Caffeinated Development: Exports, Human Capital, and Structural Transformation in Colombia*

Mateo Uribe-Castro†

Job Market Paper

This version: February 28, 2020

Latest version here

Abstract

This paper studies the effect of the first wave of globalization on developing countries' structural transformation, using data from Colombia's expansion of coffee cultivation. Counties engaged in coffee cultivation in the 1920s developed a smaller manufacturing sector by 1973 than comparable counties, despite starting at a similar level in 1912. My empirical strategy exploits variation in potential coffee yields, and variations in the probability to grow coffee at different altitudes. This paper argues that coffee cultivation increased the opportunity cost of education, which reduced the supply of skilled workers, and slowed down structural transformation. Using exogenous exposure to coffee price shocks as instrument, I show that reductions in cohorts' educational attainment led to lower manufacturing activity in the long-run. The effect is driven by both a decrease in demand for education and reductions in public goods. Finally, coffee cultivation during the early 20th Century had negative long-run effects on both individual incomes and poverty rates.

JEL: O14, N16, N56, N66.

Keywords: structural transformation, human capital, exports, coffee.

*I am grateful to John Wallis, Ethan Kaplan, and Allan Drazen for continued advice and support. I also want to thank Francesco Bogliacino, Maria M. Botero, Ryan Edwards, Irina España, Martin Fiszbein, Jessica Goldberg, Javier Mejia, Jacopo Ponticelli, Santiago Perez, Pablo Querubin, Michele Rosenberg, Felipe Saffie, Fernando Saltiel, Lesley Turner, Cody Tuttle, Sergio Urzua, Felipe Valencia, Daniel Velasquez, and participants at Cliometric Society, EHA Meetings, NBER SI-DAE, NEUDC, RIDGE Economic History, U. Nacional Colombia, LACEA, UMD Applied Micro, and UMD Political Economy workshop for their feedback and comments. Santiago Uribe and Pedro Uribe provided invaluable help with the data collection process.

†Department of Economics, University of Maryland; Email: `muribec@umd.edu`

1 Introduction

The first wave of globalization at the dawn of the 20th century allowed countries that had not yet industrialized to expand their agricultural production to supply world demand (O'Rourke and Williamson, 2002). Were these export opportunities leveraged for expanding the industrial sector? Or, on the contrary, did those places focus on agriculture and delay industrialization? Whether the rise in agricultural exports helped the development of manufacturing and services -the process of structural transformation- is a central question on development economics and has been debated for decades (Rosenstein-Rodan, 1943; Lewis, 1955; Schultz, 1964; Kuznets, 1966). In general, theoretical contributions highlight potential mechanisms in both directions.[1] The debate has influenced political views about globalization as well as trade and industrial policy in developing countries since the post-war period (Cardoso and Faletto, 1979; Wallerstein, 2011). But the direction of the change in structural transformation resulting from the expansion of agricultural exports is context-specific and, ultimately, an empirical question.

This paper provides new evidence on the effect of the first wave of globalization on developing countries' processes of structural transformation on the long run. Specifically, I study the effect of Colombia's expansion of coffee cultivation on industrialization and economic development.[2] A long peaceful period after 1902 and the construction of the Panama Canal in 1914 allowed the country to increase its participation in global trade by introducing a new labor-intensive crop, coffee, to areas mostly used to produce maize, beans, and other staples for local consumption (Parsons, 1949). Colombia's broken geography generated a set of local economies relatively isolated from one another and comparable in terms of size and population. Rich variation in climatic conditions within the

[1] The direction may depend on the degree of trade openness (Matsuyama, 1992), income elasticity of demand for manufacturing goods (Murphy et al., 1989), changes on terms of trade (Prebisch, 1950), depth of linkages with the rest of the economy (Hirschman, 1958), or features of crops' production function (Engerman and Sokoloff, 1997; Vollrath, 2011).

[2] The four-fold coffee production expansion between 1905 and 1921 is comparable to the largest expansion of modern agricultural exports (Palm oil in Indonesia (Edwards, 2019)).

country provides a good setting to study how the opportunity to produce an agricultural export good impacted long-run development.

This paper shows the expansion of coffee cultivation deterred industrialization. Counties producing coffee beans around 1920 developed a weaker manufacturing sector through the 20th century. Though manufacturing employment was consistent among coffee-bean-cultivating counties and non-coffee-bean-cultivating counties in 1912, the expansion of agricultural exports had a negative and sizable effect on manufacturing employment in 1938, 1973, and 2005, reaching its peak in 1973. By 2005, coffee cultivation's effect on manufacturing employment had halved, which follows the pattern of Colombia's structural transformation established in Figure 1. Consequently, I show that counties producing coffee beans around 1920 had lower population density and higher poverty rates as of 2005.

Identifying the causal relationship between coffee cultivation and structural transformation is challenging. Counties that would not have developed a strong manufacturing sector through the 20th century could have taken up coffee cultivation as an alternative. For instance, regions that had more difficulty importing capital goods might have seen a profitable opportunity in coffee bean production since it was transportable by mules. What would appear to be a negative effect of coffee bean cultivation on industrialization, could, in fact, be driven by geography or location.

In this paper, I exploit two different sources of variation related to climatic conditions to address endogeneity concerns. The assumption behind both instruments is that climatic conditions specific to coffee trees only affect industrialization through coffee cultivation. The first instrument for 1920 coffee cultivation is the average potential coffee yield from FAO's Global Agro-Ecological Zones project. FAO-GAEZ estimates potential coffee bean yields at a high-resolution level using a combination of local climatic conditions and coffee's growth cycle. The second instrument exploits a discontinuous reduction in the probability that a county grew coffee trees at 2,400 meters above sea level (7,874ft). The discontinuity is explained by both low temperatures in counties above the altitude threshold and the dissemination of information regarding coffee cultivation in the late 19th century. Optimal temperatures to grow coffee trees ranged between 16 and 24 degrees Celsius (60 to 75 degrees Farenheit). Given Colombia's tropical location, the temperature bandwidth mapped directly to an altitude bandwidth between 400 and 2,400 meters. Moreover, 19th century pamphlets promoting coffee cultivation explicitly identified towns just below and just above the upper altitude threshold as a reference due to lack of easily available thermometers[3] (Saenz, 1892). This fuzzy regression discontinuity strategy compares counties with average altitudes higher and lower than 2,400 meters. The main specification restricts the sample to include counties above 1,800 meters to guarantee an equal number on each side of the threshold.

The expansion of coffee cultivation in Colombia was effectively a land-augmenting technical change. A simple two-sector model with land-augmenting productivity can explain employment reallocation from manufacturing into agriculture, as Bustos et al. (2016) show using data from Brazil after 1990. However, a theory that explains coffee's negative effect on manufacturing employment must also account for the fact that around 80% of Colombia's labor force was employed in agriculture in 1912. It must explain the differential evolution of industrialization between coffee and non-coffee counties. Such a theory would apply more generally to developing countries during the first wave of globalization, before the proliferation of industrialization.

Using historical and present-day data at the local level, the empirical specifications compare structural transformation patterns throughout the 20th century between places that did and did not produce coffee beans around 1920. This approach is relevant for two reasons: first, Colombian counties during the early 20th century are characterized by low labor mobility and connected product markets. Since they behave as small open economies, empirical evidence from local units can be tied to insights from theoretical models (e.g. Foster and Rosenzweig (2004), Bustos et al. (2016) and Fiszbein (2017)). Sec-

[3] As illustrated in Figure 6.

ond, it highlights the distributional consequences of trade across local economies within countries. Though these consequences are well documented for late 20th century globalization (Autor et al., 2016; Goldberg and Pavcnik, 2007), evidence is scarce for the early 20th century. If the effect of trade on structural transformation depends on an economy's stage of development, evidence from more recent periods might not be as informative.

Given coffee's labor-intensive production function, the expansion of coffee cultivation increased the opportunity cost of education. Therefore, the supply of skilled workers in coffee-cultivating counties increased at a slower pace relative to other counties, which in turn slowed growth in the manufacturing sector. The argument connecting human capital and structural transformation is formalized explicitly by Caselli and Coleman II (2001) and indirectly by Acemoglu and Guerrieri (2008). Porzio and Santangelo (2019) use data across countries and within districts in Indonesia to provide causal evidence of the positive role of schooling in industrialization through increases in availability of workers for non-agricultural sector. This paper adds to the empirical evidence on supply-side mechanisms, specially related to education, as mediators in the process of industrialization.

Two pieces of evidence support the human capital mechanism. First, the difference in manufacturing employment between coffee and non-coffee counties is concentrated in sectors intensive in human capital, classified according to Ciccone and Papaioannou (2009). Second, I present difference-in-differences evidence from comparing adults in the 1973 census of population born between 1902 and 1952. Different cohorts were exposed to different world coffee prices while they were of school age, which determined the opportunity cost of dropping out of school. Cohorts born in coffee counties and exposed to higher coffee prices during school age accumulate fewer years of education by 1973.

These results contribute to a growing empirical literature on how export booms reduce human capital accumulation (e.g. Bobonis and Morrow (2014); Atkin (2016); Sviatschi (2018)). Moreover, they complement Carrillo (2019), who finds a negative, though smaller, effect of coffee price shocks on education using data from the second half of the

20th century[4] This paper looks at coffee price shocks during the first half of the century, when industrialization first spread, and focuses on coffee cultivation's effect on structural transformation.

The fact that coffee cultivation leads to lower levels of education could be a consequence of both household decisions and changes in supply of schooling. For instance, landowners in coffee regions might oppose the construction of schools or limit funding to existing ones in order to guarantee supply of agricultural workers (Galor et al., 2009; Galiani et al., 2008). I leverage data on county level land inequality between coffee farms to provide suggestive evidence of both education supply and demand channels. In other words, coffee-bean-producing counties develop a less skilled labor force due to individual's decisions to drop out of school and a lower number of schools per capita by 1951.

Coffee price shocks also had a negative direct effect on employment in manufacturing in 1973. The share of the labor force employed in manufacturing in 1973 is lower for cohorts born in coffee counties who were exposed to higher coffee prices during school age. The effect is similar in magnitude to the effect on education. Mediation analysis Dippel et al. (2019b) suggests around 70% of the effect of 1920 coffee cultivation on 1973 manufacturing employment is mediated by the effect of coffee cultivation on education. This result is only suggestive of the importance of the effect because it relies on one strong assumption: the sources of omitted variable bias present when estimating coffee's effect on cohort's education are identical to the ones that would bias the estimation coffee's effect on cohort's employment in manufacturing.

Finally, this paper explores other potential mechanism cited in the Colombian economic history literature: linkages between coffee cultivation and manufacturing (e.g. Ocampo (1984)). I exploit variation within coffee-bean-producing counties in terms of linkages with non-agricultural sectors by exploring one crucial stage in coffee bean exports: thresh-

[4]The effect I present in this paper is almost twice as large as Carrillo (2019) findings. The difference might be due to reduction in transportation costs, changes in education's rate of return or better enforcement of child labor and mandatory elementary school laws between the first and second half of the century.

ing, or removing the husk from the coffee bean. Threshing machines needed reliable energy sources that were also useful for manufacturing activities. Since they were imported from Britain, the presence of threshing machines also signals connection with international trade. Threshing also benefited smelting businesses that provided parts to constantly repair them. I find, however, that the effect of 1920 coffee cultivation on manufacturing employment in 1973 does not depend on the presence of threshing machines. Stronger linkages do not prevent coffee cultivation from having a negative effect on structural transformation.

This paper contributes to the empirical literature on the effect of agriculture on structural transformation and local development through productivity increases (Foster and Rosenzweig, 2004; Hornbeck and Keskin, 2015; Moscona, 2018; Bustos et al., 2016) or other factors (Fiszbein, 2017; Droller and Fiszbein, 2019). By highlighting human capital as a relevant mechanism, my findings relate to studies looking at differences in living standards at the subnational level that result from productivity gaps between agricultural and non-agricultural employment (Acemoglu and Dell, 2010; Gennaioli et al., 2013; Gollin et al., 2014; Herrendorf and Schoellman, 2018).

This paper's argument about the role of human capital on the onset of industrialization in developing countries complements scholarship about Europe's Industrial Revolution (Galor and Moav, 2004; Squicciarini and Voigtländer, 2015; Franck and Galor, 2017; de la Croix et al., 2018). Similarly, this paper fits in with recent works on Latin American economic history which highlight the role of human capital in the process of structural transformation either directly (Valencia Caicedo, 2019) or indirectly (Perez, 2017). This paper adds to the study of the adoption of coffee cultivation in Colombian history. As (McGreevey, 1971, p. 198) put it: "No other substantive economic change in Colombian economic history can have been of such overriding social importance." This paper brings comprehensive data and modern econometrics to an old debate in Colombian economic history. It revisits an established literature studying the relationship between coffee cultivation and industrialization that mostly rely on comparative studies or time series data. The next section describes this literature in more detail.

Afterwards, I turn to the empirical analysis. Section 3 describes the main datasets used in later sections. Section 4 presents main correlations between coffee cultivation and structural transformation. It also discusses the main obstacles for identification and presents the empirical strategies used in Section 5. Sections 6 and 7 discuss potential mechanisms. Finally, 8 discusses the long term effects of coffee cultivation on income and urbanization.

2 Exports and Structural Transformation in Colombia

Countries in Latin America started their processes of industrialization around the first two decades of the 20th century. There was considerable heterogeneity in the path and timing of structural transformation across the region (Salvucci, 2006; Duran et al., 2017). While some countries like Argentina or Mexico had developed manufacturing industry by 1900, smaller countries struggled to consolidate industrial activities (Williamson, 2011). Development economists and economic historians have argued that differences in the features of the export sector help to explain the diverse experiences with industrialization. What Bulmer-Thomas (2003) called "the lottery of commodities" has explanatory power to understand the development of manufacturing in the region.

Demand for commodities from the world economy might help develop the non-export economy through increases in income that increase demand for locally produced manufacturing. This is more likely to happen if the export sector benefits a large fraction of the population and if transportation costs for imported manufactured goods are high (Murphy et al., 1989; Matsuyama, 1992). Additionally, different export products had different degrees of connection with other economic activities. Linkages or complementarities of exports are cited as a reason for successful development of manufacturing (Bulmer-Thomas, 2003; Hirschman, 1958).

These conditions were not met, for instance, for crops like bananas, produced in enclaves with limited population, or for mining activities performed in isolation from the main centers of population Bulmer-Thomas (2003). On the contrary, successful episodes of industrial growth, like Argentina around 1900, have traditionally been explained by the presence of agricultural activities like wheat or the exporting of processed meat that were not available in other countries in the region. Recent empirical evidence by Droller and Fiszbein (2019) support the hypothesis that linkages in agricultural activities generate industrial growth.

Colombia did not consolidate its export sector until coffee cultivation took off around 1910. During the 19th century gold was consistently the main export, with a couple of short experiments with tobacco and quinine (Ocampo, 1984). Even though coffee was relatively new in the country, a long period of peace after 1902 and two coffee price booms (1906 and in the 1920s) allowed coffee to grow until it represented more than 80% of exports by 1940 (Nieto Arteta, 1971). Coincidentally, manufacturing took off around the 1930s. It had been relegated to cottage industry during the first two decades of the century, but more modern establishments appeared during the 30s and 40s (Ocampo and Montenegro, 2007).

Historians and economic historians have interpreted this coincidence in timing as evidence of the causal positive effect of coffee cultivation on the development of manufacturing, though the claim has been subject to extensive debate.[5] Some features of coffee cultivation fit the two theories explained above. Coffee directly employed 18% of the labor force at its peak (McGreevey, 1971). Moreover, its production and exporting connected

[5]Some version of this claim is discussed in the main economic history textbooks. The argument starts with Ospina Vásquez (1955) and Parsons (1949). McGreevey summarizes the argument saying: "the rapid growth of a new export product raised income levels and generated new demands for imported and locally produced goods of all kinds" (McGreevey, 1971, p.198). Brew (1973), Nieto Arteta (1971) and Palacios (2002) studied coffee cultivation and its social impacts to Colombia's and Antioquia's societies. Arango (1981) focused exclusively on the direct connection between coffee and manufacturing. Bejarano (1980) summarizes the literature up to 1980 and Ocampo and Botero (2000), Ocampo (2015) discuss new developments from the past 40 years. More modern literature on Colombia's industrialization downplays the role of coffee cultivation using network data on entrepreneurs and elite members (Mejia, 2018).

an extensive area and required machinery and manufacturing products like sacks.

Proponents of the positive link between coffee cultivation and manufacturing back their claims with time series or Department level data. In this paper I collect a wealth of historical data at both the county and individual level to empirically estimate the connection between coffee cultivation and structural transformation.

2.1 Coffee in Colombia: Historical Background

Colombia went from producing around 230 thousand bags per year in 1900 to 3.2 million in 1932. Figure 1a shows the evolution of exports during the first half of the 20th century. At the end of the 19th century, the Eastern part of the country produced most of the coffee. The crop made its way to Colombia's West and South West in the first two decades of the 20th century, well after the frontier closed (Parsons, 1949). By 1930, the East only produced around 30% of total coffee exports.

Early adopters of the crop wrote several pamphlets around 1880 to inform potential investors of the opportunities that coffee cultivation provided. Those pamphlets were collected in the book *Memorias sobre el cultivo del cafeto* (Saenz, 1892). They provide information about the different features of coffee's production function at the turn of the 20th century. In this paper, I highlight four of them.

First, producing coffee was labor intensive. Coffee trees had two large crops during the year, but it was possible to collect coffee cherries all year round. Even when labor was not required to pick the cherries, coffee farms demanded constant labor for other purposes like weeding, pruning, and pest control. Second, the pamphlets highlighted that a lot of the tasks involved in the collection and classification of coffee were ideal for children. I argue in this paper that those two features of coffee production function shaped incentives to accumulate human capital and ultimately affected coffee counties' process of structural transformation and development.

Third, the production of coffee required heavy machinery to remove the final grain for exporting from its husk. This process known as threshing[6] used imported machines, generally owned by farmers' cooperatives. Not every coffee producing county had threshing machines. They were in strategic locations, not necessarily in the main production centers. In this paper, I argue coffee cultivation in counties with threshing machines had stronger linkages to the non-export economy. I use this fact to test whether the effect of coffee cultivation on manufacturing depended on linkages.

Finally, coffee was ideally produced at medium altitude. Those pamphlets consistently pointed out that coffee could be produced between 24 and 16 degrees Celsius (76 to 60 Fahrenheit). Given that climate in Colombia is determined by altitude, early coffee adopters provided reference points in terms of altitude to decide which terrains were feasible to produce the crop. Figure 6 shows one of those instances. It highlights that coffee could be produced near Rionegro, located at an altitude of 2,200 meters, but could not be produced near Sonsón or Santa Rosa, at altitudes of 2,500 and 2,450 meters respectively. In general, authors of the pamphlets recognized there was an altitude bandwidth inside which coffee cultivation was suitable. In this paper, I use the upper threshold of the bandwidth in order to identify the causal effect of coffee cultivation on structural transformation.

3 Data

The empirical analysis in this paper spans several decades and uses information from various sources. Moreover, as this paper estimates the effect of exports on local development, it is crucial to consistently define the unit of observation. Colombia's population was distributed in 18 *Departamentos* during most of the 20th century. There were also a handful of *Intendencias*, where population density was lower and most of the land was unsettled. The country's smallest political division are *municipios*, equivalent to US counties. They

[6] In Spanish: *trilla*.

were generally comprised of a town (*Cabecera*) and a rural area. In this paper, I refer to them as "counties." They are the main unit of observation, as each one of them represents a local economy.

I digitized county-level data from Colombia's first coffee census (published in 1927) and 1912 and 1938 census of population. Additionally, I use 1945 First Census of Manufacturing. I match 1927, 1938, and 1945 counties to the set of 741 counties reported in 1912 Census. Whenever I could not match by name, I used historical sources to match a county created after 1912 to its "parent" 1912 county. This procedure yields a set of 734 counties with observations in 1912, 1927, 1938, and 1945. Figure 7 shows population patterns in 1912 and highlights the main sample.

I also use 1973 and 2005 Census of Population, available from IPUMS International (Ruggles et al., 2003). IPUMS homogenizes counties over time by merging small counties in terms of population and pooling them together into larger units. I call those units "IPUMS-county". There are 564 in 2005 Census. The average IPUMS-county contains 1.9 actual counties (*municipios*). However, 57% of IPUMS-counties only contain one actual county. 84.4% of IPUMS-counties contain one or two actual counties. Moreover, out of the 564 counties, only 495 counties can be traced to be part of a 1912 county. The other 69 counties are located in land that was colonized after 1950.

For each set of results, I explicitly define the unit of observation it uses, between counties and IPUMS-counties. I do this for two reasons: first, counties better represent local economies for the first part of the 20th century. I use IPUMS-counties for results for the second half of the 20th century, where larger units capture better the idea of a local economy. Second, even though there are some differences, there is significant overlap between both definitions. Results using counties look qualitatively similar as those using IPUMS-counties, but since the sample size is smaller, power tends to be lower.

Coffee cultivation before 1920

I measure coffee cultivation at the beginning of the 20th century with the number of coffee trees used in production by county. This measure comes from the first coffee producers' census: Monsalve's 1927 book, "Colombia Cafetera." Monsalve was an agricultural engineer who led Colombia's Propaganda and Information Office between 1920 and 1924. During that period, he surveyed coffee farms around the country and put together a 950-page book describing Colombia's coffee industry. In 1924, Colombia's government bought the book's rights. The goal was to promote coffee exports by "distributing the book to foreign markets, giving it out for free to public offices, and charging only the production cost to private individuals." Since coffee trees take around 5 years to start producing coffee cherries, the number of coffee trees registered in Monsalve's census is likely to represent trees that were planted in the 1910s, even though the book was eventually published in 1927. Therefore, I interpret the number of coffee trees as a measure of early exposure to coffee cultivation. For robustness, I also use the extensive margin, a dummy equal to one for counties with a positive number of coffee trees planted before 1924.

The average county had 427 thousand coffee trees, equivalent to around 95 hectares, but the distribution is skewed to the left. 43% of counties had no early coffee production. 50% of counties had less than 20,000 trees, which is equivalent to less than half a hectare. These figures show how even though coffee was taking off during 1910s and 20s, it still represented a small share of counties' land. For instance, Fredonia (Antioquia) had the largest number of coffee trees used for production in 1920. Its 8.3 million trees were equivalent to 1,800 hectares or 7% its total area. As a comparison, using data from 2005 coffee census, 22% of counties use more than 7% of their area to produce coffee. Chinchina (Caldas) was the county with highest concentration of coffee trees in 2005. It devoted 44% of its area to the crop.

I use the coffee census to measure land inequality between coffee landowners. I calculate the ratio between the average and the median farm for each county with a positive number of coffee trees. This ratio was 1.9 for the average coffee county. Appendix A describes the calculation in more detail. A typical coffee county had around 85 coffee farms and 5,600 inhabitants in 1912. A typical farm had 10 to 30 thousand trees. At a rate of $\frac{2}{3}$ pounds per tree per year, a typical coffee farm could produce between 110 and 330 60-pound bags per year.

Economic structure

I measure population, population in the labor force, and shares of labor force employed in manufacturing, agriculture, and services in 1912, 1938, 1973, and 2005. I digitized 1912 and 1938 Census of Population at the county level. I aggregated IPUMS International's Census samples (Ruggles et al., 2003) to build measures at the county level for 1973 and 2005. Additionally, I estimated shares of population who could read and write (1912, 1938, 1973, and 2005), average years of schooling of adult population by county (1973 and 2005), and created household income measures using Filmer and Pritchett (2001) methodology to summarize information about housing quality and durable goods (1973 and 2005).

1912 and 1938 Census of Population provide headcounts for different "Professions and Occupations" at the county level. 1912 census counted the "Active Population" and divided it between occupations.[7] I consider Agriculture as the combination between Agriculture and Cattle Raising. Manufacturing sector is given by the "Crafts and Manufacturing" category, while Services adds up Liberal Professions, Commerce, and Transportation. 1938 Census was also a series of headcounts at the county level, but the division between occupations was more detailed. Occupations were divided between Primary Production, Transformation Industries, Services, Liberal Activities, and Other. I define Agriculture as Primary Production employment not in "Extractive Activities" such as mining. Manufacturing employment is given by employment in Transformation Industries excluding

[7] 1912 Occupations are: Liberal Professions, Arts, Crafts and Manufacturing, Priests and Nuns, Public Employees, Military, Policemen, Agriculture, Cattle Raising, Commerce, Transportation, and Domestic Employees.

"Construction and Buildings" Finally, Services is its own category formed by Transportation, Commerce, and Banking subdivisions.

I build measures of economic structure at the county level for 1973 and 2005 using individual level data from IPUMS International. To make it comparable with 1912 and 1938 figures, I calculate share of population in the labor force. Then I build counts of people employed in Agriculture, Manufacturing, and Services to calculate shares of labor force employed in each category. Additionally, I focus on population between 18 and 65 years old to estimate household income measures. I follow Filmer and Pritchett (2001) and use the first vector out of a Principal Component Analysis using information on housing quality (roof and floor materials, number of rooms, connection to electricity and sewage) as well as durable goods consumption (washing machine, radio, refrigerator). Throughout the calculations explained in this paragraph, I weight individuals according to their sample weight provided by IPUMS. Further details are explained in Appendix A.

A different measure of economic structure comes from Colombia's First Manufacturing Census in 1945. This Census measures more established type of manufacturing than using data from employment out of Census of Population. Plants with five or more employees provided information about employment, wages, and financial status (Santos Cardenas, 2017). The census contains information for 458 municipalities. It divides the establishments in 15 different sectors. Following Ciccone and Papaioannou (2009) and Valencia Caicedo (2019), I classified the sectors in three groups according to their human capital requirements (high, medium, low). I measure the share of population working in industrial establishments with five or more employees, as well as shares of employment in each of the three human capital groups. I interpolate 1938 and 1951 census of population to obtain 1945 population data at the county level.

Human capital

The main measure of human capital comes from 1973 Census of Population. This is the first available census with individual-level data that reports county of birth. I use this information to build a panel at the gender by cohort by county-of-birth level for individuals born between 1900 and 1951. That is cohorts that are between 73 and 21 years old in 1973. I measure cohorts' average year of schooling, share of cohort-county-of birth who is literate, and occupations shares of the labor force as well as labor force participation information and average household income.

I combine 1973 cohort by county-of-birth panel data with information about international coffee prices. I assign to each cohort the series of real international coffee prices in Colombian pesos before they turn 18 years old. I use nominal exchange rate between Colombian pesos and US dollars and Colombia's price index before 1972 (GRECO, 2002) to estimate real international coffee prices between 1900 and 1972.

Additionally, I calculate literacy rates at the county level from 1912, 1938, and 1951 Census of Population. The 1951 population census also reported the number of schools per county.

County Characteristics

Finally, I compile a set of county fixed characteristics from different sources. I calculate 1912 counties and IPUMS-counties' area and average altitude using GIS software and shape files with current counties' boundaries. Similarly, I calculate average terrain ruggedness using Nunn and Puga (2010) data. To estimate connection to markets, I measure Euclidean distance from each county centroid to Bogota, the Department's capital, and the second largest town in 1912 different than the Department's capital. Climatic data comes from Dube and Vargas (2013), who calculate long term averages of rainfall and temperature. As measures of state capacity and institutions, I use an indicator for whether each county had Native communities in 1560 (Acevedo and Bornacelly, 2014) and the number of land disputes between 1901 and 1931 from LeGrand (1986).

4 Coffee Cultivation and Structural Change in Colombia

This section presents evidence of the negative relationship between coffee cultivation and structural transformation for Colombian counties. It documents the correlation between coffee cultivation at the beginning of the 20th century and labor force participation, employment in manufacturing and employment in agriculture during different years throughout the century.

The main specification is given by the following equation:

$$y_m^j = \beta \text{CoffeeTrees}_m^{1920} + \theta \mathbf{X_m} + \delta_d + \epsilon_m \tag{1}$$

Where y_m^j is an outcome for county m measured in year j. Outcomes are share of labor force employed in manufacturing and agriculture as well as share of population in the labor force. $\mathbf{X_m}$ is a vector of county-level controls including population (log), a dummy variable for Department's capitals, linear distance to Department's capital, and distance to closest largest county other than the capital. δ_d are Department fixed effects and ϵ_m is the error term. β is the coefficient on coffee cultivation, measured as log of one plus the number of coffee trees in county m around 1920.

Counties adjacent or close to one another might have similar shocks. In order to account for correlated shocks across space, I adjust standard errors using arbitrary clustering as proposed by Colella et al. (2019), who build on Conley (1999) to adjust for spatial correlation in 2SLS settings. My preferred specification allows for decaying correlation between errors of units inside a circle with 100km radius.[8] This distance allows the spatial cluster drawn around each county to include close to 30 other counties. Moreover, 100km

[8] I implement it using the `acreg` command in Stata, version Beta June 2019 (1.0.1) (Colella et al., 2019). Results are similar using 50km and 200km distance cut-offs.

is roughly half of the distance between Bogota and Medellin, Colombia's two largest cities.[9]

Table 1 shows the relationship between coffee cultivation and the outcomes of interest in 1973 using several specifications. 1973 is a relevant year since around this time employment in manufacturing peaked in the country. Panel A focuses on the share of labor force employed in manufacturing, Panel B, on the share of labor force employed in agriculture, and Panel C, on the share of adult population in the labor force. Column 1 shows results only controlling for population and subsequent columns expand controls to include geographic characteristics and Department fixed effects. Starting in Column 4, I remove counties containing the Department capital from the sample. Those counties are less likely to grow coffee and tend to be more urban, which could drive the results. My preferred specification is given by Column 4. It includes geographic controls and Department fixed effects but exclude counties containing capitals. In Columns 5 and 6, I present differential results for men and women.

Coefficients on 1920 coffee cultivation are stable across different specifications. In general, an increase of 1% in the number of coffee trees is associated with a decrease of 0.4 percentage points in 1973 manufacturing employment share and with an increase of 0.6 percentage points in 1973 agricultural employment share. These changes are equivalent to, respectively, -2% and 1.6% with respect to the means of 19.8% and 37%. Additionally, the correlation with labor force participation is not different from zero.

These correlations mask some interesting heterogeneity across gender. The relationship between coffee cultivation and men's employment in both manufacturing and agriculture is stronger than for women. However, on average women report lower levels of participation in the labor force and lower levels of employment in agriculture. This could be measurement error if domestic labor is not registered properly on the census.

I repeat the analysis using data from 1912, 1938, and 2005. Figure 2 plots OLS estimates of the correlation between coffee cultivation in 1920 and employment in manufacturing

[9] Another possibility would be to cluster standard errors on arbitrary squares from a grid overlaid on Colombia's map (Bester et al., 2011; Bazzi et al., 2017). Results are qualitatively similar.

and agriculture. All estimates are equivalent to Column 4 of Table 1. The correlation starts out very small for 1912, only a decade after the beginning of the expansion of coffee cultivation. For manufacturing it decreases (becomes more negative) throughout the century, peaking in 1973 and increasing (but still negative) in 2005. For agriculture the peak happens faster, with correlations in 1938 and 1973 being almost identical.

Results discussed so far come from Census of Population. They include self-reported occupation and lump together all types of manufacturing activity. In order to isolate the effect of coffee cultivation during the early 20th century on structural transformation, I look at data from Colombia's first manufacturing census, collected in 1945. It surveyed establishments with more than five employees. It is therefore a measure of more modern type of manufacturing. Using the same specification described above, I focus on two different outcomes: employment and number of establishments per county. I measure each outcome in logs and divided by total population. Table 2 shows correlations using the same structure as Table 1.

Panels A and B show the negative correlation between coffee cultivation in 1920 and manufacturing employment in large establishments in 1945. Panels C and D show the negative correlation between coffee cultivation in 1920 and the number of industrial establishments. The correlation is not driven by the main centers of industrial production. Column 4 does not include Departments' capitals and shows almost identical results than Column 3, which does include large cities. Panels A and C measure dependent variables in logs, while Panels B and D measure them as shares of population and are therefore more relevant to interpret. An increase of 1% in the number of coffee trees in 1920 is correlated with a reduction of 0.03 industrial workers per 100 inhabitants in 1945. This is around 6% with respect to the mean. Similarly, a 1% increase in the number of coffee trees in 1920 is correlated with a reduction of 0.02 industrial establishments per 1,000 inhabitants in 1945. That is equivalent to around 5% with respect to the mean.

In the remaining parts of this section, I discuss why these correlations, while illustrative, cannot be considered causal and propose different instrumental variable strategies to estimate the effect of coffee cultivation on structural transformation.

4.1 Empirical Strategy

The negative correlation between coffee cultivation in early 20th century and employment in manufacturing later in time could be the result of omitted county-level characteristics that deterred the rise of manufacturing and at the same time encouraged production of coffee. For instance, counties with a poor geographic location might have a hard time importing capital goods to set up manufacturing firms, which might drive them to take up economic activities that suffer less from transportation costs. One of such activities at the beginning of the 20th century was coffee production. Coffee was suitable to be transported by mules, which were ideal to overcome Colombia's difficult geography. Under that scenario, a negative correlation between coffee and structural transformation might be driven by geography rather than by the expansion of the export sector.

Another story with similar implications would be one where the only counties which produce coffee are those with low domestic market access, since coffee was primarily exported, while manufacturing entrepreneurs located close to main population centers. One could also be worried coffee counties start out the 20th century with lower levels of public goods or lower state capacity, given the colonization patterns described in Section 2. With these ideas in mind, the previous OLS results controlled for geographic characteristics intended to capture market access and exposure to the State. I showed the negative correlation between coffee production and manufacturing did not change when those controls were included. Moreover, the correlation did not change when biggest population centers were excluded from the sample.

Finally, while I am estimating the effect of the exposure to the expansion of coffee cultivation on structural transformation, my measure of coffee cultivation is taken from the 1920s and potentially suffers from measurement error. For instance, some counties might have expanded coffee cultivation in the 1920s when prices were relatively high but went back to a lower level after the Great Depression. To partially deal with measurement errors concerns, Appendix C.1 reproduces the main analysis using only the extensive margin of coffee cultivation- i.e. a dummy equal to one for counties with more than one coffee tree in 1920.

Before turning to the main empirical strategies, Figure 3 illustrate some of the dimensions over which coffee counties differed from the rest. The figure plots standardized coefficients (and 95% confidence intervals based on robust standard errors) out of OLS regressions of variables in y-axis over a dummy for coffee counties. In 1912, coffee counties were, on average, more literate and employed a higher share of labor force in agriculture, however there were no differences in the share of labor force employed in manufacturing or the level of population density, which might alleviate some of the concerns described above.

Geographically, however, there are considerable differences between the two groups of counties. Specifically, coffee counties are located at a higher altitude and their terrain is considerably more rugged. They are closer to Colombia's capital, Bogota, and to the Department capital. Interestingly, there are no differences in terms of patterns of colonization on average. Coffee counties are as likely as other counties to have had presence of native population when the Spanish arrived around 1560. Places with native population were generally settled first, while the frontier around 1600 took at least two centuries to be settled. Finally, there were around the same number of land disputes during the first three decades of the 20th century, which might be indicative of the security of property rights and the quality of institutions at the time.

These results highlight that features related to transportation costs and geography, rather than market access or state presence, are the main source of omitted variable bias. To deal with it, I exploit two exogenous sources of variation in a county's suitability for growing coffee. The main idea is that by exploiting coffee suitability, I isolate the effect of coffee exporting on structural transformation, rather than the effect of location or transportation costs.

Climate and Attainable Yields

The first source of variation is given by local climatic conditions that make some counties more productive at growing coffee. I use two different but related approaches. First, I use data from FAO's Global Agro-Ecological Zones project (FAO-GAEZ). The project produces information on maximum attainable yields for different crops at high geographical resolution by combining data on climate and crop-specific features. These potential yields do not depend on actual production and are calculated for different levels of inputs. I use rain-fed Coffee Maximum Attainable Yield with intermediate inputs and aggregate it to the county level using area-weighted averages. Then I normalize yields from 0 to 100 by dividing by the maximum value. Figure 4 shows the variation on the instrument across the country.

The first stage equation is given by:

$$\text{CoffeeTrees}_m^{1920} = \gamma_1 \text{Pot.Yield}_m + \xi \mathbf{X_m} + \mu_d + \phi_m \tag{2}$$

Where Pot.Yield_m is FAO maximum attainable yield and μ_d is a set of Department fixed effects.

Second, I follow Dube and Vargas (2013) and instrument coffee cultivation with long term averages of rainfall and temperature levels at the county level. In theory, these two approaches are identical to one another with the only difference that the rainfall and temperature instrument does not rely on a climatic model like the one used to calculate attainable yields. The first stage is given by:

$$\text{CoffeeTrees}_m^{1920} = \theta_1 \text{rain}_m + \theta_2 \text{temp}_m + \theta_3 \text{rain}_m \times \text{temp}_m + \psi \mathbf{X_m} + \mu_d + \xi_m \tag{3}$$

Fuzzy Regression Discontinuity in Altitude

The previous approach is useful to isolate coffee cultivation motivated by productivity reasons. However, since it only uses climatic conditions some of the concerns about location and geography might still apply. In other words, the IV strategies described above could compare counties with high suitability located close to the ocean with places in the interior with the same climate. Therefore, I introduce another identification strategy that does not rely directly on weather. The strategy isolates more comparable counties in terms of geographic characteristics.

Figure 5 plots $\text{CoffeeTrees}_m^{1920}$ for counties in different altitude bins. The figure focuses on counties above 1,800 meters above the sea level. The vertical line is located at 2,400 meters. The slope of coffee cultivation is negative below the 2,400 meters cut-off and flat above. Moreover, there is a downward jump at 2,400m of altitude. Around that altitude temperature at nights gets sufficiently cold that coffee does not grow as well as a couple hundred meters below. The discontinuity might also be due to information pamphlets distributed by late 19th century investors who were aiming at getting more landowners into the coffee business. These recommendations, compiled in the book *Memorias sobre el cultivo del Café* (Saenz, 1892), provided temperature bounds for the optimal production of the crop. In the 19th century those bounds were between 24 and 16 degrees Celsius. Since temperature in Colombia is driven by altitude, temperature bounds translate directly into altitude bounds between 400 and 2,400 meters above the sea level. Moreover, some of the pamphlets directly provided information on altitude and temperature of specific towns to make it easy for landowners to figure out whether their land was located inside the altitude bandwidth.

Figure 6 shows one of those instances in a pamphlet written by Mariano Ospina Rodriguez in 1880. Ospina was Colombia's president in 1857 and is considered one of the pioneers of coffee cultivation in Colombia. He started growing coffee in his family's farm well before the expansion in the first two decades of the 20th century.

From Figure 5, some counties below the threshold did not grow coffee in the 1920s and some counties above the threshold had a positive number of coffee trees. Therefore, the setting is not one of a sharp regression discontinuity. Rather, I use the discontinuous fall in the probability of growing coffee in 1920 as an instrument for actual coffee cultivation. In other words, I instrument $\text{CoffeeTrees}_m^{1920}$ with a dummy variable equal to one for counties above the altitude threshold and a simple polynomial in altitude. This allows for coffee cultivation to fall with altitude and even for the slope to change below and above the threshold. Identification comes from a discontinuous jump at the threshold.

In this fuzzy regression discontinuity design (FRDD) (Angrist and Pischke, 2008), the first stage is given by:

$$\text{CoffeeTrees}_m^{1920} = \alpha_1 \text{above}_m + \alpha_2 \text{altitude}_m + \alpha_3 \text{above x altitude}_m + \nu_d + \xi_m \quad (4)$$

Where *above* is a dummy variable equal to one for counties above 2,400 meters of altitude. *Altitude* enters the equation centered at 2,400 meters, both linearly and interacted with *above*.

The benefits of using fuzzy regression discontinuity design are evident once we compare counties above and below the threshold. Figure 8 plots coefficients from OLS regressions of variables on the y-axis on above_m dummy variable. Most of the coefficients are very close to zero, with the exceptions of literacy rate in 1912 and terrain ruggedness (both lower for counties above). Altitude is higher by construction.

Notice, however, that those means test are not necessarily all that is needed for using the fuzzy regression discontinuity as instrument for coffee cultivation. Importantly, the identifying assumption is that no other factor should change discontinuously at 2,400 meters. Only the probability of growing coffee. To test for discontinuities in other county characteristics, Table 3 shows the results from OLS estimation using specifications identical to equation 4, but plugging in as dependent variable all the factors represented in

Figure 8. There are no discontinuities for most characteristics. For manufacturing employment in 1912, the coefficient on *above* is marginally significant and on the opposite direction than expected: places above, which do not grow coffee, employ a slightly lower share of population in manufacturing in 1912.

The two different approaches (IV and FRDD) present a clear trade-off. While IV strategies (FAO data and rainfall, temperature polynomial) use all the available counties, the FRDD strategy potentially gives a more reliable estimate since it uses very comparable "treatment" and "control" groups. Figure 7 illustrate the trade-off in terms of sample size. Figure (a) shows the 759 counties populated in 1928 and classify them by the number of coffee trees per square kilometer. Figure (b) highlights counties above 1,800 meters of altitude and classifies them by their location with respect to the altitude threshold.

5 The Effect of Coffee Cultivation on Structural Transformation

This section estimates how exposure to coffee exports at the beginning of the 20th century shaped local development and structural transformation in Colombian counties. Using a sample of 550 IPUMS-counties, I document a sharp pattern of divergence in economic structure between coffee producer counties and other counties. In particular, the share of employment in manufacturing increased faster during the first part of the 20th century, up to 1973, in counties which did not produce coffee. Meanwhile, counties which produced coffee remained mostly specialized in agriculture. I focus first on results using 1973 Census of Population. Then I show how did coffee cultivation affect economic structure at various periods during the century. The following section expands on an important mechanism to explain this divergence: human capital accumulation. Finally, Section 8 estimates the long-term impact of coffee cultivation on income and urbanization.

Coffee cultivation during the early 20th century had a negative and sizable effect on structural transformation throughout the century. Results from Table 4, Panel A show an increase of 10% in the number of coffee trees planted before 1920 led to a reduction of around 0.05 percentage points in the share of labor force employed in manufacturing in 1973. This effect is equivalent to a reduction of 0.2% with respect to the average county. To put it differently, going from the median level of coffee cultivation to the 75th percentile in 1920 would decrease the 1973 share of labor force working in manufacturing by 1.6 percentage points or 8% relative to the mean. Going from the median level to the 99th percentile would decrease manufacturing employment by 15.2% relative to the average county.

Panel B shows the positive effect of coffee cultivation on agricultural employment. An increase of 10% in coffee cultivation prior to 1920 would increase employment in agriculture in 1973 by 0.08 percentage points, or 0.21% relative to the mean of 37% of the labor force. The estimated magnitude of these effects is the same regardless of the method used to instrument for coffee cultivation before 1920. Column 2 shows results using FAO coffee attainable yields. Column 3 shows results using a simple polynomial in rainfall and temperature. Results from these two methods are expected to be similar since they use the same set of counties and exploit the same source of variation (climate). Column 4, however, restricts the sample to counties with average altitude higher than 1,800 meters and instruments coffee cultivation using the fuzzy regression discontinuity approach. In other words, the set of counties "treated" by coffee availability are between 1,800 and 2,400 meters above the sea level. The fact that the results are similar between columns 2 and 3 and column 4 is evidence that the average treatment effect of coffee on structural transformation might be homogeneous, at least on dimensions related to altitude, market access, and transportation costs.

The effect of coffee cultivation on structural transformation in terms of employment could be driven by differences in labor force participation. I alleviate those concerns first by measuring employment as shares of labor force. More importantly, Panel C shows coffee cultivation had no significant effect on labor force participation. Even for the case where there is a statistically significant positive effect, it is tiny. Column 2 in Panel C implies that an increase of 10% on the number of coffee trees planted before 1920 would increase labor force participation in 1973 by 0.07% with respect to the mean. This effect is at least an order of magnitude smaller than the effects in Panels A and B for employment by sector.

The estimates discussed above rely on exogenous variation provided by three different sets of instruments. Panel D presents evidence on the relevance of the three sets of instruments. It regresses the log of one plus the number of coffee trees in 1920 on coffee attainable yield (column 2), on a polynomial on rainfall and temperature (column 3), and on altitude, a dummy equal to one for counties above 2,400 meters of altitude, and an interaction between the "above" dummy and altitude (column 4). All instruments are significant and sizable. Moreover, the table also shows the F statistic for the excluded instruments on each one of the first stages. I do not find evidence of weak instruments.

The effect of coffee exports on employment by sector varied through the century, as Figure 9 shows. The figure complements Figure 2 by adding IV estimates from 2SLS using attainable yields from FAO (like Column 2 in Table 1) and FRDD estimates (like Column 4). In 1912, there was no difference in sectoral employment between coffee counties and non-coffee counties. In other words, there was no effect of potential to cultivate coffee on the share of labor force employed in manufacturing, though there was some small positive effect on agriculture. By 1938, the effect became large and significant. It was negative for manufacturing and positive for agriculture. This effect remained through 1973, as explained earlier. Employment in manufacturing peaked in the country in the 1970s. After that most of the population shifted to services. Consequently, the effect of coffee cultivation in 1920 on manufacturing employment in 2005 is smaller, though significant.

In addition to using data collected from employees, coming out of Census of Population, I use data from employers from Colombia's first manufacturing census from 1945.

After the rapid growth in manufacturing in the 1930s, the country surveyed all industrial establishments with more than five workers. It is therefore a more formal sample of manufacturing establishments which might provide more information on the effect of coffee cultivation on the process of structural transformation.

Table 5 estimates the effect of early coffee cultivation on industrial employment and the number of industrial establishments in 1945. Column (1) reproduces results from Table 4, Column 4, Panels B and D as reference. Columns 2 to 4 follow the same order than results presented in Table 4. Once again, results across different instruments have similar magnitudes and directions despite their underlying differences in sample size and composition.

An increase of 10% on coffee trees in 1920, decreases the number of industrial establishments with more than five employees in 1945 by 1.7% with respect to the mean (Panel B). It would also decrease the share of population working in industrial establishments by 0.08 percentage points, or 16% with respect to the mean. Panel D presents the three different first stage estimations. All specifications instrument coffee cultivation with instruments that are not weak. Importantly, Column 4 shows evidence of the negative discontinuous jump in the probability of growing coffee above 2,400 meters of altitude.

6 Channel: Human Capital

Colombia's first manufacturing census provides a good setting to study whether human capital had something to do with the effect of coffee cultivation on manufacturing. I adapt Ciccone and Papaioannou (2009) classification for industrial sectors in the United States to the Colombian context and divide 15 sectors compiled by 1945 Census into three groups according to their human capital intensity. High human capital sectors include Beverages, Instruments, Arts (Printing), and Chemicals. Medium human capital sectors include Tobacco, Minerals, Paper, Rubber, and Metal. Finally, Low human capital sectors include

Leather, Textiles, Clothes, Wood, and Food. I use specification given by equation 1 for employment and number of establishments in each of the three groups. I plot the coefficients on coffee cultivation and their standard errors. Coefficients come from a 2SLS estimation using Coffee attainable yields from FAO as an instrument, like Table 5, Column 2.

Figure 10 shows the effect of coffee cultivation in 1920 on (a) employment in manufacturing and (b) number of industrial establishments in 1945 by human capital intensity. While there is not a difference between coffee and non-coffee counties in terms of employment in more basic sectors like textiles or food, the largest difference shows up for sectors with high intensity of human capital. In other words, the effect coffee cultivation has on structural transformation seems to be concentrated in activities that require a more educated labor force.

This evidence goes in line with the hypothesis described above and the models introduced by Porzio and Santangelo (2019) and Caselli and Coleman II (2001). Figure 11 complements the insight from the previous evidence. It shows the difference between coffee and non-coffee counties in terms of education of the labor force in 1973. Each point represents the difference in average number of years of schooling in coffee counties minus the average number of years of schooling in non-coffee counties for people born in each cohort. Though it only shows data for cohorts born from 1900 onward, there is a clear trend: the labor force in coffee counties becomes relatively less educated in the first decades of the 20th century. This reduction in the level of education seems to be negatively correlated with the pattern of coffee production shown by the short-dashed line.

Using individual level data from 1973 Census of Population, I show that in fact coffee cultivation reduced schooling and made the labor force more biased toward staying in agriculture. Therefore, manufacturing appeared in counties which did not produce coffee.

Empirical Strategy

The 1973 Census of Population allows me to observe in which county and year of birth for a 10% sample of Colombians. People born in the first half of the 20th century in counties suitable to produce coffee were more exposed to the first large scale exporting industry in the country. For them, the opportunity cost of attending school was higher. Moreover, the specifics of coffee's production function discussed on section 2 increased parent's opportunity cost of sending their children to school. These incentives away from education were potentially stronger during years when the coffee price was higher.

I test these hypotheses by estimating the effect of coffee price during school age on kids' education and occupation as adults. I estimate the following equation:

$$y_{mcg} = \beta \text{CoffeeTrees}_m^{1920} * \text{Price}_c^{5,16} + \delta_g + \delta_m + \delta_c + \epsilon_{mcg} \tag{5}$$

Where y_{mcg} is average education or occupation outcome for gender g, cohort c, born in county m. The coefficient of interest is β, which captures the effect of coffee price shocks between a given cohort is 5 and 16 years old. $\text{Price}_c^{5,16}$ is average log real coffee price in New York between years $c+5$ and $c+16$. $\delta_g, \delta_m, \delta_c$ are gender, county, and cohort fixed effects. The unit of observation is a gender by county-of-birth by cohort cell. Each cell is weighted by the inverse of its variance.

Comparable with the empirical strategies described in section 4, I instrument Coffee trees_{1920} using three different instrumental variables: coffee attainable yield, rainfall and temperature polynomial, and a fuzzy regression discontinuity in altitude.

6.1 Growing Up During Coffee Price Booms Reduces Schooling and Employment in Manufacturing for Cohorts Born in Coffee Counties

Table 6 shows the effect of coffee price shocks on educational attainment in 1973. Panel A measures coffee shocks as the interaction between the number of coffee trees in 1920 and the log average coffee price between a cohort is 5 and 16 years old. Panel B changes the number of coffee trees by a simple dummy equal to one for counties with some coffee cultivation in 1920. Column 1 presents the OLS results. Columns 2 to 4 show results from instrumenting coffee shocks using the variables detailed in Panel C. Interpretation of results in Panel B is more straightforward. For simplicity, I discuss results from instrumenting coffee shocks with attainable yields interacted with average school age price (Column 2): cohorts exposed to average coffee price 10% higher, born in coffee counties accumulate 0.7% fewer years of education. Another way to put it would be to compare 1910 and 1940 cohorts. The latter cohort experienced average coffee princes during school age 140% higher than the former due to differences on coffee prices. Therefore, the cohort born in 1940 acquired on average 9% fewer years of education.

Panel C shows the reduced form, that is the effect of the instrument on average years of education. Interestingly, even though the second stage is not significant and small for column 4, the reduced form shows a coefficient with a very similar magnitude than the 2SLS results for columns 2 and 4, Panel B, but with the opposite sign, as expected. Counties above the threshold did not produce coffee and therefore are not hit by shocks to prices.

Table 7 shows related results but looking at economic occupation and income. In general, children born in coffee counties during periods with high coffee prices not only accumulated less human capital but also were less likely to work in manufacturing as adults. Take the result from Panel A, Column 2. Comparing again cohorts born in 1910 and 1940, the latter cohort is almost 10% less likely to work in manufacturing due to the availability of coffee cultivation that made that individual drop out of school.

Similarly, though less precisely estimated, I find a positive effect of coffee shocks during school age on the probability of employment in agriculture as adults. Finally, in Panel C, I show that cohorts born in coffee counties, exposed to higher coffee prices during school age have lower household income, as measured by the first vector out of a Principal Component Analysis on a matrix of house characteristics and durable goods.

Notice the decline in manufacturing employment is very similar than the decline in schooling. Since schooling decisions are taken earlier (or simultaneously) than occupation decisions, I explore the effect of coffee shocks on employment in manufacturing that is channeled through education by doing a mediation analysis proposed by Dippel et al. (2019b). In other words, I estimate the effect of a cohort's schooling on the share of its members working in manufacturing in 1973 by instrumenting education using the interaction term between coffee attainable yields and average prices during school age, conditional on coffee shocks (dummy for coffee interacted with average coffee prices during school age). This approach provides an idea of how much of the effect of coffee prices on occupation is acting through human capital accumulation and what fraction is going through other channels. Specifically, I estimate the following equation:

$$\text{Occup.}_{mcg} = \beta_1 \text{Education}_{mcg} + \alpha \text{CoffeeTrees}_m^{1920} * \text{Price}_c^{5,16} + \delta_g + \delta_m + \delta_c + \epsilon_{mcg} \tag{6}$$

And instrument schooling using the following equation:

$$\text{Education}_{mcg} = \gamma_1 \text{Attn. Yield}_m * \text{Price}_c^{5,16} + \theta \text{CoffeeTrees}_m^{1920} * \text{Price}_c^{5,16} + \delta_g + \delta_m + \delta_c + \mu_{mcg} \tag{7}$$

This approach, however, relies on one very strong assumption: the concerns about endogeneity between coffee shocks and manufacturing are the same as the concerns about endogeneity between coffee shocks and schooling (Dippel et al., 2019a). Using this approach, the total effect is given by table 7. The share of the effect of coffee shocks on manufacturing that goes through schooling decisions is between 80% and 96%.[10] The share of the effect depends on the measure of education used (cohort's average years of education or literacy rate) and on the measure of coffee cultivation (continuous or dummy). Again, these results only hold under the assumption about the sources of endogeneity being the same when estimating the effect of coffee shocks on education than when estimating the effect of coffee shocks on occupation.

6.2 Supply and Demand of Schooling

So far, I have showed evidence on the negative effect of coffee cultivation on education and manufacturing employment. My main conjecture is that coffee cultivation increases opportunity cost of attending school. Differences in the opportunity cost of schooling generates differences in cohorts' levels of education. As a consequence, counties producing coffee developed lower supplies of non-agricultural workers. According to Caselli and Coleman II (2001) and Porzio and Santangello (2019), these differences shaped the process of structural transformation by reducing the availability of skilled workers for manufacturing.

In the past section I showed evidence that cohorts exposed to higher coffee prices acquired lower levels of education. However, these effects of coffee cultivation and shocks on education could come from both supply and demand. One potential explanation is that people's demand for schooling goes down with the possibility of producing coffee. However, another possibility is that simply the supply of schooling in coffee counties goes down when prices go up with respect to non-coffee counties. This might occur if, for instance, landowners benefit from lower wages and a readily available labor force (Galor et al., 2009; Galiani et al., 2008).

To explore the sources of differences in schooling between coffee and non-coffee counties, I exploit historical data on land inequality using the First Coffee Census. I observe the

[10] Detailed results in Appendix B.4.

mean and median farm size in terms of coffee trees for each county with positive number of coffee trees in 1920. My conjecture is that in places with higher land inequality within coffee landowners, the higher the market power of landowners. This would have two consequences: first, they would have perhaps more political power to block funding and construction of schools. Second, they could potentially behave like a monopsony and wages would not be as responsive to changes in international price as counties with lower inequality. In other words, if the effect of coffee shocks on education is stronger for counties with high inequality than for those with low inequality, that would be suggestive of the effect of coffee on education being mainly driven by supply of schooling.

Table 8 shows the effect of coffee shocks on schooling, literacy, employment in manufacturing, employment in agriculture, and household income in 1973 for different samples. Column 1 shows the full sample for comparison. Column 2 restricts the analysis only to counties with at least one coffee tree in 1920. Column 3 and 4 splits the sample on Column 2 according to the median of the level of land inequality (mean/median farm).

The negative effect of coffee shocks on education and income and the positive effect on employment in agriculture are concentrated in counties with low land inequality within coffee landholders. This result is consistent with the hypothesis that the effect of coffee cultivation on education is coming from changes in the demand for education. Of course, this is only suggestive evidence given that differences in inequality might be correlated with some of the forces behind differences in education or occupation.

I explore data on the number of schools per 10,000 inhabitants in 1951 to get at more direct evidence on the effect of coffee cultivation on the provision of education. Unfortunately, that is the only year with readily available information on provision of education at the local level for the first half of the 20th century. Table 9 shows the effect of coffee cultivation on the number of schools, instrumenting coffee cultivation with FAO attainable yields data. Panel A measures coffee cultivation with a dummy variable. Column 1 shows OLS results while Column 2 shows 2SLS results from using the full sample. Coffee counties have 1.05 less schools per 10,000 inhabitants than non-coffee counties in 1951. This effect is equal to 135% of the mean of 0.64 schools per 10, 000 inhabitants on average. From Panel B, an increase of 10% in the number of coffee trees decreases the numbers of schools per 10,000 inhabitants in 1%. Moreover, the effect has relatively the same magnitude when focusing only on counties with some coffee cultivation (Column 3). But perhaps it is more interesting that the negative effect of coffee cultivation in 1920 on the number of schools in 1951 is only present and stronger (thought only significant at 15%) for counties with high levels of inequality.

In other words, these results taken together suggest that the negative effect of coffee cultivation on human capital and structural transformation comes both from supply and demand of education. On one hand, coffee counties have fewer schools, especially in high inequality counties, where landowners have more power to block schooling and guarantee a higher supply of agricultural workers. On the other hand, coffee shocks have a stronger negative impact in counties with low inequality, where landowners have potentially less power to fix wages they fluctuate more with international prices.

7 Channel: Linkages

I have discussed evidence of the effect of coffee cultivation on industrialization focusing on the role of human capital accumulation, which increased the supply of non-agriculture workers in counties not suitable to produce coffee. One concern is that the effect is coming from counties isolated from the rest of the economy. In that scenario places with coffee cultivation should be better off specializing on coffee in the long run even if they end up being poorer than other counties because they would not develop manufacturing otherwise.

Though this concern is alleviated by the comparison between coffee and non-coffee counties in Figure 3, I explore if the effect of coffee cultivation varies with respect to how connected with other sectors in the economy a county is. One way I can study the level of linkages is by using the presence of threshing machines in some counties. Threshing is the last process coffee cherries undergo before being exported. It is a process through which by tumbling in a large machine, coffee cherries lose their covering husk or *pergamino*. These machines were used by owners of different farms, required heavy machinery, and expertise. Therefore, counties with this part of the coffee industry are potentially more connected with other sectors. For example, through transportation networks, through workers who can operate the machines, or banks who can fund their purchase, and so on.

Out of the 710 counties, 440 had some coffee cultivation in 1920. Around 120 coffee counties also had threshing establishments. These counties had around 0.4 machines per farm. The county with the highest number of machines had 65.

I estimate separate coefficients for the effect of producing coffee without a threshing machine and producing coffee with threshing machines. I argue the difference between both would give an estimate of the effect of linkages if the only difference between counties with and without threshing is the fact that some have linkages. Table 10 shows the results. Columns 1 and 2 replicate OLS and 2SLS estimates from section 5. Columns 3 and 4 split the dummy for coffee cultivation in 1920 in two, according to their linkages. I find that the effect is very close to one another. If anything, the effect of coffee on manufacturing for counties with threshing machines is larger. The fact that threshing may not be exogenous should give us pause to put too much weight on the coefficients.

8 Long Term Effects on Urbanization and Income

Finally, I replicate the main results using household income data for 2005 adults and counties' poverty rate as calculated by the Social Prosperity Department. Table 11 show the main results for all the different instruments for coffee cultivation. An increase in the number of coffee trees in 1920 by 10% would increase poverty rate of a county in 2005 by

10% increases poverty rate in 2005 by 0.1% with respect to the mean. In other words, going from the median level of coffee cultivation in 1920 to the 75th percentile would increase a county's poverty rate in 2005 by 3.1%.

9 Concluding Remarks

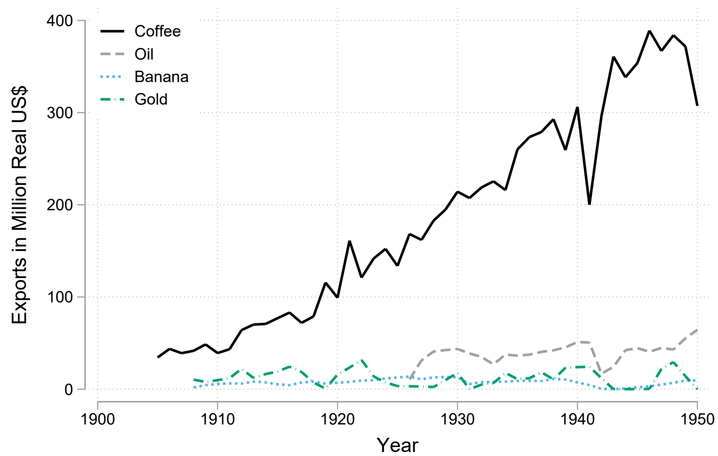
This paper illustrate how the opportunity to trade certain agricultural commodities had negative effects on structural transformation and development in the long run. Using data from Colombian counties, it shows that counties producing coffee in 1920 had slower growth in manufacturing sector than other comparable counties. Coffee cultivation had a negative long-run effect on income and poverty rates. Additionally, this paper provides empirical support to Caselli and Coleman II (2001) theory about supply-side mechanisms behind structural transformation. In particular, it highlights that slower growth in the supply of skilled workers can also slow down structural transformation. Given coffee's labor intensive production function, this paper complements evidence from Carrillo (2019) about the negative effect of coffee cultivation on human capital accumulation.

The evidence discussed in this paper suggests evaluating the effects of the first wave of globalization depends on the context. Specifically, it depends on features of commodities' production function which shape incentives to accumulate human capital and select high productivity occupations. Countries which exported more than one important agricultural product might be ideal settings to sort out which features of commodities' production functions mediate the effect of agricultural exports on structural transformation.

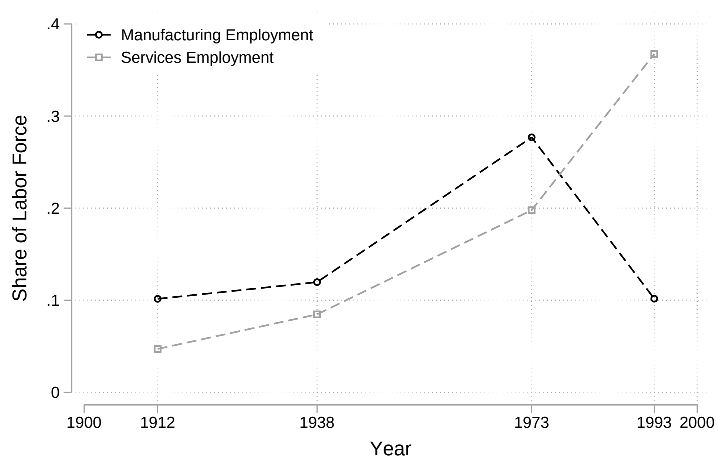
Figures

Figure 1: Patterns of Coffee Exports and Manufacturing in Colombia

(a) Value of Main Exports



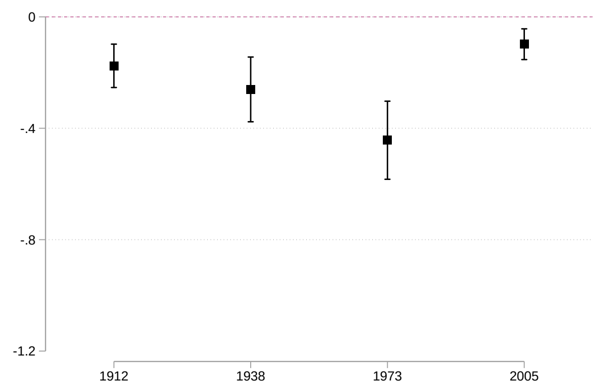
(b) Employment in Manufacturing and Services (% of labor force)



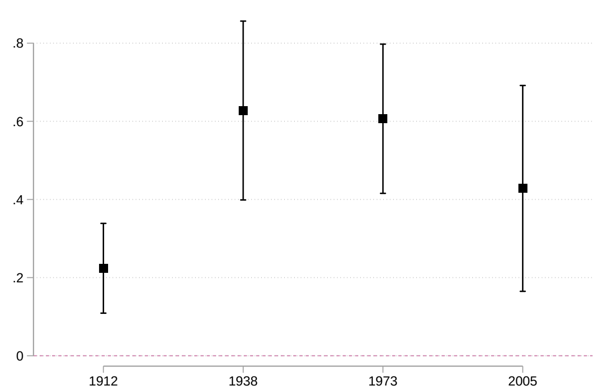
Note: Figure 1a shows the real value of Colombia's main exports in 1951 US dollars. It uses data from GRECO (2002). Figure 1b shows shares of labor force employed in manufacturing and services. It uses data from Census of Population. 1912 and 1938 Census were digitized for this paper. 1973 and 1993 Census are available in IPUMS-international.

Figure 2: Correlation Coffee Cultivation and Structural Transformation

(a) Dep. Variable: Manufacturing Employment (% of Labor Force)

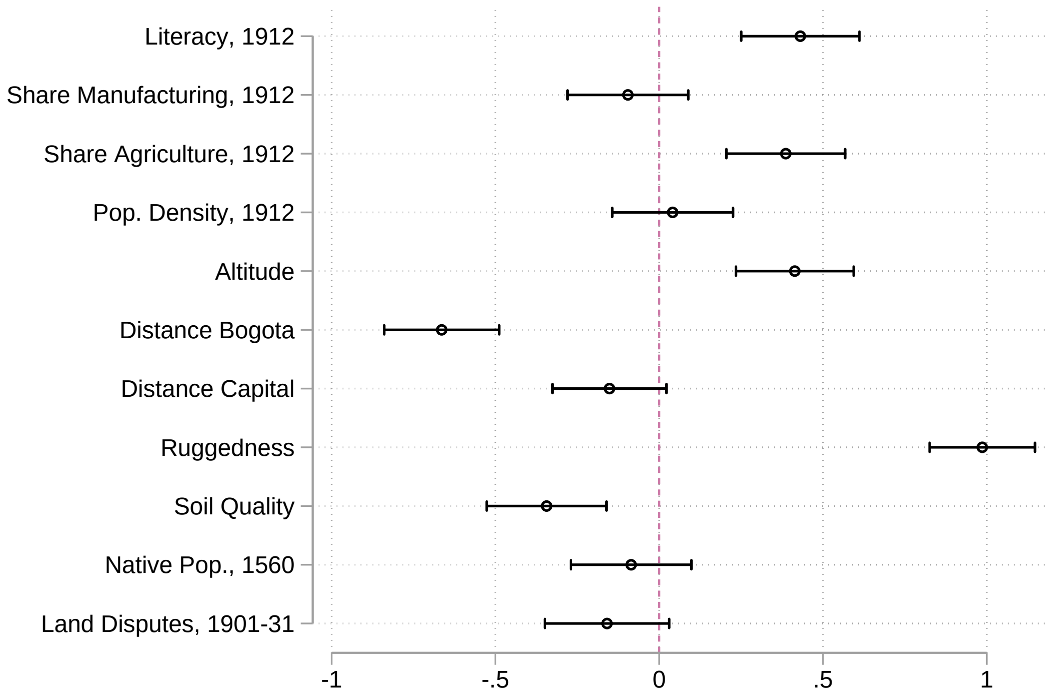


(b) Dep. Variable: Agricultural Employment (% of Labor Force)



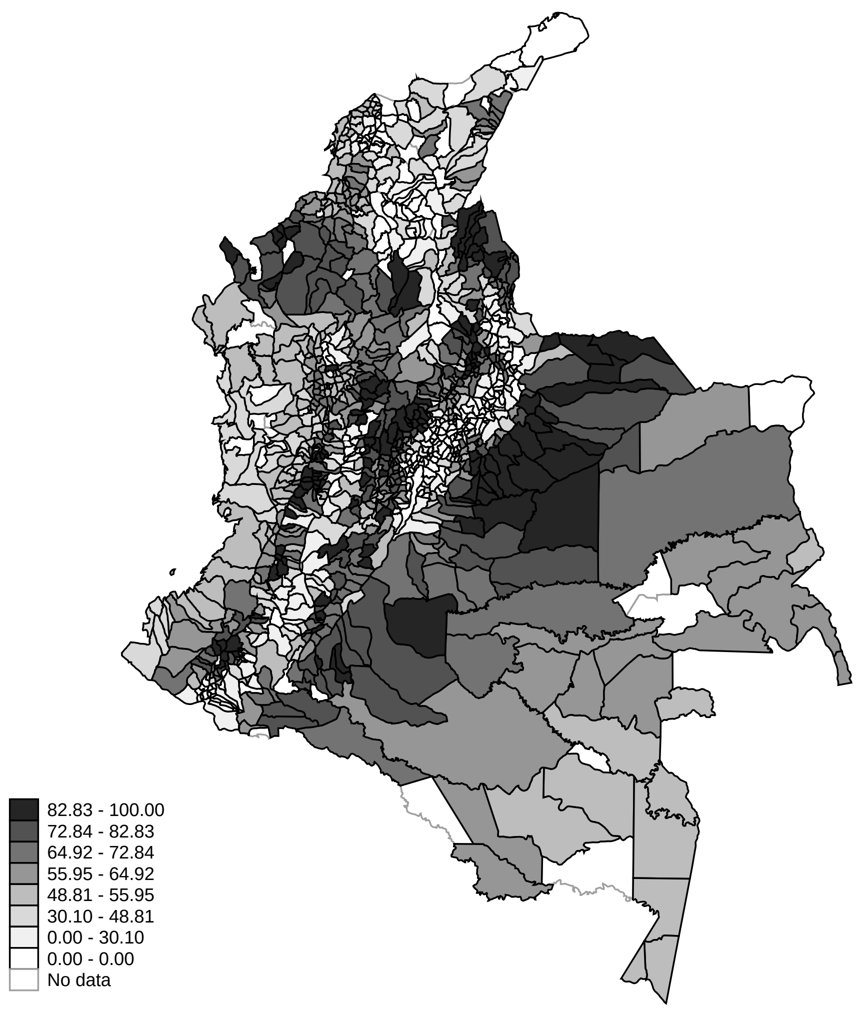
Note: The figures plot the coefficients of the relationship between coffee cultivation in 1920 and employment shares in manufacturing and agriculture during the 20th century. Estimates control for gender and Department fixed effects and geographic controls. Capital cities are excluded. Lines represent 95% confidence intervals based on Conley (1999) standard errors as described in section 4.

Figure 3: Coffee vs. Non-Coffee Counties Comparison



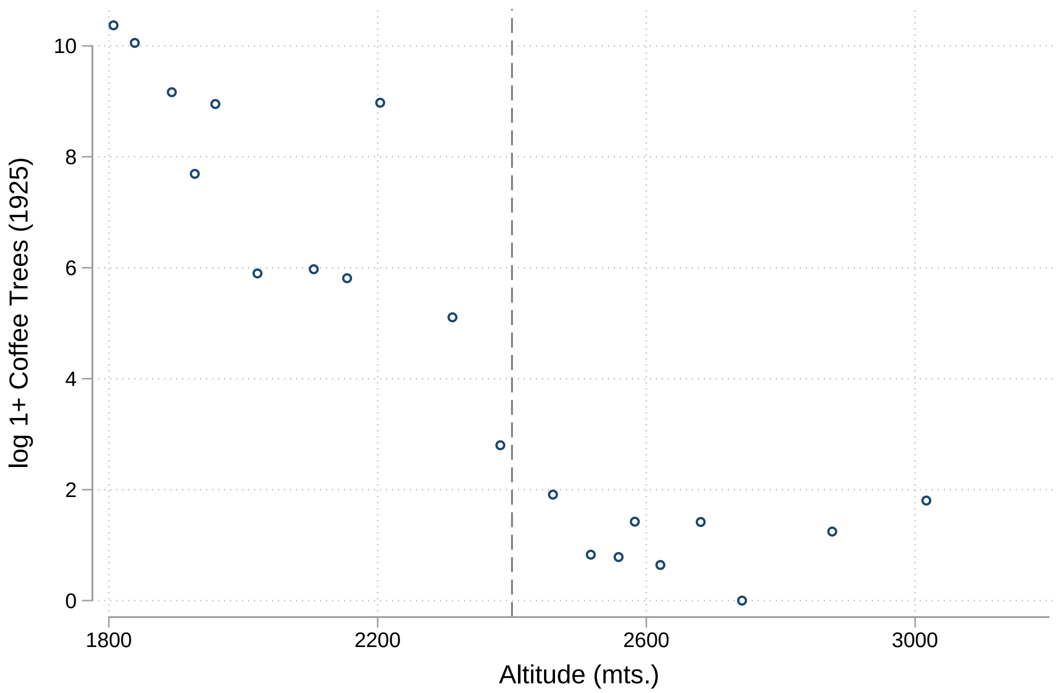
Note: Figure plots standardized coefficients on an indicator variable equal to one if the county had some coffee trees in 1920. Dependent variables are detailed on the vertical axis. For instance, the first coefficient means coffee counties had higher literacy rate in 1912 on average than non-coffee counties. Lines represent 95% confidence intervals based on robust standard errors.

Figure 4: Coffee Potential Yield



Note: Map shows the average maximum attainable yield at the county level using data from FAO-GAEZ. Yields are estimated using rain-fed conditions with intermediate level of inputs. Darker shades represent higher yields.

Figure 5: Discontinuity in the Probability of Coffee Cultivation at 2,400mts



Note: Figure plots average log of one plus number of coffee trees for counties grouped in equal sized bins in terms of altitude. The figure is restricted for counties abouve 1,800 meters above sea level.

Figure 6: Coffee Promotion Pamphlet, 1880

que temperatura señala, i esta es la temperatura media de aquel paraje.

Como no todos los labradores tendrán termómetro para que puedan juzgar por comparación de la temperatura media del paraje que les interesa, ponemos a continuacion la temperatura média de diferentes lugares de este Estado:

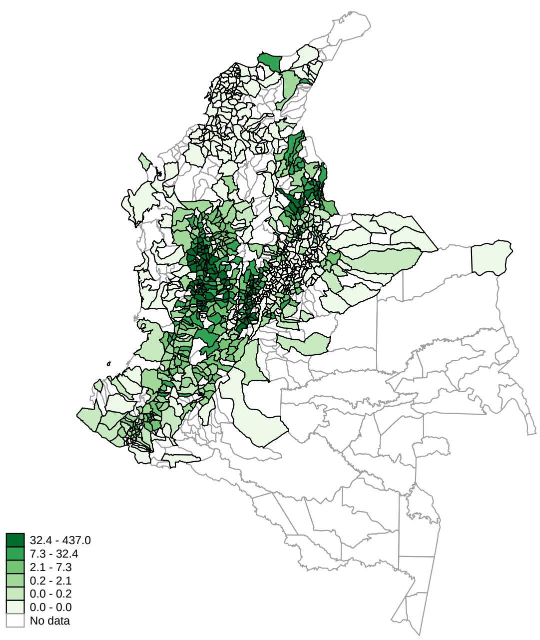
Vegas del Magdalena de Honda para abajo 27 grados centígrados.	27º
Orillas del Cauca en Sopetran o Antioquia	26º
Barbosa, en la plaza	23º
Medellin, idem	22º
Santo-Domingo, idem	18º
Rio-Negro, idem	17º
Santa-Rosa de Osos, idem	14º
Sonson, idem	14º

Medellin, 15 de Setiembre de 1880.

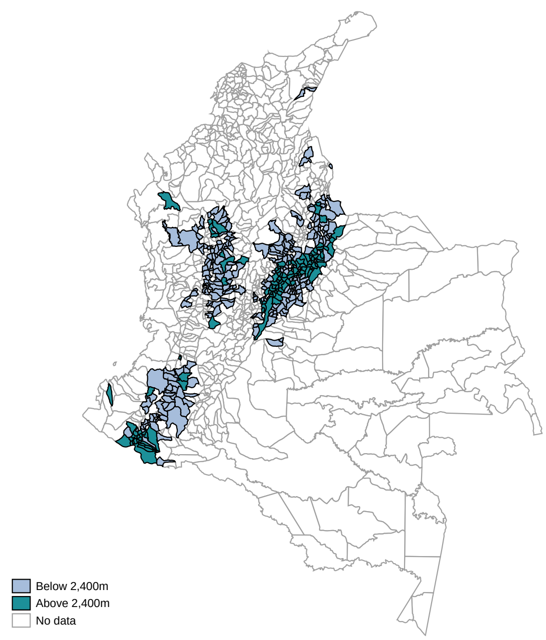
Note: Excerpt of a pamphlet promoting coffee cultivation written by Mariano Ospina in 1880. Ospina suggests coffee grows in places at or below 17 degrees celsius and then benchmarks that temperature with different towns. Rio-negro is located at 2,200 meters and average temperature was 17 degrees. Santa-Rosa de Osos and Sonson are located at 2,500 and 2,450 meters of altitude, respectively.

Figure 7: Counties in IV and FRDD Samples

(a) IV Sample: Counties by Coffee trees per sq. km, 1920

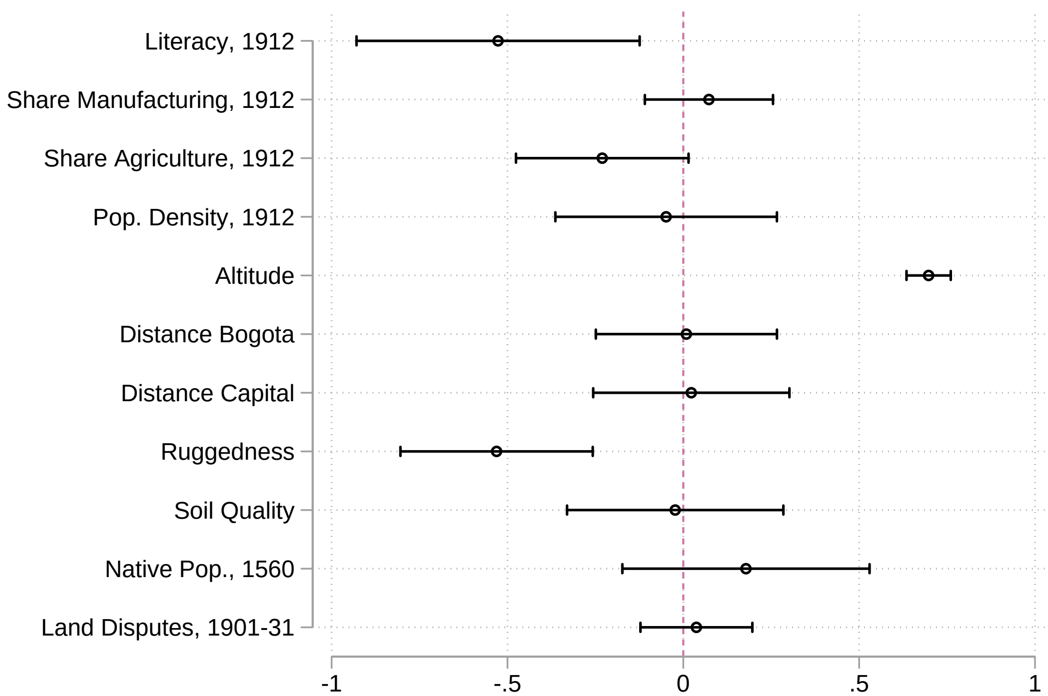


(b) FRDD Sample: Counties above 1.8km by Side of Discontinuity



Note: The maps illustrate the main samples used in each empirical strategy. Figure (a) shows the number of coffee trees per square km in 1920 for counties with positive population in 1912. Figure (b) shows counties above 1,800 meters classified by whether or not they are above 2,400 meters. Both maps use current county borders.

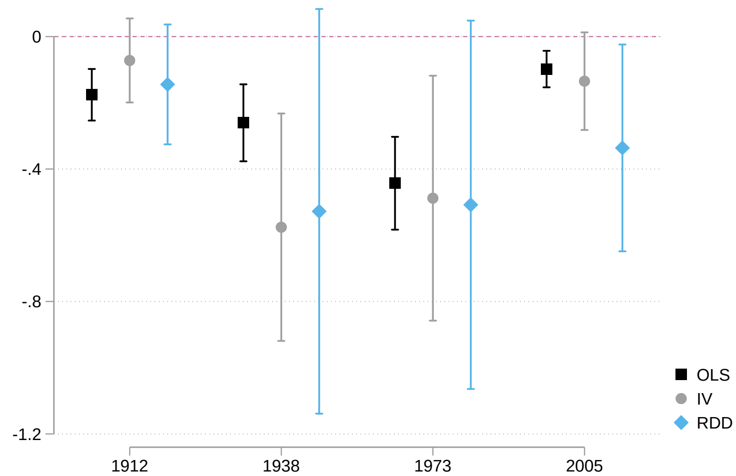
Figure 8: Comparison Counties Above and Below 2,400 mts. of Altitude



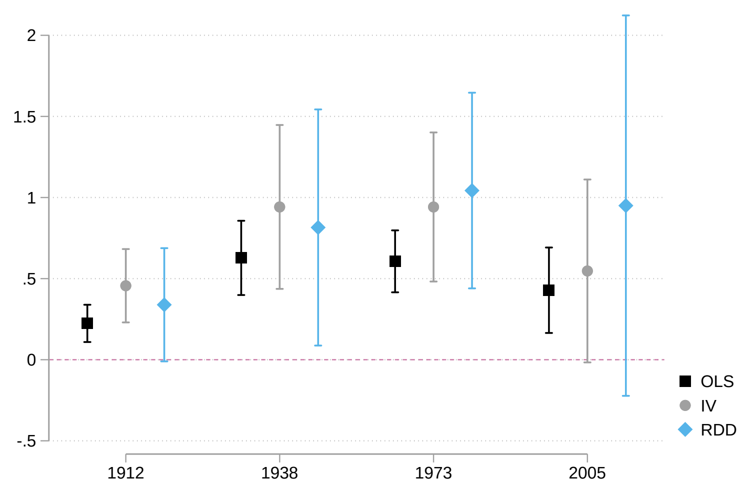
Note: Figure plots standardized coefficients on an indicator variable equal to one if for counties with altitude higher than 2,400 meters. Dependent variables are detailed on the vertical axis. For instance, the first coefficient means counties above 2,400 meters had lower literacy rate in 1912 on average than counties between 1,800 and 2,400 meters of altitude. Lines represent 95% confidence intervals based on robust standard errors.

Figure 9: The Effect of Coffee Cultivation on Structural Transformation

(a) Dep. Variable: Manufacturing Employment (% of Labor Force)



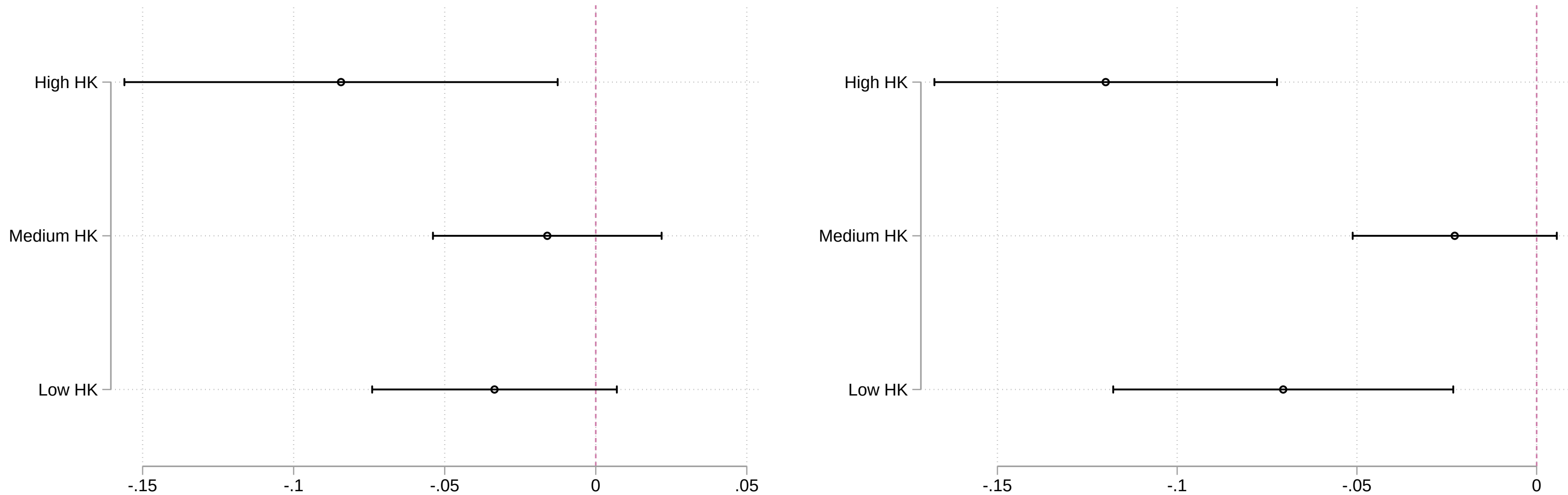
(b) Dep. Variable: Agricultural Employment (% of Labor Force)



Note: The figure illustrate the effect of coffee cultivation on employment in manufacturing and agriculture for different years. Squares represent estimates coming from OLS regressions. Circles represent estimates from 2SLS regressions using coffee potential yields as instrument for coffee cultivation in 1920. Diamonds display estimates using fuzzy regression discontinuity in altitude, focusing on counties above 1.8km of altitude. All specifications control for gender and Department fixed effects and geographic controls. Capital cities are excluded. Lines represent 95% confidence intervals based on Conley (1999) standard errors, as described in section 4.

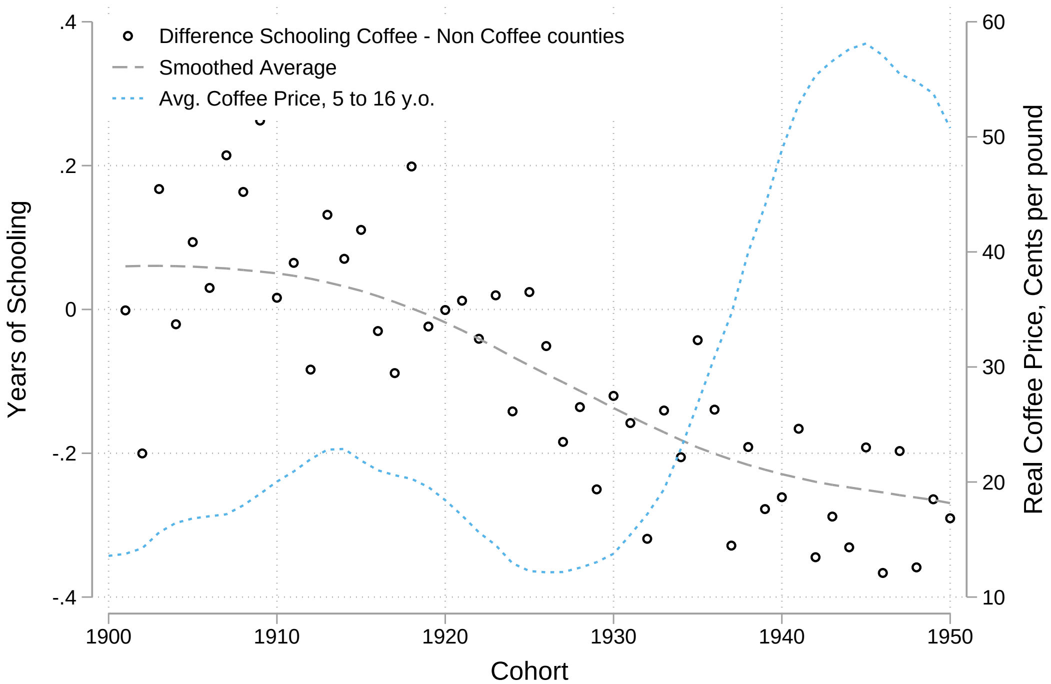
Figure 10: Effect of Coffee Cultivation on Industrialization by Human Capital Requirements in 1945

(a) Dep. Variable: Manufacturing Employment by sector (% of population) (b) Dep. Variable: Industrial Establishments per 1,000 inhab. by sector



Note: Each circle represents the coefficient of log coffee trees in 1920 (a) industrial employment and (b) industrial establishments in 1945. Each subfigure shows three different models, one for each group of industrial sectors according to their human capital intensity (high, medium, low). Coefficients stem from a 2SLS regression where log coffee trees is instrumented by coffee attainable yields. All specifications control for population in 1938 (log), distance to department's capital, distance to second largest market, and Department fixed effects. All specifications exclude capital cities. Lines represent 95% confidence intervals based on Conley (1999) standard errors, as described in section 4.

Figure 11: Differences in Cohorts' Schooling between Coffee and Non-Coffee Counties



Note: The circles show differences in average schooling in coffee counties and non-coffee counties for individual cohorts born in 1900 and 1950, using data from 1973 Census of Population. The long dashed line shows the smoothed average over time of schooling differences. The short dashed line (right axis) plots the average real coffee price between 5 and 16 years old for each cohort born between 1900 and 1950.

Tables

Table 1: Coffee Cultivation and Economic Structure, 1973

	(1)	(2)	(3)	(4)	(5)	(6)
Sample restriction:					Men	Women
Panel A:	*Dep. var.: Share of Labor Force in Manufacturing, 1973*					
log Coffee trees$_{1920}$	-0.002***	-0.002***	-0.004***	-0.004***	-0.006***	-0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Mean Dep. Var.	0.201	0.201	0.201	0.198	0.191	0.205
r2	0.082	0.104	0.201	0.198	0.387	0.279
Panel B:	*Dep. var.: Share of Labor Force in Agriculture, 1973*					
log Coffee trees$_{1920}$	0.005***	0.005***	0.006***	0.006***	0.011***	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
Mean Dep. Var.	0.363	0.363	0.363	0.370	0.635	0.108
r2	0.763	0.765	0.795	0.804	0.443	0.335
Panel C:	*Dep. var.: Share of Population in Labor Force, 1973*					
log Coffee trees$_{1920}$	-0.001*	-0.000	-0.000	-0.000	0.002***	-0.002***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0006)
Mean Dep. Var.	0.531	0.531	0.531	0.530	0.891	0.169
r2	0.967	0.967	0.973	0.974	0.294	0.540
Counties	563	563	563	550	548	548
Geo Controls		X	X	X	X	X
Department FE			X	X	X	X
Capitals	X	X	X			

Note: Each Panel estimates the correlation between coffee trees in 1920 and measures of economic structure in 1973. All specifications control for population in 1973 (log). Geo controls include: distance to department's capital, distance to second largest market, and a dummy for capital cities. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 2: Coffee Cultivation and Manufacturing in 1945

	(1)	(2)	(3)	(4)
Panel A:	*log Industrial workers, 1945*			
log Coffee trees$_{1920}$	-0.034***	-0.057***	-0.065***	-0.066***
	(0.011)	(0.012)	(0.015)	(0.015)
r2	0.343	0.395	0.443	0.360
Panel B:	*Industrial workers per 100 inhab., 1945*			
log Coffee trees$_{1920}$	-0.011	-0.023**	-0.034***	-0.033***
	(0.010)	(0.009)	(0.011)	(0.011)
Mean Dep. Var.	0.553	0.553	0.550	0.495
r2	0.059	0.093	0.120	0.074
Panel C:	*log Industrial Establishments, 1945*			
log Coffee trees$_{1920}$	-0.023***	-0.031***	-0.033***	-0.033***
	(0.006)	(0.006)	(0.008)	(0.008)
r2	0.378	0.443	0.489	0.359
Panel D:	*Industrial Establishments per 1,000 inhab., 1945*			
log Coffee trees$_{1920}$	-0.019***	-0.023***	-0.022***	-0.022***
	(0.005)	(0.006)	(0.008)	(0.008)
Mean Dep. Var.	0.431	0.431	0.429	0.397
r2	0.050	0.090	0.154	0.096
Counties	734	734	730	707
Geo controls		Y	Y	Y
Dept. FE			Y	Y
Dept. Capitals	Y	Y	Y	

Note: Each Panel presents the correlation between coffee trees in 1920 and some measure of industrial activity in 1945. All specifications control for population in 1938 (log). Geo controls include: distance to department's capital, distance to second largest market, and a dummy for capital cities (except for column (4) where capitals are excluded). Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 3: Test for Other Discontinuities

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		From 1912 census:			Geographic controls					
Dep. Variable:	Literacy	Employment in		Population	Distance to...		Terrain	Soil	Native Pop.	Land
	Rate	Manufact.	Agricult.	Density	Bogota	Dept. Cap.	Ruggedness	Quality	in 1560=1	Disputes
Altitude$> 2,400m$	-0.034	-0.016*	-0.031	-15.047	-92.356*	24.137	-0.263	0.447	0.314	-0.086
	(0.045)	(0.009)	(0.025)	(10.969)	(51.295)	(15.493)	(0.385)	(0.382)	(0.190)	(0.065)
F-stat	2.508	2.809	1.815	0.818	2.293	1.421	6.537	0.700	1.905	1.285
r2	0.055	0.061	0.040	0.019	0.050	0.032	0.131	0.016	0.042	0.029
Counties	134	134	134	134	134	134	134	131	134	134

Note: The table tests for discontinuous jumps in counties' characteristics at 2,400 meters. It shows results from regressing dependent variables on a dummy equal to one for counties above 2,400 meters over the sea level, altitude, and altitude $\times$ dummy for altitude$> 2,400m$. Results restrict the sample to counties above 1,800 meters. See appendix A for variables definitions. Standard errors clustered at 60-by-60 miles grid squares in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 4: Effect of Coffee Cultivation on Structural Transformation, 1973

	(1)	(2)	(3)	(4)
Estimator:	OLS		2SLS	
Panel A, Dep. var.: *Share of Labor Force in Manufacturing, 1973*				
log Coffee trees$_{1920}$	-0.004***	-0.005***	-0.006***	-0.005*
	(0.001)	(0.002)	(0.001)	(0.003)
Mean Dep. Var.	0.198	0.198	0.196	0.205
r2	0.198	0.103	0.087	0.159
Panel B, Dep. var.: *Share of Labor Force in Agriculture, 1973*				
log Coffee trees$_{1920}$	0.006***	0.008***	0.009***	0.010***
	(0.001)	(0.003)	(0.002)	(0.003)
Mean Dep. Var.	0.370	0.371	0.377	0.397
r2	0.804	0.795	0.804	0.833
Panel C, Dep. var.: *Share of Population in Labor Force, 1973*				
log Coffee trees$_{1920}$	-0.000	0.004***	-0.001	0.000
	(0.0003)	(0.0011)	(0.0008)	(0.0013)
Mean Dep. Var.	0.530	0.530	0.528	0.521
r2	0.974	0.970	0.978	0.983
Panel D, First Stage		*Dep. var.: log Coffee trees$_{1920}$*		
Coffee attainable yield (FAO)		0.062***		
		(0.009)		
Rainfall			0.015***	
			(0.002)	
Temperature			1.208***	
			(0.139)	
Rainfall $\times$ Temperature			-0.001***	
			(0.000)	
Altitude$> 2,400m$				-2.150*
				(1.172)
F-stat Excluded Inst.		51.761	30.675	43.183
r2		0.508	0.546	0.617
Observations	1,100	1,096	1,056	270
Counties	550	548	528	135

Note: This table shows the effect of coffee cultivation on structural transformation using data at the IPUMS-county level. Column (1) shows OLS results (equivalent to Table 1, Column 4). Columns (2) to (4) of Panels A, B, and C show results from 2SLS using instruments detailed in Panel D. Column (4) instruments coffee cultivation using altitude, a dummy equal to one for counties above 2,400 meters of altitude (Altitude$> 2,400m$), and an interaction between both. All specifications control for population in 1973 (log), gender fixed effects, distance to Department's capital, distance to second largest market, and Department fixed effects. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: 1945 IV

	(1)	(2)	(3)	(4)
Estimator:	OLS		2SLS	
Panel A:	*Industrial workers per 100 inhab., 1945*			
log Coffee trees$_{1920}$	-0.033***	-0.080**	-0.050*	-0.088***
	(0.011)	(0.035)	(0.027)	(0.029)
Mean Dep. Var.	0.495	0.495	0.467	0.399
r2	0.074	0.022	0.029	0.038
Panel B:	*Industrial Establishments per 1,000 inhab., 1945*			
log Coffee trees$_{1920}$	-0.022***	-0.071***	-0.061***	-0.084***
	(0.008)	(0.020)	(0.020)	(0.031)
Mean Dep. Var.	0.397	0.397	0.400	0.505
r2	0.096	-0.034	-0.006	0.003
Panel C: First Stage		*Dep. var.: log Coffee trees$_{1920}$*		
Coffee attainable yield (FAO)		0.065***		
		(0.007)		
Rainfall			0.010***	
			(0.001)	
Temperature			0.970***	
			(0.101)	
Rainfall $\times$ Temperature			-0.000***	
			(0.000)	
Altitude$> 2,400m$				-2.335**
				(1.098)
F-stat excluded inst.		97.464	35.960	31.581
r2		0.570	0.585	0.426
Counties	707	706	689	250

Note: This table shows the effect of coffee cultivation on on some measure of industrial activity in 1945 using data at the county level. Column (1) shows OLS results (equivalent to Table 2, Column 4). Columns (2) to (4) of Panels A and B show results from 2SLS using instruments detailed in Panel C. Column (4) instruments coffee cultivation using altitude, a dummy equal to one for counties above 2,400 meters of altitude (Altitude$> 2,400m$), and an interaction between both. All specifications control for population in 1938 (log), distance to department's capital, distance to second largest market, and Department fixed effects. All specifications exclude capital cities. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Effect of Coffee Price Shocks on Schooling by Cohort, 1973

	(1)	(2)	(3)	(4)
Estimator:	OLS		2SLS	
Dep. Variable	Average Years of Education, 1973			
Panel A: *Continuous measure Coffee, 1920*				
log Coffee $\text{trees}_{1920} \times \text{Price}_c^{5,16}$	-0.007***	-0.017***	-0.022***	-0.003
	(0.002)	(0.006)	(0.005)	(0.009)
F-stat Excluded Inst.		131.886	60.195	17.244
A-R p-value		0.002	0.000	0.233
Panel B: *Discrete measure Coffee, 1920*				
$(\text{Coffee trees}_{1920} > 0) \times \text{Price}_c^{5,16}$	-0.099***	-0.238***	-0.293***	-0.032
	(0.032)	(0.078)	(0.065)	(0.114)
F-stat Excluded Inst.		97.286	54.511	14.941
A-R p-value		0.002	0.000	0.233
Panel C: *Reduced Form*				
Coffee attainable yield $\times \text{Price}_c^{5,16}$		-0.0018***		
		(0.0006)		
Rainfall $\times \text{Price}_c^{5,16}$			-0.4147***	
			(0.0879)	
Temperature $\times \text{Price}_c^{5,16}$			-0.0270***	
			(0.0068)	
Rain. $\times$ Temp. $\times \text{Price}_c^{5,16}$			0.0156***	
			(0.0038)	
Altitude$> 2,400m \times \text{Price}_c^{5,16}$				0.2597*
				(0.1436)
Altitude $\times \text{Price}_c^{5,16}$				-0.0003
				(0.0003)
Altitude$> 2,400m \times$ Altitude $\times \text{Price}_c^{5,16}$				-0.0002
				(0.0004)
N	44,826	44,826	43,072	10,300
Counties	431	431	414	98
Mean Dep. Variable	2.881	2.881	2.873	3.131

Note: This table estimates the effect of coffee price shocks on schooling using data at the gender x cohort x county-or-birth level, for cohorts born between 1901 and 1951. The dependent variable for all specifications is average years of education. Panel A shows results measures coffee in 1920 with a continuous variable. Panel B measures coffee in 1920 with a dummy variable. $\text{Price}_c^{5,16}$ is log average real coffee price for cohort c between 5 and 16 years old. Column (1) shows OLS results. Columns (2) to (4) of Panels A and B show results from 2SLS using instruments detailed in Panel C. Panel C shows reduced form estimates. All specifications control for gender, cohort, and county-of-birth fixed effects. F statistic from Kleinberg and Paap tests and p-values from Anderson and Rubin tests are presented to test for weak instruments. Cohorts born in capital cities are excluded. Standard errors clustered at the county-of-birth level in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Effect of Coffee Price Shocks on Economic Structure and Income, 1973

	(1)	(2)	(3)	(4)
Estimator:	OLS		2SLS	
Instrument		Attn Yield	Rain x Temp	FRDD
Panel A: Dependent Variable: *Share of Cohort Employed in Manufacturing, 1973*				
(Coffee $\text{trees}_{1920} > 0) \times \text{Price}_c^{5,16}$	-0.004	-0.027**	-0.009	-0.037**
	(0.005)	(0.012)	(0.010)	(0.016)
Mean Dep. Variable	0.259	0.258	0.258	0.268
F-stat Excluded Inst.		96.135	53.614	14.569
A-R p-value		0.018	0.001	0.019
Panel B: Dependent Variable: *Share of Cohort Employed in Agriculture, 1973*				
(Coffee $\text{trees}_{1920} > 0) \times \text{Price}_c^{5,16}$	0.003	0.012	0.015*	0.001
	(0.004)	(0.010)	(0.009)	(0.013)
Mean Dep. Variable	0.311	0.311	0.313	0.293
F-stat Excluded Inst.		96.135	53.614	14.569
A-R p-value		0.230	0.107	0.978
Panel C: Dependent Variable: *Household Income, 1973*				
(Coffee $\text{trees}_{1920} > 0) \times \text{Price}_c^{5,16}$	-0.022	-0.117***	-0.100***	-0.036
	(0.018)	(0.045)	(0.034)	(0.062)
Mean Dep. Variable	-0.192	-0.191	-0.193	0.035
F-stat Excluded Inst.		97.255	54.535	14.941
A-R p-value		0.009	0.000	0.790
N	37,416	37,325	35,804	8,743
Counties	359	358	344	84

Note: This table estimates the effect of coffee price shocks on economic structure and income in 1973 using data at the gender x cohort x county-or-birth level, for cohorts born between 1901 and 1951. The dependent variable is given at the top of each panel. (Coffee $\text{trees}_{1920} > 0$) is a dummy equal to one for counties with a positive number of coffee trees in 1920. $\text{Price}_c^{5,16}$ is log average real coffee price for cohort c between 5 and 16 years old. Column (1) shows OLS results. Columns (2) to (4) show results from 2SLS using instruments detailed at the top of the table. Column (2) uses coffee attainable yields from FAO. Column (3) uses a polynomial on rainfall and temperature. Column (4) uses a fuzzy regression discontinuity design (FRDD) on altitude. All specifications control for gender, cohort, and county-of-birth fixed effects. Cohorts born in capital cities are excluded. Standard errors clustered at the county-of-birth level in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Coffee Shocks and Structural Transformation by Inequality

	(1)	(2)	(3)	(4)
Sample Counties:	All	Coffee trees>0	Low Ineq.	High Ineq.
Panel A, Dep. Var.: *Average Years of Schooling, 1973*				
log Coffee trees$_{1920}$ $\times$ Price$_c^{5,16}$	-0.0073***	-0.0005	-0.0159	0.0220
	(0.0025)	(0.0106)	(0.0144)	(0.0161)
Mean Dep. Var.	2.8814	2.9576	2.9311	3.0287
Panel B, Dep. Var.: *Literacy Rate, 1973*				
log Coffee trees$_{1920}$ $\times$ Price$_c^{5,16}$	-0.2351***	-0.6238***	-1.0410***	0.1914
	(0.0418)	(0.1658)	(0.2184)	(0.2839)
Mean Dep. Var.	72.7947	75.7333	75.1425	77.3802
Panel C, Dep. Var.: *Share of Cohort Employed in Manufacturing, 1973*				
log Coffee trees$_{1920}$ $\times$ Price$_c^{5,16}$	-0.0003	0.0009	0.0016	0.0010
	(0.0004)	(0.0013)	(0.0019)	(0.0024)
Mean Dep. Var	0.2586	0.2600	0.2518	0.2661
Panel D, Dep. Var.: *Share of Cohort Employed in Agriculture, 1973*				
log Coffee trees$_{1920}$ $\times$ Price$_c^{5,16}$	0.0004	0.0021*	0.0037**	-0.0010
	(0.0003)	(0.0012)	(0.0016)	(0.0024)
Mean Dep. Var	0.3106	0.3135	0.3180	0.3062
Panel E, Dep. Var.: *Average Household Income, 1973*				
log Coffee trees$_{1920}$ $\times$ Price$_c^{5,16}$	-0.0023*	-0.0100*	-0.0173**	0.0089
	(0.0014)	(0.0057)	(0.0085)	(0.0079)
Mean Dep. Var.	-0.1918	0.0334	-0.0080	0.1374
N	37,416	22,973	10,963	10,495
Counties	359	220	112	108

Note: This table shows correlations between coffee price shocks and outcomes in 1973 using data at the gender x cohort x county-or-birth level. It uses different county samples. Column (1) uses all counties. Column (2) restricts to counties with some coffee trees in 1920. Columns (3) and (4) restrict the sample further to coffee counties with lower and higher (respectively) land inequality than the median coffee county. All specifications control for gender, cohort, and county-of-birth fixed effects. Cohorts born in capital cities are excluded. Standard errors clustered at the county-of-birth level in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Effect of Coffee Cultivation on Number of Schools, 1951

	(1)	(2)	(3)	(4)	(5)
Dep. Variable:	Schools per 10,000 inhabitants, 1951				
Sample:	All counties				
Estimator:	OLS	2SLS			
Coffee trees$_{1920} > 0$	-0.436**	-1.053**			
	(0.176)	(0.415)			
Counties	491	476			
Mean Dep. Var.	0.678	0.643			
F-stat Excluded Inst.		49.871			
r2	0.154	-0.018			
Sample:	All counties		Coffee trees> 0	Low Ineq.	High Ineq.
Estimator:	OLS	2SLS	2SLS	2SLS	2SLS
log Coffee trees$_{1920}$	-0.036**	-0.073**	-0.089	0.015	-0.341
	(0.014)	(0.029)	(0.084)	(0.079)	(0.214)
Counties	491	476	316	147	167
Mean Dep. Var.	0.678	0.643	0.627	0.530	0.715
F-stat Excluded Inst.		72.457	37.934	35.803	8.747
r2	0.155	0.008	0.019	0.028	-0.105

Note: The tables shows the effect of coffee cultivation on the number of schools per 10,000 inhabitants in 1951 using data at the IPUMS-county level. All specifications estimated using 2SLS instrument coffee cultivation with Coffee Attainable Yields from FAO. Coffee trees$_{1920} > 0$ is a dummy equal to one for counties with positive number of coffee trees in 1920. Column (3) restricts the sample to only counties with coffee cultivation in 1920. Columns (4) and(5) further divide coffee counties by level of land inequality. All specifications control for population in 1951 (log), distance to Department's capital, distance to second largest market, and Department fixed effects. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Linkages in Coffee Production and Structural Transformation, 1973

	(1)	(2)	(3)	(4)
Dep. Variable:	Share of Labor Force in Manufacturing, 1973			
Panel A:	*OLS and Second Stage*			
Estimator:	OLS	2SLS	OLS	2SLS
Coffee trees$_{1920} > 0$	-0.049***	-0.069**		
	(0.009)	(0.027)		
Coffee trees$_{1920} > 0$, No Threshing			-0.042***	-0.064*
			(0.009)	(0.034)
Coffee trees$_{1920} > 0$, Threshing			-0.068***	-0.071***
			(0.011)	(0.023)
N	1,100	1,096	1,100	1,096
Counties	550	448	550	448
r2	0.192	0.092	0.197	0.096
F-stat Excluded Inst.		38.546		11.769
Threshing = No Threshing? (F-stat)			6.799	0.205
Panel B:	*Reduced Form*			
Coffee attainable yield (FAO)		-0.0003**		-0.0002*
		(0.0001)		(0.0001)
Coffee attainable yield (FAO) $\times$ Threshing				-0.0004**
				(0.0002)
N		1,096		1,096
Counties		448		448
r2		0.17183		0.17641

Note: This table shows the effect of coffee cultivation and coffee threshing on share of labor force employed in manufacturing (1973) using data at the IPUMS-county level. Column (1) shows OLS results (equivalent to Table 1, Column 4). "Coffee trees$_{1920} > 0$, (No) Threshing" is a dummy equal to one for counties with positive number of coffee trees in 1920 and (no) threshing machines in 1920. All specifications control for population in 1973 (log), gender fixed effects, distance to Department's capital, distance to second largest market, and Department fixed effects. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Effect of Coffee Cultivation on Long Term Income, 2005

	(1)	(2)	(3)	(4)
Estimator	OLS		2SLS	
Instrument:		Att. Yields	Rain $\times$ Temp.	FRDD
Panel A: *Poverty Rate, 2005*				
log Coffee trees$_{1920}$	0.003***	0.005**	0.005***	0.003
	(0.001)	(0.002)	(0.001)	(0.003)
Mean Dep. Var.	0.520	0.519	0.519	0.473
r2	0.701	0.374	0.349	0.226
Panel B: *Average Household Income, 2005*				
log Coffee trees$_{1920}$	-0.031***	-0.002	-0.059***	-0.054**
	(0.009)	(0.035)	(0.012)	(0.021)
Mean Dep. Var.	-0.367	-0.359	-0.369	-0.068
r2	0.670	0.410	0.411	0.492
N	472	464	449	91
F stat Excluded Inst.		12.117	20.931	12.479

Note: This table shows the effect of coffee cultivation on 2005 poverty and income using data at the IPUMS-county level. Poverty rate comes from DANE. Household income is calculated from a principal components analysis using household characteristics and durable goods, as described in 3 Column (1) shows OLS results. Columns (2) to (4) show results from 2SLS using instruments detailed at the top of the table. All specifications control for population (log), distance to Department's capital, distance to second largest market, and Department fixed effects. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

References

Acemoglu, D. and Dell, M. (2010). Productivity Differences between and within Countries. *American Economic Journal: Macroeconomics*, 2(1):169–188.

Acemoglu, D. and Guerrieri, V. (2008). Capital Deepening and Nonbalanced Economic Growth. *Journal of Political Economy*, 116(3):32.

Acevedo, K. M. and Bornacelly, I. D. (2014). Panel Municipal del CEDE. Technical Report 012223, Universidad de los Andes - CEDE.

Angrist, J. D. and Pischke, J.-S. (2008). *Mostly harmless econometrics: An empiricist's companion*. Princeton University Press.

Arango, M. (1981). *Café e industria, 1850-1930*.

Atkin, D. (2016). Endogenous Skill Acquisition and Export Manufacturing in Mexico. *American Economic Review*, 106(8):2046–2085.

Autor, D. H., Dorn, D., and Hanson, G. H. (2016). The China shock: Learning from labor-market adjustment to large changes in trade. *Annual Review of Economics*, 8:205–240.

Bazzi, S., Fiszbein, M., and Gebresilasse, M. (2017). Frontier Culture: The Roots and Persistence of "Rugged Individualism" in the United States. Technical Report w23997, National Bureau of Economic Research, Cambridge, MA.

Bejarano, J. A. (1980). Los estudios sobre la historia del café en Colombia. *Cuadernos de economía*, 1(2):115–140.

Bester, C. A., Conley, T. G., and Hansen, C. B. (2011). Inference with dependent data using cluster covariance estimators. *Journal of Econometrics*, 165(2):137–151.

Bobonis, G. J. and Morrow, P. M. (2014). Labor coercion and the accumulation of human capital. *Journal of Development Economics*, 108:32–53.

Brew, R. (1973). The economic development of Antioquia from 1850-1920.

Bulmer-Thomas, V. (2003). *The economic history of Latin America since independence*. Cambridge University Press.

Bustos, P., Caprettini, B., and Ponticelli, J. (2016). Agricultural Productivity and Structural Transformation: Evidence from Brazil. *American Economic Review*, 106(6):1320–1365.

Cardoso, F. H. and Faletto, E. (1979). *Dependency and development in Latin America* (*Dependencia y desarrollo en América Latina, engl.*). Univ of California Press.

Carrillo, B. (2019). The Value of Time and Skill Acquisition in the Long Run: Evidence from Coffee Booms and Busts. *Journal of Labor Economics*. In Press.

Caselli, F. and Coleman II, W. J. (2001). The U.S. Structural Transformation and Regional Convergence: A Reinterpretation. *Journal of Political Economy*, 109(3):584–616.

Ciccone, A. and Papaioannou, E. (2009). Human Capital, the Structure of Production, and Growth. *The Review of Economics and Statistics*, 91(1):66–82.

Colella, F., Lalive, R., Sakalli, S. O., and Thoenig, M. (2019). Inference with Arbitrary Clustering. SSRN Scholarly Paper ID 3449578, Social Science Research Network, Rochester, NY.

Conley, T. G. (1999). GMM estimation with cross sectional dependence. *Journal of Econometrics*, 92(1):1–45.

de la Croix, D., Doepke, M., and Mokyr, J. (2018). Clans, Guilds, and Markets: Apprenticeship Institutions and Growth in the Preindustrial Economy. *The Quarterly Journal of Economics*, 133(1):1–70.

Dippel, C., Ferrara, A., and Heblich, S. (2019a). ivmediate: Causal mediation analysis in instrumental variables regressions.

Dippel, C., Gold, R., Heblich, S., and Pinto, R. (2019b). Mediation Analysis in IV Settings With a Single Instrument.

Droller, F. and Fiszbein, M. (2019). Staple Products, Linkages, and Development: Evidence from Argentina. Technical Report 0898-2937, National Bureau of Economic Research.

Dube, O. and Vargas, J. F. (2013). Commodity Price Shocks and Civil Conflict: Evidence from Colombia. *The Review of Economic Studies*, 80(4):1384–1421.

Duran, X., Musacchio, A., and Paolera, G. d. (2017). *Industrial Growth in South America: Argentina, Brazil, Chile, and Colombia, 1890–2010*. Oxford University Press.

Edwards, R. B. (2019). Export agriculture and rural poverty: evidence from Indonesian palm oil.

Engerman, S. L. and Sokoloff, K. L. (1997). Factor endowments, institutions, and differential paths of growth among new world economies. In Haber, S., editor, *How Latin America Fell Behind: Essays on the Economic Histories of Brazil and Mexico, 1800-1914*. Stanford University Press.

Filmer, D. and Pritchett, L. H. (2001). Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrollments in States of India. *Demography*, 38(1):115–132.

Fiszbein, M. (2017). Agricultural Diversity, Structural Change and Long-run Development: Evidence from the U.S. Working Paper 23183, National Bureau of Economic Research.

Foster, A. and Rosenzweig, M. (2004). Agricultural Productivity Growth, Rural Economic Diversity, and Economic Reforms: India, 1970–2000. *Economic Development and Cultural Change*, 52(3):509–542.

Franck, R. and Galor, O. (2017). Technology-Skill Complementarity in Early Phases of Industrialization. Technical Report w23197, National Bureau of Economic Research, Cambridge, MA.

Galiani, S., Heymann, D., Dabús, C., and Tohmé, F. (2008). On the emergence of public education in land-rich economies. *Journal of Development Economics*, 86(2):434–446.

Galor, O. and Moav, O. (2004). From Physical to Human Capital Accumulation: Inequality and the Process of Development. *The Review of Economic Studies*, 71(4):1001–1026.

Galor, O., Moav, O., and Vollrath, D. (2009). Inequality in Landownership, the Emergence of Human-Capital Promoting Institutions, and the Great Divergence. *Review of Economic Studies*, page 37.

Gennaioli, N., La Porta, R., Lopez-de Silanes, F., and Shleifer, A. (2013). Human Capital and Regional Development. *The Quarterly Journal of Economics*, 128(1):105–164.

Goldberg, P. K. and Pavcnik, N. (2007). Distributional Effects of Globalization in Developing Countries. *Journal of Economic Literature*, 45(1):39–82.

Gollin, D., Lagakos, D., and Waugh, M. E. (2014). The Agricultural Productivity Gap. *The Quarterly Journal of Economics*, 129(2):939–993.

GRECO (2002). *El crecimiento económico colombiano en el siglo XX*. Banco de la República.

Herrendorf, B. and Schoellman, T. (2018). Wages, Human Capital, and Barriers to Structural Transformation. *American Economic Journal: Macroeconomics*, 10(2):1–23.

Hirschman, A. O. (1958). *The strategy of economic development*. Yale University Press.

Hornbeck, R. and Keskin, P. (2015). Does Agriculture Generate Local Economic Spillovers? Short-Run and Long-Run Evidence from the Ogallala Aquifer. *American Economic Journal: Economic Policy*, 7(2):192–213.

Kuznets, S. (1966). *Modern economic growth: findings and reflections*. Nobel foundation.

LeGrand, C. (1986). *Frontier expansion and peasant protest in Colombia, 1850-1936*. University of New Mexico Press.

Lewis, A. (1955). The Theory of Economic Development. *Allen and Unwin, London*.

Matsuyama, K. (1992). Agricultural productivity, comparative advantage, and economic growth. *Journal of Economic Theory*, 58(2):317–334.

McGreevey, W. P. (1971). *An economic history of Colombia, 1845-1930*. Cambridge University Press.

Mejia, J. (2018). Social networks and entrepreneurship. evidence from a historical episode of industrialization.

Moscona, J. (2018). Agricultural development and structural change, within and across countries.

Murphy, K. M., Shleifer, A., and Vishny, R. (1989). Income Distribution, Market Size, and Industrialization. *The Quarterly Journal of Economics*, 104(3):537–564.

Nieto Arteta, L. E. (1971). *El café en la sociedad colombiana*.

Nunn, N. and Puga, D. (2010). Ruggedness: The Blessing of Bad Geography in Africa. *The Review of Economics and Statistics*, 94(1):20–36.

Ocampo, J. A. (1984). The Colombian Economy in the 1930s. In Thorp, R., editor, *Latin America in the 1930s: The Role of the Periphery in World Crisis*, St Antony's Series, pages 117–143. Palgrave Macmillan UK, London.

Ocampo, J. A. (2015). *Café, industria y macroeconomía: ensayos de historia económica colombiana*. Fondo de Cultura Económica.

Ocampo, J. A. and Botero, M. M. (2000). Coffee and the Origins of Modern Economic Development in Colombia. In Cárdenas, E., Ocampo, J. A., and Thorp, R., editors, *An Economic History of Twentieth-Century Latin America: Volume 1 The Export Age: The Latin American Economies in the Late Nineteenth and Early Twentieth Centuries*, pages 55–84. Palgrave Macmillan UK, London.

Ocampo, J. A. and Montenegro, S. (2007). *Crisis mundial, protección e industrialización*. Editorial Norma.

O'Rourke, K. H. and Williamson, J. G. (2002). When did globalisation begin? *European Review of Economic History*, 6(1):23–50.

Ospina Vásquez, L. (1955). Industria y protección en Colombia. *Medellín: ESF*.

Palacios, M. (2002). *Coffee in Colombia, 1850-1970*. Cambridge University Press.

Parsons, J. J. (1949). *Antioqueño colonization in western Colombia*. University of California Press.

Perez, S. (2017). Railroads and the rural to urban transition: Evidence from 19th-century Argentina. Technical report, University of California, Davis.

Porzio, T. and Santangelo, G. (2019). Does Schooling Cause Structural Transformation? In *Barcelona GSE Forum Working Paper*.

Prebisch, R. (1950). The economic development of Latin America. *ECLAC Thinking, Selected Texts (1948-1998). Santiago: ECLAC, 2016. p. 45-84*.

Rosenstein-Rodan, P. N. (1943). Problems of Industrialisation of Eastern and South-Eastern Europe. *The Economic Journal*, 53(210/211):202–211.

Ruggles, S., King, M. L., Levison, D., McCaa, R., and Sobek, M. (2003). IPUMS-international. *Historical Methods: A Journal of Quantitative and Interdisciplinary History*, 36(2):60–65.

Saenz, N. (1892). *Memoria sobre el cultivo del cafeto*. Imprenta de la Luz.

Salvucci, R. (2006). Export-Led Industrialization. In Bulmer-Thomas, V., Coatsworth, J., and Cortes-Conde, R., editors, *The Cambridge Economic History of Latin America*.

Santos Cardenas, D. (2017). From Skirts to Slacks: Female Workers and Wage Gap in the Colombian Industry in 1945. SSRN Scholarly Paper ID 3040722, Social Science Research Network, Rochester, NY.

Schultz, T. W. (1964). *Transforming traditional agriculture.* Yale University Press.

Squicciarini, M. P. and Voigtländer, N. (2015). Human Capital and Industrialization: Evidence from the Age of Enlightenment. *The Quarterly Journal of Economics*, 130(4):1825–1883.

Sviatschi, M. M. (2018). Making a Narco: Childhood Exposure to Illegal Labor Markets and Criminal Life Paths.

Valencia Caicedo, F. (2019). The Mission: Human Capital Transmission, Economic Persistence, and Culture in South America. *The Quarterly Journal of Economics*.

Vollrath, D. (2011). The agricultural basis of comparative development. *Journal of Economic Growth*, 16(4):343–370.

Wallerstein, I. (2011). *The modern world-system I: Capitalist agriculture and the origins of the European world-economy in the sixteenth century*, volume 1. Univ of California Press.

Williamson, J. G. (2011). Industrial Catching Up in the Poor Periphery 1870-1975. Working Paper 16809, National Bureau of Economic Research.

Appendix A Data Appendix

Outcome Variables

Share of population in labor force: 1912 and 1938 census already included these numbers for every county. For 1973 and 2005 census, I calculate the county-level number of adults between 18 and 65 years old who answered affirmatively to the question about labor force participation. I then divide by total population, taken from each census.

Share of labor force employed in manufacturing and agriculture: for 1912 and 1938 census already included the number of people by occupation. For 1973 and 2005, I use the ISCO-68 3 code classification of occupation to identify worker's employment sector in three broad categories: Agriculture (Occupations in the 600 ISCO-68 code), Manufacturing (Occupations in the 700 ISCO-68 code except for "Miners and quarrymen" (711) and "Mineral and stone treaters" (712). Occupations in the 800 code and from codes 901 to 989 (inclusive)), and Services (Occupations in the 400 and 500 ISCO-68 code).

Number of manufacturing establishments per capita: Number of manufacturing establishments with more than 5 employees divided by population in 1945. From 1945 Industrial Census (Santos Cardenas, 2017). I interpolate county level population using data from 1938 and 1951 census of population.

Share of population employed in industrial establishments: Number of workers in manufacturing establishments with more than five employees divided by population in 1945. From 1945 Industrial Census (Santos Cardenas, 2017). I interpolate county level population using data from 1938 and 1951 census of population.

Human capital: I measure education in 1973. I use two variables available for individuals older than 5 years old. Literacy: a dummy equal to one if the individual can read and write, zero otherwise. Years of schooling: Highest year of education completed by the individual. Ranges from 0 to 18. I then aggregate at the county-of-birth x cohort level using population weights.

Household income: I calculate a measure of income for households in 1973 and 2005. I extract the first vector of a principal components analysis on a series of variables containing information on house quality. I use data on household characteristics to build a measure of household wealth. They are:

Electricity: a dummy equal to one if the dwelling is connected to electricity. Sewage: a dummy equal to one if the dwelling is connected to a drainage sewer system. Water supply: a dummy equal to one if the dwelling is connected to piped water supply. Toilet: a dummy equal to one if the dwelling has either flush toilet or latrine. Floor material: a dummy equal to one if the dwelling's floors are made of cement, tile, brick, wood, or plastic. It equals zero if the dwelling has unfinished or no floor. Roof material: a dummy equal to one if the dwelling's roof is made of reinforced concrete or clay tile. It equals zero if the roof is made of zinc, tin, thatch, or discarded material. Rooms per person: number of rooms the household uses divided by the number of people in the household.

Poverty rate: share of households living below poverty line in 2005. From Acevedo and Bornacelly (2014).

Coffee Cultivation

The census was part of a larger project, the book "Colombia Cafetera" by Dario Monsalve, commissioned by Colombia's Department of Commerce to promote coffee exports abroad. The book includes general information about the country, infographics, pictures, and a detailed account of coffee farms at the municipality level. I digitized information on farms' names, owners when available, and size, measured by the number of coffee trees used in production. For some of the smaller plantations, the census does not include the owner's name. For some counties, there are only counts of small farms and their size. In some rare cases, the census pools together an unknown number of plantations in a single category ("Some" or "Varias' in Spanish). The documentation on how the census was collected is not very comprehensive and I cannot say with confidence why some counties report their information pooling the smaller farms in this fashion.

Figure 12 shows the census records for the municipality of Anzá in the department of Antioquia, an instance where the three ways of reporting the information appear. Overall, the census reports information for 37,689 farms, containing 242 million coffee trees.

I use the 1928 coffee census records to build four measures at the county level. First, the total land used for coffee plantations, which is simply the sum of the individual farms' sizes. Second, the total number of farms. I measure this in two different ways to deal with the pooled category "Some:" one, assuming "Some" is equal to one farm (lower bound), and two: assuming the farms are equal to the smallest plantation in the county for which I have information (upper bound). Using the example from figure 12, the number of farms in "Some" will be, respectively, 1 and 10. Third, the number of farms allows me to measure the average and the median farm in every county. Finally, I calculate the Gini coefficient at the county level.

Ideally, I would like to use the information on the owners' name, because there are instances where the same name appears as the owner of more than one plantation. There are, however, two obstacles for doing so. One, naming conventions in Colombia use two last names system. The first last name is the father's first last name, and the second last name is the mothers' first last name. However, the data only includes one last name. Since last names in Colombia are very common, I might identify two different people with the same name as the same individual. Two, as pointed out above, there are a significant number of farms for which I do not know the owner's name. For the time being, I will assume the number of plantations is equal to the number of owners in order to calculate two measures of Gini coefficient, one for every estimate for the number of owners.

Figure 12: Example from 1928 Coffee Census (Municipality of Anza, Department of Antioquia)

10. ANZÁ

Quicimó	Dimas Navarro.	30,000
El Zarzal.	Lisandro Sánchez.	16,000
Guayabal	Efraín Jaramillo.	15,000
Peñitas.	Castor Caro.	14,000
Los Llanos	Antonio J. Holguín.	13,000
Pajal.	Antonio M. Sánchez	8,000
El Zarzal.	Heliodoro Ruiz.	8,000
Guayabal.	Germán Jaramillo	8,000
Los Llanos	Luciano Bravo	8,000
»	Secundino Holguín	5,500
Olivares	Juan Hernández	5,000
Moral	Bautista Holguín	5,000
Los Llanos	Manuel Zapata	3,000
Guamal...........	Antonio M. Velásquez...	3,000
Malpaso	Ignacio Ramírez.	3,000
La Cordillera......	Marco A. Muñoz.	1,500
Las Lomitas	Juan González	1,500
Quinamá	Serafín Moreno.	1,500
»	Eliseo Jaramillo	1,500
Campoalegre	Ignacio Trujillo.........	1,500
El Guineo	Dolores Enríquez	1,400
25 plantaciones de 1,000 cafetos		25,000
1 menores de 1,000 cafetos.		925
6 plantaciones de 800 cafetos..............		4,800
5 » de 500 »		2,500
4 » de 350 »		1,400
9 » de 200 »		1,800
11 » de 100 »		1,100
Varias. » de Varios		1,000

Note: Columns correspond to: Plantation name, owner's name, number of trees.

Appendix B Supporting Results

B.1 Main Results for 1912, 1938, and 2005

Table 12: Effect of Coffee Price Shocks on Economic Structure, 1912, 1938, and 2005

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Year:		1912			1938			2005	
Estimator:	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
Instrument		Attn. Yield	FRDD		Attn. Yield	FRDD		Attn. Yield	FRDD
Panel A, Dep. Var.: Share of Labor Force Employed in Manufacturing									
log Coffee trees$_{1920}$	-0.002***	-0.002***	-0.001	-0.003***	-0.006**	-0.005**	-0.001***	-0.001	-0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.002)	(0.000)	(0.001)	(0.002)
Mean Dep. Var.	0.035	0.034	0.033	0.097	0.096	0.137	0.024	0.024	0.034
r2	0.204	0.029	0.001	0.450	0.025	0.013	0.128	0.046	0.087
Panel B, Dep. Var.: Share of Labor Force Employed in Agriculture									
log Coffee trees$_{1920}$	0.002**	0.002	0.003**	0.006***	0.008***	0.008**	0.004***	-0.011	0.009
	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.001)	(0.007)	(0.006)
Mean Dep. Var.	0.172	0.172	0.167	0.825	0.825	0.798	0.205	0.205	0.257
r2	0.218	0.033	0.071	0.267	0.073	0.039	0.476	0.315	0.408
Observations	719	698	245	713	695	250	934	898	182
F stat Excluded Inst.		28.638	11.645		35.752	12.331		12.706	39.242

Note: This table presents supporting results for figure 9. It shows the effect of coffee cultivation on structural transformation using data at the IPUMS-county level. Columns (1) (4) and (7) show OLS results (equivalent to Table 1, Column 4). Columns (3) (6) and (9) instrument coffee cultivation using altitude, a dummy equal to one for counties above 2,400 meters of altitude (Altitude$> 2,400m$), and an interaction between both. All specifications control for population (log), gender fixed effects, distance to Department's capital, distance to second largest market, and Department fixed effects. Conley (1999) standard errors as described in section 4 in parenthesis.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

B.2 Balance Tests

Table 13: Balance Tests

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	From 1912 census:				Geographic controls						
Dep. Variable:	Literacy Rate	Employment in Manufact.	Employment in Agricult.	Population Density	Altitude (km)	Distance to... Bogota	Distance to... Dept. Cap.	Terrain Ruggedness	Soil Quality	Native Pop. in 1560=1	Land Disputes
Panel A:	*Difference in Means test Coffee vs. Non-coffee, 1925*										
Coffee trees$_{1920} > 0$	0.044***	-0.005	0.036***	1.308	0.352***	-123.438***	-7.793*	1.284***	-0.392***	-0.043	-0.060*
	(0.009)	(0.005)	(0.009)	(2.999)	(0.078)	(16.602)	(4.543)	(0.107)	(0.106)	(0.047)	(0.036)
Mean Coffee trees$_{1920} = 0$	0.108	0.035	0.120	29.332	1.001	375.607	72.661	1.360	3.021	0.562	0.225
r2	0.043	0.002	0.034	0.000	0.040	0.101	0.006	0.229	0.027	0.002	0.006
Counties	494	494	494	494	494	494	494	492	489	494	494
Panel B:	*Difference in Means test Above vs. Below 2,400mts*										
Altitude$> 2,400m$	-0.054**	0.004	-0.022*	-1.561	0.593***	1.624	1.169	-0.691***	-0.026	0.089	0.014
	(0.021)	(0.004)	(0.012)	(5.089)	(0.027)	(24.200)	(7.239)	(0.180)	(0.177)	(0.089)	(0.030)
Mean Counties Below	0.181	0.030	0.162	40.287	2.040	216.503	65.683	3.072	2.298	0.488	0.024
r2	0.048	0.005	0.025	0.001	0.785	0.000	0.000	0.101	0.000	0.008	0.002
Counties	134	134	134	134	134	134	134	134	131	134	134

Note: Panel A shows results from regressing dependent variables on a dummy equal to one for counties with positive Coffee Trees in 1925. Panel B shows results from regressing dependent variables on a dummy equal to one for counties above 2,400 meters over the sea level, restricting the sample to counties above 1,800 meters. Panel B restrict the sample to counties above 1,800 meters. See appendix A for variables definitions. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

B.3 Effects by Human Capital Sector (Industrial Census, 1945)

Table 14: 1945 IV by sector

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable:	Industrial workers per 100 inhab., 1945			Industrial Establishments per 1,000 inhab., 1945		
Instrument for Coffee	Att. Yields	Rain × Temp.	FRDD	Att. Yields	Rain × Temp.	FRDD
Panel A: **High** Human Capital Sectors						
log Coffee trees_{1920}	-0.084**	-0.051***	-0.061**	-0.120***	-0.115***	-0.044
	(0.037)	(0.011)	(0.026)	(0.024)	(0.021)	(0.032)
Mean Dep. Var.	0.057	0.057	0.073	0.066	0.067	0.104
r2	-0.032	0.016	-0.002	-0.140	-0.119	0.067
Panel B: **Medium** Human Capital Sectors						
log Coffee trees_{1920}	-0.016	-0.011	-0.056	-0.023	-0.009	-0.024
	(0.019)	(0.023)	(0.036)	(0.014)	(0.012)	(0.029)
Mean Dep. Var.	0.106	0.102	0.077	0.047	0.046	0.035
r2	0.024	0.021	0.009	0.030	0.030	0.036
Panel C: **Low** Human Capital Sectors						
log Coffee trees_{1920}	-0.034	-0.021	-0.066**	-0.070***	-0.061**	-0.083***
	(0.021)	(0.014)	(0.028)	(0.024)	(0.024)	(0.031)
Mean Dep. Var.	0.332	0.307	0.249	0.284	0.287	0.366
r2	0.013	0.016	0.032	-0.023	-0.004	-0.000
Counties	706	689	250	706	689	250

Note: Table shows effects of coffee cultivation on industrial employment and number of establishments in 1945 by sector, according to Human Capital requirement. Columns (1) and (4) use Coffee attainable yields from FAO as instrument for coffee cultivation in 1920. Columns (2) and (5) use a polynomial on rainfall and temperature. Columns (3) and (6) use a fuzzy regression discontinuity design (FRDD) on altitude. All specifications control for population in 1938 (log), distance to department's capital, distance to second largest market, and Department fixed effects. All specifications exclude capital cities. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

B.4 Mediation Analysis

Table 15: Coffee Shocks and Structural Transformation by Inequality

	(1) OLS	(2) 2nd. Stage	(3) OLS	(4) 2nd. Stage	(5) Red. Form
Panel A, Dep. Var:	Share of Cohort Employed in Manufacturing, 1973				
Avg. Years of Schooling	0.0032**	0.1244*			
	(0.0015)	(0.0636)			
Literacy Rate			0.0006***	0.0065**	
			(0.0001)	(0.0027)	
Coffee attainable yield × $\text{Price}_c^{5,16}$					-0.0002**
					(0.0001)
Mean Dep. Var.	0.2587	0.2586	0.2585	0.2585	0.2585
F-stat Excluded Inst.		8.2063		10.6217	
A-R test p-value		0.0179		0.0177	
Panel B, Dep. Var:	Share of Cohort Employed in Agriculture, 1973				
Avg. Years of Schooling	-0.0478***	-0.0558			
	(0.0013)	(0.0440)			
Literacy Rate			-0.0018***	-0.0029	
			(0.0001)	(0.0021)	
Coffee attainable yield × $\text{Price}_c^{5,16}$					0.0001
					(0.0001)
Mean Dep. Var.	0.3092	0.3105	0.3096	0.3110	0.3110
F-stat Excluded Inst.		8.2063		10.6217	
A-R test p-value		0.2308		0.2305	
N	37,558	37,269	37,558	37,269	37,269
Counties	361	358	361	358	358

Note: This table shows the effect of education on occupation in 1973, instrumenting education using coffee prices during school age for cohorts born between 1901 and 1951. It uses data at the gender x cohort x county-or-birth level. All specifications control for gender, cohort, and county-of-birth fixed effects. Cohorts born in capital cities are excluded. Standard errors clustered at the county-of-birth level in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Appendix C Robustness Checks

C.1 Extensive margin of coffee cultivation in 1920 as alternative measure

Table 16: Measuring 1920 Coffee Cultivation with Extensive Margin

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year:	1912		1938		1973		2005	
Instrument	Attn. Yield	FRDD	Attn. Yield	FRDD	Attn. Yield	FRDD		
Panel A, Dep. Var.: Share of Labor Force Employed in Manufacturing								
Coffee trees$_{1920} > 0$	-0.010	-0.018	-0.076**	-0.059**	-0.069*	-0.063*	-0.019	-0.040**
	(0.011)	(0.012)	(0.033)	(0.026)	(0.038)	(0.036)	(0.013)	(0.019)
Mean Dep. Var.	0.035	0.033	0.096	0.137	0.198	0.205	0.025	0.034
Panel B, Dep. Var.: Share of Labor Force Employed in Agriculture								
Coffee trees$_{1920} > 0$	0.050***	0.045**	0.108***	0.092**	0.111**	0.133***	-0.157	0.151*
	(0.015)	(0.018)	(0.039)	(0.038)	(0.044)	(0.032)	(0.105)	(0.075)
Mean Dep. Var.	0.239	0.218	0.825	0.798	0.377	0.397	0.210	0.257
Panel C, Dep. Var.: Labor force participation								
Coffee trees$_{1920} > 0$	-0.0020	-0.0064	0.0405	0.0219	0.063***	0.002	-0.050	-0.041
	(0.0250)	(0.0178)	(0.0311)	(0.0236)	(0.023)	(0.013)	(0.053)	(0.035)
Mean Dep. Var.	0.411	0.382	0.551	0.587	0.530	0.521	0.571	0.596
Counties	719	245	713	250	547	135	467	141
F stat Excluded Inst.	26.182	11.019	31.436	11.523	14.542	12.244	11.014	9.203

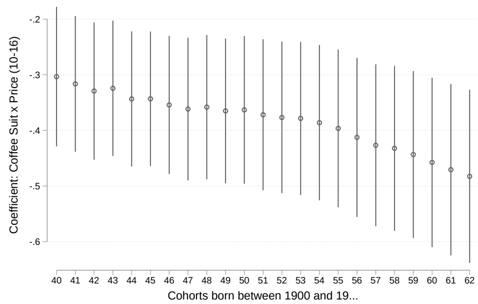
Note: This table presents the effect of coffee cultivation on structural transformation over the 20th century using a discrete value equal to 1 for counties with positive coffee production in 1920, 0 otherwise. Columns (1) (3) (5) and (7) instrument coffee cultivation using attainable coffee yields. Columns (2) (4) (6) and (8) instrument coffee cultivation using altitude, a dummy equal to one for counties above 2,400 meters of altitude (Altitude$> 2,400m$), and an interaction between both. All specifications control for population (log), gender fixed effects, distance to Department's capital, distance to second largest market, and Department fixed effects. Conley (1999) standard errors as described in section 4 in parenthesis. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

C.2 Sensitivity to Excluding Younger Cohorts

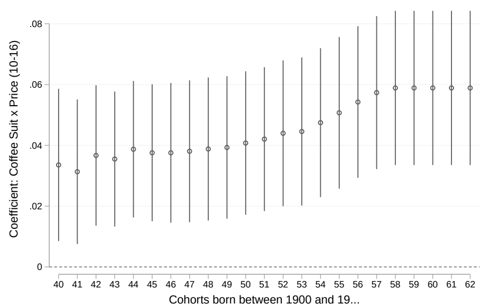
In order to test the sensibility of results to specific cohorts, I estimate results presented in Section 6.1 removing different cohorts a at a time. The following graphs show estimates of β from equation 5 including cohorts up to years depicted in the x-axis. The preferred specification includes cohorts between 1902 and 1052.

Figure 13: Sensitivity of results to different cohorts in sample

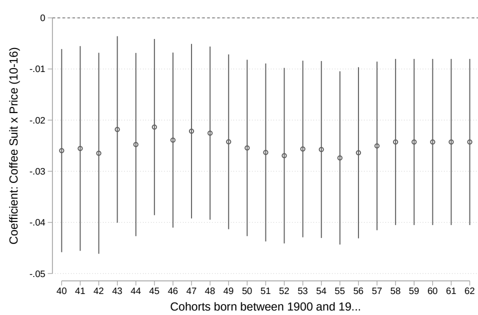
(a) Years of Schooling



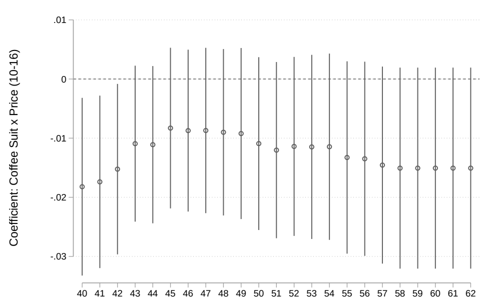
(b) Agriculture 1973



(c) Manufacturing 1973



(d) Labor force participation



Note: the scaling of the y-axis differs for all the figures.