The Effect of Western Technology on Soviet Industrial Development

Andrei Markevich and Torsten Santavirta*

August 24, 2026

Abstract

During the Soviet Union's First Five-Year Plan, Western know-how and technology were infused into industry through contracts with foreign specialists and companies. We study the effect of this state-led policy on labor productivity using its largest single recruitment effort, Karelian Technical Aid, letting us exploit exogenous variation in technology transfer within one sector: the wood processing industry. Combining individual-level data on over 5,000 North American specialists with a novel panel covering the universe of interwar Soviet enterprises in Karelia and the Northern Region, we document large and persistent productivity gains, providing the first causal estimates of Western technology transfer in Soviet industrialization. Our findings suggest that such foreign assistance served as a fast, cheaper substitute for the formal apprenticeship system. The gains operated through transmitted tacit knowledge rather than capital, concentrated at less capital-intensive stages of the value chain and where elementary schooling and a shared language enabled knowledge absorption.

JEL Classification: J24, N64, O14, O3, P2
Keywords: Industrial policy, Technology, Technical assistance, Soviet Union

*Markevich: University of Helsinki, P.O.Box 54 (Snellmaninkatu 14 A) 00014 University of Helsinki, Finland, andrei.markevich@helsinki.fi; New Economic School, Moscow, Russia amarkevich@nes.ru; CEPR. Santavirta: University of Helsinki, P.O. Box 17 (Arkadiankatu 7). FI-00014 University of Helsinki, Finland, torsten.santavirta@helsinki.fi; Institute for Housing and Urban Research, Uppsala University. Acknowledgements: We thank Sascha Becker, Paul Castaneda Dower, Ruben Enikolopov, James Fenske, Bishnu Gupta, Sergei Guriev, Mark Harrison, Adrian Haws, Chris Minns, Matti Mitrunen, Devesh Rustagi, Matti Sarvimäki, Seth Sanders, Fraser Summerfield, Roope Uusitalo for their insights; the participants of 2024 WEast conference in Dublin, 2025 Finnish Economic Association annual conference, 2025 IOS annual conference, 2025 Dondena-Cornell Gathering (DOCG) and seminars at U. Helsinki, U. Wisconsin-Madison, Bank of Finland, VATT, University of Warwick, Universidad Carlos III de Madrid for valuable comments. Andrei Kostrov, Sofia Pirogova and Kaarle Myllyneva provided excellent research assistance. The usual disclaimer applies.

> "*A combination of American business and science with Bolshevik wisdom has created these giants in three or four years...*"
>
> *Za Industrializatsiiu*, August 14, 1933.[1]

1 Introduction

In recent academic discussion on the causal impact of industrial policy (Criscuolo et al., 2019; Giorcelli and Li, 2026; Juhász et al., 2024b; Mitrunen, 2024; Choi and Levchenko, 2025; Lane, 2025; Kantor and Whalley, 2025; Bai et al., 2025), the Soviet Union's technical assistance agreements with Western firms seem to be a forgotten chapter.[2] Yet, this was one of the biggest purposeful policies of foreign technology adoption in a developing country. During Stalin's interwar industrialization—one of the most archetypal episodes of rapid industrial catch-up (Robinson, 2010; Cheremukhin et al., 2017)—several hundred industrial projects were designed by foreign engineers, built under foreign supervision and equipped with the most advanced technology, all in just a few years (1928-1934). What is more, thousands of Soviet specialists were either trained in the U.S. or locally by American experts.[3] Study of the impact of this industrial policy—at the heart of the Gerschenkronian view of Western technology adoption as the key remedy to economic "backwardness"—offers crucial insight into the drivers and hurdles of industrial upgrading (Bloom et al., 2013; Atkin et al., 2017; Giorcelli, 2019; Verhoogen, 2023; Juhász et al., 2024).

Specifically, this paper quantifies the causal effect of Western technology transfer on Soviet labor productivity by focusing on the wood processing industry in the Autonomous Republic of Soviet Karelia. In 1931-1933, more than 5,000 American and Canadian specialists of ethnic Finnish origin were recruited to this region—a place with almost equal representation of ethnic Finno-Ugric peoples and Russians—on two-year foreign expert contracts. This intervention, called Karelian Technical Aid (KTA for brevity), was the largest single recruitment effort of foreign expertise within the realms of the Soviet industrial policy of Western technology absorption in the early 1930s. The objective was to forge a cadre of skilled foremen through vocational and on-the-job training and increase (or in Bolshevik lingo, "rationalize") labor productivity in the wood processing industry, one of the main sources of export goods in the interwar Soviet Union. As has been documented anecdotally (Fitzgerald, 1996), and

[1] *Za Industrializatsiiu* or "For Industrialization" was the official newspaper of the People's Commissariat of Heavy Industry. The excerpt is also cited by Anthony Sutton, in his work, Western Technology and Soviet Economic Development, 1930 to 1945, published by the Hoover Institution Press (Stanford University), 1971.

[2] For recent reviews of the burgeoning literature studying industrial policy using the modern toolkit of applied microeconomics, see Lane (2020) and Juhász et al. (2024a).

[3] The American influence on Soviet industry was of such scale during the early 1930s that the term "Americanization" was used interchangeably with "industrialization" (Sorokin, 1944).

recently causally (Jiang and Weber, 2025), the coincidence of the First Five-Year Plan (1928-1932) with the Great Depression greatly simplified attracting North American projects and expertise.

We develop two novel datasets on Karelian Technical Aid to evaluate its impact on Soviet industrial development. The geographical penetration of the program within Karelia is documented using a registry of foreign workers from the Karelian Settlement Administration, an office established to manage work permits and assignment of North American experts to enterprises. The registry allows us to trace the time of arrival, assigned settlement, and occupation of recruited foreign workers. We combine these detailed individual-level work-related immigration records with enterprise-level accounting data on industrial input and output over 1925–1940 extracted from the archives of the Central Statistical Administration of the former USSR. Our industry dataset comprises the universe of interwar period enterprises in both Karelia and the neighboring Northern Region (*Severny Krai*). While the latter also specialized in wood processing, it did not benefit from KTA. This allows us to construct a panel of treated firms, located exclusively in Karelia, and untreated firms, located both within and outside Karelia. We also generalize our design by extending our control group to wood processing firms in the more developed neighboring Leningrad region (*Leningradskaya oblast'*).

Our research design compares changes in labor productivity in wood processing enterprises by exposure to the technical aid program. In this two-way fixed-effects (enterprise and year) setting, we find a strong positive effect of the technical assistance program on treated enterprises' labor productivity. After the arrival of the North American Finns, treated enterprises' labor productivity increased on average by roughly 80 percent, with no evidence that resources were crowded out in the long run from enterprises not affected by the program. These results are robust to adjustment for concurrent policies such as the exploitation of forced labor and for potential differences in the implementation of the interwar five-year plans across the studied regions, and they hold in four samples with alternative control groups: (1) the baseline sample of enterprises in Karelia and the Northern region, (2) enterprises located along the two core railway lines feeding the northern ports, (3) enterprises extended to the Leningrad region, and (4) enterprises restricted to Karelia only. A subsequent event study shows that labor force upgrading was already evident the year after the program reached its full scale in 1932, with the effect persisting until the end of our observation period in 1940, the year after which our enterprise data were truncated due to World War II. The parallel-trends assumption is supported by an event-study analysis showing no differential pretrends and by a pre-specification test in which a pre-treatment lead added to the benchmark specification

is statistically insignificant. Our main empirical results are stable and statistically robust to a large battery of checks (e.g., alternative definitions of the variables, estimation samples, functional form, alternative standard error adjustments, etc.).

We complement our two-way fixed-effects (TWFE) analyses with an alternative identification strategy that leverages geographical settlement restrictions for foreign workers imposed by the Soviet secret police. We observe that these settlement restrictions were orthogonal to a number of background variables potentially affecting productivity, and use this source of exogenous variation in the geographical distribution of North American Finns across industrial sites in Karelia as an instrument for placement. Our IV strategy confirms the TWFE findings: the instrumented estimates are close in magnitude throughout, falling somewhat below the TWFE estimate in some samples and somewhat above it in others.

To understand what drives these gains, we examine how the effect varies with enterprises' capital and their position in the wood-processing chain. The effect survives conditioning on capital, shrinking by only a quarter—so it is not chiefly the machinery the program brought, but the tacit knowledge and work methods the specialists taught, that raise productivity. Consistent with this, the gains are smallest in the most capital-intensive enterprises, such as sawmills, where electrification rather than know-how drove upgrading, and largest at the highest stages of the value chain, such as plywood and standardized wood components, where the specialists' techniques mattered most.

We also show that elementary school education — proxied by literacy, rather than more advanced skills associated with higher education — together with the ability to communicate with foreign instructors, is crucial for labor force upgrading. Thanks to the granularity of our novel firm-level data on the Soviet industrial apprenticeship training schools, we can distinguish the effect of training provided by foreign specialists from that of the formal system of labor force upgrading in technological skills, providing evidence that foreign technical assistance served as a roughly 1.7-times-cheaper, fast-track substitute for the latter.

A simple cost-benefit analysis based on our estimates suggests that the KTA program was efficacious on its own terms and would still have been viable at four times higher wages for foreign workers—even abstracting from knowledge spillovers across regions. This aligns with the macro view of the 1920s economic potential of Soviet Karelia, where abundant natural resources of timber and proximity to important export ports through waterways and railways constituted comparative advantages for specialization in wood processing. A few decades earlier, neighboring Finland had become one of the world's largest exporters of timber and plywood (Hjerppe, 1989; Kuisma, 1993), and it is thus unsurprising that local

leadership in Soviet Karelia, many of whom were "Red Finns" (exiles from Finland's failed revolution in 1918), saw upgrading wood processing by learning from foreign instructors as a promising avenue for industrialization.

This paper intersects in at least three important ways with the existing literature. First, to our knowledge, we are the first to study Western technology transfer to Soviet industrialization—one of the largest explicitly formulated development policies—using enterprise-level data.[4] Developing economies attempting to leapfrog richer ones through state-led industrial policy have long relied on importing foreign expertise and technology (Robinson, 2010), yet few studies have overcome the observability problem of gauging the causal effect of such complex interventions (Juhász et al., 2024a). This challenge is especially acute for the Soviet case, which case studies (Sutton, 1971; Berliner, 1976; Amman et al., 1977), simulation models (Green and Levine, 1976a,b), and macro-level production-function analysis (Weitzman, 1979) attempted to address in the 1970s with conflicting results. As the U.S. Office of Technology Assessment observed in 1979:

> More than anything else, the conflicting results obtained from these [...] approaches point to the wisdom of reverting to the study of the actual effect of Western equipment and technology on the capacity of individual sectors of the Soviet economy. A disaggregate approach in which each industry is examined individually [...] may be more productive and accurate. It must be noted that such information is very difficult to obtain even in the West, where access to information is relatively free.

We are the first to respond to this call directly. The data constraint OTA identified—that disaggregate evidence is hard to assemble even in open economies—is no longer binding for most Western countries but still holds for the Soviet Union (Zhuravskaya et al., 2024). We overcome this constraint by assembling enterprise-level data on Soviet industry in the interwar period. The intervention we study—the recruitment of foreign specialists and the associated transfer of technology, contracted at market prices rather than through state-to-state agreement—targeted a single region and a single industry. This focus lets us identify the causal effect of Western technical assistance, aimed at training the local labor force on the job, that earlier macro approaches could not isolate. The economically substantial impact we find for KTA nuances the dismal macro view of the Soviet Union's productivity

[4] A growing body of work locates the origins of aggregate productivity differences in how resources are allocated across firms, and in why productive firms in poorer economies so often fail to grow (Restuccia and Rogerson, 2008; Hsieh and Klenow, 2009)

efforts (Cheremukhin et al., 2017), suggesting that approaching Western firms and experts for technical assistance was a constructive element in the industrialization drive.

Second, we extend the firm-level evidence on technology transfer through state-led industrial policy (Criscuolo et al., 2019; Barwick et al., 2025; Choi and Levchenko, 2025; Lane, 2025; Giorcelli and Li, 2026), which has concentrated on heavy industry, to a considerably less capital-intensive and less technologically sophisticated setting. Because we observe enterprise capital, we can separate the machinery KTA brought from the know-how its specialists carried, and we find the gains mainly run through the latter—tacit knowledge and work methods rather than embodied technology. That this channel was so productive here reflects features often common for developing economies today: substantial scope for catch-up in a technologically unsophisticated industry, and a workforce well positioned to absorb the specialists' teaching—sharing a language with them, and drawn from a rapidly expanding elementary education system. The result is a large effect in exactly the kind of industry where the returns to technical assistance are least well documented.

Third, the Soviet Union placed exceptional weight on industrial training as an instrument of rapid industrialization, building one of the era's most extensive systems of vocational and on-the-job instruction (Galenson, 1956). This makes interwar Soviet Karelia an unusually favorable setting to study technical assistance: foreign-specialist instruction coexisted with a dense formal apprenticeship system. The main components of KTA — on-the-job training by North American specialists and the introduction of organizational practices — are precisely the drivers of firm-level know-how that have received close attention in recent work on place-based policy and upgrading (Bartik, 2020; Verhoogen, 2023; Carranza and McKenzie, 2024, and references therein), as well as in a large observational and experimental literature assessing firm-level upgrading through training and management assistance (Bloom et al., 2013; Bruhn et al., 2018; Iacovone et al., 2022; Bianchi and Giorcelli, 2022). Field experiments in this tradition have delivered clean, well-identified estimates of such interventions (Bloom et al., 2013; McKenzie, 2021), but they are typically silent on how a new intervention interacts with the pre-existing institutions. Our contribution is precisely to observe this interaction: we show how training by foreign specialists reshaped outcomes alongside the formal apprenticeship and general-education institutions already in place — a dimension no stand-alone experiment is designed to capture.

The rest of the paper is organized as follows. Section 2 sets forth our institutional setting. Section 3 describes the data, and Section 4 presents the identification strategy. Section 5 reports our results, Section 6 analyzes the drivers of our main findings, and Section 7 offers

concluding remarks.

2 Institutional Setting

2.1 Soviet Karelia

Soviet Karelia is located northeast of Saint Petersburg (Leningrad between 1924 and 1991), along the Russian-Finnish border (Figure 1). According to the 1926 population census, it was mostly populated by Finno-Ugric peoples and Russians (41.5% and 57.2% respectively). In 1920, it was among the first of the former Russian Empire regions to gain autonomous status. Three years later, with the Soviet policy of indigenization (Martin, 2001), it would become the Karelian Autonomous Soviet Socialist Republic (KASSR), thereby joining the Soviet Union as part of the Russian Soviet Federative Socialist Republic (RSFSR).

Finnish socialist emigrés or "Red Finns" formed the bulk of Karelian leadership. Empowered by the ethnic and cultural concessions of the Soviet central government, the regional authorities began to implement an ambitious program to consolidate the administrative and cultural dominance of Karelian and Finnish peoples and languages in the region.[5] The aim was to eventually introduce standard literary Finnish as the second lingua franca alongside Russian throughout Soviet Karelia (Kero, 1981). From the central government's perspective, concessions to national minorities demonstrated to workers abroad that under socialism, peoples could prosper while retaining their national cultures (Gelb, 1993).

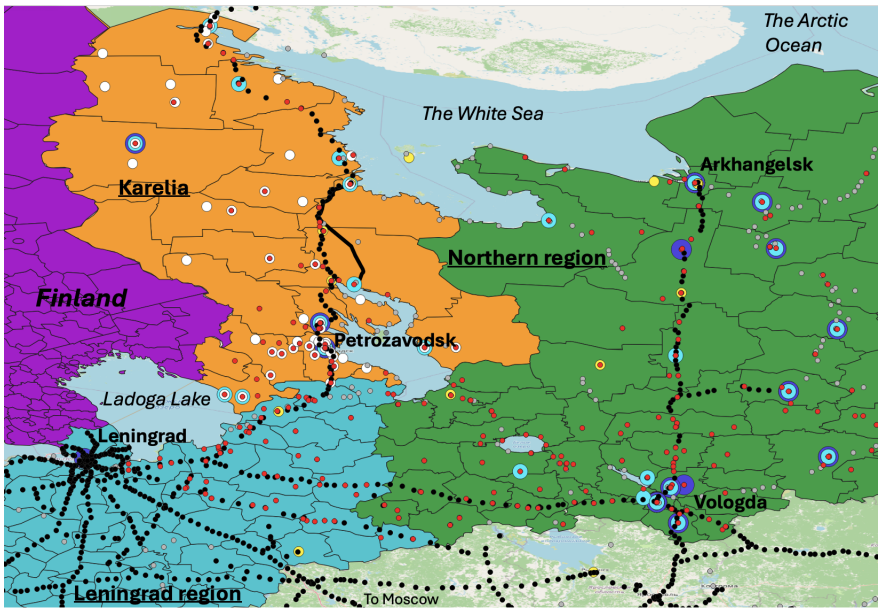
2.2 Soviet Industrialization and Western Technology

2.2.1 First Five-Year Plan

Interwar Soviet Union economic policy can essentially be divided into the rather market tolerant New Economic Policy (NEP) introduced by Lenin in 1921 and the centrally planned five-year plans implemented by Stalin in 1928. With the NEP, foreign firms operated under concessions that allowed Soviet enterprises to acquire technology they did not possess (Sutton, 1968). This changed with the introduction of the First Five-Year Plan and its goal of transforming the Soviet Union from an economically backward agrarian country to a modern industrialized nation. For the central government, this meant taking full control

[5]Language proximity between Karelian and Finnish is 13.9 on a 0-100 scaled proximity index, where lower scores indicate higher similarity; the same score between Catalan and Spanish is 23.5 (Beaufils and Tomin, 2020).

Figure 1: Soviet Karelia, the Northern and Leningrad Regions in Interwar Soviet Union.



Notes: Orange/green/blue = Karelia, Northern Region, and Leningrad region. The Northern Region (an administrative unit 1929–1936) is defined by the territories of its successor provinces. Thin black lines = 1939 administrative district boundaries. Dots: white = North American Finns; red = industrial enterprises; yellow = forced labor camps; black = railway stations; grey = river ports; light blue = factory training schools; dark blue = higher education/technical colleges. Bold black line = White Sea Canal.

of the country's resources and the mechanization of its industrial enterprises, including all technology transfer. After 1928, existing foreign concessions were terminated legally or illegally and replaced by state-sponsored technical assistance agreements with Western firms. These involved knowledge and technology transfers, including individual work contracts with engineers, technicians, and experienced workers (Sutton, 1968, 1971).[6] Paradoxically, this policy implied less self-sufficiency and more dependence on the Western capitalist system, given the increased need for hard currency to pay for foreign machinery, engineering, and expert know-how. Since the First Five-Year Plan coincided almost exactly with the Great Depression, traditional Soviet export markets were contracting and thereby obstructing the inflow of much needed hard currency. The Soviet Union was thus forced to increase the competitiveness of its main export goods, such as timber, oil, and grain (Sutton, 1971; Kero, 1983; Sanchez-Sibony, 2015).

In 1929, timber and paper products accounted for roughly 17% of Soviet export (SSSR, 1960). Compared to the mostly land-locked Siberian forests, those of Karelia were more

[6]The scale and ambition of these agreements made them relevant to some of the most successful American companies at the time, such as Ford Motor Company, General Motors, Packard, and General Electric. For a detailed account of the industrial policy of Soviet Union's technical assistance agreements in 1928-1934, see Sutton (1971).

favorable for Western export, given relatively easy access to the Baltic- and northern ports through water- and railways (Autio-Sarasmo, 2000). The otherwise undeveloped region of Soviet Karelia thus came to assume an important role in the First Five-Year Plan as one of the focus areas for the development of the wood processing industry, projected to triple during this period (SSSR, 1930). However, a lack of capital assets and low share of skilled labor limited the region's potential to fulfill its production targets (Efremkin, 2016).

To increase productivity, Karelia sought to both expand investments in wood processing industry and to recruit skilled workers from elsewhere in the Soviet Union.[7] The workforce did indeed grow during the First Five-Year Plan, even faster than projected. However, this was mostly thanks to increased in-migration of unskilled ethnic Russian workers, and not Finno-Ugric peoples from other parts of Soviet Union, who were supposed to make up 75% of this movement (Kangaspuro, 2000).[8] To tackle both the skill shortage and Finno-Ugric de-ethnicization, in March 1930 the Finnish leaders of Soviet Karelia proposed looking to skilled workers among the Finnish diaspora in North America (numbering roughly 400,000) for help, many of whom were unemployed due to the Great Depression (Kero, 1983).

The aim was to gain new technology and know-how from the technological frontier of the forestry industry while simultaneously reinforcing Finnish language and culture in Soviet Karelia by recruiting qualified North American Finns who could implement systematic vocational and on-the-job training of the local workforce (Kero, 1981; Gelb, 1993). The argument presented to the central government in Moscow was that experienced foreign workers could help the local workforce to "most rapidly learn foreign methods of forest harvesting" as they command "the highest labor productivity in the world" (Golubev and Takala, 2014). The initiative aligned with the decision of 16th All-Union Communist Party Congress (June 26 to July 13, 1930) to extend the practice of "sending workers and specialists abroad and inviting foreign engineers, foremen, and qualified workers to the USSR," thus intensifying "already existing technical assistance agreements" (Institute of Marxism and Leninism, 1984, p.156), and was approved fairly easily, despite secret police objections highlighting Karelia's long international border with Finland.

[7]The First Five-Year Plan prescribed a 20% population increase in Karelia to a target of 330,000 inhabitants in 1933, and 80% of all regional investments were directed to the wood processing industry (SSSR, 1930).

[8]Of the 98,000 internal immigrants who arrived in Karelia between the 1926 All-Union and 1933 Karelian Census, roughly 71% were Russians and only 18% Finno-Ugric (authors' own calculation based on census figures (KASSR, 1934)).

2.2.2 Karelian Technical Aid

The Soviet central government agreed to finance a recruitment scheme called "Technical Aid for Soviet Karelia," with headquarters in New York and Toronto and agents in the major Finnish-American and Finnish-Canadian communities. KTA mainly targeted those active in the forestry and wood industry, but also experienced workers of other trades such as tractor drivers, mechanics, and electricians. Only ethnic Finns were eligible to apply for work through the program.

In the years 1931-33, KTA succeeded in recruiting roughly 5,000 qualified workers, technicians, and engineers among the Finnish population in North America (6,700 along with their families). Thanks to these efforts, the share of foreign workers in Karelian industry (about 4%) was substantially larger than in the Soviet Union as a whole, which did not exceed 0.2% at its peak in 1932 (Graziosi, 1988; SSSR, 1932a).

The organized settlement of the North American Finns in Karelia was managed by the Settlement Administration (*Siirtolaishallinto*), established in Petrozavodsk (the capital of Karelia) in the spring of 1931. This body was responsible for application screening, arranging work permits, obtaining final approval of entry visas from Moscow, handling job placement and settlement, and keeping registers of all foreign workers. While workers signed a two-year contract with Karelian Technical Aid, it was ultimately local Karelian officials who assigned them to specific enterprises. Enterprises meanwhile applied for foreign experts once a year and committed to sponsoring assigned worker's visa applications.

Applicants who received work permits were encouraged to invest funds in Western machinery and equipment. The Machinery Fund was one option. This was a local-government financing vehicle set up to borrow foreign currency at favorable terms. Migrants invested dollars, intended for the purchase of machinery and equipment for Soviet Karelia, and received a guarantee of repayment by the Settlement Administration in rubles at the official exchange rate. Another option was to bring equipment and tools (e.g., cars, trucks, tractors, spare parts, saws, axes), which were compensated for upon arrival in the Soviet Union.

In Karelia, North American workers earned higher salaries (partly paid in U.S. dollars) than locals and had access to some amenities (e.g., the *Insnab* grocery stores and canteens established in 1931) that catered to the needs of a growing community of foreigners (Efremkin, 2011; Golubev and Takala, 2011, 2014).[9] Formally, they were free to leave a job and find

[9] An experienced North American worker earned roughly 200 rubles per month, while a technician was paid between 550 and 850 rubles per month, considerably more than the monthly wage of local workers, at about 120 rubles (Kero, 1983; Golubev and Takala, 2014).

another, but in practice these workers were bound to their assigned locations by a complicated administrative procedure for transfer permission. Many found this restricted freedom, along with poor housing conditions and a scarcity of regular daily groceries, to be unworthy treatment of foreign experts, leading numerous workers to breach their contracts. According to official records of the Settlement Administration, by the end of 1932, some 300 North American workers had left the Soviet Union. Many others left after the end of their initial two-year contracts; by the end of 1935, about 2,300, i.e., almost a half of the foreign workers, had gone, though these numbers are likely higher due to unreported departures. For those who chose to remain in the Soviet Union longer than the terms of their initial contracts, migration often became a tragic experience; many fell victim to the Great Terror of 1937-38, which further erased North American Finns as a distinct group in Karelia (Golubev and Takala, 2014).

2.3 Technical Assistance in Karelia

Despite ample qualitative historical research on North American foreign workers in Soviet Karelia, systematic study of their economic contributions is lacking. However, Dalrymple (1966) provides a helpful categorization of American technical assistance and technology transfer for Soviet agriculture: training in adapting mechanized processes; shipments of machinery and support in their operation; engineering assistance in the construction and operation of machinery plants; and imitation of unintentionally provided designs. We loosely follow this typology below in elucidating the input and know-how contributed by the North American Finns, whose technical assistance was centered on instruction and the on-the-job transmission of occupational skills across each of these four components.[10]

Training in adapting mechanized processes. Soviet officials' objective was to maximize the return of KTA through deliberate knowledge transfer. In the short run, this meant a focus on the most pressing processes in Karelia, while the long run goal was to forge a Soviet Union-wide cadre of forestry foremen who would update their local subordinates on new methods via ongoing vocational training. Karelian leadership had, however, full autonomy in organizing these efforts locally, and focused them on Karelia itself. The North American newcomers formed a team of elite forestry workers that toured logging camps in Karelia

[10]This subsection is based on historical assessments of the Settlement Administration archives, meeting minutes, Karelian officials' correspondence with enterprise managers, articles published in *Red Karelia* (the Soviet Karelian newspaper), and many other sources. Sources of particular note include Popov (1957), Kero (1983), Takala (2004), Efremkin (2011), and Golubev and Takala (2014).

and occasionally other regions to teach state-of-the-art methods to local foremen. Courses in "Canadian-American forestry work processes and equipment" were, for instance, arranged on the premises of one of the larger logging camps in Karelia, and could accommodate roughly 100 students per course (Kero, 1983). A course would consist of some 200 hours of theory and 600 hours of practical exercises, taught by four North American Finnish instructors and one course principal, called the "rationalization comrade."[11] By the end of 1935, roughly 500 students, mostly from Karelia, had become "junior forestry managers" , through such instruction. Precise records of their origins are lacking, but the Northern Region was likely only marginally represented, if at all.

Shipments of machinery and support in their operation. In North America, the mechanization of forestry had only begun in earnest in the 1920s, with the introduction of crawler tractors for hauling and trucks for transportation. Their acquisition through KTA was therefore seen as an opportunity to leap to the technology frontier. While a small number of tractors were available at a few logging camps in Karelia before the technical assistance program, a lack of qualified mechanics and drivers limited the use of this already scarce resource, leaving loggers with horses as their only viable solution for transportation needs.[12] The arrival of American tractors and trucks along with a large number of professional mechanics and drivers from the U.S. and Canada relaxed these constraints and frictions. Beyond operating this equipment themselves, the foreign experts instructed local workers to drive and maintain these new machines. Training in North American forestry techniques likely also helped Karelia exploit their tractors more efficiently than elsewhere in the Soviet Union. Moreover, the newly established automotive trust (*Karjalan Auto*), essentially a garage more so than a car dealer, managed the maintenance of equipment and vehicles used in the Karelian wood processing industry, through its roughly 300 North American mechanics. This service of Western standards compensated for the endemic shortage of spare parts common in the Soviet Union (Kero, 1983).

The qualitative historical literature furthermore highlights the manual tools and semi-mechanized technology introduced by the North Americans. For example, North American horse- or tractor-driven derricks sped up the loading of timber on "double sleds," which were wider and easier to load than traditional Karelian ones. Further examples include Canadian portable frame saws, North American cross cut saws, and Canadian axes, brought in by

[11] Skills taught included construction of derricks (lifting devices for forestry introduced by North American Finns), service and repair of axes and saws, and organizational practices on felling sites.

[12] Indeed, tractors are a textbook case of a slow-diffusion technology, even in the absence of the aforementioned human capital vintage and search frictions (Manuelli and Seshadri, 2014).

the thousands. North American newcomers instructed local workers in the proper use of this equipment, much of which required careful handling and regular maintenance. The Karelian state-backed Forestry Research Institute rigorously measured the productivity gains granted by this machinery at so-called "model plants." Established with the arrival of North American Finns, the Institute regularly published research reports and manuals (Appendix Figure E.2).[13] A summary of the studies and archival documents that quantify the productivity improvements of specific equipment and methods is provided in Appendix Table E.1.

Engineering assistance in the construction and operation of plants. Many Karelian factories were mechanized by machinery brought by North American Finns via their machinery fund. Specifically, they invested in, imported, and supervised installation of this equipment in local factories and trained local workers to operate and maintain it. For example, the ski factory in Petrozavodsk, one of the largest in the Soviet Union, was mechanized by American technology. It employed some 150 North American Finns (30% of all employees), who also taught at the affiliated vocational school that trained 25 to 30 local workers annually. North American Finns also participated in the construction of new industrial plants such as the Kontupohja Paper and Pulp Mill and its associated hydropower station. On-the-job training was implemented at most enterprises that recruited North Americans. Appendix Section E.1 provides further examples of the American and Canadian contributions to the so-called "Fordization" of the Soviet enterprises.

Imitation. Imitation and duplication were the primary means of enhancing the technological side of Soviet wood processing. Local mass production of North American (mainly Canadian) tools began a few years after their introduction by foreign workers, who advised locals on the manufacturing process. The Canadian axe was first produced in 1934 at the Onegan factory in Petrozavodsk, while North American-type saw blades started being produced from 1933 onward at the Kaganovitch Steel Plant in Moscow. As policy shifted toward more autarky, it became important to erase the origin of the tools. For instance, the Caterpillar tractor was reincarnated as the *Stalinetz* (Son of Stalin), while the "Canadian" axe became the "Onegan" axe.

[13]The emergence of model plants may have been triggered by similar such stations established by the American Forest Service in the 1920s (Godfrey, 2013).

2.4 Industrial Training in the Soviet Union

In its training component, KTA complemented a broader Soviet effort to upgrade the skills of an industrial labor force rapidly expanding under industrialization. Already in the 1920s, the Soviet government began expanding the system of factory apprenticeship training schools (*Fabrichno-zavodskie uchilishcha or F.Z.U.*), inherited from the Tsarist era. Under the 1931 decree, Soviet industrial ministries were required to devote four percent of their total labor costs to these vocational schools (SNK, 1931). There were almost a million apprentices enrolled in nearly four thousand factory training schools in the Soviet Union in 1932 (TsUNKhU, 1936). Despite these considerable expenditures and scale, the system trained no more than a quarter of new industrial workers, and training took an average of nineteen months to complete (Galenson, 1956). Karelia had seventeen factory training schools, with two thousand apprentices, by the beginning of 1933 (KASSR, 1934), while the Northern Region had ninety-two training schools, with about nine thousand students (VKPb, 1933).

3 Data

We construct a novel panel combining two archival data sources. First, individual-level records of North American Finns contracted via KTA measure the program's geography and intensity. We link these assignments to an enterprise-level accounting panel spanning the years surrounding the intervention. Our baseline sample covers the population of industrial enterprises in Karelia and the Northern Region, supplemented with wood-processing firms from neighboring districts in the Leningrad region. To our knowledge, this is the first panel analysis of interwar Soviet enterprises.

3.1 Archives of the Settlement Administration

The individual-level records on North American Finns provide information on their characteristics such as surname, name, date of birth, country of outmigration, time of arrival and settlement of destination, but also individual's occupation and sometimes establishment. These records were compiled into a database comprising 6,663 North American immigrants through a linking algorithm that excludes duplicates based on harmonized names and sociodemographic characteristics across archival sources of the Settlement Administration available at the Karelian National Archive (Appendix Section D.2 describes the linking algorithm). By comparing our database to official statistics of the Settlement Administration reporting arrivals (but likely underestimating the return migration) up until the end of 1934

(n=5,411) and to the thus far most comprehensive, but self-reportedly incomplete, compilation of archival sources (n=5,557) collected by Golubev and Takala (2014), we conclude that our database must be very close to the definitive scale of American and Canadian foreign workers' presence in Karelia in the 1930s.[14]

In order to characterize the immigration to the Soviet Union, we link the individual records of the Settlement Administration to North American census records. Appendix Section D.2 describes the census linking and the resulting linked data. In total, we managed to link 1,018 foreign workers and their family members to either the 1930 U.S. Census or the 1931 Census of Canada for a match rate of roughly 15%.

3.2 Data on Soviet Industrial Enterprises

We use the most disaggregated annual accounting data available at the archives of the USSR Central Statistical Administration. We digitized annual records on inputs and outputs for the universe of industrial enterprises (*predpriyatie*) in Karelia and the Northern Region. For 1926–1928, these data come from comprehensive enterprise-level annual reports.[15] For later years, we digitized archival spreadsheets that summarize these annual reports. For 1925, 1929, and 1934, we rely on published enterprise-level statistics.

Our panel comprises about 1,900 enterprises in Karelia and the Northern Region between 1925 and 1940, yielding roughly 2,000 enterprise-years in wood processing and 2,300 in other sectors. We also observe all wood-processing firms (roughly 300 enterprise-years) in the neighboring Leningrad districts that are situated to the North-West of the Leningrad-Moscow train line. The panel contains gaps for all enterprises in 1930–1931 and 1935–1936.[16]

All enterprises operated under state agencies, subordinated to local, regional, or central ministries. The panel is unbalanced due to the large-scale establishment of new enterprises in the 1930s and frequent administrative reorganizations, mergers, and splits.

[14] While the coverage of individual workers and family members is as good as complete in our dataset we lack full coverage for variables such as assigned settlement, enterprise, and occupation. To ameliorate this limitation, we complement the list of settlements identified in our individual-level records with settlements that by the archival sources of the Settlement Administration are documented to have received North American workers (Golubev and Takala, 2014).

[15] In the 1920s, the Soviet business year started on October 1 and lasted until September 30 in the following year. For brevity, we refer to 1924/25, 1925/26, 1926/27 and 1927/28 as 1925, 1926, 1927, and 1928, correspondingly.

[16] The 1930–1931 gap was caused by the reorganization of the statistical administration and its incorporation into the State Planning Committee (Gosplan). For 1935–1936, regional enterprise-level spreadsheets were not preserved in the archives.

For each enterprise-year, we observe output in 1926/27 rubles, the number of industrial workers, industry and sub-industry, birth year. Fixed capital assets are available for all years except 1925 and 1929. We geocoded the exact location of most enterprises, allowing us to uniquely match them to the individual-level records of North American Finns. Furthermore, using historical maps and statistical volumes, we geolocated establishments relative to Gulag forced labor camps, railway stations, river ports, power stations, and vocational or higher education institutions. We supplement these data with information on ethnicity, literacy, and political party connections (see Appendix Table D.1 for exact archival references).

3.3 Summary Statistics

Panel A of Table 1 reports summary statistics for our wood-processing panel in Karelia and the Northern Region.[17] We observe 93 establishments in Karelia and roughly 600 in the Northern Region. About three-quarters of Karelian establishments are located in settlements receiving foreign workers. The Northern Region has no such settlements, as the program operated exclusively in Karelia (Kero, 1983). Enterprises across both regions are comparable in age, employment, and capital assets, though Karelian enterprises are, on average, more productive and located closer to forced labor camps.

Following standard Soviet economic-geography classifications (SSSR, 1930), we treat the Northern Region — which comprises the contemporary Arkhangelsk, Vologda, and Komi regions — as the closest comparator to Karelia. In the 1920s, both were remote northern peripheries specializing in wood processing industry, characterized by low population density and low industrialization. Kolmogorov-Smirnov and Wilcoxon-Mann-Whitney tests confirm no significant differences in industrial output or employment between the regions' wood-processing sectors in 1925. Furthermore, the two regions shared similar geoclimatic conditions: both were heavily forested (60.9% and 51.9%, respectively) and dominated by identical coniferous species (SSSR, 1932b; Popov, 1957). Appendix Figure B.1a further document these baseline similarities.

Both regions relied on a single north-south railway to transport timber to northern export ports (Appendix Figure B.1b). Because economic activity clustered along these corridors, we construct an alternative sample restricted to enterprises within 150 km of these railways, effectively excluding the sparsely populated eastern areas of the Northern Region. Panel B

[17] We follow the Soviet industry classification tradition (Helle, 1926; Autio-Sarasmo, 2000) and define the wood processing industry broadly to include forestry as well as all activity in which wood enters as the main intermediate input (NACE: A2, C16, C17, C18, C31).

of Table 1 shows this railway restriction improves baseline balance across both inputs and output. A difference in forced labor proximity remains due to the 1930s Belomor Canal construction in Karelia, which we account for via baseline controls and robustness checks.

Table 1: Summary Statistics: Wood Processing Enterprises in Karelia and the Northern Region

Baseline sample: Karelia and the Northern Region

	Karelia		Northern Region			
	Mean	Obs.	Mean	Obs.	Difference	S.E.
Panel A: Enterprises						
Number of enterprises		93		617		
Share with North American Finns	0.72	93	0.00	617		
Birth year	1924	70	1928	386		
Panel B: Enterprise-year observations, 1925–1940						
Number of workers	429.41	287	438.69	1,589	-9.29	32.48
Output per worker (1926/27 rubles)	4,239.59	315	3,535.51	1,589	704.07***	204.43
Capital per worker (nominal rubles)	5,602.75	265	5,052.21	1,298	550.54	881.45
Distance to forced labor camps (km)	163.69	315	205.04	1,589	-41.35***	9.50

Sub-sample: enterprises within 150 km of the Murmansk or Vologda–Arkhangelsk railway

	Karelia		Northern Region			
	Mean	Obs.	Mean	Obs.	Difference	S.E.
Panel C: Enterprises						
Number of enterprises		80		241		
Share with North American Finns	0.69	80	0.00	241		
Birth year	1923	61	1927	172		
Panel D: Enterprise-year observations, 1925–1940						
Number of workers	434.12	258	483.67	706	-49.55	38.39
Output per worker (1926/27 rubles)	4,322.67	280	4,159.14	706	163.53	273.58
Capital per worker (nominal rubles)	5,754.92	237	6,142.27	593	-387.35	1,066.66
Distance to forced labor camps (km)	156.09	280	180.79	706	-24.69**	10.40

Notes: The upper block reports the main analysis sample of wood-processing enterprises in Karelia and the Northern Region. The lower block restricts the sample to enterprises within ±150 km of railway lines leading to the northern export ports. Panels A and C report firm-level cross-sectional characteristics; Panels B and D report enterprise-year means. Observation counts vary due to missing data. "Difference" denotes the Karelia mean minus the Northern Region mean, with standard errors from two-sample t-tests. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

We also construct an extended sample incorporating wood-processing enterprises in the neighboring Leningrad region. To avoid confounding effects from the highly industrialized Leningrad metropolitan area, we restrict this control group to the forested districts northeast of the Moscow–Leningrad railway, which geographically mirror Karelia (Appendix

Figure B.1a).[18] Panel A of Table A.1 summarizes this extended sample. Importantly, Panel B shows that within Karelia itself, enterprises in settlements exposed and unexposed to North American Finns are balanced across all observed baseline characteristics.

Appendix Table A.2 summarizes the North American specialist population. Consistent with historical accounts (Kero, 1983; Golubev and Takala, 2014), recruitment (which peaked in 1932) heavily targeted experienced loggers and wood-processing specialists.[19] Adult male arrivals averaged 36 years of age—substantially older than the typical 25-year-old immigrant during the U.S. Age of Mass Migration (Ruggles et al., 2024). Workers arriving from the U.S. had typically emigrated from Finland before World War I, whereas Canadian arrivals averaged only ten years in North America, largely reflecting post-1922 U.S. entry restrictions. In Karelia, assignment to settlements varied little across years.

3.4 Reliability of Internal Soviet Statistics

As this paper uses enterprise-level data from Stalin's Soviet Union, a discussion on data quality is warranted. Some readers will know from the interviewees' accounts in Berliner (1952) that Soviet managers were known for misreporting to the higher levels of hierarchy. However, as Bergson (1953) and many others after him have concluded (e.g., Grossman, 1960), Soviet statistics are not quite so flawed and Soviet managers did not in general resort to widespread falsification or double bookkeeping. We analyze the same set of confidential disaggregated and detailed enterprise-level records as the Soviet central government had at its disposal. There are no alternative sources of statistical records in the former Soviet archives (Gregory and Harrison, 2005).[20] The Soviet government needed reliable enterprise-level information for decision making. To this end the central government closely monitored information flows and penalized misreporting (Bergson, 1953; Markevich, 2011). Harrison (2011) shows that the distribution of detected falsifications implies limited space for constant upward-biased misreporting since such practice would accumulate fraud and thereby increasing probability of detection. Moreover, if some enterprises in our dataset were notoriously misreporting, the inclusion of enterprise-level fixed effects in our models should deal with this culture.

[18] Kolmogorov-Smirnov and Wilcoxon-Mann-Whitney tests reject the null hypotheses of no difference in the distribution of industrial output and the number of workers in the wood processing industry between Karelia and the Leningrad Region as a whole in 1925.

[19] Appendix Table A.3 compares the top 10 assigned occupations of these recruits to the occupational distribution of working-age Finnish-origin men in the 1930 U.S. and 1931 Canadian censuses.

[20] Granular statistics may however be available in multiple sources. Our cross check of enterprise-level accounting data across two sources (Appendix Figure B.2) demonstrate striking similarity of statistics.

4 Empirical Strategy

This section outlines the empirical model that tests our central hypothesis that North American technical assistance and technology transfer had an effect on labor productivity in USSR.

4.1 Two-Way Fixed Effects Model

We explore the effect of exposure to KTA – measured with the presence of North American Finns D_i – of Soviet enterprise i on its labor productivity using a two-way fixed effects model

$$y_{it} = \alpha_i + \gamma_t + \mathbf{X}_{it}^{'}\eta + \beta(\text{POST}_t \times D_i) + \epsilon_{it}, \tag{1}$$

where y_{it} is *revenue* labor productivity measured as the enterprise's log output in 1926/7 sector-level product prices in rubles (i.e., real revenue) per industrial worker in year t, α_i represents a full set of enterprise fixed effects, γ_t stands for a full set of year dummies and X_{it} is a vector of time-varying enterprise-specific covariates that might influence labor productivity.[21] The main explanatory variable of interest is the interaction term $\text{POST}_t \times D_i$ with coefficient β. Here, POST_t is a dummy variable that takes a value equal to one for the post-1932 years, i.e., the period by which 80% of the total influx of foreign workers had arrived via KTA and D_i is a dummy variable taking a value equal to one if the enterprise was exposed to KTA.

Our interest in labor productivity is motivated by the real life concerns of its low level in Karelia just like elsewhere in the Soviet Union in late 1920s, mostly due to an unskilled work force (Siegel, 1953; Efremkin, 2016). These concerns greatly contributed to the central government's support for recruitment of foreign engineers, skilled workers and consultants (Institute of Marxism and Leninism, 1984). More generally, labor productivity was believed to be the "most important national economic index" in Soviet Union (Slovar' Spravochnik, 1948).

Vector $\mathbf{X}_{it}$ includes the following controls for concurrent policies:

[21] Enterprise-level output is reported from 1932 onward in sector-level product prices fixed to 1926/27. For the years in 1920s, annual enterprise-level output is deflated using a universal index for wholesale prices of industrial goods developed by Allen (1997), which potentially masks sector-specific shocks. Since our analysis focuses on one industry, this limitation is mitigated. As to potential enterprise-specific price shocks (De Loecker and Warzynski, 2012), they are of less concern in our context at least after 1928 as annual prices for output and input in the command economy were determined by the central planner and applied universally to the whole of Soviet Union.

1. Soviet five-year plans in Karelia - Interaction of a dummy taking on value one if the enterprise is located in Karelia and zero if located in the Northern Region with a post-1928 period dummy to allow for a difference in five-year plans implementation between regions under study.

2. Forced labor - Second-order polynomials of Euclidean distance to time-varying Gulag headquarters locations, which we also interact with a post-1929 dummy to capture the shift toward large-scale forced-labor use in industry (Khlevniuk, 2004).

We also consider a variant of equation (1) with an additional interaction term $d_{1932} \times D_i$ that serves as a pre-specification test informing whether there are any differential pretrends in labor productivity between enterprises that did or did not receive technical assistance. We further estimate a fully flexible event-study version of equation (1), including the interactions terms of the KTA dummy with a full set of year dummies (except 1932 which is the reference year). Such adjustment allows both time-varying post-treatment effects and also a more flexible investigation of whether there are any differential trends in enterprises' labor productivity by treatment status in any of the years up to 1933.

To account for potential serial correlation of the observations from the same enterprise, we adjust the standard errors by allowing for an arbitrary variance-covariance matrix within each enterprise over time. We also computed standard errors adjusted for spatial correlation using the statistical package developed by Colella et al. (2023). In practice, as we show in the main results beginning with Table 2 and in Appendix Table A.7, this adjustment does not have much effect on the standard errors and does not vary substantially across the level within which this so-called clustering is assumed to occur.

A key set of questions concerns how to measure D_i, i.e., the exposure of enterprises to KTA, and how to define the control group. We consider enterprises treated if the Settlement Administration records document the presence of North American Finns within 15 km radius (results are robust to radius of 1, 3, 5, and 30 km). We make this assumption because we are able to associate substantially more foreign workers with locations than with enterprises.[22] We assume that an enterprise's production technology is exposed to the presence of North American technical assistance and technology at the location where it operated.

Having defined treatment, we now turn to the choice of control group, building on the discussion of the similarity between Karelia and its neighboring regions in Section 3.3. We

[22]In particular for the North American Finns who were recruited to enterprises active in lumbering, it was common practice to associate them with the Karelian forestry trust *Karelles* (under which the majority of forestry enterprises in Karelia were subordinated), and specifying only the settlement.

consider Karelia and the Northern Region as our baseline sample, which effectively means that we treat all enterprises in the Northern Region, as well as enterprises in Karelian settlements without North American experts, as our control group. To address potential concerns about how comparable enterprises in Karelia and the Northern Region are, we also estimate Equation (1) in the railway sample, the sample extended to Leningrad districts, and the within-Karelia-only sample.

The key identifying assumption in estimating equations (1) and its versions is that in the absence of KTA, enterprises with different treatment status D_i would on average *not* have experienced differential changes in labor productivity in the post-1932 period. As it would be naïve to think that North American Finns were randomly assigned to enterprises, we pay particular attention to pre-specification test and the event-study estimation that allow us to use the pre-1933 data to assess the validity of the identifying assumption by looking for differential trends prior to the North American Finns' placement to Karelian enterprises. The results below reassuringly show little evidence of such pre-existing trends, lending support to our key identifying assumption.

4.2 Exogenous Variation from Secret Police Directives

In Section 2.2.2, we document that the foreign workers were assigned to enterprises and locations by the Settlement Administration and entered the Soviet Union via enterprise-sponsored visas. This circumstance strongly limited their self-selection to specific industrial sites. However, the assignment of foreign workers to enterprises could be correlated with time-varying enterprise-specific factors that are unobserved to the researchers but associated with labor productivity, which would bias our estimates of β in equations (1) and its variants. Another potential source of bias is that we are not able to link all foreign workers included in the Settlement Administration records to Soviet enterprises due to missing information of establishment assignment, which could generate estimates of β attenuated towards zero. To address these concerns, we take advantage of a source of exogenous variation, namely the state security considerations that as such are arguably orthogonal to labor productivity.

The recruitment of foreign workers faced strong opposition from the Soviet secret police, which in 1923-1934 was called the Unified State Political Administration (known by its Russian acronym, OGPU, which we will use hereafter). However, as discussed in Section 2.2.1, leaning towards the 1930 All-Union party decision to invite foreign experts and experienced workers, the Karelian government managed to persuade the Communist leadership in Moscow that the recruitment of North Americans would contribute to the economic develop-

ment of the region and help to finance the First Five-Year Plan (Gelb, 1993; Takala, 2002). Despite the central government's approval, the local OGPU office in Leningrad (under which Karelian affairs were subordinated) persisted in opposing the recruitment plans and issued directives of how a potential settlement, if any, should be implemented. According to these directives no North American Finns would be allowed to settle in the proximity to the White Sea Canal construction which exploited forced labor or in the Kemi and Uhtua sub-districts due to the strategic importance of the Uhtua road and the Kemi harbor (Takala, 2002, p. 28). Even though the compliance by the Karelian government and the Settlement Administration with these OGPU directives was only partial (presumably because Moscow never formally authorize them), we exploit these directives to construct an instrument based on this source of exogenous variation in the enterprises to which North American Finns were assigned. The secret police settlement directives concern Karelia only; the Northern Region was closed for North American Finns by design of KTA, which was confined to enterprises within the Autonomous Republic of Soviet Karelia.[23] Accordingly, to extend our instrument beyond the Karelia border, we treat the Northern Region as subject to the same effective restriction.

5 Results

This section presents the empirical analysis of the effects of North American technical assistance and technology transfer under KTA on labor productivity in the interwar USSR. We exploit the variation in assignment of North American experts and technology to enterprises and in the labor productivity of Soviet enterprises between 1925 and 1940.

5.1 Two-Way Fixed Effects Results

Panel A of Table 2 presents the two-way fixed-effects (TWFE) results for all wood processing firms in Karelia and the Northern Region between 1925 and 1940 (baseline sample), as well as for three alternative samples – firms located within the 150 km railway band, the sample extended to include Leningrad Region enterprises, and the within-Karelia sample. All columns suggest that North American technical assistance and technology transfer had a statistically significant effect on labor productivity in treated enterprises, and the magnitude of the effects is similar across specifications. Taken at face value, the estimate of the key parameter β in the baseline sample (column 1) implies that on average, the presence of North

[23]The New York office of Intourist, the Soviet Union's travel agency, handled recruitment to other parts of the Soviet Union, but there is no evidence of any project in the Northern Region that contracted North American technical assistance (Sutton, 1971).

American skilled workers and experts increased enterprises' labor productivity by roughly 59.5 log points or 81.3 percent.

Panel B of Table 2 investigates whether any differential growth in labor productivity between treated and control enterprises was present in 1932, before KTA gained full momentum. Our pre-specification test shows no detectable differential pretrends in any of the four samples: the coefficient on the interaction term reflecting exposure to KTA in 1932 is positive but statistically insignificant, while the main coefficient of interest remains positive, highly statistically significant, and broadly stable across samples.

Table 2: Average Impact of Western Technical Assistance and Technology on Labor Productivity: Evidence from Karelian Technical Aid

	Dependent variable: $\log(\text{Labor productivity})_{it}$			
	(1)	(2)	(3)	(4)
	(1) Karelia & Northern R.	(2) 150 km railway band	(3) Incl. Leningrad	(4) Within Karelia
Panel A: Benchmark results				
$\text{POST}_t \times D_i$	0.595***	0.588***	0.597***	0.615***
	(0.136)	(0.151)	(0.135)	(0.152)
	[0.172]	[0.171]	[0.173]	[0.141]
Observations	1,904	986	2,184	315
Number of enterprises	710	321	838	93
Panel B: Pre-specification test				
$\text{POST}_t \times D_i$	0.704***	0.753***	0.705***	0.784***
	(0.204)	(0.233)	(0.203)	(0.237)
	[0.147]	[0.170]	[0.149]	[0.204]
$d_{1932} \times D_i$	0.162	0.259	0.161	0.411
	(0.246)	(0.275)	(0.244)	(0.324)
	[0.164]	[0.178]	[0.165]	[0.281]
Observations	1,904	986	2,184	315
Number of enterprises	710	321	838	93

Notes: OLS estimates of eq. (1) for 1925–1940. The dependent variable is log output per worker (in 1926/27 rubles). Columns use different samples: (1) Baseline (Karelia and Northern Region; Table 1); (2) Railway (Table 1); (3) Extended (+ Leningrad; Table A.1); and (4) Within-Karelia (treated vs. untreated Karelian enterprises; Table A.1). Panel A reports baseline results; Panel B adds a $d_{1932} \times D_i$ pretrend interaction. $POST_t$ is an indicator for 1933–1940; D_i indicates whether North American Finns were present within 15 km of the enterprise by 1933. All regressions include enterprise and year fixed effects. Additional controls include a Karelia × post-Five-Year-Plan indicator (except column 4), and a distance-to-Gulag second-order polynomials, which we also interact with the post-1928 indicator. In column 3, the reference group is extended to the Leningrad region, and the first five-year plan is allowed to affect productivity differently in all three regions. Standard errors clustered by enterprise in parentheses; Conley standard errors (250 km cutoff; 30 km in column 4) in brackets. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Figure 2 reports the TWFE event-study coefficients for each calendar year, relative to 1932, in the baseline sample of wood processing enterprises in Karelia and the Northern region. This allows a further investigation of the identifying assumption as well as an examination of the timing and persistence of the labor productivity response to KTA. The results indicate that enterprises that were exposed to North American Finns did not experience a significant change in labor productivity in the years before KTA relative to enterprises that did not receive any technical assistance—for instance, ruling out concerns that the earlier arrival of "Red Finns" (who were mostly politicians rather than technical experts) in the early 1920s may have generated differential trends between the two groups. The large differences in labor productivity between treated and untreated enterprises materialize from 1933 onward, i.e., next year after the recruitment of North American Finns gained it full momentum, with the annual point estimates being statistically significant at least at the 10% level. Given that the pretrend estimates are close to zero in magnitude and are neither individually nor jointly statistically different from zero, we interpret our event-study results as causal evidence that North American technical assistance and technology transfer increased enterprises' labor productivity in the Soviet wood processing industry.

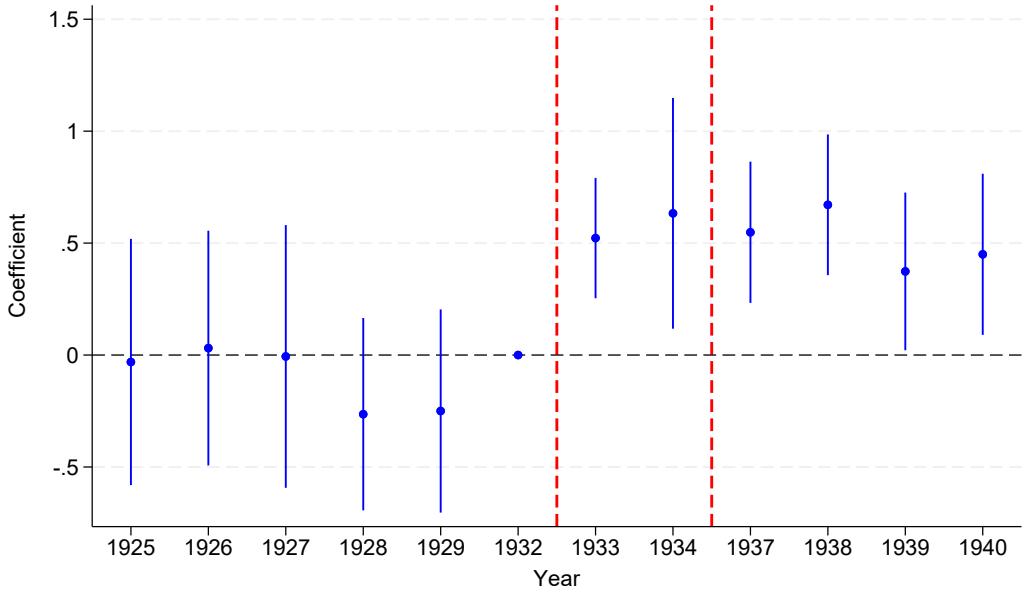
To explore the potential crowding-out effect channeling resources from non-treated to treated enterprises within the wood-processing industry, we plot raw averages of labor productivity in the two groups in the baseline sample in Appendix Figure B.3. Compared to the stagnant 1920s, both groups of enterprises substantially raised output per worker by the end of the 1930s, but in control enterprises this boost was delayed and remained on a slower growth path. This pattern provides little evidence of a crowding-out effect in the wood processing industry in the 1930s. Note, however, the decline in average labor productivity in non-treated wood processing enterprises in 1934, which does not allow us to exclude short-term crowding out across wood processing enterprises in the initial phase of KTA.

We address the possibility of a crowding-out effect between industries within Karelia in Appendix Figure B.4. We plot raw averages of labor productivity in Karelian enterprises excluding the wood processing industry and use the All-Union industrial labor productivity series, constructed from formerly classified Soviet archival materials, as a rough benchmark.[24] The figure, which also plots the Karelian wood-processing trend for reference, shows little sign of crowding out. Labor productivity outside wood processing in Karelia and in Soviet industry on average follows similar dynamics, with a decline during the first Five-Year

[24]Data limitations prevent us from excluding either Karelia or the wood processing industry from the All-Union aggregate data. Their influence is nevertheless modest as Karelian industrial workers account for less than one percent of the All-Union industrial labor force, and the wood processing industry accounted for roughly 19% of industrial workers in the Soviet Union in 1936 (TsUNKhU, 1936).

Plan (1928-1932) and a rapid increase thereafter. The one exception is 1933, the first post-intervention year, when only Karelian non-wood industry continues to decline — possibly reflecting a short-term diversion of resources toward treated enterprises upon the specialists' arrival, such as a temporary reallocation of consumption goods away from workers in untreated industries.

Figure 2: TWFE Event-Study Estimates of Western Technical Assistance and Technology on Labor Productivity in Wood Processing Industry



Notes: The figure plots TWFE event-study coefficients relative to 1932, with 90% confidence intervals, estimated on the baseline sample—Karelia and the Northern Region ($n = 1904$)—from a variant of eq. (1) in which D_i is interacted with a full set of year dummies (1932 omitted) rather than a single post-period indicator. The dependent variable, fixed effects, controls, and clustering are as in column (1) of Table 2. The dashed red lines mark mid-1932 to mid-1934, when the North American Finns were most intensively engaged. The p-value for the joint test that the pre-1933 coefficients are zero is 0.64.

5.2 Instrumental-Variable Results

In Section 2.2.2, we document that the foreign workers were assigned to enterprises and locations by the Settlement Administration and entered the Soviet Union via enterprise-sponsored visas. This circumstance strongly limited their self-selection to specific industrial sites. However, assignment of foreign workers to enterprises could be correlated with time-varying enterprise-specific factors that are unobserved to the researchers but associated with labor productivity which would bias our estimates of β in equations (1). Another potential source of bias is that we are not able to link all foreign workers included in the Settlement

Administration records to Soviet enterprises due to missing information of establishment assignment, which could generate estimates of β attenuated towards zero. To address these concerns, we take advantage of a source of exogenous variation, namely the state security considerations that as such are arguably orthogonal to labor productivity.

Panel A of Table 3 reports the (2SLS) estimate of β_{it}^{IV} in our baseline sample and three additional samples. The coefficient is stable in magnitude across all samples and similar to those we find in Panel A of Table 2: it is about 15% smaller in the baseline sample and the sample extended to the Leningrad region, and slightly larger in the railway and within-Karelia samples. While our estimate of β_{it}^{IV} in the within-Karelia sample — where, as we show below, the instrument is comparatively weak — is imprecise, taken together our estimates of β_{it}^{IV} corroborate our TWFE estimates in Panel A of Table 2, suggesting that neither attenuation from measurement error nor upward bias from time-varying, enterprise-specific unobserved factors is driving our results.

Table 3: IV Estimates of the Effect of Western Technical Assistance and Technology on Labor Productivity

	Dependent variable: $\log(\text{Labor productivity})_{it}$			
	(1) Karelia & Northern R.	(2) 150 km railway band	(3) Incl. Leningrad	(4) Within Karelia
Panel A: Second stage				
$\text{POST}_t \times D_i$	0.509*	0.591**	0.511*	0.660
	(0.268)	(0.285)	(0.265)	(0.648)
	[0.259]	[0.269]	[0.257]	[0.576]
VtF 95% confidence interval	-0.005; 1.022	0.053; 1.129	0.003; 1.018	-0.495; 1.930
Observations	1,904	986	2,184	315
Panel B: First stage. Dependent variable: $POST_t \times D_i$				
$\text{POST}_t \times \text{Settlement prohibition}_i$	-0.698***	-0.705***	-0.705***	-0.305***
	(0.072)	(0.085)	(0.072)	(0.099)
	[0.079]	[0.100]	[0.075]	[0.123]
Kleibergen–Paap rk Wald F	92.70	69.22	96.32	9.45
Observations	1,904	986	2,184	315

Notes: The dependent variable is log of output per worker in 1926/27 prices in rubles. The table reports two-stage least squares (2SLS) estimates of eq. (1), instrumenting the presence of North American Finns with the secret-police settlement restrictions described in Section 4.2. Each column corresponds to one of the four estimation samples defined in the notes to Table 2; the time-varying enterprise-level controls are likewise those listed there. The data cover 1925–1940, and all regressions include enterprise and year fixed effects. POST is an indicator for the years 1933–40, and D_i indicates whether North American Finns were present within 15 km of the enterprise by 1933. Standard errors clustered at the enterprise level are in parentheses; Conley standard errors adjusting for two-dimensional spatial dependence with a 250 km cutoff (30 km in column 4), are in brackets; and VtF 95% confidence intervals are the valid-t-ratio intervals of Lee et al. (2023), which adjust IV inference for first-stage strength. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The first stage of the instrumental-variables approach, reported in Panel B of Table 3, documents strong instrument relevance. The Kleibergen-Paap F-test statistic in column 1 reaches 92.7, well above conventional thresholds, alleviating concerns about weak-instrument bias. Instrument strength is naturally more limited within the Karelia-only sample, reflecting a number of enterprises more than six times smaller than in the baseline sample: the first-stage F-statistic is 9.5, below the level needed for weak-instrument-robust inference at conventional tolerances. Even so, the relationship between the instrument and the instrumented variable remains negative and significant at the 1% level in this sample. This is consistent with reduced power in the most geographically restrictive cut of the data rather than a failure of the instrument itself, since the first stage is comfortably strong in the less restrictive samples of columns (1)-(3), where the F-statistic exceeds 65.

The reduced-form relationship between our instrument based on secret police directives of settlement and labor productivity is negative and statistically significant at 10% level, the coefficient (standard error) of interest is -0.355 (0.192) in the baseline sample. To address the concern that our instruments might have a direct effect on labor productivity, we show correlations between the instruments and a range of enterprise-level variables from the 1920s in Panel A Table A.4. By 1929, wood processing enterprises affected by the secret police directives were not more capital-intensive, larger, older, or closer to power plants, nor did they have a higher total payroll or more total labor-days worked.

Finally, a discussion on causality of our estimates is warranted. The extent to which it is even meaningful to think of an RCT as the ideal design to approximate as closely as possible is debatable in quantifying efficacy of industrial policy (Juhász et al., 2024a; Giorcelli and Li, 2026; Lane, 2025). Our estimate of β of our main estimating equation (1) identifies the average treatment effect on the treated (ATT), which is particularly policy relevant in our context. KTA was in the first place intended to ameliorate the skill shortage and acute productivity deficiencies of the enterprises that it targeted. In the recruitment of foreign experts, Karelian leaders were strategically promoting a specific industry and, within it, likely placed foreign workers with precision to enterprises that were expected to capitalize on new knowledge. Causal analysis in such a context of heterogeneous treatment effects (Heckman et al., 2006), calls for a design that would allow for the estimation of local average treatment effects. However, Heckman et al. (1998) show, as Lane (2025) has recently pointed out in the context of sectoral industrial policy, that if selection on enterprises' expected responses remains constant over time, then common trends assumption will, if being satisfied, allow for placing a causal interpretation on the difference-in-difference estimator. We find it unlikely that, in a relatively rigidly planned context, selection on expected responses would have

changed over time, but cannot fully exclude Karelian policymakers' updating of priors.

5.3 Robustness

Our main findings of a large, statistically significant, positive effect of North American technical assistance and technology transfer on wood-processing labor productivity have thus far been shown to be robust to our prespecification tests and across both TWFE and IV estimation strategies. We show next that they remain robust to a variety of modifications of the baseline specification. Appendix Table A.5 documents, using a continuous difference-in-differences design, that our main results remain broadly robust to marginal rather than discrete changes in treatment, although the estimates are less precise — understandably so, given that we cannot geolocate many individuals.[25] These results are also robust to using secret police settlement restrictions to instrument the continuous measure of treatment intensity rather than the binary presence indicator (Table A.6): the second-stage estimates are positive and broadly consistent with the corresponding OLS results, though the first stage is necessarily weaker, since the secret police restrictions governed whether foreign specialists could be assigned to a location rather than how many were assigned—so the instrument predicts the extensive margin more strongly than the intensive one.

Further, Appendix Table A.7 demonstrates that our results remain robust to the exclusion of controls, a linear functional form, alternative approaches to cluster standard errors, the choice of radius length used to define geographical reach of exposure, and regional restrictions. The magnitude of the coefficient of interest is stable. Thus, Panel A of Appendix Table A.7 shows that excluding all control variables for concurrent policies, the treatment effect becomes only eight percent smaller than in the baseline specification.

We also repeat the exercises reported in our benchmark Table 2 for all industries, using data on enterprises of all industries, not just wood processing enterprises.The results, presented in Table A.8, are weaker. While the main finding holds, the magnitude is smaller, and the results do not pass the prespecification test: the main coefficient of interest remains positive but becomes insignificant once we account for potential confounding factors affecting treated enterprises in 1932. This is understandable, given that the KTA program focused on the wood-processing industry, whereas our treatment measure is based on the geographical presence of American Finns, so the all-industries sample's treatment group includes enterprises outside KTA's targeted industries, diluting the estimated effect.

[25] Continuous treatment difference-in-difference designs require a stronger parallel-trends assumption to rule out selection bias (Callaway et al., 2024).

Lastly, we estimate effects on total factor productivity (TFP). Appendix Table A.9 finds a positive effect of the American technical assistance and technology transfer on log industrial output in the TWFE design, controlling for labor and capital inputs (also in logs). The effect is imprecisely estimated in the within-Karelia sample, which has the smallest number of observations. Unfortunately, we do not have information on intermediate inputs, such as materials or fuel, to implement more sophisticated TFP estimation methods.

5.4 Magnitude in Context

How do the productivity gains of KTA compare to similar policies? Our ATT estimates appear larger relative to other studies quantifying effects of industrial policy. Giorcelli and Li (2026) study a similarly motivated state-led intervention to transfer technology and know how from Soviet Union to the People's Republic of China, though in the context of more capital-intensive and more technologically advanced heavy steel industry, and in enterprises roughly ten times larger than those in our data; the authors find a total factor productivity increase of 15% six years after the initiation of the transfer, with larger effects over the longer run. In a recent paper, Lane (2025) finds that, in South Korea's 1970s state-led heavy industry drive, which combined investment incentives with trade policy, labor productivity in treated industries increased by about 15%, with effects materializing roughly in five years. The magnitude of our estimates is also notably larger than typical average treatment effects (5–10%) found in experiments on worker training and firm performance in the contemporary development context (McKenzie, 2021). At the higher end, two recent experimental studies — Bloom et al. (2013) and Iacovone et al. (2022) — evaluate extensive management training and find effects of roughly 10–17 percentage points on total factor productivity and labor productivity. As in our setting, both studies focus on small and medium-sized firms.

Several features of our setting likely contribute to the size of the effect. The intervention itself was unusually intensive: the Soviet practice of contracting foreign specialists for relatively long terms (two years) and deploying them directly in enterprises' operations, alongside group training, allowed for sustained on-the-job transmission of tacit knowledge—the returns to which are especially large in a low-technology industry. The setting was also well suited to absorbing what the specialists taught. Much of the local workforce shared a language with the North American Finns and benefited from a rapidly expanding elementary education system. We show in the next section that these channels were indeed at work. Finally, the technological gap between the technological frontier and the Soviet wood processing industry was wide, leaving substantial room for catch-up.

Indeed, in the 1920s, the wood processing industry in the U.S. experienced the highest TFP growth of any period in the last century, with average annual rates of 2.5% to 4.5%, translating into cumulative growth of 28% to 55% over the decade, depending on the subsector (Field, 2011). In contrast, having already lagged behind before 1917, the Soviet economy collapsed during the Civil War and managed to recover to the 1913 level only by 1928 (Markevich and Harrison, 2011). Soviet officials illustrated this productivity gap in the early 1930s by pointing to the share of kiln-dried lumber in the Soviet Union (1%) as compared to the West (more than 60%) (Sutton, 1968, p. 160). More directly, a 1931 Soviet book (Gerbek, 1931, pp. 82-3, 110), prepared by a Soviet commission that visited the U.S. to study the forestry and wood processing industry, explicitly compares labor costs in the two countries and finds Soviet labor costs to be at least four times the U.S. level. Moreover, at the outset of the First Five-Year Plan, Karelia was not a national timber champion; labor productivity in the wood processing industry stood at 89% of the All-Union average in 1925 (SSSR, 1927a,b). Studies conducted at Karelian research stations show manyfold rapid productivity gains from the methods and inputs introduced by North American Finns (Appendix Table E.1). The large effect we find is also consistent with wood processing being among the fastest-growing sectors of Soviet industry in the early 1930s (Popov, 1957, Vol. 1, p. 69).

6 Drivers of Firm-Level Upgrading

The results in the previous sections show that the effect of North American experts on labor productivity in the wood processing industry was substantial. As the wood processing workforce in Karelia comprised roughly 64,000 individuals in 1932 and was rapidly growing, the North American workers accounted for at most eight percent of employees. It is therefore clear that the substantial increase in labor productivity induced by the North Americans, and its persistence after their departure, could not be explained by a productivity differential between local and foreign workers. Rather, the evidence suggests that the foreign specialists were successful in instructing and training the local workforce, as well as in mechanizing production and introducing technologies. This section takes a closer look at potential drivers behind the causal effect of KTA. We implement this analysis using the baseline sample of wood processing enterprises in Karelia and the Northern Region.

6.1 Tacit Knowledge

A first question is which of the two channels of KTA drove the productivity gain. The program combined technology transfer—the imported machinery the enterprises installed and put in operation—with technical assistance—the work methods and know-how that North American Finns conveyed to local workers. Both were present by design, and the effect we document could in principle operate through either. Because we observe the enterprise capital stock, which directly captures the imported and domestic equipment, we can separate the two: conditioning on capital holds the embodied-technology channel fixed and isolates what the specialists contributed beyond it. Column 1 of Table 4 does exactly this; the coefficient on $\text{POST}_t \times D_i$ remains positive and significant at the 1% level, while being only about twenty-five percent smaller than the baseline estimate in column 1 of Table 2. This indicates that the productivity gain is only partially driven by the physical capital operated by the enterprises, but mostly by the non-embodied contribution of the program—the work methods and tacit knowledge that the specialists imparted on the shop floor.

Table 4: Drivers of Firm-Level Upgrading: Physical Capital and Electrification

	Dependent variable: $\log(\text{Labor productivity})_{it}$			
	(1)	(2)	(3)	(4)
$\text{POST}_t \times D_i$	0.456***	0.419***	1.419***	1.038**
	(0.134)	(0.146)	(0.535)	(0.468)
	[0.133]	[0.109]	[0.277]	[0.429]
$\log(\text{Capital per worker})_{it}$	0.175***	0.122***		0.126***
	(0.036)	(0.043)		(0.043)
	[0.032]	[0.031]		[0.032]
$\text{POST}_t \times D_i \times \log(\text{Capital per worker})_{it}$		-0.149*		-0.118
		(0.089)		(0.098)
		[0.064]		[0.072]
$\text{POST}_t \times D_i \times \text{Access to electricity}_i$			-1.002*	-0.676
			(0.558)	(0.472)
			[0.292]	[0.437]
Observations	1,550	1,550	1,550	1,550
Number of enterprises	620	620	620	620

Notes: The dependent variable is log of output per worker in 1926/27 rubles. The table reports OLS estimates. All four columns use the baseline sample—enterprises in the wood processing industry in Karelia and the Northern Region—conditioned on non-missing annual capital stock, otherwise identical to that in column (1) of Tables 2 and 3. All regressions include enterprise and year fixed effects and the same time-varying enterprise-level controls as in Table 2. POST_t is an indicator for the years 1933–40, and D_i indicates whether North American Finns were present within 15 km of the enterprise by 1933. Access to electricity is an indicator for the enterprise being connected to the electricity network (proxied by being located ≤15km from a power station in 1933). Log of Capital per worker is demeaned by deducting the sample average from each individual observation. Standard errors clustered at the enterprise level are in parentheses; Conley standard errors adjusting for two-dimensional spatial dependence with a 250 km cutoff are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Two further contrasts in Table 4 sharpen this reading. The triple-difference term interacting the treatment with capital per worker is negative (column 2), as is the interaction with an indicator for access to the electricity network (column 3): the gains from technical assistance were smaller precisely where physical technology was most present. Electrification was the general-purpose technology transforming wood processing in the interwar period; as a homogeneous good, it raised productivity via capital accumulation rather than through transferred know-how. The Soviet government had, since the early 1920s, actively promoted a nationwide electrification campaign (the 1920 GOELRO plan); yet, because electricity was not transmitted over long distances at the time, only enterprises located near a power plant had access to it. Such enterprises had therefore already captured much of the gain available from this general-purpose technology, leaving less scope for the specialists to raise productivity further. We cannot fully distinguish between local electricity networks and other forms of capital: in column (4), we include both triple interactions—with capital and with proximity to a power plant—and both coefficients are negative, though statistically significant only jointly ($p = 0.042$) and not individually. The pattern is nonetheless consistent throughout: where machinery did most of the upgrading, the North American Finns added little at the margin, and where it did the least, they added the most.

The heterogeneity across stages of the wood-processing chain (Table 5) points the same way. Here we interact the treatment with dummies for an enterprise's sub-industry, restricting attention to sub-industries with more than fifty enterprises in our dataset. In Karelian forestry—the extractive base of the industry—the differential is close to zero. Given the large baseline effect, this implies a productivity gain roughly equal to the sample average, rather than the absence of a gain. This is consistent with electricity having played little role in logging at the time: although the electric chainsaw existed, its use in Soviet forestry was constrained by the lack of on-site electrical infrastructure (Shegel'man, 2008, p. 52). The effect is attenuated in sawmilling, the most capital-intensive stage, where mechanization and electrification, rather than craft knowledge, drove upgrading—especially in sleeper sawing (Lesnaya promyshlennost', 1947, Vol. 2, p. 55)—in keeping with the capital and electricity contrasts above. It is amplified, by contrast, in the manufacture of advanced wood products—plywood, furniture, boxes, barrels, and other wood goods—the highest-value and most skill-intensive stage of the chain, where the time- and place-specific innovations—the pressing of dry plywood, the standardized production of furniture and wood components (Zinov'ev, 1947; Popov, 1957)—depended on exactly the kind of tacit, practical knowledge that does not travel embodied in a machine.[26] The productivity gain is largest, that is, not

[26] In the early 1930s, labor productivity growth across sub-sectors of the Soviet wood processing industry

where capital is greatest but where skilled technique matters most, locating the source of the effect in the transfer of knowledge and work methods rather than equipment.

Table 5: Heterogeneity by Wood Processing Sub-Industry

	Dependent variable: log(Labor productivity)$_{it}$		
	(1)	(2)	(3)
$\text{POST}_t \times D_i$	0.479***	0.891***	0.441***
	(0.147)	(0.177)	(0.156)
	[0.145]	[0.219]	[0.217]
$\text{POST}_t \times D_i \times$ Forestry	0.0130		
	(0.195)		
	[0.116]		
$\text{POST}_t \times D_i \times$ Sawmilling		-0.560**	
		(0.219)	
		[0.167]	
$\text{POST}_t \times D_i \times$ Advanced Wood Processing			0.843***
			(0.320)
			[0.226]
Observations	1,904	1,904	1,904
Number of enterprises	710	710	710

Notes: The dependent variable is log of output per worker in 1926/27 rubles. The table reports OLS estimates on the baseline sample—enterprises in the wood processing industry in Karelia and the Northern Region—as in column (1) of Tables 2 and 3. All regressions include enterprise and year fixed effects and the same time-varying enterprise-level controls as in Table 2. POST_t is an indicator for the years 1933–40, and D_i indicates whether North American Finns were present within 15 km of the enterprise by 1933. Each column adds a triple interaction of $\text{POST}_t \times D_i$ with a dummy for sub-industry: *Forestry* (logging and timber extraction), *Sawmilling* (primary conversion of logs to sawn timber), and *Advanced Wood Processing* (more processed products further along the wood-processing value chain). Standard errors clustered at the enterprise level are in parentheses; Conley standard errors adjusting for two-dimensional spatial dependence with a 250 km cutoff are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6.2 Skill Upgrading and the Local Training System

A distinctive feature of our setting is that we observe not only the foreign specialists but the full human-capital infrastructure of the localities into which they were sent, spanning literacy and elementary schooling at its base, through the schools of factory and plant apprenticeship, to the technicums and higher-education institutions at its apex. This lets us go beyond asking *whether* technical assistance mattered and instead situate the on-the-job training provided by the North American Finns within the formal system of labor-force upgrading already in place. We build up this picture one tier at a time.

in general follows the same ranking, rising from sawmills to forestry to furniture (NKLes, 1935).

6.2.1 Elementary Schooling and Language

At the base of the training system is elementary education. Because formal schooling in this period consisted overwhelmingly of elementary education—primary education was rapidly universalized under the Soviet literacy campaign, while secondary and higher education remained rare (Eklof, 1986)—literacy in the local population is a natural proxy for elementary human capital. Literacy was also low—below 50% in both Karelia and the Northern Region in 1926—leaving ample room for variation across localities. However, elementary human capital raises the return to technical assistance only if it can be put to use, and in this setting a shared language was a precondition for its transmission. A recent literature stresses that the absorption of the tacit knowledge underlying new technology runs through instruction (Giorcelli, 2019; Giorcelli and Li, 2026; Juhász et al., 2024b), and experimental evidence on contemporary multinationals shows that language barriers impede communication between foreign and native personnel (Guillouët et al., 2024). Our enterprises, averaging some three hundred workers, were smaller and more hands-on than the multinationals, but the introduction of new methods and organizational practices still required unhindered communication on the shop floor.

The North American specialists were native Finnish speakers with little or no Russian. As described in Section 2.1, the population of Karelia was split almost evenly between Russians and Finno-Ugric peoples; few Russian residents had acquired Finnish by the early 1930s, whereas Karelians and other Finno-Ugric speakers could communicate directly with the North American Finns. We therefore measure two features of the local labor force at the sub-district level, both from the 1926 population census: literacy rate, as a proxy for elementary human capital, and the share of Finno-Ugric speakers, as a proxy for the absence of a language barrier between the specialists and the local workforce.

Columns 1 and 2 of Table 6 interact the treatment term $\text{POST}_t \times D_i$ with each of these measures in turn.[27] Entered on its own, neither interaction is statistically significant: the share of Finno-Ugric speakers in column 1 and the literacy rate in column 2 are each positive but imprecisely estimated. This changes, however, once they are entered jointly in column 3, where both triple-difference terms are positive and significant. A larger share of Finno-Ugric speakers—and hence a lower language barrier—amplifies the productivity gains, and so, independently, does a higher local literacy rate. A one standard deviation increase in the share of Finno-Ugric speakers (0.21) raises the treatment effect by $0.21 \times \beta_{\text{F-U}} = 0.214$ log points; a one standard deviation increase in the literacy rate (0.11) raises it by $0.11 \times \beta_{\text{lit}} =$

[27] Unlike literacy, the share of Finno-Ugric speakers is not demeaned, as it is zero in many sub-districts.

0.272 log points. Reading a causal interpretation into these triple-difference terms requires assuming that no factor other than the interacted characteristic generates differential trends in enterprise labor productivity. Further, as the coefficient on the double interaction in column 3 shows, the effect of KTA for an enterprise from a district with no Finno-Ugric speakers and the sample-mean 1926 literacy rate is about half the average effect estimated in our baseline specification. Taken together, these results indicate that elementary schooling and the ability to communicate with instructors operate as distinct, complementary channels: the first builds the capacity to absorb new methods, the second opens the channel through which they are conveyed.

Table 6: Drivers of Firm-Level Upgrading: Language, Literacy, and Training Institutions

	Dependent variable: $\log(\text{Labor productivity})_{it}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{POST}_t \times D_i$	0.461***	0.594***	0.299**	0.700***	0.658***	0.469***
	(0.134)	(0.144)	(0.135)	(0.149)	(0.172)	(0.156)
	[0.113]	[0.193]	[0.146]	[0.218]	[0.209]	[0.191]
$\text{POST}_t \times D_i \times$ Finno-Ugric language$_r$	0.506		1.017**			1.092***
	(0.340)		(0.410)			(0.413)
	[0.299]		[0.257]			[0.338]
$\text{POST}_t \times D_i \times$ Literacy pc$_r$		0.0572	2.470*			3.346**
		(1.112)	(1.261)			(1.484)
		[0.986]	[1.053]			[1.713]
$\text{POST}_t \times D_i \times$ Factory training school$_i$				-0.756***		-0.808***
				(0.197)		(0.181)
				[0.295]		[0.169]
$\text{POST}_t \times D_i \times$ Higher vocational & general education$_r$					-0.229	-0.336
					(0.255)	(0.261)
					[0.217]	[0.160]
Observations	1,904	1,904	1,904	1,904	1,904	1,904

Notes: OLS estimates on the baseline sample (wood processing enterprises in Karelia and the Northern Region), as in column (1) of Tables 2 and 3. The dependent variable, fixed effects, time-varying controls, POST_t, and D_i are as in Table 2. Each column interacts $\text{POST}_t \times D_i$ with measures of the local training and human-capital environment: the district (r) shares speaking a Finno-Ugric language and literate per capita, and indicators for a factory training school (F.Z.U.) in connection to the enterprise (i) and a technicum or higher-education institution in the district (r). Because these institutions were not randomly placed, their interactions describe how the program's effect covaried with local training provision rather than identifying the institutions' causal effect. Standard errors clustered at the enterprise level are in parentheses; Conley standard errors with a 250 km cutoff are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6.2.2 The Formal Training Tiers: Apprenticeship and Beyond

Above elementary schooling sat the formal apparatus of vocational and higher education. Here our data let us do what evaluations of a single training program cannot: with information on the apprenticeship factory training schools (F.Z.U.), technicums, and higher-education institutions that existed by the beginning of 1933, we observe the foreign specialists' training within the local system it coexisted with, rather than as an isolated intervention.

Columns 4 and 5 interact the treatment $\text{POST}_t \times D_i$ with the presence of, respectively, a factory training school in the enterprise and a higher vocational or general education institution in the enterprise's settlement. The factory-training-school interaction is negative and significant, roughly offsetting the baseline effect: where such schools were already present, the North American Finns had no additional effect on labor productivity. The interaction with higher and general education, by contrast, is small and insignificant. The asymmetry is telling. Factory apprenticeship and on-the-job instruction by foreign experts are two routes to the same end—a skilled shop-floor workforce; higher education produces skills that are only deployed in the higher segments of the hierarchy of wood processing and rarely at the plant level; the presence of such institutions therefore neither substitutes for nor complements the foreign specialists' contribution. Column 6 confirms that these patterns hold together when all the measures are included at once.[28]

Taken overall, Table 6 places the foreign specialists within the local training system rather than treating their instruction as an isolated intervention. Elementary schooling and a shared language raise the return to the specialists' presence; an existing apprenticeship system substitutes for them. The upshot is that technical assistance by foreign experts operated as a fast, informal alternative to the formal apprenticeship track—reaching the same skilled-workforce objective through on-the-job training rather than multi-year schooling.

6.3 Alternative Pathways

The evidence so far attributes the productivity gain to the knowledge and work methods the North American Finns transferred, and to the local conditions that shaped how far that transfer went. A remaining concern is that the treatment effect is driven by alternative correlates of their placement—a locational advantage, access to coerced labor, access to information, or a political factor that happened to coincide with their arrival. We address

[28] Because the placement of factory training schools was not random, these interactions describe how the program's effect covaried with the local training system rather than identifying the causal effect of the institutions themselves.

these alternatives in Appendix Table A.10, which augments the baseline specification with the interaction of the initial level of each candidate channel with the post-period and a triple interaction with the treatment. Each channel variable is demeaned by its sample average. The triple-interaction coefficient—which would absorb the productivity gain if the effect operated through that channel—is small and insignificant in every column. Meanwhile, the coefficient on $\text{POST}_t \times D_i$ itself remains large, positive, and statistically significant.

We consider four alternative channels. The first channel concerns geography and market access. Enterprises near ports and railways, or better positioned to reach export markets, might have had stronger incentives to make effective use of technical assistance. Columns 1 and 2 of Table A.10 include additional interactions with the distance to the nearest port or railway and with a measure of market access, estimated as the minimal transportation cost to one of three major regional export ports — Arkhangelsk, Leningrad, and Murmansk.[29] Neither interaction is significant. The productivity gain is therefore not a repackaged return to location or trade access. This is to be expected in a planned economy with a state monopoly on foreign trade, under which the central government effectively appropriated any geography-driven premiums that would otherwise have accrued to individual exporters.

The second channel concerns access to forced labor. The baseline specification already conditions on proximity to the general network of Gulag forced labor camps and the major change in Soviet penal policy in 1929, but the Karelian setting featured two further concentrations of coerced labor that could have supplied enterprises near them: the forced-labor settlements of illegal Finnish immigrants, and the labor complex of the White Sea Canal, whose construction employed many thousands of prisoners over the sample period. Columns 3 and 4 of Table A.10 interact the treatment with the distance to each; in neither case is the interaction significant, indicating that the productivity gain is not a return to the availability of Karelia-specific forms of coerced labor.

The third channel concerns the flow of information. If the arrival of the North American Finns coincided with a broader diffusion of ideas or practices, the effect might reflect exposure to new information rather than the specialists' instruction. Column 5 of Table A.10 interacts treatment with newspapers per capita in the district, a proxy for the local circulation of information; the interaction is small and insignificant. Because of data limitations, this column is estimated on the Karelia-only sample; the number of observations is correspondingly

[29] Using historical per-ton-kilometer freight rates—1 kopeck by railway, 0.5 kopecks by river steamer, 1/16 kopeck by sea steamer, and 60 kopecks by dirt road (Baranskii, 1933)—we construct relative cost weights by mode of transport, normalized to sea transport (=1): railway = 16.0, river = 8.0, sea and coastal = 1.0, and overland = 960.

smaller, and the estimates should be read as suggestive.

The fourth channel concerns political connections. A prominent critique of industrial policy is the risk of *political capture*: that the benefits flow not to the most productive recipients but to the most politically connected (Juhász et al., 2024a). In our setting the concern is concrete—more politically connected enterprises might have lobbied the Settlement Administration to have North American specialists assigned to them, so that the productivity gain would reflect the rents of connection rather than the value of the assistance itself, and the policy, however productivity-enhancing, need not be socially optimal. We proxy an enterprise's political connectedness by the share of its workers who were members of the Communist Party, which averaged roughly 15%.[30] Column 6 of Table A.10 interacts the treatment with this share. The interaction is insignificant, offering no evidence that the productivity gain was captured by politically connected enterprises.

6.3.1 Who Participated, and Why?

A distinct concern is not that the effect operated through an enterprise-level channel, but that the recruits themselves were unrepresentative. Karelian Technical Aid was promoted in Finnish-language socialist newspapers and workers' halls across North America, and may have drawn ideologically motivated, left-leaning workers whose response to the program would not generalize. Historians conclude, however, that only a small fraction—roughly 15%—chose recruitment for political reasons, with economic and cultural forces dominating (Takala, 2004; Efremkin, 2011): employment in the regions and industries where Finnish immigrants were concentrated, such as the Great Lakes and the lumber industry, fell especially sharply during the Great Depression (Wallis, 1989).

Our linked data let us examine this directly. Matching the Karelian Settlement Administration records to the 1931 Canadian Census—which records individual annual earnings, allowing occupation fixed effects, unlike the imputed occupational averages of the 1930 U.S. Census—we find that Finns who chose to participate earned roughly 18% less than their within-industry ethnic counterparts (Appendix Table A.11), consistent with an economic rather than ideological rationale for leaving.[31] Relating state-level socialist-party membership among Finnish immigrants in the 1920s (Kostiainen, 1978) to the state-level share of

[30] These unusually detailed data are available only for a subset of Karelian enterprises and only for 1932, so the estimate should be read as suggestive.

[31] Re-running the exercise with imputed occupational median income (OCCSCORE) for both countries confirms that this differential is driven by within-industry, and even within-occupation, earnings variation; results available on request.

recruits (Appendix Figure E.1), we find a negative correlation in both measures: participants were not overrepresented where the local Finnish population was more politically organized.

7 Discussion

7.1 Cost-Benefit Analysis

Know-how and leading technology are almost always desirable to enterprises, but when acquired at market prices, their cost must be weighed against future gains. We evaluate the program against a counterfactual of no North American presence in Karelian wood processing in the early 1930s, comparing actual and counterfactual output and personnel costs; Appendix Section C gives the details behind these back-of-the-envelope calculations.

Holding capital and other inputs constant, output in the absence of the North American Finns would have been more than forty percent smaller, only partly offset by lower personnel costs (22.7%). Karelian Technical Aid was thus an efficacious industrial policy: it generated substantial surplus for the Soviet government—counterfactual surplus, revenue net of personnel costs, would have been about ninety percent smaller—and would have remained profitable even at 4.2 times the foreign workers' actual wages. Suggestively, our estimates imply the Soviets paid these workers competitive wages in source-country terms, consistent with the economic motivation for migration we document above.

The program also compares favorably with the Soviet apprenticeship schools. The wage premium for employing North American Finns was about 4.59% of total labor costs in Karelian wood processing, close to the 4% devoted to apprenticeship training—but once we adjust for the scale and duration of that training, its share rises to 7.7%, roughly 1.7 times higher than the cost of KTA.

7.2 Managerial Incentives

An aspect that warrants consideration in a paper that deals with enterprises in a command economy is the question of managers' objectives and whether they sought to maximize profit. The question extends to entrepreneurship in developing countries generally, where evidence remains scarce (Kremer et al., 2019; Verhoogen, 2023). The classic work on Soviet enterprise (Berliner, 1957; Gerschenkron, 1962) shows that managers ran an informal system alongside the formal one to keep production moving; archival evidence dates the principal-agent problem to the earliest days of the command economy (Gregory and Harrison, 2005).

Three circumstances nonetheless suggest managers responded to financial incentives. First, middle management and foremen were often paid piece rates (Schwarz, 1952): the emerging Karelian cadre of foremen trained in North American techniques were paid by the cubic meter of timber (Kero, 1983).[32] Second, with inputs temporarily fixed by plan, labor productivity was the parameter managers could most readily optimize in the short run, and target fulfillment earned bonuses (Berliner, 1957). A residual worry is that better-connected managers might have bargained for softer plans—but we find no difference in political connections between treated and untreated enterprises (Table A.10).[33] Third, managers might have prioritized hitting output targets over quality. But KTA carried heavy political capital at both central and local levels and was closely monitored, and much Karelian output served exports and foreign-currency earnings (Autio-Sarasmo, 2000); quality manipulation would soon have surfaced in complaints from foreign buyers.

7.3 Concluding Remarks

This study shows that Western technical assistance and technology transfer causally increased labor productivity in the wood processing industry during the Soviet Union's interwar industrialization drive. Specifically, our sectoral design isolates the effect for treated enterprises within one region. In this concluding section, we discuss the extent to which our results have predictive value more generally.

Thanks to KTA, the scale at which foreign experts were recruited to the Soviet Union was largest in Karelia. Yet, when comparing the share (roughly 4%) of North American specialists deployed in Karelian industrial projects with that in other industrial projects elsewhere in the Soviet Union, the numbers are fairly comparable. For example, the Stalingrad tractor plant, a flagship project, employed one American foreman for every 20 to 30 Russian workers (Dalrymple, 1966). While we cannot directly extrapolate our results to Western technical assistance outside the Soviet wood processing industry, we can speculate about long-term union-wide within-sector gains through successful diffusion of what colloquially became known as "North American methods."[34] In an economy reliant on foreign innovation, the extent and speed at which the economy adjusts to new technology are crucial.

[32]Piece rates were topped up with bonuses for fulfillment of the norm including a particular progressive booster on all output that exceeded the norm (Tonkel, 1932).

[33]Fulfillment of production targets and the exposure to Karelian Technical Aid are also not correlated in 1938, the only year, for which we observe production targets at the enterprise level (the regression results are available from the authors upon request).

[34]Note that labor productivity in Soviet industry broadly, as demonstrated by Figure B.4, started to grow rapidly in 1933, i.e., exactly after the peak period (1931-32) of technical assistance.

Studies in other contexts characterized by similar spatial frictions suggest that new knowledge takes many years to diffuse (Kantor and Whalley, 2019). While the Soviet Union was relatively good at distributing codified information on foreign techniques, it was much slower at adjusting equipment and input materials to these new ideas and upgrading the labor force (Sutton, 1973). If this pattern applies to KTA, the persistently lower labor productivity growth in non-treated wood-processing enterprises is thus likely due to a lack of necessary inputs rather than a shortage of formal information flows. In the long term, scaling up domestic equipment production through copying, together with the gradual spread of on-the-job training as skilled local foremen became more widely available, could have reduced these institutional barriers. We observe that, in 1959, labor productivity in the Karelian wood-processing industry was on par with that of two of three successor provinces of the former Northern Region, namely Arkhangelsk and Vologda (Kessler and Markevich, 2020). In the Komi Republic, the most remote province of former Northern Region relative to Karelia, labor productivity was still lagging behind, being one third lower than in Karelia. We take this as suggestive evidence of a diffusion process with spatial frictions.

Broadly, the Stalinist development strategy of aggressive emphasis on heavy industry and large industrial projects at the expense of the agricultural sector was arguably ill-suited to the country's comparative advantages. Even positive evaluations of Stalin's industrialization drive such as Allen (2003) highlight failures to modernize agriculture, which contributed to excess mortality in the millions during the 1932-1933 famine (Markevich et al., 2024). Nonetheless, certain components of the policies adopted during Soviet industrialization deserve closer scrutiny. As the case of KTA demonstrates, exploiting Western technical assistance and technology generated rapid economic improvement.

Many developing countries struggle with deficient labor force upgrading systems and are far from achieving technological convergence with the West. This makes understanding the efficacy of technical assistance a priority. As we have shown in this paper, exploiting diasporas of Western-educated experts in strategic sectors, coupled with inputs such as machinery imports and on-the-job training, can lead to large productivity gains. Market distortions aside, the fiscal cost of attracting foreign know-how may be an argument against such policies; contemporary approaches might nonetheless take advantage of push factors, just as the Soviets did during the Great Depression.

References

Allen, Robert (1997) "Agricultural Marketing and the Possibilities for Industrialization in the Soviet Union in the 1930s," *Exploration: in Economic History*, 34, 387–410.

Allen, Robert C. (2003) *Farm to Factory: A Reinterpretation of the Soviet Industrial Revolution*: Princeton University Press, http://www.jstor.org/stable/j.ctv1mjqtx0.13.

Amman, Ronald, Julian Cooper, and Robert Davies eds. (1977) *The Technological Level of Soviet Industry*, New Haven, Connecticut: Yale University Press.

Atkin, David, Azam Chaudhry, Shamyla Chaudry, Amit K. Khandelwal, and Eric Verhoogen (2017) "Organizational Barriers to Technology Adoption: Evidence from Soccer-Ball Producers in Pakistan*," *The Q. J. Econ.*, 132 (3), 1101–1164, 10.1093/qje/qjx010.

Autio-Sarasmo, Sari (2000) *Suunnitelmatalous Neuvosto-Karjalassa 1928-1941: Paikallistason Rooli Neuvostoliiton Teollistumisessa [Engl. Planned Economy in Soviet Karelia 1928-1941: The Role of the Local level in the Industrialization of the Soviet Union]*: Suomalaisen Kirjallisuuden Seura.

Bai, Jie, Panle Jia Barwick, Shengmao Cao, and Shanjun Li (2025) "Quid Pro Quo, Knowledge Spillovers, and Industrial Quality Upgrading: Evidence from the Chinese Auto Industry," *Am. Econ. Rev.*, 115 (11), 3825–52, 10.1257/aer.20221501.

Baranskii, Nikolai Nikolaevich (1933) *Ekonomicheskaya geografiya SSSR*, Moscow: Gosudarstvennoe uchebno-pedagogicheskoe izdatel'stvo, [Economic Geography of the USSR].

Bartik, Timothy J. (2020) "Using Place-Based Jobs Policies to Help Distressed Communities," *Journal of Economic Perspectives*, 34 (3), 99–127, 10.1257/jep.34.3.99.

Barwick, Panle Jia, Myrto Kalouptsidi, and Nahim Bin Zahur (2025) "Industrial Policy Implementation: Empirical Evidence from China's Shipbuilding Industry," *Rev. Econ. Stud.*, 92 (6), 3611–3648, 10.1093/restud/rdaf011.

Beaufils, Vincent and Johannes Tomin (2020) "Stochastic approach to worldwide language classification: the signals and the noise towards long-range exploration," socarxiv papers, https://doi.org/10.31235/osf.io/5swba.

Bergson, Abram (1953) "Reliability and Usability of Soviet Statistics: A Summary Appraisal," *The American Statistician*, 7 (3), 13–16, http://www.jstor.org/stable/2685494.

Berliner, Joseph S. (1952) "The Informal Organization of the Soviet Firm," *The Q. J. Econ.*, 66 (3), 342–365, 10.2307/1885308.

——— (1957) *Factory and Manager in the USSR*, Cambridge, MA: Harvard University Press.

——— (1976) *The Innovation Decision in Soviet Industry*, Cambridge, Massachusetts: MIT Press.

Bianchi, Nicola and Michela Giorcelli (2022) "The Dynamics and Spillovers of Management Interventions: Evidence from the Training within Industry Program," *J. Political Econ.*, 130 (6), 1630–1675, 10.1086/719277.

Bloom, Nicholas, Benn Eifert, Aprajit Mahajan, David McKenzie, and John Roberts (2013) "Does Management Matter? Evidence from India *," *The Q. J. Econ.*, 128 (1), 1–51, 10.1093/qje/qjs044.

Bruhn, Miriam, Dean Karlan, and Antoinette Schoar (2018) "The Impact of Consulting Services on Small and Medium Enterprises: Evidence from a Randomized Trial in Mexico," *J. Political Econ.*, 126 (2), 635–87.

Callaway, Brantly, Andrew Goodman-Bacon, and Pedro H. C Sant'Anna (2024) "Difference-in-differences with a Continuous Treatment," Working Paper 32117, NBER, 10.3386/w32117.

Carranza, Eliana and David McKenzie (2024) "Job Training and Job Search Assistance Policies in Developing Countries," *Journal of Economic Perspectives*, 38 (1), 221–44, 10.1257/jep.38.1.221.

Cheremukhin, Anton, Mikhail Golosov, Sergei Guriev, and Aleh Tsyvinski (2017) "The Industrialization and Economic Development of Russia through the Lens of a Neoclassical Growth Model," *Rev. Econ. Stud.*, 84 (2), 613–649.

Choi, Jaedo and Andrei A. Levchenko (2025) "The long-term effects of industrial policy," *Journal of Monetary Economics*, 152, 103779, https://doi.org/10.1016/j.jmoneco.2025.103779.

Colella, Fabrizio, Rafael Lalive, Seyhun Orcan Sakalli, and Mathias Thoenig (2023) "acreg: Arbitrary correlation regression," *The Stata Journal*, 23 (1), 119–147, 10.1177/1536867X231162031.

Criscuolo, Chiara, Ralf Martin, Henry G. Overman, and John Van Reenen (2019) "Some Causal Effects of an Industrial Policy," *Am. Econ. Rev.*, 109 (1), 48–85, 10.1257/aer.20160034.

Dalrymple, Dana G. (1966) "American Technology and Soviet Agricultural Development, 1924-1933," *Agricultural History*, 40 (3), 187–206.

De Loecker, Jan and Frederic Warzynski (2012) "Markups and Firm-Level Export Status," *Am. Econ. Rev.*, 102 (6), 2437–71, 10.1257/aer.102.6.2437.

Efremkin, Evgeny (2011) "Recruitment in North America: an Analysis of Emigrants to Soviet Karelia, 1931–1934," *Journal of Finnish Studies*, 15 (1-2), 103–125, 10.5406/28315081.15.1.2.08.

——— (2016) "At the Intersection of Modernities: Migrants as Agents of Economie and Cultural Chan," *Journal of Comtemporary History*, 51 (3), 531–554, 10.1177/0022009414564802.

Eklof, Ben (1986) *Russian Peasant Schools: Officialdom, Village Culture, and Popular Pedagogy, 1861–1914*, Berkeley: University of California Press.

Field, Alexander J. (2011) *A Great Leap Forward: 1930s Depression and U.S. Economic Growth*, New Haven and London: Yale University Press.

Fitzgerald, Deborah (1996) "Blinded by Technology: American Agriculture in the Soviet Union, 1928-1932," *Agricultural History*, 70 (3), 459–486.

Galenson, Walter (1956) "Industrial Training in the Soviet Union," *ILR Review*, 9 (4), 562–576, 10.1177/001979395600900404.

Gelb, Michael (1993) "'Karelian fever': The Finnish immigrant community during Stalin's purges," *Europe-Asia Studies*, 45 (6), 1091–1116, 10.1080/09668139308412142.

Gerbek, G.G. (1931) *Lesnaya promyshlennost' SASSh*, Moscow-Leningrad, [The Forest Industry of the USA].

Gerschenkron, Alexander (1962) *Economic Backwardness in Historical Perspective: A Book of Essays*, Cambridge, MA: The Belknap Press of Harvard University Press.

Giorcelli, Michela (2019) "The Long-Term Effects of Management and Technology Transfers," *Am. Econ. Rev.*, 109 (1), 121–52, 10.1257/aer.20170619.

Giorcelli, Michela and Bo Li (2026) "Technology Transfer and Early Industrial Development: Evidence from the Sino-Soviet Alliance," *Rev. Econ. Stud.*, rdag047, 10.1093/restud/rdag047.

Godfrey, Anthony (2013) "The Search for Forest Facts: A History of the Pacific Southwest Forest and Range Experiment Station, 1926–2000," General Technical Report PSW-GTR-233 PSW-GTR-233, Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture, Albany, CA, https://www.fs.usda.gov/treesearch/pubs/43690.

Golubev, Alexey and Irina Takala (2011) "The Harsh Reality of Fine Words: The Daily Implementation of Immigration Policies in Soviet Karelia," *Journal of Finnish Studies*, 15 (1-2), 126–146, 10.5406/28315081.15.1.2.09.

——— (2014) *Finnish Immigration to Soviet Karelia from the United States and Canada in The 1930s*, East Lansing, Michigan: Michigan State University Press, https://ebookcentral.proquest.com/lib/helsinki-ebooks/detail.action?docID=3338353.

Graziosi, Andrea (1988) "Foreign Workers in Soviet Russia, 1920-40: Their Experience and Their Legacy," *International Labor and Working-Class History* (33), 38–59, http://www.jstor.org/stable/27671737.

Green, Donald W. and Herbert S. Levine (1976a) "Implications of Technology Transfers for the USSR," in North Atlantic Treaty Organization ed. *East-West Technological Cooperation*, Brussels: NATO Economic Directorate.

——— (1976b) "Macroeconomic Evidence of the Value of Machinery Imports to the Soviet Union," Soviet Econometric Model Working Paper No. 51, Stanford Research Institute.

Gregory, Paul and Mark Harrison (2005) "Allocation under Dictatorship: Research in Stalin's Archives," *Journal of Economic Literature*, 43 (3), 721–761, 10.1257/002205105774431225.

Grossman, Gregory (1960) *Soviet Statistics of Physical Output of Industrial Commodities: Their Compilation and Quality*: Princeton University Press, http://www.nber.org/books/gros60-1.

Guillouët, Louise, Amit K. Khandelwal, Rocco Macchiavello, Madhav Malhotra, and Matthieu Teachout (2024) "Language Barriers in Multinationals and Knowledge Transfers," *Rev. Econ. Stat.*, 1–56, 10.1162/rest_a_01487.

Harrison, Mark (2011) "Forging Success: Soviet Managers and Accounting Fraud, 1943 to 1962," *Journal of Comparative Economics*, 39 (1), 43–64.

Heckman, James, Hidehiko Ichimura, Jeffrey Smith, and Petra Todd (1998) "Characterizing Selection Bias Using Experimental Data," *Econometrica*, 66 (5), 1017–1098.

Heckman, James J., Sergio Urzua, and Edward Vytlacil (2006) "Understanding Instrumental Variables in Models with Essential Heterogeneity," *Rev. Econ. Stat.*, 88 (3), 389–432, http://www.jstor.org/stable/40043006.

Helle, A. (1926) "Karjalan metsäteollisuuden päivän kysymyksistä [Engl. Karelian Lumber Industry Today],"Technical report, KASNT:n suunnittelukomitean ja tilastohallinnon äänenkannattaja.

Hjerppe, Riitta (1989) *The Finnish Economy 1860-1985: Growth and Structural Change*, Helsinki: Bank of Finland.

Hsieh, Chang-Tai and Peter J. Klenow (2009) "Misallocation and Manufacturing TFP in China and India," *The Q. J. Econ.*, 124 (4), 1403–1448, 10.1162/qjec.2009.124.4.1403.

Iacovone, Leonardo, William Maloney, and David McKenzie (2022) "Improving Management with Individual and Group-Based Consulting: Results from a Randomized Experiment in Colombia," *Review of Economic Studies*, 89 (1), 346–71.

Institute of Marxism and Leninism (1984) *Kommunisticheskaya partiya Sovietskogo Sojuza v rezolutsiyakh i resheniyakh sezdov, konferetsij i plenumov TsK (1898–1986)*, 5, Moscow: Politizdat.

Jiang, Jerry and Jacob P. Weber (2025) "Who collaborates with the Soviets? Financial distress and technology transfer during the Great Depression," *Explor. Econ. Hist.*, 95, 101637, https://doi.org/10.1016/j.eeh.2024.101637.

Juhász, Réka, Mara P. Squicciarini, and Nico Voigtländer (2024) "Technology Adoption and Productivity Growth: Evidence from Industrialization in France," *J. Political Econ.*, 132 (10), 3215–3259, 10.1086/730205.

Juhász, Réka, Nathan Lane, and Dani Rodrik (2024a) "The New Economics of Industrial Policy," *Annual Review of Economics*, 16 (Volume 16, 2024), 213–242, https://doi.org/10.1146/annurev-economics-081023-024638.

Juhász, Réka, Shogo Sakabe, and David Weinstein (2024b) "Codification, Technology Absorption, and the Globalization of the Industrial Revolution," Working Paper 32667, NBER, 10.3386/w32667.

Kangaspuro, Markku (2000) *Neuvosto-Karjalan taistelu itsehallinnosta [Engl. Soviet Karelia's Independence Struggles]*: Suomalaisen Kirjallisuuden Seura.

Kantor, Shawn and Alexander Whalley (2019) "Research Proximity and Productivity: Long-Term Evidence from Agriculture," *J. Political Econ.*, 127 (2), 819–854, 10.1086/701035.

——— (2025) "Moonshot: Public R & D and Growth," *Am. Econ. Rev.*, 115 (9), 2891–2925, 10.1257/aer.20220540.

KASSR, Upravlenie Narodno-khozyastvennogo ucheta (1934) *Ezhegodnik. 1932. 1933*, Petrozavodsk: Soyuzorguchet.

Kero, Reino (1981) "The role of Finnish settlers from North America in the nationality question in Soviet Karelia in the 1930s," *Scandinavian Journal of History*, 6 (1-4), 229–241, 10.1080/03468758108578992.

——— (1983) *Neuvosto-Karjalaa rakentamassa: Pohjois-Amerikan suomalaiset tekniikan tuojina 1930-luvun Neuvosto-Karjalassa [Engl. Building Soviet Karelia: North American Finns as Agents of Technology Transfer in 1930s Soviet Karelia]*, Helsinki: Suomen historiallinen seura: Helsinki.

Kessler, Gijs and Andrei Markevich (2020) "Electronic Repository of Russian Historical Statistics, 18th - 21st centuries. Version I,"Technical report, https://ristat.org/.

Khlevniuk, Oleg V. (2004) *The History of the GULAG: From Collectivization to the Great Terror*, New Haven: Yale University Press.

Kostiainen, Auvo (1978) *The Forging of Finnish-American Communism, 1917–1924 : a Study in Ethnic Radicalism*, Petrozavodsk: Siirtolaisinstituutti: Turku, Finland, https://urn.fi/URN:ISBN:951-9266-14-3.

Kremer, Michael, Gautam Rao, and Frank Schilbach (2019) "Chapter 5 - Behavioral development economics," in Bernheim, B. Douglas, Stefano DellaVigna, and David Laibson eds. *Handbook of Behavioral Economics - Foundations and Applications 2*, 2 of Handbook of Behavioral Economics: Applications and Foundations 1, 345–458: North-Holland, https://doi.org/10.1016/bs.hesbe.2018.12.002.

Kuisma, Markku (1993) *Metsäteollisuuden maa: Suomi, metsät ja kansainvälinen järjestelmä 1620–1920 [Engl. Land of the Forest Industry: Finland, Forests and the International System 1620–1920]*, Helsinki: Suomen Historiallinen Seura.

Lane, Nathan (2020) "The New Empirics of Industrial Policy," *Journal of Industry, Competition and Trade*, 20, 209–234, 10.1007/s10842-019-00323-2.

——— (2025) "Manufacturing Revolutions: Industrial Policy and Industrialization in South Korea," 10.31235/osf.io/6tqax_v2.

Lee, David S, Justin McCrary, Marcelo J Moreira, Jack R Porter, and Luther Yap (2023) "What to do when you can't use '1.96' Confidence Intervals for IV," Working Paper 31893, NBER, 10.3386/w31893.

Lesnaya promyshlennost' (1947) "Lesnaya promyshlennost' za 30 let," [The Forest Industry over 30 Years].

Manuelli, Rodolfo E. and Ananth Seshadri (2014) "Frictionless Technology Diffusion: The Case of Tractors," *Am. Econ. Rev.*, 104 (4), 1368–91, 10.1257/aer.104.4.1368.

Markevich, Andrei (2011) "How Much Control is Enough? Monitoring and Enforcement under Stalin," *Europe-Asia Studies*, 63 (8), 1449–1468.

Markevich, Andrei and Mark Harrison (2011) "Great War, Civil War, and Recovery: Russia's National Income, 1913 to 1928," *J. Econ. Hist.*, 71 (3), 672–703.

Markevich, Andrei, Natalya Naumenko, and Nancy Qian (2024) "The Causes of Ukrainian Famine Mortality, 1932–33," *Rev. Econ. Stud.*, rdae091.

Martin, Terry (2001) *The Affirmative Action Empire: Nations and Nationalism in the Soviet Union, 1923-1939*: Cornell University Press.

McKenzie, David (2021) "Small business training to improve management practices in developing countries: re-assessing the evidence for 'training doesn't work'," *Oxf. Rev. Econ. Policy*, 37 (2), 276–301, 10.1093/oxrep/grab002.

Mitrunen, Matti (2024) "War Reparations, Structural Change, and Intergenerational Mobility*," *The Q. J. Econ.*, 140 (1), 521–584, 10.1093/qje/qjae036.

NKLes (1935) "Promyshlennost' Narkomlesa SSSR. Ot VII k VIII s"ezdu Sovetov SSSR," [The Industry of the People's Commissariat of Forestry of the USSR. From the 7th to the 8th Congress of Soviets of the USSR].

Popov, V.A. ed. (1957) *Lesnaya promyshlennost' SSSR, 1917–1957*, Moscow: Goslesbumizdat, [The Forest Industry of the USSR, 1917–1957], in 3 volumes.

Restuccia, Diego and Richard Rogerson (2008) "Policy Distortions and Aggregate Productivity with Heterogeneous Establishments," *Review of Economic Dynamics*, 11 (4), 707–720, 10.1016/j.red.2007.07.002.

Robinson, James A. (2010) "Industrial Policy and Development: A Political Economy Perspective," in Lin, Justin Y. and Boris Pleskovic eds. *Annual World Bank conference on development economics global 2010 : lessons from East Asia and the Global financial crisis*, 61–79, Washington, DC: World Bank.

Ruggles, Steven, Sarah Flood, Matthew Sobek et al. (2024) "IPUMS USA: Version 15.0 [U.S. Census 1930]," https://doi.org/10.18128/D010.V15.0.

Sanchez-Sibony, Oscar (2015) "Depression Stalinism: The Great Break Reconsidered," *Kritika: Explorations in Russian and Eurasian History*, 15 (1), 23–49.

Schwarz, Solomon M. (1952) *Labor in the Soviet Union*, New York: Frederick A. Praeger.

Shegel'man, I.R. (2008) *Lesnye transformatsii (XV–XXI vv.)*, Petrozavodsk: Izdatel'stvo PetrGU, [Forest Transformations (15th–21st Centuries)].

Siegel, Irving H. (1953) "Labor Productivity in the Soviet Union," *J. Am. Stat. Assoc.*, 48 (261), 65–78, http://www.jstor.org/stable/2280879.

Slovar' Spravochnik (1948) *Slovar'-spravochnik sotsial'no-ekonomicheskoi statistike [Engl. Dictionary and Manual on Social and Economic Statistics]*, Moscow: Gosstatizdat.

SNK (1931) *Sobranie zakonov i rasporiazhenii Raboche-Krest'ianskogo Pravitel'stva SSSR*, Moscow.

Sorokin, Pitirim A. (1944) *Russia and the United States*, New York: Dutton.

SSSR (1932b) *Narodnoe khozyastvo SSSR. Statisticheskij spravochnik. 1932.*, Moscow, Leningrad: Gosudarstvennoe sotsialno-ekonomicheskoe izdatelstvo.

SSSR, Gosplan (1930) *Pyatiletnij plan narodno-khozyastvennogo stroitelstva SSSR. Statisticheskij obzor*, 3, Moscow: Planovoe khozyastvo, 3rd edition.

SSSR, Ministerstvo Vneshney Torgovli (1960) *Vneshnayay Torgovlya SSSR za 1918-1940. Statisticheskij obzor*, Moscow: Vneshtorgizdat.

SSSR, Tsentralnoe Statisticheskoe Upravlenie (1932a) *Trud v SSSR*, Moscow: Gosudarstvennoe sotsialno-ekonomicheskoe izdatelstvo.

SSSR, TsSU (1927b) *Statisticheskij Spravochnik SSSR. 1927.*, Moscow: Izdanie TsSU SSSR.

SSSR, VSNKh (1927a) *Prilozhenie k karte promyshlennosti SSSR. Evropejskaya chast*, Moscow: 14 tipografiya Mospoligraf.

Sutton, Antony C. (1968) *Western Technology and Soviet Economic Development, 1917 to 1930*, Stanford, CA: Hoover Institution Press, Stanford University.

——— (1971) *Western Technology and Soviet Economic Development, 1930 to 1945*, 2, Stanford, CA: Hoover Institution Press, Stanford University.

——— (1973) *Western Technology and Soviet Economic Development, 1945 to 1965*, 2, Stanford, CA: Hoover Institution Press, Stanford University.

Takala, Irina (2002) *Finny v Karelii i v Rossii: Istroriya vozniknoveniya i gibeli diaspory*, Saint Petersburg: Neva.

——— (2004) "From the Frying Pan into the Fire: North American Finns in Soviet Karelia," *Journal of Finnish Studies*, 8 (1), 103–117.

Tonkel, Josef (1932) *Brigadit ja jatsheikat metsätöissä Karjalassa*: Valtion kustannusliike Kirja, Karjalan osasto.

TsUNKhU, Tsentralnoe Upravlenie Narodno-khozyastvennogo Ucheta Gosplana SSSR (1936) *Sotsialisticheskoe stroitelstvo SSSR. (Statisticheskij ezhegodnik) 1936*, Moscow: Souzorguchet.

Verhoogen, Eric (2023) "Firm-Level Upgrading in Developing Countries," *Journal of Economic Literature*, 61 (4), 1410–64, 10.1257/jel.20221633.

VKPb, Severnyi kraevoi komitet (1933) *Sbornik postanovlenii Sevkraikoma VKP(b) po voprosam podgotovki kadrov dlia narodnogo khoziaistva Severnogo kraia*, Arkhangel'sk.

Wallis, John J. (1989) "Employment in the Great Depression: New Data and Hypotheses," *Explor. Econ. Hist.*, 26 (1), 45–72, https://doi.org/10.1016/0014-4983(89)90004-1.

Weitzman, Martin L (1979) "Technology transfer to the USSR: An econometric analysis," *Journal of Comparative Economics*, 3 (2), 167–177, https://doi.org/10.1016/0147-5967(79)90013-1.

Zhuravskaya, Ekaterina, Sergei Guriev, and Andrei Markevich (2024) "New Russian Economic History," *Journal of Economic Literature*, 62 (1), 47–114.

Zinov'ev, V.V. (1947) "Fanernaya promyshlennost' SSSR," *Lesnaya promyshlennost'* (10), 14–15, [The Plywood Industry of the USSR].

Appendix

A Additional Tables

Table A.1: Summary Statistics: Extended Sample and Within-Karelia Comparison

Extended sample: Karelia, Northern Region and Leningrad region						
	Karelia		Northern R. & Leningrad			
	Mean	Obs.	Mean	Obs.	Difference	S.E.
Panel A: Enterprises						
Number of enterprises		93		745		
Share with North American Finns	0.72	93	0.00	745		
Birth year	1923.9	70	1928.5	445		
Panel B: Enterprise-year observations, 1925–1938						
Number of workers	429.41	287	414.12	1,869	15.29	30.96
Output per worker (1926/27 rubles)	4,239.59	315	3,575.48	1,869	664.10***	203.89
Capital per worker (nominal rubles)	5,602.75	265	4,904.11	1,507	698.64	827.46
Distance to forced labor camps (km)	163.69	315	207.03	1,869	-43.34***	9.21
Within Karelia: enterprises with vs. without North American Finns						
	With N.A. Finns		Without N.A. Finns			
	Mean	Obs.	Mean	Obs.	Difference	S.E.
Panel C: Enterprises						
Number of enterprises		67		26		
Share with North American Finns	1.00	67	0.00	26		
Birth year	1924.1	52	1923.1	18		
Panel D: Enterprise-year observations, 1925–1938						
Number of workers	452.52	212	364.07	75	88.46	55.23
Output per worker (1926/27 rubles)	4,233.99	236	4,256.31	79	-22.32	479.71
Capital per worker (nominal rubles)	5,514.45	198	5,863.71	67	-349.26	1,233.69
Distance to forced labor camps (km)	163.43	236	164.47	79	-1.04	14.69

Notes: The upper block reports the sample of wood-processing enterprises in Karelia and the Northern Region extended to Leningrad region enterprises. The lower block restricts the sample to enterprises within Karelia. Panels A and C report firm-level cross-sectional characteristics; Panels B and D report enterprise-year means. Observation counts vary due to missing data. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.2: Summary Statistics: North American Finns Recruited to Soviet Karelia

	USA		Canada		North America, unspecified[§]	
	Mean	Obs.	Mean	Obs.	Mean	Obs.
Year of birth	1899	2,973	1904	2,077	1897	211
Share male	0.64	3,462	0.67	2,503	0.72	494
Arrival age	32.40	2,969	28.57	2,073	34.90	198
Year of immigration to N. America[†]	1910	649	1921	364		
Share of lumberjacks[‡]	0.39	1,372	0.54	999	0.25	64
Share arriving by 1932	0.80	3,462	0.78	2,503	0.78	494

Notes: The table reports characteristics of the foreign workers recruited to the USSR through the Karelian Technical Aid (see Section 2.2.2 for a detailed description of the recruitment policy). No North American Finns are documented to have settled outside the borders of the Autonomous Republic of Soviet Karelia. [§] "North America, unspecified" refers to immigrants whose source country is recorded simply as "North America" in the Settlement Administration records. [†] Year of immigration to North America is drawn from the sub-sample of North American Finns in the Soviet Karelian immigration records successfully matched to the complete-count 1930 U.S. Census or complete-count 1931 Canadian Census. [‡] The share of lumberjacks is the share of male immigrants with HISCO code 63110 (see Leeuwen et al. (2002) for the historical occupational classification), among all male immigrants aged 14–64 for whom occupation is known; occupation is observed for 85% of all male immigrants.

Table A.3: The Top-10 Occupations for North American Finns in the Soviet Union and North America in the Early 1930s

Karelian Settlement Administration Records				**1930 U.S. and 1931 Canadian censuses pooled**			
Occupation	Freq.	Percent	HISCLASS	Occupation	Freq.	Percent	HISCLASS
Forestry worker	1,242	44.50	10	General worker	21,157	17.01	11
Carpenter	541	20.25	7	Farmer	17,556	14.11	8
General worker	250	9.36	11	Farm worker	12,327	9.91	12
Driver	183	6.85	9	Miner	11,053	8.88	9
Sawyer	98	3.67	9	Carpenter	10,275	8.26	7
Mechanics	85	3.18	7	Forestry worker	6,954	5.59	10
Brick layer	56	2.10	7	Other prod worker	5,257	4.23	11
Farm worker	52	1.95	12	Mechanic	4,079	3.28	7
Miner	50	1.87	9	Manager	3,668	2.95	2
Machinist	38	1.52	9	Driver	3,497	2.81	9
Total (top 10)	2,595	93.00		Total (top 10)	95,823	77.02	
Outside top 10	195	7.00		Outside top 10	28,584	22.98	
Total	**2,790**	**100.00**		**Total**	**124,407**	**100.00**	

Notes: Both samples restricted to men aged 15 to 64. U.S. 1930 Census data come from IPUMS and Canadian 1931 Census data were distributed by the Government of Canada (Ruggles et al., 2024; Statistics Canada, 2023). HISCLASS is a 12-class categorization system indicating the social class of each occupation (Maas and Van Leeuwen, 2016).

Table A.4: Instrument Exogeneity: Balance of Preintervention Enterprise Characteristics

	(1) Capital per worker	(2) Number of workers	(3) Birth year	(4) Total payroll (thousands)	(5) Total working days (thousands)	(6) Power plant ≤15 km	(7) Dist. to power plant
Secret police directives (S_i)	-218.0	-0.0517	22.85	-36.706	-21.546	-0.0810	10.76
	(235.458)	(0.099)	(15.120)	(44.152)	(22.431)	(0.151)	(8.802)
	[152.070]	[0.061]	[7.234]	[24.931]	[14.716]	[0.101]	[9.004]
Mean dep. var.	1278.07	0.33	1903.52	274.084	101.313	0.87	9.19
Observations	57	83	63	63	64	106	106

Notes: OLS estimates from regressions of pre-intervention enterprise characteristics (one per column, shown in the header) on the instrument, the secret police settlement directive (S_i), for a cross-section of enterprises in 1925–1928, using each enterprise's last observed pre-intervention year. Total payroll and total working days (columns 4 and 5) are in thousands. Additional controls include a Karelia × post-Five-Year-Plan indicator, and a distance-to-Gulag second-order polynomial, which we also interact with the post-1928 indicator; year dummies absorb the differential measurement years in the unbalanced panel. Standard errors clustered at the sub-district level are in parentheses; Conley standard errors with a 250 km cutoff are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.5: Continuous Treatment TWFE Estimates of Western Technical Assistance and Technology on Labor Productivity

	Dependent variable: $\log(\text{Labor productivity})_{it}$			
	(1) Karelia & Northern R.	(2) 150 km railway band	(3) Incl. Leningrad	(4) Within Karelia
Panel A: Benchmark results				
$\text{POST}_t \times n_i$	0.0315**	0.0304**	0.0312**	0.0207
	(0.015)	(0.015)	(0.015)	(0.017)
	[0.003]	[0.004]	[0.003]	[0.008]
Mean of dependent variable	7.90	8.04	7.90	8.03
Observations	1,904	986	2,184	315
Panel B: Pre-specification test				
$\text{POST}_t \times n_i$	0.0391	0.0459*	0.0385	0.0448
	(0.027)	(0.028)	(0.027)	(0.030)
	[0.007]	[0.006]	[0.007]	[0.007]
$d_{1932} \times n_i$	0.0137	0.0278	0.0130	0.0475
	(0.029)	(0.030)	(0.029)	(0.033)
	[0.010]	[0.011]	[0.010]	[0.012]
Observations	1,904	986	2,184	315

Notes: This table reports the intensive-margin (continuous-treatment) analogue of Table 2. The treatment n_i is the number of North American Finns present within 15 km of the enterprise i by 1933 (per 100), so that $\text{POST}_t \times n_i$ measures the effect of an additional hundred specialists after their arrival, rather than of their mere presence. The dependent variable, specification, fixed effects, and time-varying enterprise-level controls are otherwise identical to those in Table 2, whose notes describe them in full, as are the four estimation samples—(1) Karelia and the Northern Region; (2) enterprises within 150 km of the railway; (3) the sample extended to include the Leningrad region enterprises; and (4) enterprises within Karelia. Panel A reports the benchmark results and Panel B the pre-specification test, which adds the pre-treatment lead $d_{1932} \times n_i$, where d_{1932} is an indicator for the year 1932. Standard errors clustered at the enterprise level are in parentheses; Conley standard errors adjusting for two-dimensional spatial dependence with a 250 km cutoff (30 km in column 4) are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.6: IV Estimates of Continuous Treatment Effect of Western Technical Assistance and Technology on Labor Productivity

	Dependent variable: $\log(\text{Labor productivity})_{it}$			
	(1) Karelia & Northern R.	(2) 150 km railway band	(3) Incl. Leningrad	(4) Within Karelia
Panel A: Second stage				
$\text{POST}_t \times n_i$	0.0557*	0.0601*	0.0565*	0.0353
	(0.032)	(0.033)	(0.032)	(0.036)
	[0.038]	[0.040]	[0.039]	[0.038]
VtF 95% confidence interval	0.003; 0.136	0.007; 0.143	0.004; 0.137	-0.026; 0.119
Observations	1,904	986	2,184	315
Panel B: First stage. Dependent variable: $POST_t \times n_i$				
$\text{POST}_t \times \text{Settlement prohibition}_i$	-6.377***	-6.937***	-6.381***	-5.700***
	(2.109)	(2.296)	(2.108)	(2.106)
	[1.955]	[1.870]	[1.962]	[3.138]
Kleibergen–Paap rk Wald F	9.15	9.14	9.17	7.35

Notes: The dependent variable is log of output per worker in 1926/27 rubles. The table reports two-stage least squares (2SLS) estimates of a continuous-treatment variant of eq. (1) for the wood processing industry; it is the intensive-margin analogue of the (extensive-margin) IV estimates in Table 3. The variable n_i measures the number of North American Finns present within 15 km of the enterprise i by 1933 (per 100), and POST_t is an indicator for the years 1933–40. The excluded instrument is the post-1932 indicator interacted with the secret police settlement prohibition. The data cover 1925–1940. All regressions include enterprise and year fixed effects; for the time-varying enterprise-level controls included in both stages, see the notes to Table 2. Column (1) uses Karelia and the Northern Region sample; column (2) restricts the sample to enterprises within 150 km of the railway; column (3) adds enterprises from the Leningrad region to the sample; column (4) restricts the sample to Karelia. Standard errors clustered at the enterprise level are in parentheses; Conley standard errors adjusting for two-dimensional spatial dependence with a 250 km cutoff (30 km in column 4) are in brackets.; and VtF 95% confidence intervals are the valid-t-ratio intervals of Lee et al. (2023), which adjust IV inference for first-stage strength. Significance stars refer to the clustered standard errors. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.7: Robustness Checks

	TWFE coefficient (β)	Standard error	Robust s.e.	Observations
Panel A: Controls and Functional Form				
Excluding controls	0.550***	0.124	0.138	1,904
Labor productivity, in levels	1552.333***	437.279	366.730	1,904
Labor productivity, in levels, excl. controls	1149.839***	368.340	211.598	1,904
Panel B: Clustering of Standard Errors				
Sub-district clustering	0.595***	0.157	0.186	1,904
Spatial HAC, 100 km cutoff	0.595***	0.136	0.180	1,904
Spatial HAC, 500 km cutoff	0.595***	0.136	0.157	1,904
Panel C: Radius Around Settlement				
1 km	0.459***	0.144	0.139	1,904
3 km	0.489***	0.133	0.144	1,904
10 km	0.495***	0.133	0.144	1,904
30 km	0.573***	0.135	0.183	1,904
Panel D: Regional Sample Restrictions				
Excl. Arkhangelsk	0.644***	0.139	0.173	1,397
Excl. Vologda	0.598***	0.135	0.189	1,488
Excl. Komi	0.591***	0.136	0.186	1,773
Excl. Severodvinsk	0.586***	0.137	0.186	1,646
Panel E: Enterprise Sub-samples				
Karelia treated + Northern Region	0.552***	0.165	0.199	1,825

Notes: The table reports robustness checks of our baseline estimate, presented in column (1), top panel, of Table 2. Each row reports the TWFE coefficient on $\text{POST}_t \times D_i$, its clustered standard error, the corresponding Conley spatial standard error, and the number of observations. Except in Panel B, standard errors are clustered at the enterprise level and Conley spatial standard errors use a 250 km cutoff, as at baseline. Panel A presents results estimated without controls and with the dependent variable, labor productivity, in levels rather than logs. Panel B holds the baseline specification fixed and varies only the standard-error adjustment: clustering at the sub-district level, and Conley spatial standard errors using cutoff thresholds of 100 km and 500 km. Panel C alters the definition of treatment by the maximum distance of an enterprise from the settlement to which North American specialists were assigned, using radii of 1 km, 3 km, 10 km, and 30 km (in contrast to the 15 km radius at baseline). Panel D excludes each sub-province of the Northern region in turn. Panel E presents sub-sample analyses excluding the non-treated Karelian enterprises. Significance stars are based on the clustered standard error. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table A.8: Benchmark Results and Pre-Specification Test, All Industries

	Dependent variable: $\log(\text{Labor productivity})_{it}$			
	(1) Karelia & Northern R.	(2) 150 km railway band	(3) Incl. Leningrad	(4) Within Karelia
Panel A: Benchmark results				
$\text{POST}_t \times D_i$	0.400***	0.385***	0.397***	0.204
	(0.091)	(0.102)	(0.090)	(0.156)
	[0.095]	[0.107]	[0.095]	[0.214]
Observations	4,335	2,125	4,628	595
Number of enterprises	1,923	829	2,064	185
Panel B: Pre-specification test				
$\text{POST}_t \times D_i$	0.230	0.213	0.231	0.259
	(0.231)	(0.239)	(0.231)	(0.290)
	[0.276]	[0.278]	[0.276]	[0.360]
$d_{1932} \times D_i$	-0.213	-0.223	-0.208	0.120
	(0.253)	(0.262)	(0.253)	(0.359)
	[0.279]	[0.270]	[0.277]	[0.347]
Observations	4,335	2,125	4,628	595
Number of enterprises	1,923	829	2,064	185

Notes: This table reproduces the benchmark and pre-specification estimates of Table 2 on the sample of enterprises across all industries, rather than the wood processing industry alone. The dependent variable, specification, estimator, fixed effects, and time-varying enterprise-level controls are otherwise identical to those in Table 2, whose notes describe them in full. As there, Panel A reports the benchmark results and Panel B the pre-specification test, and the four columns correspond to the same estimation samples—(1) Karelia and the Northern Region; (2) enterprises within 150 km of the railway; (3) the sample extended to include the Leningrad region enterprises; and (4) enterprises within Karelia—here with the wood processing restriction removed. POST_t is an indicator for the years 1933–40, D_i indicates whether North American Finns were present within 15 km of the enterprise by 1933, and d_{1932} is an indicator for the year 1932. Standard errors clustered at the enterprise level are in parentheses; Conley standard errors adjusting for two-dimensional spatial dependence with a 250 km cutoff (30 km in column 4), are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.9: Average Impact of Western Technical Assistance and Technology on Total Factor Productivity: Evidence from Karelian Technical Aid

	Dependent variable: $\log(\text{Output})_{it}$			
	(1) Karelia & Northern R.	(2) 150 km railway band	(3) Incl. Leningrad	(4) Within Karelia
$\text{POST}_t \times D_i$	0.455***	0.454***	0.459***	0.255
	(0.135)	(0.149)	(0.134)	(0.180)
	[0.126]	[0.128]	[0.128]	[0.169]
log of labor (l_{it})	0.738***	0.700***	0.745***	0.597***
	(0.054)	(0.082)	(0.050)	(0.096)
	[0.040]	[0.045]	[0.037]	[0.072]
log of capital (k_{it})	0.132***	0.120*	0.127***	0.0823
	(0.038)	(0.062)	(0.037)	(0.118)
	[0.041]	[0.066]	[0.040]	[0.142]
Mean of dependent variable	6.59	6.84	6.53	6.92
Number of enterprises	620	298	729	91
Observations	1,550	822	1,759	265
Adjusted within-R^2	0.49	0.46	0.50	0.38

Notes: The dependent variable is log of output in 1926/27 rubles (y_{it}). Total factor productivity is estimated assuming a standard firm-level production function of the Cobb–Douglas type, $Y = f(K, L)$, in which the primary inputs, log of capital k_{it} and log of labor (number of industrial workers) l_{it}, are included as explanatory variables. The model is otherwise identical to estimating equation (1), estimated by ordinary least squares (OLS). All regressions include enterprise and year fixed effects. The data cover 1926–1940. POST_t is an indicator for the years 1933–40, and D_i indicates whether North American Finns were present within 15 km of the enterprise by 1933. The four columns correspond to the estimation samples of Table 2: (1) Karelia and the Northern Region; (2) enterprises within 150 km of the railway; (3) the sample extended to include the Leningrad region enterprises; and (4) enterprises within Karelia. The included time-varying enterprise-level controls are those of Table 2: an interaction of a Karelia indicator with a post-five-year-plans period dummy; a distance-to-Gulag second-order polynomial, which we also interact with the post-1928 indicator. The time-varying enterprise-level controls are identical to those in Table 2. Standard errors clustered at the enterprise level are in parentheses; Conley standard errors adjusting for two-dimensional spatial dependence with a 250 km cutoff are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.10: Alternative Channels

	Dependent variable: $\log(\text{Labor productivity})_{it}$					
	(1)	(2)	(3)	(4)	(5)	(6)
$\text{POST}_t \times D_i$	0.556***	0.534***	0.761***	0.588***	0.513**	0.468**
	(0.137)	(0.166)	(0.178)	(0.194)	(0.212)	(0.208)
	[0.150]	[0.154]		[0.223]	[0.186]	[0.090]
$\text{POST}_t \times D_i \times$ Dist. to port or railway$_i$	0.0448					
	(0.067)					
	[0.053]					
$\text{POST}_t \times D_i \times$ Market access (export cost)$_i$		-0.0639				
		(0.108)				
		[0.092]				
$\text{POST}_t \times D_i \times$ Dist. to Finnish settlements$_i$			0.0776			
			(0.124)			
$\text{POST}_t \times D_i \times$ Dist. to White Sea Canal$_i$				-0.0511		
				(0.149)		
				[0.075]		
$\text{POST}_t \times D_i \times$ Newspapers per capita$_r$					0.171	
					(0.227)	
					[0.101]	
$\text{POST}_t \times D_i \times$ Party penetration$_i$						4.274
						(3.281)
						[2.616]
Observations	1,904	1,904	1,904	1,904	281	134

Notes: OLS estimates. Columns (1)–(4) use the baseline sample (wood processing enterprises in Karelia and the Northern Region), as in column (1) of Tables 2 and 3; columns (5) and (6) restrict the sample to Karelia, where the newspaper and party-penetration measures are available and the Karelia × First 5-year plan term drops out as collinear with the fixed effects. The dependent variable, fixed effects, time-varying controls, POST_t, and D_i are as in Table 2. Each column adds a double interaction of POST_t with a candidate channel, along with a triple interaction of $\text{POST}_t \times D_i$ with the same channel: log distance to the nearest port or railway; market access (transportation cost); log distance to Finnish settlements; log distance to the White Sea Canal; newspapers per capita in the district (r); and party penetration, the share of party members among industrial workers. Each channel variable is demeaned by its sample average, so the coefficient on $\text{POST}_t \times D_i$ gives the program's effect at the mean of the interacted characteristic and the triple interaction gives the change per unit deviation from it. Standard errors clustered at the enterprise level are in parentheses; where available, Conley standard errors with a 250 km cutoff are in brackets. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A.11: Worker Selection Regressions, Matched Soviet Immigration Records and 1931 Canadian Complete Count Census

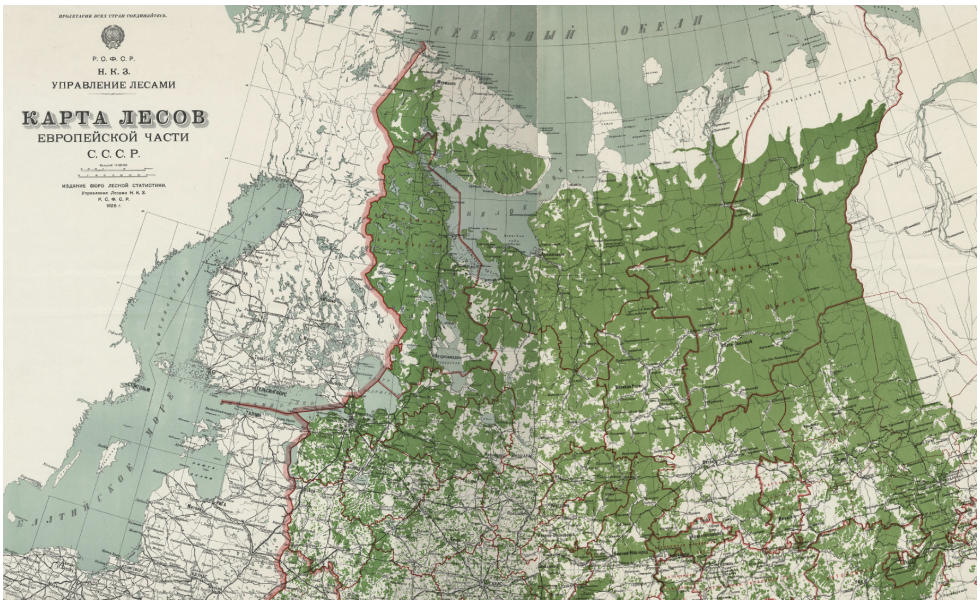
	Dependent variable: $\log(\text{Earnings})_j$		
	(1)	(2)	(3)
Recruited by Karelian Technical Aid	-0.188*	-0.202**	-0.192**
	(0.099)	(0.092)	(0.083)
Age	0.0388***	0.0385***	0.0312***
	(0.006)	(0.005)	(0.008)
Age^2	<-0.001***	<-0.001***	<-0.001***
	(0.000)	(0.000)	(0.000)
Speaks English	0.416***	0.354***	0.274***
	(0.021)	(0.028)	(0.011)
Unemployed		-0.575***	-0.526***
		(0.031)	(0.022)
Province fixed effects		Yes	Yes
Occupation fixed effects			Yes
Observations	10,421	10,421	10,421

Notes: The sample includes working-age (15–64 years) men whose own or parents' place of birth is Finland in the 1931 Canadian Census. The dependent variable is the logarithm of annual earnings (past 12 months) of individual j. The explanatory variable "Recruited by Karelian Technical Aid" is defined as positive individual-level match with the Settlement Administration records of Soviet Karelia. For the details of matching individuals across the mentioned administrative data, see Appendix Section D.2. Nine province dummies are included in columns 2 and 3. We define occupation based on the 2-digit HISCO code, 59 occupation dummies are included in column 3 (see Leeuwen et al. (2002) for the historical occupational code (HISCO) classification). Standard errors (in parentheses) are clustered at occupation level. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B Additional Figures

Figure B.1: Soviet Historical Maps

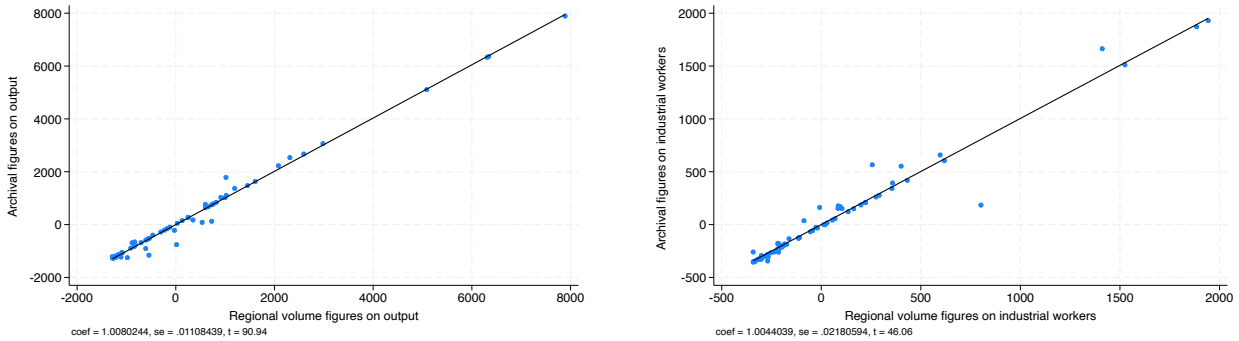
(a) Forests, 1926



(b) Railway stations and river Ports, 1939

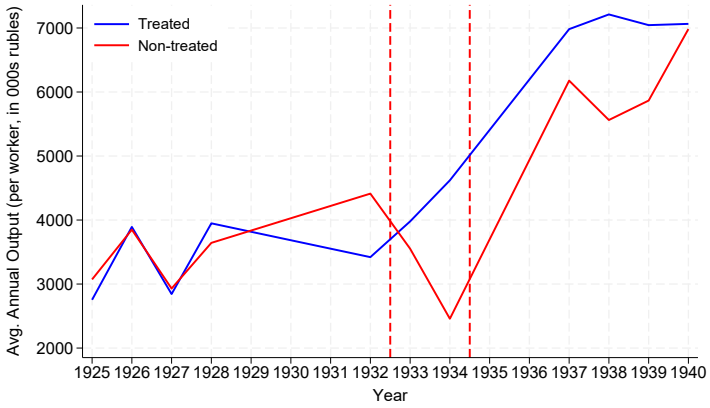
Sources: NKZ (1926) and NKPS (1939).

Figure B.2: Cross-Checks of Karelian Enterprise-Level Statistics Reported in Two Different Sources



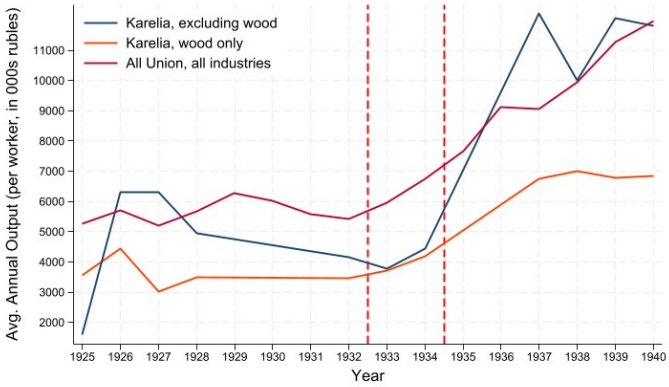
Notes: Added-variable plots of pairwise regressions of archival and published annual Karelian statistics for 1932 and 1933, for output (left) and number of industrial workers (right). Archival statistics are from RGAE F. 1562, Op. 8, D. 864 and F. 1562, Op. 8, D. 1261; published statistics are from KASSR (1934).

Figure B.3: Enterprises' Labor Productivity Trends by Exposure to Karelian Technical Aid, 1925–1940



Notes: Averages of output per industrial worker (1926/27 rubles) for treated (blue) and non-treated (red) wood-processing enterprises. To reduce compositional change over time, the sample retains only sub-industries present in each of four time bins—roughly corresponding to the NEP period and the three interwar Five-Year Plans (1925–27, 1928–32, 1933–37, 1938–40)—and only enterprises observed both before and after 1932; missing years are linearly extrapolated. The dashed red lines mark mid-1932 to mid-1934, when the North American Finns were most intensively engaged in Karelian wood processing.

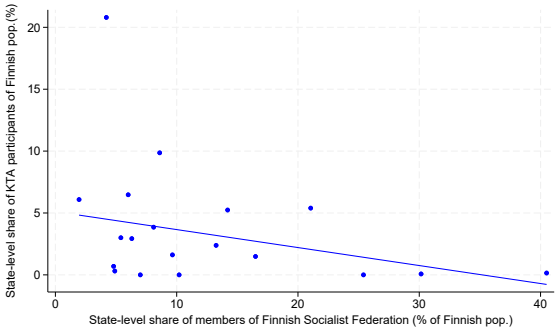
Figure B.4: Labor Productivity Trends in Karelia and the Soviet Union, 1925–1940



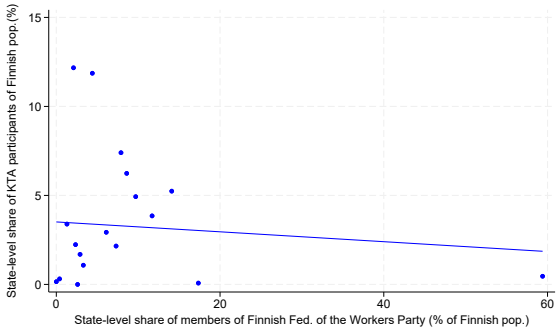
Notes: In Karelia we also exclude beverage enterprises, owing to the gradual removal of alcohol prohibition in 1925–30; missing years in both Karelian series are linearly extrapolated. The All-Union series (blue) is output per industrial worker in the USSR in 1926/27 rubles: before 1937, industrial output divided by industrial employment; for 1937–40, from a 1946 declassified archival memo (RGAE F. 1562, Op. 329, D. 1912, L. 47). Output is from a second 1946 memo (RGAE F. 1562, Op. 329, D. 1593, L. 6); the harmonized labor-force series is built from official statistical publications (VTsSPS, 1926; TsUNKhU, 1934, 1936; TsSU, 1956). Dashed red lines mark mid-1932 to mid-1934, when the North American Finns were most intensively engaged in Karelian wood processing.

Figure B.5: Migrant Selection: State-Level Share of Ethnic Finnish KTA Participants and Socialist Party Members

(a) KTA migrants and Finnish members of the Socialist Party of America, 1917



(b) KTA migrants and Finnish members of the Workers Party of America, 1923



Notes: State-level shares of Karelian Technical Aid (KTA) participants relative to the ethnic Finnish population in the 1930 U.S. Census are authors' calculations from matched immigration records of Soviet Karelia and the complete-count census (Ruggles et al., 2024); see Appendix D.2 for the matching algorithm. Party-membership data are from Kostiainen (1978), relating state-level membership in the Finnish Federation of the Socialist Party of America (1917) and of the Workers Party of America (1923) to the ethnic Finnish population by state in the 1920 U.S. Census. Only states in his data are shown.

C Cost-Benefit Analysis

This section discusses the details of the cost-benefit analyses summarized in subsection 7.1 by walking the reader through the calculations presented in Table C.1. For simplicity, we assume that all 5,000 working-age Americans and Canadians recruited to Karelia worked in the wood processing industry or in its backend support, such as construction of housing and infrastructure. We estimate that the number of native workers in the wood processing industry in 1933 amount to 59,000 by deducting foreign workers from total employment (64,000). We normalize labor productivity in the counterfactual to one and increase it by the magnitude of our estimated treatment effect in column (1) of Panel A in Table 2 (1.81) to obtain ex-post labor productivity in wood processing industry. The share of labor force treated by KTA is set equal to the share of employment in treated wood processing enterprises among all wood processing Karelian enterprises in our data in 1933 (0.76). We estimate counterfactual total output in wood processing industry from the 1933 official figure (121,464 thousand rubles) decreasing it proportionally to the change in the number of effective units of labor if KTA did not start. This change consists of two parts: first, the labor force affected by the program would be less productive in the counterfactual scenario, and second, the labor force would be smaller in the absence of North American Finns. Specifically, we estimate the counterfactual output as $121,464 \times (59/(64 \times 0.76 \times 1.81 + 64 \times 0.24 \times 1))$.

Monthly wage in wood processing industry in 1931-1933 comes from (KASSR, 1934, p. 191). To deflate to 1926/7 rubles, we use the wholesale industrial price index developed by Allen (1997). Monthly wage of American and Canadian workers are from (Golubev and Takala, 2014, pp. 120, 227), deflated to 1926/7 rubles. To account for investments by foreign workers in a machinery fund and the documented illiquidity of these investments, we adjust foreign workers monthly wages by assuming that everyone invested equally much in the machinery fund and that the documented ruble repayments were shared equally by al workers (Golubev and Takala, 2014, p. 89, 90). The negative difference between raised and repaid funds is treated as a write-off. The total amount of capital raised was $262,000 ($162,146 to the Machinery Fund plus machinery and equipment brought by North American Finns of about $100,000 value (Golubev and Takala, 2014, pp. 89-90)), which we transform into 1,507 thousand rubles using the conservative Torgsin U.S. dollar to ruble exchange rate (1 to 5.75). By conservative, we mean that the Torgsin – a Soviet state-run hard-currency shop – used almost three times higher exchange rate than the official exchange rate (1 to 2). Then,

to get the total write-off, we deduct the repaid compensation for the fees to the Machinery Fund (304,629 rubles – (Golubev and Takala, 2014, p. 89)) and the compensation for brought equipment estimated using the official exchange rate (200,000 rubles). We deduct the write-off from monthly wages by assuming a linear write-off scheme over the whole span of the two-year work contract.

Total personnel costs were computed based on the number of workers and reported monthly wages (i.e. abstracting from pensions, social security and income tax).[35] Surplus is computed as the difference between total output (i.e. sales) and personnel costs.

We use Canadian average annual earnings from the 1930 Canadian Census (i.e., reported in 1931 Canadian dollars) for the matched Canadian workers contracted by KTA as the reservation wage of the foreign workers (individual-level earnings are not available for Americans in the 1930 U.S. Census). To arrive at the competitive wage in rubles (i.e., that would match Canadian reservation wage), we use the standard foreign worker contract practice under technical assistance agreements and apply 0.8 and 0.2 as weights for payments in hard currency (Torgsin) and official exchange rate, respectively (Sutton, 1971).

We also estimate the maximum wage satisfying the condition of a strictly positive surplus. This is the maximum monthly compensation to foreign workers (in 1926/27 rubles) that would still leave the KTA intervention marginally profitable for the social planner.

We think of the North American workers' wage premium as the cost of KTA and define this premium as the product of the number of North American workers and the monthly wage differential, multiplied by twelve and divided by one thousand: $5{,}000 \times (170.7 - 105.6) \times 12 \div 1{,}000 = 3{,}905$ thousand 1926/27 rubles, or 4.59 % of total personnel costs. We compare this percentage against the 4% cost of the Soviet apprenticeship training schools (SNK, 1931). Vocational training in apprenticeship schools (F.Z.U.) lasted, however, an average of nineteen months and reached no more than a quarter of new industrial workers, whereas the effect of North American Finns was already evident after their first full year of presence and extended to more than three-quarters of the workforce. The adjusted F.Z.U. cost share is 7.7% ($= 4\% \div 0.25 \times 0.76 \div (19 \div 12)$), roughly 1.7 times higher than that of KTA.

[35] All foreign workers paid their own travel costs.

Table C.1: Cost-Benefit Analysis Table

	Karelian Technical Aid			
	Did occur (realized)	Did not occur (counterfactual)	Dif. (1) – (2)	Dif. as % of (1)
	(1)	(2)	(3)	(4)
Total employment excl. self-employed and collective farmers, Karelia 1933 (000s)	133	128	5	3.8
Total employment in wood processing, 1933 (000s)	64	59	5	7.8
of which local workers (000s)	59	59	0	0
of which American and Canadian workers (000s)	5	0	5	100
Ex-post labor productivity in wood processing	1.81	1	0.81	44.8
Share of labor force affected by the program in wood processing	0.76	0	0.76	100
Total output (sales revenue) in wood processing, 1933 (000s 1926/7 rubles)	121,464	69,237	52,227	43.0
Monthly wage, local workers (1926/7 rubles)	105.6	92.87	12.8	12.1
Monthly wage, Am. & Can. workers, unadjusted	170.7	–	–	–
adjusted for foregone investment repayments	163.6	–	–	–
Personnel costs (000s 1926/7 rubles)	85,027	65,750	19,277	22.7
Surplus (sales revenue − personnel costs, 000s 1926/7 rubles)	36,437	3,487	32,950	90.4
Canadian competitive monthly wage (1926/7 rubles)	161.5	–	–	–
Max wage satisfying program profitability (1926/7 rubles)	719.9	–	–	–
North American workers' wage premium (5,000 × avg. wage differential):				
in 000s 1926/7 rubles	3,905	–	–	–
as % of total personnel costs	4.59	–	–	–
Apprenticeship-school expenditure as % of personnel costs, unadjusted	4	–	–	–
adjusted for duration and scope of training	7.7	–	–	–

Notes: Estimations and sources are as described in Appendix Section C above.

D Data Appendix

D.1 Historical Sources

Table D.1: List of Historical Sources

Data	Year	Source
A. *Individual-level records**		
Registration lists of North American Finns	1933-34	NA RK (hereafter refers to National Archive of Republic of Karelia) F. P-3, Op. 6, D. 12774.
Files of the Settlement Administration of Karelia	1931-36	NA RK F. R-685 Op. 1 D. 1, 3, 4, 5, 34, 36, 37, 40, 43, 72, 73, 96, 99, 120, 124, 153, 162, 164, 166; NA RK F. R-685 Op. 2, D. 10, 11, 12, 13, 16, 17, 24, 26, 30, 34, 58, 60, 62, 64, 65, 67, 70, 71, 89, 91, 96, 98, 99, 100, 105, 109, 110, 111, 112, 117, 119, 120, 121, 122, 124, 125, 126, 128, 129, 130, 131, 133, 134, 136, 138, 139, 140, 143, 152, 166, 167, 170, 171, 173, 174, 175, 196, 246, 248, 249, 263, 300, 340; NA RK F. R-685 Op. 15, D. 8
Files of Karelian Council of Ministries	1931-38	NA RK F. R-690, Op. 1, D. 181; NA RK F. R-690, Op. 3, D. 46, 466, 630; NA RK F. R-690, Op. 13, D. 17.
Ski factory files	1931-38	NA RK F. R-1503, Op. 3, D. 3, 22, 36, 65
Files of other Karelian agencies	1931-38	NA RK R. P-630, Op. 2, D. 21, 218; NA RK F. R-721, Op. 16, D. 29, 72; NA RK F. R-676, Op. 1, D. 137; NA RK F. R-689, Op. 15, D. 7, 8; NA RK F. R-1042, Op. 2, D. 20; NA RK F. R-2883, Op. 1, D. 8; NA RK F. P-3, Op. 6, D. 10792.
B. *Establishment-level data from the Central Statistical Administration files and other sources*		
Output, Number of industrial workers	1925	SSSR (1927a).
Output, Number of industrial workers Capital asset, Birth year, Self-reported distance to railways and waterways	1926, 1927	RGAE (Hereafter refers to the Russian State Archive of Economy) F. 1562, Op. 8 D. 2, 6, 8, 40, 45, 63, 64, 67, 91, 95, 111, 117, 118, 126, 132, 153, 169, 180, 183, 209, 303, 340, 341, 344, 406, 408, 411, 422, 437, 439, 443, 462, 477, 480, 485, 499, 521, 522, 525.
Output, Number of industrial workers Capital asset, Birth year, Self-reported distance to railways and waterways	1928	RGAE F. 1562, Op. 8, D. 614, 623, 626, 643, 647, 655, 656, 664, 676, 685, 688, 689, 720, 722, 726, 737, 744, 757, 758, 774, 776, 784, 785, 791, 802, 810; Pervozvanskii (1959).
Output, Number of industrial workers	1928, 1929	Statisticheskoe upravlenie Karel'skoi ASSR (1929) KASSR (1929); TsSU (1931).
Output, Number of industrial workers, Capital asset	1932	RGAE F. 1562, Op. 8 D. 851, 856, 864.
Party membership	1932	Karelobkom (1932)
Output, Number of industrial workers, Capital asset	1933	RGAE F. 1562, Op. 8, D. 1251, 1261.
Output, Number of industrial workers, Capital asset	1934**	KASSR (1934).
Output, Number of industrial workers,	1937, 1938	RGAE F. 1562, Op. 53, D. 1231, 1236, 1238,

Continued on next page

Table D.1: List of Historical Sources (continued)

Data	Year	Source
Capital asset		1239, 1240, 1241, 1242, 1243, 1244, 1245, 1246, 1247, 1249, 1250, 1251, 1252, 1253, 1255, 1256, 1257, 1258, 1259, 1261, 1262, 1263, 1265, 1266, 1267, 1269, 1270, 1272, 1274.
Output, Number of industrial workers, Capital asset	1939, 1940	RGAE F. 1562, Op. 312, D. 483, 484, 493, 511, 544.
C. Subdistrict-level data from the 1926 Population Census		
Literacy, Speaking language	1926	SSSR (1928).
D. Maps		
Administrative map	1926	Markevich et al. (2024).
Electro-stations	1933	Hand-made using Kurashev (1934).
Factory training schools (F.Z.U.), Technicums and higher-education institutions	1933	Hand-made using KASSR (1934); VKPb (1933).
Forced labor camps with Finnish unskilled labor	1931-1933	Hand-made using Takala (2002).
Headquarters of Gulag forced labor camps	1925-1938	Kapelko and Markevich (2014).
Newspapers	1926	KASSR (1934).
Railways and river ports	1933	Hand-made using NKPS (1939).
*D. Other Sources****		
Labor productivity in Soviet Industry	1937-1938	RGAE. F. 1562, Op. 329, D. 1912, L. 47.
Industrial output in Soviet Union	1925-1936	RGAE. F. 1562, Op. 329, D. 1593, L. 6.

Notes: *Archival sources with individual-level records are available online at *uf.rkna.ru* as a part of the electronic database "North American Finns in forestry industry of Soviet Karelia in 1920s and 1930s" by M. Jaaskelainen, I. Takala, and E. Usacheva; **reported output is for the first half of the year which is multiplied by two to impute annual output. *** available online at *istmat.org* as a part of the electronic database "Historical materials".

D.2 Matching the Settlement Administration Records to the 1930 U.S. Census and 1931 Canadian Census

D.2.1 Settlement Administration Records

The two main archival sources consist of a registry by the Karelian Settlement Administration on Canadians (n=1,840) and Americans (n=2,585) who were living in Karelia as of January 1934. We cleaned these records and linked them based on first name, last name, birth year, occupation, arrival date in the Soviet Union, and workplace in Karelia to other archival sources of the archives of the Settlement Administration. Duplicates arising due to foreign workers appearing in multiple archival sources are removed (deduplication algorithm available from the authors), for a final dataset of 6,663 unique individuals.

D.2.2 Matches in the 1930 U.S. Census

The immigrants from the United States (or North America, source country unknown) were linked to the complete count of the 1930 U.S. Census made available by Ruggles et al. (2024). All 336,773 first or second generation Finnish immigrants to the U.S., defined based on own birthplace, mother's or father's birthplace, were linked to the Settlement Administration records based on first names, surname and birthdate. In total, 649 individual matches between the Soviet Karelian and the U.S. data sources were found for a linking rate of roughly 18.5%.

D.2.3 Matches in the 1931 Canadian Census

The immigrants from Canada (or North America, source country unknown) were linked to the complete count of the 1931 Canadian Census recently made available by Statistics Canada (2023). The Canadian census sample includes all individuals whose ethnicity is recorded as "Finn" or "Finnish". Additionally, individuals whose ethnicity is recorded as "Swedish" but who were born in Finland are included, as they are likely Swedish-speaking Finns. Of the 38,113 Canadian Finns in the 1931 Canadian census that fit these criteria, we matched 364 individuals to the Settlement Administration records for a linking rate of roughly 14.2%.[36]

[36] According to Korkiasaari (1989), there were 43,585 first or second generation Canadian Finns in the 1931 census suggesting that our search criteria do not fully capture the entire population of Canadian Finns in

D.2.4 Linking North American Finns to Records Across the Continents

The Soviet Karelian immigration records are linked to the 1930 U.S. Census and 1931 Canadian Census using the following algorithm:

Starting with the complete count U.S. Census that covers over 122 million observations, these census data are first filtered to retain only records where Finland is listed as the individual's, mother's, or father's place of birth. These restrictions yield a dataset of 336,773 observations, consisting of Finnish first-generation immigrants and their children. Next, the name variables are cleaned by removing non-alphanumeric characters and suffixes such as "Mr." or "Mrs.". A variable for middle-name initial is generated, and nicknames are standardized by replacing them with their formal equivalents. The Soviet Karelian immigration records are prepared in a similar manner. The complete Settlement Administration sample of foreign workers arriving through KTA contains 6,663 observations. Of these, 3,523 list the United States as country of origin, 2,557 list Canada, and 583 list only "North America." The 583 ambiguous records enter the U.S. linking first; those left unmatched are then re-used in the Canadian linking. The U.S. linking sample therefore contains 4,106 records.

The linking algorithm follows a rule-based approach proposed by Abramitzky et al. (2012, 2014). The linking process is conducted in two stages. In the first stage, only observations with information on birth year are included. The algorithm blocks observations by the initials of the first and last names to reduce computational demands, at the cost of missing matches where initials differ through spelling variation (e.g., Vihtori vs. Wihtori). Within these blocks, the algorithm compares birth years and calculates Jaro-Winkler (JW) string distances for both first and last names of each possible pair. JW-thresholds for the distance scores are set at 0.12 for last names and 0.15 for first names.[37] If a pair exceeds both thresholds, their birth years are compared. If multiple matches share the same name and birth year, the match is considered non-unique and is rejected. If only one match with the

the 1931 Canadian census, in particular the second generation Canadian Finns. This shortcoming should be innocuous for our analysis as most Canadian immigrants to Soviet Karelia were first generation immigrants.

[37]The thresholds for JW-scores are determined empirically by iterating and refining the routine. Since JW-similarity gives higher weight to the initial characters of a string and does not heavily penalize differences in string length, only matches differing by a maximum of two characters are tolerated. This rule is particularly important for Finnish names, as many Finnish surnames stem from the same word but differ only with respect of the suffix, e.g., Mäki, Mäkilä, Mäkinen are all distinct surnames, but their JW-similarity score is 0.086, implying that the algorithm reads them as one and the same name at conventional thresholds.

same name and birth year exists, it is accepted. In cases of no exact match, the closest match within an age difference of ± 2 years is retained, provided the match is unique (i.e., both records having exactly the same first and surname). Only same-sex matches are accepted. In linking the Settlement Administration records to the 1930 U.S. Census, the first stage yields 631 matches.

The identified matches are set aside, and the second stage begins with all remaining observations, regardless of whether birth year is observed. The process is otherwise identical to the first stage, except birth year is not considered. Linking is based solely on name variables, with the same Jaro-Winkler thresholds as in the first stage. This second stage results in 18 additional matches.

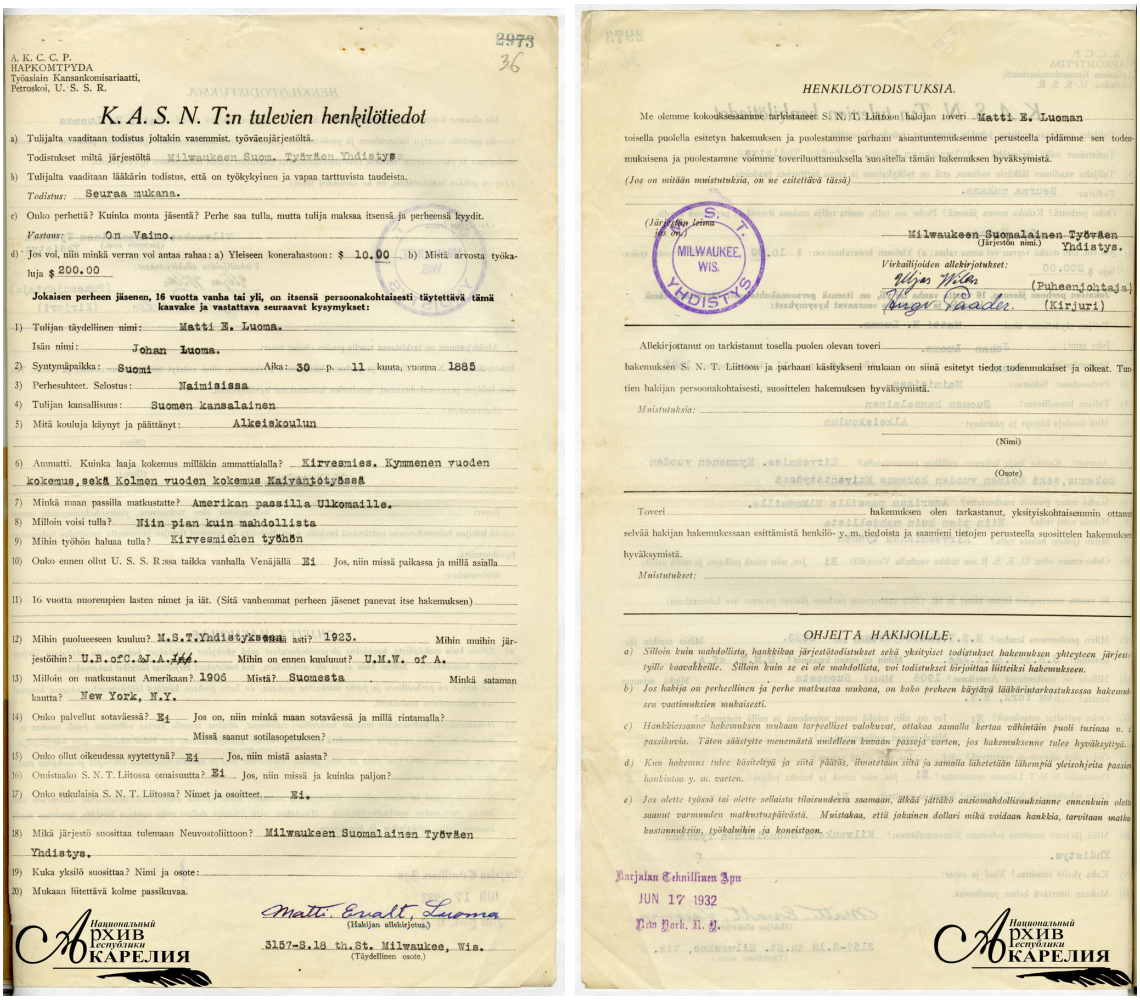
The two-stage linking approach is necessary because 22.5% of the Soviet Karelian immigration records lack birth year information. Combining the results yields a dataset of 649 matched individuals, corresponding to a match rate of 15.8%. The linking procedure for the 1931 Canadian Census closely follows the method used for the U.S. Census. In this case, the Soviet Karelian dataset, containing only observations with Canada or the remaining unmatched observations with North America as the country of origin, includes 3,108 records. A total of 364 matches are identified, resulting in a match rate of 11.7%.

E Karelian Technical Aid

The selection of North American applicants included the following stages. People who wished to participate in the program had to fill out an application form and obtain a reference from a local workers' organization. The references were considered by commissions in New York and Toronto, and the lists of the selected applicants were sent on to Petrozavodsk. The authorities of Karelia confirmed the lists and matched the applications to enterprises' expressions of interest, after which the documents were sent to Moscow for entry visas to be issued. The formal criteria for selection of applicants included the workers' professional experience and a worker's union background. However, the selection process of KTA was guided by other considerations than ideology. Ideology seems to have been secondary to relevant work experience or occupational mismatch (We found in the archives of the Settlement Administration rejection letters motivated by these two reasons). Apart from work experience, the amount of tools and equipment that worker's intended to bring along and their ability to

invest hard currency in a newly formed machinery fund, seem to have played an important role. Of particular note is that these two intentions were among the first things inquired in the application form (see below for the contents of the complete application form).

Figure E.1: Application Form



A. K. C. C. P.
HAPKOMTPYDA
Työasiain Kansankomisariaatti,
Petroskoi, U. S. S. R.

2973
36

K. A. S. N. T:n tulevien henkilötiedot

a) Tulijalta vaaditaan todistus joltakin vasemmist. työväenjärjestöltä.
Todistukset miltä järjestöltä Milwaukeen Suom. Työväen Yhdistys
b) Tulijalta vaaditaan lääkärin todistus, että on työkykyinen ja vapaa tarttuvista taudeista.
Todistus: Seuraa mukana.
c) Onko perhettä? Kuinka monta jäsentä? Perhe saa tulla, mutta tulija maksaa itsensä ja perheensä kyydit.
Vastaus: On Vaimo.
d) Jos voi, niin minkä verran voi antaa rahaa: a) Yleiseen konerahastoon: $ 10.00 b) Mistä arvosta työkaluja $ 200.00

Jokaisen perheen jäsenen, 16 vuotta vanha tai yli, on itsensä persoonakohtaisesti täytettävä tämä kaavake ja vastattava seuraavat kysymykset:

1) Tulijan täydellinen nimi: Matti E. Luoma.
Isän nimi: Johan Luoma.
2) Syntymäpaikka: Suomi Aika: 30 p. 11 kuuta, vuonna 1885
3) Perhesuhteet. Selostus: Naimisissa
4) Tulijan kansallisuus: Suomen kansalainen
5) Mitä koulu ja käynyt ja päättänyt: Alkeiskoulun
6) Ammatti. Kuinka laaja kokemus milläkin ammattialalla? Kirvesmies. Kymmenen vuoden kokemus, sekä Kolmen vuoden kokemus Kaivantötyössä
7) Minkä maan passilla matkustatte? Amerikan passilla Ulkomaille.
8) Milloin voisi tulla? Niin pian kuin mahdollista
9) Mihin työhön haluaa tulla? Kirvesmiehen työhön
10) Onko ennen ollut U. S. S. R:ssa taikka vanhalla Venäjällä Ei Jos, niin missä paikassa ja millä asialla
11) 16 vuotta nuorempien lasten nimet ja iät. (Sitä vanhemmat perheen jäsenet panevat itse hakemuksen)
12) Mihin puolueeseen kuuluu? M.S.T.Yhdistykseen Mistä asti? 1923. Mihin muihin järjestöihin? U.B.of C.&J.A.~~of~~. Mihin on ennen kuulunut? U.M.W. of A.
13) Milloin on matkustanut Amerikaan? 1906 Mistä? Suomesta Minkä sataman kautta? New York, N.Y.
14) Onko palvellut sotaväessä? Ei Jos on, niin minkä maan sotaväessä ja millä rintamalla? Missä saanut sotilasopetuksen?
15) Onko ollut oikeudessa syytettynä? Ei Jos, niin mistä asiasta?
16) Omistaako S. N. T. Liitossa omaisuutta? Ei Jos, niin missä ja kuinka paljon?
17) Onko sukulaisia S. N. T. Liitossa? Nimet ja osoitteet. Ei.
18) Mikä järjestö suosittaa tulemaan Neuvostoliittoon? Milwaukeen Suomalainen Työväen Yhdistys.
19) Kuka yksilö suosittaa? Nimi ja osote:
20) Mukaan liitettävä kolme passikuvaa.

Matti Ervalt, Luoma
(Hakijan allekirjoitus.)
3157-S.18 th.St. Milwaukee, Wis.
(Täydellinen osote.)

Национальный Архив Республики Карелия

HENKILÖTODISTUKSIA.

Me olemme kokouksessamme tarkistaneet S. N. T. Liittoon hakijan toveri Matti E. Luoman toisella puolella esitetyn hakemuksen ja puolestamme parhaan asiantuntemuksemme perusteella pidämme sen todenmukaisena ja puolestamme voimme toveriluottamuksella suositella tämän hakemuksen hyväksymistä.
(Jos on mitään muistutuksia, on ne esitettävä tässä)

(Järjestön leima (jos on))
S. J. MILWAUKEE, WIS. YHDISTYS

Milwaukeen Suomalainen Työväen Yhdistys.
(Järjestön nimi.)
Virkailijoiden allekirjotukset:
(Puheenjohtaja)
(Kirjuri)

Allekirjottanut on tarkistanut tosella puolen olevan toveri hakemuksen S. N. T. Liittoon ja parhaan käsitykseni mukaan on siinä esitetyt tiedot todenmukaiset ja oikeat. Tunnen hakijan persoonakohtaisesti, suosittelen hakemuksen hyväksymistä.
Muistutuksia:
(Nimi)
(Osote)

Toveri hakemuksen olen tarkastanut, yksityiskohtaisemmin ottaen selvää hakijan hakemuksessaan esittämistä henkilö- y. m. tiedoista ja saamieni tietojen perusteella suosittelen hakemuksen hyväksymistä.
Muistutukset:

OHJEITA HAKIJOILLE.

a) *Silloin kuin mahdollista, hankkikaa järjestötodistukset sekä yksityiset todistukset hakemuksen yhteyteen järjestyille kaavakkeille. Silloin kuin se ei ole mahdollista, voi todistukset kirjoittaa liitteiksi hakemukseen.*
b) *Jos hakija on perheellinen ja perhe matkustaa mukana, on koko perheen käytävä lääkärintarkastuksessa hakemuksen vaatimuksien mukaisesti.*
c) *Hankkiessanne hakemuksen mukaan tarpeelliset valokuvat, ottakaa samalla hertaa vähintäin puoli tusinaa n. passikuvia. Täten säästytte menemästä uudelleen kuvaan passeja varten, jos hakemuksenne tulee hyväksytyä.*
d) *Kun hakemus tulee käsiteltyä ja siitä päätös, ilmoitetaan siitä ja samalla lähetetään lähempiä yleisohjeita passin hankintaa y. m. varten.*
e) *Jos olette työssä tai olette sellaista tilaisuudessa saamaan, älkää jättäkö ansiomahdollisuuksianne ennenkuin olette saanut varmuuden matkustuspäivästä. Muistakaa, että johainen dollari mikä voidaan hankkia, tarvitaan matkakustannuksiin, työkaluihin ja koneistoon.*

Karjalan Tehtiinen Apu
JUN 17 1932
New York, N. Y.

Национальный Архив Республики Карелия

Translation of the Application Form "K.A.S.N.T:n tulevien henkilötiedot"
(Personal Information of Soviet Karelian Technical Aid Applicants)

Preliminary Requirements:

1. Certificate from a leftist workers' organization required.
2. Doctor's certificate required, stating fitness for work and freedom from contagious diseases.
3. Do you have a family? How many members? The family may come, but the applicant must pay their own and their family's transportation.
4. How much money can you invest, if able: (a) in the general machinery fund: $_____ (b) in tools: $_____

Each family member 16 or older must complete this form personally, answering:

1. Full name.
2. Place and date of birth.
3. Family relations.
4. Nationality.
5. Schools attended and graduated from.
6. Occupation, and extent of experience in each.
7. On which country's passport do you travel?
8. When could you travel?
9. What kind of work do you expect to be recruited to?
10. Have you been in the USSR or old Russia before? If so, where and on what business?
11. Names and ages of children under 16. (Older family members file their own application.)
12. Party affiliation, since when, and other current and past organizations.
13. When did you travel to America, from where, and through which port?
14. Military service: if any, in which country's military, on which frontier, and where trained?
15. Have you been prosecuted in court? If so, for what?

16. Do you own property in the USSR? If so, where and how much?
17. Relatives in the USSR: names and addresses.
18. Which organization recommends you?
19. Which individual recommends you (name and address)?
20. Three passport photos must be attached.

E.1 North American Organizational Innovations

The organization of felling sites and the hauling of timber offers a case study of how North American workers introduced new organizational practices. According to the pocket guide by Bekrenev (1932), available in both Russian and Finnish and intended to serve as manual for local workers, the Canadian logging model divided the felling site into 30 meter wide plots, each to which one logger was assigned. Ice roads were built between each plot to reduce the friction in hauling. Hauling began immediately after the first plot was felled. The hauling was done using several fast-loading double-sleds each pulled by a pair of horses (as compared to the traditional Karelian one-horse sled), or crawler tractor. A logging team would consist of two to three sleds with one driver each, two loaders and five to six fellers. These between nine to eleven workers formed a team that would be called "brigade" in the Bolshevik lingo whereas the local model of organization was mostly pairs of loggers or so-called Yatcheikas that consisted of three to four workers with primitive division of tasks and fairly unorganized felling sites. The North American style brigade's horse-drawn transports unloaded directly the load onto a tractor-drawn sled that carried it to the side of a truck route. Empty sleds were transported back to the felling sites on different roads to avoid blocking the road of loaded sleds and also to preserve the roads. Figure E.2 provides some examples of these manuals that were published shortly after the arrival of the North American workers.

Several other organizational changes were introduced by North American Finns, for example they use clocks and regular schedule (instead of operating on a solar clock), improved the hygiene in workers' canteens which are known to have been on a different level in logging camps where North American Finns worked (Golubev and Takala, 2014).

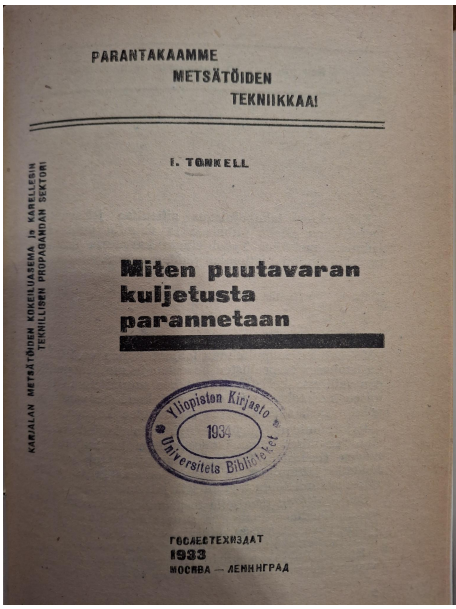
Table E.1: Productivity Gains of North American Methods and Technology

Technology	Measurement year	Unit	Productivity gain	Reference
Primary felling	Harvesting seasons 1930-31 and 1931-32	time	53.2%	Bekrenev (1932)
Frame saw	Harvesting seasons 1930-31 and 1931-32	time	33.6%	Bekrenev (1932)
Forest thinning (with axe)	Harvesting seasons 1930-31 and 1931-32	time	63.2%	Bekrenev (1932)
Gain of foreign worker in North American type logging team	Harvesting seasons 1930-31 and 1931-32	volume	74.9%	Bekrenev (1932)
Gain of foreign worker in a traditional Yatcheika	Harvesting seasons 1930-31 and 1931-32	volume	127.5%	Bekrenev (1932)
Loading of unit of timber on Canadian sled vs. local sled	Harvesting season 1931-1932	time	500%	Tonkel (1932)
Single foreign lumberjack gain per day in volume	Harvesting season 1931-1932	volume	283 %	NARK, f. R-286, o. 1, d. 22/200, l. 12
"North American methods" (Matroosa) gain per day in volume	Harvesting season 1931-1932	volume	400%	NARK, f. R-286, o. 7,
Log bucking	1933	volume	$\sim$ 200%	NARK, f. R-690,op. 3, d. 466, l. 17

Notes: Karelian Forestry Research Institute studied closely the organization of labor in logging teams of North American workers to create a scientific model of effective timber-harvesting methods, and many of the researchers were employed at the research station of Paatjärvi (Golubev and Takala, 2014). The cited research reports do not reveal whether the results are based on randomized controlled trials. We interpret them as observational studies.

Figure E.2: Manuals of North American Methods in Forestry

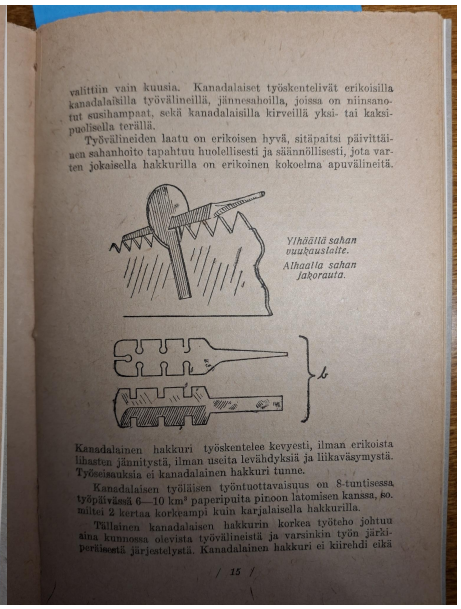
(a) Manual on timber hauling



(b) Planning of hauling roads

(c) Canadian frame saw manual

(d) Saw sharpening instructions



Note: Figures E.2a and E.2b come from a manual published in 1933 describing North American hauling methods and construction of transport roads to felling sites (Tonkel, 1933a). Figures E.2c and E.2d come from a manual manual published in 1933 providing instructions on how to build, apply and service a Canadian frame saw (Tonkel, 1933b). Both manuals are in Finnish but appear to be translations from Russian.

References

Abramitzky, Ran, Leah Boustan, and Katherine Eriksson (2012) "Europe's Tired, Poor, Huddled Masses: Self-Selection and Economic Outcomes in the Age of Mass Migration," *Am. Econ. Rev.*, 102 (5), 1832–1856, 10.1257/aer.102.5.1832.

Abramitzky, Ran, Leah Platt Boustan, and Katherine Eriksson (2014) "A Nation of Immigrants: Assimilation and Economic Outcomes in the Age of Mass Migration," *J. Political Econ.*, 122 (3), 467–506, http://www.jstor.org/stable/10.1086/675805.

Allen, Robert (1997) "Agricultural Marketing and the Possibilities for Industrialization in the Soviet Union in the 1930s," *Exploration: in Economic History*, 34, 387–410.

Bekrenev, Nikolai (1932) "Kanadalaiset Metsätöissä Neuvostokarjalassa [Canadians at Forestry Work in Soviet Union],"Technical report, Karjalan metsätutkimusasema, Kirja: Petroskoi.

Golubev, Alexey and Irina Takala (2014) *Finnish Immigration to Soviet Karelia from the United States and Canada in The 1930s*, East Lansing, Michigan: Michigan State University Press, https://ebookcentral.proquest.com/lib/helsinki-ebooks/detail.action?docID=3338353.

Kapelko, Natalia and Andrei Markevich (2014) "The Political Legacy of the Gulag Archipelago," working paper.

Karelobkom (1932) "Buyllyuten,"Technical report, Karelskij Oblastnoj Komitet VKP(b), Petrozavodsk.

KASSR (1929) *Materialy Statisticheskogo sbornika*, Petrozavodsk: Tipografiia im. Anokhina, Vypushchen 9 ianvaria 1929 g. In Russian.

KASSR, Upravlenie Narodno-khozyastvennogo ucheta (1934) *Ezhegodnik. 1932. 1933*, Petrozavodsk: Soyuzorguchet.

Korkiasaari, Jouni (1989) *Suomalaiset maailmalla : Suomen siirtolaisuus ja ulkosuomalaiset entisajoista tähän päivään / Jouni Korkiasaari.*, Turku: Siirtolaisuusinstituutti.

Kostiainen, Auvo (1978) *The Forging of Finnish-American Communism, 1917–1924 : a Study in Ethnic Radicalism*, Petrozavodsk: Siirtolaisinstituutti: Turku, Finland, https://urn.fi/URN:ISBN:951-9266-14-3.

Kurashev, M. I. ed. (1934) *Spisok promyshlennykh predpriyatiy k atlasu "Promyshlennost' SSSR na nachalo 2-y pyatiletki"*, Moscow: Vsesoyuznyy kartograficheskiy trest.

Lee, David S, Justin McCrary, Marcelo J Moreira, Jack R Porter, and Luther Yap (2023) "What to do when you can't use '1.96' Confidence Intervals for IV," Working Paper 31893, NBER, 10.3386/w31893.

Leeuwen, Macro. H.D. van, Sören Edvinsson, Ineke Maas, and Andrew Miles (2002) *HISCO : Historical International Standard Classification of Occupations: Historical International Standard Classification of Occupations.*, Leuven: Leuven University Press.

Maas, I and M. Van Leeuwen (2016) "A Short Note on HISCLASS," 10622/HEFSW2.

Markevich, Andrei, Natalya Naumenko, and Nancy Qian (2024) "The Causes of Ukrainian Famine Mortality, 1932–33," *Rev. Econ. Stud.*, rdae091.

NKPS (1939) *Skhema zheleznodorozhnykh i vodnykh putei soobshcheniia SSSR*, In Russian.

NKZ (1926) "Karta lesov Evropeiskoi chasti SSSR," [Map of forests of the European part of the USSR / RSFSR, People's Commissariat of Agriculture, Forestry Administration].

Pervozvanskii, I. V. (1959) "Ocherki po razvitiiu lesnogo khoziaistva i lesnoi promyshlennosti Karelii," in *Voprosy ratsional'nogo ispol'zovaniia lesov Karelii*, 5–75, Petrozavodsk, In Russian.

Ruggles, Steven, Sarah Flood, Matthew Sobek et al. (2024) "IPUMS USA: Version 15.0 [U.S. Census 1930]," https://doi.org/10.18128/D010.V15.0.

SNK (1931) *Sobranie zakonov i rasporiazhenii Raboche-Krest'ianskogo Pravitel'stva SSSR*, Moscow.

SSSR, TsSU (1928) *Vsesoyuznaya perepis naseleniya 1926 goda. Tom 1, otdel 1, Severnyj rajon, Leningradsko-Karelskij rajon: narodnost, rodnoj yazyk, vozrast, gramotnost.*

SSSR, VSNKh (1927a) *Prilozhenie k karte promyshlennosti SSSR. Evropejskaya chast*, Moscow: 14 tipografiya Mospoligraf.

Statisticheskoe upravlenie Karel'skoi ASSR (1929) "Biulleten'," 19 iiulia 1929 g. In Russian.

Statistics Canada (2023) "Census of Canada 1931," https://recherche-collection-search.bac-lac.gc.ca/eng/Census/Index, Retrieved October 8, 2024 from Statistics Canada.

Sutton, Antony C. (1971) *Western Technology and Soviet Economic Development, 1930 to 1945*, 2, Stanford, CA: Hoover Institution Press, Stanford University.

Takala, Irina (2002) *Finny v Karelii i v Rossii: Istroriya vozniknoveniya i gibeli diaspory*, Saint Petersburg: Neva.

Tonkel, Iosif (1933a) *Jännesaha*: Goslestekhizdat, toinen painos edition.

——— (1933b) *Miten puutavaran kuljetusta parannetaan [Engl. On How to Rationalize Timber Transports]*, Parantakaamme metsätöiden tekniikkaa!, Moskova - Leningrad: Karjalan metsätöiden kokeiluasema ja Karellesin teknillisen propagandan sektori: Leningrad, Karjalan metsätöiden kokeiluasema ja Karellesin teknillisen propagandan sektori.

TsSU (1931) *Ezhegodnik: 1929* (4).

TsSU, Tsentralnoe Statisticheskoe Upravlenie SSSR (1956) *Narodnoe Khozyastvo SSSR v 1956. (Statisticheskij sbornik)*, Moscow: State statistical press.

TsUNKhU, Tsentralnoe Upravlenie Narodno-khozyastvennogo Ucheta Gosplana SSSR (1934) *Sotsialisticheskoe stroitelstvo SSSR. (Statisticheskij ezhegodnik) 1934*, Moscow: Souzorguchet.

——— (1936) *Sotsialisticheskoe stroitelstvo SSSR. (Statisticheskij ezhegodnik) 1936*, Moscow: Souzorguchet.

VKPb, Severnyi kraevoi komitet (1933) *Sbornik postanovlenii Sevkraikoma VKP(b) po voprosam podgotovki kadrov dlia narodnogo khoziaistva Severnogo kraia*, Arkhangel'sk.

VTsSPS, Vsesoyuznii Tsentralnij Sovet Professionalnikh Soyuzov (1926) *Trud v SSSR. 1924–1926. Diagrammy*, Moscow: VTsSPS Press.