Doubling Semiconductor Exports Over the Next Five Years

An Economic Analysis by the Semiconductor Industry Association

June 17, 2010
Doubling Semiconductor Exports
Over the Next Five Years

“... we need to export more of our goods. Because the more products we make and sell to other countries, the more jobs we support right here in America. So tonight, we set a new goal: We will double our exports over the next five years, an increase that will support two million jobs in America.”

President Obama
State of the Union Address
January 27, 2010

Executive Summary

In the five year period from 2005-2009 total semiconductor exports averaged $48 billion, highest of all exports; and were $38 billion during the 2009 downturn, second only to petroleum refinery products.\(^1\) The semiconductor industry will thus play a major role in meeting the President’s goal to double exports over the next five years.

This paper models a doubling of semiconductor exports, from $38 billion in 2009 to $76 billion in 2014, through a combination of market growth, increased market share overseas by U.S. headquartered companies, and increased activity located in the U.S. Exports can increase to about $56 billion, or about half of the needed increase, due to projected growth in markets alone. However to reach the doubling target, U.S. firms must also increase their market share and increase activity in the U.S.

To strengthen American companies’ competitiveness and to encourage investment in research and manufacturing in the U.S., SIA encourages policy makers to adopt the following policies:

- Double the nation’s basic research investment at national laboratories and universities by 2016, pass the America COMPETES reauthorization, and appropriate funds this year consistent with a doubling path.

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The principal author for this paper is Daryl Hatano, Vice President of Public Policy at the Semiconductor Industry Association.

\(^1\) Industry and product categories in this report are at a six digit NAICS level. Semiconductor and related devices is NAICS 334413. Unless otherwise noted, “exports” refers to total exports, including reexports, since SIA understands that this is the metric used by the Administration for analyzing the doubling goal.
• Enact tax policies that retain and attract semiconductor R&D and manufacturing investment in America by 1) making the R&D credit permanent, 2) avoiding piecemeal changes to international tax laws that would disadvantage U.S. companies against their foreign competitors in low-tax countries, and 3) considering measures to counter our trading partners’ tax incentives for investments in semiconductor research and manufacturing.

• Reform U.S. export controls by streamlining the licensing process; establishing an Intra-Company Transfer License Exception so companies can export technology, products and equipment within the perimeters of their global operations without the substantial burdens of case-by-case export licensing requirements; eliminating encryption controls for widely available semiconductors much as they were already lifted for widely available encryption software; and not subjecting civilian, general purpose semiconductors to U.S. Munitions Controls.

• Provide incentives and adopt other policies to promote energy efficiency and renewable energy.

• Avoid those climate change policies that add costs, limit flexibility and otherwise make U.S. companies less competitive.

• Enhance our workforce through education reform; investments in science, technology, engineering, and mathematics education; and reform our immigration policies including making green cards immediately available to graduates with masters and PhD degrees from U.S. universities.

While some of the policy recommendations involve additional Federal resources and tax expenditures, this is more than offset by the additional Federal taxes generated by the expansion of the industry and by the benefits that government agencies receive from increased computing power at lower costs as a result of research investments. SIA estimates that the increased shipments attributed to increased competitiveness, as opposed to increased shipments resulting from market growth, would lead to about $2 billion in additional Federal personal and corporate tax receipts, not including macroeconomic multiplier effects and before accounting for additional tax incentives.

Furthermore, faster and cheaper computing power allows government agencies to fulfill their missions more effectively. Federal, state, and local governments spent $109 billion cumulatively on computers from 1995-2009; however if this computing power was purchased at 1995 prices, the government would have spent $1.2 trillion – effectively the government agencies were able to get over a trillion dollars of computing free. Investments in semiconductor and other information technology research programs at national laboratories and universities lay the ground work for the continued advances computing technology with a tremendous rate of return for the government even if only the consumption of the government sector is considered and the positive benefits for the private sector of the U.S. economy are ignored.
A Semiconductor Export Model

The model developed to forecast semiconductor exports considers three major components: affecting exports:

- **Markets:** Increases/decreases in world market size and the percentage of the world market outside the U.S.

- **U.S. Share:** Increases/decreases in the U.S. companies’ share of the world market and particularly U.S. share in markets outside the U.S.

- **U.S. sales to exports ratio:** The ratio of U.S. sales outside the U.S. to U.S. exports is used as a proxy for the proportion of U.S. company activity that takes place in the U.S.

It should be noted that there are other factors that will impact exports including semiconductor packaging trends causing semiconductors to be classified outside traditional semiconductor categories in government statistics programs, exchange rate changes, foreign capital affiliated firms’ activity in the U.S., mergers and acquisitions, and changes in trade in intermediate goods.²

² There are a number of factors that may impact forecasted exports, including:

- **Semiconductor packaging changes** – New forms of semiconductor packages have emerged as customers demand smaller form factors, e.g. the increased capabilities in mobile phones. Multichip or multi-component packages are composed of two or more integrated circuits and other electronic components that are combined indivisibly into a single package for assembly onto a printed circuit board. Depending on the types of components that are packaged with the integrated circuit, these products may not meet the technical definition a hybrid semiconductor under Harmonized Tariff System number 8542 (integrated circuits), so, a product that the industry considers to be a “semiconductor” in its statistics program might be classified as a computer part, telecom part, or other export code, thus cause a decline in U.S. government measures of “semiconductor exports” and a corresponding increase in other electronic parts export categories. It is also possible that a semiconductor that is defined as a computer part might, with further integration of the electronic components within the package, get reclassified as a hybrid semiconductor which would cause an increase in the semiconductor export category and a decrease in the computer parts category. Since most semiconductor chips fabricated in the U.S. are exported outside the U.S. to Southeast Asia or China for packaging, the impact of packaging changes on export data is mitigated in the U.S., but since total exports includes product brought back to the U.S. and re-exported, there will also be an impact on U.S. statistics.

- **Exchange rates** – Changes in exchange rates affect the size of markets since local markets are all converted into dollars to calculate the worldwide total. Exchange rates also impact the competitiveness of different regions over time as their products become more or less expensive relative to products produced in other regions.

- **Foreign capital affiliated firms’ activity in the U.S.** – Exports include foreign firms that produce in the U.S. and export abroad. It is difficult to find data on foreign semiconductor companies’ U.S. activity, and the SIA data only includes U.S. headquartered companies. Foreign firms’ U.S. activities are subject to many of the same competitive issues such as exchange rates and capital equipment and labor costs as U.S. headquartered companies so their exclusion from the model should not affect the result. The one exception would be if the U.S. weakens the deferral of taxes on overseas income, a change that would negatively impact U.S. headquartered companies and help the competitive
Using trend lines for market growth, an estimate is made for exports in 2014. Scenarios are drawn on the numbers that would have to change to achieve an export doubling, and policy options to further these scenarios are outlined.

The Table 1 provides the historic data on the key components to export growth.

**Markets**

The semiconductor market is cyclical. In 2009 the market dropped 9 percent, following a 3 percent decline in 2008 (See Table 1, Row 1). With the rapid growth of China, the percentage of the world market that is outside of the U.S. grew steadily from 67 percent in 1994 to 82 percent in 2004, but appears to have leveled off (it was 83 percent in 2009, see Table 1, Row 3). For our purposes, we can keep this factor constant in the forecast model.

The world semiconductor market is forecasted to grow 10.2 percent in 2010 and 8.4 percent to $270 billion in 2011 when it will surpass the previous high of achieved in 2007.\(^3\) Assuming 7 percent growth in 2012-2014, the world semiconductor market would be $331 billion, a 46% increase. In other words, we can get about half of the targeted doubling of exports just from growth in the worldwide market.

Semiconductors are pervasive, and demand is a function of everything from consumer spending on home entertainment electronics to corporate purchases of laptops and mobile phones to increased electronics content in automobiles. New products such as tablet computing, e-books, 3D televisions, 4G cell phones, and in-car GPS, will help drive demand over the next decade.

One future demand driver worth noting is energy efficiency and renewable energy. A recent study by the American Council for an Energy Efficient Economy (ACEEE) sponsored by SIA described a number of semiconductor enabled technologies including power management and virtualization in our computers and data centers, electronic-controlled efficient motors in our factories, light emitting diodes to replace compact fluorescent and incandescent bulbs in our offices and homes, plug-in electric vehicles on our highways, solar panels and wind turbines generating our electricity, and smart meters and sensors that will intelligently monitor and control our power lines. In total,

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3 SIA Forecast, November 2009.
accelerating semiconductor usage by one percentage point per year can save 1.2 trillion KWHr by 2030, an amount that is 11% less than today, even though the economy will be about 70 percent larger. The savings is 27% less than the Department of Energy’s reference and equates to 733 million metric tons less CO₂ emitted in 2030, 296 plants (600 megawatt) that will not be built by 2030, and $1.3 trillion in cumulative savings from

Table 1
Historic Data on Key Components of Export Growth

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<tr>
<td>1. World semiconductor market ($M)</td>
<td>$227,484</td>
<td>$247,716</td>
<td>$255,645</td>
<td>$248,602</td>
<td>$226,313</td>
<td>-9%</td>
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<tr>
<td>2. U.S. Market as Percent of WW Market</td>
<td>17.9%</td>
<td>18.1%</td>
<td>16.6%</td>
<td>15.2%</td>
<td>17.0%</td>
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<tr>
<td>3. Percent of WW Market Outside of U.S.</td>
<td>82.1%</td>
<td>81.9%</td>
<td>83.4%</td>
<td>84.8%</td>
<td>83.0%</td>
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<td>4. U.S. WW market Share (%)</td>
<td>48.3%</td>
<td>46.2%</td>
<td>46.2%</td>
<td>48.2%</td>
<td>50.7%</td>
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<td>5. U.S. market Share in U.S. Market (%)</td>
<td>60.9%</td>
<td>59.7%</td>
<td>58.7%</td>
<td>61%</td>
<td>57.7%</td>
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<td>6. U.S. market Share outside U.S. market (%)</td>
<td>45.6%</td>
<td>43.3%</td>
<td>43.7%</td>
<td>45.9%</td>
<td>49.3%</td>
<td></td>
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<tr>
<td>7. Percent of U.S. industry sales outside of U.S. Market</td>
<td>77.4%</td>
<td>76.6%</td>
<td>79.0%</td>
<td>80.7%</td>
<td>80.6%</td>
<td></td>
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<tr>
<td>8. U.S. industry sales outside of U.S. Market</td>
<td>$85,067</td>
<td>$87,756</td>
<td>$93,257</td>
<td>$96,695</td>
<td>$92,537</td>
<td>-4%</td>
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<tr>
<td>9. Total U.S. Exports ($M)</td>
<td>$46,942</td>
<td>$52,010</td>
<td>$50,763</td>
<td>$51,120</td>
<td>$38,085</td>
<td>-25%</td>
</tr>
<tr>
<td>10. Ratio of sales outside US:Exports</td>
<td>1.8 : 1</td>
<td>1.7 : 1</td>
<td>1.8 : 1</td>
<td>1.9 : 1</td>
<td>2.4 : 1</td>
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2010-2030. While the study quantifies the U.S. impact, the general story also applies outside the U.S. and offers a great export opportunity. In fact, SIA has translated the study into Chinese and has shared the results with the Chinese government.

**U.S. Share**

The SIA collects data on U.S. headquartered companies sales in a number of product and regional markets. The U.S. industry’s share of the worldwide semiconductor market share has been in the high 40 percents since 1996, and was 51 percent in 2009 (See Table 1, Row 4). The U.S. is particularly strong in microprocessors and micro-peripherals (82% worldwide share in 2009) and analog (62% share), and weaker in memory (22% share) and discrete devices (28% share). The 58 percent U.S. share in the U.S. market is higher than its 49 percent share in markets outside the U.S., although in 2009 its share in the U.S. market dropped but increased in markets outside the U.S. market. (See Table 1, row 6-8).

**U.S. Sales to Exports Ratio**

Semiconductor production can be viewed in three stages – 1) R&D - semiconductor products are designed using sophisticated computer design automation tools to either improve standard products or to meet particular customer needs, with industry R&D spending among the highest of all industries; 2) circuits are etched on silicon wafers at wafer fabrication factories (called “fabs” in industry parlance); and 3) at the assembly/test stage wafers are cut into individual silicon chips, the chips are put into plastic or ceramic packages easy for insertion on printed circuit boards, and the final products are tested. U.S. companies perform three quarters of their R&D in the U.S., 65% of the fabs they own are in the U.S., but very little assembly/test is in the U.S. as that stage was particularly labor intensive and moved offshore in the 1970's. Most U.S. exports are products fabricated in the U.S. and sent to offshore assembly/test facilities. In addition, companies can contract out the fab and assembly/test activities.

With fabs costing up to $4-5 billion to build, few companies have the revenue base to support a steady stream of new state-of-the-art factories, so contract manufacturers, (called “foundries”) and companies without factories (called “fabless”) have emerged as an important part of the business. While fabless companies perform substantial R&D, manufacturing oversight, sales and marketing, and administrative activities in the U.S., their electronic transmission of a semiconductor design to an overseas factory is an intangible transfer and thus not captured in U.S. Customs export data.

U.S. semiconductor exports increased 9 percent from 2005 to 2008, then fell 25% in the 2009 downturn to $38 billion, the lowest level of exports since 1998 but still America’s second largest export behind petroleum refinery products. (See Table 1, Row 9)

Of greater concern is the ratio of U.S. industry sales outside the U.S. to U.S. exports, which had held steady at about 1.8 to 1 from 2005 to 2008, but increased to 2.4 to 1 in
2009 as exports fell 25% while U.S. sales outside the U.S. market fell only 4%. (See table 1 Row 8-9) Some of the difference may be an anomaly caused by the steep downturn in Q4 2008 followed by the rebound in 2009, but other data suggest that the ratio may reflect increased U.S. companies’ sales coming from plants abroad – either their own overseas plants or through manufacturing contracts with foundries abroad. Two data points that SIA has shared with policy makers in the past are relevant here:

- While sixty-five percent of U.S. industry capital spending for wafer fabrication and three-quarters of U.S. industry R&D is today located in the United States, this does represent a decline by almost 15 percentage points and more than 8 percentage points respectively in recent years.\(^5\)

- Thirty percent of worldwide semiconductor equipment shipments were in the U.S. in 1999-2002. This fell to 15 percent in 2004-2007, half the level of just five years before. In 2008 this recovered to 20 percent, still short of the levels of a decade ago.\(^6\) Indeed, as shown on the map below, if each region’s area reflected its investment in new semiconductor equipment, Japan and Taiwan would be larger than North America, and Korea would be close.

\(^4\) An examination of monthly U.S. sales and U.S. export peak-to-trough data shows that U.S. sales outside the U.S. market declined by 58% from September 2008 to January 2009, while U.S. exports declined by 42% from October 2008 to February 2009. By December 2009, U.S. sales outside the U.S. had increased by 114% from the January nadir, while U.S. exports only increased 37% from its February low point. We cannot exclude the possibility that the 2009 reflects a statistical anomaly, particularly since government semiconductor statistics have a number of unexplainable discrepancies, e.g. the difference between the $45B production values reported in the Current Industrial Reports and the $66B reported in the Annual Survey of Manufacturers. The proposal by the Economic Classification Policy Committee to clearly define factory-less manufacturers in the manufacturing sector rather than as wholesalers may help improve the consistency of the data in the semiconductor industry, although the proposal to split the national industry into two industries risks creating opportunities for new anomalies as census respondents across the economy misclassify commodities (See NAICS, 75 Fed Reg 26856 – May 12, 2010).


\(^6\) The U.S. was 24% of the world equipment shipments in 2009, but SIA considers this an anomaly because the market had collapsed by 46%.
The conclusion that the export ratio may not reach pre-2009 levels is corroborated by a recent report that 27 semiconductor wafer fabrication (fab) plants closed worldwide in 2009, with 15 of them in the United States (followed by four in Europe, four in Japan, two in China, one in Korea and one in Southeast Asia).  

Looking toward the future, the same report found that of the 16 new fabs that began construction around the world in 2009, only one was in the U.S. Seven of the fabs that began construction will produce light-emitting diodes, one of the most promising energy-saving technologies developed in 50 years, yet none of those fabs will be in the U.S. China led the world in new semiconductor factory construction, with six fabs, followed by Taiwan with five, and Korea, Japan, the European Union and Southeast Asia, all with one apiece. The only semiconductor fabrication plant that started construction last year in the U.S. is the GlobalFoundries facility in Saratoga County, N.Y.

It is important to recognize that foreign locations are attractive largely due to government policy since semiconductor plants are very capital intensive and labor is a relatively small proportion of total costs. SIA has estimated that there is a billion dollar difference between building and operating a new 300mm wafer fabrication facility over a ten year period, and of this billion dollar difference, about 70 percent is due to tax benefits, 20 percent due to capital grants, and only 10 percent due to lower labor and other operating costs such as lower utility costs or cheaper logistics. Thus 90 percent of the billion dollar difference is due to government policy. To underscore the point, Taiwan’s legislature was considering a corporate income tax reduction to 17 percent and a major Taiwan semiconductor maker was quoted as stating that because the government already provided tax rebates and investment benefits to high-tech companies, the legislation would not affect the company. U.S. and foreign companies face the same dilemma; either locate their plants in regions that offer incentives, contract out manufacturing to others who have plants in regions that offer incentives, or lose sales to competitors who have plants in regions that offer incentives.

**Doubling Scenarios**

There are three key variables in the model that are used to drive forecasted semiconductor exports: worldwide market growth, U.S. share outside the U.S. market, and the ratio of U.S. sales outside the U.S. market to U.S. exports.

Table 2 summarizes the results under five scenarios. The first scenario holds U.S. market share and sales:export ratio constant with 2009 to show that market growth

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7 Manufacturing and Technology News, February 12, 2010, Volume 17, No. 3 quoting Daniel Tracy, senior director of industry research and statistics at Semiconductor Equipment Materials International.


9 “Taiwan Tax Cut Agreement Expected to Benefit Businesses,” Asia Pulse, April 13, 2010.
alone can increase U.S. exports to over $50 billion. In fact market growth alone will allow the industry to get halfway to the doubling target. The second scenario holds U.S. share constant and brings the sales:export ratio to the 2005-2008 level of 1.8:1, resulting in forecasted U.S. exports around $75 billion in line with the $76 billion doubling goal. This scenario demonstrates that market growth coupled with a return to traditional patterns of activity in the U.S. can allow the U.S. to reach the doubling target.

The third scenario increases U.S. share outside the U.S. market by one percentage point a year while holding the sales:export ratio constant, resulting in forecasted exports of $62 billion. The point of this scenario is that, absent an increase in activity in the U.S. as reflected in the ratio of U.S. sales outside the U.S. market to U.S. exports, increases in market share coupled with market growth are not enough to achieve an export doubling target. The fourth scenario picks the midpoints of the first three scenarios, i.e. a half percentage point per year increase in share and a 2.1:1 ratio, and results in forecasted exports of over $68 billion and still short of the goal.

Table 2
Scenarios to Double Exports from $38B in 2009 to $76B in 2014

<table>
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<tbody>
<tr>
<td>1. U.S. share outside of U.S. Market, constant with 2009</td>
<td>2.4 : 1 , constant with 2009</td>
<td>$56.4B</td>
</tr>
<tr>
<td>2. U.S. share outside of U.S. Market, constant with 2009</td>
<td>1.8 : 1 , constant with 2005-2008 average</td>
<td>$75.3B</td>
</tr>
<tr>
<td>3. U.S. share increases 1 percentage point a year, = 54.3% in 2014.</td>
<td>2.4 : 1 , constant with 2009</td>
<td>$62.2B</td>
</tr>
<tr>
<td>4. U.S. share increases half percentage point a year, = 51.8% in 2014.</td>
<td>2.1 : 1 , median between 2009’s 2.4:1 and 2005/8’s 1.8:1</td>
<td>$67.8B</td>
</tr>
<tr>
<td>5. U.S. share increases half a percentage point a year, = 51.8% in 2014.</td>
<td>1.9 : 1 , slightly higher than the 2005-2008 average</td>
<td>$74.9B</td>
</tr>
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</table>

The final scenario increases share by a half percentage point a year and uses the 1.9:1 ratio – slightly above the 2005-2008 time period average -- and results in forecasted U.S. exports of $75 billion, in line with the doubling goal.

¹⁰ 10.2% growth in 2010, 8.4% in 2011, then 7% in 2012, 2013, and 2014.
Policies to Increase American Competitiveness

Market growth alone will not lead to a doubling of U.S. semiconductor exports. The U.S., already the market leader, must build on its strong position and become more competitive. If exports are to double, U.S. competitiveness must be seen as both U.S. headquartered companies and the geographic U.S. as a location for business.

SIA supports the President’s National Export Initiative, reform of U.S. export controls, a permanent R&D credit, investments in science and technology and efforts to negotiate and enforce multilateral and bilateral trade agreements. These initiatives are all necessary, but not sufficient to achieve the President’s export doubling goal. We must also recognize that other governments are focused on helping their companies become more competitive by providing favorable tax policies and incentives and adopt public policies that don’t put U.S. companies at a competitive disadvantage. In short, we must choose to compete.

To encourage investment in research and manufacturing in the U.S., SIA encourages policy makers to adopt the following policies:

- Double the nation’s basic research investment at national laboratories and universities by 2016, pass the America COMPETES reauthorization, and appropriate funds this year consistent with a doubling path.

- Enact tax policies that retain and attract semiconductor R&D and manufacturing investment in America by 1) making the R&D credit permanent, 2) avoiding piecemeal changes to international tax laws that would disadvantage U.S. companies against their foreign competitors in low-tax countries, and 3) considering measures to counter our trading partners’ tax incentives for investments in semiconductor research and manufacturing.

- Reform U.S. export controls by streamlining the licensing process; establishing an Intra-Company Transfer License Exception so companies can export technology, products and equipment within the perimeters of their global operations with the substantial burdens of case-by-case export licensing requirements; eliminating encryption controls for widely available semiconductors much as they were already lifted for widely available encryption software; and not subjecting civilian, general purpose semiconductors to U.S. Munitions Controls.

- Provide incentives and adopt other policies to promote energy efficiency and renewable energy.

- Avoid those climate change policies that add costs, limit flexibility and otherwise make U.S. companies less competitive.
- Enhance our workforce through education reform; investments in science, technology, engineering, and mathematics education; and modernization of the green card system including making green cards immediately available to graduates with masters and PhD degrees from U.S. universities.

**Semiconductor Leadership Improves the U.S. Government Fiscal Situation**

A number of the public policy recommendations necessary to preserve U.S. semiconductor leadership and increase U.S. sales will require additional Federal resources and tax expenditures. However, the resulting economic growth will generate additional Federal corporate and individual taxes, and spending on semiconductor research will provide government agencies with increased computing power to achieve government agency missions. This section estimates the additional tax revenues from increased exports, summarizes economic impact studies of semiconductor fabs, and quantifies the “free computing power” that the Federal government has received as a result of its investment in semiconductor related basic research.

**Doubling Exports can generate over $2 billion in gross additional Federal Tax Revenue**

At the outset, it should be noted that estimating additional tax revenue is difficult as there are no readily available data sources on personal income taxes collected from semiconductor industry workers. According to the Bureau of Labor Statistics,¹¹ the semiconductor industry employed 207,500 people in 2008, and paid $21B in annual wages, or $100,600 in annual pay per employee. Semiconductor wages are over double the $45,600 in annual wages for all employees (including government) or $45,400 in average annual pay by all private employers. The high wages place semiconductor workers in higher tax brackets, and this paper uses a 15% tax rate for semiconductor workers’ pay.¹²

¹¹ Quarterly Census of Employment and Wages, at http://www.bls.gov/data/#employment 2008 data is the most recent available as this analysis is being conducted.

¹² Determining the appropriate tax rate on the semiconductor employee income is of course difficult. The statutory marginal rate for married filing jointly the $16,000-$68,000 income brackets is 15%, and between $68,000-138,000 is 25%. The Bureau of Labor Statistics (BLS) reports average annual pay for semiconductor workers at over $100,000, but this may include health benefits that are not taxed and, with standard and other deductions semiconductor workers’ taxable income will be lower than the BLS income figures. A 15% tax rate is used in this paper’s analysis because in 2008, 36% of the population had a zero marginal rate, 52% had 10% or lower marginal rate, 28% had a 15% marginal rate, 15% were in the 25% marginal tax bracket, and the remaining 3% had a 28% or higher marginal rate. In other words, the 52-97th percentile of all tax payers were in the 15% or 28% marginal tax bracket rate higher paid semiconductor workers. (“Overview of the Federal Tax System as in Effect for 2008,” prepared by the staff of the Joint Tax Committee, April 15, 2008.) The progressive income tax rate adds to the complexity because simply multiplying the average mean salary by the average tax rate would underestimate total taxes paid. Furthermore, for married workers with working spouses, it is reasonable to assume that the non-semiconductor spouse salary is a base and the semiconductor worker hired due to the increase in
With regard to corporate income taxes, the Treasury Department reports that the semiconductor and electronic components sector paid $4.4B in 2007, and SIA estimates that the semiconductor industry portion of this might be on the order of $3.2B. Extrapolating from this is difficult, however, since corporate taxes paid varies widely among companies from very profitable companies to those with large tax loss carry-forwards as a result of heavy losses in past years. If the U.S. were more competitive and exports doubled, companies with tax loss carry-forwards should more quickly use the carry-forwards and would have profits on which to pay income taxes. It should also be noted that semiconductor operations that are part of larger corporations filing consolidated returns are likely to be included in the industries associated with the larger corporation rather than the semiconductor industry. Finally, it is unclear whether the IRS is classifying companies that contract out manufacturing in a manner consistent with other agencies whose statistics are used in this paper, a problem that the government Economic Classification Policy Committee is seeking to resolve.

For purposes of estimating increased tax revenues from measures to increase U.S. competitiveness, this paper does not include growth that can be attributed to projected market growth that is independent of such measures, and uses direct exports rather than total exports that the Administration is using to benchmark the doubling goal. Direct exports are those exports from the U.S. for consumption abroad, while total exports includes re-exports of goods that are imported and reexported without substantial transformation. Semiconductor direct exports for the past 5 years were 71 percent of total exports. If we assume that total exports would increase from $38B to $56B in 2014 just due to growth in world semiconductor markets, and that policies that enhanced competitiveness and match our trading partners' policies helped increase total exports by $18B to $74B in 2014, then it is appropriate to estimate the additional tax revenue that can be generated by the $12.8B of direct exports associated with the $18B increase.

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13 Source: Treasury Department, Statistics on Income Program, Corporation Report 2007, Table 1. The Treasury data is at a 4 digit NAICS level. Since this paper is using the 6 digit industry level, it was necessary to estimate what portion of the 4 digit semiconductors and electronic components is the 6 digit semiconductors and related devices industry. The Commerce Department’s Annual Survey on Manufacturers has the 6 digit semiconductors and related devices 334413 at about 68% of the 4 digit 3344 semiconductors and electronic components. The international Trade Commission has exports of 334413 at about 76% of the 3344 level. This paper is using the average of these figures, or 72%.

14 SIA understands that some agencies classify companies that contract out manufacturing to be wholesalers, while others consider them to be engineering design companies, and others consider them to be manufacturers. In order to get comparability and consistency of the economic data published across agencies, the Economic Classification Policy Committee has recently recommended that “establishments that bear the overall responsibility and risk for bringing together all processes necessary for the production of a good [be classified] in the manufacturing sector, even if the actual transformation is 100 percent outsourced.” 75 Fed. Reg 26856 (May 12, 2010)
As a final observation, as noted at the outset, the policy recommendations to maintain U.S. competitiveness include lower tax rates and tax incentives. This paper does not estimate the Federal revenue impact of such proposals, and as such the estimates in this section should be considered gross additions to government receipts as a result of increased industry shipments, and from which the decreases to government receipts from tax incentives can be netted out.

With these caveats in mind, tax revenue estimates are made from a macro and micro perspective.

The macro-perspective assumes that the Federal Tax receipt increase from a dollar increase in exports is the same as the average Federal tax receipt per dollar of GDP. In the last ten years, average Federal receipts were 15.0 percent of GDP, or 9.9 percent of GDP if only personal and corporate income tax were included and social security and related receipts were excluded. Using these figures, a $12.8 billion increase in semiconductor direct exports would translate into $2.7 billion in additional Federal receipts, or $1.3 billion in additional personal and corporate tax receipts.

A second approach is a micro-perspective. This is more difficult in practice, but conceptually it is simply the sum of the personal and corporate income taxes paid by semiconductor companies, semiconductor workers, and the direct suppliers of materials, services, equipment, and energy used to make semiconductors.

- Personal Income Taxes: Semiconductor exports per employee are $246,000, so a straight extrapolation would suggest an increase of $12.8 billion in direct exports would represent 52,000 jobs. It is more likely that the total job number would be substantially less since the marginal exports per employee are likely to be higher than the average. To be conservative, assume that the export per worker at the margin were double the average, so $12.8 billion in direct exports only resulted in 26,000 new jobs, with a total added payroll of $2.6 billion. If the $2.6 billion is taxed at a 15% rate, the additional personal income tax from semiconductor workers is $392 million.
- Corporate Income Taxes -- $12.8 billion of direct exports is 35 percent of the 2007 semiconductor direct exports of $36.3 billion, and 35 percent of the semiconductor industry’s estimated corporate taxes in 2007 is $1.1 billion.
- Suppliers – Intermediate inputs such as chemicals and power represent just over half of the value of semiconductor shipments. However the industry is very capital intensive and adding capital equipment purchases could easily bring the total contribution of industry suppliers to 70 percent of more. Some of the supplies are imported, and some of the supplier industries are more labor intensive (and pay less) than the semiconductor industry, but it would not be unreasonable to assume that supplier taxes would represent an additional billion dollars given the analysis above.

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15 Bureau of Economic Analysis, Input Output Commodity Use table, 2002 Benchmark year.
Micro-perspective total additional taxes would be $392M+$1.1B+$1B = $2.5 Billion.

The $2.5 billion micro-perspective is understandably higher, and likely more accurate, than the $1.3 billion macro-perspective derived from average tax receipts per dollar GDP because 1) semiconductor wages are higher than average and thus taxed at higher rates, 2) tax receipts per dollar GDP implicitly includes the government sector which is 20 percent of GDP and does not pay corporate income tax, and 3) the macro-perspective assumed GDP increased by the same amount as exports while the micro-perspective implicitly increased taxes on non-export activities such as products designed in the U.S. but produced overseas with no physical product crossing a border.

It is also important to recognize that these dollar estimates do not involve multipliers. In fact the additional exports puts money in the hands of semiconductor workers who in turn dine at local restaurants, buy new clothes and cars, and vacation at tourist destinations; which in turn adds to the income of waiters, cooks, retailers, auto workers, and hotel maids who in turn spend their income throughout the economy. The tax revenue from this stimulated economic activity is thus a multiplier of the direct tax impact estimated in this paper.

New factories create jobs and tax revenue

There have been three studies of economic impact of new semiconductor plants on local economies: the Micron Technology fab in Manassas, Virginia; a planned AMD (now GLOBALFOUNDRIES) fab in Saratoga County, New York; and Intel’s presence in Oregon. These studies found that a new fab creates:

- 1013 to 1,465 permanent manufacturing jobs
- An additional 4,626 to 5,050 jobs in the region due to plant spending (maintenance, business services, office supplies, etc) and regional multiplier effects (spending by employees, maintenance workers, etc. in the regional economy)
- 4,300 jobs during the construction phase of a new fab.

While the studies did not assess Federal tax revenues, they did estimate state/local revenues. The Micron study found that the City of Manassas gained $5.7 million in tax revenue, had an increase of $0.8 million in expenditures, or net gain of $4.8 million due to Micron’s fab, and that but for this gain, the city would have had a budget deficit of $3.7 million rather than a surplus of $1.2 million. The study also noted that in 2005

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Micron paid $6 million in Virginia corporate taxes, payroll withholding, and unemployment taxes. The 2002 Intel study found that Intel paid $46 million in local government taxes, but imposed only $7 million in government costs, and that Intel employees paid $125 million in property taxes and $107 million in state income tax (45% of which goes to schools) but only cost local governments and schools $53 million. The 2005 study of Intel's investments found that its Oregon investments would add $7.7 million annually to the local county government with little increase in services.

The Federal Government has a huge return on investment in research.

In assessing the Federal budget impact from leadership in semiconductors, policy makers should also recognize that faster and cheaper computing power allows government agencies to fulfill their missions faster, cheaper, and more effectively. From improved hurricane predictions by NOAA, to an effective health information plan whereby most Americans have electronic health records in 10 years and doctors e-prescribe drugs directly to pharmacies; from local police searches of FBI fingerprint databases to electronic filing of taxes to the IRS; and from bioidentification used by Homeland Security to the extensive satellite command and control systems used by our military today, the government is a huge consumer of semiconductor technology.

The Bureau of Economic Analysis reports that the government sector – Federal, state, and local - spent $109 billion cumulative on computers over the fifteen year period from 1995-2009. However if this computing power was purchased at 1995 prices, the government would have spent $1,164 billion – effectively the government agencies were able to get over a trillion dollars of computing power for free.

Calculations based on chained price indexes by the Bureau of Economic Analysis at www.bea.gov/national/xls/comp-gdp.xls
Investments in semiconductor and other information technology related research programs at the NSF, NIST, DARPA, and DOE Office of Science that lay the groundwork for the continued advances computing technology has a tremendous rate of return for the government even if only the consumption of the government sector is considered and the positive benefits for the entire U.S. economy are ignored.

**Conclusion**

Semiconductors will have a major role in meeting the President’s goal to double exports over the next five years, but market growth alone will not be sufficient. U.S. companies must increase market share and the U.S. must be a more attractive place for research and manufacturing. Competitive U.S. tax, export control, university research funding, immigration, and energy policies will all help U.S. companies build leadership positions in their market segments and create jobs in the U.S. The cost of these policies is more than offset by the estimated $2 billion in additional Federal personal and corporate tax receipts generated from the increased shipments, and by the benefits to government agencies resulting from faster and cheaper computing power.