RUSSIA, SANCTIONS, AND THE ACCIDENTAL KNOWLEDGE BUST AND BOOM: EVIDENCE FROM THE BOYCOTT OF THE 1980 MOSCOW SUMMER OLYMPICS*

Lisa D. Cook and Maksym Ivanyna

Corresponding Author:
Lisa D. Cook
Department of Economics
110 Marshall-Adams Hall
Michigan State University
486 W. Circle Drive
East Lansing, MI 48824
lisacook@msu.edu
517-432-7106 (o)

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Abstract

We use the boycott of the Summer Olympic Games in Moscow in 1980 and related events to identify a causal effect of escalation of the Cold War on the magnitude and direction of knowledge creation in the economy. Using data on over 165,000 U.S. and East German patents, we show that Soviet inventors who patent in the U.S. prior to 1979-80 both decrease their patent activity in the U.S. and other observant countries and increase their patent activity in non-observant countries, namely East Germany, after the boycott is announced. We find that on average a 10% increase in inventive activity by Soviet scientists in East Germany increases domestic invention by 2.5% in the long run. We also identify knowledge spillovers through greater participation of Soviet inventors on East German patent teams and through larger Soviet patent teams in general. Our results suggest that political decisions may have far-reaching, unintended consequences for economic activity through knowledge production.

Keywords: innovation, inventive activity, technological spillovers, patents, Soviet Union, sport

JEL-classification: N44, N74, O31, O33
1 Introduction

There are strong historical and empirical reasons to believe that political events and decisions can substantially affect economic growth through international knowledge spillovers. McGovern (1964), Neufeld (1995), Lasby (1971), Gimbel (1986, 1990), and Naimark (1995) explain the centrality of Projects Overcast, Paperclip, and Osoaviakhim, which forcibly transferred German rocket scientists to the U.S. and the U.S.S.R., to these superpowers’ rocket programs and the space race. Waldinger (2010) demonstrates the nontrivial impact of the expulsion of mathematics professors from Nazi Germany on Ph.D. mathematics students’ research productivity. Kerr and Lincoln (2010) exploit large changes in the U.S. H-1B visa program and find that higher admissions of scientists and engineers on this visa increase patenting among those with Chinese and Indian names. Likewise, Moser and Voena (2012) find that the confiscation of foreign patents through compulsory licensing via the Trading-with-the-Enemy Act results in a large positive effect on domestic invention in the U.S.

Factors affecting inventive activity originating among Soviet inventors are of great interest, since many researchers have tied the collapse of the Soviet Union to the slowdown in innovation, productivity, and economic growth in the late 1970’s and 1980’s. Although Soviet scientists and inventors were fairly isolated, Cook (2011) establishes that they obtained patents all over the world throughout the Soviet period. Researchers at the time were largely unaware of the magnitude and scope of this activity. Given the seemingly apolitical, clandestine existence of Soviet patents abroad, were the level, scope, and direction of Soviet knowledge spillovers insulated from unrelated political events?

New data on patenting by Soviet residents abroad provide direct evidence that knowledge flows to and from the West fell dramatically after the escalation of the Cold War in 1979, followed by the boycott of the Moscow Summer Olympics in 1980. Simultaneously, after 1980, Soviet inventors continued to respond to market-oriented incentives and desired to patent abroad to enhance their reputations, but they shifted their inventive efforts towards countries in the Eastern Bloc, such as East Germany. We show that knowledge spillovers increased in East Germany, as measured by partnerships with

\[1\text{E.g. Balassa (1964); Bergson (1968, 1987); Berliner (1964); Brubaker (1972); Desai (1976, 1986); Gomulka (1986); Kontorovich (1986); OECD (1969); Ofer (1987); U.S. Congress (1982a,b); Weitzman (1970)}\]
Soviet scientists and patenting by East German inventors, although Soviet patenting in the West was not entirely replaced. We also find positive effects of these knowledge spillovers on East German domestic inventive activity.

Our findings not only support growing evidence that links between Soviet and Western scientists were much greater than once thought, e.g., Harrison (2005); Borjas and Doran (2011); Cook (2011), and Ganguli (2012), but also that political events may produce real and persistent unintended consequences for economic growth.

2 Olympic and Other Boycotts

From 1952 when the Soviet Union rejoined the modern Olympic Games, these games served as a second front of the Cold War. The tradition of the Olympic Games as the focal point of international relations dates back to the Greeks. More recently, there are a few well-known examples. Hitler used the 1936 Olympics in Berlin to legitimate the Nazi regime. In 1968 in Mexico City, student protesters of the Olympics were killed by the Mexican government. During the 1972 Olympics in Munich, Palestinian terrorists kidnapped and killed nine Israeli athletes, coaches, and officials. The 1976 Olympic Games in Montreal were boycotted by 32 countries, many from sub-Saharan Africa, who protested New Zealand’s engagement in sports competitions with South Africa. For 40 years, the U.S. and the U.S.S.R. competed mightily to win medal counts and point totals.

Soviet troops were first deployed in Afghanistan in December 1979. In addition to temporarily withdrawing the U.S. ambassador to Moscow, reducing the number of passenger flights and cultural exchanges to the Soviet Union, and restricting grain and high-technology exports to the Soviet Union, on January 23, 1980, President Jimmy Carter threatened a boycott of the XXII Summer Olympics in Moscow in 1980. Since the Soviets did not withdraw their troops by the mid-February deadline set, President Carter announced a boycott of the Moscow Olympics on March 21, 1980. West Germany joined the boycott in May, as did Canada, Britain, Argentina, and Turkey. Islamic nations also decided to join the boycott, since Afghanistan was also a Muslim nation. A total of 65 countries refused to participate in the games. Sixteen countries decided to allow athletes to participate under the Olympic flag rather than their national flag, including Britain, Ireland, France, Italy, Switzerland, and Denmark. Facing international embarrassment and eco-
nomic and financial losses, Soviet diplomats secretly urged West Germany and other countries to reverse their decisions to participate in the boycott. Despite these efforts, by June 1980, 23 percent of available tickets remained unsold, at least 80,000 Olympics-bound tourists had canceled their hotel reservations in the Soviet Union, and several Western sponsors, including Daimler-Benz, had dropped their sponsorship contracts.\(^2\)

While the Olympic boycott is better known, another boycott immediately preceded it. At the end of 1978, a group of American scientists created the Scientists for Sakharov, Orlov and Sharansky (SOS) Committee, which was designed to protest the detention and treatment of Soviet scientists who were also political dissidents. By the second half of 1979 the Committee was joined by 2,400 U.S. scientists. The list included Nobel prize winners, members of National Academies of Science, and presidents of national scientific organizations. In 1980, after the exile of Andrei Sakharov, the Committee expanded internationally, and roughly 8,000 scientists from 44 countries joined the boycott. The SOS Committee committed to the suspension of personal cooperation with the Soviet Union, including the transfer of advanced Western technology and cooperation with Soviet scientists, which supported the regime, until the three scientists were released, which only happened in 1986. Members of the Committee also did peaceful pickets of conferences, which featured complying prominent Soviet scientists. Last but not least, the SOS Committee lobbied the National Academy of Science in the US to reduce the number of formal researchers’ exchanges with the Academy of Sciences of the USSR. As a result of the boycott - in sports, science, or politics - the number of short-term exchanges in science and technology fell from 296 in 1979 to 22 in 1980. The number of long-term exchanges declined from 27 to 7.\(^3\)

From Cook (2011), we know that Soviet inventors had strong incentives to produce inventions with ”international significance” that would ultimately improve Soviet living standards. Did external inventive activity change as a result? If so, how did this affect inventive activity in new “host” countries?

### 2.1 Implications of the Boycotts

Relations between the Soviet Union and boycotting countries disintegrated. Most scholars studying the boycott note formal retaliation later through the

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\(^2\)Zhyrnov (2010).

\(^3\)Hoover Institution (1980); Ginsburgs and Slusser (1981); Ginsburgs (1987)
Soviet boycott of the Los Angeles Olympics in 1984. However, this had an impact in realms far beyond amateur sports. The U.S. State Department notes that this marked the beginning of cooling relations between the Soviet Union and the U.S.\textsuperscript{4}

Bernard and Busse (2004) notwithstanding, little has been written about economic factors and the Olympics. Nonetheless, implications from such a disruption in technological spillovers have likely been underestimated. In the contemporaneous accounts of the boycott and in the literature scrutinizing it, there is no mention of potentially realized effects related to technological spillovers. Unique new data from patents may shed light on this. Despite little scientific cooperation between the U.S.S.R. and most Western countries during the Cold War, the significant technological flows via patents obtained abroad by Soviet inventors between 1959 and 1991 were interrupted. When the U.S. boycott of the Moscow Olympics was announced, there was a steep decline in the number of applications in the U.S. from Soviet inventors (Figure 1). Similar patterns were observed in West Germany and Japan (Figure 2).

\textsuperscript{4}U.S. Department of State, Office of the Historian (2012)
What happened to the inventive effort that was externally oriented? Did it just come to a sudden halt? Figure 1 suggests otherwise. It shows that flows from the Soviet Union to East Germany were orthogonal to flows to the U.S. following the boycott. In 1978, there were 223 applications for East German patents by Soviet scientists, as compared to 450 in the U.S. In 1979 the number of applications fell to 193. After the boycott, the annual number of Soviet applications in East Germany exploded, reaching its maximum of 561 in 1981, and then stabilizing at about 300-350 applications per year until 1987.

Below, we test systematically the sequencing of events and whether these political boycotts resulted in changes in knowledge spillovers and creation.

3 Data

Newly available data on East German patents are combined with U.S. patent data to answer the questions above.

3.1 US Patent Data

Data on patents granted to Soviet citizens abroad were collected from the USPTO. We know from Cook (2011) that Soviet inventors often bypassed their domestic patent office. Therefore, most patents obtained by Soviet in-

Source: DEPATIS

Figure 2: Patents of Soviet Origin in West Germany and Japan, 1970-1990, by Application Date

Source: DEPATIS
ventors abroad would not refer to a Soviet patent or patent-like document.\(^5\) This would result in an undercount of patents obtained by Soviet inventors abroad. We executed patent searches using further criteria - country of inventor and of assignee (applicant). Each patent record contains first initial or first name, middle initial or middle name (patronymic), and surname of inventor(s); patent or IC number; application date; grant date; USPTO class at the 6-digit level; applicant (assignee); and a brief description or title of the patent. There are 5904 U.S. patents applied for by Soviet residents between 1963 and 1991 in the data set.

### 3.2 East German Patent Data

We collected East German patent data from the German Patent and Trademark Office’s (GPTO) patent information system DEPATIS. Our data set contains 160,814 patents records spanning 1977 to 1991.\(^6\) Each record contains first name, middle initial, and surname of inventor(s); patent number; application and grant dates; International Patent Classification (IPC) section, subclass and group; applicant; title of the patent.

In a separate exercise we use DEPATIS to find all East German patents by Soviet residents. We search by country of priority (where it is first registered), of inventor, and of assignee. In addition, we execute a manual check of all records to identify Soviet and non-Soviet inventors on a patent due to problems of classification in the data.\(^7\)

The system of intellectual property protection in East Germany was similar to that of West Germany. Both countries retained their membership in the Paris Convention for the Protection of Industrial Property, which Germany signed in 1903. The life of a patent in both countries was 20 years, and in both countries the “first-to-file” rule was implemented. The major difference was that East Germany provided less protection for inventors. As in the Soviet Union, there were two types of patents in the GDR: the “exclusion patent” (Ausschliessungspatent) and the “economic patent”\(^8\)

\(^5\)Patents were very rarely awarded to Soviet inventors in the Soviet Union. More common were inventor’s certificates, which offered inventors recognition of authorship but no control rights.

\(^6\)We have data prior to 1977, but for most of the electronic records - 97% according to DEPATIS - from this time period there is no information about applicants and inventors, including their country of residence, which is a necessary information for us.

\(^7\)See Appendix for details of manual matching process.
While the former type of patent granted an inventor the exclusive right to use and license his or her invention, the latter type was subject to compulsory licensing for a nominal fee. In 1991, 80 percent of active East German patents were of the “economic” type. Like Soviet inventor’s certificates, East German patents do not have backwards citations, since references to “prior art” were not required.

In total, our dataset contains 3612 East German patents granted to Soviet residents. According to the International Patent Classification, 29% of the patents are in section B (Performing Operations, Transporting), 22% are in section C (Metallurgy, Chemistry), and 15% are in section G (Physics).

4 Empirical strategy

Our empirical strategy is to determine what effect, if any, boycotts had on knowledge spillovers.

First, we examine changes in patent applications. Specifically, we want to estimate whether changes in patenting by foreign applicants have any effect on changes in patenting patterns by domestic applicants, i.e. the following regression:

\[
< \# \text{GDR-origin pat's in GDR} >_t = \alpha + \\
\beta_1 < \# \text{SU-origin pat's in GDR} >_t + \\
\beta_2 < \# \text{SU-origin pat's in GDR and US} >_t + I_t + FE_i + \epsilon_t. \tag{1}
\]

\(< \# \text{X-origin pat's in Y} >_t\) is the number of patents by scientists from country X issued in country Y in subclass i over period t, by application date. We explore the spillovers from Soviet (SU) to East German (GDR) scientists, both groups patenting in East Germany. We also control for the general level of innovation by Soviet scientists, which is proxied by the number of Soviet applications both in East Germany and the U.S. (US). \(FE_i\) are subclass fixed effects, and \(I_t\) are period dummies.

Our interest is in \(\beta_1\). Estimating \(\beta_1\) by OLS (i.e., no \(FE_i\)) or by fixed effects would produce inconsistent coefficients, as \(< \# \text{GDR-origin pat's in GDR} >\) and \(< \# \text{SU-origin pat's in GDR} >\) may be driven by common omitted technology- and innovation-specific factors. For instance, a major technology breakthrough in a class \(i\) would change both dependent and independent
variables in our regression. We cannot control for these factors directly.

The escalation of the Cold War in 1979-1986 provides a source of variation in patenting that is orthogonal to the innovation process. During the escalation, applications for patents by Soviet residents shifted from countries in the Western Bloc, in particular the U.S., to political allies like East Germany. As a result, technological fields in which Soviet inventors frequently patented before the escalation may have experienced a concomitantly large inflow of patent applications by Soviet inventors in the GDR.

To identify the Cold-War-induced patent flows from the U.S. to East Germany, we construct the following instrumental variable (IV). At first, we use the pre-escalation data on the U.S. patenting by Soviet scientists to estimate “business-as-usual” projected patent counts in 1979-1991. To do this, we simply take an average of a subclass, or technological category, over the pre-escalation period, 1972 - 1978. Then we define the IV as follows:

\[
IV = \begin{cases} 
0 & \text{in } 1977-78 \\
< \# \text{ pats} >^{\text{pred}} - < \# \text{ pats} >^{\text{act}} & \text{in } 1979-91 
\end{cases}
\]  

- the difference between predicted and actual patent counts.

Justification for our IV is provided in Appendix in a stylized model of East German inventive activity. Figure 3 demonstrates its workings. The left panel shows the difference between patent counts by Soviet scientists in East Germany in the subclasses, where the IV is larger than the sample median, and the rest of the subclasses. The “affected” subclasses received substantially higher inflows of patent applications in 1979-85 - a pattern which is unlikely to be the outcome of preexisting trends. The right panel shows the patent counts by East German scientists over the same grouping of subclasses. In 1977-84 neither of the groups shows different behavior before and during the Cold-War escalation. But in 1985 the difference between the “affected” and “unaffected” subclasses sharply increased and remained large until 1990. This suggests that the influx of Soviet patents in the beginning of the 1980s affected domestic invention in East Germany half a decade later.

\[8\] Another example, that would bias \( \beta_1 \), is an agreement on scientific cooperation between the Soviet Union and East Germany, which would drive up patenting by both Soviets and East Germans.

\[9\] We also use an alternative procedure to estimate “business-as-usual” patent counts. Instead of taking averages we fit an AR(2) process to each patent subclass. We find that our main conclusions are robust to this change of estimation procedure. The estimation results are reported in Appendix, Table 5.
Sources: East German patents - Depatis; U.S. patents - USPTO. “Significant patent outflow” - if the IV is lower then the sample median; “minor or no outflow” otherwise. Patent counts are by application date.

In specification (1) we assume two time periods. The pre-escalation period extends from 1977 to 1978. The lower boundary reflects the availability of the data on East German patents. The upper boundary corresponds to the period when the SOS Committee began its activity. The escalation and post-escalation periods are merged in one and extend from 1979 to 1991. All data are averaged over both periods, based on half-yearly frequency.

The patents in our specification are divided by International Patent Classification (IPC) four-symbol subclasses. This is the way they are recorded in DEPATIS. To compare with the U.S. patents by Soviet residents we do USPTO-to-IPC concordance using the Johnson and Evenson Patent Set. The concordance and IPC classification in general are described in detail in the Appendix. Overall, there are 644 IPC four-symbol subclasses.

In addition to technological spillovers to East German inventors, we assess the benefits from patenting in East Germany on Soviet inventors themselves. We use the same specification (1) and the IV defined by (2), but the dependent variables are different. First, to measure possible international spillovers we use number of patents by international teams of inventors, where an international team consists of at least one Soviet and one non-Soviet resident. Second, we look at the average number of Soviet inventors on patents in East Germany.

\footnote{Accessed from \url{http://acad.coloradocollege.edu/jeps/index.php} on July 24, 2011}
Table 1: Variables Used in Regressions: Summary Statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>St.dev</th>
<th>Mean</th>
<th>St.dev</th>
</tr>
</thead>
<tbody>
<tr>
<td># GDR-origin pat’s in GDR</td>
<td>4.92</td>
<td>10.32</td>
<td>5.81</td>
<td>11.82</td>
</tr>
<tr>
<td># SU-origin pat’s in GDR</td>
<td>0.14</td>
<td>0.63</td>
<td>0.13</td>
<td>0.48</td>
</tr>
<tr>
<td># SU-origin pat’s in GDR and US</td>
<td>0.43</td>
<td>1.13</td>
<td>0.4</td>
<td>1.09</td>
</tr>
<tr>
<td>IV (see Equation 2)</td>
<td>0</td>
<td>0</td>
<td>0.06</td>
<td>0.68</td>
</tr>
<tr>
<td># int. teams on SU-origin pat’s in GDR</td>
<td>0.03</td>
<td>0.25</td>
<td>0.04</td>
<td>0.19</td>
</tr>
<tr>
<td># inventors on SU-origin pat’s in GDR</td>
<td>0.74</td>
<td>3.92</td>
<td>0.67</td>
<td>2.89</td>
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<tr>
<td># IPC four-symbol subclasses</td>
<td>644</td>
<td>644</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: East German (GDR) patents - DEPATIS; U.S. patents - USPTO. Inventors’ team is considered international if it contains at least one Soviet (SU) resident and at least one non-Soviet resident. All variables are averaged by half-year and by IPC four-symbol subclasses.

The statistical summary of dependent, independent and instrumental variables is given in Table 1. In regressions, all variables are used in logarithms, e.g., $x^{new} = \log(1 + x)$.

5 Results

The main estimation results are reported in Table 2.

5.1 Did Soviet inventors shift activity Eastward after the boycotts?

Column (8) in Table 2 shows the first stage in the IV estimation. The IV we use is fairly strong. The difference between the actual number of Soviet applications for the U.S. patents in 1979-91 and its predicted value based on 1972-78 is a very good predictor of how many patent applications Soviet scientists submitted in East Germany in 1979-1991. The point estimate for the IV is 0.41. That is, a lack of patenting by Soviet scientists in the U.S. is matched by an increase in patenting in East Germany by almost a half.
5.2 Did the boycott-induced Soviet presence in East Germany affect patterns of invention in East Germany?

Columns (1-3) of Table 2 report results for technological spillovers to East German inventors. Estimates are reported for OLS, FE, and IV estimation. We find a positive effect of the influx of Soviet patents on patenting by East German inventors in the same classes in 1979-91. \(^{11}\) The magnitudes of our IV estimates are not trivial. In case of IV, for subclasses with a large number of applications, the elasticity of East German applications with respect to Soviet ones is about 0.45. On average, we find that a 10\% increase in Soviet patent activity in East Germany increases domestic inventions by 2.5\%.\(^{12}\) This positive spillover from Soviet to East German scientists does not materialize immediately. Columns (4-7) of Table 2 show its evolution over time. In the first year after the escalation of the Cold War, the effect is negative, but statistically not different from zero. This is consistent with the finding in Borjas and Doran (2011) that a sudden influx of competition (for research ideas, funding) may reduce innovation. With time the spillover becomes positive, and in 1985 it is statistically significant at 10\%, and remains so until 1991.\(^{13}\)

We also find that the boycott and the Cold War escalation had a long-lasting effect on Soviet inventors’ patenting in East Germany. First, an increased number of Soviet patents in East Germany led to significantly more patents by international teams in the same classes (Table 3). Second, more inventors are recorded on patents in the affected classes (Table 4). Unlike spillovers to German inventors, spillovers to Soviet inventors are positive and significant regardless of which escalation/post-escalation period we use (columns 4-7 in the respective tables). In fact, the effect of more Soviet patent applications on number of inventors on a patent team and number of international teams is higher in the beginning of the escalation period (see column 4 vs. column 3 in Table 3). This suggests that, especially in

\(^{11}\)OLS and FE estimates are higher than the ones from IV, which is consistent with the model described in Section 4 and in Appendix.

\(^{12}\)Given the functional form that we use in the regressions, the exact effect of \(x\) on \(y\) is: \(\Delta y = \Delta x(1+y)/(1+x)\).

\(^{13}\)This is consistent with the view in the literature that the positive innovation spillovers take time to materialize. For example, Moser and Voena (2012) shows that the significant benefits from compulsory licensing appeared only seven years after it was introduced.
Table 2: IV estimation: Spillovers to East German inventors

<table>
<thead>
<tr>
<th></th>
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<tr>
<td>SU-origin pat’s in GDR</td>
<td>0.568***</td>
<td>0.720***</td>
<td>0.443**</td>
<td>-0.0837</td>
<td>0.171</td>
<td>0.289*</td>
<td>0.429**</td>
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<tr>
<td></td>
<td>(0.193)</td>
<td>(0.117)</td>
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<td>(0.212)</td>
<td>(0.162)</td>
<td>(0.152)</td>
<td>(0.177)</td>
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<td>SU-origin pat’s in US and GDR</td>
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<td>-0.269***</td>
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<td>0.0201</td>
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<td>(0.0193)</td>
<td>(0.0317)</td>
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<td>Constant</td>
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<td>1.503***</td>
<td>2.019***</td>
<td>1.764***</td>
<td>1.876***</td>
<td>2.021***</td>
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<td>-0.139***</td>
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</table>

Note: Dependent variable: columns (1)-(7) - # GDR-origin pat’s in GDR, column (8) - #SU-origin pat’s in GDR. * - significant at 10% level, ** - significant at 5% level, *** - significant at 1% level. See definitions of variables in Table 1. Robust standard errors are reported in parentheses. All variables are in logarithms: $x_{new} = \log(1 + x)$.

the beginning of the escalation, Soviet inventors were actively looking for scientific contacts, in East Germany and among themselves, that would help them “switch” from the U.S. to East German patent office.

5.3 A Case Study from Molecular Macrocompounds

Increased networking and international cooperation in the beginning of the escalation period could serve as a channel for increased domestic innovation in East Germany five years later. A case study of East German chemist Heinz Raubach demonstrates how this channel worked. In 1980, Dr. Raubach renewed his cooperation with colleagues from the Soviet Union N. Bekasova and V. Korshak. Together with other East German scientists they filed for a patent in subclass C08G (one of the subclasses of molecular macrocompounds). After this patent application Dr. Raubach continued active work in subclass C08G. Together with his East German colleagues he successfully applied for six patents in this subclass between 1981 and 1986, and then for nine more between 1987 and 1989. While in this example the scientific activity of Dr. Raubach in 1981-89 could just be a result of his general interest in subclass C08G, our empirical analysis shows that on average inflow of Soviet patent applications in the beginning of the 1980’s did lead to increased domestic invention in East Germany.

14H. Raubach and V. Korshak cooperated before, but their last joint application for a patent before 1980 was in 1976. No applications in subclass C08G were made by H. Raubach between 1976 and 1980.
Table 3: IV estimation: Spillovers to Soviet inventors - Number of International Teams

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>FE</td>
<td>IV</td>
<td>IV</td>
</tr>
<tr>
<td># SU-origin pat’s in GDR</td>
<td>0.419*** (0.0203)</td>
<td>0.335*** (0.0238)</td>
<td>0.301*** (0.0547)</td>
<td>0.416*** (0.0596)</td>
</tr>
<tr>
<td># SU-origin pat’s in US and GDR</td>
<td>0.0537*** (0.0126)</td>
<td>-0.0401** (0.0191)</td>
<td>-0.0287 (0.0359)</td>
<td>-0.0877*** (0.0418)</td>
</tr>
<tr>
<td>1 if 1977-78</td>
<td>0.00835 (0.00461)</td>
<td>0.00430 (0.00390)</td>
<td>0.00185 (0.00841)</td>
<td>0.00750 (0.00750)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.00799** (0.000116)</td>
<td>0.000666 (0.00091)</td>
<td>0.000666 (0.000756)</td>
<td>0.0211*** (0.00120)</td>
</tr>
<tr>
<td>Observations</td>
<td>1288</td>
<td>1288</td>
<td>774</td>
<td>774</td>
</tr>
<tr>
<td>Number of subclasses</td>
<td>644</td>
<td>387</td>
<td>387</td>
<td>387</td>
</tr>
</tbody>
</table>

Note: * - significant at 10% level, ** - significant at 5% level, *** - significant at 1% level. See definitions of variables in Table 1. Robust standard errors are reported in parentheses. All variables are in logarithms: $x'_{new} = \log(1 + x)$

5.4 Other Technological Spillovers

The direct effect of increased cooperation between Soviet and East German scientists, while easy to trace empirically, is not the only channel that connects foreign patent applications to domestic invention. Networks and research ideas could spread beyond initial ties. For example, Dr. Raubach worked with many other East German chemists in the 1980’s, who could then apply for a patent in subclass C08G on their own or as a part of other research teams. Information about the Soviet inventions became “closer” to East German science in the 1980’s: it was more wide-spread in East Germany, and it was translated into German. Finally, patenting in one subclass could lead to more inventive activity in other subclasses. For example, at the end of the 1980s, Dr. Raubach patented extensively in subclass C08L (also in the group of molecular macrocompounds). In this sense, we underestimate the true effect of foreign patenting on domestic inventive activity.

6 Conclusions and Future Research

We use newly available data from the East German Patent Office to examine the effects of decisions related to politics, or international relations, on economic outcomes. Specifically, we use data on patents obtained by Soviet inventors in the U.S. and East Germany and show statistically significant changes in inventor behavior following the announcement of the boycotts -
Table 4: IV estimation: Spillovers to Soviet inventors - Number of Inventors on a Patent

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS (1)</td>
<td>FE (2)</td>
<td>IV (3)</td>
<td>IV (4)</td>
</tr>
<tr>
<td># SU-origin pat’s in GDP</td>
<td>2.317***</td>
<td>2.400***</td>
<td>2.545***</td>
<td>2.598***</td>
</tr>
<tr>
<td></td>
<td>(0.0473)</td>
<td>(0.0599)</td>
<td>(0.135)</td>
<td>(0.134)</td>
</tr>
<tr>
<td># SU-origin pat’s in US and GDR</td>
<td>0.101***</td>
<td>-0.0319</td>
<td>-0.122</td>
<td>-0.105</td>
</tr>
<tr>
<td>1 if 1977-78</td>
<td>(0.0294)</td>
<td>(0.0481)</td>
<td>(0.0885)</td>
<td>(0.0952)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.0850***</td>
<td>0.101***</td>
<td>0.139***</td>
<td>0.0626***</td>
</tr>
<tr>
<td></td>
<td>(0.00786)</td>
<td>(0.00985)</td>
<td>(0.0187)</td>
<td>(0.0232)</td>
</tr>
<tr>
<td>Observations</td>
<td>1288</td>
<td>1288</td>
<td>774</td>
<td>774</td>
</tr>
<tr>
<td>Number of sub-classes</td>
<td>644</td>
<td>387</td>
<td>387</td>
<td>387</td>
</tr>
</tbody>
</table>

Note: * - significant at 10% level, ** - significant at 5% level, *** - significant at 1% level. See definitions of variables in Table 1. Robust standard errors are reported in parentheses. All variables are in logarithms: $x^{new} = \log(1 + x)$

the one of 1980 Moscow Olympics and the one by "Scientists for SOS" committee. Our evidence suggests that inventors sought to maximize patenting in countries where adherence to boycotts was relatively weak or non-existent and that the boycotts exposed deeper and broader linkages between Soviet and Western inventors and scientists than once thought. More broadly, like Borjas and Doran (2011) and Moser and Voena (2012) it provides further support for the idea that political activity may have wide-ranging and persistent unintended effects on economic growth through knowledge spillovers.

Many additional questions could be answered with the new data. Among them are: Were there other spillover effects to East Germany from the observed shift in patenting? Was there an increase in productivity or living standards in the sectors most affected by Soviet innovation? Given the positive effect of Soviet inventors on East German scientific output, should countries encourage patenting by foreign scientists in national patent offices, e.g., by easing regulation or reducing cost?
A Appendix

A.1 Search for East German Patents by Soviet Inventors

We take all records, which satisfy at least one of the following criteria:

- A patent has SU priority numbers;
- At least one inventor on a patent has a patronymic letter in his/her name (indicating he/she is from Soviet Union);
- At least one inventor on a patent indicates SU as his/her country of origin.

We did manual check of all records to identify Soviet/non-Soviet inventors on a patent. This is due to some problems with the original data: country of origin is necessarily indicated only starting from 1983; there are obvious flaws with the country of origin - surely German inventors are sometimes recorded as SU; some Soviet inventors are recorded without patronymic.

We do the following procedure to identify patents by Soviet inventors from all records that we find. First, we fill in the list of Soviet names. These are the names of those inventors who are marked as Soviet in DEPATIS database (only after 1983). Second, we clean the list from obviously German names of inventors, which were apparently marked as Soviet by mistake, - such names as Matthias, Gunter, or Sylvia. We also clean the list from “suspicious” names like Leon or Sofia. Third, we run through all records and mark an inventor Soviet if she/he has a Soviet name from our list. The rest of inventors are marked as international. Fourth, we manually check all records with at least one international inventor, which may also include Soviet inventors with “suspicious” names.

As a result, we should have all Soviet inventors, and all patents with SU priority numbers. The only omission is Soviet inventors recorded without patronymic, and using non-SU priority numbers. This is unlikely to be a big group but it may introduce downward bias in the number of international teams of inventors.
A.2 USPTO-to-IPC Concordance

Using the Wellesley Technology Concordance (WTC) probability tables, we transform all patent classes into IPC (International Patent Classification) notation. We do it for two reasons. First, the datasets of all East German patents and East German patents by Soviet residents classify patents using only IPC notation. Therefore, we only need to transform the dataset of US patents by Soviet residents. Second, the WTC probability tables only allow transformation from USPTO subclasses (six-digit codes) to IPC subclasses (four-symbol codes), therefore reverse concordance, which is possible to construct, would be less precise.

USPTO-to-IPC concordance goes the following way. Probability of each USPTO subclass falling into domain of IPC subclass X are estimated based on patent families assignments by WIPO and USPTO in 1976-1994. For example, if of 100 patents assigned to subclass 100/001 by USPTO 50 were assigned to, say, A01B and 50 were assigned to A01D, then corresponding probabilities for A01B and A01D are 0.5 and 0.5. The probabilities for the rest of IPC subclasses are zero. Accordingly, in our dataset a patent assigned USPTO subclass 100/001 counts as 0.5 patents with A01B IPC subclass, and 0.5 patents with A01D IPC subclass. According to WTC, one USPTO subclass concords with on average 2.4 IPC subclasses, although the number varies from 1 to 91. The average maximal probability of a USPTO subclass being concorded with a IPC subclass is 0.85, it varies from 0.11 to 1. Less than 50 percent of USPTO subclasses concord with IPC subclass exactly (i.e. maximal probability is one), while for 25 percent of USPTO subclasses the maximal probability is less than 0.5.

A.3 A Brief Guide to IPC Notation

IPC assigns each patent a section, class, subclass, and group. Section is the highest level of classification’s hierarchy. There are eight of them: A - Human Necessities; B - Performing Operations, Transporting; C - Chemistry, Metallurgy; D - Textiles, Paper; E - Fixed Constructions; F - Mechanical Engineering, Lighting, Heating, Weapons, Blasting; G - Physics; H - Electricity. Sections are divided into classes, which are represented by two digits, and then classes are divided into subclasses, which are denoted by a Latin letter. Subclasses are further divided into groups, however we are only interested in subclasses given the difficulties with USPTO-to-IPC concordance.
An example of IPC classification symbol is presented on Figure 4. Our merged dataset of East German (all) and US (only by Soviet residents) patents contains representatives of all eight IPC sections, 256 classes, and 1110 subclasses.

A.4 “Scientists for SOS” Logo

Figure 5: “Scientists for SOS” Logo

Source: Hoover Institution, SOS Archives.
A.5 A stylized model of East German domestic innovation

The following small stylized model of East German domestic innovation explains why our IVs are likely to be valid in the specification (1). Our assumption is that the number of East German patent applications by domestic scientists in subclass \( i \) in period \( t \), \(< \# \text{ DD pats in DD }>_{it}\) depends on the following:

\[
< \# \text{ DD pats in DD }>_{it} = \alpha + \beta_1 < \# \text{ SU pats in DD }>_{it} + \\
+ \beta_2 < \text{ World }>_{it} + \beta_3 < DD - SU >_{it} + I_t + FE_i + \xi_{it},
\]

where \(< \text{ World }>_{it}\) are world-wide factors or shocks to innovation in subclass \( i \), \(< DD - SU >_{it}\) are factors related to bilateral scientific cooperation between East Germany and a country in focus, in our case the Soviet Union, \( \xi_{it}\) includes factors that are not related to \(< \# \text{ SU pats in DD }>_{it}\), e.g. East German domestic R&D policy. Let \( s_{it}\) be the share of the Soviet patent applications in East Germany in the total number of Soviet applications in the U.S. and East Germany. Then

\[
< \# \text{ SU pats in DD }>_{it} = s_{it} < \# \text{ SU pats in DD and US }>_{it} .
\]

The regression error \( \epsilon_{it}\) in the specification (1) contains \(< \text{ World }>_{it}\) and \(< DD - SU >_{it}\), and our concern is that \(< \# \text{ SU pats in DD }>_{it}\) is correlated with these two variables, which makes OLS or FE estimator of \( \beta_1\) biased.

Controlling for \(< \# \text{ SU pats in DD and US }>_{it}\), correlation between \(< \# \text{ SU pats in DD }>_{it}\) and \(< \text{ World }>_{it}\) is likely to be zero:

\[
E(< \# \text{ SU pats in DD }>_{it} * < \text{ World }>_{it} | < \# \text{ SU pats in DD and US }>_{it}) = \\
= < < \# \text{ SU pats in DD and US }>_{it} * \\
* E(s_{it} * < \text{ World }>_{it} | < \# \text{ SU pats in DD and US }>_{it}) = 0,
\]

since the worldwide innovation shocks affect the total innovation effort in the Soviet Union, but not how much of it is patented in a given country.

The situation with \(< DD - SU >_{it}\) is different, as scientific cooperation between the Soviet Union and East Germany can affect not only the total innovation effort by Soviet scientists, \(< \# \text{ SU pats in DD and US }>_{it}\), but
also the share of inventions that are patented in East Germany, because the inventions resulting from the cooperation are more likely to be patented in East Germany than in the U.S.:

\[ E(s_{it} < DD - SU >_{it} | < \# SU pats in DD and US >_{it}) \neq 0. \]  

(6)

The proposed instrumental variables help resolve the situation. First, if Soviet scientists do shift their patent applications from the U.S. to East Germany due to the boycotts, then the difference between actual and “business-as-usual” U.S. patent applications by Soviet scientists should affect patent applications in East Germany:

\[ E(< \# SU pats in DD >_{it} * IV_j | < \# SU pats in DD and US >_{it}) \neq 0, j = 1, 2. \]  

(7)

We test this assumption formally. Second, controlling for the total number of Soviet applications in the U.S. and East Germany, our IVs should not be correlated with \( \epsilon_{it} \), i.e. with \(< World >_{it} \) or \(< DD - SU >_{it} \). The argument for the correlation with the \(< World >_{it} \) is the same as in (5). \(< DD - SU >_{it} \) could be correlated with the patent applications by Soviet scientists in the U.S. but only if the DD-SU cooperation involved dimensions, which are not related to the innovation process, e.g. reduction of barriers to patent in East Germany or boycott-related issues. These factors affect domestic innovation in East Germany only through the innovation effort by Soviet scientists.
A.6 Alternative IV estimation: Results

Table 5: Alternative IV Estimation

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th># SU-origin pat’s in GDR</th>
<th># GDR-origin pat’s</th>
<th># Intl. Teams</th>
<th># Inventors</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>$IV_{alt}$</td>
<td>0.237***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0225)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># SU-origin pat’s in GDR</td>
<td>0.336</td>
<td>0.281***</td>
<td>2.636***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.256)</td>
<td>(0.0681)</td>
<td>(0.169)</td>
<td></td>
</tr>
<tr>
<td># US-origin pat’s</td>
<td>0.764***</td>
<td>-0.0466</td>
<td>-0.0175</td>
<td>-0.173</td>
</tr>
<tr>
<td></td>
<td>(0.0323)</td>
<td>(0.160)</td>
<td>(0.0425)</td>
<td>(0.106)</td>
</tr>
<tr>
<td># Intl. Teams</td>
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<td>(0.0358)</td>
<td>(0.00953)</td>
<td>(0.0237)</td>
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<td># Inventors</td>
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<td>0.00743</td>
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<td>Observations</td>
<td>774</td>
<td>774</td>
<td>774</td>
<td>774</td>
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<tr>
<td>Number of subclasses</td>
<td>387</td>
<td>387</td>
<td>387</td>
<td>387</td>
</tr>
</tbody>
</table>

* - significant at 10% level, ** - significant at 5% level, *** - significant at 1% level. $IV_{alt}$ is defined by equation (2), where $< # \text{ pats } >^{pred}$ is estimated by fitting an AR(2) process on pre-escalation data (1972-1978) for each subclass. See definitions of other variables in Table 1. Estimation method - FE. Robust standard errors are reported in brackets.
References


Zhynov, Y. (2010). No other Olympics was so unprofitable. *Kommersant Vlast*, 21(875).