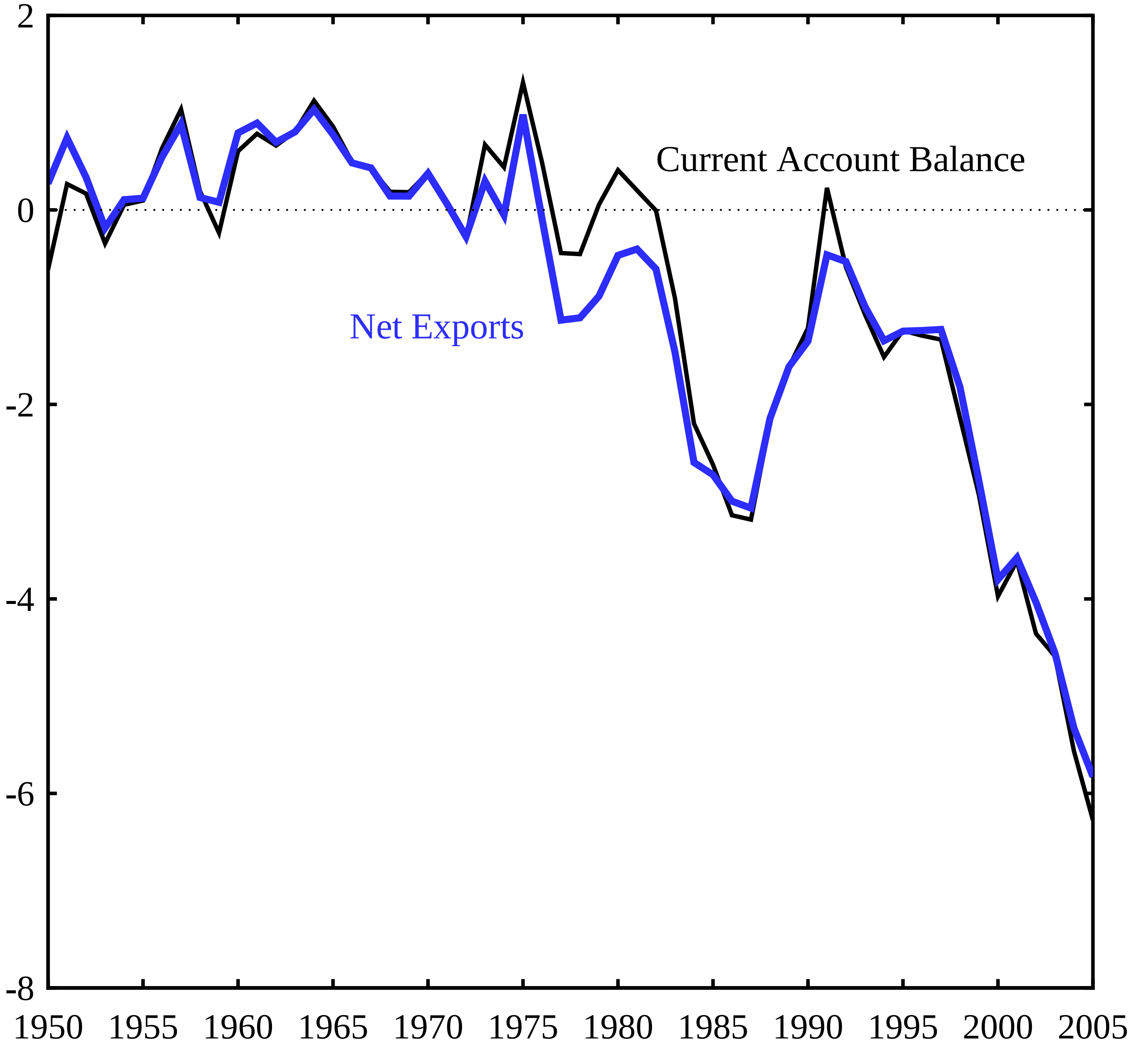
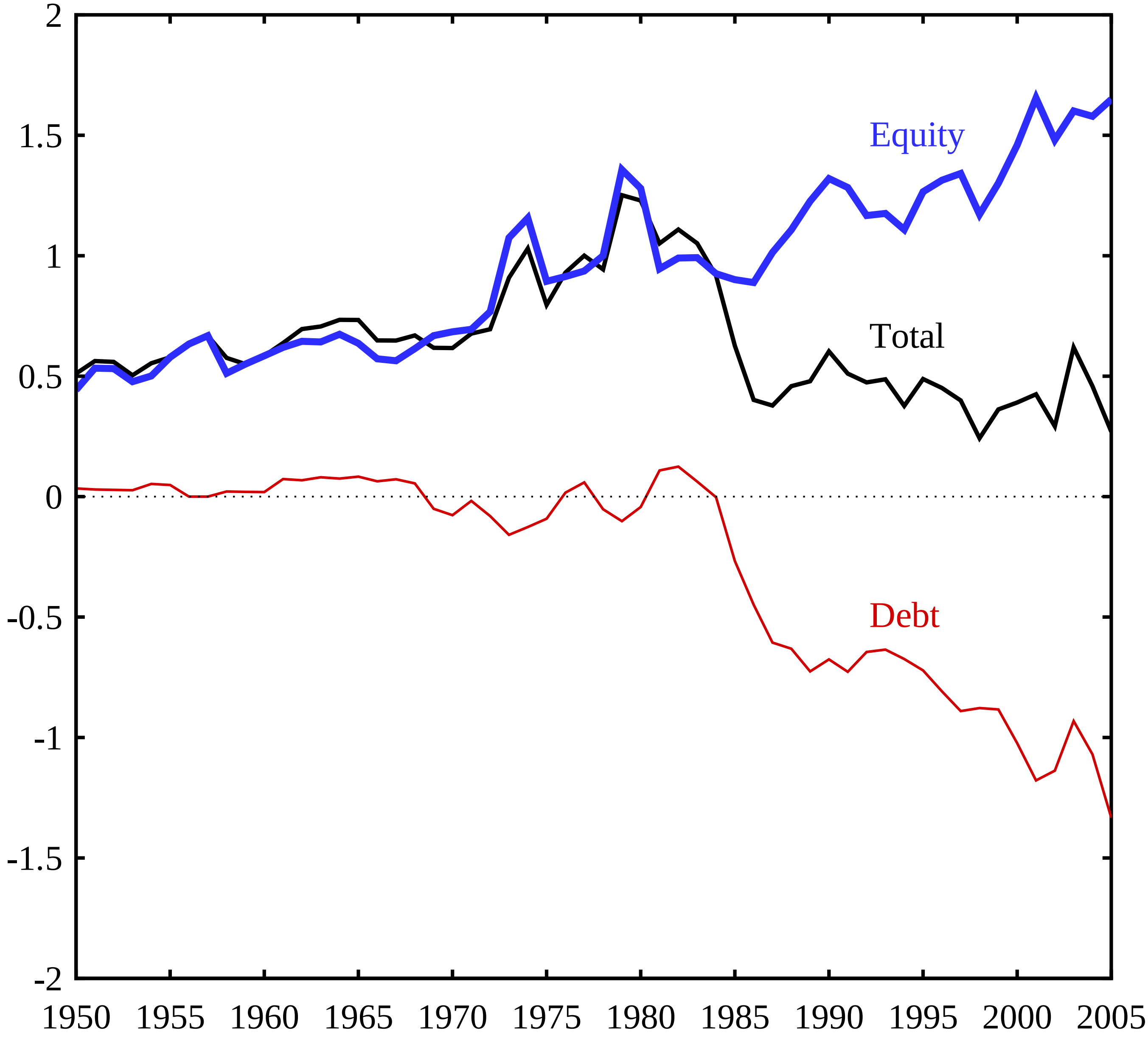


Figure 2

U.S. Net Factor Income Receipts less Payments



Figures 3–5

Examining the U.S. Net Asset Positions
Annually, 1950–2005, Relative to Gross National Income

Figure 3
U.S. and Foreign Net Debt Asset Positions

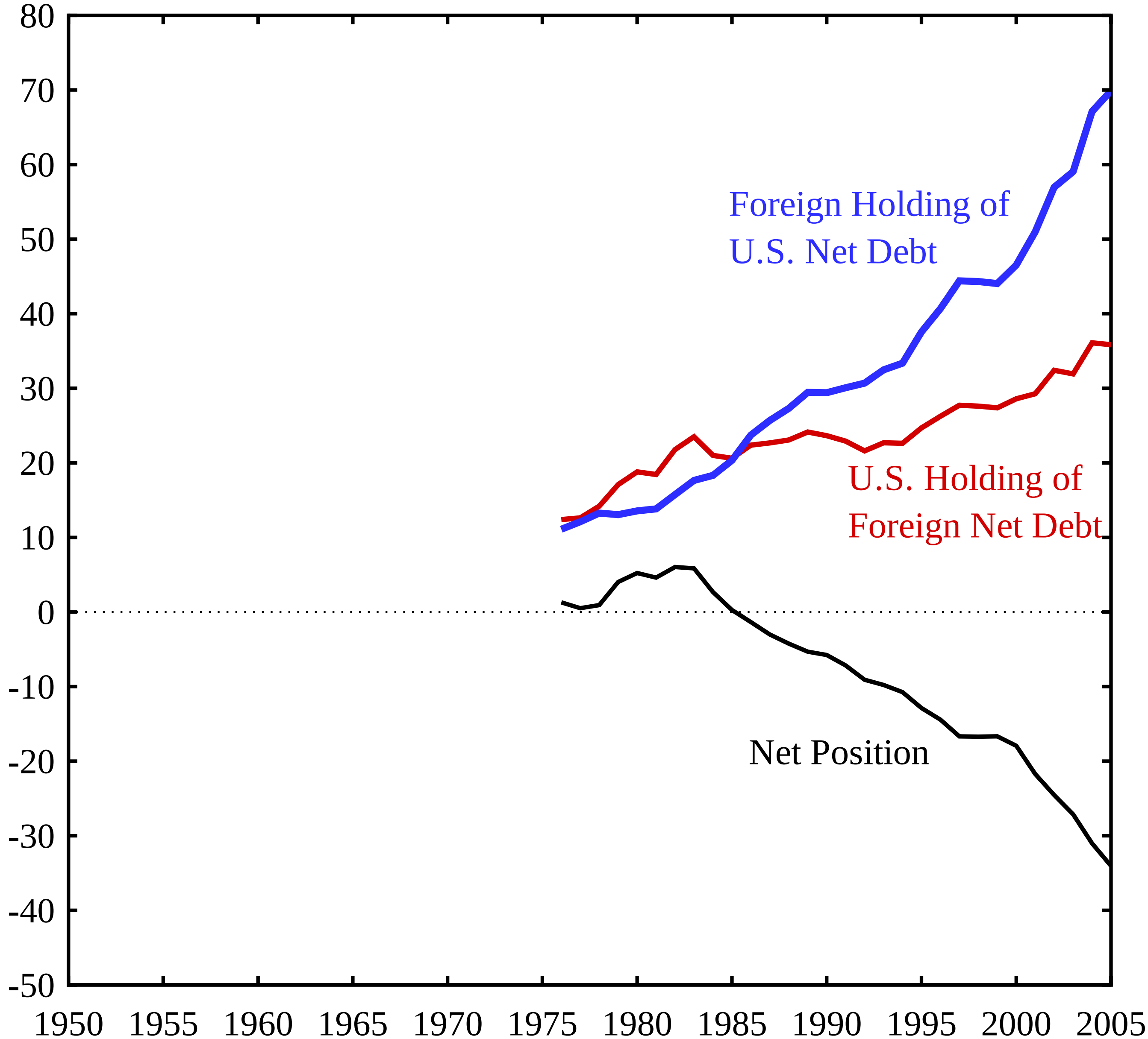


Figure 4
U.S. and Foreign Corporate Equity Positions

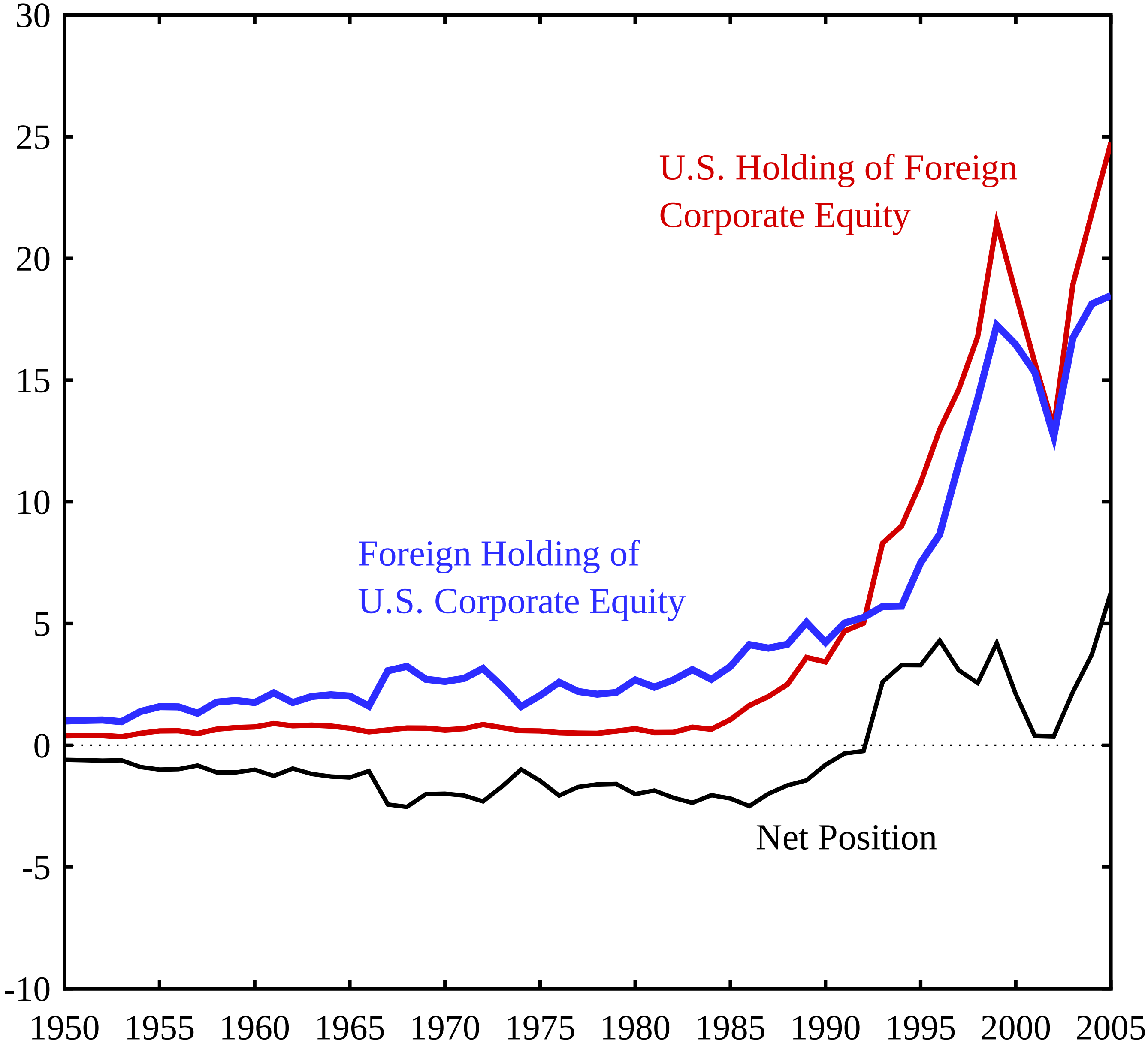
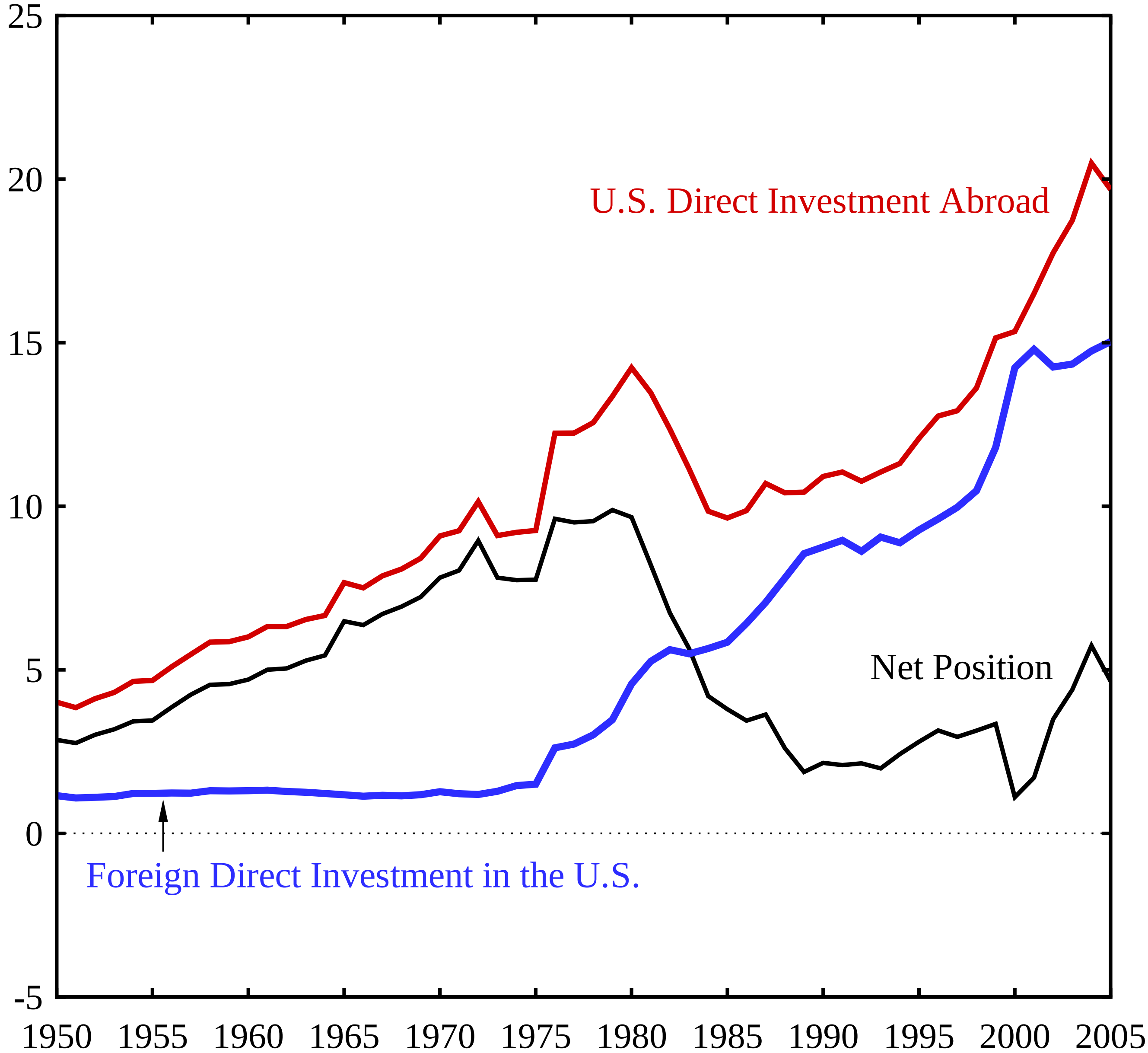


Figure 5

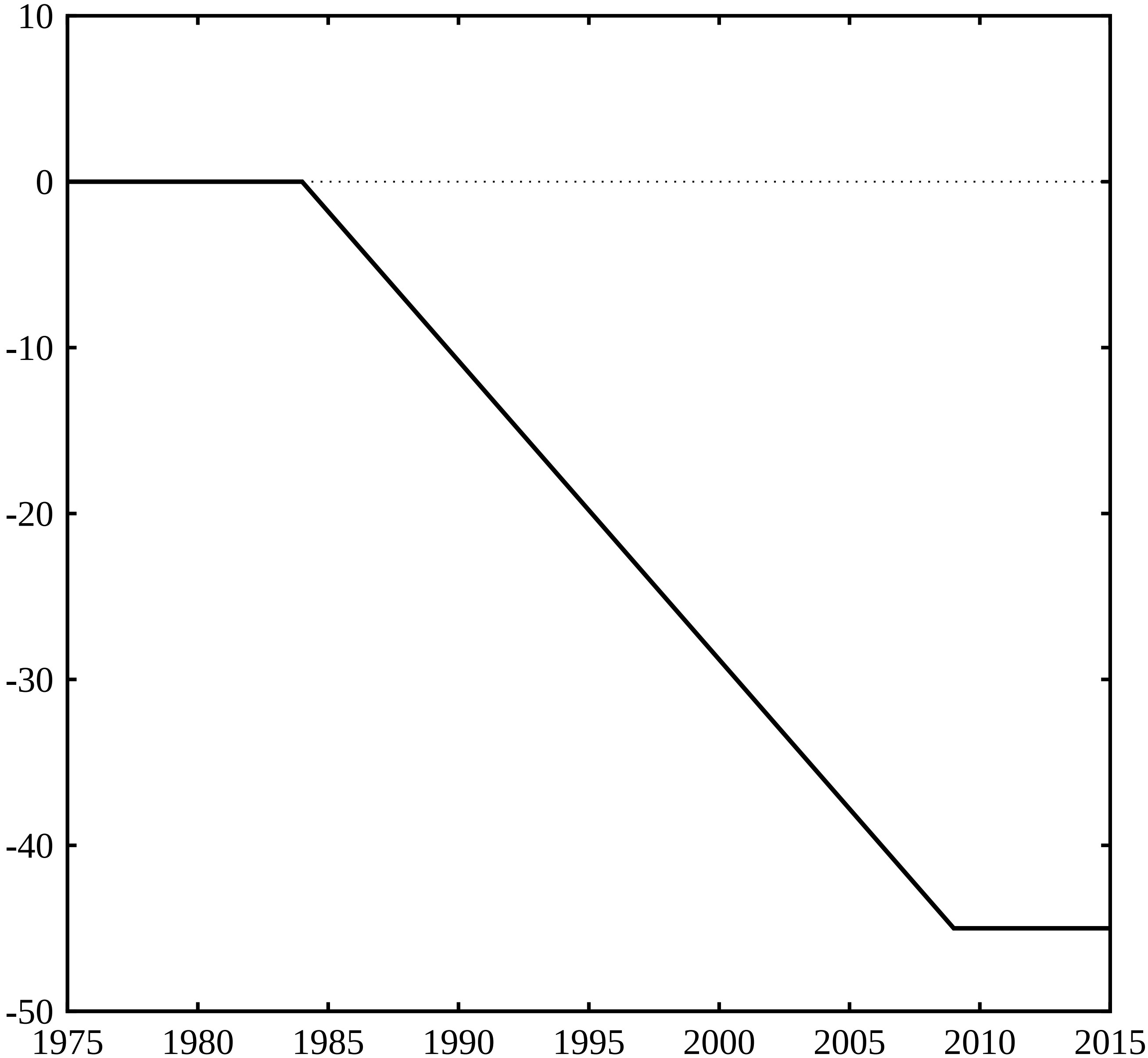
U.S. and Foreign Direct Investment Positions at Current Cost



Figures 6–9

U.S. Level of Debt
Model Input in All Numerical Experiments

Figure 6
U.S. Borrowing Relative to Trend



Figures 7A–7C

Model Inputs and Outputs
A Neutral Swap of Equity for Debt

Figure 7A
U.S. Share of Foreign Equity

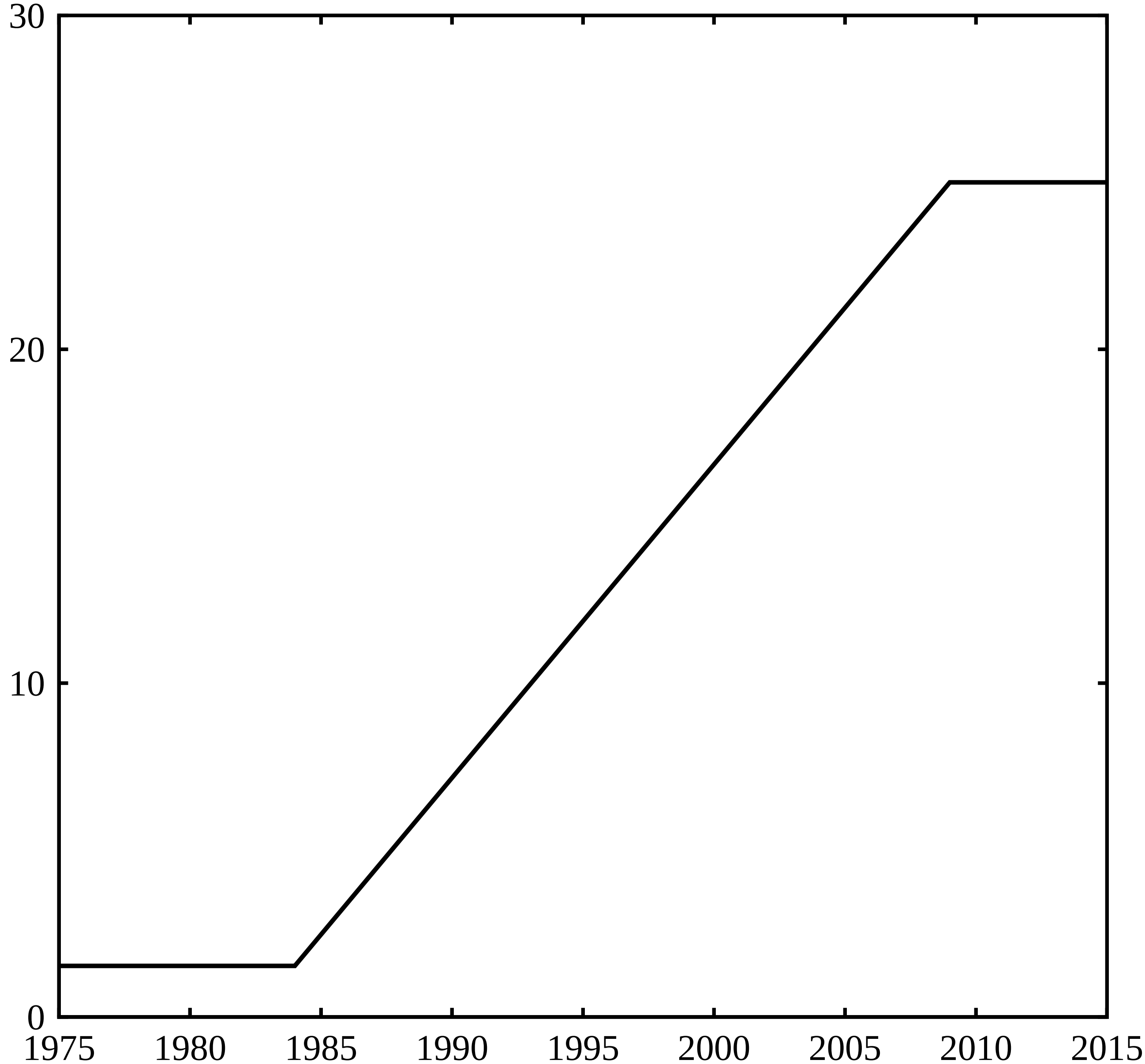


Figure 7B
Actual and Reported Current Account Balance
In Percent, Relative to U.S. GNI

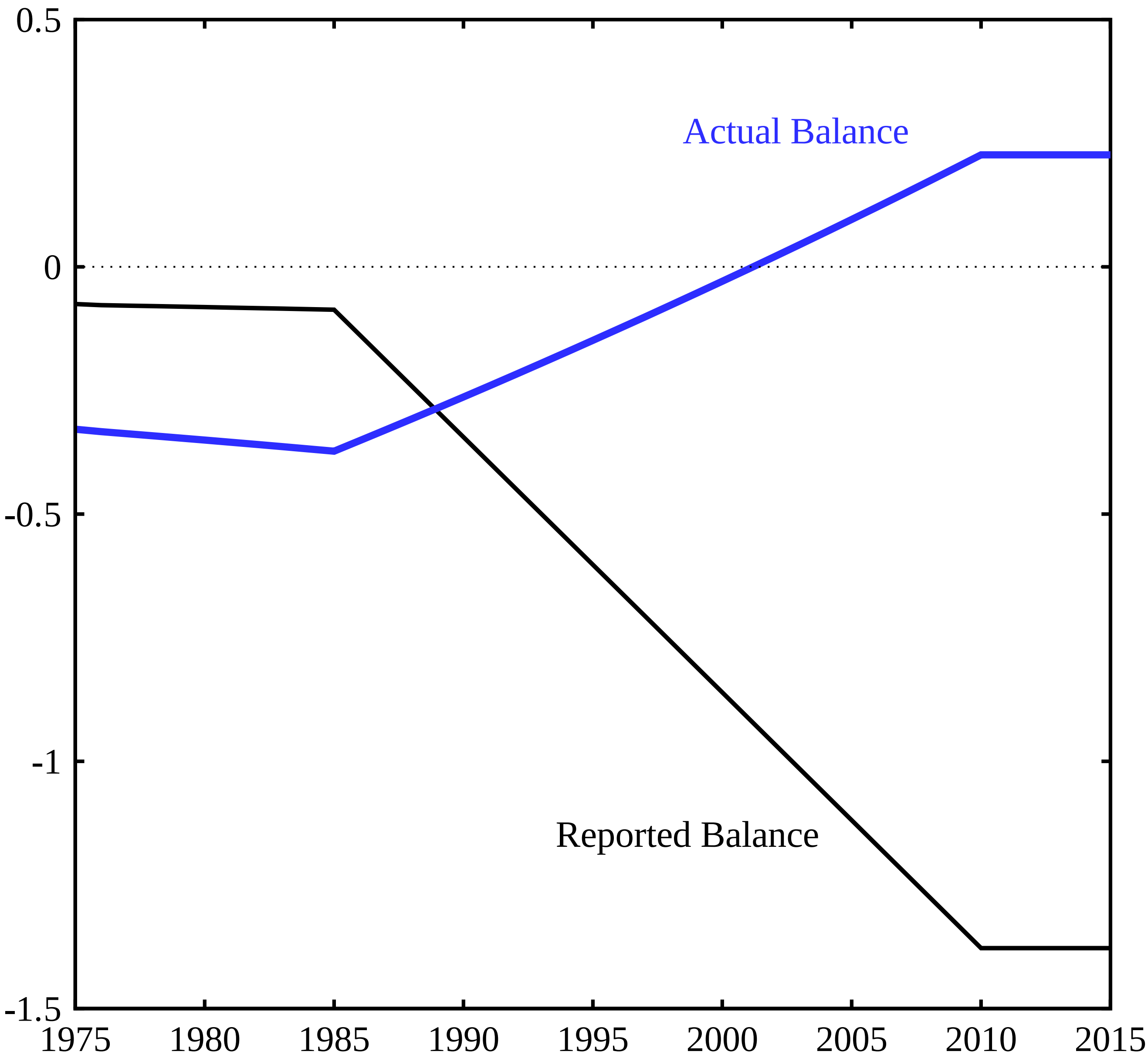
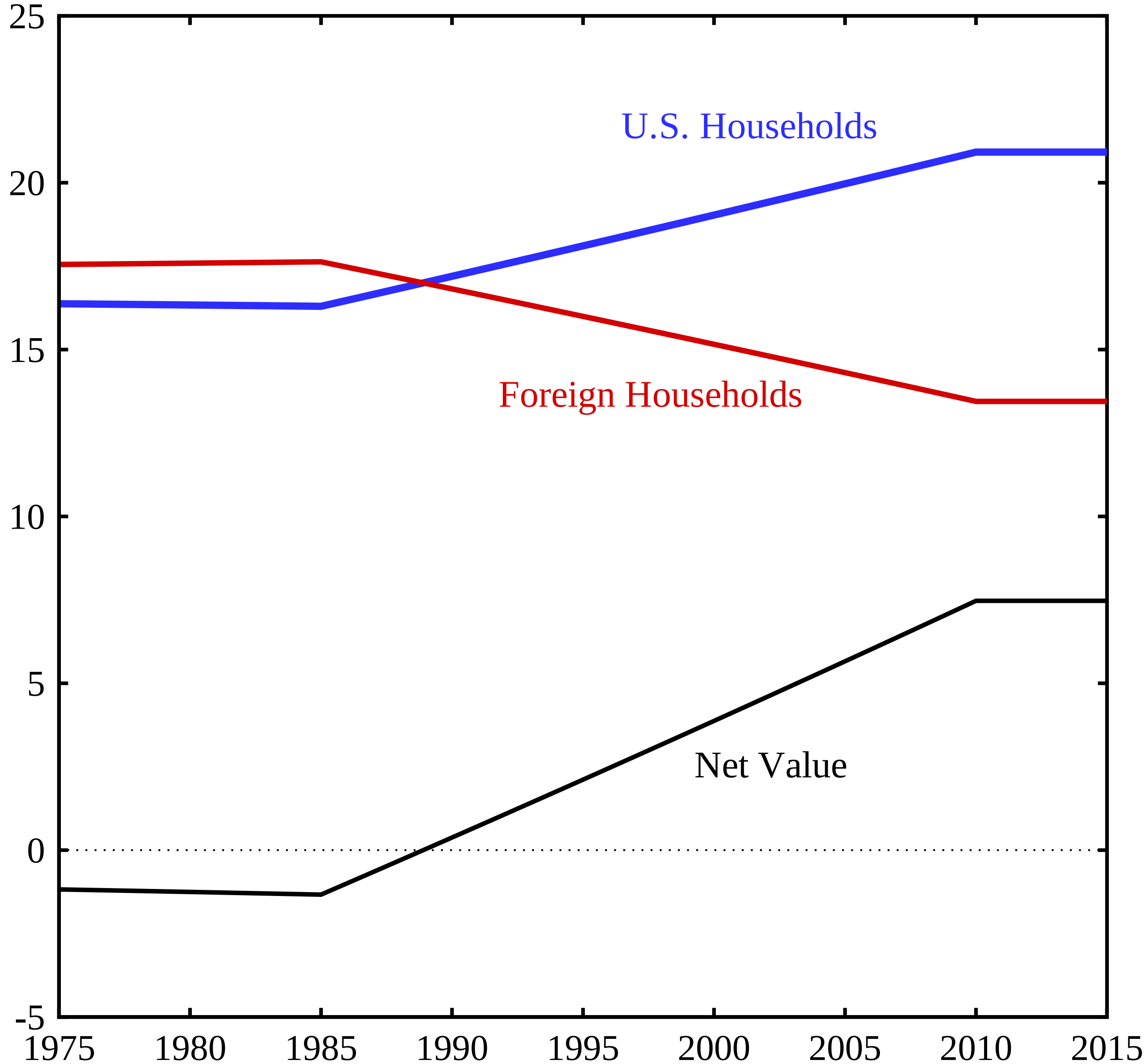


Figure 7C

Ownership of Technology Capital at Market Value

In Percent, Relative to U.S. GNI



Figures 8A–8D

Model Inputs and Outputs
A Boom in U.S. Nonbusiness Investment

Figure 8A
Share of U.S. Nonbusiness Investment in GDP, in Percent

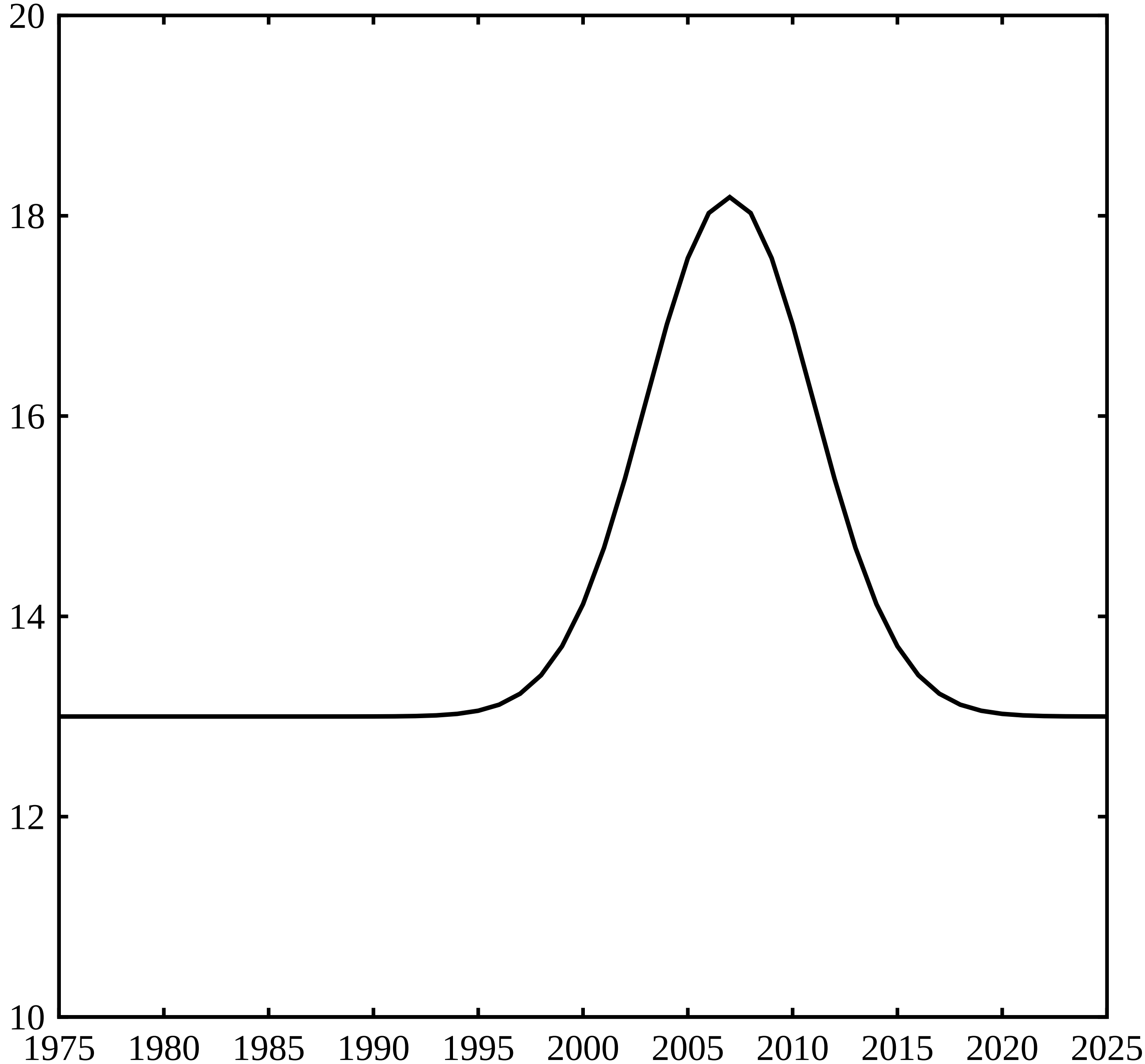


Figure 8B
Reported Current Account Balance and Components
In Percent, Relative to U.S. GNI

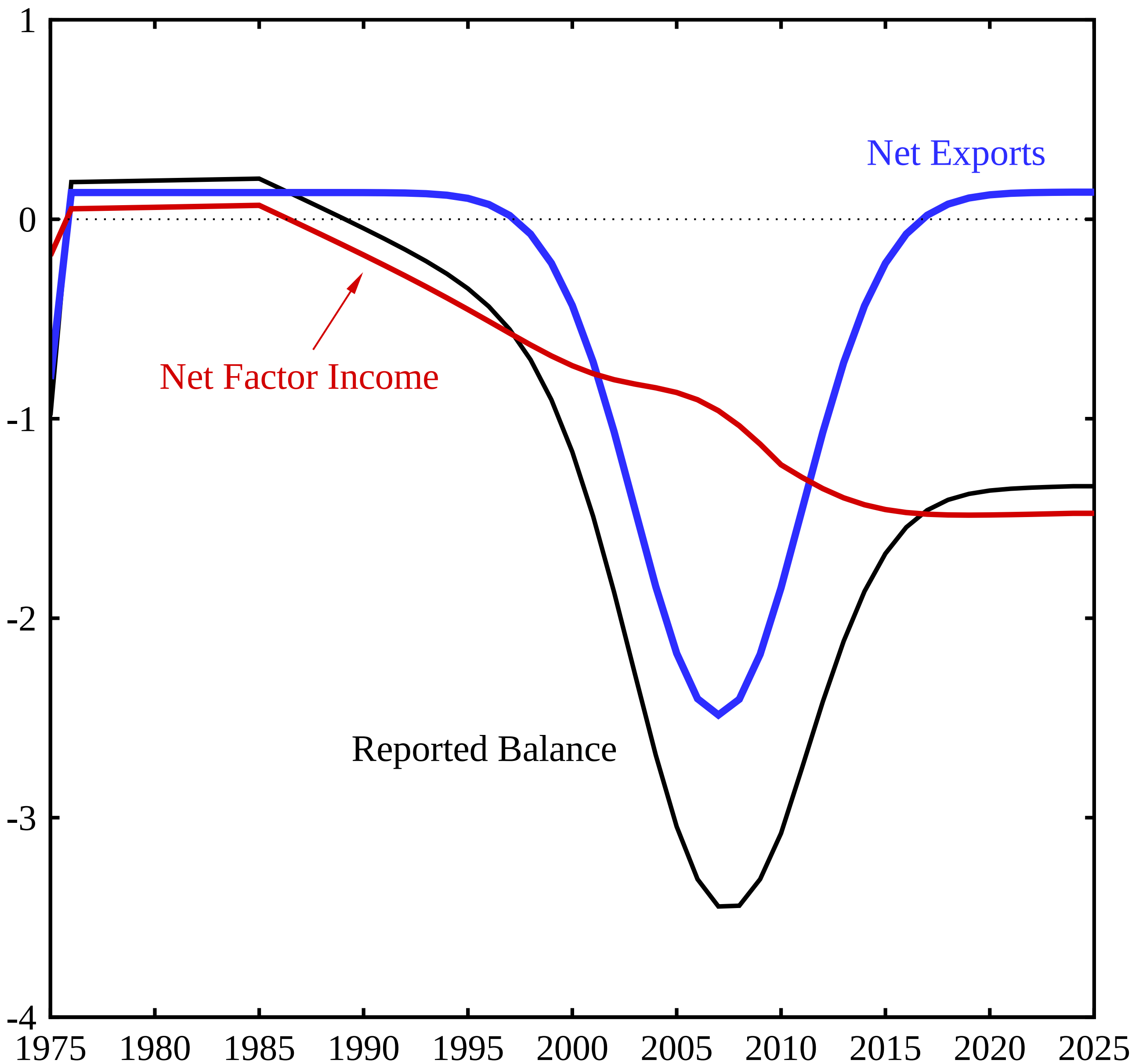


Figure 8C
Actual Current Account Balance and Components
In Percent, Relative to U.S. GNI

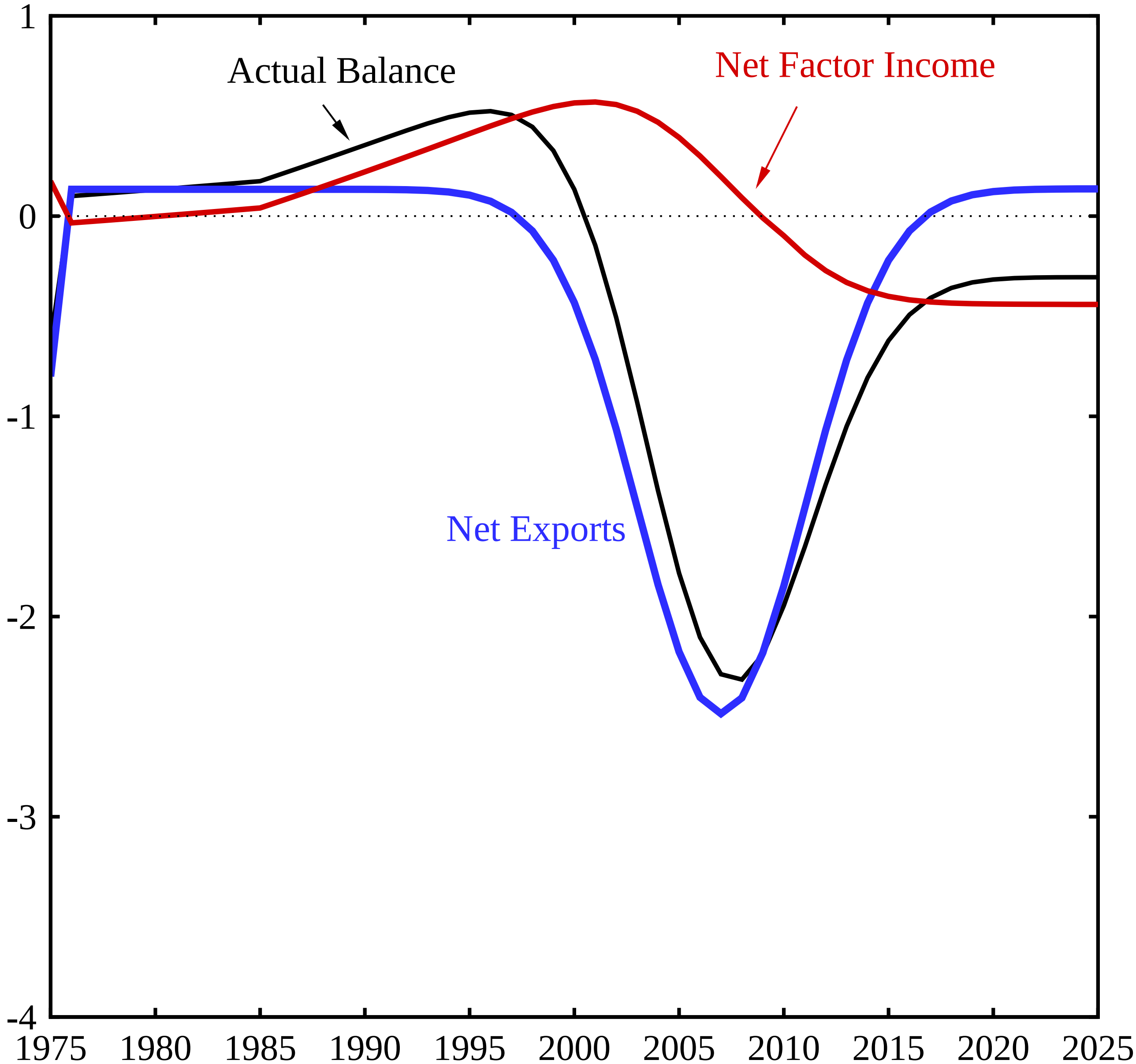
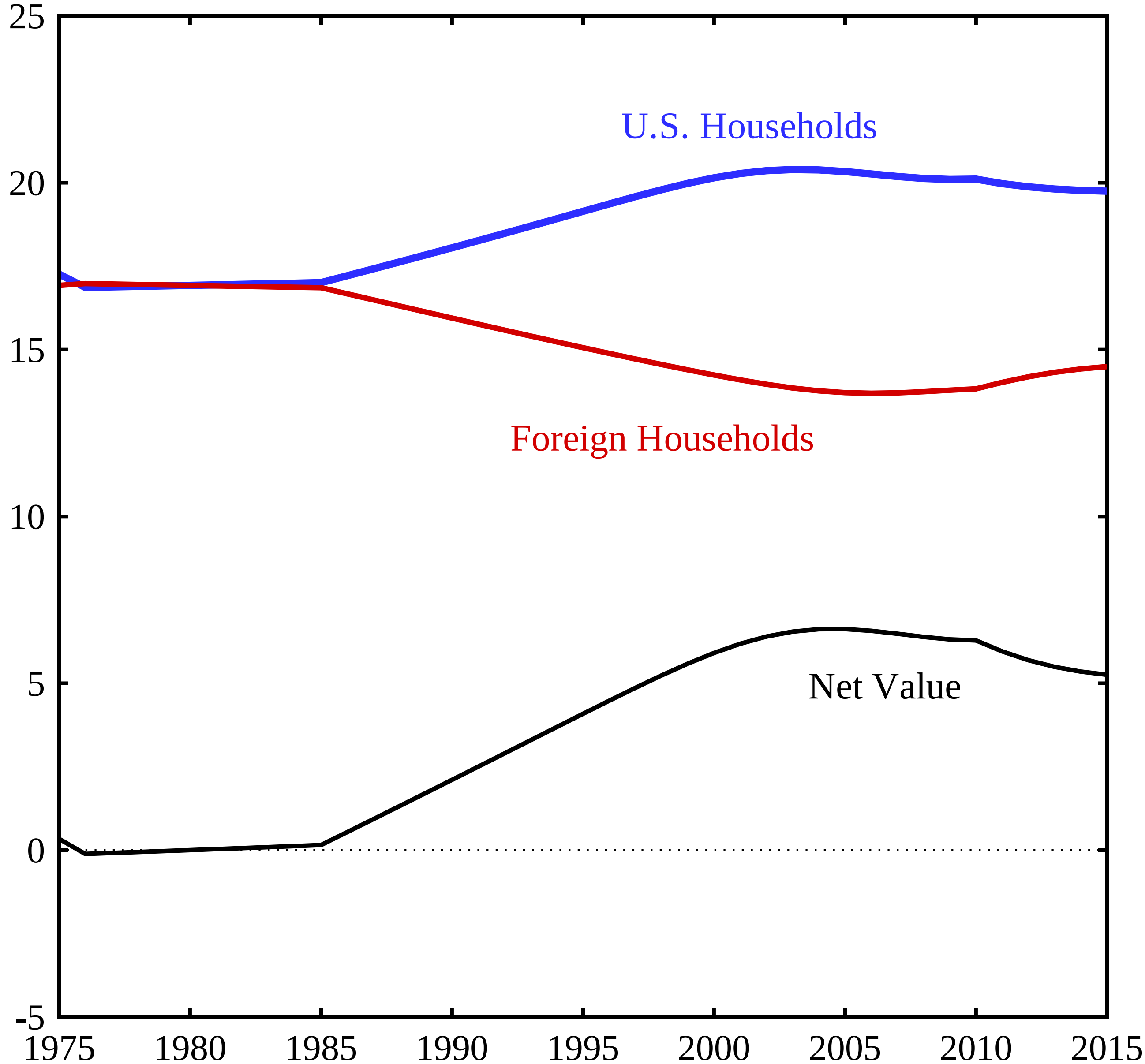


Figure 8D

Ownership of Technology Capital at Market Value

In Percent, Relative to U.S. GNI



Figures 9A–9F

Model Inputs and Outputs
A Decline in Foreign Population Growth

Figure 9A
U.S. and Foreign Populations, 1975 = 1

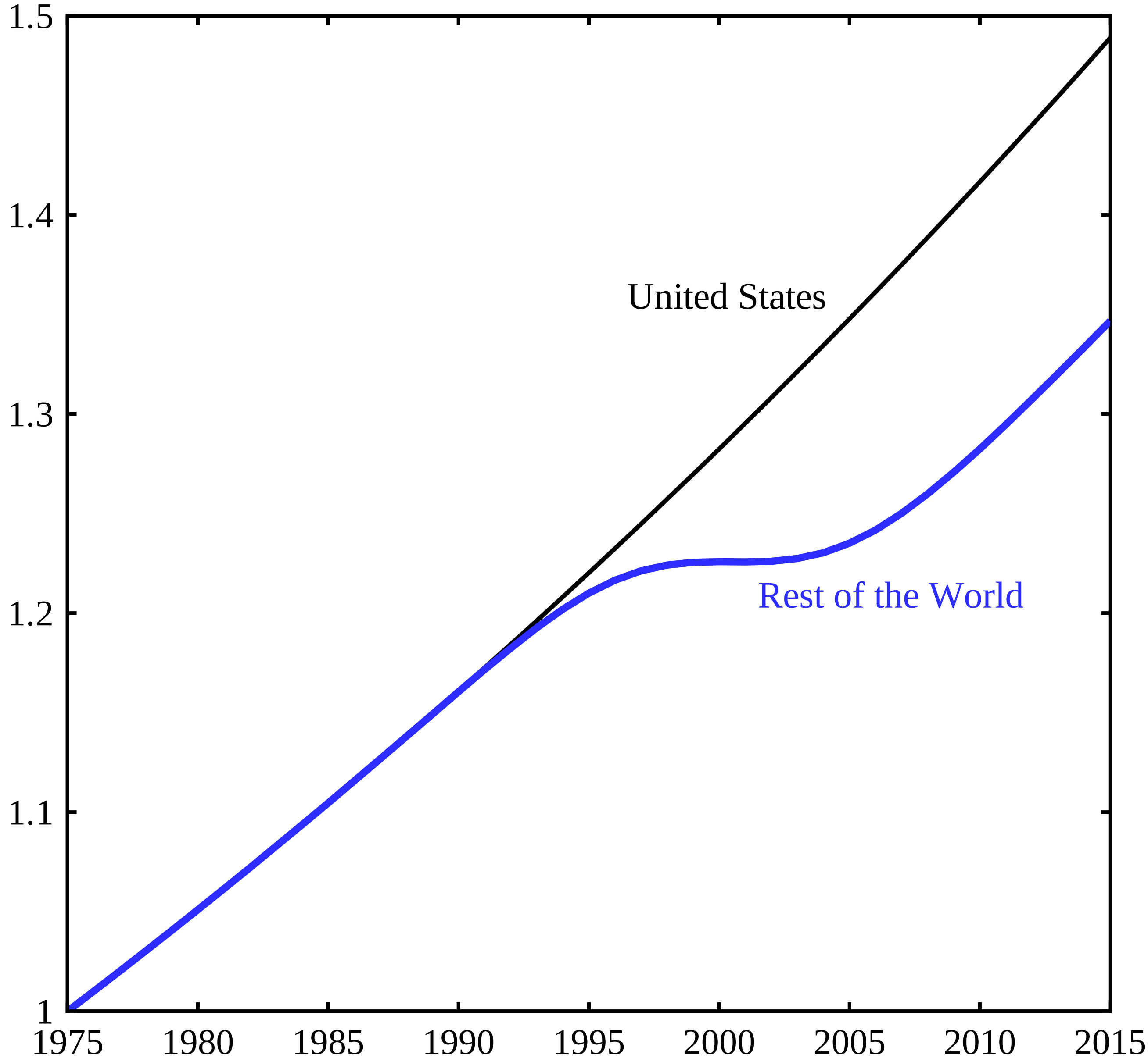


Figure 9B

Reported Current Account Balance and Components

In Percent, Relative to U.S. GNI

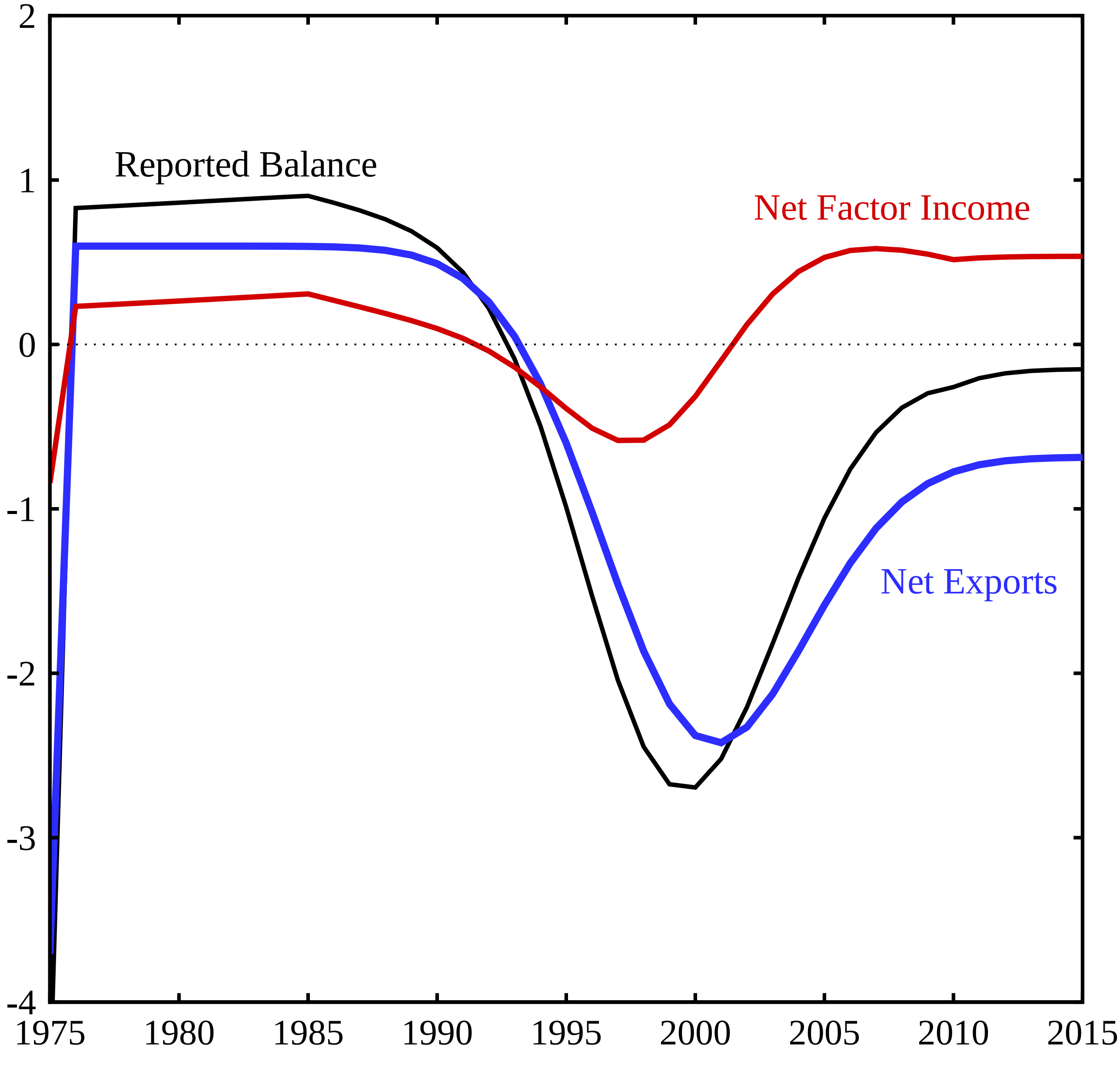


Figure 9C

Actual Current Account Balance and Components

In Percent, Relative to U.S. GNI

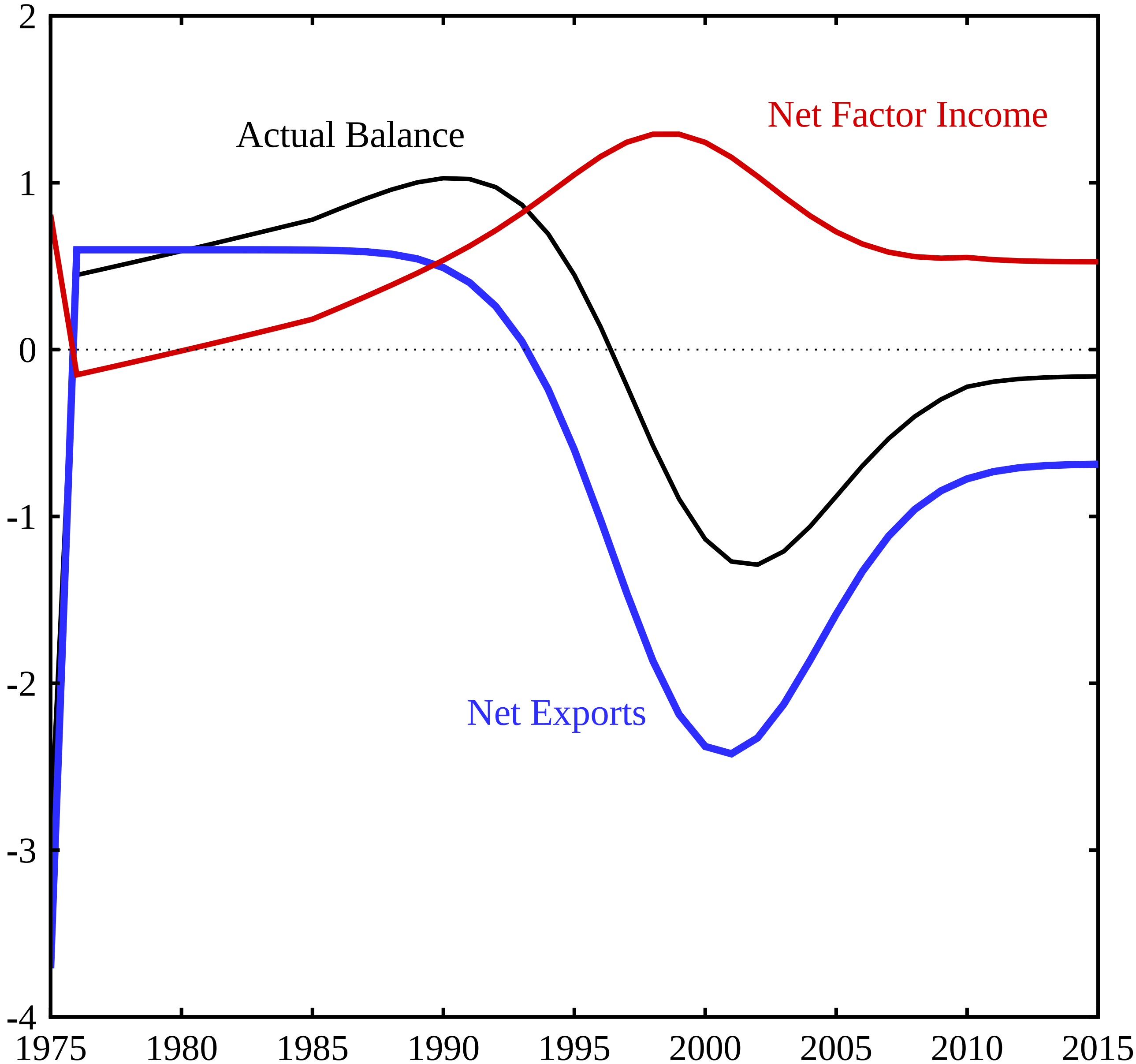


Figure 9D

Ownership of Technology Capital at Market Value

In Percent, Relative to U.S. GNI

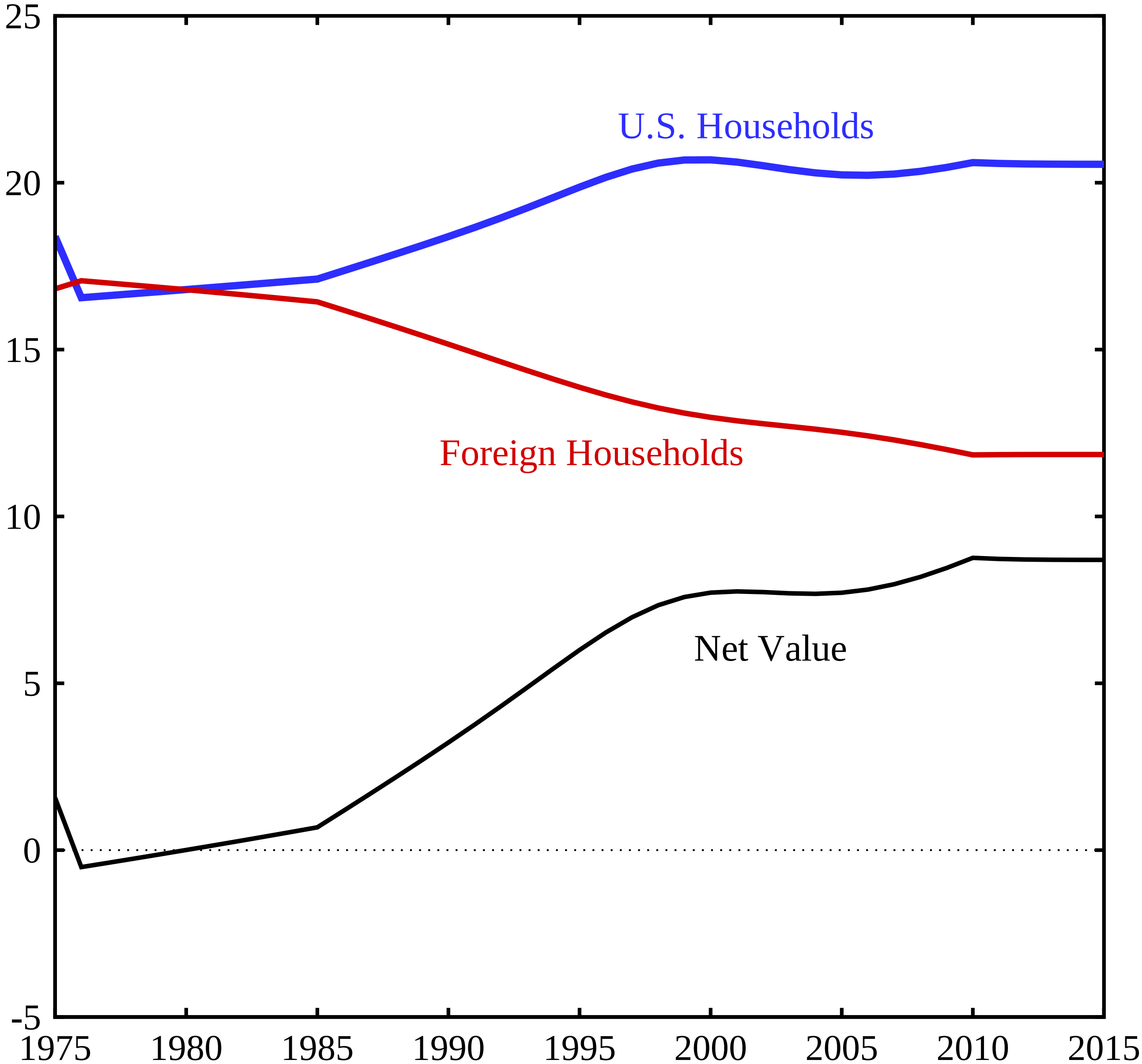


Figure 9E

Actual and Reported Net Direct Investment Positions

At Current Cost, Excluding Technology Capital, in Percent, Relative to U.S. GNI

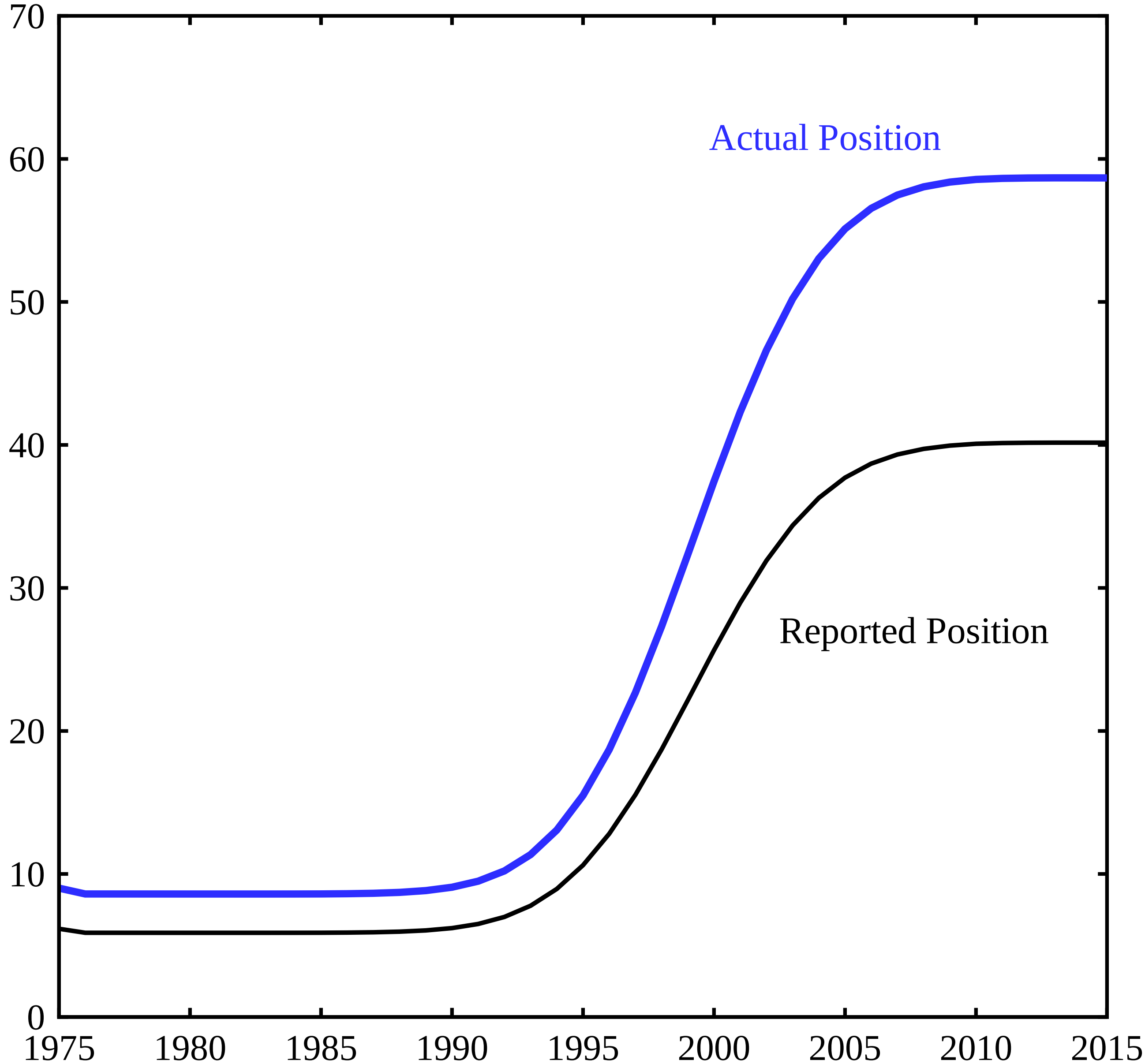


Figure 9F
U.S. and Foreign Technology Capital
At Current Cost, in Percent, Relative to U.S. GNI