Does Trade Cause Capital to Flow? Evidence from Historical Rainfalls

Sebnem Kalemli–Ozcan*
University of Maryland and NBER

Alex Nikolsko–Rzhevskyy†
Lehigh University

December 2018

Abstract

We use a historical quasi-experiment to estimate the causal effect of trade on capital flows. We argue that fluctuations in regional rainfall within the Ottoman Empire capture the exogenous variation in exports from the Empire to Germany, France, and the U.K., during 1859–1913. The provisionistic policy of the Ottoman Empire—that is, only a surplus production was allowed to be exported—combined with the fact that different products grow in different regions that are subject to regional variation in rainfall and Germany, France and the U.K. import different products, constitute the basis of our identification. When a given region of the Empire gets more rainfall than others, the resulting surplus production is exported to countries with higher ex-ante export shares for those products and this leads to higher investment by those countries in the Ottoman Empire. Our findings support theories predicting complementarity between trade and capital flows.

JEL Classification: F10, F30, F40, N10, N20, N70

Keywords: FDI, exports, default, empire, rainfalls

*University of Maryland, Department of Economics, 4118D Tydings Hall, College Park, MD, 20742, Tel: 301-405-3486, Email: kalemli@econ.umd.edu.

†Corresponding author. Lehigh University, Department of Economics, Bethlehem, PA 18015, USA. Tel: 832-409-2187, Email: alex.rzhevskyy@gmail.com.

1 Introduction

We investigate whether there is a causal relationship between trade and financial flows, and if there is, whether trade in goods and trade in finance are complements or substitutes. To identify the relation between trade and capital flows, we use a historical quasi-experiment. We obtain unique yearly panel data for the period 1859–1913 that covers trade and private financial flows between France, Germany, the U.K., and the Ottoman Empire. As a measure of private capital inflows, we use foreign direct investment (FDI) of these three source countries into the Empire. For trade flows, we use exports from the Empire into France, Germany, and the U.K. Hence, trade flows are outflows from the Empire and financial flows are inflows to the Empire. The predominantly uni-directional capital flows were typical for the first wave of globalization when the industrialized North was investing into the agricultural South. It's important to notice that our data set covers all major Ottoman Empire investors – as of 1914, FDI from France, Germany and the U.K. constitute 96% of total foreign direct investment into the Empire (Geyikdagi, 2011).

A simple OLS regression of FDI in the Empire on exports from the Empire to France, Germany, and the U.K., using country fixed effects for the investor countries produces a positive coefficient. This result is the panel version of the cross-sectional findings in the literature. The advantage of the panel data is that we can use country fixed effects and hence control for the unobserved country-level heterogeneity in foreign investment. Nevertheless, these OLS estimates suffer from reverse causality. As implied by the various theoretical models causality can run both ways. For instance, in Kemp (1966) and Jones (1967) and Helpman and Razin (1978), causality runs from international capital flows to trade. OLS estimates also suffer from the simultaneity problem since omitted variables such as common shocks can determine both trade and capital flows as argued by Mitchener and Weidenmier (2005). Taylor and Wilson (2006) instruments trade with distance to solve the endogeneity problem, obtaining a positive effect of instrumented-trade on capital flows in a cross-section of countries. However, Guiso, Sapienza, and Zingales (2009), Portes and Rey (2005) and Aviat and Coeurdacier (2007) show that distance determines both trade in assets and trade in goods, since distance also captures information asymmetries that are important determinants of capital flows. These results suggest the possibility that distance affects capital flows not through trade but through information asymmetries.

Our contribution to this literature is to use a historical quasi-experimental setting to identify the causal effect of trade on capital flows. During late 18th and early 19th century, similar to other countries in that era, the Ottoman economy was closely determined by the political and administrative environment. The leading concern of the Ottoman policy was the adequate provisioning of food for the army, palace, and the urban areas. This emphasis on "provisioning" created an important distinction between imports and exports. Imports were encouraged since they added to the available goods in the urban markets. Exports, on the other hand, were permitted *only* once the requirements of the domestic economy were met (See Genc (1994) and Inalcik (1994)). Pamuk and Williamson (2011) argue that these provisionistic views paved the way for the Ottoman de-industrialization process that had been completed around 1880. During 1880-1913, 90% of the labor force was employed in the agricultural sector, while industrial production constituted only 10% of Ottoman GDP (Altug, Filiztekin and Pamuk, 2008). As a result, during our sample period, the Empire was an importer of manufactured goods and exporter of *surplus* agricultural goods. Given the dependency on widely-used furrow irrigation systems (Food and Agricultural Organization of the United Nations, 2003), weather—rainfall variation—was an exogenous factor that determined exports since surplus production varied with the regional variation in rainfall in the Ottoman Empire.

Our identification methodology can be summarized as follows. The Ottoman Empire only exported agricultural goods, namely cotton, wheat, grapes, corn, barley, olives, raisins, nuts and figs. These goods grow in different regions of the empire and hence depending on regional variation in the rainfall, there is surplus production in a given region and hence in a given group of goods. We will group goods as grains and orchards. We know the regions these goods were grown and we combined this information with our historical data for the regions of the Ottoman Empire on rainfalls, that vary by region and by time, to obtain good groups specific surplus production. Different regions of the Empire specialize in different types of good groups. While some consist of cultivated land and grow various grains, others consist of non-cultivated orchard land and grow primarily fruits and vegetables. Hence, within the Empire differences in rainfalls ensure that Ottoman grain and orchard products were affected differently in different years. Ottoman trading partners were historically purchasing very different exports bundles from the Empire: while some were mainly buying grains, others were interested in olives and grapes. Therefore, if we interact the time-varying grain and orchard production shocks, caused by the time variation in rainfalls, with the country-specific export bundles, we obtain rainfall-based time-varying country-specific instruments for Ottoman exports into France, Germany, and the U.K.

There is an extensive literature that uses weather shocks as an instrument for growth in GDP in agricultural economies without well-developed irrigation systems that rely on rain.[1] Our identification strategy is based on temporary fluctuations in agricultural production caused by year-to-year changes in *regional* rainfall around the "permanent" component of rainfall which might affect long-run production and trade patterns.[2] This strategy is relevant for our case, since we want rainfalls to affect capital flows *only* through exports in the short-run. For this strategy to be valid, there should not be any significant autocorrelation in precipitations, which is indeed the case as shown in Figure A1. Short-run fluctuations in rainfalls create temporary variation in the size of surplus production, which in turn created variation in exports. Our strategy of using short-run fluctuations allows us to avoid the effects of permanent rainfall differences on permanent incomes, which might also affect capital flows.[3] The length of our time series allows us not only to exploit time-series variation and control for unobserved heterogeneity using country fixed effects, but also makes it possible to include country specific trends that will account for any increasing/trending investment by Northern countries into the Ottoman Empire due to certain trade/war treaties.

We measure historical rainfalls based on the "tree-ring" methodology. This methodology recovers the level of rainfall during a growing season based on the width of the tree rings, in a given year. During droughts, rings are narrower, while extensive moisture results in wider rings. To check the validity of the tree-ring methodology, we compared our rainfall data constructed from tree-rings to real-time historical rain data. The real-time historical data comes from the Ottoman Archives but only for a few regions. The correlation between the real time data and

[1]This literature goes back to Paxson (1992), who used weather variability to measure response of savings to temporary income fluctuations. See Schlenker and Roberts (2006), and Deschenes and Greenstone (2007) who focus on U.S. agricultural production. See Donaldson (2018) estimates for the India.

[2]Miguel, Satyanath, and Sergenti (2004) use yearly changes in rainfall to identify the effect of temporary growth on the likelihood of civil conflict in Africa.

[3]Temporary fluctuations in income will affect savings only, resulting in net capital outflows, according to the standard models. During the course of the 19th century, capital flows were one way from the center to the periphery countries, as argued by Obstfeld and Taylor (2004), and hence capital outflows were essentially zero. The authors argue that this is either because periphery countries were full colonies or they were not integrated fully into the world markets to invest their savings.

our data is 0.495 for the overlapping regions, and significant at 5%. We use data that we obtain using the tree-ring methodology for our analysis since this data is available for all the regions of the Empire during the entire time period we are interested in.

Our first stage predicts that a deviation of 10 percent in rainfall from the mean (which approximately corresponds to one standard deviation in rainfall from the mean) resulted in a 5 percent increase in Ottoman exports.[4] Our second stage regressions deliver an effect of a 3.5 percent increase in FDI as a result of a 5 percent increase in exports in our main specification. Our results are robust to various different specifications and additions of variables and are consistent with theories that predict complementarity between trade and capital flows such as Antras and Caballero (2009). In their model, with trade integration, the South (here the Ottomans) specialize in the unconstrained sector (agriculture) and become a net importer of the financially dependent sector (manufacturing). This was indeed the case, as argued by Pamuk and Williamson (2011).

A valid threat to the identification is the possibility of a third variable driving both Ottoman exports to North and North's investment in the Empire. Our instrumental variables strategy will be able to deal with this issue as long as the omitted variable is not correlated with the instrument. To advance on this, we use country and time fixed effects and country-specific time trends together with controls for GDP and population differences. We also condition our results on the direct negative effect of 1876 Ottoman default. As a result of default both trade and financial flows can go down regardless of the temporary shocks to trade caused by rainfalls. Our results are robust to controlling for the default episode. We have also created a dummy to control the effect of the establishment of Ottoman Public Debt Administration (OPDA) in 1881. The OPDA was established after the debt restructuring negotiations for the purpose of paying the creditors. If more trade induces more financial flows since trade serves as an implicit guarantee for the creditors, once an institution is established to pay the creditors (OPDA), there might be less need for trade (See Wright (2004), Mitchener and Weidenmier (2005), Rose and Spiegel (2004), Eaton and Gersovitz (1981)). Our results are robust to all these tests.

The rest of the paper proceeds as follows. Section 2 lays out the historical context and intro-

[4] See also Dell et al. (2009, 2012) who focus the effect of weather changes (temperature and precipitation) on GDP and exports and find large estimates in the case of exports.

duces the data. Section 3 discusses the descriptive statistics. Section 4 presents the empirical specification, the results and the robustness analysis. Section 5 concludes.

2 Historical Context and Data

The Ottoman Empire stood at the crossroads of civilizations, stretching from the Balkans to Egypt for six centuries prior to World War I. Given the coverage of our data from 1859–1913, this paper focuses on the borders of the Empire from 1830 until World War I, as shown in figure 1. These borders include northern Greece, Syria, Iraq and present-day Turkey, but exclude Egypt and Libya.

In light of the new evidence from the archives, historians no longer think that the Ottoman Empire was in a state of a permanent decline since the 16th century. It is now realized that the Ottoman state was flexible and pragmatic and was able to adapt to the changing environment. Although the 17th century was a period of crisis, the 18th century witnessed an expansion of trade and an increase in production. The Empire was shrinking starting in the middle of the 18th century due to territorial losses, but at the same time, during most of the 19th century, the Empire became more linked to Europe via commercial and financial networks. The provisioning of the capital city, the armed forces and the urban areas, taxation, support, regulation of long-distance trade, and the maintenance of a steady supply of money were among the main policy concerns of the state. Hence, the government constantly intervened in economic affairs. The Ottoman Empire is not unique in this respect, as the pursuit of similar policy goals is thought to have led to the emergence of powerful nation states in Europe and Asia (Tilly, 1975).

During our sample period, the world economy had witnessed an enormous expansion of trade between center and periphery countries. Thanks to the Industrial Revolution, European countries became exporters of manufactured goods. These countries were selling their manufactured products to the third world (periphery) countries, while at the same time buying primary products and raw materials from them.

Among the periphery countries, China and the Ottoman Empire had a unique place since they had a strong central bureaucracy and their governments had the upper hand in the struggle between the bureaucracy and the interest-groups such as merchants and export-oriented landlords (Genc (1987); Inalcik and Quataert (1994)). These countries were also never colonized. In the case of the Ottoman Empire, the sultans and state officials were aware of the critical role played by merchants. Long distance trade was very important for the provisioning of the Empire. Foreign merchants were especially welcome since they brought goods that were not available in Ottoman lands and they were granted various privileges and concessions at the expense of domestic merchants. Historians argue that this is the primary reason why mercantilist ideas never took root in Ottoman lands. While the ideas of domestic merchants and producers were influential in the development of mercantilism in Europe, the priorities of the central bureaucracy dominated economic thought in the Ottoman Empire.

The policy priority was such that only surplus agricultural production could be exported abroad after the army, palace and the urban markets were satiated. This provisionistic policy created a difference in the attitude of sultans towards foreign and domestic merchants, and hence between imports and exports (Genc (1987); Inalcik and Quataert (1994)). Trade between the Ottoman Empire and the European countries increased 15-fold between 1820–1914. However, given the provisionistic policy, the share of Ottoman exports in total production did not exceed 6 to 8 percent and in agricultural production – 12 to 15 percent until 1910 (Pamuk (1987)). By 1910, 25 percent of agricultural production was exported, whereas 80 percent of manufactured goods were imported.

The 19th century was characterized by one-way capital flows from center European countries to periphery third world countries. Our data covers such one-way private capital flows (FDI) from France, Germany, and the U.K. into the Ottoman Empire during 1859–1913 period. These three countries were responsible for practically all FDI inflows over that period. For example, right before the World War I, all other countries combined contributed only 4% of total FDI. We also have data on exports from the Ottoman Empire into France, Germany and the U.K. and imports of the Ottoman Empire from these three center countries. Both sets of data come from Pamuk (2003) and Pamuk (1987), and they are expressed in British pound sterling. Figure 2 shows the total Ottoman exports and imports during our sample period, using data from Pamuk (1987). There was an eight-fold increase in imports and a quadrupling of exports, a pattern that led to accumulation of foreign debt. The sharp decline in both exports and imports after the default of 1876 is visible.

The expansion of trade between center and periphery countries was followed by investment of European powers into the third world. It was not only the case that European governments lent money to the periphery governments, but in addition private foreign money flowed into the periphery countries.[5] Some of this investment was in the form of foreign direct investment (FDI) to finance infrastructure such as railroads, with the aim to expand trade even more. Foreign investment was not solely concentrated in infrastructure. As of 1888, while 33 percent of total foreign investment from Europe in the Ottoman Empire was in railroads, 31 percent was in banking, 9 percent was in utilities, 8 percent in commerce, 12 percent was in industry, and 5 percent was in mining, as shown in Pamuk (1987). Foreign investment in the agricultural sector remained limited until the end of World War I.

The top panel of figure 3 shows private investment (FDI) from the U.K., France and Germany into the Empire. Overall, France was the biggest investor followed by the U.K. and Germany. German investment did not start until after the signing of the strategic German-Ottoman partnership, which also marks the start of the construction of the Berlin-Baghdad railroad in 1885. The bottom panel of the same figure shows the country by country decomposition of exports from the previous figure. Again, exports into Germany in general are low compared to the U.K. and France, and only slightly increased during the last three decades of our sample period, coinciding with the increased FDI from Germany. Similar to exports and imports in the previous figure, there is a stark decline after 1876 in FDI, up to 60 percent, and then a recovery. This is also true for exports by destination country as shown in the bottom panel. Both declines follow the default of the Ottoman Empire on its external debt in 1876.

In the course of the 19th century, the Ottomans undertook many reforms to modernize the economy. They needed foreign capital not only to finance this modernization effort but also to keep their growing fiscal deficit under control given the increased cost of Russian and Balkan wars. The Ottomans borrowed heavily from Europe during the 1850s and 1860s. This did not prevent the financial crisis of 1873 and the subsequent default in 1876 on the sovereign debt. As of 1876, the outstanding debt was 200 million pounds sterling and debt servicing was taking up half of the budget (Pamuk (1987)). After negotiations, the Ottoman Public Debt

[5] Ottoman government bond issues and major purchasers over 1854-1914 are listed in Pamuk (1987) on Page 74, Table 4.4

Administration (OPDA) was established in 1881 to exercise European control over Ottoman finances and to ensure debt payments. The outstanding debt was reduced to half of its value in nominal terms during the debt restructuring negotiations (Blaisdell, 1929). The OPDA helped to repair the lost reputation of the Ottomans, and hence the Ottoman state gained renewed access to the international capital markets.

3 Descriptive Statistics

Table 1 shows the descriptive statistics. The longest series for capital inflows is for the U.K., where data are available for the entire sample of 55 years. The magnitude of British investment flows into the Empire, however, was the smallest and constituted on average 0.39 million pounds sterling versus 1.04 and 0.77 million pounds for France and Germany, respectively. We can also see from Table 1 that Britain was the biggest trading partner of the Ottoman Empire and purchased, on average, 4.6 million sterling worth of the Empire's exports, while selling them about 7.6 million sterling worth of imports, on average. The smallest trade was between the Empire and Germany – only 1.1 million sterling worth of goods were exported, and 0.4 million sterling was imported by Germany. Unlike the U.K. and Germany, France was the only country (out of three) which has purchased more than it sold, with Ottoman exports being 3.8 million and French imports being 2.5 million sterling, respectively. Overall, the Empire was running a current account deficit against all these three countries in total, during our sample period.

The Gross Domestic Product (GDP) of France, Germany, and the U.K. comes from Mitchell (1988). Mitchell (1992) and Maddison (1995) also provide some GDP numbers for Turkey. However, we use the GDP data for the Ottoman Empire that comes from Clemens and Williamson (2004), which is based on Pamuk's GDP estimates.[6] All the GDP data are expressed in local currencies, which we have converted into British sterling using the "Gold Standard" exchange rates (see Table A1). During our sample period, 1 sterling corresponded to a fixed 7.3223 grams of fine gold, and thus, we implicitly measure all the "monetary" variables in gold. As shown in Table 1, the Ottoman Empire was roughly 10 times poorer, per capita, than the European

[6] Those sources, however, provide comparable GDP estimates as well as relative ratios. For example, while Maddison's UK and Turkey per capita GDP estimates for 1913, expressed in 1990 International Geary-Khamis dollars, are 4,921 and 1,213, Clemens and Williamson estimates, expressed in British Sterling, are 52 and 10.

countries.

Population numbers for the Ottoman Empire come from Behar (1996) while the data on the population of France, Germany, and the U.K. come from Maddison (1995). Table 1 shows that at the beginning of the sample in 1859, France was the largest country among those three, with a population of over 37 million. The smallest was Great Britain with about 29 million in population. During 1859–1913, France, Germany and Great Britain experienced drastic differences in population growth rates. By 1913, Germany's population had increased by 85 percent, and it approached WWI with more than 65 million people. The population of France and the U.K. in the middle of 1913 were 41 and 46 million, respectively.

4 OLS Analysis

4.1 Empirical Specification

Our benchmark specification is as follows:

$$\ln\left(\frac{FDI_{it}}{GDP_{it}}\right) = \alpha_i + \lambda_{it} + \beta \ln\left(\frac{EXPORTS_{it}}{GDP_{it}}\right) + \gamma Z_{it} + \epsilon_{it} \qquad (1)$$

where α_i is a country-fixed effect and λ_{it} is either time fixed effect or a country specific-trend. We also control for specific events in the specifications with no time fixed effect such as a time dummy for the creation of the Ottoman Public Debt Administration (OPDA) in 1881, and other time dummies characterizing the effect of Empire's default on the foreign debt in 1876, and the Resettlement of the debt in 1903. The left hand side variable is gross FDI inflows from the source countries (denoted as i), which are France, Germany and the U.K., into the Ottoman Empire; *Exports* are Ottoman exports into these countries. Both FDI and *Exports* are normalized by GDP of the source countries, GDP_{it}. The set of control variables, Z_{it} includes source countries' and the Empire's GDP per capita, population, lagged FDI, imports, and aggregate Ottoman public debt.

4.2 OLS Results

We report results from the OLS estimation of equation (1) in Table 2.[7] Our results are very strong given our sample size of 88 observations.[8] In all of the specifications, exports turn out to be positive and significant. None of the controls change the main result. The results are also economically significant, where a 10 percent increase in exports leads to a 2.4-3.9 percent increase in FDI flows. We first present results with time dummies and then replace them with dummies for important events such as default while also allowing for country-specific time trends. To estimate the effect of the Ottoman Empire's default in 1876, we introduce a "Default" dummy, which equals 0 before 1876, and 1 thereafter. As was expected, by defaulting on its foreign debt, the Ottoman Empire discouraged further investment, reducing capital flows into the country. In 1881, the Ottoman government decided to take actions toward repayment of the debt, and established a European-controlled organization, called the Ottoman Public Debt Administration (OPDA), designed to collect taxes which then were turned over to creditors. We take this event into account by introducing an "OPDA" time dummy, which is equal to 0 before 1881, and 1 after that. In 1903, the creditors voluntarily restructured the remaining debt of the Ottoman Empire, partially reducing its size. We capture that effect by yet another time dummy, "Resettlement," which equals 1 after 1903. All the dummies appear to have expected signs. We also control for source and host country GDP per capita. These variables do not seem to have an impact and hence we do not report those results.[9]

[7] Standard errors are clustered by country and the calculated p-values reflect the fact that we have only 3 county-pairs (and therefore, 3 fixed effects) in the dataset.

[8] Even though the dataset contains 125 FDI observations (for all three countries combined) and 122 Exports observations, for some years, one of the variables is missing while the other is not. As a result, we end up with only 88 complete FDI/Exports pairs, which constitutes the effective sample size.

[9] For robustness, we also normalize FDI and exports by population of source countries instead of their GDP. Note that there is no point in normalizing by Ottoman GDP and population since that will be a common factor among the three source countries and be absorbed by the constant term. When we normalize by population of the source country, the results are very similar in magnitude to those described and are available upon request.

5 IV Analysis

5.1 Rainfalls, Agricultural Production, and Trade

In this section, we lay out our argument on the linkage between trade, production and weather conditions, specifically the regional variation in the amount of rainfall within the Ottoman Empire. We explain in detail how the composition of exports into the U.K., France, and Germany, as well as specialization of the Empire's regions in different types of crops, allows us to construct the instrument.

The first step is to highlight the dependency between the level of exports and production. Excessive output in one particular year leads to a surplus of goods which were available for sale in and out of the country, causing exports to increase. This line of thought mainly comes from the "provisionistic" nature of Empire's policy. As the government policy at those times was aimed to primarily satisfy the needs of the Ottoman army, the supply of exports was determined not only by the prices, but also by the yield in that particular year. If the yield was low, it had to go first towards satisfying the army needs; if there remained any excess over this amount it could be traded abroad.

As discussed in Pamuk and Williamson (2011), by the beginning of the second half of the 19th century, the de-industrialization of the Ottoman Empire was practically complete. Labor and other resources were pulled out of industry, and agricultural production constituted the biggest part of the Ottoman Empire's GDP. Altug, Filiztekin, and Pamuk (2008) state that "Mechanization of agriculture began [only] in the 1950s, making nature one of the most important determinants of people's well-being at those times," and Quataert (1994) adds that "Mechanized factory output was and remained relatively insignificant in the 19th century when compared with domestic and handcraft production."

Agricultural goods made up a significant share of Ottoman exports. Therefore, the amount of rainfall was an important determinant of both domestic production and trade. Indeed, Donaldson (2018) for the case of India during 1861–1930 shows that "a one standard deviation increase in rainfall causes a 27 percent increase in agricultural productivity," thus affecting both quantity and quality of agricultural crops. For the case of grapes – one of the most important exports – Hellman (2004) gives an estimated 98 mm of water use per month to maximize quantity and quality of crop. This estimate is obtained for the most efficient modern drip irrigation system; for the furrow irrigation that historically was used in the Ottoman Empire, ideal water usage doubles to 196 mm. Another important agricultural product of the Empire was cotton. There is substantial evidence that "water deficit during critical growth stages can significantly reduce cotton yields" (Steger et al. (1998), Grimes et al. (1970)). For example, in the time of emergence (typically, in October) cotton fields require about 60 mm of monthly water usage. Water requirements increase during the next 5 months, reaching 255 mm a month in late February. Again, one of the main determinants of the yield of dryland (unirrigated) cotton are regular and predictable rainfalls. Similar patterns hold for other important agricultural export goods of the Ottoman Empire such as corn, grain, and olives. Dependency on rainfall is especially important given that the development of irrigation systems occurred in Turkey only at the end of the 20th century (Food and Agricultural Organization of the United Nations, 2003), which is outside the time frame we consider in this paper.

Measuring the effect of rainfalls on various types of crops produced, including grain, grape, olives, cotton and others, is possible since the rainfall data is available on a region by region basis, and different regions specialized in different crops. The area of modern-day Turkey amounts to 300,948 square miles, which equals 779,452 square kilometers. 265,931 square kilometers (a little more than one third) of those lands are used for agricultural purposes (TSY (2005)). In the past, a higher fraction of the land was used for agricultural production, plus there was more land under the Ottoman Empire's boundaries. We will focus on the regions that constitute today's modern Turkey and assume the specialization of regions in crops stays more or less the same in the last 200 years. This assumption is based on the maps provided by the State Institute of Statistics' (SIS) historical and contemporaneous yearbooks for grain and orchard production. Hence, we aggregate the products to groups such as "grains" and "orchards" and focus on bigger geographical regions than cities.

Let us explain this in detail. Turkey consists of 80 administrative provinces, 12 statistical regions (SRE) and 7 geographical regions. The first 4 of the 7 geographical regions have the names of the seas which are adjacent to them. Those regions are Black Sea Region, Marmara Region, Aegean Region, and Mediterranean Region. The other 3 regions are named according to their location in the Anatolia: Central Anatolia Region, Eastern Anatolia Region, Southeastern

Anatolia Region. In every region, agricultural land is typically split into two parts. The first part is cultivated field land. These cultivated lands are used to grow various types of grain (corn, wheat, barley, rye, etc), as well as cotton and tobacco. The second type is the area of fruit trees, olive trees, vineyards, vegetable gardens, and an area reserved for tea plantations. For consistency, we call the first type of land "grain" land, and the second type "orchard" land. As shown in Table 3, the share of "grain" land varies from 35 percent in the East Black Sea region, to as high as 99 percent in North East Anatolia. These shares of "grain" and "orchard" lands remained roughly the same in the last 200 years.

Let us work out an example. Assume there is extensive rain in the Aegean region, and abnormally dry weather in the Mediterranean region. We can conclude that first, this event would have a negligible effect on total "grain" production in the country. Indeed, if we look at Table 3, we can see that the area of positively affected "grain" land in the Aegean region equals $2,187$ thousand hectares, and it is fairy close to the negatively affected "grain" area in the Mediterranean region, which equals $2,132$ million hectares. Second, we expect whole country's output of "orchard" products to increase. The reason for that is that the "orchard" land in the Aegean region is much bigger than that in the Mediterranean region (828 thousand hectares versus 490 thousand hectares). This simple thought experiment will constitute a basis for the construction of our instrument.

The historical precipitation dataset we employ in this study is assembled based on the "tree-ring" methodology – a technique proposed by A. E. Douglass in the 20th century. This methodology recovers relatively precisely the level of rainfall during a growing season in each particular year based on the width of age rings, where each ring corresponds to a certain year. During droughts, rings are typically narrower, while extensive moisture results in wide rings. This data is not real-time historical data in the sense that it was not collected in the past, but instead, is being reconstructed nowadays.[10]

Analyzing tree-ring sites location maps in each study (the maps are available in the original studies), we are able to tie precipitation data series to different statistical regions (SRE), which are listed on Figure 4. Historical precipitation time series for North-West and South-Central

[10] As a robustness check, we compare reconstructed precipitation data to "true" historical data from the Ottoman Archives. Unfortunately, archival data only covers limited regions. The correlation between the two datasets for the overlapping regions is 0.495.

regions of Turkey (TR8 and TR5) were constructed by Akkemik et al. (2007) and Akkemik and Aras (2007) respectively, and the time span of those series exceeds 300 years. North-West study area – Kastamonu-Pinarbasi and its vicinity – was located on the southern side of the Kure Mountains. This corresponds to TR8 statistical region. The South-Central sampling area was located in the upper and northern part of the Western Taurus Mountains in proximity to Konya, and corresponds to TR5 region. Griggs et al. (2007) dataset covers North Aegean (TR2), specifically, North-East Greece and North-West Turkey, and goes back by 900 years. The authors reconstruct (May-June) precipitation based on analysis of oak tree rings. North-West of Turkey under consideration corresponded to TR2 statistical region. Touchan et al. (2003) build the dataset which reconstructs Southwestern Turkey (TR3) Spring (May-June) precipitations. Their data start in 1776, and the sites were located in the TR3 statistical region. Finally, Touchan et al. (2007) is an extensive reconstruction of precipitations in Eastern-Mediterranean Region for the last 600 years. This study covers not only Turkey, but also other countries in the region. Majority of sites located in Turkey are concentrated in TR3 and the West half of TR6.

To identify whether there was unusually rainy weather or unusually dry weather in a region $j (j = 1..J)$, and hence whether there was a shock to productivity, we proceed as follows. First, we measure the percentage deviation of yearly precipitations r_{jt} in a region j during year t from their average values over the time period under consideration (1859–1913):

$$dr_{jt} = \log(r_{jt}) - \log\left(\frac{1}{T}\sum_{t=1859}^{1913} r_{jt}\right) \tag{2}$$

where t indexes years, and T, the sample length, is 55, and dr_{jt} measures the deviation from the average. Positive values of this statistic would indicate that in a year t, region j experienced a high amount of rainfall, which most likely would have resulted in high yield. Having this index and knowing the distribution of land between the "grain" and "orchard" land in each region allows us to construct a variable, which reflects the country-wide "grain" and "orchard" production shocks as a result of a unique rain map over the Ottoman Empire in year t. Let L_j be the agricultural area of region j. It is split into two parts: "grain" land L_j^g and "orchard" land L_j^o, and $L_j = L_j^g + L_j^o$. We can define S_j as the share of "grain" land in the total agricultural area of region j

$$S_j = \frac{L_j^g}{L_j} \tag{3}$$

Then the country-wide output shock to "grain" production P_t^g and the output shock to the "orchard" production P_t^o at year t would be the average of the regional shocks, weighted by the share of their area in the total area:

$$P_t^g = \frac{\sum_{j=1}^{J} L_j^g \times dr_{jt}}{\sum_{j=1}^{J} L_j^g} = \frac{\sum_{j=1}^{J} S_j L_j \times dr_{jt}}{\sum_{j=1}^{J} S_j L_j} \tag{4}$$

$$P_t^o = \frac{\sum_{j=1}^{J} L_j^o \times dr_{jt}}{\sum_{j=1}^{J} L_j^o} = \frac{\sum_{j=1}^{J} (1-S_j) L_j \times dr_{jt}}{\sum_{j=1}^{J} (1-S_j) L_j} \tag{5}$$

This set of indices is used to model the deviations in production of both types of agricultural outputs as a function of the amount *and* location of rainfalls in Turkey, under assumption that both types of crop are similarly affected by rainfalls. This gives us the time series variation in our instrument.

The best way to illustrate this formula is to go over an example. Suppose, we know that some year t was especially rainy. Specifically, the percentage deviation from the usual level of precipitations was 10 percent for the West Marmara region, 20 percent for Aegean and 6 percent for West Anatolia. All other regions experienced usual level of rainfalls. What can we say about the deviations of grain and orchard production from their average values? The answer depends on the size of a region L_j and its agricultural specialization S_j. The values of L_j and S_j come from Table 3, and they are equal to {1,736; 0.87}, {3,010; 0.73} and {4,221; 0.96} for the West Marmara, Aegean and West Anatolia regions, respectively. To find country-wide shock to the production of "grain" and "orchard", we need to use Eq. (4) and Eq. (5). After substituting the values, we get $P_t^g = \frac{0.10 \times 1{,}510 + 0.20 \times 2{,}187 + 0.06 \times 4{,}050}{13{,}846} = 6.00 \times 10^{-2}$ and $P_t^o = \frac{0.10 \times 226 + 0.20 \times 828 + 0.06 \times 171}{1{,}971} = 10.07 \times 10^{-2}$. These numbers mean that in year t, production of grain has experienced a positive shock of 6 percent, while production of orchard has experienced a positive shock of 10 percent. Different rain patterns from year to year cause the time variation of production.

Our next step is to introduce cross sectional variation (meaning between the Empire and the various Northern trading partners) to our instrument. We are able to do this by relying on the fact that the composition of exports differs for Germany, France, and the U.K. Pamuk and Williamson (2011) argue that the Ottoman Empire, while importing manufactures, specialized in the export of primary products. As is evident from Table 4, at the beginning of the sample, agricultural products constituted about 70 percent of exports to both Germany and the U.K. For France, this share makes up only 26 percent. We speculate that the reason for this is that, unlike Germany and the U.K., France used to purchase high volumes of raw silk. Its share constantly made up more than 30 percent of France imports, falling to 18.3 percent only in 1880–1882, right after the default (Pamuk, 2003).

The differences in exports bundles allow us to obtain cross sectional variation of our instrument. Let m index the country, where $m = \{\text{France}, \text{Germany}, \text{U.K.}\}$. And let $\overrightarrow{\theta}_m = (\theta^g_m, \theta^o_m, \theta^0_m)$ represent the decomposition of exports of country m into "Grain", "Orchard" and "Other" according to Table 4. It is important that we use initial values (first year in our sample) for these export bundles and do not allow them to vary over time. Hence these initial export shares can be thought of structural demand for the Empire's products by the Northern countries.

We construct the variable "Rainfalls," R_{mt}, which reflects the effect of rainfalls onto exports into country m, and thus is able to instrument for country-time varying exports:

$$R_{mt} = \theta^g_{m0} P^g_t + \theta^o_{m0} P^o_t \tag{6}$$

where as usual, "g" and "o" denote "grain" and "orchard" production, respectively, and the values of shocks to outputs P^g_t and P^o_t are defined according to Eq. (4) and Eq. (5).

5.2 IV Results and Threats to Identification

The top panel of Table 5 shows the 2SLS results and the bottom panel reports the coefficient on rainfalls from the corresponding first stage regression. We can see that exports were indeed a significant determinant of FDI, with a coefficient on exports that is roughly twice as large as its OLS counterpart. This is true when we use time effects (column 1) and when we drop them, replacing with various event control dummies (column 2). The third column runs a dynamic panel regression using the lagged dependent variable as a control given the persistence in long-term foreign investment. In order to correct for Nickell bias, in that specification we expand the instruments set by adding the second lag of FDI for robustness. This lagged term turned out to be insignificantly different from zero, and did not change the main result. Hence, we move on with standard rainfall instrument and time trends in the last column. In all columns, the exports coefficient remains significant.

The first stage regressions shows that rainfalls were a significant determinant of exports. The value of the coefficient is around 0.5, suggesting that an increase in the rainfall index by 10 percent (which corresponds to a one standard deviation in rainfalls from the mean) leads to a 5 percent increase in Ottoman exports. Figure 5 shows the partial plot for column 5 of the first stage regression and it is clear that the strong first stage relation is not driven by outliers.

Our identification strategy builds on a unique historical context, where as a result of temporary weather fluctuations, the resulting surplus agricultural production was exported. The exclusion restriction requires that that rainfall shocks will not affect capital flows via any other channel such as income. We undertake another test to assure that our exclusion restriction is valid. In Table 6, using aggregate data and time series variation, we provide evidence that in response to positive rainfall shocks, exports increase (column 1). We also report an informal test of the exclusion restriction where we regress GDP on rainfall shocks and exports to show that rainfall shocks do not have an independent effect on income other than through exports, since such an effect would violate the exclusion restriction. It is clear, as shown in column (2), that rainfalls enter this regression insignificantly upon controlling for exports, providing further evidence that the effect of rainfall shocks does not operate through their effect on income.

6 Conclusion

This paper investigates the causal effect of trade on financial flows using a historical quasi-natural experiment from the Ottoman Empire. We use fluctuations in regional rainfall within the Ottoman Empire to capture the exogenous variation in exports from the Empire to Germany, France, the U.K., during 1859–1913. The provisionistic policy of the Ottoman Empire provides the basis for our identification. This policy dictates that only a surplus production was allowed to be exported. Since different products grow in different sub-regions of the empire, there will be differences in the surplus production based on the differences in regional variation in rainfall.

The trading partners of the Empire, namely, France, Germany and the U.K., have different demands and hence import different products. As a result, we can link regional variation in rainfalls to exogenous cross-sectional variation in exports over time to these 3 countries.

When a given region of the Empire gets more rainfall than others, the resulting surplus production is exported to countries with higher ex-ante export shares for those products and this leads to higher investment by those countries in the Ottoman Empire. We find that one standard deviation in rainfalls from the mean lead to a 5 percent increase in Ottoman exports, which in turn causes a 3.5 percent increase in capital inflows, on average. This result holds also after accounting for the negative effect of the Ottoman 1876 default on foreign investment and trade. Our findings are supportive of trade theories predicting complementarity between trade and capital flows as a result of causality running from exports to foreign direct investment.

7 Acknowledgments

We thank Michael Clemens, James Feyrer, Graciela Kaminsky, Christopher Meissner, Elias Papaioannou, Eric Pentecost, Alan Taylor, Dietrich Vollrath for helpful discussions and comments, and Ünal Akkemik for help with historical tree-ring rainfalls data. This work was supported in full or in part by a grant from the Fogelman College of Business and Economics at the University of Memphis.

8 References

References

[1] Altug, Sumru, Alpay Filiztekin, and Sevket Pamuk. 2008. "Sources of long-term economic growth for Turkey, 1880-2005." *European Review of Economic History*, 12, 393-430.

[2] Antràs, Pol, and Richardo J. Caballero. 2009. "Trade and Capital Flows: A Financial Frictions Perspective." *Journal of Political Economy, University of Chicago Press*, 117(4), 701-744.

[3] Akkemik, Ünal, and Aliye Aras. 2007. "South-Central Turkey April-August Precipitation Reconstruction." *IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series 2007-026. NOAA/NCDC Paleoclimatology Program*, Boulder CO, USA.

[4] Akkemik, Ünal, N. Dagdeviren, and Aliye Aras. 2007. "Western Black Sea Region, Turkey Spring Precipitation Reconstruction." *IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series 2007-025. NOAA/NCDC Paleoclimatology Program*, Boulder CO, USA.

[5] Aviat, Antonin, and Nicolas Coeurdacier. 2007. "The Geography of Trade in Goods and Asset Holdings." *Journal of International Economics*, 71(1), 22-51.

[6] Behar, Cem. 1996. "1500-1927: The Population of the Ottoman Empire and Turkey." In *State Institute of Statistics, Historical Statistics Series, Volume 2.*

[7] Blaisdell, D. C. 1929. "European Financial Control in the Ottoman Empire." New York: Columbia University Press.

[8] Clemens, Michael A., and Jeffrey G. Williamson. 2004. "Wealth bias in the first global capital market boom, 1870-1913." *Economic Journal*, 114(495), 304-337.

[9] Dell, Melissa, and Jones, Benjamin F. and Olken, Benjamin A., 2009. "Temperature and Income: Reconciling New Cross-Sectional and Panel Estimates." *American Economic Review*, 99(2), 198-204.

[10] Dell, Melissa and Jones, Benjamin F. and Olken, Benjamin A., 2012. "Temperature Shocks and Economic Growth: Evidence from the Last Half Century." *American Economic Journal: Macroeconomics*, 4(3), 66-95.

[11] Deschenes, Olivier and Michael Greenstone. 2007. "The Economic Impacts of Climate Change: Evidence from Agricultural Output and Random Fluctuations in Weather." *American Economic Review* 97(1), 354-385.

[12] Donaldson, Dave, 2018. "Railroads of the Raj: Estimating the Impact of Transportation Infrastructure." *American Economic Review*, 108(4-5), 899-934.

[13] Eaton, Jonathan, and Gersovitz, Mark, 1981. "Debt with Potential Repudiation: Theoretical and Empirical Analysis," *Review of Economic Studies*, 48(2), 289-309.

[14] FAO: Food and Agriculture Organization of the United Nations. 2003. "Medium-term prospects for agricultural commodities, projection to the year 2010."

[15] Genc, Mehmet. 1987. "A Study of the Feasibility of Using Eighteenth Century Ottoman Fiscal Records as an Indicator of Economic Activity," In Huri Islamoglu-Inan (Ed.), *The Ottoman Empire and the World-Economy* (pp. 345-373). Cambridge: Cambridge University Press.

[16] Genc, Mehmet. 1994. "Ottoman Industry in the Eighteenth Century: General Framework, Characteristics, and Main Trends," In Donald Quataert (Ed.), *Manufacturing in the Ottoman Empire and Turkey, 1500–1900* (pp. 5986). Albany: State University of New York Press.

[17] Geyikdagi, V. Necla. 2011. "Foreign investment in the Ottoman Empire: international trade and relations 1854-1914." London and New York: I. B.Tauris Publishers.

[18] Griggs, Carol, Arthur DeGaetano, Peter Kuniholm, and Maryanne Newton. 2007. "A regional high-frequency reconstruction of May-June precipitation in the north Aegean from oak tree-rings, A.D. 1089-1989," *International Journal of Climatology*, 27(8), 1075-1089.

[19] Grimes, Donald, Raymond J. Miller, and L. Dickens. 1970. "Water stress during flowering of cotton," *California Agriculture*, 24(3), 4-6.

[20] Guiso, Luigi, Paola Sapienza, and Luigi Zingales. 2009. "Cultural Biases in Economic Exchange?" *Quarterly Journal of Economics*, 124(3), 1095-1131.

[21] Hellman, Ed. 2004. "Irrigation Scheduling of Grapevines with Evapotranspiration Data." Downloaded from: http://winegrapes.tamu.edu/grow/irrigationscheduling.pdf

[22] Helpman, Elhanan, and Assaf Razin. 1978. "Uncertainty and International Trade in the Presence of Stock Markets." *Review of Economic Studies*, 45(2), 239-250.

[23] Inalcik, Halil. 1994. "An Economic and Social History of the Ottoman Empire, 1300–1600." In H. Inalcik and D. Quataert (Eds.), *An Economic and Social History of the Ottoman Empire, 1300–1914*, Cambridge: Cambridge University Press.

[24] Inalcik, Halil and Donald Quataert. (Eds). 1994. "An Economic and Social History of the Ottoman Empire, 1300–1914," Cambridge: Cambridge University Press.

[25] Jones, Ronald W. 1967. "International Capital Movements and the Theory of Tariffs and Trade", *The Quarterly Journal of Economics* 81(1), 1–38.

[26] Kemp, Murray C. 1966. "The Gain from International Trade and Investment: A Neo-Heckscher-Ohlin Approach." *American Economic Review*, 56(4), 788–809.

[27] Maddison, Angus. 1991. "A long run perspective on saving." *The Scandinavian Journal of Economics*, 94(2), 181-196.

[28] Maddison, Angus. 1995. *"Monitoring the World Economy, 1820-1992,"* Washington, DC: Organization for Economic Cooperation and Development.

[29] Miguel, Edward, Shanker Satyanath and Ernest Sergenti. 2004. "Economic Shocks and Civil Conflict: An Instrumental Variables Approach." *Journal of Political Economy*, 112(4), 725-753.

[30] Mitchell, Brian R. 1988. "British historical statistics," Cambridge: Cambridge University Press, ISBN-10: 0521330084.

[31] Mitchell, Brian R. 1992. *"International Historical Statistics Europe 1750-1988,"* Stockton Press, ISBN-10: 156159038X.

[32] Mitchener, Kris James, and Marc D. Weidenmier. 2005. "Supersanctions and Sovereign Debt Repyament." *Journal of International Money and Finance*, 29(1), 19-36.

[33] Obstfeld, Maurice and Alan M. Taylor. 2004. "Global Capital Markets: Integration, Crisis, and Growth," Cambridge: Cambridge University Press

[34] Pamuk, Sevket. 1987. "The Ottoman Empire and European Capitalism, 1820-1913," Cambridge: Cambridge University Press, ISBN-10:0521331943.

[35] Pamuk, Sevket. 2003. "Ottoman foreign trade in the 19th century." *Historical Statistics Series, Volume 1*, State Institute of Statistics.

[36] Pamuk, Sevket, and Jeffrey G. Williamson. 2011. "Ottoman de-industrialization, 18001913: assessing the magnitude, impact, and response." *The Economic History Review*, 64(s1), 159-184.

[37] Paxson, Christina H. 1992. Using Weather Variability to Estimate the Response of Savings to Transitory Income in Thailand. *The American Economic Review*, 82(1), 15-33.

[38] Portes, Richard, and Helen Rey. 2005. "The determinants of cross-border equity flows." *Journal of International Economics*, 65(2)i, 269-296.

[39] Rose, Andrew K., and Mark M. Spiegel. 2004. "A Gravity Model of Sovereign Lending: Trade, Default, and Credit." *IMF Staff Papers*, 51(1), 50-63.

[40] Quataert, Donald. 1994. "The Age of Reforms, 1812-1914." In H. Inalcik and D. Quataert (Eds.), *An Economic and Social History of the Ottoman Empire, 1300-1914* (pp.759-946). Cambridge: Cambridge University Press.

[41] Schlenker, Wolfram and Michael Roberts. 2006. "Nonlinear Effects of Weather on Corn Yields." *Applied Economic Perspectives and Policy*, 28(3), 391-398.

[42] Steger, Adele J., Jeffrey C. Silvertooth and Paul W. Brown. 1998. "Upland cotton growth and yield response to timing the initial postplant irrigation." *Agronomy Journal*, 90, 455-461.

[43] Taylor, Alan M., and Janine L. F. Wilson. 2006. “International Trade and Finance under the Two Hegemons: Complementaries in the United Kingdom 1870-1913 and the United States 1920-30.” *NBER Working Paper No. 12543*

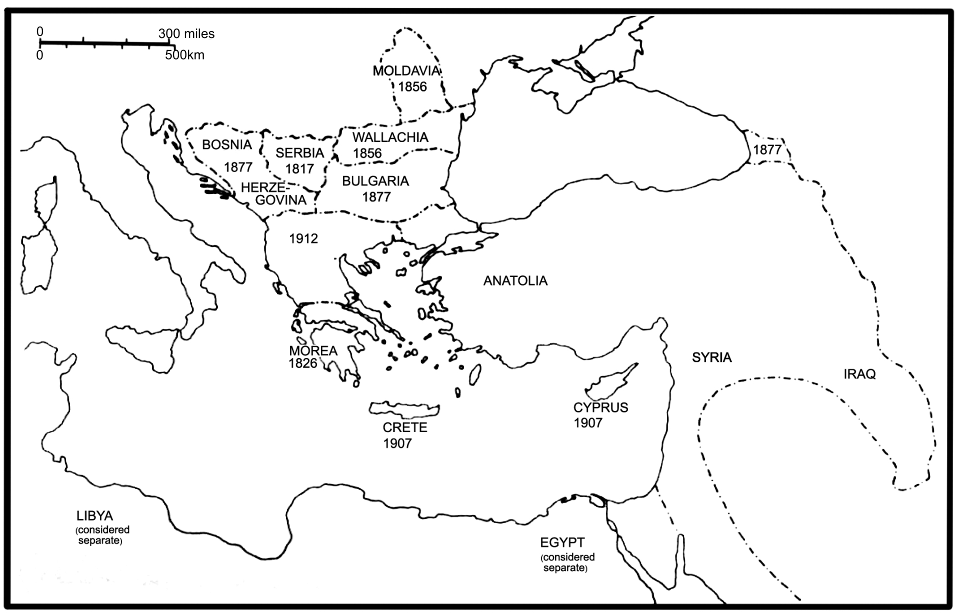
[44] Tilly, Charles, Ed. 1975. “The Formation of National States in Western Europe”, Princeton: Princeton University Press.

[45] Touchan, Ramzi, Gregg M. Garfin, David M. Meko, Gary Funkhouser, Nesat Erkan, Malkolm K. Hughes, and Brian S. Wallin. 2003. “Preliminary reconstructions of spring precipitation in southwestern Turkey from tree-ring width.” *International Journal of Climatology*, 23(2), 157-171.

[46] Touchan, Ramzi, Elena Xoplaki, Gary Funkhouser, Jurg Luterbacher, Malkolm K. Hughes, Nesat Erkan, Ünal Akkemik, and J. Stephan. 2007. “Eastern Mediterranean Spring/Summer Precipitation Reconstruction.” *IGBP PAGES/World Data Center for Paleoclimatology Data Contribution Series 2007-020. NOAA/NCDC Paleoclimatology Program*, Boulder CO, USA.

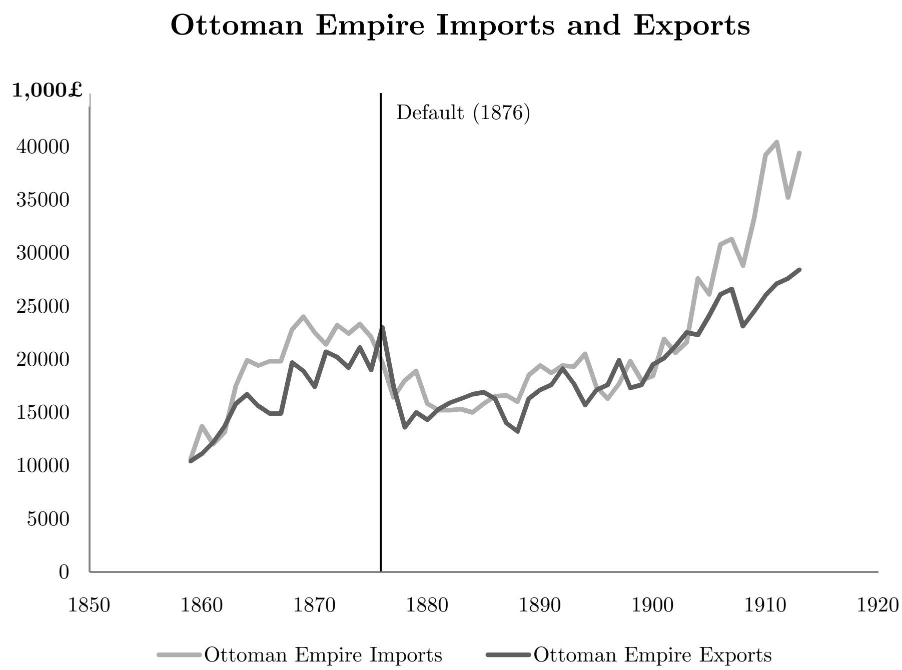
[47] Prime Ministry Republic of Turkey and Turkish Statistical Institute. 2005. “TSY: Turkey’s Statistical Yearbook.”

[48] Wright, Mark L. J. 2004. “New Empirical Results on Default: A Discussion of ”A Gravity Model of Sovereign Lending: Trade, Default and Credit.” *IMF Staff Papers*, 51, 64-74.



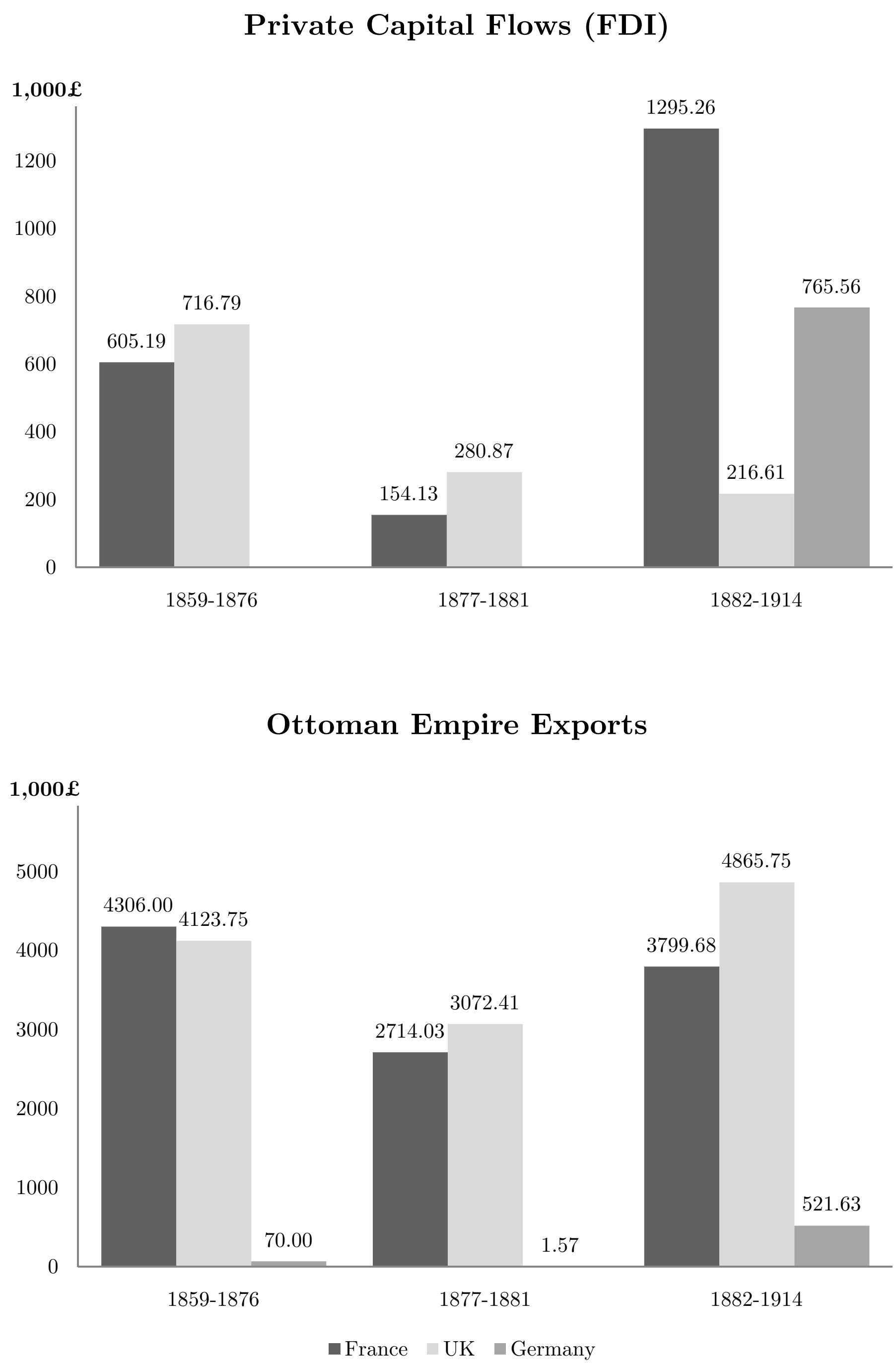
Notes: This map is taken from Pamuk (1987).

Figure 1: Ottoman Borders: 1830–1913



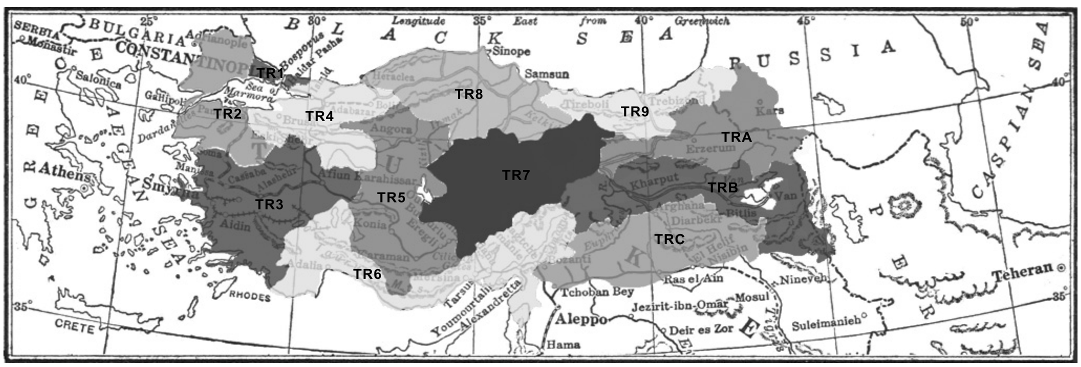
Notes: This data is taken from Pamuk (1987). All variables are measured in thousand sterling.

Figure 2: Aggregate imports and exports of the Ottoman Empire during 1859–1913



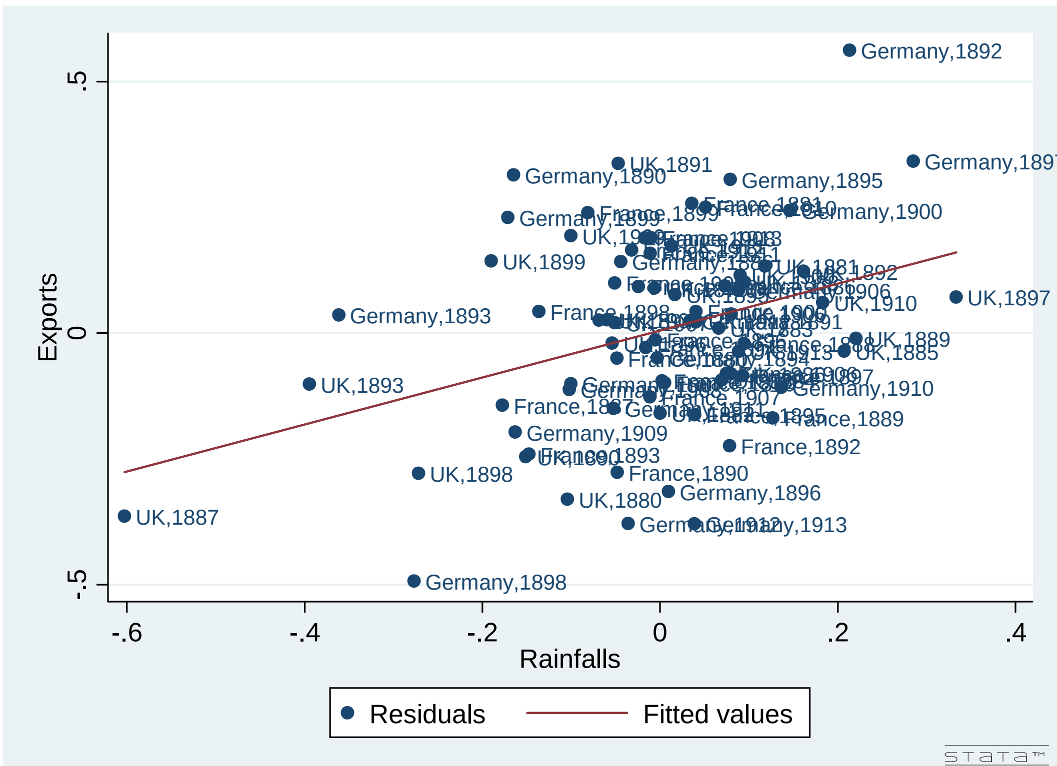
Notes: This data is taken from Pamuk (1987). All variables are measured in thousand sterling.

Figure 3: Private capital inflow (FDI) and Exports of the Ottoman Empire during 1859–1913



Notes: The figure shows the location of the statistical regions (SRE). TR1-Istanbul, TR2-West Marmara, TR3-Aegean, TR4-East Marmara, TR5-West Anatolia, TR6-Mediterranean, TR7-Central Anatolia, TR8-West Black Sea, TR9-East Black Sea, TRA-North East Anatolia, TRB-Central East Anatolia, TRC-South East Anatolia. Names of the statistical regions and their tags accord to TSY(2005), page 413 "Classification of statistical regions (SRE)". Long-term rainfall data is available for TR2 statistical region (Griggs et al. (2007)), TR3 region (Touchan et al. (2003)), TR5 region (Akkemik and Aras (2007)), TR6 region (Touchan et al. (2007)), and TR8 region (Akkemik et al. (2007)).

Figure 4: Statistical regions of Turkey with long-term rainfall data



Notes: The scatterplot and the solid line correspond to the first stage regression for specification (4) from Table 5 with the partial effect of rainfalls on exports being equal to 0.497 with the standard error of 0.079.

Figure 5: The partial effect scatterplot of rainfalls and Ottoman Empire exports

Table 1: Descriptive Statistics by Source Country: 1859–1913

Variable	# of Obs	Mean	Std. Dev.	Min	Max
France					
GDP	55	1137.10	272.21	706.34	1965.43
FDI	41	1.04	1.54	0.04	9.23
Imports from France	40	2.49	4.84	1.58	3.56
Exports into France	40	3.77	0.59	2.32	4.92
Population	55	39.47	1.26	37.24	41.46
UK					
GDP	55	1401.04	405.29	761.00	2354.00
FDI	55	0.39	0.43	0.03	2.12
Imports from the UK	40	7.62	1.47	3.43	9.93
Exports into the UK	40	4.58	1.00	2.49	6.34
Population	55	36.63	5.18	28.66	45.64
Germany					
GDP	55	1259.98	633.49	431.60	2782.56
FDI	26	0.77	0.76	0.09	3.40
Imports from Germany	40	1.11	1.39	0.02	4.66
Exports into Germany	40	0.43	0.51	0.00	1.46
Population	55	47.50	8.69	35.63	65.05
Ottoman Empire					
GDP	49	153.27	36.70	73.97	208.64
Population	55	16.54	3.10	10.17	21.89
Regression Variables (Entire sample)					
FDI/GDP	122	0.001	0.001	0.000	0.008
Exports/GDP	103	0.002	0.002	0.000	0.005
Imports/GDP	120	0.003	0.002	0.000	0.007
Source GDP per capita	165	30.43	8.479	12.11	51.57
Host GDP per capita	147	8.825	1.424	5.128	10.89
Rainfalls	165	-0.024	0.141	-0.716	0.268

Notes: For France, the UK, Germany, and the Ottoman Empire, all variables except Population are measured in millions of British Sterling. Population is measured in million people. Imports and Exports are Ottoman Empire Imports and Exports. FDI denotes average Private Capital Inflows from source countries (France, Germany and the UK) into the Ottoman Empire during 1859–1913. Data comes from Pamuk (1987), Table A3.3. Exports and Imports are average values of goods exported from and imported into the Ottoman Empire from France, Germany and the U.K. over 1859–1913, from Pamuk (2003) Table 7.5 and Pamuk (1987) Table 2.3, with values converted from Turkish Golden Lira into British sterlings using Gold Standard exchange rates from Table A1. Source country GDPs come from Mitchell (1992) Table J1. The table includes data on GDP for France and the U.K., and the NNP data for Germany. NNP figures for Germany were converted into GDP following the procedure described in Maddison (1992). Ottoman GDP data is from Clemens and Williamson (2004) dataset. Population figures for the Ottoman Empire are from Behar (1996). The data on population of France, Germany and the U.K. come from the Maddison dataset.

Table 2: Ottoman Exports and FDI Inflows

	Dependent Variable: log FDI/GDP				
	(1)	(2)	(3)	(4)	(5)
log Exports/GDP	0.243*	0.394*	0.297**	0.266**	0.319*
	(0.076)	(0.131)	(0.069)	(0.034)	(0.098)
	[0.086]	[0.095]	[0.049]	[0.033]	[0.080]
Default		-1.344***	-2.177*	-2.190*	-1.772
		(0.011)	(0.673)	(0.690)	(1.367)
OPDA			0.939	0.982	1.068**
			(0.782)	(0.790)	(0.209)
Resettlement				-0.101	1.031*
				(0.200)	(0.342)
Country dummies	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	No	No	No	No
Time trends	No	No	No	No	Yes
R-Square	0.212	0.061	0.112	0.114	0.223
Sample size	88	88	88	88	88

Notes: Exports and FDI are normalized by source countries (France, Germany, the U.K) GDPs. Default is a time dummy variable equals 1 after the default of the Ottoman Empire in 1876. OPDA is a time dummy variable equals 1 after establishment of the Ottoman Public Debt Administration (OPDA) in 1880. Resettlement is a time dummy variable equals 1 after 1903 when the Ottoman external debt was significantly decreased after negotiations with creditors. Default/OPDA is a dummy variable that is 1 after 1876. For the specifications without country time trends, the Exports variable for each country was detrended prior to estimation. The standard errors are clustered by country. Shown in square brackets for the main variable of interest are the small sample p-values for the hypothesis that the main variable of interest is insignificant. They are calculated taking into account that we have only 3 clusters/country-pairs in the dataset, which is the reason that very high values of t-stats are associated with lower significance levels. ***, **, *, and # indicate significance at 1, 5, 10, and 15% levels.

Table 3: Agricultural Land of Turkey by Statistical Region (SRE)

Region	Agricultural Land by SRE, thousand Hectare			
	Total Land	Cultivated Field Area	Non Cultivated Area	Share of Cultivated Land in Total Land
	L_j	"Grain Land"	"Orchard Land"	S_j (percent)
Istanbul (TR1)	83	76	7	92
Marmara				
West Marmara (TR2)	1,736	1,510	226	87
East Marmara (TR4)	1,564	1,226	338	78
Aegean (TR3)	3,010	2,187	828	73
Mediterranean (TR6)	2,623	2,132	490	81
Black Sea				
West Black Sea (TR8)	2,251	1,996	256	87
East Black Sea (TR9)	736	259	476	35
Anatolia				
West Anatolia (TR5)	4,221	4,050	171	96
Central Anatolia (TR7)	4,003	3,872	131	97
North East Anatolia (TRA)	1,461	1,443	18	99
Central East Anatolia (TRB)	1,451	1,328	123	92
South East Anatolia (TRC)	3,453	3,992	461	87
Total	26,593	23,066	3,526	87

Notes: The data come from Turkey's Statistical Yearbook, 2005. Table 11.11 at page 177. "Grain" produce include corn, wheat, barley, rye. Also, we included cotton into this category, because cotton is typically rotated with the grain. "Orchard" produce include grape, fig, unspecified fruits and vegetables, vine, olive oil, acorn, hazelnuts and peanuts. "Other" include animal products such as sheep, goat and lamb wool, leather, silk and several minor categories.

Table 4: Ottoman Decomposition of Exports

	Decomposition of Exports, percent		
	France	U.K.	Germany
Grain produce	16.9	44.8	41.4
Orchard produce	9.2	21.0	31.4
Other	73.9	34.2	27.2
Total	100.0	100.0	100.0

Notes: "Grain" produce include corn, wheat, barley, rye. Also, we included cotton into this category, because cotton is typically rotated with the grain. "Orchard" produce include grape, fig, unspecified fruits and vegetables, vine, olive oil, acorn, hazelnuts and peanuts. "Other" include animal products such as sheep, goat and lamb wool, leather, silk and several minor categories. Exports shares data comes from Pamuk (2003), page 62, Table 7.2. For the UK and France, the percentage shares are the averages over 1860-1862; for Germany, we take averages over 1880-82. This way, for all three countries, we are using the initial exports shares that correspond to the beginnings of the respective samples.

Table 5: Ottoman Exports and FDI Inflows: 2SLS Regressions

	Dependent Variable: log FDI/GDP			
	(1)	(2)	(3)	(4)
log Exports/GDP	0.632*	0.705**	0.712*	0.897**
	(0.179)	(0.110)	(0.419)	(0.209)
	[0.072]	[0.022]	[0.089]	[0.048]
First Stage Rainfalls Coefficient				
Rainfalls	0.531**	0.529**	0.597*	0.497**
	(0.156)	(0.104)	(0.183)	(0.079)
p-value (F-test)	0.000	0.000	0.001	0.002
Sample size	75	75	73	75
Controls	No	Yes	Yes	Yes
Lagged LHS	No	No	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes
Time dummies	Yes	No	No	No
Time trends	No	No	No	Yes

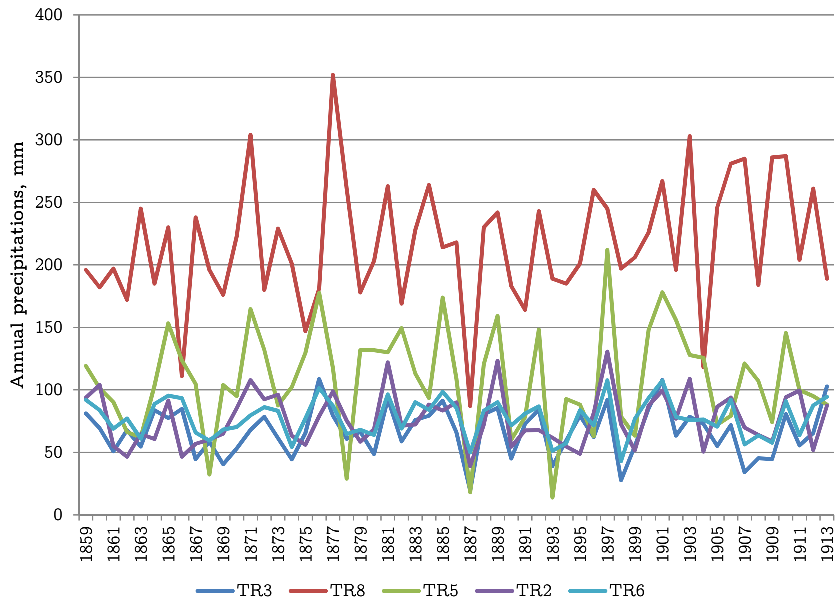
Notes: Exports are instrumented only by Rainfalls first (column (1)) and then by lags of exports in a dynamic panel (columns (2-4)). The p-values (F-test) correspond to the F-test with the null that the instruments are jointly insignificant. The standard errors are clustered by country. Shown in square brackets are the small sample p-values for the hypothesis that the main variable of interest is insignificant. They are calculated taking into account that we have only 3 clusters/country-pairs in the dataset. ***, **, *, and # indicate significance at 1, 5, 10, and 15% levels.

Table 6: Aggregate Ottoman Exports, GDP, and Rainfalls

	Dependent variable	
	log Exports	log GDP
	(1)	(2)
Rainfalls	0.059*	0.011
	(0.033)	(0.023)
log Exports	No	Yes
OPDA/Default	Yes	Yes
Time trend	Yes	Yes
R-Square	0.525	0.818
Sample size	55	49

Notes: Newey-West HAC standard errors are reported in parentheses. ***, **, *, and # indicate significant at the 1, 5, 10, and 15 percent level.

A Figures and Tables (Not for publication)



Notes: For definition of the statistical regions, refer to Section 5.1.

Figure A1: Annual precipitation in various statistical regions of the former Ottoman Empire

Table A1: Gold Standard Exchange Rates

Country	France	United Kingdom	Germany	Ottoman Empire
Currency	Franc	Pound Sterling	Mark	Gold Lira
Adopted	04/07/1803	05/01/1821	12/04/1871	01/05/1844
Abandoned	08/05/1914	08/06/1914	08/04/1914	08/03/1914
Grams of Fine Gold	0.2903	7.3224	0.3584	6.6152
Sterling Exchange Rate	25.2215	1.0000	20.4290	1.1069
Dollar Exchange Rate	5.1827	0.2055	4.1979	0.2275

Notes: These data come from Global Financial Data, and available for download at http://www.globalfinancialdata.com/gh/GHC_XRates.xls

Table A2: Ottoman Exports and FDI Inflows: Robustness check for standard errors

	Dependent Variable: log FDI/GDP				
	(1)	(2)	(3)	(4)	(5)
log Exports/GDP coefficient	0.243	0.394	0.297	0.266	0.319
	p-values under different assumptions about the data				
A: Clustered, small sample (benchmark)	0.086*	0.095*	0.049**	0.015**	0.080*
B: Clustered, no small sample adjustment	0.000***	0.000***	0.000***	0.000***	0.000***
C: Newey-West HAC consistent	0.181	0.033**	0.067**	0.075*	0.115#
D: White, independent observations	0.228	0.035**	0.076*	0.099*	0.148#
Other controls	Yes	Yes	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes	Yes	Yes
Time dummies	Yes	No	No	No	No
Time trends	No	No	No	No	Yes
R-Square	0.212	0.061	0.112	0.114	0.223
Sample size	88	88	88	88	87

Notes: The right-hand-side independent variables mimic those in Table 2. *A* repeats our benchmark results from Table 2. *B* clusters errors without accounting for the small sample size across the cross-sectional dimension. *C* calculates Newey-West, and *D* calculated White errors. ***, **, *, and # indicate significant at the 1, 5, 10, and 15% level.