Trade Competition and Migration: Evidence from the Quartz Crisis

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Abstract. Foreign competition and technological change can both present threats to domestic industries, potentially resulting in out-migration from cities and regions where these industries are spatially agglomerated. In this paper, I study the migration effects of one such trade shock: The quartz crisis, which devastated the globally dominant Swiss watch industry in the 1970s. Using a differences-in-differences strategy, I show that this trade shock led to a rapid loss of population in affected areas, and a long-run change in growth patterns. This contrasts with many other studies of large trade shocks, which find little migration response. I highlight three key factors that distinguish this shock from others and may explain the divergence: 1.) the crisis negatively impacted a key export industry while generating no offsetting gains, 2.) the affected labor markets were highly non-diversified, and 3.) the affected workers were highly mobile.

1. Introduction

Economists have long recognized that the gains from international trade are not evenly distributed. Some firms and industries benefit from expanded export markets and lower cost intermediate goods, and competition can be efficiency enhancing, benefiting consumers. However, trade can also threaten the survival of competing domestic industries, as well as the livelihoods of the workers who depend on them. Much recent work has examined how the effects of trade competition may vary across space; some regions, specializing in newly-threatened industries, may bear a disproportionate burden of the costs of trade expansion. One key potential margin of response to industry decline resulting from trade competition is

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migration. Displaced workers may relocate from declining regions towards more prosperous ones. However, many recent studies documenting trade-induced job losses in Brazil, Europe, and the United States find little migration response. This naturally invites the question of when and where we should expect to see workers relocate in response to trade-driven employment loss.

To shed light on this question, I examine the consequences of one particular trade shock driven by both foreign competition and technological innovation: The quartz crisis, which led to the dramatic decline of the Swiss watch industry. From its roots in 16$^{\text{th}}$ century Geneva, this industry had experienced tremendous growth, becoming a major employer concentrated in many cities and towns across the Swiss Jura Arc; with some exceptions, the industry was completely absent in other areas of the country. Refinement of craftsmanship transmitted over hundreds of years eventually led the Swiss to dominate the global mechanical timepiece industry by the mid-20$^{\text{th}}$ century. This dominance was challenged in the mid-1970s by a surge in export competition from Japan and Hong Kong and, most enduringly, the invention of low-cost electronic quartz watch movements, which rendered mechanical timepieces functionally obsolete. This crisis affords an opportunity to study how cities and regions adapt to a sudden trade-induced economic dislocation.

I begin by discussing the geographic agglomeration of the watch industry. Using industry histories, employment data, and a nearly-exhaustive inventory of registered watchmakers and trademarks, I map its pattern of spatial concentration across Switzerland at the municipality level. I illustrate how the adverse shocks in the 1970s led to a sharp decline in exports, employment, and wage growth in the industry. Using a differences-in-differences approach, I then examine the growth of watchmaking areas compared to other areas of Switzerland before and after the crisis. I find evidence of only a modest growth rate differential before the crisis; during the crisis, municipalities involved in watchmaking experienced a sharp decline in population, followed by decades of stagnant growth.

To explore the mechanisms behind this population change, I exploit microdata from the Swiss Federal Census to document worker flows at the canton level. I show that cantons which were more exposed to the crisis saw a sizable reduction in their labor forces, and that this was largely driven by a decline in manufacturing workers. There is little evidence to suggest a shift towards non-manufacturing employment. The decline was largest among workers who were young, spoke German as a first language, were not homeowners, and had recently moved. Both native and foreign-born workers were affected similarly during the crisis, but the impact on the foreign workforce was larger in later decades, suggesting a long-run shift in immigrant location choices. None of these results are sensitive to a canton's share of non-watch manufacturing activity, suggesting that the impacts are industry-specific and not driven by general declines in manufacturing or export competitiveness. I also show that the labor market areas in which watchmaking was embedded were generally remote and highly non-diversified, with a significant share of their populations engaged in watchmaking, and with few other major industries.

This paper connects to a large literature on the effects of trade disruptions on local labor markets, as well as the literature that has extended this to examine how these labor market changes affect migration patterns. Similar in spirit to this study, Hanlon (2017) analyzes the effect of a transitory shock to the British textile industry due to cotton shortages stemming from the U.S. Civil War. He finds that this trade shock led to a temporary decline in growth rates for textile-producing cities, but not a sizable absolute population loss. Growth rates for these cities then increased following the war, approach their previous trend. The disruption I study reflected a more permanent demand shock and resulting reorganization of production, which led to a much larger absolute decline in both the population level and growth rate of affected areas.

This study is also closely related to recent work on the impact of trade liberalization and the rise of trade between the West, China, and Eastern Europe. Dix-Carneiro and Kovak (2019) study the regional effects of trade liberalization in Brazil, finding that workers in some areas were exposed to a much greater reduction in import tariffs than others. Despite the associated declines in employment and earnings, they find no substantial inter-regional migration response. Looking at the China shock in the U.S., Autor, Dorn and Hanson (2013) found that the sharp rise in imports between 1990 and 2007 had a substantial negative impact on employment and wages in regions vulnerable to Chinese competition. However, this shock did not translate into a sizable population decline in affected areas, suggesting that the geographic mobility of displaced workers may be quite low. Greenland, Lopresti and McHenry (2019) extend the work of Autor et al. (2013) to account for pre-existing growth trends and additional years of data, finding that the China shock did result in a negative shift in growth rates in affected areas, but with a considerable lag. Research in other contexts has found similar results. Analyzing the China shock in Norway, Balsvik, Jensen and Salvanes (2015) find a substantial impact on unemployment and labor force participation, but little mobility response. Donoso, Martín and Minondo (2015) likewise find little mobility response in Spain.

Why do we observe such a small migration effect in these settings? Some evidence from Feenstra, Ma and Xu (2019) provides a possible answer. They examine the China shock in the US and document job losses due to increased competition, as in previous work. They also find that much of the losses are offset by job gains in export-oriented industries that benefit from both a larger export market and lower input prices. Likewise, Caliendo, Dvorkin and Parro (2019) show that, at least in the long run, employment losses due to manufacturing decline are partially offset by the expansion of non-manufacturing industries. Dauth, Findeisen and Suedekum (2014) find results similar to those of Feenstra et al. (2019) in Germany: Overall job losses in Germany due to Chinese import competition were substantial, but they were offset by employment gains due to export-oriented industries, primarily those aimed at Eastern Europe. Donoso et al. (2015) find that manufacturing workers displaced by import competition from China were generally absorbed into non-manufacturing industries, resulting in little impact on unemployment or labor force participation. Dix-Carneiro and Kovak (2019) found that Brazilian workers displaced by trade were more likely to transition into the nontradable informal and service sectors.

This can help reconcile my findings in Switzerland with those of this recent literature. These studies have focused on broad increases in import competition, which negatively impact those affected by greater foreign competition, but which also generate benefits through lower-cost intermediate goods and exposure to larger export markets. This can facilitate sectoral mobility within different geographic areas, obviating the need for out-migration. In contrast, my study focuses on an industry-specific export shock with no associated gains from trade. Amplifying the effect of this shock is the composition of these local labor markets. They tended to be highly non-diversified, with a large share of the affected workers being relatively mobile. These results strongly suggest that the presence or absence of trade-induced migration will depend on both the composition of the trade shock itself, the industrial diversity of the affected regions, and the characteristics of the workforce.

The paper proceeds as follows. Section 2 reviews the data sources used in the analysis. Section 3 describes the growth and spread of the watch industry in Switzerland and its interactions with global competitors, outlining the economic forces that led to the decline of the industry. Section 4 examines the implications of this crisis for regional growth. Section 5 outlines the demographic composition of the affected workforce, compares mobility responses across different demographic groups, and examines the characteristics of their local labor markets. Section 6 concludes.

2. Data

The empirical analysis is based on data from numerous sources and can be divided into three broad categories: Locational information for the areas involved in watchmaking, economic data on the scale of the watch industry in Switzerland and competitor nations, and disaggregated, geographically-harmonized population data. I discuss each of these in further detail below.

2.1. **Geography of the watch industry.** Watchmaking emerged in many cities and towns across the country, and no complete inventory is available at the municipal level.[1] To determine what municipalities were engaged in the production of watches, I consulted a number of historical works on the development of the watch industry in Switzerland, including Jaquet and Chapuis (1970), Landes (1983), Glasmeier (2000), Trueb (2005), Marti (2007), Donzé (2011), and Donzé (2014). From these, most centers of watch production were identified.

Pritchard (1997) has compiled the most complete historical inventory of Swiss watchmakers to date, covering the entire period from 1775 to 1975. To supplement my initial inventory, I digitized the cities and towns recorded for the 5,578 watchmakers for which this information was available. The frequency of appearances here along with supplemental research was used to determine the final list of 90 municipalities substantially engaged in watchmaking prior to the crisis. Figure 1 illustrates the locations of these municipalities.

2.2. **Exports, exchange rates, and labor market outcomes.** Data on exports of watches from Switzerland is drawn from HSSO (2012d) and table 10 of Landes (1983).[2] The HSSO data covers the period 1960-1986 and are drawn from the Statistisches Jahrbuch der Schweiz, Bde. 1931-1987. Landes's export data is sourced from a 1980 report by the Chambre Suisse d'Horlogerie, and covers the period from 1926 to 1980. Where they overlap, both series report the same export figures. This data is presented in figure 2. Export data for Japan comes from table 8.4 of Glasmeier (2000), sourced from the Japanese Ministry of Trade and Industry; it is shown alongside the Swiss data in figure 3. Exchange rates for the Swiss franc and Japanese yen (relative to the US dollar) are drawn from FRED (2020a,b).

Estimates of total employment in the Swiss watch industry are drawn from Bédat (1992), Glasmeier (2000), Donzé (2011), and HSSO (2012a,b,e). The estimates from each source differ in the time span covered; some are drawn from official government statistics while

[1]The share of the industrial workforce engaged in watchmaking at the canton level (up to 1965) is available; see panel (H) of appendix figure A4.

[2]Much of the data utilized here comes from the Historical Statistics of Switzerland (HSSO), which aggregates social and economic data from a large array of historical sources. See Leimgruber (2018) for a history of this project.

Figure 1. Watchmaking Areas of Switzerland

Map depicts Switzerland divided into 16 distinct large labor market areas, as defined by the Swiss Federal Statistical FSO (2018). Municipalities involved in watchmaking are denoted by triangles.

others are based on information from trade groups.[3] Some provide different estimates for the same years, likely due to differences in the extent to which they capture part-time and home workers. Appendix figure A2 plots the raw data from each series, revealing a generally high level of agreement and the same trend of expansion followed by decline. To construct a single estimated time series for employment covering the entire period of interest, 1900 to 2000, I linearly interpolate each series over the range it covers, then average these interpolated series. This estimated series is plotted in figure 4. HSSO (2012e) provides a breakdown of employment across cantons and nine different secondary-sector industries over the period 1895 to 1965. This is used to estimate the share of manufacturing workers employed in watchmaking and other sectors for each canton as of 1965 (appendix figure A4).

[3]The data from Donzé (2011) was sourced from the Convention Patronale de l'Industrie Horlogère's *Recensement* 2007, page 13. Glasmeier's (2000) table 7.5 data is from the Suisse Recensement Fédéral des Entreprises, Année 1929, II, pages 2-5. Glasmeier's (2000) table 9.3 data is taken from the Fédération de l'Industrie Horlogère Suisse and includes (self-employed) homeworkers, who were a sizable share of the total workforce.

Data on wages in the industrial sector is taken from HSSO (2012c), which reports average nominal wages for all male secondary-sector workers and separate averages for twelve subsectors.[4] This data was sourced from statistical yearbooks and Federal Office of Industry, Commerce, and Labor publications. Appendix figure A3 illustrates the evolution of mens' wages in each subsector relative to the average.

2.3. **Population.** To track regional growth over time, a geographically-harmonized population time series is needed. Switzerland is subdivided into 26 cantons, each with substantial political autonomy.[5] Some cantons are further subdivided into districts, and all cantons record the municipality as the smallest official administrative subdivision.[6] In the year 2000, there were 2,896 municipalities; population characteristics for these can be found in table 1. Mergers of municipalities are very common; divisions occur as well, but they are relatively rare. The Federal Statistical Office of Switzerland has provided a decadal population data series that harmonizes merged municipalities over the entire period from 1880 to 2000; divided municipalities are reported separately, and controls are added to each model to account for population changes due to secessions.[7] Additional microdata comes from the 5 percent sample of the Swiss population from each decadal census from 1970 to 2000 available through IPUMS (MPC 2019); while this data contains more detail, it only covers the period after 1970 and only reports geographic location at the canton level. This will allow

[4]The subsectors included are chemicals, clothing, construction, electricity, food, graphic arts, metals and machines, paper, stone and earth, textiles, watches and jewelry, and wood. I exclude the clothing and paper industry wage data from the individual-subsector analysis, as the definition of both subsectors was changed substantially in 1974, so it is not clear if the wage series is comparable pre- and post-crisis. However, both are included in the overall average by necessity.

[5]Prior to 1979, there were only 25 cantons; the canton of Jura seceded from Bern in 1979, hence its absence from appendix figure A4. In the population time series, municipalities that are part of Jura are recorded as such over the entire time span.

[6]All areas of Switzerland are part of a municipality; some municipalities are proper cities and towns, others are entirely rural.

[7]While the boundaries have been largely harmonized in this data series, there are occasional population changes due to land/building exchanges or changes in recorded municipality for individual villages/hamlets. Of the 2,896 municipalities, 193 were identified as possibly subject to boundary changes that may have affected population levels. Most of these changes occurred in the late 19th or early 20th century. Only five affected watchmaking municipalities, including Vevey (1892), La Chaux-de-Fonds (1900), Les Ponts-de-Martel (1910), Biel (1919), Geneva (1982), and Sion (1989,1900). The first four of these boundary changes occurred far before the crisis period I focus on. The last three affected only a handful of individuals. Excluding all 193 municipalities with possible boundary changes yields results that are virtually identical to those presented below.

for an exploration of heterogeneous effects across demographics, as well as the calculation of industry concentration measures. To compare such measures with those in the US, similar data was obtained from NHGIS (Manson, Schroeder, Van Riper, Kugler and Ruggles 2021).

Table 1. Summary Statistics

	Watch-producing municipalities	Other municipalities
Average population:		
▷ 1900	7,804 (22,164)	936 (2,667)
▷ 1970	16,606 (52,669)	1,705 (5,484)
▷ 1980	14,980 (46,514)	1,792 (5,090)
▷ 2000	15,053 (46,091)	2,114 (5,065)
Median population:		
▷ 1900	1,423	489
▷ 1970	1,962	591
▷ 1980	1,961	635
▷ 2000	2,281	829
Share of total Swiss population:		
▷ 1900	21%	79%
▷ 1970	24%	76%
▷ 1980	21%	79%
▷ 2000	19%	81%
Total number	90	2,806

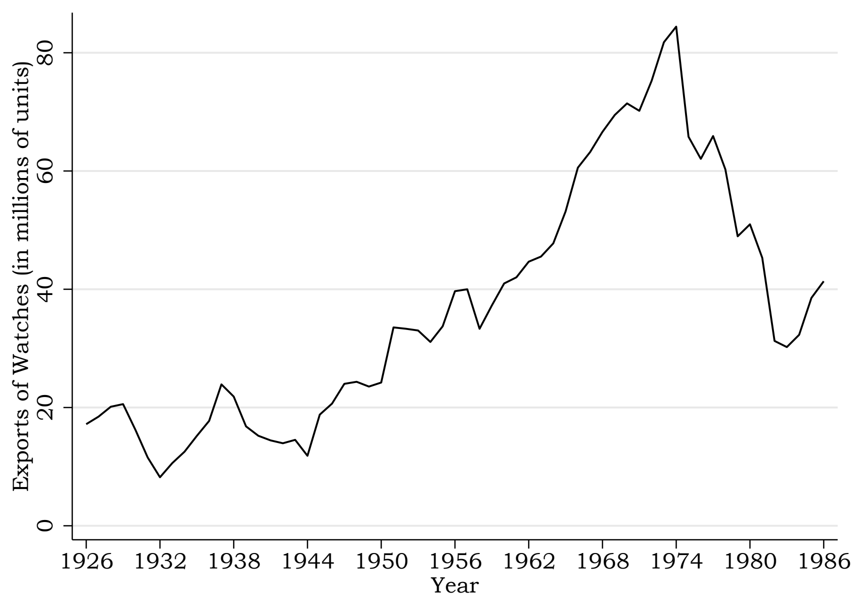
Standard deviations are reported in parentheses.

3. Historical context

3.1. **Watchmaking before the crisis.** The watch industry in Switzerland initially rose to international prominence in Geneva during the 16$^{\text{th}}$ century, later expanding throughout the Jura Mountain Arc. Watchmaking became a major industry in cities like La Chaux-de-Fonds, Le Locle, and Neuchâtel, and the surrounding area would come to be known as the "Watch Valley." This can be seen in the upper left portion of figure 1; most of Switzerland's watch industry concentrated in this largely French-speaking region of the country. Some outposts in

German-speaking areas developed in the 19th century, particularly in Grenchen, Solothurn, and Schaffhausen, while in the south, some watchmaking emerged in the predominantly Italian-speaking canton of Ticino (Landes 1983). The industry grew substantially throughout the 19th and early 20thcentury. Between 1910 and 1940, the industry experienced instability due to trade disruptions stemming from World War I, the Bolshevik Revolution (which closed off the important Russian market to trade), and the Great Depression (Donzé 2011, Glasmeier 1991). Following World War II, exports began to grow rapidly (figure 2). Post-war demand was high, and Switzerland's main European rivals had seen their industrial capacity decimated. By the 1950s, the Swiss had achieved a position of global dominance, accounting for over half of global watch exports (Landes 1983). Swiss exports reached a peak of around 84 million units in 1974.

FIGURE 2. Exports of Swiss Watches, 1926-1986

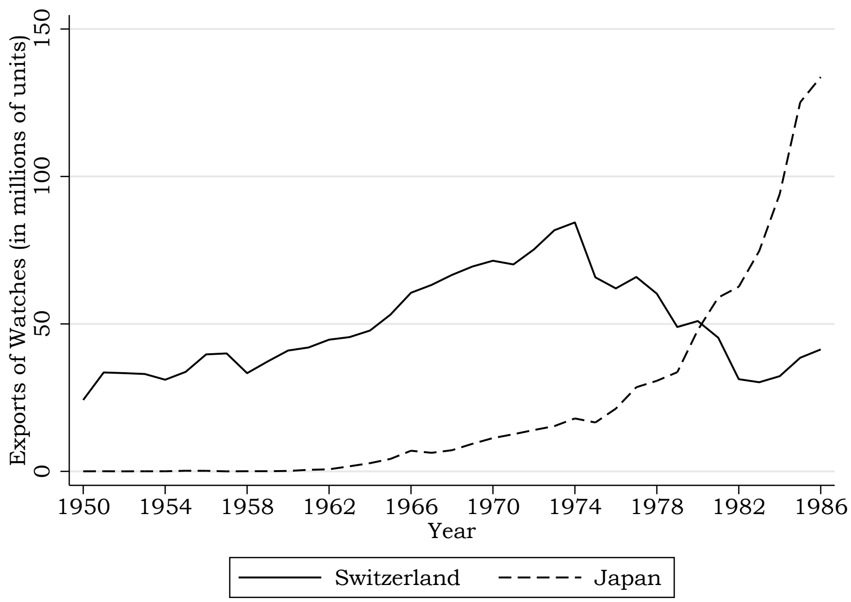


3.2. **The quartz crisis.** The spectacular growth in Swiss watch exports over the 1950s and 1960s was matched by an equally spectacular decline beginning in the mid-1970s. This period is often referred to as the quartz crisis.[8] Two major factors led to this decline. The first was the rise of competition from Japan. Japanese companies, such as Seiko, Citizen,

[8]It is also variously referred to as the *crise horlogère* (watchmaking crisis) and the quartz revolution.

Orient, and Casio, began to hone their ability to mass produce mechanical watch movements that were both high quality and affordable (Glasmeier 2000). Exports from Japan expanded rapidly throughout the 1970s, and finally exceeded those of Switzerland by 1981 (figure 3). By 1985, the Japanese were exporting three times as many watches as the Swiss, whose exports declined by over 50 percent from a peak of 84 million in 1974 to around 30 million in the early 1980s. This represented a major competition shock.

Figure 3. Watch Exports from Japan and Switzerland, 1950-1986



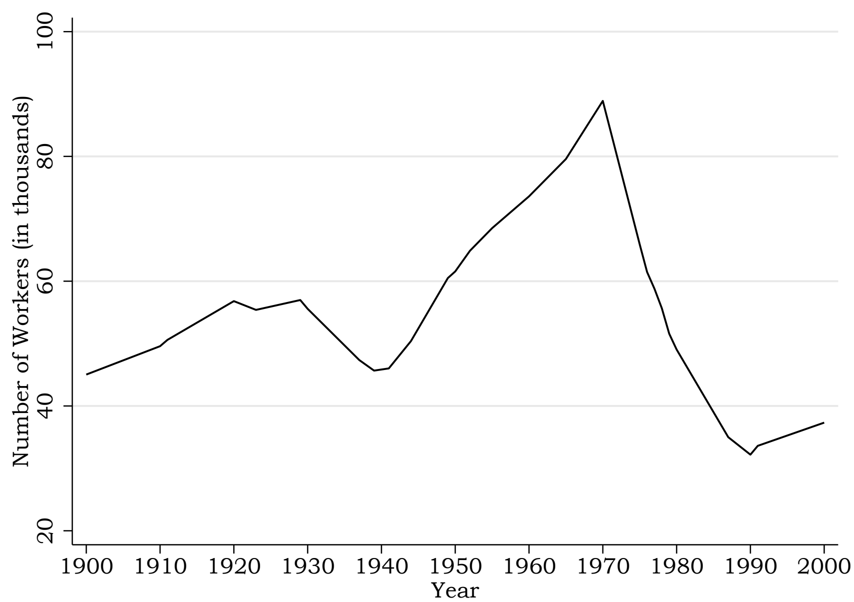
The second and most important factor in this decline was the result of a crucial technology shock: The development of quartz wristwatches. In contrast to purely mechanical timepieces, these kept time using an electronic quartz oscillator, with much greater accuracy than any mechanical watch.[9] In December 1969, Seiko released the *Astron*, the first production quartz wristwatch. Priced at around the cost of a new car, it posed little threat to the existing mechanical industry. However, the technology developed rapidly, and by the end of the 1970s the cost of producing a reliable quartz watch had declined to a small fraction of the cost of a quality mechanical timepiece. This shift towards easy-to-manufacture quartz movements allowed both Japan and (especially) Hong Kong to greatly expand their watch

[9] The first quartz-based wall clocks had been proposed at Bell Labs in the 1920s; however, it took much longer to practically miniaturize the technology (Marrison 1948, Stephens and Dennis 2000).

industries. Employment in Hong Kong's watch and clock industry rose from around 10,000 in 1970 to almost 50,000 in 1980 (Donzé 2012). By then, Hong Kong was the world's fastest growing watch producer (Thompson 2017). With the development and mass marketing of quartz watches, Swiss mechanical timepieces were rendered functionally obsolete.

The shocks outlined above had a rapid and sizable impact on the Swiss watch industry. Overall employment in watchmaking fell sharply (figure 4). From its 1970 peak of almost 90,000, employment declined to less than 50,000 over the course of the decade; by 1990, employment would reach 34,000. Only five of the twenty-six cantons experienced an absolute decline in employed workers between 1970 and 1980, and three of them (Neuchâtel, Solothurn, and Bern) were centers of watchmaking, with over 20 percent of their secondary-sector workforce engaged in the watch industry prior to the crisis. The canton of Neuchâtel was hit particularly hard. 24 percent of its workers (and almost 60 percent of its secondary-sector workers) were employed in watchmaking prior to the crisis (Garufo 2015). By 1990, only 11 percent of workers remained in the watch trade. Neuchâtel's total employed population declined by 9 percent between 1970 and 1980, and its employment to population ratio declined by 7 percent.

Figure 4. Employment in Watchmaking, 1900-2000



Nominal wage growth also suffered relative to other industries. Panel (I) of appendix figure A3 shows the growth of nominal hourly wages for men in the watch industry, plotted against an average across all industrial sectors. The wage series are virtually identical until the early 1970s, when a clear divergence begins. Between 1970 and 1983, the average wages across all industries increased by 132 percent; this increase was only 87 percent for the watches and jewelry subsector. The overall price index for the Swiss franc increased approximately 88 percent over this period, suggesting stagnant wages in watchmaking despite growing real wages in other industries. Appendix figure A3 also shows the evolution of wages for nine other secondary-sector industries. For eight of these industries, there is essentially no divergence from the average for the entire period for which I have data.[10]

3.3. **Industry response.** With the rise of foreign competition and quartz technology, the Swiss were forced to substantially reorganize production. Many firms responded by shrinking employment and output; others closed entirely. In 1970, there were 1,618 enterprises involved in watchmaking in Switzerland, but by 1980 that number had declined by nearly half to 861; by 1990, there were only 572 enterprises remaining (Donzé 2011). Many of the remaining companies slowly consolidated under the umbrella of several large watchmaking groups, such as the Swatch Group (1983) and Richemont (1988). Many large companies, such as Longines and Omega, ceased producing watch movements in house. The production of movements was increasingly consolidated within ETA, which adopted mass production methods that reduced the required labor input. Additionally, the production of some watch components (such as cases) was increasingly outsourced abroad.[11] Instead of focusing on production,

[10]The one exception is the textiles sector, which saw a similar decline. However, the clothing industry contributed relatively little to employment in the major watchmaking cantons, and was virtually absent in Neuchâtel. The share of industrial workers in watchmaking at the canton level was negatively correlated with the share in the clothing sector (appendix table A1).

[11]Switzerland was already quite open to trade by the 1960s, with the lowest tariff rates on imports among advanced industrial countries, and this remained the case throughout the 1970s as part of their strategy of export promotion (Katzenstein 1980). Switzerland had been part of the European Free Trade Association since 1960, and party to the GATT since 1966 (Church and Head 2013). The approval of the 1972 Free Trade Agreement with the European Community may have modestly lowered the cost of offshoring production to Germany, Italy, and France, who were major suppliers of watch cases.

brands instead pivoted to a reliance on marketing, using standardized and outsourced movements packaged in different ways to target different audiences and price points.[12] The shift towards centralized production and a branding-centered approach to sales can be seen in the employment numbers. Between 1970 and 1980, the number of industrial and home workers in the watch industry declined by 49% and 79%, respectively, while the number of managerial employees declined by only 18% (Glasmeier 2000). The Swatch Group also marketed quartz watches, including the famous Swatch.

Despite this consolidation, the Swiss still lost considerable market share, as Japan and Hong Kong were able to scale output much faster. Why were the Swiss slow to respond to their new competitors? Several factors come into play here, with one of the most important being the highly decentralized nature of the Swiss industry initially. One of the key factors behind Japanese success was standardization and mass production. On the eve of the crisis, the Swiss industry was in the opposite position - most firms were small, and products were highly diverse in terms of quality, materials, and price. In 1970, there were 1,618 different firms, averaging only 55 employees each. Additionally, a substantial amount of components were produced by self-employed home workers, accounting for around 15% of the workforce (Glasmeier 2000).

This organization of production was partly due to historical factors that encouraged decentralization. In the early 20$^{\text{th}}$ century, the vast majority of watchmaking firms were family-owned, averaging only 35 employees each in 1923 (Donzé 2011). These owners preferred to maintain control over their firms, supporting a cartel-like arrangement to prevent consolidation; this also prevented the standardization that would allow for more mass production. The Swiss government supported this organization of production. The Jura region during this time was heavily dependent on watchmaking, and had few alternative industries (Bassand 1975, Donzé 2011). The centralization of production in major urban centers, or its offshoring to other countries, would represent a major threat to the economy of the region.

[12] This is very similar to the evolution of manufacturing that Bernard, Smeets and Warzynski (2017) document for Denmark. They find that manufacturing companies frequently shifted out of production, but maintained the marketing, sales, and distribution aspects of their core businesses.

The government also believed that centralization of production would be conducive to trade unions and communist activism, a major concern in the aftermath of the 1918 general strike (Donzé 2011). This led them to support many policies aimed at keeping production within Switzerland and concentrated in small and medium enterprises, including restrictions on exports and factory expansions and the legalization of price floors. Donzé (2011) suggests that this decentralization delayed the rationalization of production necessary for the Swiss to become competitive on the world market, giving other countries a chance to establish a firm foothold.[13]

Additionally, the shift towards quartz eliminated much of the lower-price end of the market for Swiss watches. While the Swatch was a successful product, this was largely based on marketing, and its popularity eventually declined. In a world where analog quartz watches could be cheaply produced anywhere, there was limited opportunity for profit given the costs of production in Switzerland. Quartz was also associated with the use of digital watch displays utilizing inexpensive LCD screens. The popularity of these watches arguably put Switzerland at a structural disadvantage (Glasmeier 2000). Japan and the United States had developed a substantial electronics industry as a byproduct of World War II; Switzerland, however, lagged in this area as a result of its neutrality. Hong Kong benefited greatly from trade and technology transfer with Japan and the U.S., and they were easily able to expand their digital watch industry (Donzé 2011). Due to the highly decentralized nature of the Swiss system at the start of the crisis, they were unable to quickly enter this market.

4. Implications for regional growth

The results in section 3 suggest a large and rapid economic shock to a highly spatially-concentrated industry. What impact did this have on the growth of the affected cities and

[13] One additional factor may have helped Japan and other countries out-compete the Swiss in the early days of the crisis. Donzé (2011, 2014) argues that the impact of Japanese competition was magnified by exchange rate dynamics. The 1970s collapse of the Bretton Woods system and ensuing inflation in the United States greatly increased the demand for safe currencies, including the Swiss franc (Baltensperger and Kugler 2017). This flight to safety led to a dramatic appreciation of the franc relative to the US dollar (figure A1). While the Japanese yen also appreciated relative to the dollar, this appreciation was much less severe. As the U.S. accounted for 36 percent of Swiss watch exports prior to the crisis, this change in relative exchange rates likely accelerated the Japanese takeover of the watch market.

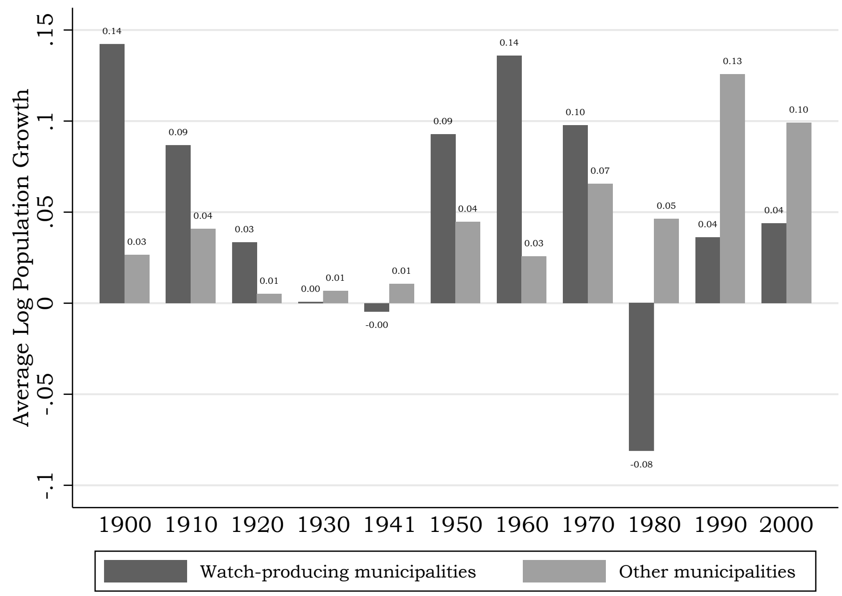
regions? Figure 5 documents the average decadal change in log population for municipalities engaged in watchmaking compared to other municipalities between 1888 and 2000. Prior to the crisis, watchmaking municipalities tended to have relatively high growth rates. However, a stark divergence emerged during the period of the crisis in the 1970s. Between 1970 and 1980, watchmaking areas saw population declines of 0.08 log points on average, while non-watchmaking areas grew by 0.05 log points.[14] Overall, watchmaking municipalities lost almost 150,000 residents over this period. The rest of Switzerland saw an increase in population of almost 250,000. This was the largest decadal divergence between these two groups over the entire period examined, and a decline without precedent in the previous 100 years. Following that decline, growth in watchmaking areas was anemic amidst strong overall population growth in Switzerland. Appendix figure A5 shows the entire distribution of municipal growth rates for the pre-crisis, crisis, and post-crisis decades, illustrating that these results are not driven by outliers, but reflect a sizable shift in the entire distribution of growth rates for watchmaking municipalities.

As is clear from figure 1 and table 1, municipalities involved in the watch trade differed systematically from others. Geographically, they were more likely to be located in the mountainous northern and western areas of the country, close to the borders with France and Germany. Culturally, they tended towards French-speaking areas. They were also larger on average, and exhibited greater variance in population size. Differences in size and location could result in differential growth patterns.[15] This motivates the use of a standard differences-in-differences approach, where we can compare the relative decadal change in log population ($\Delta \ln(population_{mt}) = \ln(population_{mt}) - \ln(population_{mt-10})$) between watchmaking and non-watchmaking municipalities, accounting for year and municipality fixed effects. Equation 4.1 presents the general estimating equation.

[14] I use the change in log population growth as the main outcome variable, following Autor et al. (2013) and others in this literature. Using raw growth rates provides very similar results.

[15] Leuba (2019) shows that natural amenities strongly influence the spatial distribution of income in Switzerland, providing further evidence on the importance of accounting for local fixed effects.

Figure 5. Average Municipal Growth Rates



Average of decadal change in log population across municipalities, computed separately for watchmaking and non-watchmaking areas.

$$
\begin{aligned}
\Delta \ln(population_{mt}) = \; & \beta' \gamma_t \times \lambda_m + \gamma_t + \delta_m + \phi \ln(population_{mt-10}) \\
& + \varphi \ln(population_{mt-10})^2 + \eta' X_{mt} + \epsilon_{mt}
\end{aligned}
\tag{4.1}
$$

This empirical specification includes municipality (δ_m) and year (γ_t) fixed effects, as well as a quadratic for the lagged level of log population; this allows for a systematic relationship between city size and growth. The year fixed effects are interacted with an indicator λ_m for municipalities that were engaged in watchmaking prior to the crisis.[16] In the most basic

[16] Typically, studies of trade-induced disruption use a measure of employment intensity, rather than the indicator approach I use here (see, e.g., Autor et al. (2013)). In that case, the main term of interest would take the form $\beta' \gamma_t \times \frac{Emp_{mtw}}{Emp_{mt}}$, where Emp_{mtw} is the number of workers employed in watchmaking in a given year/municipality and Emp_{mt} is the total number of workers, so that $\frac{Emp_{mtw}}{Emp_{mt}}$ measures the share of the working population employed in watchmaking. This is not feasible to implement in this setting, as there is no comprehensive record of municipality-level employment in different industrial sectors. Thus, I follow the approach of Hanlon (2017), measuring exposure to the shock using an indicator for pre-crisis involvement in watchmaking. Given the relatively small size of most affected cities (averaging fewer than 20,000 residents in 1970, with a median of 2,000), the presence of watchmaking at scale likely made the sector an important part of the local economy for most of these cities. Across the entire district of Courtelary, home to 18 municipalities (11 engaged in watchmaking), 56% of the working population were engaged in watchmaking in 1970 (Marti 2007).

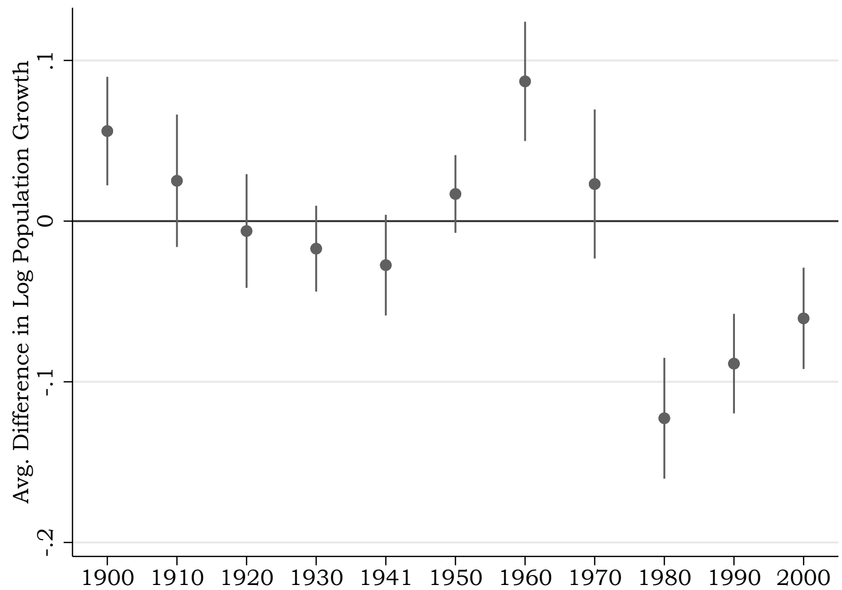
specification, presented in column (1) below, the only other predictors included in X_{mt} are indicators for municipal secession (where necessary). Additional predictors are added in other regressions. In my preferred specification, nonparametric canton-level time trends are included in X_{mt} to account for growth fluctuations at the regional level. Cantons have significant policymaking autonomy, and canton-level policy changes may affect municipal growth rates.[17] The estimated βs from this regression, representing the average difference in log population change between watchmaking municipalities and others for each decade, are plotted in figure 6; exact values and standard errors are given in column (3) of table 2.

This analysis shows that, prior to the 1970s crisis, watchmaking municipalities tended to grow at a slightly faster rate, on average about 0.02 log points, once differences in size and regional growth trends are accounted for. Watchmaking areas grew somewhat faster at the end of the 19$^{\text{th}}$ century and in the 1950s, both of which were boom times for the industry. These areas may have grown moderately more slowly during the 1910-1941 period, possibly due to instability experienced by the industry during this time (discussed in section 3). Though the estimated grow rate differential does vary from year to year, it is significantly different from zero in only two of the eight pre-crisis decades, and positive in both cases.

This changes substantially after the onset of the crisis. Between 1970 and 1980, watchmaking areas grew almost 0.12 log points slower than non-watchmaking areas. This large relative growth disparity persists through the following two decades. Between 1990 and 2000, growth in watchmaking cities was 0.06 log points lower than in others, a relative decline not

[17] For example, both cantons and municipalities set their own tax rates, and research has found sizable mobility responses to both (Brülhart, Gruber, Krapf and Schmidheiny 2019, Feld and Kirchgässner 2001, Schmidheiny 2017). Appendix figure A6 illustrates how these changed over the period 1965-1989 for cantonal capitals. Rates for five cantons where watchmaking was a major industrial sector are plotted; all of these capitals were watchmaking cities, and were generally also among the largest of these in each canton. I also include the average rates across all other cantons. For the 25,000 and 50,000 CHF tax brackets, rates in watchmaking cantons were similar to or slightly higher than average, but declined at the same pace over this period. Rates in the 200,000 CHF bracket tended to be substantially higher than average, though this likely affected relatively few watchmaking workers. Wealth tax rates varied considerably more, with some watchmaking cantons levying higher than average rates on some brackets and others lower. Of three watchmaking cantons that saw the largest population declines between 1970 and 1980, only Solothurn levied a higher tax on the 100,000 bracket, and by 1989 their rate had converged to the average. Neuchâtel and Solothurn did levy substantially higher rates on the highest wealth levels over this period, which may have further incentivized some to relocate in response to the crisis. Likewise, Schmidheiny (2017) finds that contemporary tax rates on the highest levels of wealth and income are greatest in the Jura arc region.

FIGURE 6. Relative 10-Year Average Changes in Log Municipal Population



Graph depicts the coefficients and confidence intervals from column (3) of table 2.

seen in any decade in the 80 years preceding the crisis. The estimated growth disparities, accounting for year/municipality fixed effects, differences in population size, and variation in regional growth trends, are strikingly similar to those seen in the raw data. The differences in growth rates shown in figure 6 are numerically almost identical to those found in figure 5. This strongly suggests that the crisis led to a substantial population decline, followed by decades of stagnant growth, and that this is not an artifact of broader regional trends.

Table 2 provides results from several alternative specifications. Results from the most basic analysis, including only year/municipality fixed effects and secession indicators, are shown in column (1). Column (2) add linear canton-specific time trends. Both of these specifications yield results very similar to those of the primary specification with nonparametric trends, shown in column (3). In column (4), I replicate (3) while excluding all municipalities that may have experienced boundary changes; this yields virtually identical results. In column (5), I include canton-level lagged employment shares in eight non-watch industrial sectors, interacted with year fixed effects to allow their impact to vary over time. This should capture growth changes due to changes in the relative performance of different industries.

TABLE 2. Relative Changes in Log Municipal Population Growth

	Change in log total population				
	(1)	(2)	(3)	(4)	(5)
1900 × λ_m	0.050***	0.054***	0.056***	0.051***	
	(0.0170)	(0.0166)	(0.0172)	(0.0182)	
1910 × λ_m	-0.008	0.003	0.025	0.026	-0.028*
	(0.0210)	(0.0209)	(0.0210)	(0.0228)	(0.0146)
1920 × λ_m	-0.020	-0.005	-0.006	-0.005	-0.057***
	(0.0176)	(0.0172)	(0.0180)	(0.0197)	(0.0199)
1930 × λ_m	-0.051***	-0.034**	-0.017	-0.017	-0.068***
	(0.0135)	(0.0133)	(0.0136)	(0.0146)	(0.0137)
1941 × λ_m	-0.061***	-0.042***	-0.027*	-0.031*	-0.078***
	(0.0148)	(0.0152)	(0.0160)	(0.0173)	(0.0141)
1950 × λ_m	0.002	0.022**	0.017	0.015	-0.033**
	(0.0114)	(0.0111)	(0.0123)	(0.0131)	(0.0132)
1960 × λ_m	0.069***	0.093***	0.087***	0.088***	0.038**
	(0.0199)	(0.0195)	(0.0189)	(0.0202)	(0.0188)
1970 × λ_m	0.002	0.031	0.023	0.030	-0.023
	(0.0229)	(0.0227)	(0.0236)	(0.0247)	(0.0224)
1980 × λ_m	**-0.154*** **	**-0.122*** **	**-0.123*** **	**-0.121*** **	**-0.168*** **
	(0.0181)	(0.0186)	(0.0192)	(0.0199)	(0.0211)
1990 × λ_m	**-0.129*** **	**-0.100*** **	**-0.089*** **	**-0.086*** **	**-0.137*** **
	(0.0156)	(0.0153)	(0.0158)	(0.0165)	(0.0198)
2000 × λ_m	**-0.102*** **	**-0.073*** **	**-0.061*** **	**-0.057*** **	**-0.110*** **
	(0.0169)	(0.0162)	(0.0161)	(0.0171)	(0.0184)
Year FEs	Yes	Yes	Yes	Yes	Yes
Municipality FEs	Yes	Yes	Yes	Yes	Yes
Canton-level trends	None	Linear	Nonparametric	Nonparametric	Nonparametric
Omit boundary changes	No	No	No	Yes	No
Lagged industry shares	No	No	No	No	Yes
Observations	34,643	34,643	34,643	32,334	31,770
Adjusted R^2	0.203	0.230	0.277	0.274	0.290

*** p<0.01, ** p<0.05, * p<0.1

Regressions of decadal change in log municipal population on various predictors for the period 1888 to 2000. All regressions include a quadratic of the log municipal population level in the previous decade and indicators for municipal secession (if necessary). All regressions also include year fixed effects interacted with an indicator (λ_m) for involvement in watchmaking; these coefficients are reported in the table. Bold indicates growth rates in the post-crisis period. Column (2) adds canton-specific linear time trends. Column (3) replaces the linear time trends with year-canton fixed effects (these coefficients are plotted in figure 6). Column (4) repeats (3), but excludes any municipality that may have experienced a boundary change. Column (5) repeats (3) with the inclusion of lagged canton-level employment shares in eight non-watch industrial sectors; employment shares are interacted with year fixed effects to allow their impact to vary over time. Standard errors are clustered at the municipality level.

This approach yields even larger estimates for the impact of the crisis. Overall, all of these models show a substantial decline in the population of watchmaking municipalities (in both relative and absolute terms) during the quartz crisis, and the growth disparities persisted for at least two decades. The size of the 1970-80 decline in watchmaking areas was without precedent in the previous 100 years.

The possibility remains that the decline in watchmaking cities and towns was due to other microregional factors, such as proximity to national borders or changes in transportation infrastructure.[18] To test for this, I employ a placebo-type approach using municipalities that were located proximate to watchmaking areas.[19] If regional factors independent of watchmaking are driving out-migration decisions, then we would expect to see relative population declines in these adjacent municipalities as well. If we do not, this would provide further evidence that the crisis was indeed the cause of decline.

The interpretation of this exercise is complicated by two other possible factors. The reason that this is not a true placebo exercise is precisely because these adjacent municipalities may be indirectly affected by the watchmaking crisis. If economic activity in these municipalities tended to serve watchmaking areas, then they may experience a relative decline due to a reduction in the value of their target markets. So, observing that adjacent municipalities are also negatively affected does not necessarily imply that the crisis is not driving out-migration; it might simply be evidence of spillover effects. Alternatively, we may observe relatively high growth rates in these adjacent areas, as individuals from watchmaking areas may switch occupations and relocate to these areas. Despite these possibilities, the comparative exercise is still informative. If it is the case that watchmaking-adjacent areas grow at a rate similar to (or faster than) other non-watchmaking areas, this does provide evidence that the crisis is

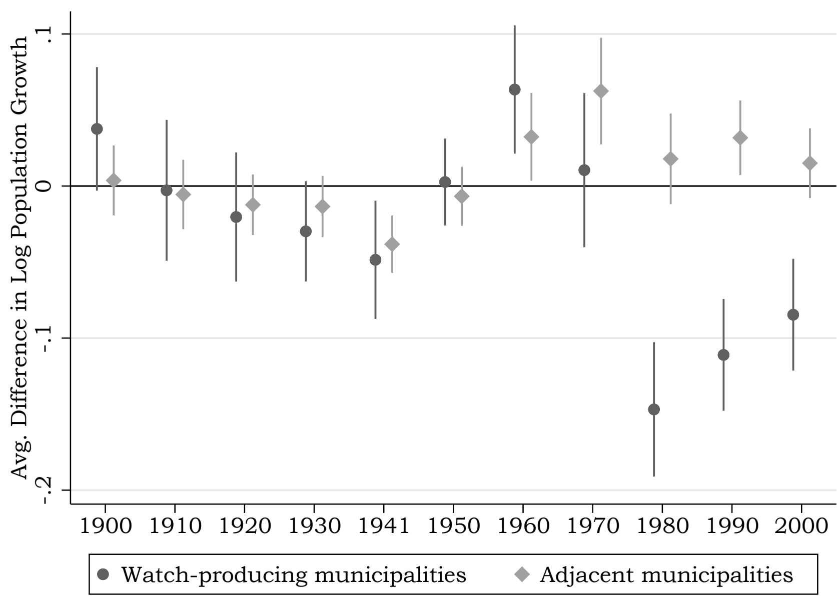
[18]Both Fretz, Parchet and Robert-Nicoud (2017) and Büchel and Kyburz (2020) have illustrated the importance of infrastructure development for regional growth in Switzerland.

[19]Since historic municipality-level geospatial data is not available, I treat municipalities as proximate if they are located in the same district. Districts tend to be fairly small; currently, the median district land area is 66 mi^2 (171 km^2), with an average of 104 mi^2 (269 km^2). This is roughly the land area of Brooklyn and Queens, respectively. While most municipalities are associated with a district, some areas do not have district subdivisions. I group non-districted municipalities together by canton; the largest of these non-districts is in the canton of Neuchâtel, with a land area of approximately 309 mi^2 (800 km^2, about the size of New York City proper).

driving out-migration. If they grow faster, this is positive evidence of spillover effects. This latter possibility illustrates the value of the highly localized data used here; data at a more aggregate level (e.g., districts or cantons) would miss this local migration effect.

To generate this comparison, I use the main specification from column (3) of table 2 and estimate it on two samples. The first sample includes only watchmaking municipalities and municipalities outside of districts containing watchmaking activity. The second sample replaces watchmaking municipalities with non-watchmaking municipalities located within a watchmaking district; these act as a placebo group whose growth can then be compared to that of municipalities outside these districts (and uninvolved in watchmaking). The results can be see in figure 7.

Figure 7. Relative 10-Year Average Changes in Log Municipal Population



Graph depicts the coefficients and confidence intervals from two regressions. The first compares growth in the 90 watch-producing municipalities to that of the 2,174 other municipalities outside of watchmaking districts. The second compares growth in the 632 non-watch-producing municipalities located in watchmaking districts to the same set of municipalities outside of watchmaking districts.

What we see here is that municipalities engaged in watchmaking and those adjacent to them had very similar relative growth patterns prior to 1970. The relative growth rates of these two groups of municipalities were, statistically, almost indistinguishable between

1888 and 1970. This changes considerably after 1970; while the growth rates of adjacent municipalities were, on average, slightly higher than those of other non-watchmaking areas, the watchmaking municipalities experienced sharp relative declines. This large gap persists through the end of the sample period. This provides additional support for the hypothesis that the presence of watchmaking specifically was the key driver behind these population losses; it also serves to highlight the extremely localized effect of this economic shock. The fact that adjacent municipalities tended to grow slightly faster than other non-watchmaking areas also further justifies the small-area approach here, as it suggests that some may have relocated from watchmaking areas to adjacent non-watchmaking areas. The estimated impact of the crisis would be attenuated if a larger unit of geography were used.[20]

5. Mechanisms

The results in section 4 show substantial out-migration from watchmaking cities and towns as a result of the quartz crisis. On average, these cities experienced both an immediate decline in population as well as persistently low growth rates (in relative and absolute terms) decades later. These findings differ substantially from many previous studies of trade competition, which either found little migration response or modest declines in growth rates. What makes the Swiss case different? As discussed earlier, the character of this particular trade shock differed from many others studied in the literature. Trade competition stemming from broad trade liberalization or rising imports across many sectors (as in, e.g., the China shock) has the potential to generate both winners and losers. While some industries may decline as a result of competition, others may benefit from lower cost inputs or a more robust export market. If an area is economically diversified, workers may be able to switch from declining industries to growing ones without a long-distance move; Feenstra et al. (2019) document precisely this phenomenon in the US over the period 1991-2011. The quartz crisis provided no such opportunities for Switzerland.

There are also two other potential factors that merit further analysis. The first involves the composition of the watchmaking workforce. There may be substantial heterogeneity in

[20] I discuss this further in section 5.2.

migration responses across different demographic groups. If some types workers are more mobile than others, and if these workers constituted a significant share of the watch industry, then we may expect to see a larger migration response as a result of the crisis. The second important factor involves the availability of alternative employment opportunities. If watchmaking areas are in isolated, highly non-diversified labor markets, there may be fewer local opportunities for job-switching, a point made by Caliendo et al. (2019) with regards to the impact of the China shock in the US. This may also generate a large migration elasticity. I present evidence for the significance of each mechanism below.

5.1. **Workforce characteristics and heterogeneous migration elasticities across groups.** To understand the characteristics of the watchmaking workforce, I exploit the Swiss federal census microdata available through IPUMS (MPC 2019). This 1-in-20 random sample of the population contains information on individual labor force participation, employment, and demographics. However, it has two important limitations: The data only extends from 1970 to 2000, and the finest unit of geography available is the canton.[21] I first replicate the main result from section 4 at the canton level. Then, I look at how this effect varied across different groups. To do this, I re-estimate a simpler version of equation (4.1), including only year fixed effects interacted with a lagged measure of watchmaking intensity (θ_c) and a separate measure of the importance of non-watch industrial production ($\widetilde{\theta}_c$). This allows me to explore how different segments of the population evolved during and after the crisis, and how the intensity of watchmaking involvement affected these trends (controlling for overall employment in industrial activity). The estimating equation is given in (5.1).

$$\Delta \ln(population_{ct}) = \alpha + \beta' \gamma_t \times \theta_c + \eta' \gamma_t \times \widetilde{\theta}_c + \gamma_t + \epsilon_{ct} \tag{5.1}$$

I consider a number of outcome variables for $population_{ct}$. I first look at total population, population in the labor force, and manufacturing and non-manufacturing employment. I then compare effects across population groups defined by individual demographic characteristics,

[21]Two cantons, Appenzell Innerrhoden and Appenzell Ausserrhoden, are combined in the IPUMS data.

such as gender, age, nativity, citizenship, schooling, and language. Lastly, I look at two circumstantial factors that may affect mobility, namely whether or not an individual owns their home or has moved recently.

The measure of exposure to the quartz crisis is θ_c, computed as the share of a canton's population in 1960 that was employed in watchmaking. For ease of interpretation, I normalize θ_c to range from zero to one, with zero representing a canton with no watchmaking industry, and one representing the canton with the highest share of the population engaged in watchmaking. The key identifying assumption underlying equation (5.1) is that these shares are not correlated with any other factors that may have led to out-migration from these cantons during the period of the crisis. One potential threat to this exogeneity is that population decline may have been the result of a general decline in export industries, rather than the watch industry in particular. This is plausible due to the previously discussed appreciation of the Swiss franc during the 1970s. To mitigate the concern that these results are driven by export sensitivity in general, I include additional interactions between the year fixed effects and $\widetilde{\theta}_c$, which measures the share of a canton's 1960 population employed in the industrial sector *excluding* watchmaking. Bergier (1984) notes that during this time period, the industrial sector accounted for approximately 90 percent of Swiss exports, so this measure should effectively capture the extent to which cantons were exposed to non-watch-related export shocks. It will also help distinguish between declines driven by the watch industry and declines due to general deindustrialization, which was common among developed countries during this period (Bernard et al. 2017). Like θ_c, this measure is normalized to lie within the unit interval. The correlation between θ_c and $\widetilde{\theta}_c$ is quite low at 0.05, suggesting that the watch industry was not concentrated in areas that would be relatively sensitive to export shocks for other reasons. Nonetheless, I include the $\widetilde{\theta}_c$ interactions in all models; the results are not sensitive to excluding them.

Table 3 shows the results of this analysis, and figure 8 presents the θ_c interaction coefficients graphically. Using the IPUMS data supplemented with 1960 canton population counts from the municipality series, the regression in column (1) shows no difference in overall population

TABLE 3. Changes in Log Cantonal Population Growth

	Change in log total:			
	Population	Labor force	Mfg. emp.	Non-mfg. emp.
	(1)	(2)	(3)	(4)
1970	0.085** (0.0393)			
1980	0.075** (0.0286)	0.101** (0.0401)	-0.026 (0.0646)	0.123*** (0.0379)
1990	0.096*** (0.0333)	0.199*** (0.0471)	0.070 (0.0515)	0.206*** (0.0506)
2000	0.107*** (0.0296)	0.140*** (0.0382)	-0.037 (0.0925)	0.167*** (0.0311)
1970 $\times$ θ_c	0.026 (0.0368)			
1980 $\times$ θ_c	-0.087*** (0.0306)	-0.162*** (0.0410)	-0.207*** (0.0594)	-0.069 (0.0559)
1990 $\times$ θ_c	-0.096*** (0.0291)	-0.087* (0.0427)	-0.235*** (0.0743)	0.037 (0.0411)
2000 $\times$ θ_c	-0.008 (0.0336)	-0.051 (0.0399)	0.003 (0.0756)	-0.047 (0.0415)
1970 $\times$ $\widetilde{\theta}_c$	0.059 (0.0804)			
1980 $\times$ $\widetilde{\theta}_c$	-0.075 (0.0547)	-0.057 (0.0709)	-0.135 (0.1073)	0.093 (0.0776)
1990 $\times$ $\widetilde{\theta}_c$	-0.022 (0.0608)	-0.064 (0.0885)	-0.268*** (0.0903)	0.117 (0.0979)
2000 $\times$ $\widetilde{\theta}_c$	-0.087 (0.0588)	-0.099 (0.0720)	-0.322** (0.1485)	0.017 (0.0652)
Observations	100	75	75	75
Adjusted R^2	0.549	0.661	0.532	0.864
*** p<0.01, ** p<0.05, * p<0.1				

Regressions of decadal change in log (sub)population on year fixed effects interacted with a measure of watchmaking employment (θ_c) and industrial employment excluding watchmaking ($\widetilde{\theta}_c$) as a share of total population in 1960. Both measures are scaled to lie in the unit interval, with zero representing no employment in that sector and one representing the highest share of employment in that sector observed across cantons. The data used in column (1) spans the period 1960-2000; in all other columns, the data begins in 1970. Outcome in column (1) is the change in log total population at the canton level; in column (2), I restrict to the population in the labor force; in columns (3) and (4), the populations are workers employed in manufacturing and workers employed in non-manufacturing industries, respectively. Standard errors are clustered at the canton level.

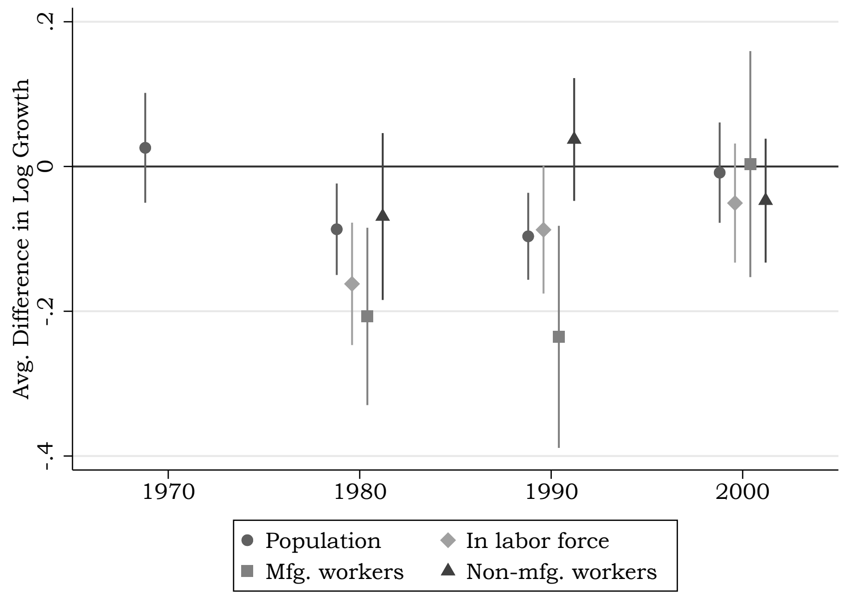
growth between more or less exposed cantons over the 1960-1970 period; this is similar to the result found using the municipality-level data. Between 1970 and 1980, overall Swiss growth was low, but substantially lower for watch-intensive cantons. The effect estimated at the canton level is around 2/3rds the size of the estimated effect at the municipality level, illustrating that within-canton moves somewhat attenuate the impact of the crisis when measured at this coarser geography. This lower relative growth persists until 1990, after which the growth differential shrinks to zero. This again differs from the municipality-level results, which showed slower relative growth during the 1990s, further highlighting the value of estimates based on a finer geography.

Column (2) shows a substantial relative decline in the employed population in watchmaking areas after 1970; like the overall population decline, this persists up to the 1990s. Turning to column (3), it becomes clear that this relative employment decline is being driven by a sharp fall in manufacturing employment. While manufacturing employment was declining throughout the country after 1970, as it did in many highly developed countries, it fell much faster in watch-intensive cantons. This is not the case for non-manufacturing employment, which continued to grow across cantons after 1970. Areas specializing in non-watch industrial activity also see a decline in manufacturing employment, but this does not become significant until the 1980s.

I turn now to the demographic breakdown of watchmaking workers, as different types of workers may be more or less mobile, and the composition of the workforce may partly explain the high observed out-migration rates. The data available through IPUMS does not have a category specifically for all employees in watchmaking. It does identify individuals involved in "clock making," which captures about 94% of the watchmaking workforce. 4,200 individuals are identified as employed in "clock making" in the 1970 census data; since this is a 5% sample, that implies 84,000 watchmaking workers. The estimate of total employment I derived from other industry and government sources suggests the total number is around 89,000. The missing 5,000 workers were likely categorized differently.[22] Since the census data identifies the overwhelming majority of workers correctly, it is sufficient to perform the demographic analysis.

[22]Some working in sales or warehousing probably fell into the broad industry defined as "Precision instruments, optical, radio, TV, musical instruments, clock making in wholesale and retail businesses."

Figure 8. Relative Changes in Log Cantonal Population



Graph depicts the coefficients and confidence intervals for the θ_c interaction terms from table 3.

Table 4 reports the share of the watchmaking workforce falling into different groups. Close to half of workers were young (aged 15-34), and more than half were women. Most workers were citizens and/or native to Switzerland, however, significant minorities were not. These individuals might also be more inclined to relocate (or may be forced to, as I discuss further below). Most watchmaking workers had general-track secondary education, but around a third had technical-track education, and virtually none had failed to complete secondary education. Slightly more than half of all workers spoke French as their first language, which is unsurprising given the location of the industry. However, a sizable minority spoke German as their first language. These workers may have been more mobile given that German is the predominant language in Switzerland.

Table 4 also shows that many in the watchmaking sector may have lacked strong locational anchors. Almost 80% were not homeowners. As Glaeser and Gyourko (2005) have pointed out, homeowners may suffer greater relocation costs when trying to leave areas experiencing population decline, as the durability of housing leads to a market asymmetry that generates

Table 4. Demographics of watchmaking workers in 1970

Characteristic	Percentage of watchmaking workers	Percentage of all other workers
Age 15-34	43.8	46.6
Female	54.5	33.5
Non-citizen	20.6	22.0
Foreign-born	23.9	24.5
Secondary education, technical track	35.6	45.3
Post-secondary education, technical track	3.4	4.9
University eduction	0.5	3.4
German language	29.5	62.3
Italian language	16.3	14.8
Other language	3.9	6.8
Homeowner	23.0	28.4
Moved within canton, last 5 years	22.9	29.2
Moved across cantons/countries, last 5 years	12.9	17.5
Observations: 4,200		

large price declines in such areas. Both Notowidigdo (2020) and Dix-Carneiro and Kovak (2017) have suggested that this could slow the process of interregional migration; Switzerland's notoriously low homeownership rate may be an important factor in explaining higher worker mobility. Lastly, we see that around a third of workers in the industry had moved within the previous five years. Workers who had relocated only recently may have had a weaker attachment to their new location, and perhaps stronger ties to a different area.

In figure 9, I compare relative growth rates across different demographic groups using the specification from equation (5.1). In the first panel, I separately examine men and women by age group. All four groups saw considerably lower growth rates in watch-intensive cantons, but the impact of the crisis was more than twice as large for younger workers, suggesting higher mobility for this group. Men and women were affected similarly, which is unsurprising as they were roughly equally represented in the watchmaking industry. Somewhat surprisingly, the second panel shows that the initial impact of the crisis on citizens and non-citizens was very similar; the same is true for foreign-born and native workers. The relative decline in the growth rate of the native-born and citizen population extends until 1990 and disappears thereafter, while the relative decline for foreign-born workers increases and continues up to

2000.[23] In the third panel, breaking down groups by education, we see declines for those with secondary education and post-secondary technical education, though the standard errors are large. It is difficult to infer much from the increase for university graduates, as they made up a very small share of the population at this time, less than 1.5% (and only 0.5% in the watch industry). Moving to the fourth panel, we do see a fairly large immediate decline in the relative growth rate of German-speakers, in line with expectations.[24] Both the German and Italian speaking populations also grow more slowly over the following decade.

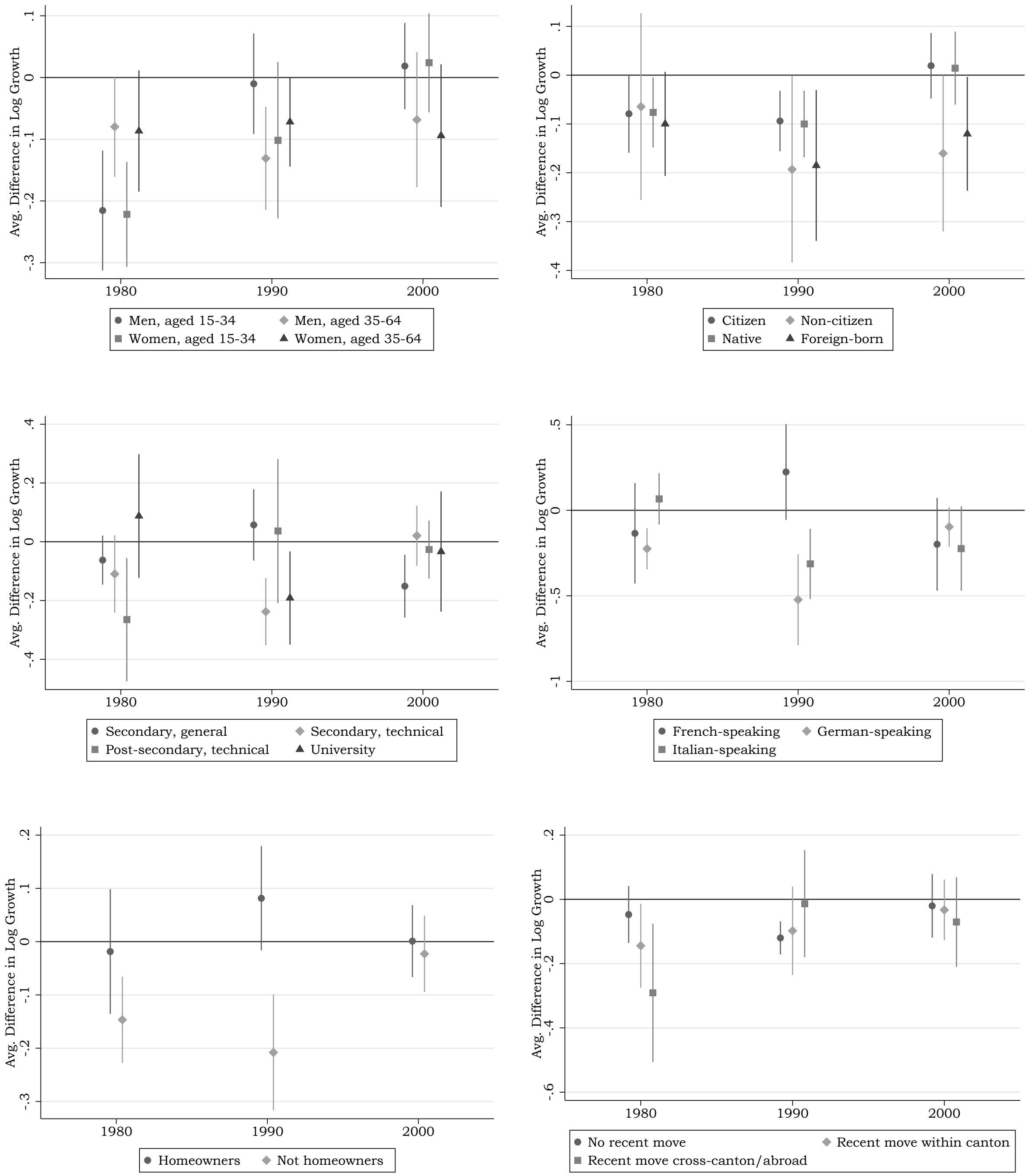
In the final two panels of figure 9, I examine two other important factors that may influence mobility. In the first panel, we see a substantial relative decline in the population of non-homeowners in watchmaking areas, while we see almost no change in the homeowner population. As shown earlier, most watch workers (and most Swiss residents in general) are not homeowners, so this result is suggestive of the possibility that low homeownership rates may increase worker mobility. This may partly explain why we see more migration in response to this shock relative to that observed in other contexts. Previous work finding little migration response has looked at Brazil, Germany, Norway, Spain, and the United States, countries with considerably higher homeownership rates that Switzerland (Hirt 2015). Lastly, the final panel shows estimates of relative growth rates for the subpopulations who have either not moved in the past five years, moved within a canton, or moved across cantons or from another country. Here, we see a large and immediate relative decline in the population that has recently made a within-canton move or (especially) a cross-canton/cross-national move. This could be driven by highly mobile individuals being more likely to leave watchmaking cantons; they may also have been more likely to avoid moves to such cantons.

Taking these results as a whole, the overall picture is one of an industry where a large share of workers tended to be relatively mobile. This could be due to their age, education, nativity, citizenship, or language skills. It could also be due to a lack of attachments to place,

[23]This may partly reflect policy changes due to the recessionary environment of the mid-1970s. Restrictions on temporary workers were imposed during this period, as the Swiss government tried to use the size of the immigrant population to regulate the unemployment rate of native workers (Baltensperger and Kugler 2017, Kuhn 1978).

[24]Note that the standard errors are large here, exaggerating the y-axis.

Figure 9. Relative Changes in Log Cantonal Subpopulations



stemming from a lack of homeownership, or the fact that they had not been in their location for a particularly long time. Thus, they would be more likely to exercise a migration option if displaced from their industry. This would be especially true if their local labor markets presented few alternative employment possibilities, a topic I turn to next.

5.2. **Local labor market characteristics.** In this section, I consider aspects of the local labor markets surrounding watchmaking areas that may have influenced migration decisions in response to the crisis. Figure 1 (in section 2.1) depicts the location of watchmaking municipalities across Switzerland's 16 large labor market areas (LMAs). 78% of these municipalities were located in the Jura mountain arc, with an average linear distance to the nearest major city of 17 miles (27 km).[25] Looking across all watchmaking areas that were not themselves major cities, the typical linear distance is around 20 miles (32 km). This is the first characteristic of potential importance: Remoteness. A large majority of watchmaking municipalities are located in labor market areas that do not include a major city or metro, including the 65% that are located in either the Biel-Jura or Neuchâtel LMAs. Workers displaced from a job by trade competition are more likely to remain in their current location if they can easily switch jobs. If instead they are faced with limited opportunities nearby and substantial commutes to access major metros, the prospect of relocation is more attractive.[26]

What about the (relatively) large cities that *were* located in watchmaking labor market areas? The Biel-Jura and Neuchâtel LMAs are useful cases to examine, as each contained about a third of the watchmaking municipalities. In Biel-Jura, the largest cities (those with at least 10,000 residents) were Biel/Bienne, Grenchen, Solothurn, and Delémont. All four of these cities were centers of watch production. In Neuchâtel, the largest cities were La Chaux-de-Fonds, Neuchâtel city, and Le Locle, also major centers of the watch industry.

[25] I define "major city" here as all cities with a contemporary city-proper population of over 100,000. This includes Zürich, Geneva, Basel, Lausanne, Bern, and Winterthur. The first five of these were also the only cities to have more than 100,000 residents in 1970, and the only cities with more than 250,000 residents in their contemporary metro agglomeration.

[26] Historical data on commuting behavior is not available, but currently, the typical one-way commute in Switzerland is 8.7 miles (14 km), about half the typical linear distance from watchmaking areas to the nearest major city (FSO 2019). Linear distance of course understates the total distance via road or rail due to mountainous character of the area; for example, La Chaux-de-Fonds is about 30 linear miles (48 km) from Bern, but around 42 miles (68 km) by road. Thus, regular commutes from many of these municipalities to a major city would entail substantial costs.

These urban areas also tended to be fairly small; the two largest, Biel/Bienne and La Chaux-de-Fonds, had populations of 64,333 and 42,347 in 1970, respectively. Delémont and Le Locle had populations of 11,797 and 14,452. Thus, both of these labor markets were distant from major cities and centered around urban areas that were small and highly specialized in watchmaking. This strongly suggests that displaced workers had far fewer local options for alternative employment, especially given the level of industrial concentration, which I discuss next.

How concentrated were these local labor markets? Some insight can be gleaned by examining the employment data available from the 5% sample of the Swiss census. This data includes the general economic sector in which an employed individual works (divided into 14 categories) as well as the individual's specific industry (91 different industries within manufacturing). This allows me to compute standard market concentration indices for both the overall economy and the manufacturing sector specifically. Unfortunately, this data is not available at the LMA level, only the canton level, and these boundaries do not always match closely. However, this exercise is still valuable, as the concentration of watchmaking activity in the northwestern area of the country results in 84% of watchmaking municipalities (and 93% of employment) lying in just 7 cantons, which in total largely lie within or coincide with a contiguous arc of 6 LMAs. I proceed by calculating the standard Herfindahl-Hirschman index (HHI) for each canton, separately measuring concentration across the 14 broad sectors of the economy (manufacturing, agriculture, wholesale and retail trade, etc.) and concentration specifically within the manufacturing sector. The results can be seen in table 5.

In the top panel and first column of table 5, we see that cantons are typically characterized by moderately high levels of concentration across broad sectors.[27] Looking specifically at the seven cantons where watchmaking was prominent, this rises to the threshold of highly concentrated, with manufacturing being the key sector, on average accounting for 43% of

[27]An HHI less than 0.15 indicates an unconcentrated market, an HHI between 0.15 and 0.2 indicates a moderately concentrated market, and one above 0.25 indicates a highly concentrated market.

Table 5. Industrial Concentration

	Switzerland (cantons)	United States (metro areas)
	Concentration across 14 broad sectors	
HHI:		
▷ Mean	0.22	0.14
▷ Median	0.19	0.13
HHI (watchmaking cantons only):		
▷ Mean	0.24	0.14
▷ Median	0.25	0.13
HHI (main watchmaking cantons):		
▷ Jura	0.29	0.14
▷ Neuchâtel	0.33	0.13
Average share in manufacturing (watchmaking cantons only for Switzerland):	0.43	0.25
	Concentration within manufacturing sector	
HHI:		
▷ Mean	0.13	0.10
▷ Median	0.10	0.08
HHI (watchmaking cantons only):		
▷ Mean	0.15	0.10
▷ Median	0.10	0.08
HHI (main watchmaking cantons):		
▷ Jura	0.26	0.10
▷ Neuchâtel	0.26	0.08

Herfindahl–Hirschman index (HHI) calculated as $\sum_{i=1}^{n} s_i$, where s_i represents (upper panel) the share of the workforce employed in each of 14 broad sectors covering the whole economy (e.g., manufacturing, construction, healthcare, etc.) or (lower panel) the share of the manufacturing workforce in each of 91 manufacturing subsectors (90 for the United States). HHI is calculated at the canton level for Switzerland using the 1970 5% census sample. HHI is calculated at the metro area level for the United States using the 1970 1% form 1 sample.

total employment in these cantons. Moving specifically to Jura and Neuchâtel, we see very high levels of concentration in manufacturing.[28]

[28]These two cantons are useful to examine not only because they were the most heavily engaged in watchmaking, but also because of their relationship with their respective labor markets. Neuchâtel canton is located entirely within the Neuchâtel LMA, with the remainder of that LMA as a part of Jura. The rest of Jura is part of the Biel-Jura LMA, which additionally contains almost all of the watchmaking municipalities from the cantons of Bern and Solothurn. Given how close these areas are to each other, it appears reasonable to suggest that the industrial structure of the Biel-Jura and Neuchâtel LMAs, containing 65% of watchmaking cities, are probably fairly close to that of Jura and Neuchâtel cantons.

These results imply a high degree of dependence on manufacturing in areas with substantial watchmaking activity. This is shown in the first column of the bottom panel of table 5. Here, we see a lower level of concentration, likely to be due in part to the fact that there are many more possible industry classifications. Moving to the main watchmaking cantons, the HHI rises considerably, implying a high level of concentration. This is only partly due to the high share of watchmaking in manufacturing, as this would not be sufficient on its own to generate such a high value. In all seven of the watch-producing cantons, one of the largest industries (often second to watchmaking) was the production of machinery.[29] As watchmaking involves a substantial amount of specialized machinery, it's reasonable to expect that this industry may have been negatively affected by the crisis as well, as it was likely geared towards providing such machinery in watchmaking areas.

How does the level of concentration in the Swiss labor market compare to that in other developed countries? A comparison with the United States is informative here; as discussed earlier, the China shock had a considerably smaller and more delayed impact on migration, which may be due to differences in labor market characteristics. The second column of table 5 replicates the first column, but for US metro areas in 1970.[30] Concentration was substantially lower across US metros than Swiss cantons, and this difference was even larger when focusing on watchmaking cantons. Concentration levels in Jura and Neuchâtel were 2-3 times larger than they were in the typical US metro. US metros also had a substantially smaller manufacturing share. Looking specifically at the manufacturing sector, concentration in Switzerland was about twice as high as the US on average. In Jura and Neuchâtel specifically, concentration was five times higher than in the typical US metro.

Taking all of these results together, we see that watchmaking in Switzerland generally took place in highly non-diversified labor markets where the largest cities and towns were heavily specialized in manufacturing vulnerable to foreign competition. These areas also tended to be fairly distant from major cities that may have provided alternative employment

[29] This industry is technically classified as "Machine and vehicle construction, electrical, electronic and optical construction." As this classification is quite broad, it tended to be a major industry in almost every canton.
[30] The data available for the US defines 227 distinct industries; I crosswalked these to the 14 broad industry classifications used in Switzerland to get a consistent measure of concentration across broad sectors.

opportunities. This suggests that the most mobile workers would have a substantial incentive towards out-migration.

6. Conclusion

This study has examined the impact of a large trade shock to an important, geographically-concentrated local export industry. After rising to a position of global dominance in the mid-20$^{\text{th}}$ century, the Swiss watch industry rapidly contracted during the quartz crisis of the 1970s. Due to historical factors dating back centuries, this industry had developed and agglomerated in a relatively small number of cities and towns, and was an important part of these local economies. Using a long panel of municipality-level population records, I show that these cities and towns tended to have modestly larger growth rates in the decades prior to the crisis. During the crisis, these places experienced a rapid loss of population. In the decades following, their growth was anemic. Switzerland's population increased by over 38 percent between 1970 and 2018; despite this, most of the major centers of watch production (such as Biel/Bienne, Grenchen, La Chaux-de-Fonds, Le Locle, Neuchâtel, and St. Imier) are smaller today than they were in 1970. These local population declines were large enough to affect the balance of population across Swiss cantons, an effect that is independent of general changes in the competitiveness of the Swiss manufacturing sector.

These results contrast which much of the literature on trade and migration in other contexts. Studies of the impact of rising trade with China have found that it resulted in substantial employment dislocations in Germany (Dauth et al. 2014), Norway (Balsvik et al. 2015), Spain (Donoso et al. 2015), and the U.S. (Autor et al. 2013), however, none of these studies found a sizable migration response. The reanalysis of the China shock in the U.S. by Greenland et al. (2019) did find that growth patterns shifted towards less import-exposed areas, but that this was not associated with a sizable absolute population loss. I argue that the very different results I find here can be explained by several factors. First, this particular shock greatly reduced the export competitiveness of the watch industry, but was not associated with any sort of broad trade liberalization or increase in imports to other sectors. In the case of the China shock, Feenstra et al. (2019) document job losses due to increased competition, but also find that these losses are generally offset by job gains in export-oriented industries that benefit from both a larger export market and lower input prices. Dauth et al. (2014) similarly finds that increased trade between Germany and China/Eastern Europe led to job losses in import-competing industries, but sizable job gains in export-oriented industries, generating only small migration effects. In both cases, changing patterns of trade generated winners and losers among different industries, and when labor markets are diversified, job switching across these industries can occur with little long-distance migration. The quartz crisis was a sector-specific negative shock with no associated opportunities for gains from trade.

The second important factor, which arguably exacerbated the first, was the fact that the labor market areas associated with watchmaking were highly non-diversified. These cities and towns were also located largely in more remote mountain areas not adjacent to major cities. This meant that there were fewer local opportunities for sectoral reallocation. This contrasts with US metros, which tended to be much more diversified during this time period. This may again explain the divergence between the Swiss case and the China shock in the US; Caliendo et al. (2019) find that within-state sectoral mobility was vastly higher than geographic mobility. Another potential explanation for this divergence hinges on the third factor of importance: The mobility characteristics of the affected workers themselves. Many workers in the watch industry were young, had technical education, and spoke German. Many also may have lacked strong attachments to place; a large share of workers were foreign-born (working in Switzerland only temporarily), had recently relocated, and were not homeowners. These workers were much more likely to move in response to the crisis. Mobility was much lower in the US despite high and persistent unemployment, suggesting higher costs of moving (in line with Caliendo et al.'s (2019) interpretation).

These results have general implications for thinking about the impact of trade policy and changes in trade patterns due to the emergence of new industrialized economies. When attempting to understand how foreign competition will affect cities or regions, it is key to understand both what industries will be affected, and how. It is also crucial to understand the composition of the local economy and the workers within. Migration responses may be especially large when employment losses due to trade competition are not offset by gains in industries that benefit from expanded trade. This is especially likely to occur when areas are highly specialized in a few sectors. Out-migration may also depend on the composition of the workforce. When moving costs are higher, perhaps due to age, wealth, language barriers, or family ties, one might expect to see smaller out-migration responses. This could also have implications for the regional welfare effects of trade. If specialized regions see disproportionate negative impacts on employment, and their workers are less mobile, they may disproportionately suffer from trade. This could be an important consideration for policymakers when constructing measures to mitigate the potential impacts of increased trade exposure.

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7. Appendix

Figure A1. CHF/USD and JPY/USD Exchange Rates

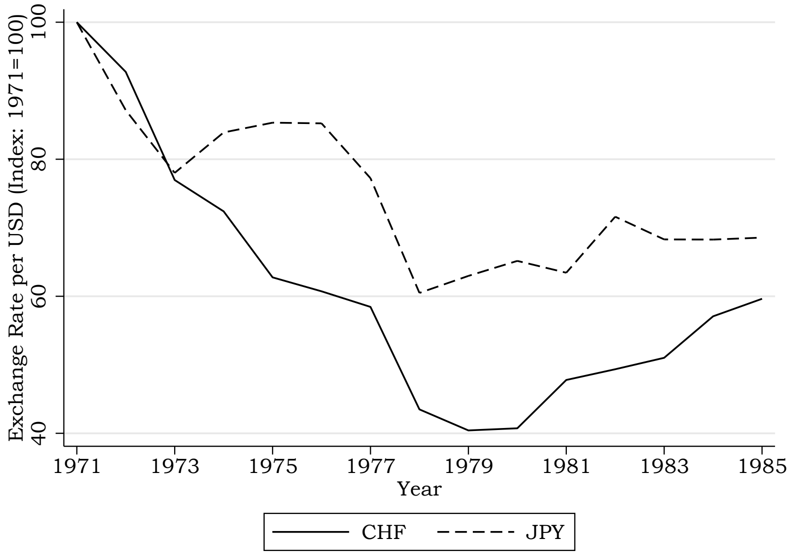
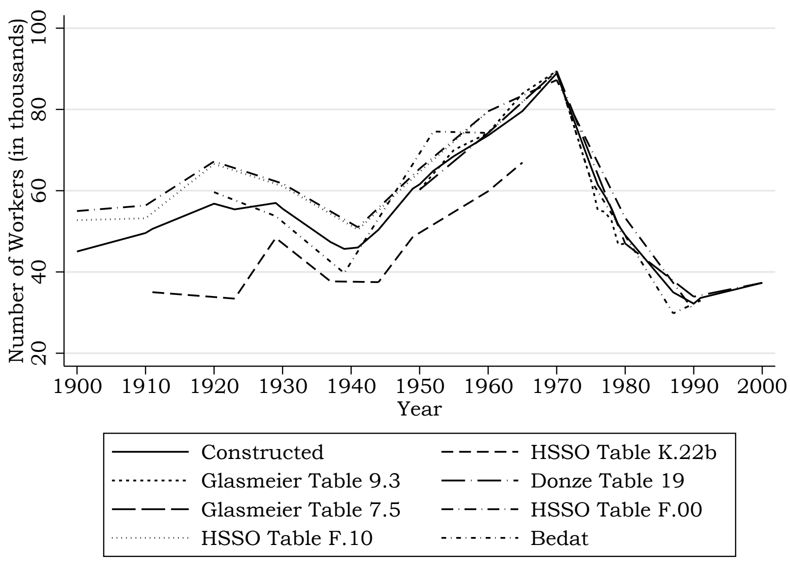
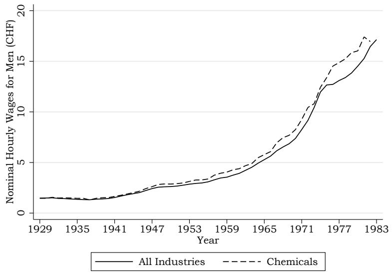


Figure A2. Employment in Watchmaking, 1900-2000

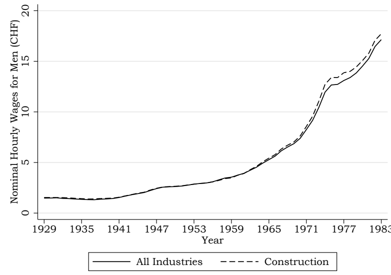


Data from multiple sources; see section 2.2.

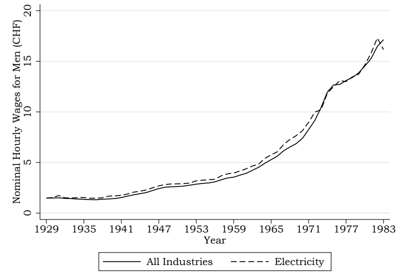
FIGURE A3. Nominal Hourly Wages for Men across Industries, 1926-1983



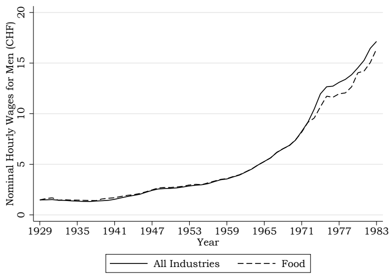
(A) Chemicals.



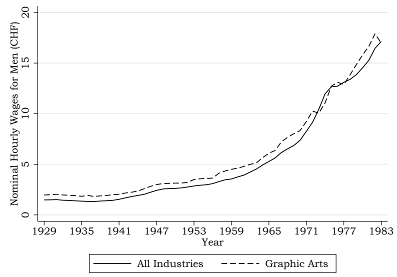
(B) Construction.



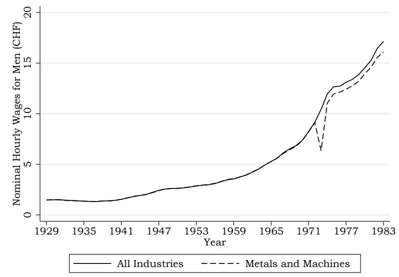
(C) Electricity.



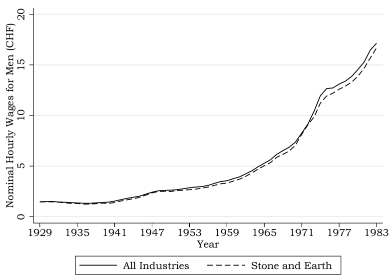
(D) Food.



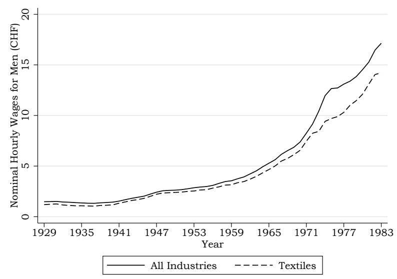
(E) Graphic arts.



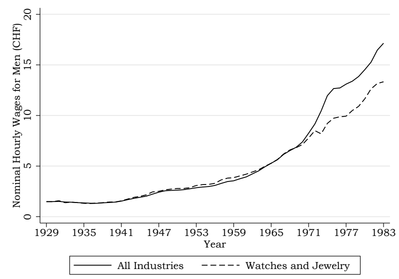
(F) Metals and machines.



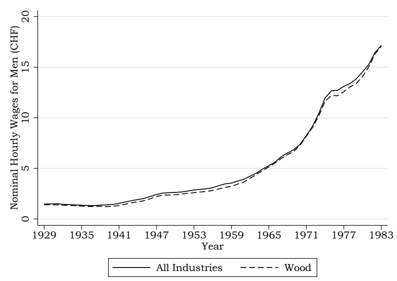
(G) Stone and earth.



(H) Textiles.



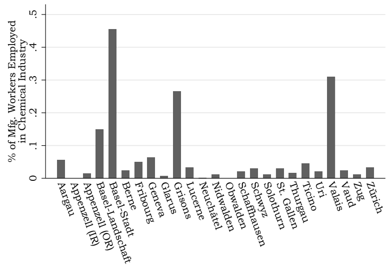
(I) Watches and jewelry.



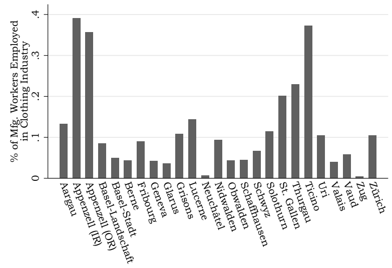
(J) Wood.

Data from HSSO (2012c).

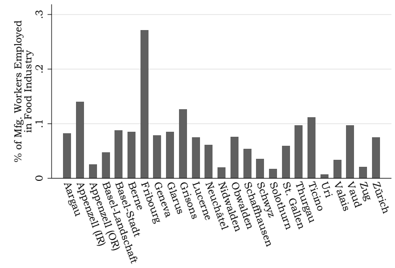
Figure A4. Distribution of Industrial Employment across Cantons, 1965



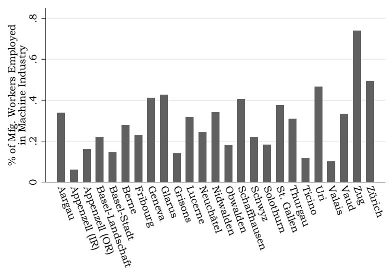
(A) Chemicals.



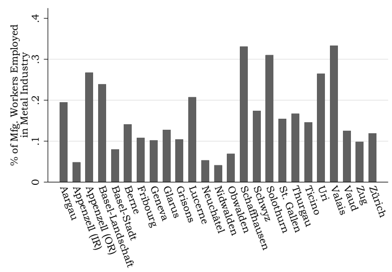
(B) Clothing.



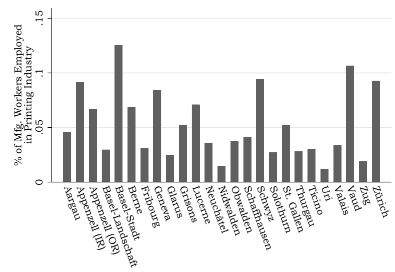
(C) Food, beverages, tobccco.



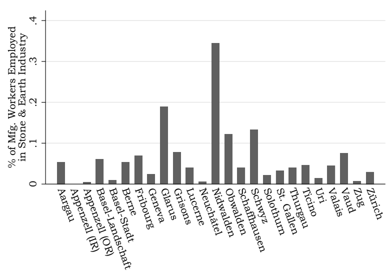
(D) Machines and instruments.



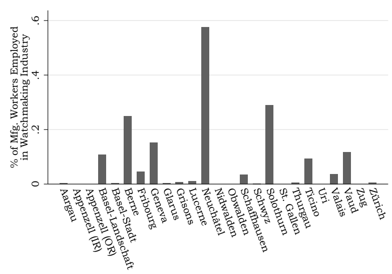
(E) Metals.



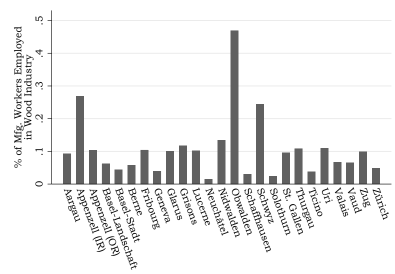
(F) Printing.



(G) Stone and earth.



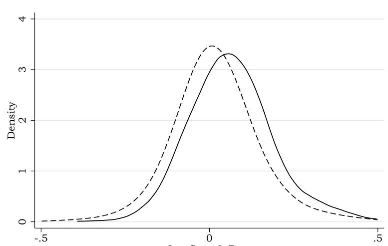
(H) Watches and jewelry.



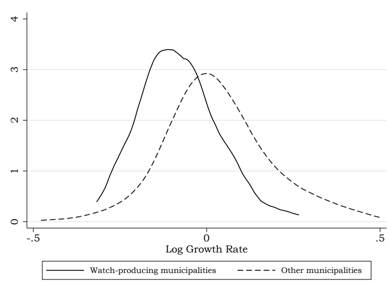
(I) Wood.

Data from HSSO (2012e).

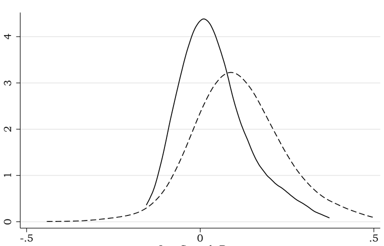
Figure A5. Distribution of Municipal Growth Rates



(A) 1880-1970.

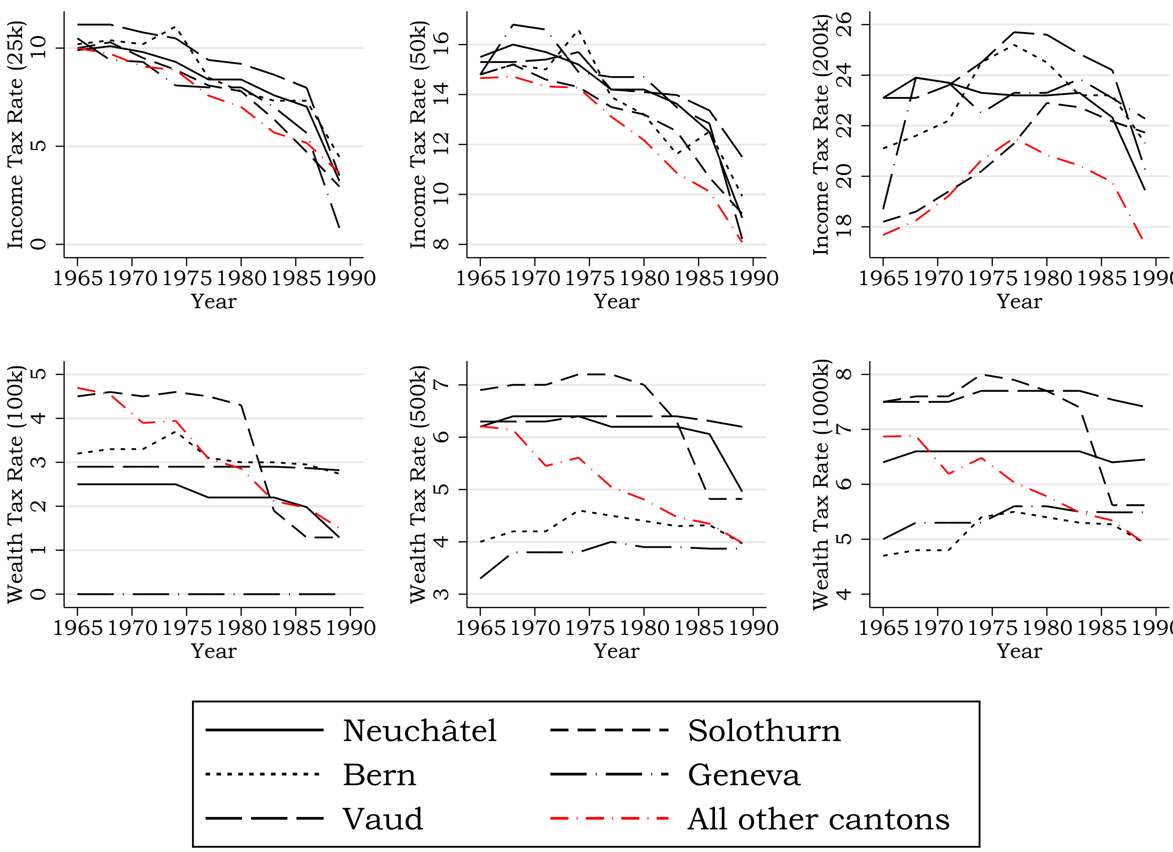


(B) 1970-1980.



(C) 1980-2000.

Figure A6. Income and Wealth Tax Rates across Cantonal Capitals, 1965-1989



Data from HSSO (2012f) and HSSO (2012g). Top three panels depict changes in income tax burdens (in percentage terms) for employed persons married without children across cantonal capitals, assuming total incomes of 25,000 CHF, 50,000 CHF, and 200,000 CHF, respectively. Bottom three panels depict changes in wealth taxes (per thousand) for employed persons married without children across cantonal capitals, assuming total assets of 100,000 CHF, 500,000 CHF, and 1,000,000 CHF, respectively.

Table A1. Cross-correlation table

	% Watches	% Chem.	% Cloth	% Food	% Mach.	% Metals	% Print	% Stone	% Wood
% Watches	1.00								
% Chem.	-0.16	1.00							
% Cloth	-0.26	-0.20	1.00						
% Food	-0.06	0.07	0.17	1.00					
% Mach.	-0.13	-0.38	-0.42	-0.29	1.00				
% Metals	-0.07	0.06	0.04	-0.41	-0.06	1.00			
% Print	-0.08	0.30	0.07	0.17	-0.21	-0.25	1.00		
% Stone	-0.22	-0.14	-0.22	-0.07	0.04	-0.29	-0.26	1.00	
% Wood	-0.38	-0.21	0.11	0.08	-0.22	-0.32	0.02	0.29	1.00

Canton-level secondary-sector employment share correlations, 1965.