Secrecy in the USSR and German Democratic Republic Patent Systems

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John A. Martens

Abstract

Why did the Soviet Union and its East European allies establish patent offices? Patents, after all, create private property rights which may interfere with the goals of state ownership and central planning.

The Soviet Union and its allies also established secret patents, but wouldn't secret patents undermine the free flow of information, one of the purported advantages of state planning and the inventor's certificate, a socialist form of patent? Although most developed market economies had secret patents or rules on maintaining secrecy for patent applications judged important to national security, why did the Soviet Union and its allies believe they needed to do so too? Were the communist countries more or less secretive than the market economies?

This article explores the above questions by examining the Soviet and GDR secret patent systems, comparing them to each other and to the systems in selected developed market economies (the FRG, United States, United Kingdom and France). This analysis provides the first quantitative cross-national assessment of state secrecy, showing that considerable national differences have existed in how secrecy was used even in the former Communist countries.

Centrally-planned economies struggled to keep up technologically with developed market economies and encountered enormous difficulties in establishing incentives that would push their enterprises to create new products and technologies or to raise the quality of their existing products. Once a product was produced in a centrally planned economy, making more of it seemed relatively straightforward for state enterprises; creating an entirely new product proved more difficult.

The Soviet and GDR patent systems, after being modified to conform to state ownership, served as key managerial tools for central planners in their struggle to force new technology usage. Patents permitted quantification of innovation, the establishment of planners' objective goals in an area that generally lacked them. Patents also had an international aspect, permitting planners to compare new technologies in other countries with their own.

By following the development of the USSR and GDR patent systems, we examine their efforts at industrial innovation and tap into a major source of micro level data. Both the Soviet Union and the GDR filed thousands of domestic patents yearly; the Soviet Union, tens of thousands.[1] Analyzing how their patent systems developed reveals the problems central planners faced as they sought a rate of technological progress comparable to that of market economies. Laser technology provides a brief case study on secrecy and technology development in the USSR and GDR. Patent data show that the USSR and GDR economies lagged behind the United States in filing patent applications for lasers, even though USSR scientists were among the pioneers in the field of quantum electronics and the GDR excelled in the optical sciences. Central planning required the top-down management of laser technology and left little room for small, independent developers.

Military competition with the West increased the urgency of managing technological progress in the Warsaw Pact countries, for new weapons systems depended on new or improved technologies. This urgency was especially acute in the Soviet Union, which shouldered the major burden of military competition with the Warsaw Pact's adversaries. Secret patenting expanded in the Soviet Union; it appears to have been less significant in the GDR, where military production was at first discouraged, then subsequently occupied only a relatively modest share of the national economy.

Following the collapse of the GDR regime, the *Deutsches Patent und Markenamt* (DPMA) obtained data on 930 secret GDR patents. This information is analyzed for its comprehensiveness and, together with other GDR patent information, provides a basis for estimating the share of total patents accounted for by secret patents. This estimation for the GDR is compared to Soviet data and data on secret patents from selected market economies.

1 The USSR.

1.1 Inventor's Certificates: Adapting Patents to Central Planning

During the second half of the 19th century the Russian economy began a period of rapid industrialization, tapping into foreign investment. The growing influence of patent laws in supporting industrial progress elsewhere and their presumed importance to foreign investors caught the attention of Tsarist officials. In 1896 Russia promulgated a Decree of Privileges for Inventions and

[1] For simplicity's sake we consider a Soviet inventor's certificate and a GDR *Wirtschaftpatent* a form of patent.

Improvements that brought its system much closer to practices found in the rest of Europe.

When the Bolsheviks consolidated power, encouraging inventors seemed an unlikely economic policy priority; yet Marxists viewed new technologies as drivers of economic and social change. Lenin's decree to replace Tsarist patents in 1919 with Bolshevik ones was based on ideological conviction and occurred at the same time as the Bolsheviks nationalized industry and banking, banned private enterprise and rationed food. Under Lenin's decree inventions could be declared the property of the Russian government and subject to use by all citizens through compulsory negotiations. While other countries' patent laws permitted compulsory licensing, usually with an overriding social good such as broader access to miracle drugs, invoking such compulsion was considered extreme and rarely done; in early post-revolutionary Russia, it was to be the general rule for all technologies.

Russian economic hardship softened post-revolutionary rigidity. Living conditions had declined under the new Bolshevik-led government making its hold on power tenuous, and the leaders responded by tempering their radical economic policies with what became known as the New Economic Policy (NEP). Replacing Lenin's decree with a more traditional patent law to encourage local inventors and attract foreign investment was one of the many NEP economic policy changes. The re-institution of patents evidently encouraged local scientists and engineers, and patent applications from Soviet citizens rose from about 4,300 in 1924 to about 24,000 in 1929 (Martens table A5.5, p. 256). [2] One prominent inventor and pioneer in semiconductor research, Oleg Losev, responded to the new incentives and received ten patents during this brief market-oriented period.

The NEP and its attempts to attract foreign investment clashed with Bolshevik ideological fervor and Stalin's maneuverings to consolidate his political power. The inauguration of the five-year plan in 1928 spelled the end of the NEP and with that, the return to a more ideologically acceptable patent policy. How the change happened was also instructive as it foreshadowed more violent political methods. Spies were discovered in the patent office,[3] tried, and executed. The head of the patent office, an early Bolshevik and friend of Lenin's, Ludvig K. Martens, was removed from his position. In 1931 a new law on inventions was promulgated and with it a parallel system of protection: patents for foreigners and inventor's certificates (*avtorskoye svidetel'stvo*) for Soviet citizens.[4]

[2] From 1919-1923 only about 4,000 applications were recorded.

[3] Known as the Committee for Invention (*Komitet po Delam Izobretenii*).

[4] The 1931 law permitted foreigners and Soviet citizens to choose either form of pro-

Soviet legal specialists proclaimed the superiority of the inventor's certificate over the bourgeois patent in promoting the use of new technologies. According to Soviet theorists, capitalist patent systems were flawed for they:

- Suppressed the talents of the masses. Workers were reluctant to invent, for they understood that any inventions they made would be used against them and only enrich their overlords.
- Slowed innovation, often blocking the use of the most advanced technologies. Finance capitalists didn't compete, but rigged the markets in global cartels that suppressed new inventions.
- Fostered a cult of industrial secrecy that choked off the flow of important technical information. Patent owners paid lip service to disclosure, but worked hard to prevent the release of any useful information on their inventions.

1.2 Inventions and the Soviet Five-Year Plans

Soviet economic theory was soon put into practice when the Communist Party announced a centrally planned economy based on five-year plans. Planning imposed quantitative goals - tons of steel, number of tractors, square meters of cloth, etc. - on industrial managers and provided few incentives for using or creating new manufacturing technologies or new products. Left on their own, factory managers fulfilled plan targets and ignored innovation, especially if it might interfere with immediate plan fulfillment. Managers' efforts focused on getting the plan goals they wanted, not on discovering risky new products or processes.

The inventor's certificate provided Soviet planners with an answer to their quandary about how to force factory managers to pay attention to new technologies. The 1931 invention law had left the Soviet patent office, the Committee for Inventions, intact and required it to conduct technical examinations for novelty on all applications for inventor's certificates. The resulting logic for state policy was straightforward: if an inventor's certificate was granted, then it was new to the world and should be used by industry. Consequently, the Committee for Inventing established a special department

tection, but the law's intent is clearly shown in the annual statistics. In the twenty years after the 1931 law Soviet citizens were granted 66,771 inventor's certificates; foreigners, 95. See Martens, table A5.7. In the same period Soviet citizens were granted 423 patents; foreigners, 1,782. Soviet citizens subsequently received only 22 patents from 1941 to 1987. See Martens table A5.8.

for choosing new inventions to be sent to factory directors and recommended for use. Inventor's certificates belonged to the state and that eliminated any worry about ownership. The Committee still issued patents, but they were carefully neutered during examination and went largely to foreigners.[5] Planners created relevant metrics on which to judge factory innovation performance and counterbalance the preoccupation with production goals: the number of inventor's certificate applications, number of applications that passed the technical examination and number of inventions used in production. If factory directors failed to use new inventions, they faced pressure from state planners to explain themselves.

Only a half dozen years passed before Soviet economic officials backtracked on pressuring factory managers to use inventions. The Great Terror, a period of political violence from 1936 to 1938, resulted in the execution of top officials at the Committee for Inventions. In 1936, the Committee was abolished and its main resources were transferred to the military. Most alarmingly, "false inventors" (*l'zhi izobretateli*) were discovered. One false inventor, Aleksandr Moisyevich Zarkhin, wrote Stalin from the GULag pleading the case for his misunderstood technology. (RGAE 4461/8/44/1-5 cited in Martens 67-68) False inventors had tricked the Communist Party into funding inventions that didn't work and cost the state valuable resources and time. The Committee had supported such false inventors, much to the consternation of factory managers who often saw innovation as an activity that got in the way of plan fulfillment. The pressure on factory managers to use inventions eased, and they were allowed to satisfy central planners by using worker suggestions (*ratsionalizatorkoye predlozheniye*), a much less rigorous type of innovation.

Worker suggestions, while sometimes quite useful, were usually not linked to the world's latest technological advancements. The earlier Soviet slogan of "catching up and overtaking" (*dognat' i peregnat'*) the technologically advanced capitalist countries might never happen if factory managers could get by with only using worker suggestions and ducking more advanced inventions.

World War II showed the Soviet leadership just how important advanced technologies were for military might. In 1956 Soviet officials once again em-

[5]The Committee for Inventions forwarded foreigners' patent applications to factory directors via the NKVD's classified channels and asked them for help in drafting claims to make sure that granted patents wouldn't negatively affect Soviet industry (RGAE 4461/8/46/271). Patents offer protection only in the country or countries where they are granted. If foreigners did not patent their new inventions in the Soviet Union, then Soviet factories were free to use them.

braced inventions as a solution for their innovation problem. A wealthier Soviet state was able to invest significant resources into rebuilding a Committee for Inventing, soon to be called the State Committee for Inventions and Discoveries, and relaunch its experiment in promoting inventor's certificates on a much grander scale.

Statistically the new invention campaign was a success. Plan indicators, such as the number of new inventor's certificates granted and used, continued to grow robustly during the 1970s and early 1980s, but they appeared to be hollow propaganda victories and had little direct impact on the economy. In 1964 the Committee for Inventions recorded 72,135 inventor's certificate applications from Soviet inventors; in 1984, 145,910. The U.S. patent office in 1964 reported 72,317 patent applications by U.S. residents; in 1984, 61,841.

Was the Soviet Union's economy dominating international technology markets with its renewed emphasis on inventions? International comparisons by Western economists showed the Soviet Union falling behind the advanced capitalist economies technologically, not overtaking them (Martens and Young; and Amann, Cooper and Davies). Foreign patenting by Soviet institutions, perhaps a relatively accurate measure of technological competitiveness, slumped and remained an extremely small share of total annual inventor's certificate grants.[6] Soviet officials had also hoped to expand technology licensing as a way to benefit from their investments in science and engineering; yet Soviet enterprises concluded relatively few licenses with foreign firms. During the sixty years that the inventor's certificate existed, Soviet newspaper articles often bemoaned the failure of Soviet factories to innovate, and Western studies tracked lagging Soviet performance in developing and using new technologies. Stagnation (*zastoy*) became the term often applied by economists to this period in the history of Soviet socialism.

On 31 May 1991 the U.S.S.R. Supreme Soviet replaced the law on inventions with a patent law and in so doing enacted a controversial economic reform. Inventor's certificates, created in 1931 as an ideological alternative to capitalist patents, were abolished. Violence had accompanied the 1931 changeover, with accusations of espionage and the arrest and execution of patent office officials. Now, sixty years later, the change was peaceful. It was a stark admission by the Soviet leadership that their 60-year central-planning experiment had failed. The Soviet economy had proven incapable of competing with market economies in creating and using new technologies.

[6]By the end of the 1980s Soviet inventors filed in the United States slightly fewer patents (about 400) than they had in the early 1970s. See Martens, 134-135. In 1970 Soviet inventors filed about 115,000 inventor's certificate applications; in 1985, 168,000. See Martens, table A5.1.

2 The German Democratic Republic

2.1 Following in the Soviet Union's Footsteps, the German Democratic Republic creates the *Wirtschaftspatent*

After World War II each of the four victorious major allied powers (France, United Kingdom, United States and Soviet Union) administered a distinct geographic area of the new post-war boundaries of the former German Reich. The Cold War engendered numerous differences among the occupiers on how to govern post-war Germany, with most of the disputes occurring between the Soviet Union and the other three powers. In 1949 the three western zones were combined into one Federal Republic (FRG) and the Soviet zone assumed the title of German Democratic Republic (GDR). In 1955 the FRG and GDR each acquired de facto sovereignty over their territories.

Early Soviet governing of its occupation zone focused on extracting war reparations. At first, entire German factories were crated and shipped back to the Soviet Union. Later the reparations focused on tapping into German technological prowess, for German technology had impressed Soviet military officials during the war. On Sept. 1947 Marshal Vasiliy D. Sokolovskiy, the commander in chief of Soviet occupation forces, sent a secret memo on this subject to Minister of Foreign Affairs Molotov:

> "It is known that the British and Americans have taken from the Germans valuable patents, designs, formulas, etc. Thanks to careful preparations made by them even before the invasion of Europe, they prepared and sent into Europe for this purpose several thousand highly qualified specialists, and they are now conducting a major, well-funded effort to identify and acquire German inventors for work in the interests of America and England ... The Americans intend to decide separately the issue of the German Patent Office ... We are seriously behind on this issue and we should take measures to activate work in the very same direction, both in bringing inventors to work in the U.S.S.R. and speeding up the use in the U.S.S.R. of valuable German inventions."(RGAE 4372, op. 94, delo 438 t.1 (194) p. 396).

One year later Sokolovskiy ordered the establishment of an Office for Invention (*Büro für Erfindungswesen*), which would function to meet the challenge made by any patent office established by the Western powers.[7]

[7]Befehl des Obersten Chefs der SMAD des Oberkommandierenden der Gruppe der

Living in the shadow of their Soviet mentors to the east and an increasingly prosperous FRG economy to the west, GDR leaders carefully articulated their economic development policies. Many GDR leaders were trained in the USSR and their economic policy choices largely reflected Soviet views on the supremacy of the communist party and its use of central planning. Yet, after Stalin's death Soviet economic policies were in flux, making the outlines of orthodoxy less clear. An immediate implementation of Soviet economic policy in the GDR required practical choices quite different from what Soviet officials had faced. The GDR's domestic political situation remained unsettled after the workers' riots in 1953, and economic policies had to take into account potential unrest. The open border with West Berlin allowed GDR citizens to express their economic dissatisfaction by leaving the country.

Developing and using new technologies was a difficult problem for Soviet planners and it soon surfaced as a major problem area for the GDR's planners as well.[8] Changes in the GDR's economic policies that promoted technological innovation closely paralleled the policy changes occurring in the Soviet Union. The GDR's second five year plan (1956-60) "... envisaged a stronger increase of productivity and profitability through the introduction of new technology. The prioritization of science and technology was the essential difference between the second and the first Five-Year Plans." (Steiner 71). This sudden emphasis on technological innovation in the GDR echoed Moscow's call for a shift from extensive development to intensive development, a shift from quantitative successes (e.g., more steel) to qualitative ones (e.g., new or better steel).

To bolster intensive development, the Communist Party in Moscow created a State Committee for New Technology (May 28, 1955) and several years later it announced a new law on inventions and discoveries.[9] GDR officials followed Soviet organizational changes with the creation of a Research Council (*Forschungsrat*), which had many of the same duties as the USSR State Committee for New Technology. In the early 1960s the GDR switched from the German system of technical standards (DIN) to the Soviet system (GOST)(Steiner 107). Standards provided Soviet central planners incentives to motivate innovation-shy managers, especially in the "mark

Sowjetischen Besatzungstruppen in Deutschland Nr 107, 11.6.1948. Cited in Wießner, p. 238.

[8]This issue is carefully woven through a major economic history of the GDR. See Steiner pp. 84-85, 112 and 134

[9]Ron Amann pinpoints this USSR shift in economic policy to a July 17, 1955 speech by Nikolay A. Bulganin. Amann and Cooper, p.146.

of quality" or "quality attestation" system. (Hill 53-54) Furthermore, Soviet standards bound GDR industry closer to their Council for Mutual Economic Assistance (CMEA) partners. In the mid to late 1960s, combines, such as the *Volkseigene Betriebe* or VEB and large-scale scientific research centers, were established in the GDR, following on the heels of the Soviet formation of Scientific-Production Associations (*nauchno-proizvodstvennye ob"yedineniya*) which aimed to bring science closer to production.

As described above, the invention system became a central pillar of the Soviet Union's efforts at creating and using new technologies. Modeled on capitalist patent systems, it was expected to motivate scientists and engineers to contribute to economic development. They believed that a patent law's novelty requirement, that new applications not replicate what existed in the international patent literature, assured that new inventions were cutting edge, world class. Planners needed only to motivate enterprise directors to use these new inventions.

Many GDR scientists and engineers were familiar with intellectual property institutions, for Germany had had an established national patent office and patent law since 1877. The Soviet patent system might also have seemed familiar to GDR specialists, for it drew heavily on earlier German law.[10] When crafting their new post-war system, the GDR Patent Office (*Das Amt für Erfindungs- und Patentwesen der DDR – AfEP*) grafted their prior German experience to the model established by the Soviet State Committee for Inventions and Discoveries.

The immediate post-war Soviet invention system was in flux and provided rather shaky guideposts for the GDR's legislators. When the GDR was formed, worker suggestion plans remained in ascendancy in the Soviet Union, but this focus was changing. Early post-war GDR officials had also favored worker suggestions over inventions (Breith 26 and Koblank). Worker suggestions had no novelty examination, nor were the dates of their creation relevant. Factory managers preferred them, for they made plan fulfillment much easier. Central planners, however, doubted the effectiveness of worker suggestion plans in spurring the creation and use of path-breaking technologies. In the end, central planners won and economic policies in the Soviet Union and GDR favored emphasizing inventions over worker suggestion plans.

The new GDR patent law and patent office also reflected Soviet experi-

[10]Ludvig Karlovich Martens, a German immigrant and fervent Bolshevik, oversaw the drafting of the Soviet Patent Law of 1924 and headed the first Soviet patent office. Martens is buried in Moscow's Novodevichiy cemetery.

ence. The patent law introduced an economic patent or *Wirtschaftspatent*, which had the essential characteristics of the Soviet inventor's certificate.[11] The GDR Ministry of Planning directly oversaw the patent office, a bureaucratic chain of command that mirrored the Soviet practice at the time.

GDR economic officials studied Soviet practices carefully and hoped that invention management would overcome the planned economy's difficulties in nurturing new technologies. The GDR statistical administration published in the state's annual economic statistics the growth in the number of invention applications as a principal indicator of increasing technological progress in the economy. Simply put, more inventions or suggestions meant more progress (Statistisches Jahrbuch). [12] This statistical good news reportage mirrored closely how the Soviet Goskomstat tracked the growth of inventor's certificates.

The GDR statistical administration also provided annual confidential reports on inventing for Party leaders. These insider reports reflected changes in the Party's views on which problem areas needed most attention. They contained micro level data from the VEBs and put direct peer pressure on enterprise managers (Ergebnisse). Each year VEBs showed plan fulfillment in applying for a specific number of inventions; it was a category that could be manipulated relatively easily. Tracking quicker and more extensive use of new technologies proved more difficult and became an important focus of the confidential statistical report, sometimes revealing the game of cat and mouse played by central planners and enterprise directors. Each year the report recorded a VEB's planned number of inventions to be used (*Eingeführt in die Praxis*) and its success rate. Of course, such reporting couldn't begin to capture how significant each invention was. Consequently, from 1980-85 the report added a demand that the inventions' usefulness (measured monetarily) during the year be reported and that subsequent usage by other enterprises (*Nachnutzung*) also be reported. It's difficult to imagine that the required calculations for these reports provided useful information; after all, prices largely signaled planners' priorities, not market conditions.[13] In 1986

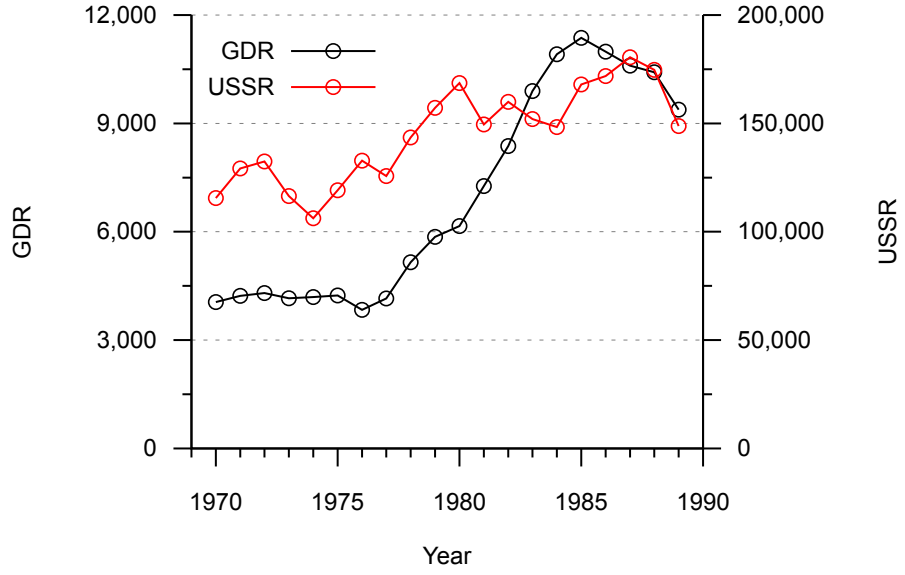
[11]The traditional patent was named an *Ausschließungspatent* or exclusive patent, emphasizing the right to exclude others from use of the invention. As with the inventor's certificate, inventors who used state property in developing their inventions were obligated to apply for a *Wirtschaftspatent*. It could be used freely by any state-owned enterprise.

[12]Invention data were similarly reported in the official Soviet statistical handbook *Narodnoye Khozyaistvo SSSR*. One GDR writer referred to this way of thinking as "Tonnenideologie" or ideology by the ton. Gregor, p.8.

[13]The U.S.S.R. State Committee for Inventions and Discoveries' journal, *Voprosy izobretatel'stva*, contained numerous articles outlining how to calculate an invention's usefulness, spelling out complicated mathematical formulae. Some inventions resulted not in

officials dropped these categories in favor of a new concept, social usefulness (*Gesellschaftlicher Nutzen*). Central planners were spinning their wheels while staying in place.

Figure 1: GDR and USSR Invention Applications from State-Owned Enterprises



Source: GDR: Various copies of *Ergebnisse der Erfindertätigkeit und Schutzrechtsarbeit*, Ministerrat der Deutschen Demokratischen Republik Staatliche Zentralverwaltung für Statistik. Vertrauliche Verschlußsache – gelöscht. Bundesarchiv DE2 30031 and DE2 300343. USSR: Martens table A5.5.

The problems in creating and using new technologies became increasingly obvious to the GDR's economic officials, but much like their Soviet counterparts, they seemed perplexed at what to do. The Berlin Wall had ended the hemorrhage of highly-qualified specialists, but the technological level of GDR industry, like that of its Soviet counterpart, continued to fall slowly behind that of the Western economies. Party dogma had insisted that all of the advantages for capturing the benefits of technological progress belonged to central planning; yet, their data showed that enterprises remained

economic savings, but in quality improvements. There were special calculations for these inventions, too. The whole exercise reflected the difficulties, some might say futility, in judging new technologies with no market signals for guidance.

unmotivated to use new technologies. Only two percent of the economy's recorded economic benefits from new technology came from secondary use (*Nachnutzung*) (Wiedemann and Zobel 164). GDR legislators sought to fine tune the state's innovation system by making changes to its patent law in 1963.(Gesetz. GBl. I Nr. 9 p. 121). The revised law tackled the issue of speeding up the flow of patent information on domestic inventions to state enterprises by creating a new, more limited, examination procedure whereby applications were approved after a short review, one that did not include examining novelty, technological level, prior art or inventive step. These latter standard requirements for issuing patents came into play when a patent was challenged by a second party or used by an enterprise.

Party theorists had assumed that once capitalist ownership restrictions disappeared, state enterprises would automatically embrace new technologies. As a result they placed confidence in AfEP, which oversaw a system for distributing information on new inventions.[14] AfEP's Economic Department functioned much like the Soviet Committee for Inventing in the 1930s and the State Committee after the mid-1950s, reviewing all new patent applications and signaling to enterprises what they considered to be unusually useful inventions. It assumed that innovation needed direction from above and left little room for local initiative.

The lack of results undoubtedly disappointed Party leaders who believed that the *Wirtschaftspatent* had a key role to play in their innovation strategy. State enterprises functioned under central plan guidelines, but potential users of new technologies would avoid using a *Wirtschaftspatent* if it risked undermining the plan indicators or required significant funds. At best, state enterprises might agree to include the use of new technologies in later plans, a slow and cumbersome process ill-suited to the increasing tempo of the technological revolution. The developers of new technologies also saw little advantage to being involved in the process, for Party dogma left little room for being adequately compensated for their efforts.

In 1966 several GDR legal specialists proposed a major change - a system of socialist licenses for compensating the organizations that developed new technologies, giving them incentives to spread their new technologies to other state users.(Wießner 258-260; Adrian and Schönfeld 58-60; and Kastler 514-524). The proposed change maintained state ownership, but tried to inject financial incentives akin to the royalties earned by licensors in market

[14]The Soviet Union at first published when and where inventions were used for the first time in the economy in its annual patent journal (*Byulleten' izobretenii*); later it issued a separate, dedicated journal, *Vnedryennye izobreteniya*, with the information. The GDR published summary descriptions of new inventions in the journal *Der Neuerer*.

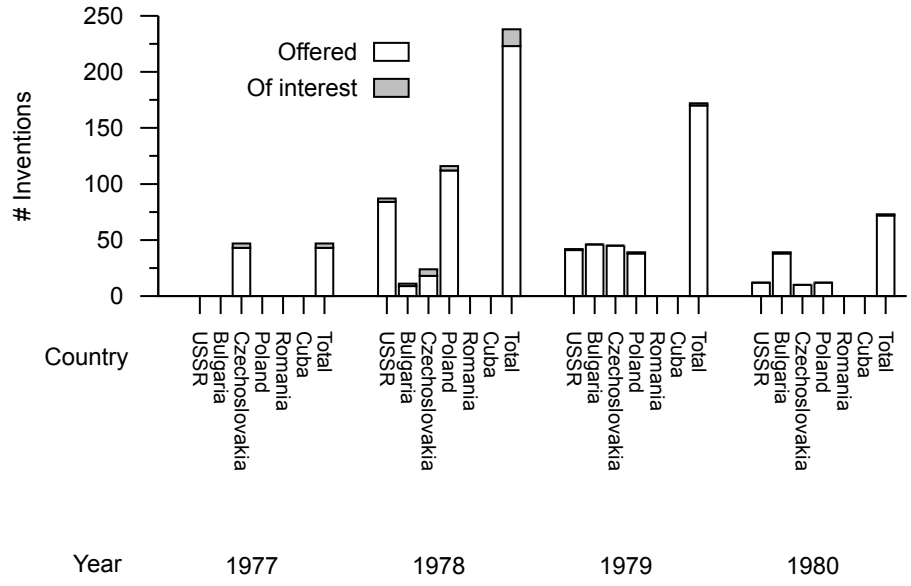
economies. Technology developers, when adequately compensated, would become stakeholders in the new technology's success at the using enterprises, thereby reducing risks for the new users, and the developers would actively champion their new technologies rather than remaining passive bystanders. Perhaps the GDR's greater proximity to Western thinking led it to propose such a solution; shortly after the discussion was launched in the GDR, a similar proposal surfaced in the U.S.S.R.(Mitrakov 9-11 and Dumesh 5). Ultimately a socialist license required granting a quasi-monopoly right to the developer, for the scheme depended on giving developers bargaining power. It also by-passed the central planners' role in dictating statewide priorities, for technology developers could amass resources for developing what planners considered non-priority areas. Challenging the power of state planners was tantamount to challenging the power of the Party. As a result, the discussion went nowhere in either the GDR or the U.S.S.R.

Soviet and GDR inventions weren't only to be shared free of charge with their own country's enterprises, but with other CMEA country enterprises as well. Efforts to promote the sharing of new inventions among the CMEA countries sputtered just as had domestic sharing. Little came of them. Patents represent new ideas, but much development work remains before they can be commercialized. Moreover, not all new ideas have commercial value. Not surprisingly, GDR enterprises showed no interest in about 96 percent of the "most significant" inventions touted by other CMEA patent offices (see figure 2).

Once the push for socialist licenses had failed, the political leadership satisfied itself with tinkering at the edges of their technology problem. A new patent law in 1983 kept the lawyers in the academic think tanks busy, but changed very little substantively. GDR statistics continued to show that everything was fine, for the number of patent applications and the number of inventions used in the economy continued to grow.

The GDR economy's relatively slow use of new technology and general failure to innovate did not mean, of course, that all GDR entrepreneurs were thwarted. Some GDR individuals and organizations did overcome the difficulties of a centrally-planned economy. Dieter Moseman, an engineer at the VEB Kühltechnik, successfully patented state-of-the-art rotary screw compressors while in the GDR and continued to commercialize his inventions once living in the FRG (Patente). VEB Carl Zeiss Jena developed an original fiber-optic projection system for use in planetariums and found a ready market for it world wide. Soviet commercial successes with new technologies are less evident. Although Soviet scientists and engineers pioneered in the development of many important technologies, they rarely succeeded in

Figure 2: Significant Inventions from CMEA Member States for which GDR Kombinate Showed an Interest.



Source: Bundesarchiv 05.11.1981 DF3 9387

commercializingd them (Graham).

3 Secret Patents

Most developed market economies, recognizing the growing importance of military technologies and hoping to prevent their spread to potential adversaries, modified their patent systems to establish secret patents even though this change contradicted the principle of disclosure. [15] World War I propelled the extension of secrecy to patenting in France, Germany, the United Kingdom and the United States. Each of these countries has a different legal tradition and historical experience that are reflected in their differing approaches to patent secrecy. While some secrecy measures were disbanded at the end of World War I, they resumed to become even more rigorous following World War II and the advent of atomic weapons. One recent ex-

[15] A patent application must disclose the invention in sufficient detail for a person skilled in the art to carry out the.

amination of patent secrecy lists twenty-one countries with patent secrecy as part of their national legislation. (Wuylens 132).

Most intellectual property lawyers rarely encounter patent secrecy regulations in their practices, patent law textbooks usually mention it only briefly and the economic analyses of patent regimes generally ignore the subject. The very nature of the subject constrains the availability of public information, for governments are reluctant to discuss their secrecy policies openly. The United Kingdom has published a redacted list of technology areas that guides its patent office in identifying applications that may require secrecy. The list comprises many technologies that have significant military uses, which explains why governments sometimes consider it prudent to temporarily block publication of related patents.[16]

In Germany *Büro 99* of its Patent and Trademark Office (DPMA - Deutsches Patent- und Markenamt) examines and stores the secret patents, which comprise a relatively small share of domestic applications. From 1965 to 1984 the DPMA granted about 1.2 million patents to German residents, of which about 0.2 percent (1,975) were secret (Breith 45-52). The total number of secret patents declined during this period as did the total number of granted patents. As a result, the share of total patents made up by secret patents remained relatively constant, varying between 0.1 and 0.2 percent of all patent grants.

France's secret patents are managed by its Bureau des Brevets and Inventions at the Ministry of Defense (Cochet-Grasset 17-28).[17] Approximately 99 percent of its secret inventions come from Ministry of Defense employees or contractors. In 1979 74 percent of secret invention applications came from the Commissariat for Atomic Energy, 20 percent from other state employees, 5 percent from French industry (e.g., Thomson, SNECMA, Aerospatiale, and ONERA.) and 1 percent from independent inventors of small and medium-sized enterprises. From 1965 to 1984 the French Patent Office (INPI) granted about 200,000 patents to French residents, of which about 0.6 percent (1,305) were secret. France also issues secret patents to foreign applicants under conditions established in agreements with foreign countries (Wuylens 161).[18]

[16] Many governments also limit commerce in military equipment and technology sales. For the United States see International Traffic in Arms Regulations (ITAR). Trade in products and data that have both military and non-military importance are also limited. For the United States see the export control regulations.

[17] Foreign patent recipients were excluded from the German and French data to facilitate the comparison with Soviet data, which do not include foreign recipients.

[18] France has established the following agreements on secret patents: Sweden (15 March 1984), NATO (21 September 1961 and 19 October 1970), Federal Republic of Germany (28 September 1961) and the United States (12 March 1957).

The total number of French secret patents remained relatively small and showed no noticeable trend (Wuylens 69). A 1980 statistical study of secret patents from the 1970s revealed that one-fourth of them were declassified within five years; one half, between five and ten years; and the remaining fourth in 20 or more years (Wuylens 162).

Instead of granting secret patents, the United States government opted to suspend any further treatment of applications and it forbids inventors from publicly discussing their inventions. The use of secrecy orders stopped at the close of the World War I only to restart as World War II loomed. A 1940 Act re-instituted the prior war's secrecy regime for patents, but it did so without a reference to a formal state of war, which had been a previous precondition to imposing secrecy orders. The Commissioner of Patents now had the power to impose secrecy whenever he judged it important for national security. To provide guidance determining which applications affected national defense, the Commissioner of Patents requested to consult defense agency personnel in an advisory board, today known as the Armed Services Patent Advisory Board (ASPAB).

The creation of nuclear weapons fostered a consensus for a patent secrecy regime after the war's end and resulted in the Invention Secrecy Act of 1951, which broadened past wartime practices. The ASPAB maintained a Patent Security Category Review List and continued to provide guidance on all relevant patent applications. The Act required U.S. citizens to file first with the USPTO before filing abroad unless they obtained a special license.[19] Applications were dealt with by the Licensing and Review Branch of the Special Laws Administration Group, also known as *Group 220*. Reviews were coordinated with other interested U.S. government agencies. This system has largely remained in place with few changes.

The available official statistical data for U.S. secrecy orders show that a relatively small share of total resident patent applications is affected. Of total resident patent applications (direct and PCT national phase entries) from 1985-2016 (5,723,684), there were 8963 new secrecy orders, which represent about 0.1 percent of the total (Hausken 202 fn10; Aftergood; WIPO). Nevertheless, the data also show that the rescission of orders increased shortly after the end of the Cold War and sharply decreased after the 9/11 attack, indicating that the terrorist attack led patent officials to broaden the reach of national security concerns (Aftergood).[20]

[19] Other countries also require their citizens to file first in their home country before filing abroad.

[20] From 1989-2000 recisions averaged 360 per year; from 2001-2016, 51 per year.

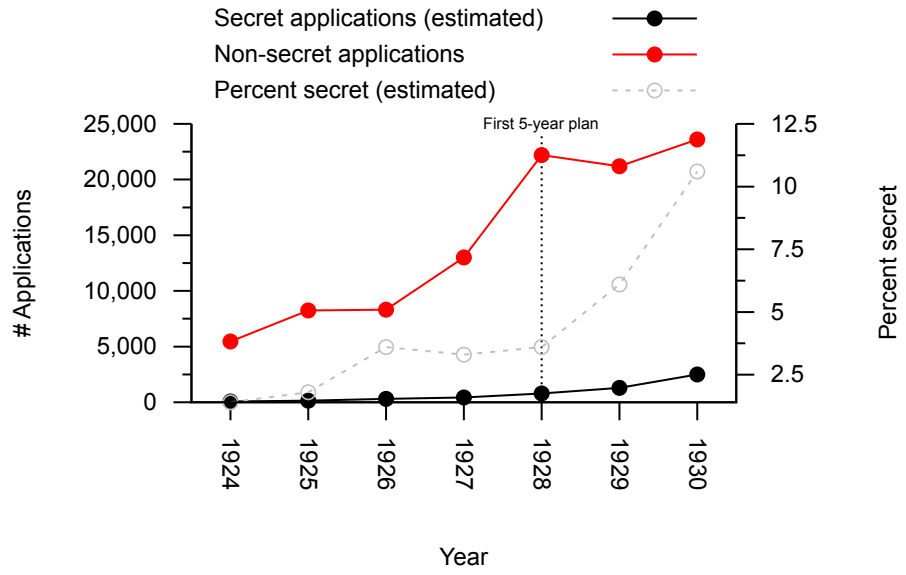
3.1 USSR Patent Secrecy

The 1991 Soviet patent law, enacted just before the USSR's dissolution, was the product of lengthy discussions (Andrews); it ended socialism's experiment with inventor's certificates and re-instituted patents as the sole form of legal protection for inventions (Zakon). The new law also made a radical change that escaped the attention of Western experts and received little discussion in the Soviet press: it ended secret Soviet inventions. Article 1, point 4 of the new law stated laconically: "Inventions that may contain information that might harm the security of the U.S.S.R. should be made secret according to procedures established by the U.S.S.R. Council of Ministers." What procedures? It didn't say. One year later such procedures remained unfinished, and the new 1992 Russian Federation patent law (Article 3, point 3) reiterated the need for them. The Russian government didn't establish new secrecy procedures until 2004 (Khromushina 61).

The abrupt abolition of secret patents reflected serious policy disputes. Secret patents, after all, began at the outset of the Soviet Union. The 1924 Soviet patent law established secret patents for inventions relating to national defense, not unlike those that other countries had instituted during World War I (Postanovlenie, Article 37). Data from Russian archives show that prior to central planning (1928), secret applications ranged from 1.4 to 3.6 percent of total patents (see figure 3). As noted above, a 1931 radical change to the patent system introduced inventor's certificates for Soviet citizens (Polozheniya).

As fears of a new international war resurfaced and domestic political violence gripped the Soviet political elite, questions arose about imposing greater secrecy and restricting the dissemination of information on new Soviet technologies. In the late 1930s the head of the People's Commissariat for Light Industry's Invention Department sent an alarmist memo to top Party officials calling for greater secrecy over all inventions. He was distressed, for example, that foreigners could use his commissariat's invention for processing leather hides. "There is no doubt that they [foreigners] carefully follow all of the branches of our national economy, especially inventing, and they use whatever they find for their own needs"(RGAE 4372/92/133/1-3). He proposed a system whereby information in inventor's certificate documents would be carefully restricted. His concern likely echoed the opinions of other industry officials and perhaps resonated even more now that policies deemphasized the use of new technologies. "If present circumstances prevent us from using our own technological developments, why should we make them available to foreigners?" was undoubtedly a strong argument heard in

Figure 3: The NEP Period: Annual Number of USSR Patent Applications and Non-Secret Patent Grants



Source: 1924-1925 secret estimates based on data from RGANTD fond R-1/51-5 and 52-5. 1926-1930, actual data from RGAE 4461/8/33 l 8 back. Non-Secret data from Izobretatel'stvo, 310-15.

favor of increasing secrecy.[21]

As noted above, increased secrecy accompanied the switch to central planning and inventor's certificates. The first two years of central planning (1928-1929) saw a tripling of secrecy. Increased secrecy continued into the 1930s. Of the more than 126,000 inventor's certificate applications made between 1930 and 1935, over 9 percent were secret, an astoundingly high share when compared to the less than 1 percent share in some developed market economies.

Soviet invention secrecy expanded to include areas outside of direct military application. In 1941 a redraft of the earlier invention law introduced a new concept: "inventions not subject to publication." Publishing information on these inventions resulted in the same criminal charges (i.e., espionage) as

[21] A patent provides legal protection to make, use or sell an invention only in the country where it is issued. Inventors need to patent in each country where they want legal protection.

publishing information on secret inventions.

Military secrecy eased somewhat during the early post-war years, but still remained unusually high. Secret inventor's certificate applications submitted directly to the military in 1947 accounted for about twenty percent of total applications. Furthermore, non-military inventions could also be declared secret. An analysis of non-defense inventor's certificates granted in 1947[22] revealed that ten percent of them were "inventions not subject to publication." In other words, post-war officials considered information on thirty percent of all Soviet inventions to be secret, a level of secrecy far greater than that encountered in developed market economies.

The Khrushchev period (1958-1964) witnessed a slight relaxation in invention secrecy, with slightly less than 10 percent of total invention applications secret (Martens, table A5.6). During this period the annual number of new secret inventions continued to grow faster than the annual number of older secret inventions being declassified. [23] Although new invention laws were enacted, strict secrecy procedures remained. The 1959 revised invention statute kept the extremely broad regulations on secrecy established in 1941, as did the 1973 revised law. Article 42 from 1959 reiterated that the Committee "may, with a view to safeguarding the interests of the State, either postpone the publication of individual inventions or not publish them at all."

Soviet patent secrecy extended beyond restrictions imposed on the technical details of the inventions. Soviet officials also censored bibliographic information on published inventions, such as inventors' and assignees' names, with some military applicants being identified only at a very general organizational level, such as the State Committee for Aviation Technology. Post office box numbers, the designation system used to camouflage military institutes and enterprises, were rarely published and the actual facility names remained secret. Many inventions, even non-military ones, left the inventors' organizations (*zayavitel'*) blank. Sometimes significant delays occurred in publishing the full-specifications (*opisaniye*), which contained the most explicit technical information, after the grant of an inventor's certificate was announced in the Committee's official publication (*Byulleten'*). These delays were another form of secrecy. The censorship rules were not spelled out in any published decree, but were handled secretly by *Glavlit*, (the General

[22]Inventions with application numbers outside of the ranges reserved for secret inventions registered at the Ministry of Defense (Martens, table 4.2).

[23]See Martens, Figure 7.8. Calculations of the Committee's unpublished inventions were difficult until 1970, when about 6 percent of the Committee's grants were declared not subject to publication.

Directorate for the Protection of State Secrets in the Press). Although this period witnessed a surge in the declassification of formerly secret military inventions, the organizational names related to them generally remained secret.

As the Soviet economy slumped, patent secrecy grew. The number of secret invention applications, their share of total applications and censorship grew during the immediate post-Khrushchev period. From 1965 to 1984 the Ministry of Defense Invention Department received over 330,000 secret applications, which equaled about 14 percent of the total applications received by the State Committee for Inventions and Discoveries. The State Committee received a rapidly growing number of applications considered "not subject to publication" (NSTP). It is estimated that four-fifths of them were *For Official Use Only* and one-fifth, secret (Russian Federation State Duma 78). In 1970 only slightly more than one per cent (about 1,750 applications) of the State Committee's total applications were NSTP, but by 1984 this share had increased to almost 19 percent (about 21,000).[24]

When Mikhail Gorbachev became General Secretary, Soviet socialism confronted a barrier to economic growth that must have surprised most ardent Communist Party members. The economy was proving incapable of managing science and technology in the way their ideology had predicted. Most striking, perhaps, was that socialism's removal of profit barriers should have launched a free flow of information, but it was nowhere to be seen. In fact, invention data show that the Soviet Union had created its own, stronger barriers of censorship and secrecy, a web that greatly hampered the interchange of new ideas. Soviet socialism seemed a dead end, not a new beginning.

Early in Gorbachev's tenure as General Secretary, officials launched a campaign of *perestroika* (restructuring) that included a policy of conversion, i.e., requiring military-industrial enterprises to convert their output to greater civilian production. Some conversion efforts aimed at selling dual-use technologies, those useful to both defense and civilian customers. Such programs necessarily required greater access to secret information. The government seemed poised to open what it imagined as a veritable treasure chest of technologies previously closed by excessive secrecy. Reformers assumed that valuable new technologies, hidden by Soviet secrecy, would generate substantial profits on Western markets, thereby boosting Soviet economic

[24] About 18 percent of the State Committee's NSTP applications consist of inventions temporarily unpublished (two years or less). The NSTP estimate used here adjusted the data by subtracting the temporarily unpublished applications from the total.

growth. As one part of this effort the government designated *Licensintorg*, the state licensing organization, to sell satellite services abroad. Officials hoped that removing secrecy constraints would open other areas as well.

It appears that a cautious first step of *perestroika* was to redirect secret Ministry of Defense data to the civilian State Committee. Data from the Committee's technical examination organization (VNIIGPE) further suggest this early Gorbachev era challenge to the military-industrial complex's extreme secrecy regime. In 1986 the number of invention applications the Committee handled in the three departments most closely tied to the defense establishment – special techniques, radio electronics and technical physics – increased dramatically.[25] In addition, a new defense-related examination department, Special Electronics, was created. These VNIIGPE data present further evidence of an early *perestroika* policy that redirected a large number of the Ministry of Defense's secret and top-secret applications to the civilian Committee for Inventions and Discoveries for examination. While some secret inventions started out in the Ministry of Defense system and were therefore included among the secret application numbers, they were later sent to the Committee causing the jump in applications received by defense-related examination areas. Not all of these inventions were declassified once in the Committee, but the Ministry of Defense's default position of determining secrecy was being challenged.[26]

Only weeks after the new patent law was passed, a coup was attempted against General Secretary Gorbachev. The coup failed, Yeltsin came to power and the Soviet Union collapsed on 26 December 1991. Secret applications to the Ministry of Defense for inventor's certificates ended just prior to the collapse, with the last published document dating from 28 June 1991. The Russian Federation didn't resolve the issues of patent secrecy until 2004.

3.2 GDR Patent Secrecy

The 1950 GDR patent law differed from the contemporaneous Soviet law by having no provisions for secret patents. This difference followed logically from the Potsdam Agreement's demilitarization requirements for post-war Germany. Since secret patents are usually granted for military technologies,

[25] Applications to the Special Techniques department (40-23) more than tripled from 1,384 applications in 1985 to 6,677 in 1986. Radio Electronics (26-9) grew from 2,046 to 3,398; Technical Physics (26-25), 3,916 to 5,425. (Korchagin).

[26] Maintaining secrecy, possibly just a *FOUO* classification, likely explains the upswing in the number of NSTP grants by the Committee for Inventions and Discoveries during the *perestroika* campaign.

the GDR law didn't need to include them. Furthermore, Soviet officials likely recalled their country's heroic efforts to relocate much of their defense production to the Urals during World War II. Soviet military planners probably viewed the GDR's proximity to the West as a strategic weakness and disincentive to defense-industrial investments, a judgment further reinforced when the FRG joined NATO in 1955. Military planners also shared their citizens' general mistrust of all foreigners, even those from fellow Warsaw Pact countries.

Section 29(4) of the basic 1950 GDR law allowed inventors to request a delay in the issuance of the patent specifications.[27] Delaying publication paralleled the Soviet practice of declaring that some granted inventor's certificates were "not subject to publication," a supple form of secrecy that didn't require an official to stamp "Secret" or "For Official Use" on the documents. It's not clear if AfEP's *Hauptabteilung I* (HA I), which processed all of the GDR's secret patent applications, had any role in suppressing the timely publication of applications under Section 23 (1983).

Soviet reluctance to allow GDR defense-related production slackened by 1963 when the GDR revised its patent law to permit secret patents for "inventions that directly or indirectly secure the defensive preparation" of the country. As one German legal expert observed: "The timing [of the GDR legal change] is nevertheless conspicuous as it followed closely on the building of the Berlin Wall and the West German introduction of secret patents in 1961" (Breith 28).

The 1963 GDR law at first restricted the subject matter for secret patents to defense technologies, a narrower sphere than covered by the Soviet law at the time. That narrow definition didn't last long, however, for in 1968 a special decree on secret patents expanded the subject matter to include economic secrets that "affected other state interests," a broad formulation that echoed Soviet practices (Breith 29). This decree was later incorporated in a new 1983 law. The rationale behind the expanded coverage was explained as follows by Wiedemann and Zobel in a dissertation that was supervised by the GDR patent office official who oversaw secret patents in AfEP's HA I:

> "Secrecy serves to deny the adversary access to scientific-technical results. Maintaining secrecy is a proper means to secure an achieved technological advantage over capitalist competitors in order to surprise the adversaries in markets and eliminate them

[27] This practice became Section 23 on "Publication" of the 1983 patent law. "The patent publication can be delayed when accompanied by a well-documented request" (Patentrecht) 12).

> as competitors. Furthermore, the capitalist businesses should be given no possibility to enrich themselves at the expense of the work of GDR employees by appropriating their scientific-technical achievements" (Wiedemann and Zobel 50-51). [28]

Wiedemann and Zobel noted that Western firms often protect their technologies with trade secrets, but this type of protection does not give firms the benefits of priority that come with secret patents. A secret patent would allow the GDR to block any foreigner who would try to make, use or sell an equivalent invention with a later application date on GDR territory.

The GDR's system for secret economic patents was decentralized and gave enterprise directors and the heads of research institutes the authority to determine which patents would be declared secret on economic grounds (Klinger §7 para 4, 129). Economic secrecy was evidently less stringent than national defense secrecy. Enterprise directors were permitted to discuss their secret economic patents with other potential users in the GDR. They could also opt to delay the publication of some of their non-secret applications. Of course, such an effort might slow down the circulation of technological information among potential users; however, for the GDR, a relatively small country where top specialists generally knew each other, the concern about information exchange was less important than in a larger economy such as the Soviet Union. Still, it's reasonable to ask if economic policy makers were in a position to identify correctly which technologies should be classified as secret or subject to publication restrictions. With expanded secrecy coverage, GDR law had fallen largely in line with Soviet law. How the law would be applied in practice remained an open question.

Soviet and GDR officials weren't alone in fearing that their technologies strengthened their adversaries' economies. In 2012 the U.S. Congress asked the United States Patent and Trademark Office (USPTO) to "examine the feasibility of placing economically significant patents under a secrecy order," which led the USPTO to issue a request for public comments" (Federal Register 23662-23665). More specifically, Congress asked "whether the United States should identify and bar from publication certain patent applications as detrimental to the nation's economic security." French governments have resisted such an extension of secrecy.[29] Two critics of globalization and the

[28] The dissertation adviser was R. Rosenthal, Head of AfEP's secret department (Hauptabteilung I).

[29] Although not precluded by law, the French Ministry for the Economy and Finance and the Ministry for Health have never sought the powers to restrict the publication and use of patent applications in the same way accorded to the Ministry of Defense (Wuylens

current U.S. patent system championed this change.[30] Among the published comments, IBM Corporation's Chief Patent Counsel voiced opposition to the proposal in terms which could well describe the difficulties faced by Soviet and GDR government officials with their system:

> "Inventors and/or rights-holders are in the best position to evaluate the optimal means for protection, including when and if to maintain secrecy, and the patent system gives them the flexibility to do so. Unlike inventions impacting national security, the government has no special expertise in analyzing the economic value of an invention or the need to keep it secret. Neither the USPTO nor any other government body can do a better job determining how best to exploit an invention than the inventor who stands to reap the rewards of that invention."[31]

3.3 Secret Patents as Share of Total GDR Patents

As noted above, the GDR's laws on secret patenting evolved to resemble Soviet laws; yet the GDR officials were to some extent still rooted in earlier German traditions. Did GDR practices resemble how Soviet officials managed secret patents or were GDR practices influenced by their earlier history and more Western orientation? To examine this issue, we compared the share of all domestic patents comprised by secret patents in the two countries. Although the relatively smaller importance of defense industrial production in the GDR should result in a relatively smaller share of secret inventions, similar GDR and Soviet secrecy practices should also result in a strikingly larger share of secret patents in the GDR than is found in Western economies.

After the collapse of the GDR government, HA I's director, Colonel Rosenthal, destroyed the official register of secret patents and many internal HA I documents, thereby making it impossible to establish precisely how

130).

[30] Pat Choate, director of the Manufacturing Policy Project and past vice presidential candidate for the Reform Party, and the American Innovators for Patent Reform (AIPR) are linked to the proposal.

[31] Schecter, Manny W. and Marian Underweiser, IBM Corporation Comments in response to "Notice of Request for Comments on the Feasibility of Placing Economically Significant Patents Under a Secrecy Order and the Need to Review Criteria Used in Determining Secrecy Orders Related to National Security," June 1, 2012, 77 Fed. Reg. 23662 (April 20, 2012). web.archive.org/web/20170628054956/ www.uspto.gov/patents-getting-started/international-protection/economic-security-so

many secret patents the GDR had granted. The Appendix below describes in more detail how we derived an estimation without the HA I official register or internal HA I reports.

According to Hans-Jürgen Breith, in his general legal survey of how state secrets are protected by invention and utility patents, on 3 October 1990 the 950 remaining files for secret GDR patents and patent applications were transferred to the FRG's DPMA in Munich. He noted that the DPMA considered about 500 of them to involve subject matter outside of technological areas needing secrecy protection and it quickly published them. The DPMA then notified the inventors of 382 other patents or patent applications of its intent to declassify them; since nobody appealed, these were also published. The FRG Ministry of Defense inherited the remaining 68 secret patents, and kept only three of them as temporarily secret. Those final three have since been declassified. The rapid declassification actions by FRG officials suggest that the GDR's view of what technological areas secrecy should cover was broader than that of FRG and other market economies and would lead one to expect a greater share of secret patents in the GDR.

DPMA (Deutsches Patent und Markenamt, Geschäftsstelle 99) officials provided us with a list of application numbers for 930 secret GDR patents, which closely resembles the number of secret patents cited by Breith. No background was provided on how the list was created. While Breith's characterization of GDR secrecy practices suggested that GDR officials imposed secrecy somewhat more frequently than their FRG counterparts, we needed to establish if the DPMA list was comprehensive. Did it include most of the secret patents that would have been found in the HA I register? If not, we can't use 930 to estimate precisely what share of total GDR patents is made up by secret patents.

A brief examination of three important GDR technology-intensive firms, *Carl Zeiss Jena*, *VEB Chemieanlagenbau Kombinat Leipzig-Grimma* and *VEB Spezialtechnik*, revealed that their patenting to be underrepresented in the DPMA list. The missing patent information was evidently destroyed when the GDR regime collapsed. Our next task was to examine the extent of the missing information.

We had access to the *Carl Zeiss Jena Patentregister* in which secret patents are identified and we also created a random sample of published GDR applications. If *Carl Zeiss Jena* can be considered representative of GDR industry and if the random sample is valid, then total secret GDR patents might be about twice those represented solely by the DPMA list, i.e., 1.2 percent instead of 0.6 percent of total GDR patents.

We also had other information that could give us insights into GDR se-

cret patent policy. The *Carl Zeiss Jena Patentregister* contained data on patenting in its U-Betrieb (see Appendix for details), which was established at Zeiss in the 1980s as the Soviet Union pressured GDR officials to devote more resources to military technologies. The U-Betrieb concentrated on military technologies, such as those used in guidance systems for rocket nose cones. Reflecting typical Soviet secrecy practices, the *Carl Zeiss Jena Patentregister* only published ranges of register numbers for U-Betrieb patents, no details. It recorded 687 U-Betrieb patents. If all U-Betrieb patent applications were secret, then the share of secret inventions for *Carl Zeiss Jena* would be about 13.5 percent. This assumption, while certainly extreme, forms a convenient upper boundary for our estimation.

Carl Zeiss Jena was one of the GDR's most prominent facilities and hardly representative of the rest of the industry. To project this upper boundary for secret inventions onto GDR industry as a whole ignores that much of the GDR's industry supported the agricultural and other civilian sectors. It seems that secret patents comprised less than 13.5 percent of total GDR patents, but we're unable to state precisely how much less. Still, at least we have arrived at an upper boundary that is useful in comparing GDR practices with Soviet practices.

We can assert with some confidence that the share of total GDR patents comprised by secret patents equalled between 1.2 percent to 13.5 percent of total patents, a range somewhat greater than that found in some developed market economies (0.1 to 0.6 percent), but far smaller that that of the Soviet Union (36 percent of total domestic inventor's certificates). Since *Carl Zeiss Jena* was a leading GDR technology-intensive firm, we expect the actual share of secret patents to be considerably below the upper boundary derived from *Carl Zeiss Jena* data. The lower level of GDR secret patenting likely reflects the GDR's relatively smaller defense-industrial economy and the influence of German cultural differences.

4 Quantum Electronics and Laser Technology: Illustrating Soviet and GDR Innovation Difficulties and Secrecy

Lasers present a concrete example that illustrates how the Soviet and GDR patent systems struggled to promote technological progress and how they dealt with secrecy concerns. Quantum electronics was a new scientific field with important commercial and defense potential and Soviet and GDR economic policy makers believed that it deserved priority development.

Three American (Charles Townes, Gordon Gould and Theodore Maiman) and three Soviet physicists (Aleksandr M. Prokhorov, Nikolay G. Basov and Valentin A. Fabrikant) are generally recognized for having made unusually important early contributions to the field of quantum electronics and to the development of lasers.[32] In addition to scientific publications, they obtained important patents, for each envisioned valuable future applications – new scientific instrumentation, medical devices, guidance systems, materials sciences tools, etc. - from their research. Many other physicists and engineers quickly contributed to the new field and some of them, in addition to publishing their research results, sought patent protection, either directly or through their employers.[33]

In the United States the government and private industry began funding laser-related research soon after the scientific breakthrough was reported. Some U.S. government money created secret projects subject to government restrictions while other U.S. government funds went to unclassified projects, with considerable Defense Department funding going to both classified and unclassified research. Private funding also flowed to laser research as its commercial potential became quickly understood by business leaders. Funding decisions were decentralized and if one start-up group failed to find funding through one source, it might well succeed with other sources. Corporations also sensed new opportunities and quickly expanded their own in-house research efforts. Looking back in 2010 on quantum electronics, Charles Townes observed: "I did realize that the laser had wider applications such as communications and cutting and welding, but I never envisaged the breadth of applications for which it is used today."

One account of the early days of laser research describes a gold rush atmosphere with the founding of many new, small companies focused on laser research. Some U.S. scientists with an entrepreneurial bent went into business for themselves. "If these clucks can run a company, so can we," opined Larry Goldmuntz, a U.S. physicist and start-up leader (Taylor 74). Small companies, facing relatively low barriers to entry, made important basic and applied research breakthroughs. Some of them prospered and grew larger; others floundered or were taken over by larger operations. The scientific personnel often moved easily among the firms (Bromberg 124 ff).

The new laser field witnessed the destruction of the traditional bound-

[32]Townes, Prokhorov and Basov shared a Nobel Prize. Fabrikant's contributions are described in Lukishova, 10045s and Pogrebysskaya. Gould's contributions, in Taylor and Maiman's in Bromberg 91-96 and Inventor Profile.

[33]Early laser developments occurring in the United States are described in detail by Joan Bromberg (Bromberg).

aries among many fields and in the more bureacratic USSR and GDR, traditions hindered those scientists who tried to step over the boundaries (Albrecht 62). A Soviet labor book (Soviet - *trudovaya knizhka* was maintained by employers and could be used to hinder job changes; nothing like it faced U.S. scientists establishing start-ups. U.S. scientists simply gave a week's or a month's notice before taking up a new job and the new employers, not the state, assessed their job qualifications. U.S. scientists also faced no government restrictions on their right to move to any U.S. city, whereas their Soviet scientific colleagues might have had to navigate internal passport requirements before moving to a job in another city. Finding new laboratory space was also easier for U.S. scientists, for they could tap into an open real estate market, another advantage unavailable to Soviet and GDR scientists. Finally, U.S. scientists could readily access a service sector of financial specialists, lawyers and accountants who were experienced in establishing new businesses. No such service sector existed in the Soviet Union or GDR, where the government blocked private enterprise. As a result, commercially-oriented laser research quickly blossomed in the United States, whereas it had to navigate formidable bureaucratic challenges in the Soviet Union and GDR.

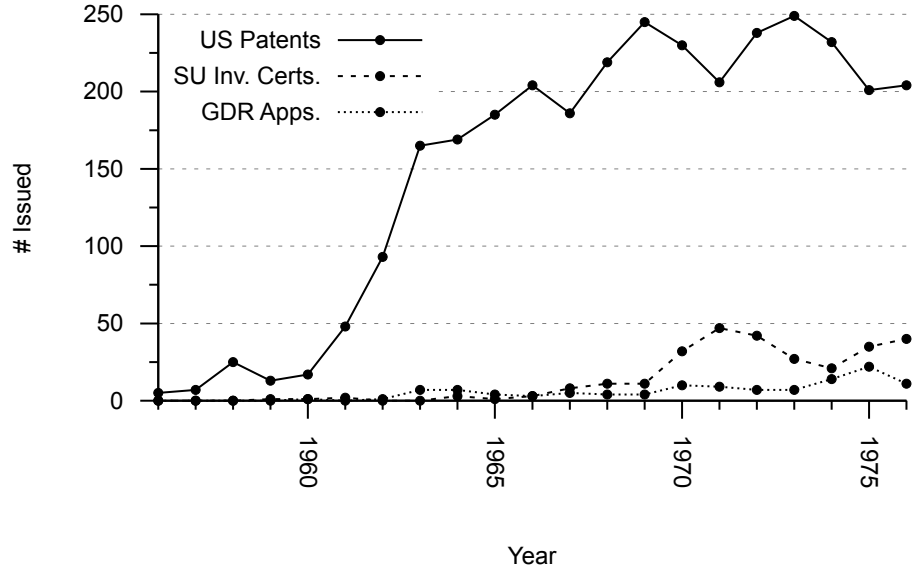
New firms, established companies, individuals and the government quickly sought to protect the commercialization of their efforts by filing laser-related patents. Between 1956 and 1976 the annual number of US Patent and Trademark Office laser-related patent applications from U.S. inventors grew from 5 to over 200. The total for the entire period was 3,141 applications, of which only eleven were from the USSR and six from the GDR.[34]

Soviet and GDR organizations were slow to patent laser-related inventions in their respective countries and their domestic patenting reached only two percent of U.S. levels during the ten-year period that followed Charles Townes' original application (1956-1966). The GDR had less than 10 percent of the USSR's population, but its inventors obtained almost half as many laser related patents as Soviet inventors obtained during those early years. As is discussed in more detail below, secrecy policies may have hidden a more active Soviet patenting effort.

Patent activity picked up for both the Soviet Union and GDR during the next ten years, but their totals for the entire 1956-1976 period remained

[34]We define laser-related to be those applications belonging to the International Patent Classification subclass H01S (Devices Using Stimulated Emission). Furthermore, only those applications that successfully passed the patent office technical examination are counted. The Depatis online database was used to make the selection. Hard currency restrictions undoubtedly reduced patenting in the West by USSR and GDR inventors.

Figure 4: Number of U.S., U.S.S.R. and GDR Laser-Related (H01S) Patents According to Application Date, 1956-1976.



Source: Depatis

quite low compared to those of the market economies. Since overall patent activity in the Soviet Union between 1956 and 1976 was half that of the United States, one might expect the Soviet Union to have had half as many laser-related inventions as United States.[35] Yet, the United States reported 3,141 laser-related grants to its citizens; the Soviet Union, 285 (See figure 4). The GDR, a much smaller country, recorded 116 laser-related applications from its citizens.[36]

[35]Inventors in both countries were strongly motivated to patent, for commercial reasons in the United States and to meet central planning success indicators in the Soviet Union. Total USSR inventors certificate grants in 1976 roughly equaled U.S. origin patent grants for that year.

[36]In 1963 the GDR ended technical examinations for all applications, requiring them only if requested by the applicant, if the application was challenged by a third party, or if a bonus were to be paid. This change to the *Offenlegungsschrift* system likely created an upward bias in the GDR patent data when compared to the United States and Soviet Union, which continued their technical examinations of all applications, rejecting some of them for lack of novelty, etc. To avoid double counting, we only used data for the *Offenlegungsschrift*.

Half of Soviet laser-related inventions failed to identify the originating facility, making it difficult to characterize accurately what types of facilities were most active in patenting. Of the laser-related patents that identified the originating facilities, most came from Academy of Sciences and educational research organizations. In the GDR two organizations, *Carl Zeiss Jena* and the GDR Academy of Sciences (the Center for Scientific Instruments and the Central Institute of Optics and Spectroscopy) accounted for almost all of the GDR's laser-related patent activity. Since neither the Soviet Union nor the GDR permitted private enterprise, the advent of quantum electronics did not spur the founding of new companies, but instead motivated existing research institutes and factories to petition their superior organizations for new laboratories and equipment. If at some point an entirely new institute were to be proposed, it might well unleash bureaucratic squabbling over its administrative affiliation. The patent activity data in figure 4 suggest that this lack of flexibility from over-centralization greatly impeded the rapid development of laser technology in the USSR and GDR.

U.S. university and government organizations accounted for slightly under 15 percent of U.S. laser-related inventions during this period, although government funding certainly played a role in the research being done in many of the companies owning patents.[37] Ten U.S. companies accounted for just over 40 percent of the laser-related patents; whereas individual inventors and small and medium-sized enterprises accounted for almost one-fifth of them. An array of large and medium-sized companies comprised the remaining forty percent of the U.S. laser-related patent holders. The significant participation of individuals and small and medium-sized enterprises constitutes a striking difference to the Soviet Union's use of its Academy of Sciences and universities and the GDR's highly centralized industrial and scientific establishment.

In the Soviet Union's and the GDR's more hierarchical system, there practically no opportunities for young Soviet and GDR scientists to wave good-bye to the "clucks" running the show and start building their own laser companies. They certainly couldn't easily decamp to a foreign country. The Soviet and GDR societies were staid, respectful of existing hierarchies, and they generally rewarded those who could work within existing organizational structures. To join any scientific gold rush, scientists would first require convincing numerous superior organizations, from those in one's own institute

[37]The United States has no organization analogous to the Soviet Academy of Sciences. Some U.S. government organizations have their own laboratories and appear as assignees to inventions. Bromberg emphasizes the role of government spending, especially by the military, for the U.S. post-WWII electronics industry (Bromberg 2 ff).

to those in the state's central planning organizations. Nevertheless, an early GDR laser pioneer, Kurt Lenz, proved an exception by creating the GDR's first functioning laser without direct establishment support and by successfully avoiding the pinch of Western technology embargoes (Albrecht 87).

The large observed difference between U.S. and Soviet domestic laser related patent activity may also stem from another somewhat hidden issue – state secrecy. In developed market economies such as the United States a general openness surrounds many scientific breakthroughs, even some with potential military importance. The rapid development of new technologies by firms competing for financial gain is understood to benefit all, civilian as well as defense industries. Soviet central planning, on the other hand, was determined by the Communist Party's priorities and often deferred to its defense-industrial and national security leadership, who took a more secretive approach, censoring the names of many laboratories or facilities and stamping much research as secret. GDR central planning was also stifling, but it oversaw a relatively smaller defense-industrial establishment and focused less on the military.

4.1 Lasers and State Secrecy

4.1.1 Valentin Fabrikant, Gordon Gould and Paul Görlich: Three Researchers, Victims of Excessive Security Measures

Governments rely on their counterintelligence officials to catch citizens who betray secrets to foreign governments or whom they deem untrustworthy in handling the state's secrets. It's a difficult job and often lacks clear-cut evidence. Rarely are there news accounts of counterintelligence officials being punished for wrongly accusing individuals of lacking trustworthiness, an accusation generally based on intuitive judgments that can be clouded by prejudice or personal antipathy. This lack of checks and balances sometimes makes it easier for counterintelligence officials to assume guilt on the part of the people they are investigating. Defense officials recognized very early that laser research could have important military as well as commercial applications and in the Soviet Union, the United States and the GDR this realization set in motion counterintelligence surveillance over laser research programs.

Valentin Aleksandrovich Fabrikant, one of the world's earliest laser pioneers, applied for a seminal laser-related inventor's certificate in 1951, but he soon ran into security problems. His father, Aleksandr Osipovich, was re-arrested and according to Soviet practices that made Valentin Aleksan-

drovich a security risk. Moreover, Fabrikant was Jewish and the early 1950s had witnessed a reaction to Zionism from top Party officials, many of whom began to question the loyalty of Jewish fellow citizens.[38] Fabrikant's 1951 inventor's certificate application was at first rejected, then declared secret and finally published as two separate inventions in 1959 and 1962.[39] Fabrikant was subsequently honored by the Soviet Union through the award of an official discovery in 1962.

Secrecy also shadowed some U.S. laser research. Gordon Gould, an early laser pioneer and gifted inventor, had dropped his dissertation work to join the laser gold rush. He ran into significant problems when his early project, which depended on government funding, was declared secret and he failed to get a security clearance because of past political views. The government's denial of a clearance meant that Gould could not work directly on his own project and his full talents were left underutilized. It also meant that while a stripped down version of his patent application moved forward, the larger, more comprehensive application remained in abeyance until the project was declassified, which occurred after a relatively short period of several years.[40] Gould subsequently continued to openly patent his ideas.

As mentioned above, the Soviet Union's war reparations policy included shipping equipment from German industrial facilities to the USSR. The Zeiss Jena factory's equipment was sent to Krasnogorsk, a center of the Soviet military's optical work. Paul Görlich, who had worked at Zeiss, was recruited to work in Krasnogorsk. Afterwards he headed Carl Zeiss Jena, taught at the Friedrich Schiller University and was a director of the GDR's Academy of Sciences' Institut for Optics and Spectroscopy. In spite of his scientific accomplishments and expertise, the East German Stasi subjected him to considerable surveillance (Albrecht 44 and 151), not least, perhaps, because of his previous membership in the Nazi party (Augustine 157), but also

[38]The Soviet leadership at first supported an independent state of Israel, but reconsidered its support when it became clear that Israel was going to be aligned with the United States. At that moment Soviet leaders viewed Jews as a potential fifth column and began to persecute prominent Jewish citizens. (Sebag Montefiore 558-562).

[39]New Soviet inventions were first announced in the official publication (*Byulleten' izobreteniy*), but only an abstract was printed. The full-specifications (*opisaniye*), which came closest to enabling "any person skilled in the art or science to which the invention appertains ... to make and use the same," were sometimes published with significant delays and resembled yet another form of Soviet secrecy. The full-specifications for Fabrikant's 1951 application appeared as No.123209 in 1959 and No.148441, in 1962. The file wrapper shows that the inventions had been declared secret (Pogrebysskaya 500 and Lukishova 5).

[40]Email correspondence with Gordon Gould's patent lawyer, Bob Keegan, 23 October 2018.

because the Stasi began in 1962 to focus increased surveillance over all laser research (Albrecht fn 87). Görlich may also have offended Party ideologues by his insistence, contrary to Marxist-Leninist principles, that GDR laser research not be shared freely with fraternal socialist countries, especially the USSR.[41] His views on the matter were reported by a Stasi informer (Albrecht 202). Görlich hoped to position the GDR favorably in exploiting laser research in trade with other CMEA countries.

Other important Soviet inventors saw much of their work classified. Aleksandr Prokhorov, who shared a Nobel Prize with Charles Townes and Nikolai Basov, witnessed some of his later laser-related inventions suffer from the heavy hand of the Soviet censor. Seven of his eleven published inventions were revealed only after the Soviet Union's collapse and three of them came from the separate Ministry of Defense secret invention department. Two of these Ministry of Defense inventions, 451647 and 478575, had remained secret for over thirty years. Many of Prokhorov's inventions probably still remain secret. We have found no evidence of Prokhorov suffering any persecution by counterintelligence officials beyond strict censorship.

4.1.2 Using Patent Data to Understand the Scope of Laser Secrecy

To remain competitive, businesses carefully restrict access to information on new, commercially important scientific breakthroughs. Patent protection offers businesses an incentive, through a temporary monopoly, to share information which otherwise would remain closely held. Shortly after scientific journals reported on quantum electronics breakthroughs, many researchers published their achievements as patent applications, garnering both professional recognition and possible financial rewards.

Governments, too, are interested in exploiting new technologies, especially those considered militarily important. When laser-related research began, governments needed to decide which areas appeared militarily critical, a difficult task in a nascent industry. Under U.S. law, the government can invoke a secrecy order, stopping the publication of information from any patent application deemed important to the military. In the Soviet Union and the GDR, as in some other countries, a patent could be declared secret.

Published patent data allow an assessment of the extent to which Soviet

[41] It appears that Soviet officials, too, avoided even more sharing laser technology information with allies. Soviet researchers applied for only two GDR laser-related patents prior to 1976; during this period, GDR researchers applied for seven Soviet inventor's certificates (EPO Espacenet).

secrecy affected laser-related research. Such an assessment needs to take into account the Soviet Union's two patent systems: one run by the Ministry of Defense, and the other, by the State Committee for Inventions and Discoveries.

As mentioned above, from 1936 to 1991 the Soviet Ministry of Defense administered a parallel, secret patent system and fewer than one percent of the inventor's certificates granted by this system have been published. We estimate that the Ministry of Defense granted at least 120,000 patents during the 1956-76 period (Martens, table A5.9). According to OECD data for 1976-1989, laser related inventions (IPC H01S) accounted for about 0.32 percent of total OECD area applications to the EPO.[42] If this share were true for the Soviet Union, one would expect about 380 declassified Ministry of Defense laser-related patents. Yet, the Ministry of Defense has declassified only 12 laser-related inventions from this period, reflecting its extremely strict secrecy regime.

An analysis of the laser patent data of the Soviet State Committee for Inventions and Discoveries reveals that secrecy concerns weighed heavily there, too. As mentioned above, the State Committee was also empowered to impose secrecy on inventions. Some of the inventions examined by the State Committee came from defense-industrial research organizations, although Soviet censorship attempted to hide these connections.[43] Between 1970 and 1989 the State Committee granted over 1.2 million inventor's certificates. Using the OECD data showing that lasers (H01S) comprise about 0.32 percent of patents, the State Committee might well have issued over 3,800 grants for laser technologies; yet, it granted only 460, a further indication of how secrecy may have affected the dissemination of information on Soviet laser research.

The Soviet Union's patent system included technical examinations for all applications. The period of time between the application and publication dates generally reflected the time needed for this technical examination. The average examination time for laser patents (8 years) was excessive, suggesting a reluctance to release information. The USPTO examined laser-related patents in 2.7 years, not too different from the average examination regu-

[42] Earlier patent data not available. OECD, "Patents by main technology and by International Patent Classification (IPC)", OECD Patent Statistics (OECD).

[43] Many Soviet defense-industrial research organizations were identified by a system of post office boxes created to obscure their defense activities. Some online information has revealed p.o. box numbers (*pochtoviy yashchik* or p-ya) that are missing from the printed documentation. State Committee examined laser inventions listed p-ya 3726, p-ya 6681, p-ya 3695 and p-ya 8584.

lar Soviet patents (2.2 years).[44] It took more than 20 years to publish 20 laser-related patents handled by the State Committee during the 1956-72, suggesting that these inventions had been secret.

Soviet laser-related inventions differed markedly from U.S. and GDR inventions in another way – the names of the developing organizations were heavily censored. Soviet censors maintained comprehensive lists of industrial facilities and research organizations that, because they belonged to the defense-industrial or national security establishment, could not be mentioned in print. About 51 percent of laser-related inventions failed to name any assignee or developing organization; whereas only 34 percent of inventions in a random sample of Soviet inventions did so. An analysis of the inventors listed in laser-related inventions helped identify some of the missing organizational names and confirmed that many were related to the Soviet defense establishment.[45]

While our GDR patent data are incomplete, the number of laser-related inventions is fairly close to what one would expect based on the country's overall patent activity.[46] At the early stages of the GDR laser program, Carl Zeiss Jena appears to have made use of its authority to delay the publication of its laser-related patents. The average time between the application and publication for the 1962-1970 period was 3.3 years; while for the 1971-1990 period, it was 1.8 years. [47] These delays are relatively small compared to the Soviet ones mentioned above.

Other comparisons reveal a more relaxed GDR approach to secrecy. From 1982 on, when the GDR began listing originating facility names on patent publications, no censorship occurred for laser-related inventions. The Patent Register at *Carl Zeiss Jena*, a principal GDR laser developer, revealed no secret laser patents[48] and no laser patents were included in the DPMA list of 930 secret GDR patents. GDR patent officials, unlike their Soviet counterparts, appear to have sparingly imposed secrecy on laser technology research.

Two U.S. laser-related inventions from Lockheed and from Northrop

[44]See Figure 7.5 Examination Times for a Random Sample of Soviet Inventor's Certificates from 1974 to 1978 in Martens, p. 154.

[45]Thanks to the Russian government's greater openness or *glasnost'* campaign, we were able to identify the following organizations: Istok, p-ya 8584, NII-801, Institute of Radionavigation and Time (RIRT), NII-4 MO, Moscow Scientific-Research Institute for Radio Communications, and the Institute for Precision Instrument Engineering.

[46]We have no total GDR patent application data prior to 1970.

[47]Using a z-test for two means, with known population standard deviations, this difference is statistically different at the 95 percent level.

[48]As mentioned above no detailed patent data is available for the 687 inventions from the *Carl Zeiss Jena's* U-Betrieb.

Grumman were published after more than 25 years had elapsed from the date of application, suggesting strongly that they had been under secrecy orders. Data on secrecy orders between 1956 and 1976 aren't available, but in 1979 3,513 secrecy orders were in effect, which likely includes most orders from the 1956-1976 period. Using the OECD statistics, we estimate that 14 laser-related secrecy orders were in effect on laser-related inventions and that the subsequent Lockheed and Northrop Grumman patents were among those orders.

The laser industry's development in two centrally-planned economies, the USSR and the GDR, reflects how central planning struggled to match the performance of market economies in technological innovation. Central planning's insistence on controls from the top thwarted or delayed the type of bubbling up of initiative found in the market economies. Scientists and engineers in the centrally planned economies were sometimes at the forefront of new ideas, but as figure 4 shows, their contributions toward industrial application as reflected in patenting lagged considerably behind their peers in market economies. In addition, USSR scientists and engineers faced excessive secrecy that also acted as a damper on disseminating new technologies. Secrecy appears to have been a smaller issue in the GDR, but that country's top-down hierarchical structure likely impeded initiatives from below. Censorship and secrecy weighed more heavily on Soviet laser-related technologies in comparison with U.S. and GDR practices.

5 Summary and Conclusions

The development of the GDR's patent system shows the clear influence of the Soviet Union's economic model, with the GDR's Socialist Unity Party (SED) setting overall economic priorities and administering the economy through a central plan. The Soviet dual system of patents for foreigners and inventor's certificates for citizens was also copied, as were the use of patents as success indicators and the efforts to achieve technological diffusion by central administrative actions.

The GDR was not, however, a pure imitation of the Soviet Union, but a country with its own culture and traditions that could result in differing approaches to important economic and social issues. It should serve as a reminder to outside observers that lumping today's communist countries together without recognizing their differences is an oversimplification that may cloud our understanding of them. Judging from the available materials, patenting and patent secrecy were issues on which GDR practices sometimes

differed from those of the Soviet Union.

The Soviet and GDR management of secret patents appears to have differed as follows: (1) the GDR patent office had no counterpart to the Soviet military's separate invention department; the GDR system was administered through a single state organization, the *Amt für Erfindungs- und Patentwesen (AfEP)*; (2) GDR enterprise directors appear to have had wide discretion in making secrecy decisions, whereas Soviet decision-making on secrecy appears to have been directed by central authorities; (3) GDR secrecy sometimes was connected to specific GDR political sensitivities, such as devices related to border security or citizen surveillance; (4) the GDR had no extensive system of codenames to hide entire enterprises and institutes from the public; and (5) GDR secrecy affected a far smaller share of total inventions than did Soviet secrecy.

We believe that our study provides the first cross-national, quantitative study of state secrecy, albeit for the highly specific area of patent secrecy. Our analysis of patent data shows that Soviet officials invoked patent secrecy far more frequently (about 36 percent of total grants) than did government officials in several developed market economies (France, Germany, United Kingdom and the United States - from 0.1 to 0.6 percent of total grants), suggesting that market economies, contrary to what Marxist-Leninist ideology depicted, promoted the unfettered dissemination of information more vigorously than did centrally-planned economies.

Although GDR officials imposed secrecy on technological areas not usually considered secret by market economy officials, they did so less than did their Soviet counterparts (about 1.2 to 13.5 percent of total GDR grants were secret). In limiting patent secrecy, perhaps drawing upon more open German scientific and administrative traditions, GDR officials evidently viewed excessive secrecy as counterproductive.

A brief comparison of Soviet and GDR patent policies in the new and potentially important field of lasers highlights significant differences between the secrecy policies of the two countries, both with each other and with market economies. A major study of early U.S. laser developments (Bromberg) describes an active, open exchange of information among U.S. scientists, who organized conferences, both national and international, and seemed generally unencumbered by state secrecy regulations. As noted in a history of German laser developments (Albrecht), the GDR began to face increasing scientific isolation at the start of its laser programs, which occurred contemporaneously with the building of the Berlin Wall. The GDR's secrecy for laser technologies nevertheless appears relatively light-handed compared to Soviet practices. GDR laser-related patents comprised about the same

share of total patents as found in many market economies, whereas domestic laser inventions were greatly underrepresented in the Soviet patent information. The *Carl Zeiss Jena Patentregister* contained no secret laser patents, although its laser patents often had publication delays; no laser patents were included in the DPMA's list of secret GDR patents.

Some GDR enterprise officials did invoke secrecy to shield laser developments from their Soviet allies in an effort to protect what they believed to be important export markets within the CMEA and possibly beyond. Here GDR national interest trumped fraternal socialist cooperation, for the relatively small GDR economy struggled to develop sources of foreign currency earnings. Soviet officials also ignored fraternal socialist cooperation in laser developments, applying for almost no laser *Wirtschaftpatente* in the GDR. Since much of the Soviet Union's laser research was conducted in secret institutes, secrecy undoubtedly presented a barrier to such cooperation, even with its allied countries.

U.S. laser developments originated foremost in businesses, both existing and newly founded small and medium-sized enterprises and in large corporations. U.S. government and educational organizations were also important contributors to laser technology. This early organizational history, described in detail by Bromberg and Albrecht, is reflected in the information on U.S. patent assignees. Patent assignee data for Soviet and GDR domestic patenting provides a contrasting organizational picture, showing very few initiatives outside of existing hierarchies. The Academy of Sciences, educational facilities and one industrial enterprise, *Carl Zeiss Jena*, accounted for the GDR's laser developments; the Academy of Sciences, educational facilities and defense-industrial organizations for Soviet developments. Russia's current science establishment still struggles to overcome this legacy of extreme centralization.

During the final years of the Soviet Union some officials grew concerned that excessive secrecy imposed an economic drag that negatively affected military power. Exaggerated secrecy complicated domestic enterprises' access to information on new technologies and limited the chances for commercializing such technologies abroad. The GDR's smaller economy reduced the impact of secrecy on domestic information flows, but concerns remained about technology leakage to capitalist countries.

Soviet patent secrecy policies became more relaxed when Mikhail Gorbachev became General Secretary. In 1986 many applications that would have been filed at the Ministry of Defense's patent department were now filed in the secret department (*Spetstekhniki*) of the civilian State Committee for Inventions and Discoveries and more of them were published. Finally,

in 1991 patent secrecy took a radical turn when the new Soviet patent law abolished inventor's certificates and the Ministry of Defense's separate secret examination system. The Russian Federation government created no national procedures for handling secret inventions until 2004; in the meantime, secret Russian patent applications piled up in a *Rospatent* safe.

The end of secret patents in the GDR proved less dramatic; after the GDR's collapse many of its secret patent holdings were destroyed and the remaining documentation was transferred from AfEP's HA I to Büro 99 of the German Patent and Trademark Office (DPMA) in Munich. Most of the transferred files were subsequently declassified.

6 Appendix - Estimating the Number of Secret GDR Patents

The DPMA provided us with a list of the application numbers for 930 previously secret inventions (Deutsches Patent und Markenamt, Geschäftsstelle 99). To estimate the total number of secret patents granted from mid-1963 to 1990, we examined if the DPMA list of 930 was comprehensive.

If the DPMA list contains all secret GDR patents, then secret inventions would have comprised about 0.6 percent of total GDR non-secret inventions,[49] a considerably smaller share than that recorded for secret inventions in the Soviet Union and not out of line with patent secrecy in developed market economies.

We established that the DPMA list is not comprehensive. First, it excluded secret patents that had been declassified prior to 1990. Second, a random sample showed that the list doesn't include some pre-1990 patents with unusual delayed publications, something akin to secrecy. Third, we noted that some GDR enterprises were underrepresented. Finally, a closer look at Carl Zeiss Jena's U-Betrieb, a largely defense-oriented part of the firm, indicated that a large number of its patents have never been published.

[49] We are unable to explain why the DPMA's list of 930 differs from Breith's 950. The estimate for total non-secret GDR applications combines the WIPO data for the number of GDR patent applications from 1965 to 1969 (24,419), adjusted to exclude applications by foreigners, and AfEP data for domestic GDR non-secret applications from 1970 to 1989 (139,532) from figure 1. The year 1965 is chosen to account for the fact that secrecy didn't start until mid-1963 and to allow for the time lag between the receipt of an application and its publication.

6.1 Declassified Patents

Secret patents declassified prior to 1990 are not in the DPMA list, which contains only those patents that were still secret in 1990. Excluding declassified patents biases the estimate downwards, i.e., understates the total number of secret GDR patents.

What share of total GDR patents is accounted for by declassified patents? Did the GDR, much like the Soviet Union, declassify only a few of its secret inventions? In *Carl Zeiss Jena's* official *Patentregister* 22 secret patents were identified, a relatively small share of the firm's total patents, and 10 of them had publication dates, indicating that they had been declassified. For the published secret patents, the average time between application and publication was 11.1 years, a much longer time than the average for non-secret inventions (Betriebsarchiv: Patentregister). If one assumes the Carl Zeiss Jena firm's share of secret patents and its rate of declassification as a norm for other enterprises, then secret patents may actually comprise about 1.2 percent of total GDR patents.

6.2 Random Sample

We constructed a random sample from EPO Data to examine the possible impact of delayed publications on our estimate of the total number of secret GDR patents. The Espacenet patent search website provides access to bibliographic information for the first publication level of 221,950 GDR patents, from patent DD1 (application date 1951-06-04) to patent DD302035 (application date 1987-04-22).[50]

Using our random sample of GDR patents from the EPO database, we calculated the length of time between the application and publication dates for each of the patents in the sample.[51] After excluding 77 foreign applications, we were left with a sample of 148 inventions. The time between application and publication for the applications with no examination aver-

[50] The European Patent Officean in an email correspondence was unable to explain why information was not available for many of the publication numbers. The DPMA notes that publication numbers 161274 to 200000 were not used. Taking that information into account and assuming that each unique publication number represents a single invention, one would expect there to be information on 263,309 (302,035 minus 38,726) patents, not 221,950.

[51] We used Libre Office Calc to pick 225 random numbers between 77017 (Sept 1969) and 140160 (Oct 1978). Surprisingly our random sample contained 77 foreign applications, a much higher share than would have been found among Soviet applications. Germany accounted for 27 of the foreign applications; other CMEA, for only 13. The foreign applications were excluded from the analysis.

aged 1.3 years; for those with examinations, 4.2 years. For two inventions the time between application and publication was more than ten years. This time period resembled what one might reasonably expect for secret inventions, i.e., about 1.4 percent of the randomly sampled inventions might have been secret, either declassified or with a delayed publication, a share that closely resembles our Carl Zeiss Jena result.

The small share of total GDR patents accounted for by delayed publications contrasts strikingly with Soviet practices. Soviet delayed publications expanded continuously and by 1989 they represented about 34 percent of all grants made by the State Committee for Inventions and Discoveries (Martens, table A5.3).

6.3 Underrepresented Enterprises

As noted above, DPMA officials did not find HA I's official register, which would have provided an comprehensive accounting of all secret patents, among the files remaining after the GDR's implosion. We examined more closely the 930 secret inventions to ascertain if they included most of the GDR's important technology-intensive enterprises that one might expect to have secret patents. If facilities seem to be missing or underrepresented, then the 1.2 percent estimate would need further adjusting.

In fact some of the GDR's defense-industrial enterprises appear to be underrepresented in the DPMA list. The *Kombinat Spezialtechnik* from Dresden-Klotzsche, for example, was almost entirely focused on military technology (Weckbrodt), [52] which probably accounts for the fact that it's not included in the list of enterprises listed in AfEP's confidential patent survey. One would expect to see *Kombinat Spezialtechnik* inventions well represented among the 930 secret patents, but that's not the case. Only 9 of the 930 secret patents list *Kombinat Spezialtechnik* as an applicant.

The *VEB Chemieanlagenbau Kombinat Leipzig-Grimma* was another leading GDR technology-intensive enterprise. This enterprise also had secret sections which had many secret patents, most likely for commercial rather than national defense reasons. One such secret research group had 13 previously secret patents published after 1989, but none were in the DPMA list.[53] Only one invention from the VEB Chemieanlagenbau appeared in the DPMA list. Consequently, it seems reasonable to conclude that the missing HA I *Patentregister* contained far more secret inventions than were later listed by the

[52] Spezialtechnik was a common Soviet euphemism for military technology.

[53] We learned of them only through one of the inventors. Email communication with one of the inventors Nov. 11, 2016.

DPMA.

6.4 Carl Zeiss Jena U-Betrieb

A closer look at the *Carl Zeiss Jena Patentregister* provided further insights into the DPMA list's lack of comprehensiveness. *Carl Zeiss Jena* was one of the GDR's leading enterprises, focusing its research on technologies related to optics, specialty glass, scientific instrumentation, lasers and semiconductors. According to AfEP data, *Carl Zeiss Jena* consistently ranked among the most active filers of non-secret patents.[54] The enterprise's official *Patentregister*, a log of all patent applications and their disposition, recorded 4,524 GDR applications for the 1963-1990 period.

In the early 1980s Soviet officials pressured GDR officials to devote more resources to military technologies. At this time *Carl Zeiss Jena* established its U-Betrieb, which focused on military technologies such as those used in laser guidance systems. The *Carl Zeiss Jena Patentregister* only published ranges of register numbers for U-Betrieb patents, no details, a practice that mirrored how Soviet defense-industrial facilities accounted for secret inventions. It recorded 687 U-Betrieb patents.

Given the general secrecy that surrounded the U-Betrieb, one can reasonably assume that many U-Betrieb patents were secret – but what share of them? Even in the Soviet Union many defense industrial facilities published non-secret inventions, albeit usually minus the facility name.

The DPMA list of 930 secret patents contained only 46 *Carl Zeiss Jena* or *Jenoptik* inventions. An analysis of the *Carl Zeiss Jena Patentregister* also revealed that most information on U-Betrieb secret patents remained unpublished.[55]

We conclude that most of the 687 U-Betrieb patents remain unaccounted for in either the on-line information or in the DPMA list of 930 secret patents, and therefore we further conclude that the destroyed HA-I register contained information on many more secret GDR patents than the 930 included in the DPMA list. If all U-Betrieb patent applications were secret, then the share of secret inventions for *Carl Zeiss Jena* would be about 13.5 percent, a share closer to, but still considerably lower than, Soviet practices. The 13.5 percent

[54] AfEP data excluded secret patents from its data, paralleling Soviet practices.

[55] The *Carl Zeiss Jena* Register lists all *non*-U Betrieb inventions with their publication numbers. By searching the publication numbers in online databases, one can determine the original application number for each of these inventions. Subsequently one can search those post-reunification patents with *Carl Zeiss Jena* or *Jenoptik* as assignee that have no application number listed in the *Patentregister*, which would likely be U-Betrieb inventions. We found only 17 such patents out of the 97 patents published in 1990 or afterwards.

share, while convenient to use as a maximum upper boundary, certainly overstates for the share for the economy as a whole. *Carl Zeiss Jena* was a prominent technology intensive firm and not typical of many other GDR industrial firms that were oriented toward civilian economic sectors such as food processing and agriculture.

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Our internet society can be quite intrusive; yet when busy experts suddenly received one of my emails unannounced, many of them responded and proved willing to help my research. I found Dr. Jürgen Breith's published materials and his responses to my inquiries quite useful. Prof. Dr. André Steiner (Leibniz-Zentrum für Zeithistorische Forschung) provided me with thoughtful comments on GDR economic history. Prof. Dr. Svetlana Lukishova, Group Leader and Adjunct Professor, The Institute of Optics, University of Rochester, helped my appreciation for Valentin Fabrikant's contributions to the development of the laser; and likewise Nick Taylor, for Gordon Gould's contributions. I would be remiss in not mentioning the responses of Dr. Klaus-Dieter Gattnar and Mr. Arnold Gallien.

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