

## **Regulating Satellite Exports**

The United States regulates satellite exports in order to preserve its military advantage. This policy, like the policies that once applied to encryption or computers, grows from the days when the United States faced a “mirror-image” superpower competitor and the primary purpose of satellites was military or intelligence. This is no longer the case. The U.S. regulatory structure now faces a situation where commercial activity has become more important and where a single competitor has been replaced by many.

Exports are of central importance to satellite manufacturing, particularly for U.S. firms, as they do not have the same direct government support received by their foreign competitors and must depend on private markets for financing and revenue. The increased importance of exports has put significant pressure on the traditional national security policy for satellites, which has been to impede foreign space capabilities by limiting access to U.S. satellite technology and services. This policy was successful in an era when the United States had a near-monopoly on advanced satellite technology and when government programs dominated space. It has been increasingly ineffective since 1991 in the face of market and political forces.

The United States recognized at the end of the Cold War that military and government ventures would no longer dominate space, and it took hesitant and incomplete steps to adjust its policies to the emerging commercial satellite market. These steps have not kept pace with global developments. Hesitation has real consequences for the United States. When satellites and satellite services are available from foreign sources, a restrictive policy can actually damage national security by limiting U.S. influence in shaping the global satellite services market without denying other nations access to satellite capabilities.

This argument—restriction hurts security—is counterintuitive, but its validity can be measured by looking at foreign industries. Foreign sources for communications, remote sensing, and navigation satellites and services continue to multiply, while the U.S. industry faces contraction. Restrictions have not prevented other nations from acquiring threshold satellite capabilities, and five countries—France and the European Union, Russia, Israel, China, and India are developing increasingly sophisticated satellite capabilities. An effort to restrict access to satellites may cost the United States its opportunity to lead the global market.

Since that time the U.S. has grappled unsuccessfully with how to characterize and regulate satellites, their components and satellite technology. The issue is whether to continue to treat commercial satellites as a military technology requiring tight restrictions. After decisions by the Republican and Democratic Presidents in 1992 and 1996 to increase the role of the commerce Department in satellite regulation, Congress passed legislation redefining commercial satellites as a military technology.

From 1988 until 1998, the United States adjusted its policies on satellite exports to

recognize the growing internationalization of the satellite market. The first step was the Reagan administration's decision in 1988 allowing China to launch U.S. commercial satellites. In the context of the Cold War strategic equation, the United States obtained pricing, launch quota, and technology safeguard agreements with China to reduce commercial and military risk. In the early 1990s, the Bush administration negotiated similar agreements with the Russians and allowed U.S. companies to enter into joint ventures with Russian space firms in the provision of launch services. Commercial satellites were a valuable bargaining chip for security in nonproliferation negotiations with the Russians and the Chinese, and this security incentive helped move the United States toward greater trade liberalization and economic competitiveness.

The first Bush administration decided, in 1992, to split the jurisdiction of commercial communications satellites and allow less advanced models to be exported as civil goods under more predictable Commerce Department regulations. The United States, unlike its European allies and Japan, controlled satellites as a munition or military good until 1992. The first Bush administration decided that, given the changed international security environment, communications satellites and the equipment needed to launch them could be exported under Commerce Department licenses, but it also decided that satellite technology and manufacturing techniques remain a munition. This split jurisdiction would create serious implementation problems that persist a decade later.

The first Bush administration established nine technical parameters for determining whether a commercial communications satellite should be treated as a munition or a commercial good. These included antennae size, cross-linking (the ability of one satellite to talk to another), and encryption. The nine criteria had become unworkable by 1995. For example, the large LEO telecom constellations planned for launch (such as Iridium) would require both larger antennas and cross-link capability, which had previously been used only by military satellites.

U.S. manufacturers argue that they are put at a disadvantage when satellites are treated as munitions. The basis for this lies not only in the more complicated license processing and long delays associated with munitions, but also in the differing requirements of U.S. law and regulation for munitions and for commercial goods. If a foreign product incorporates a U.S. component classified as a munition, the entire foreign item becomes subject to U.S. licensing. If a \$100 million European satellite incorporates a \$15 U.S.-controlled component, a State Department license is required for that satellite's export. Under Commerce

#### **Multilateral Satellite Controls**

The Wassenaar Arrangement is the only multilateral regime that controls satellites. Wassenaar is not like other nonproliferation regimes and is generally considered ineffective. Although major satellite-producing countries (the United States, Russia, France, Italy, Japan, and Canada) are Wassenaar members, new producers (China, Israel, India) are not. Other Wassenaar members do not share U.S. views on the risk of exporting commercial satellite systems or technology. The chief difference between the United States and its Wassenaar partners is that they control satellites as "dual-use" goods while the United States controls them as munitions.

rules, reexport requirements apply only when the U.S. content reaches 25 percent of the value of the foreign item. In light of this licensing requirement, foreign manufacturers have chosen to “design out” U.S. components when foreign substitutes are available and have begun production of those components that are now available only from the United States.<sup>1</sup> The result is that a European satellite’s use of U.S. components requires a U.S. State Department license for export. An increasing number of European firms have chosen to design out U.S. components or to avoid partnerships with U.S. firms rather than face the license process.

Commerce regulations are less restrictive than the State Department’s regulations because multilateral agreements determine the Commerce Control List’s scope. If a multilateral regime does not control an item or technology, Commerce does not control it (except to sanctioned countries). Satellites are controlled by the Wassenaar Arrangement (which grew out of CoCom, the Cold War export regime). Wassenaar does not control satellite technology or “know-how.” Commerce officials also chose in 1992 to interpret the new satellite controls in the most liberal fashion allowed by their regulations.

The U.S. is also significantly more restrictive in its control of satellite technology. The Wassenaar Arrangement, the only multilateral regime that covers satellites, does not control any commercial satellite technology because commercial satellite technology has no strategic or military relevance. This means that companies in Europe, Japan, Canada and Russia do not face the same level of restriction and oversight faced by U.S. companies, an issue that becomes more important in the context of U.S. monitoring requirements (discussed below). Despite the intense domestic debate over the implications for national security of satellite technology, the United States has never proposed that Wassenaar or the Missile Technology Control Regime (MTCR), the international missile nonproliferation regime, apply controls to it.

The MTCR does control some components that can be used in satellites, such as radiation-hardened chips and various guidance technologies. These components are available from foreign sources, but almost all MTCR members have been scrupulous in not allowing exports of these items to missile programs. However, the MTCR allows the export of these items for manned aircraft and satellites. This is another area of discrepancy between the United States and its nonproliferation partners, as the United States has taken a more restrictive approach, not only in regard to countries like China but also for space programs in allied countries.<sup>2</sup>

This difference reflects an element of confusion that has entered into the debate over satellites regarding their relation to missile programs. Satellites themselves make little or no contribution to missiles, which is why the MTCR chose not to control them. Satellite launches pose a more difficult problem because launches involve technologies of very serious concern for ballistic missile proliferation. However, there has been a blurring of the distinction between missile and satellites that exaggerates the potential proliferation risk of satellite exports. The inability to accurately measure risk is one of the most serious problems for the U.S. system of export controls.

### **U.S. Policy, 1993–2000**

The Clinton administration continued the review of jurisdiction for satellite exports begun under President Bush. Faced with the erosion of the technical parameters usefulness in determining whether a commercial satellite was a “munition” or a “dual-use good,” the Clinton administration transferred jurisdiction of communications satellites not previously transferred in 1992 to Commerce. The decision reflected the evolution of satellites from a military to a civil technology (as had been the case with jet aircraft and jeeps) and reflected the administration’s confidence in its new Executive Order 12981, which gave Defense and State new, broad-ranging authorities to participate in Commerce licensing. The move was bitterly resisted by the State Department, which saw it as a significant loss of turf, and State officials lobbied Congress to have the decision reversed.

The Clinton administration also decided to retain the Bush administration decisions on splitting jurisdiction between State and Commerce for satellites and satellite technology. Although communications satellites went to Commerce, the related technology remained a munition. Technology for space-launch vehicles, which was never considered for transfer, also remained a munition.

The difficulties of the split jurisdiction in the U.S. satellite manufacturing industry were brought into sharp focus by the 1998 debate over whether satellite exports to China, either for use by Chinese telecommunications firms or for launch by China’s commercial launch service provider, had resulted in the transfer of technology that would improve China’s ballistic missiles (see Appendix B). Foes of the Clinton administration and its China policies were able to exploit these technology transfer concerns.<sup>3</sup> Acting with a speed that reflected both unhappiness with the administration (the satellite debate was intertwined with impeachment proceedings) and concern over China, the Congress passed legislation that returned jurisdiction of communications satellites to the State Department, made communications satellites a munition by law, and imposed new restrictions on the transfer of missile related technology to China.

The State Department complemented these legislative changes by expanding the reach of its own regulations. State declared that not only were communications satellites now munitions, but their components were now munitions as well; that all satellite technology, even fundamental research that had been excluded from control by the Reagan administration, now requires a munitions license for export; and that foreign operators of commercial communications satellites must apply for a technology safeguards agreement even if they had been operating the U.S.-made satellite for years before the transfer.

For example, the “Thermistor Bolometer” is a resistor that senses infrared radiation from heat. First developed for use by railroads in the 1950s (the thermistor bolometer was attached to station platforms and when a car with overheated bearing went by, the heat set off a signal used to alert the train crew). The same thermistor bolometer technology was used, beginning in the 1970s, to orient satellites towards the horizon (known as “attitude determination”): the thermistor distinguished between the dark side of the planet (cold) and the light side (hot). Although originally designed for use with steam locomotives, after the 1998 legislative change, the Departments of State and Defense decided that the thermistor

was a munition and required arms export licenses. Two years later, agencies were still debating how this piece of equipment should be treated. Thermistor producers experienced a sudden and damaging jolt in their revenue stream as their export status changed and as the debate dragged on.<sup>4</sup>

Foreign operators of U.S. commercial communications satellites were surprised in 1999 when the Department of State went to them and required that they retroactively obtain Technical Assistance Agreements (TAAs) governing technology transfers for satellites that had been licensed by Commerce and exported and launched years before. These Technical Assistance Agreements are usually required for the manufacture and launch of satellites. One Nordic embassy official told CSIS that it was puzzled as to how a technology transfer could occur for a satellite already in space and to which the Nordic operator had no access.<sup>5</sup>

When satellite licensing moved back to the State Department, new regulations governing satellite technology removed the fundamental research distinction, and State issued “deemed export” directives to NASA and universities requiring licenses for collaboration with foreign researchers on fundamental research. This had a chilling effect on the space research community. Scientists and researchers from the National Labs, Universities and companies tell us that they find it increasingly difficult to carry out their research because of these restrictions.<sup>6</sup>

These measures were accompanied by an expansion of the satellite-monitoring regime implemented by the Defense Department under State’s authorities. Defense monitoring had been a part of the 1988 Reagan administration decision to allow China to launch U.S. satellites. When the first Bush administration decided to transfer some communications satellites, Commerce agreed to Defense monitoring when it received jurisdiction in 1992, but did not support DOD charging the satellite firms for travel costs. Although it reversed its position in 1996 to support monitoring, this opposition was held against it in the jurisdictional debates.

The Defense Department’s satellite export monitoring programs also came in for criticism in 1998 for being overly lax. In at least one instance, Defense had the authority to send a monitor to a China launch but chose not to do so. In response to congressional criticism, Defense greatly expanded its monitoring program. The new program covered not only Chinese and Russian launches of U.S.-made satellites (Defense even planned to monitor French launches of U.S. satellites), but also extended to domestic U.S. launches and activities not previously monitored. In the new program, U.S. government monitors have access to satellite-related activities by U.S. manufacturers during the construction of the satellite, including the participation of monitors in telephone conferences, prior review of data to be exchanged, and access to the manufacturers’ databases. These measures entail remarkable access to unclassified company information, but the manufacturers, fearful of a congressional reaction, dependent in many cases on Defense for other contracts, and wary of potential delays in license approvals, did not object.

This expanded monitoring program reflects a larger debate in the United States over the treatment of unclassified information. The Economic Espionage Act and the Commerce Department's "deemed export" rule exemplify the increased concern to protect information. The trend in the 1990s was to apply export control restrictions to privately held information that was not sufficiently sensitive to require classification. For satellites, the Department of State went even further in its 1998 regulations and required licenses for basic research information that the Reagan administration had released from control.

### Satellite Licensing at State

**Average time for approval: 4 months**

**Average number of licenses required: 9**

- 1 Marketing license
- 1 Program TAA\* (notified to congress)
- 1 DSP-5 Export License for hardware
- 1 DSP-5 for fuel
- 1 DSP-61 import license for fit-check
- 1 TAA for data to insurance companies
- 1 Launch Services TAA
- 1 Customer service and operation license
- 1 DSP-5 for post-launch anomalies

\* Technical Assistant Agreement

The single most significant difference between Commerce and State licensing is the treatment of technology. State regards all satellite technology as sensitive and controlled, irrespective of its use, its intended recipient, or its availability from non-U.S. sources.<sup>7</sup> State regards anything having to do with Space as militarily sensitive. The effect of the 1998 legislation was to reinstitute satellite technology controls from the 1970s. The treatment of technical data will be an especially difficult issue. The high end of technology is particularly sensitive, and the most sensitive military technologies are classified. The State Department, however, applies its technology controls in a blanket fashion, catching both the high end and the low, defining satellite technology as

information, in any form, which is directly related to the design, engineering, development, production, processing, manufacture, use, operation, overhaul, repair, maintenance, modification, or reconstruction of defense articles. This includes, for example, information in the form of blueprints, drawings, photographs, plans, instructions, computer software and documentation. This also includes information that advances the state of the art of articles on the U.S. Munitions List.<sup>8</sup>

This broad reach covers too much and sometimes defies common sense. One European satellite manufacturer, Alenia, reported that when it sends technical data to a U.S. partner, the U.S. partner needs a license to send the same data back, even though it originated with the European company.

To put this problem in perspective, compare it to speed limits. When cars were first introduced, many cities imposed a speed limit of 5 to 10 miles an hour on the new and potentially dangerous technology. They did this for reasons of public security. This low threshold essentially caught all cars. If cities had not raised speed limits to reflect technical change and a new environment, most people today would violate the speed limits and "threaten" security. State's low threshold for technology controls, like the 5-mile-an-hour speed limit, are appropriate for an earlier age, but results in many "technical

violations that have nothing to do with security and unnecessarily impede the flow of legitimate traffic.

The marked increase in the number of Technical Assistance Agreements required by State for technical data over the last few years is evidence of this overreach. TAAs are long, contract-style documents, often comprising dozens or even hundreds of pages that list explicitly what can be exported. Obtaining a TAA is a lengthy process, often involving complex, lengthy negotiations that result in inflexible agreements that are difficult to interpret. This difficulty creates a high degree of risk for anyone planning to partner with a U.S. company, and satellite manufacturers in NATO countries have told us that it deters them from buying from or cooperating with U.S. firms.

State, recognizing that its slow performance in license processing was a liability, sought to implement a number of reforms for satellites. U.S. allies were displeased in 1998 to discover that new U.S. satellite export restrictions applied to their requests as equally as to those from other nations, and Congress encouraged State to relax restrictions on exports to NATO allies. However, the reforms did not address the question of overbroad controls on technology. State also froze license approval to China for a period of months as part of secret negotiations on missile proliferation, although when State announced that it was lifting the freeze, there was no noticeable improvement in license processing—major U.S. manufacturers reports that the mean time for licensing went from 104 days in 2000 to 169 days in 2001 and 150 days in 2002.<sup>9</sup>

### **U.S. Share of the Communications Satellite Market**

In 1998, congressional concerns over alleged leaks of space technology to China led to the passage of legislation that transferred the export-licensing jurisdiction for communications satellites from the Department of Commerce to the Department of State. The effect of this transfer on U.S. market share for commercial satellites has become an important element of the satellite debate. The changes in U.S. revenues and share of the commercial communications satellite market shows that a significant decline has occurred. Our review suggests that the export controls administered by the State Department are one of the factors responsible for the decline.

If foreign firms did not have a larger share of the satellite market since the transfer, we could dismiss claims that the 1998 legislation damaged U.S. satellite manufacturers' market share. However, showing that a decrease occurred after the change in jurisdiction does not establish why it occurred. The temporal correlation—the decline began after the legislative change—suggests that they are connected, but a decline in U.S. market share could reflect several other factors. Having a “strong” dollar makes European satellites cheaper. New entrants into the commercial market, such as China, India, Israel, and Russia, take market share (this also suggests that some 1998 technology restrictions are futile). A determined effort by European governments to become more competitive in the space market through mergers and collaboration has reduced U.S. market share.<sup>10</sup>

Foreign exchange difference are the most compelling alternative to export controls for

explaining a diminished market share, but a stronger dollar does not explain the decline in U.S. satellite sales. The dollar rose by 7–8 percent against foreign currencies in 2000, but U.S. exports of goods and services continued to increase until the last quarter of 2000.<sup>11</sup> Other large U.S. multinational firms estimate that a strong dollar has lowered their sales by 2 to 4 percent in the last year.<sup>12</sup> The continued rise in the value of the dollar may help explain future losses, but it does not account for losses in satellite manufacturers' revenues in the period after export jurisdiction was changed.

If an overvalued dollar caused the decline in satellite sales, we should see a similar decline in sales from other industries. Using orders for large commercial jet aircraft, we can assess whether the decline in market share reflects factors unique to satellites or is part of larger aerospace industry trends. The U.S. share of orders for large commercial jet aircraft does not track satellite market share.<sup>13</sup> Both went down in 1999, but the U.S. share of large aircraft orders went back up in 2000. Although U.S. sales of satellite systems recovered somewhat in 2001, this was offset by a dramatic fall in the U.S. share of the satellite component market and a marked increase of imports from Europe and elsewhere of the hardware needed to build satellites.<sup>14</sup>

How would legislative changes shape the market for satellites? Export controls that apply only to the United States affect market share because they change the price differential between United States and foreign satellite manufacturers. The new regulations created delays and uncertainties and increased the risk and expense of acquiring a satellite from the United States. Purchasers must commit funds to the satellite manufacturer; they must pay interest on these funds and lose the opportunity to invest them elsewhere while the satellite is being built. On a \$100 million satellite, these finance charges could be substantial. Every day the satellite is not in orbit is a day of lost revenue and greater finance charges.

Both U.S. and European companies have told us that State's extensive technology rules and Defense's monitoring requirements slow down discussion between U.S. companies and foreign satellite purchasers and component suppliers. These are usually Western firms, so there is little security risk to justify the added government oversight. European companies have told us that making the design changes and modifications that are often part of the manufacturing process is slowed considerably when U.S. companies must get approval for conversations, faxes, or e-mails, making them unattractive partners. The requirement for congressional notification can add several months' delay, primarily owing to unpredictable delays in submitting notifications.

U.S. manufacturers must commit to a specific delivery date or face financial penalties. Since they know that State licensing adds delays of unpredictable length, they build in extra time into their delivery dates. This would make U.S. satellites more costly to purchase. Changes in manufacturing—the use of standardized parts and assembly-line techniques—have reduced satellite production times, but the ultimate uncertainty of when State will issue a license for a satellite—measured in months—increases the risks for foreign purchasers. The chief source of this uncertainty, according to U.S. companies, is the delay in State's submission of congressional notifications, which are unpredictable and can add up to three months in processing times.

The extraterritorial aspects of State's regulations also affect demand for U.S. satellites. State-controlled items fall under sanctions that restrict sales to India and China. U.S.-made satellites, or foreign-made satellites that use State-controlled components, have additional retransfer and licensing restrictions. U.S.-made satellites, or foreign-made satellites that use State-controlled components, have additional retransfer and licensing restrictions. State is currently reviewing an in-orbit transfer of a communications satellite to a European operator, but it has delayed making a decision for several months on whether to approve the transfer, what licenses are required, and whether to notify Congress. Foreign firms have stated that these factors make U.S. satellites less attractive.<sup>15</sup>

### **Implications of Declining Market Share**

Using conservative measures, the United States suffered at least a 16 percent decline in its share of the GEO satellite market since the transfer of jurisdiction. Perhaps more important, we have seen a shift in components and subcontractors that has long-term implications for the health of the U.S. satellite industry. In 1995, U.S. satellite component suppliers had 90 percent of the market whereas by 2000 they retained only 56 percent. In contrast, European suppliers' share had increased from less than 10 percent in 1995 to 34 percent in 2000.<sup>16</sup> The shift of component manufacturing to non-U.S. sources is very damaging, and the United States already finds many of its commercial and military satellite programs dependent on foreign suppliers as a result. U.S. export control changes bear considerable responsibility for this because of their effect on prices and demand for U.S. satellites and satellite components.

The 1998 restrictions on commercial communications satellites were not the only factor responsible for a decline in U.S. market share (exchange rates, new suppliers, and European industrial policy also played a role), but they came at a time when U.S. manufacturers were already under substantial pressure and reinforced trends that worked against the health of U.S. satellite industry. Foreign competitors do not face the more extensive technology restraints, the extraterritorial requirements, and the higher degree of uncertainty in licensing faced by U.S. satellite manufacturers. These differences put U.S. firms at a disadvantage by increasing uncertainty and risk for potential foreign purchasers of U.S. satellites.

Since one of the external trends affecting market share is the entrance of new supplier nations like China and India into satellite and launch vehicle production, it is possible that the new restrictions placed new costs on U.S. industry with little or no compensating effect on foreign space capabilities. More important, of the factors that account for a decline in market share, the United States only has effective leverage over export controls. It has little or no influence on exchange rates for the euro, decisions by other nations to enter into satellite production, or European industrial policy. If the United States wants a healthy satellite industry in the face of intense competition, exchange rate difficulties, and the declining effectiveness of technology restrictions, it will have to reconsider legislation widely perceived as making its satellite companies less competitive.

This question is complicated because many in the United States see communications satellite exports as proliferation and security problems. The national security aspect that has been emphasized is the effect of the transfer on potential leakage of space and launch technology. However, an equally important aspect of satellite exports for national security has not received equal attention. This is the need to maintain a robust and technologically advanced manufacturing base to build military and intelligence satellites.

Restrictions work against the health of U.S. companies in global markets when foreign competitors do not face similar controls. However, national restrictions could be justified if they applied to unique U.S. satellite and launch technologies from which others could use for military advantage. If these technologies were not unique to the United States, restrictions would damage industry without compensating security benefits. Since U.S. leadership in space depends on a robust commercial satellite-manufacturing sector, we may have done more harm than good for national security by restricting exports of replaceable technologies in an effort to lower the risk of technology leakage.

For example, current State regulations require that the reexport to a third country of any U.S. munitions items or technology, no matter how small, requires a State Department license. This raises serious problems when a U.S. munitions item is incorporated into a foreign satellite. No other country has this requirement. Foreign companies had to accept this restriction when the United States was the only source for satellite technology. Now that the United States no longer has a monopoly on many satellite technologies, they have “designed out” U.S. components and replaced them with foreign equivalents.

The impetus the 1998 changes gave to foreign satellite manufacturers has resulted in a larger share of the satellite market for these firms, much in the way that Airbus has established itself as a leading manufacturer of passenger aircraft. In an era of fierce competition and overcapacity in satellite manufacturing, supportive government policies and a positive regulatory environment will be a key determinant for a healthy space industry. For the United States, removing regulatory obstacles may be a key determinant for keeping America strong in space.

Decline in market share is just one element of the satellite jurisdiction debate. Other elements include the effect of the change of jurisdiction on space research, on smaller component suppliers (“subcontractors”), and on the composition of the satellite services market. The climate of regulatory uncertainty created by the transfer also affects crucial related activities, such as insurance and financing of satellite construction and launch. Measuring changes in market share does not fully reflect these other issues, but there is also considerable evidence that just as the transfer of jurisdiction damaged U.S. market share, it damaged U.S. activities in these other sectors.

A study by Booz-Allen & Hamilton sponsored by the National Reconnaissance Office and the Office of the Secretary of Defense found that although there are “more than adequate capacity and competition” in the U.S. satellite industry today, the “deteriorating financial health” of companies poses a threat to future U.S. sufficiency in this sector. It summarized the satellite industry as one with overcapacity in production, increased

business risk without adequate returns, and increased debt, making the sector “unattractive” for the investment community.<sup>17</sup>

The study found excess production capacity for satellites and a “growing reluctance for companies to invest in restructuring” and innovation. The return on assets (ROA) for satellite manufacturers fluctuates between the return on a BBB corporate bond and U.S. Treasury bonds—assets with much lower risk.

Technological improvements have also put pressure on the industry. Existing satellite fleets (both commercial and military) will be replaced in the next 5 to 10 years with satellites of greater capabilities and longer lifespan (approaching 15 years, according to some sources). The result will be fewer satellite purchases and longer gaps between government satellite programs, but additional financial strain on primary producers and component manufacturers.

## End Notes

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- <sup>1</sup> See John J. Hamre et al., *Technology and Security in the 21st Century: U.S. Military Export Control Reform* (Washington, D.C.: CSIS, 2001).
- <sup>2</sup> See the provisions of the 1998 National Defense Authorization Act.
- <sup>3</sup> See, for example, Michael May, editor, "The Cox Committee Report: An Assessment" (Stanford University: Center for International Security and Cooperation, December 1999); Gerald Seib, "Another Threat Looms: China as a New Demon," *Wall Street Journal*, May 26, 1999; Walter Pincus, "China Spy Gains Overvalued, Two Former Lab Directors Say," *Washington Post*, May 30, 1999, p. A10; Steven Fidler, "Secrets Thefts May Be Overblown," *Financial Times*, May 27, 1999.
- <sup>4</sup> CSIS interviews with BXA and company officials. See <http://www.servo.com/elecpl1.htm> (24 March 2002) for more information about thermistors
- <sup>5</sup> See *Aeronautics and Space Report of the President* for a general account of this problem.
- <sup>6</sup> See <http://www.aau.edu/research/LaneLtr5.16.00.html> (March 24, 2002). State was preparing regulations to overturn its earlier decision restricting research as this study goes to press.
- <sup>7</sup> The allegations of satellite information being transferred to China were the result of State's broad interpretation making these technical violations of the rules rather than actual transfers of sensitive military technology.
- <sup>8</sup> Department of State, International Traffic in Arms Regulations (ITAR).
- <sup>9</sup> Statement of Brian Daley, Lockheed Martin, CSIS Conference on Space Policy, March 12, 2002.
- <sup>10</sup> See page 18 in "Towards a Space Agency for the European Union, Annex II, Joint ESA/EC Document on a European Strategy for Space," and John M. Logsdon, "'Constructing Europe' and the Future of European Space Activities for the United States," May 2000.
- <sup>11</sup> Federal Reserve Board, Monetary Policy Report submitted to Congress on July 18, 2001, pursuant to section 2B of the Federal Reserve Act, Section 2, Economic and Financial Developments in 2001.
- <sup>12</sup> Danny Hakim and Greg Winter, "G.M. Official Says Dollar Is Too Strong," *New York Times*, August 9, 2001; David Huether, "NAM Says Strong Dollar and Weak Growth Abroad Continue to Hamper U.S. Exports," April 2001; Federal Reserve Statistical Release, Foreign Exchange Rates (Monthly), August 1, 2001.
- <sup>13</sup> Aerospace Industries Association, "Net New Orders, Shipments, and Backlog for Large Civil Jet Transport Aircraft," see [http://aia-aerospace.org/stats/aero\\_stats/aero\\_stats.cfm/](http://aia-aerospace.org/stats/aero_stats/aero_stats.cfm/), accessed December 2001.
- <sup>14</sup> Bureau of the Census, *Statistical Abstract of the United States*, 2000; statement of Brian Daley, Lockheed Martin, at CSIS conference, "Space and National Security in the Twenty-First Century," March 12, 2002.
- <sup>15</sup> The latest example appears in the June 25, 2001 edition of *Space News*, where Asiasat says it will no longer buy U.S. satellites because of the restrictions.
- <sup>16</sup> Statement of Brian Daley at CSIS conference, March 12, 2002.
- <sup>17</sup> Moorman, Thomas, "U.S. Space Industrial Base Study," Booz-Allen & Hamilton, February 2000.