Of Flower Blooms and Female Booms:

The Impact of The Flower Industry on Female Outcomes

Sara Hernández*

August 15, 2015

Abstract

This paper investigates the impact the growth of the fresh-cut flower industry had on the lives of Colombian women. My goal is to understand how flower shocks affect the timing of fertility and marriage decisions for women exposed to them during their adolescence. The empirical strategy exploits municipal variation in the geo-climatic suitability for floriculture together with time variation from the industry's growth. I find that girls exposed to the flower shocks are more likely to have initiated sexual activity, to be pregnant and married at younger ages. The results remain robust to different forms of shock aggregation, differential trends by municipality characteristics, accounting for migration, and geographically restricting the sample to the departments that concentrate flower production.

Keywords: Flower Exports, Colombia, Fertility, Marriage, Sexual Initiation

*I am extremely grateful to Esther Duflo her feedback and guidance. Special thanks to Frank Schilbach for all his comments and suggestions. Joel Yuen and Raissa Fábregas were avid proofreaders. Ana Bermúdez and Jorge Bermúdez provided expert insights into the Colombian flower industry. All errors are my own. PhD Candidate. Massachusetts Institute of Technology, Department of Economics. Email: sara_hdz@mit.edu

1 Introduction

The feminization of the labor force has been a shared phenomenon across many emerging economies. The incorporation of females into the labor market has often relied on the expansion of the manufacturing and agro-processing industries, spurred by international trade. Leading examples of this experience are found in the textile and garment industries of Bangladesh, the *maquilas* of México and the *dagongmei* in China. In the present context of growing global trade, the question of whether and how fertility timing outcomes respond to local employment shocks is of primary relevance for development economists.

This paper exploits the dramatic growth in the Colombian flower industry to evaluate the impact employment opportunities have on an array of events relating to the lives of Colombian women. The outcomes that I concentrate on are: initiation of sexual activity, first pregnancy and marriage. As mentioned, the labor shocks come from the Colombian flower industry, which emerged in the year 1965. The arrival of these flower jobs soon transformed the landscape of formal employment opportunities, particularly for women, offering them 'wages, security, and [a] sense of community' (Friedeman-Sánchez, 2006). It is also throughout this period that Colombia experienced a secular increase in the female labor force participation rate, going from 47 percent in the 1980s to 65 percent by 2006 (Amador et al, 2012).

For this study, I use several waves of the Demographic and Health Surveys (DHS) from 1986, 1990, 1995, 2000, 2005 and 2010. This allows me to construct a repeated cross-sectional sample of females born between 1952 and 1997. I then link their fertility and marriage outcomes with the municipality-level flower conditions while they were growing up.

Understanding the factors that affect whether a female will be sexually active, pregnant or married during her adolescence remains a pressing issue. Worldwide, about 16 million girls aged 15 to 19 give birth every year, and close to 1 million do so under 15 (WHO, 2014). The risks and consequences of adolescent pregnancies are acute: not only for the health of both infant and mother, but also for what they entail in economic terms. Females who begin motherhood at earlier ages "pay the highest wage penalty for childbearing" *(ibid)*, and girls who marry in their adolescence are likely to enter into adulthood in extremely unequal conditions (UNFPA, 2013). Postponing their first birth allows young women to continue investing in their education, work more and live independently later in life (Miller, 2005).

At the global level, the prevalence of pregnancies among girls less than 18 years of age has seen a slight decline over the past decades. Singularly, Latin America and the Caribbean have been the exception to that trend (UNFPA, 2013). In Colombia, there is evidence that the adolescent pregnancies are more likely to occur among the poor and uneducated (DHS, 2010). Thus, I hypothesize that the exposure to local employment shocks might affect the lives and choices of these young women, ultimately altering their exercise of agency.

In my setting, the exposure to the rose jobs will depend simultaneously on the interaction between two sources of variation: (i) being an adolescent in a municipality that is a flower producing center and (ii) the international market conditions for the flower exports. To address endogeneity concerns about the location of flower farms, I proceed with an instrumentation strategy that depends on geo-climatic conditions. This allows me to determine the suitability of a municipality to become a flower-producing center. With the aim to generate shocks to the value of flower exports, I incorporate the Colombian peso exchange rate into the 2SLS strategy.

In summary, I find that a 10% increase in the flower value results in a significant increase of 1.037 percentage points (pp) in the probability of sexual initiation by age 17 in flower suitable municipalities. In relative terms, this corresponds to a 2.16% more above the mean fraction of females who were sexually active by that age over the sample period—48.1% of them. The significant increase in the initiation of sexual activity is also found to be aligned with a positive impact on early childbearing. In particular, the 10% rise in the flower value leads to a differential increase of 0.598 percentage points in the probability of being pregnant for the first time by age 17. Considering that 21.5 percent of the females had been pregnant by that age, that corresponds to a 2.78% increase over the sample period. Their marriage[1] decision is also positively and significantly affected. The impact remains positive when the events are evaluated at the younger age of 15, albeit the pregnancy event becomes marginally significant.

My results remain robust to different forms of shock aggregation: I analyze export value changes that occur on a particular year, and also shocks that are aggregated across time, thus representing a finer form of total exposure to the industry. I also control for differential trends by municipality characteristics and regional, linear time trends. I show that the estimates are also consistent for the sample of females for whom I know their migration history. By tracking the municipalities in which they grew up, I can better determine the actual exposure to the flower industry. As a further check, I contrast the flower shocks on the sample of women who were migrants (and for whom the municipality of residence during their adolescence is unknown), and I find no significant impact. Last, I restrict my analysis to the two Departments[2] that concentrate flower production and the findings remain consistent.

The results emanating from the rose jobs offer a subtle picture on the impact that the expansion of export-oriented semi-industrial employment opportunities has had for women in the developing world. By examining how the timing of sexual initiation, childbearing and nuptiality change across cohorts in response to differential employment shocks, I provide new evidence of how the transition into marriage and first birth is being shaped by international trade forces. Remarkably, these modern factory-line type of jobs, the

[1] The definition for the marriage category includes any type of union: legal marriage and cohabitation.
[2] Departments in Colombia are autonomous country subdivisions. There are 32 departments, and each of them agglomerates multiple municipalities.

epitome of today's globalization, accelerated the timing of early sexual and reproductive events for females.

The remainder of the paper is organized as follows. In Section II, I describe the institutional context and the development of the flower industry in Colombia. In Section III, I provide an overview of the identification strategy. In Section IV, I describe the data, and Section V is devoted to presenting the estimation results. Finally, Section VI concludes.

2 Institutional Context

2.1 Fertility and Marriage Evolution in Colombia

Colombia is an Andean republic whose political stability in the last century was ghastly eroded by factional internal dissent. Its modern history has been characterized by political strife, arising from a three-way conflict between: the two leftist guerrilla groups, the Fuerzas Revolucionarias de Colombia (FARC, in its Spanish acronym) and Ejército de Liberación Nacional (ELN); the military, representing the government; and paramilitary groups.

Despite this geography of terror, Colombia saw profound transformations and steady economic development in the last half century: rapid urbanization, mass education and a rural exodus, amidst the major ones (Rosero-Bixby et al, 2009). Amador et al (2012) add the dramatic change in female participation as another force reshaping the Colombian economic landscape. In their findings, it is worth mentioning that the groups that exhibited the highest increases in participation are women with children younger than 18, married women, and women with low educational attainment.

For this study, the nature of the outcomes of interest relates to the timing of sexual initiation, first pregnancy and first union. I begin with a graphical representation of these trends in Figure 1. First, in Figure 1a, I look at the fraction of females who have been sexually active and pregnant by age 15, separately. The sexual initiation and the first birth probabilities, as of age 15, remained remarkably stable from the early 1950s into the late 1960s, and saw a gradual increase thereafter. In the same graph, I also identify 1952, since females born this year will reach their fertile age (age 13) in 1965, which marks the first Colombian shipment of fresh-cut roses to the US. Thus, cohorts born after 1952 came into a world where roses offered a promising source of employment. Second, in Figure 1b, I graph the average number of children and the average age for sexual initiation by birth cohort.[3] The tendency in these two events is clear: the decline in the age of sexual debut was also accompanied by a decline in the average number of children.

In the context of a galloping economy, it is remarkable that the fraction of adolescent pregnancies (first

[3] To compute this statistic I condition the sample to females who are at least 25 years of age on the survey year. This covers the 90th percentile for the first pregnancy.

birth as of age 15) is increasing. Bozon et al (2009) have termed the absence of a trend toward delayed childbearing as yet another "Latin American paradox". One the one hand, the economic stability arising from the access to new employment opportunities might motivate young females to become early mothers via income effects. On the other hand, the present job opportunities and work requirements simultaneously raise the direct and opportunity costs of becoming pregnant, and females might opt to delay motherhood. Not only that, in a country that is deeply Roman Catholic, and where pregnancy is almost a universal event for females, early motherhood might still be regarded as a deeply rooted social imperative. I will elaborate on the channels between a blooming flower industry and their effect on fertility in the next section.

2.2 Related Literature

Recognizing that female empowerment and economic development stand in a symbiotic relationship (Duflo, 2012), a body of literature has investigated the correspondence between the expansion of female opportunities via the labor force and fertility and nuptiality outcomes. Schultz (1985) was one of the pioneer studies showing how economic opportunities for females can trigger a fertility transition. His analysis of the 19th century Swedish economy relies on variation in the relative wages for women versus men. Following a change in world prices of butter relative to grains, he finds that the higher female relative wages exerted a depressing effect on birth rates at all ages, except among teenagers—defined as the group between 15 to 19 years old.

More recently, Heath and Mobarak (2015) study the impact of the Bangladeshi ready-made garment industry on women. In the context of the Bangladeshi case, the garment jobs are giving females the opportunity to enter an alternative transition period, away from the traditional path of childhood to motherhood (Amin et al, 2012). Using a random sample of garment-proximate and non-garment proximate villages, Heath and Mobarak (2015) find that girls exposed to the garment sector indeed avoid early marriage and delay childbirth.

A similar experience is found with the working girls, *dagongmei*, in the Chinese industrial towns. As described by Pun (2005), these workers are women in their late adolescence who migrate from their rural homes to the urban factory centers for a transient period of time. This allows them to delay marriage, and consequently childbirth, slowly abrading the societal and familial norms to marry early.

In Mexico, Atkin (2009) analyses how the *maquila* women induced to work in the export manufacturing industry have significantly taller children. The arrival of the employment opportunities for females did much more than to raise their incomes and outside options, ultimately strengthening their bargaining power. Interestingly, these females do not seem to be any more likely to have more children or get married at earlier ages. Contrary to this, and exploiting the time variation of the local employment shocks on a yearly level, I find results that affect the timing of the fertility events in the Colombian case.

Majlesi (2015) further exploits the Mexican *maquila* and the heterogeneity in the demand for female versus male labor across different export industries. His results suggest that the increased local labor opportunities for females (in relative terms) led to an improvement in their bargaining position and increased their decision-making power within the household. In a parallel *maquila* study, Antman (2014) also finds a positive relationship between the female work status and her involvement in the household decision-making process. It should be mentioned that these studies analyze the impact of improving labor opportunities for females on intra-household outcomes and human capital investments. They do not focus on the timing of the events that led to the household formation in the first place—I understand the marriage and pregnancy decisions to be a precursor to both intra-household bargaining and human capital investments for the children, respectively.

In India, Jensen (2012) randomly offered recruiting services to help young girls get jobs in the booming business process outsourcing (BPO) industry. He finds that women in the treatment villages are less likely to get married and have children during the period of the intervention. Noticeably, the increased awareness of and access to the BPO jobs was sufficient to generate these responses. Sivasankaran (2014) exploits another dimension of female employment: the variation in work duration. Using a natural experiment at a large South-Indian textile firm, she finds that the more time women were exposed to a fixed-term contract, the longer they stayed in the formal labor market. An immediate consequence of the longer working spell is that these women delay marriage, and also report having a lower desired fertility.

In previous work in the Colombian flower industry, Hernández (2015) shows an increase in the completion rate of secondary education in response to the flower jobs, and a parallel decrease in the levels of unorganized violence experienced in the flower suitable municipalities. There are a number of channels through which the blooming rose industry may have affected the fertility timing. First, the flower exports brought along stable, secure and permanent income earning opportunities, particularly for women. If children are normal goods, in principle, this should lead to increases in the demand for children, via income effects. This procyclical pattern of fertility has been documented in the literature (see Holtz, Klerman, and Willis, 1997). This could also happen if females have an intrinsic desire (shaped by social and religious norms) to be early mothers, but were lacking the financial security and stability to do so. Alternatively, if there is any social stigma associated with early pregnancy, the increased employment opportunities might grant them the economic resources to act independently. Setting aside the quality-quantity tradeoff present in the fertility dynamics, the increased flower opportunities may have further accelerated motherhood if skill deterioration could occur during pregnancy or childrearing absences (Dehejia and LLeras-Muney, 2004).

As mentioned, one of the most prominent features of the flower employment has been its feature of permanence. Females assess the current flower conditions, as well as the accumulated past performance of the industry, particularly as they were reaching the legal working age. This is important because the cumulative measure of flower performance serves as a proxy to capture the level of future uncertainty in employment. Thus, booming periods may indirectly affect the perception of present and future economic stability, and this could in turn incentivize motherhood.

Nevertheless, the evidence cited from the aforementioned studies suggests that women may use their actual, or potential, work status to forge independence with which to delay marriage and childbirth. Higher female wage rates imply a higher cost of female time, leading to an opposing substitution effect, which should have delayed the childbearing timing. In the end, whether the timing of initiation into sexual activity, nuptiality, and fertility respond to local employment shocks, and in what direction, remains an empirical question.

2.3 The Flower Industry

In spite of the conflict that engulfed Colombia, successive government administrations directed their efforts to promote economic growth as a means of achieving a more peaceful society. Since the 1960s, attention was concentrated on diversifying Colombian exports, which at the time were highly dominated and dependent on coffee. These initiatives were concomitant with the "Alliance for Progress", a program initiated by the Kennedy administration in 1961 with the intention of maintaining and reinforcing stability in the broader, if mercurial, Andean region.

In the year 1964, the publication of a graduate thesis study at Colorado State University identified Colombian farmland as highly substitutable with American farmland (Colombian Ministry of Agriculture and Rural Development, 2008). The country presented favorable climatic conditions, soil quality, and labor was abundantly available. Given its proximity to the US market (through the Miami port of entry) as well as lower production costs, Colombia constituted an attractive investment destination for flower entrepreneurs, who were quick to take advantage of the opportunity to relocate.

By the early 1980s, fifteen years after the first flower shipment was sent to the US, Colombia had already become the second largest world exporter of fresh-cut flowers (Méndez, 1991). The industry was a major employer of female labor from the low-income areas in the regions surrounding the Sabana de Bogotá and Antioquia. The World Bank reported that the flower industry was "a textbook story of how a market economy works" (*ibid).* Except for a decline starting in calendar year 1995, the rose exports grew continuously since the inception of the industry. Towards the end of 1994, the industry was negatively affected by an American anti-dumping ruling, vehemently fought by the Californian flower growers. This protectionist measure brought a lot of uncertainty to the Colombian growers; it also sent their exports into a sluggish period, which lasted for approximately a quinquennium. The episode was registered in the popular press: "companies that produce roses in Colombia could go out of business if the measure is upheld; that would put out of work thousands of poor women who make up 80% of the labor force in the industry" (Ambrus, 1994).[4]

The major sources of production costs sector were, and remain: labor, the availability of specialized transportation, and cold storage technologies. Urrutia (1985) calculated that the low daily wage for production workers in 1966, together with the less capital-intensive production, process gave Colombia cost advantages that were instrumental for the successful establishment of the industry.[5]

Within the flower farms, the entire production process is highly labor-intensive and resembles the modern assembly-line factories. Flowers require labor at every stage of production and the delicacy of the product itself leaves very "little room for mechanization" (Friedemann-Sánchez, 2006). On a given farm, each woman is responsible for the care of approximately 12,000 plants across dozens of flower beds. There are close to 28 tasks that need to be performed on each plant (*ibid)*, making it a rather laborious activity.

The entry-level workers, *operarias*, get permanent contracts, earn the government-specified minimum salary, and enjoy other legally mandated employment benefits, including contributions to the Social Security pension funds and to the National Health Insurance Plans. Two other types of workers can be found on the farms: monitors of plant diseases and supervisors. Both of them are paid above the minimum salary, a compensation that is a direct reflection of the higher required skills and derived responsibilities involved. The seasonality of US demand also leads to foreseeable temporary labor contracts within a given year. In particular, in order to meet "the demand levels for Mother's Day and Valentine's Day" Colombian growers have to "hire additional seasonal employees" (Figueroa et al, 2013).

At this point, it is critical to acknowledge the stability of employment, for "jobs in the industry are so stable that working in the fresh cut-flower industry is becoming a métier" (*ibid).* The permanence trait of employment can be seen in the following figures: on average, women remain employed at a given flower farm for 5 years, and they stay 15 years within the industry—rotation of workers among flower farms being a common phenomenon.[6] The alternatives for females outside the flower farms are scarce and lean towards informality. They often entail lower wages and lack the added legal and social security benefits.

In terms of the gender component, women constitute over 60 percent of the floriculture workforce (Census,

[4]Steven Ambrus. "International Business : U.S. Ruling a Thorn in Colombian Rose Growers' Side : Trade: Commerce Department decision imposes punitive anti-dumping levies". Los Angeles Times, October 20, 1994. Accessed June 17, 2015. http://articles.latimes.com/1994-10-20/business/fi-52664_1_colombian-rose

[5]In Colombia, greenhouses can be constructed with relatively cheaper materials like wood and plastic. In many instances, no heating or cooling mechanisms are needed given the natural growing conditions. This helps to reduce production costs and increase the profitability margin.

[6]Based on information gathered by the Colombian Association of Flower Producers (Asocolflores) from its members. Private correspondence with Asocolflores.

2005). Moreover, flower jobs represent 25 percent of rural employment for women (Ministry of Agriculture and Rural Development, 2008). Anthropologists have accentuated the fragility and perishability of flower production as a rationale behind the industry being female intensive. This argument falls within the "*nimble fingers*" discourse (Elson and Pearson, 1981):

> 'Women work in the Colombian flower industry according to a strict gendered division of labor. They attend to all activities required in cultivation, such as planting, fertilizing, cutting, classifying, and bunching flowers together, while men are hired to apply pesticides, maintain the greenhouse structures, and transport the flowers to Bogotá's international airport' (Talcott, 2004).

Friedemann-Sánchez (2006) notes that this division is often grounded on the assumptions that "equate production imperatives of quality, consistency, and speed with ostensibly feminine traits of dexterity, conscientiousness, and aversion to unrest".

2.4 Flower Production 101

As discussed in the first chapter of this dissertation, "Guns N' Roses: The Impact of Female Employment Opportunities on Violence in Colombia", flowers call for very particular climatic requirements to bloom. I will incorporate this optimal range of temperatures, 13 to 24 Celsius, to my empirical strategy.

As of 2007, and for the entirety of the Colombian territory, there were 142 municipalities growing flowers (out of 1,120). Across these municipalities, there were 2,113 farms (*fincas*), cultivating a total of 7,849 hectares. The average number of hectares per flower municipality was 65.7, with a standard deviation of 141.6.

The pooled DHS waves, however, only covered a subsample of the Colombian territory, surveying a total of 446 municipalities. Out of these 446, 77 are flower producing. The average flower municipality in the DHS cultivates 74 hectares. Using the estimates from the 2005 Census and data on employment by Major Industry Sector, each flower hectare generated employment for approximately 25 people. As such, the average flower-municipality in the DHS sample would employ nearly 1,850 people.

A graphical display of the distribution of flower farms is presented in Figure 3. This graph identifies the distribution of flower farms for the sample of municipalities that were surveyed in subsequent DHS waves (1986 to 2010). The flower municipalities are those municipalities in which there were flower farms in operation as of the year 2007.[7]

[7] Data on the timeline of municipalities becoming flower-producing centers, and the evolution of hectares cultivated per municipality, is unfortunately unavailable.

3 Empirical Strategy

My empirical strategy uses the growth in the national value of flower production and the geographical distribution of flower farms to proxy for the generation of agro-industrial employment opportunities at the local level. Using a difference-in-difference specification, I assess whether changes in the value of the flower exports affect the timing of a series of outcomes, including initiation to sexual activity, pregnancy[8] and marriage. I am interested in the impact that the shocks have at different stages of adolescent development: early adolescence, corresponding to ages 10 to 14; middle adolescence, encompassing ages 15-16; and late adolescence, covering approximately 17-21 years of age (Spano, 2004).

I assess whether the likelihood of a particular fertility-related event, occurring by age a, is differentially affected by the export shocks in the municipalities that are flower suitable. For that purpose, I construct dichotomous dependent variables that evaluate these outcomes at different relevant ages, from age 13 to 25.

The employment shocks are proxied with the national value of flower exports from Colombia to the US market (total dollar value of exports, adjusted by an export price index).[9] I chose to concentrate on the bilateral trade relationships between Colombia and the US for several reasons. First, Colombian growers enjoy a high degree of exclusivity in the US market. This is partly because of the proximity between the two countries and partly due to the perishability of the good being traded. Second, more distant destinations are logistically less feasible and less profitable, due to higher transportation costs and the rapid decay in the product's quality.[10] Third, Colombian domestic consumption of flowers is, at best, residual when compared to the volume exported abroad.

I proceed to estimate how cohort fertility-related events vary with: (i) shocks to the value of the flower industry and (ii) the presence of flower farms. For notation purposes, the impact of the flower industry is constructed at the level of the municipality of residence m, birth cohort c, the year t, in which the females turn age a:

$$Flower\ Presence_m \times ln(Export\,Value\ at\ Age\ a_{\ t})$$

$Flower_m$ is a dummy variable for whether municipality m cultivates flowers or not. I interact it with the (log) national value of exports on the calendar year t, in which the cohort c turns age a, $Export\ Value\ at\ Age_t$. This leads me to my first equation of interest, Equation (1):

$$pregnant_{i,m,c,t} = \beta Flower_m \times ln(Value_t) + \lambda_m + \lambda_c + \sum_{t=1952}^{1990} [\mathbf{X}_m d_t]\rho_{m,t} + \varphi_d \times t + \epsilon_{i,m,c,t} \qquad (1)$$

[8]Throughout the analysis I use the timing of the first pregnancy (inception) as the relevant outcome of interest, not the timing of the first birth (delivery).

[9]Alternative measures for flower performance include the volume of production (flower stems exported).

[10]Once cut, flowers are highly perishable. Roses last 3 to 5 days, carnations 7 to 19 days. The perishability used to be the principal determinant of the location of cut flower production in the US prior to 1950. Development of reliable air transportation freed this constraint (Méndez, 1991).

where $pregnant_{i,m,c,t}$ refers to whether female i, residing in municipality m, born in cohort year c, is pregnant by year t, in which she turned age a.[11]

Notice that the age a, at which I evaluate whether a female has been pregnant or not, is a linear combination of the birth year c and the calendar year t in which I observer her. The coefficients λ_m and λ_c represent municipality and cohort of birth fixed effects. Next, I generate a vector of differential trends by municipality characteristics. For that, I interact year dummy variables with a host of municipal-level covariates, $\mathbf{X}_m$, including: the distance to the closest international airport (Bogotá or Medellín) and a rurality index (to gauge at the level of rural versus urban development). I also add linear time trends defined at the department level, $\varphi_d \times t$. Other outcome variables include: the initiation to sexual activity, $sexually\ active_{i,m,c,t}$, and being married, $married_{i,m,c,t}$, by age a.

The coefficient β accompanies the main regressor of interest. It captures the differential impact that flower exports had on the likelihood that a female was pregnant for the first time by age a in a flower municipality as compared to a non-flower one. Given that the value of exports does not vary by region, the identification strategy relies on the interaction between the national performance of the flower industry on a particular year and the flower status of a municipality. Thus, the interpretation of the coefficients is equivalent to assuming that the number of flower jobs in each flower municipality grew at the nationwide annual export rate. Unfortunately, data is not available to measure the growth of hectares over time, making the proxy for the national expansion of the industry a reasonable, if not sole, alternative.

Equation (1) assesses the impact of the shock on a particular year, $Export\ Value_t$, but it is limited, since it does not reflect the immediate accumulated performance of the flower industry. A more nuanced approach would take into consideration a measure of total exposure, where the aggregation is carried over relevant ages. I thus construct an alternative, cumulative measure aggregating the value of flower exports from the year a cohort turns age 10 to the year when they turn age a, the later being the age at which the fertility event is evaluated.

I chose age 10 as a lower bound in order to account for the age of menarche—this is important, considering that the age for first pregnancy is among my main outcomes of interest. Alternative aggregation measures (from age 6, or age 13) lead to similar estimates, and will be shown in the Appendix. With the cumulative exposure to flower shocks, the regression of interest now takes the following form:

$$pregnant_{i,m,c,t} = \beta Flower_m \times ln(\sum_{\tau=0}^{a-10} Value_{t-\tau}) + \lambda_m + \lambda_c + \sum_{t=1952}^{1990} [\mathbf{X}_m d_t]\rho_{m,t} + \varphi_d \times t + \epsilon_{i,m,c,t} \qquad (2)$$

[11]The pregnancy variable is constructed for each age category a, cohort c, on calendar year t as:

$$Pregnant\ by\ age\ a = \mathbb{1}\{Age\ at\ Inception\ \geq t - c\}$$

In Equation (2), I assess if the exposure to the flower industry from age 10 might have affected the fertility event by age a, where $a \geq 13$. A negative β coefficient implies that childbearing shifted to later ages in response to a burgeoning flower industry.

Because of the potential endogeneity of the location of flower farms, I exploit the natural geo-climatic flower suitability at the municipality level. I proceed with an instrumental variable strategy that I now describe. First, I consider the discontinuity *coolness,* measured by temperatures that are in the range of 13 to 24 degrees Celsius. This criterion allows me to determine the likelihood that a municipality meets the optimal conditions to grow flowers (extensive margin), as well as the number of hectares that it would cultivate (intensive margin). Equation (3) below captures this suitability regression:

$$Flower_m = \gamma_o + \gamma_1 \times coolness_m + \epsilon_m \tag{3}$$

Next, in Equation (4) I present the corresponding first-stage regression. I incorporate the *coolness* criterion without instrumenting for the temporal variation in flower exports. Below is this initial version:

$$\begin{aligned} Flower_m \times ln(\sum_{\tau=0}^{a-10} Export\,Value_{t-\tau}) &= \delta coolness_m \times ln(\sum_{\tau=0}^{a-10} Export\,Value_{t-\tau}) \\ &+\psi_m + \psi_t + \sum_{t=1952}^{1990} [\mathbf{X}_m d_t]\theta_{m,t} + \phi_d \times t + \nu_{m,t} \end{aligned} \tag{4}$$

In order to address concerns about the influence of certain flower-growing regions over the total value of the flower exports, I bring the exchange rate of the Colombian peso to the US dollar. This strategy relies on the theory that a depreciated Colombian peso should spur Colombian exports and the production of Colombian flowers. Indeed, peso depreciations have been found to do so, as reported in the popular US press: a "weak peso waters Colombia's garden" (Molinski, 2014).[12] This alternative first-stage is presented in Equation (5):

$$\begin{aligned} Flower_m \times ln\left(\sum_{\tau=0}^{a-10} Export\,Value_{t-\tau}\right) &= \delta coolness_m \times ln\left(\frac{\sum_{\tau=0}^{a-10} Peso\,Exchange\,Rate_{t-\tau}}{a-10}\right) \\ &+\psi_m + \psi_t + \sum_{t=1952}^{1990} [\mathbf{X}_m d_t]\theta_{m,t} + \phi_d \times t + \nu_{m,t} \end{aligned} \tag{5}$$

Although Colombian flower exports dominate the US flower market, they only represent 2% of the total value of all goods the country exports: crude and refined petroleum, coal, gold and coffee, combined, add up to 72 percent of the value exported.[13]

[12]Molinski, Dan. "Weak Peso Waters Colombia's Garden". The Wall Street Journal. March 17th, 2014. Accessed on May 15th, 2015. http://www.wsj.com/articles/SB10001424052702303546204579439813904252966

[13]Observatory of Economic Complexity. Colombian Case. Accessed on June 15th, 2015: https://atlas.media.mit.edu/en/profile/hs/0603/

4 Data

4.1 Data Sources

For this study, I obtained the data on the female outcomes from the Colombian Demographic Health Surveys (DHS). The waves that I use belong to the years 1986 (DHS-I), 1990 (DHS-II), 1995 (DHS-III), 2000 (DHS-IV), 2005 (DHS-V) and 2010 (DHS-VI). The DHS surveyed a subsample of all Colombian municipalities, covering 446 municipalities out of the existing 1,120. Taking into account that the industry was born in the year 1965, and that the first fertile age category of interest is age 13, I concentrate on all cohorts born after 1952 as potentially having seen their sexual initiation, first pregnancy and first marriage affected by the flower shocks. My sample is thus made of 115,824 females born between 1952 and 1993.[14]

The DHS surveys are divided into several sections. For this analysis, I extract all the outcomes from the *Individual Recode* questionnaire, which covers detailed information about fertility-related events for all females aged 13 to 50 years old that are residing in the household. Females are asked about the age at which the first intercourse took place, the age for the first pregnancy and the age for the first union/marriage. I can then construct their individual histories for being sexually active, pregnant or married from the answers to those questions.

The questionnaire identifies the municipality of current residence. In addition to that, it also covers questions for migration spells—years lived in place of residence. This allows me to identify the females that were already residing in their current location before the age of 10. Migrants are then defined as those females who moved to their current municipality of residence older than the age of 10. This is important because I will later conduct a separate analysis contrasting the subsample of residents and migrants.

The data to identify the geographic distribution of flower farms comes from a government registry, publicly released by the Agriculture and Rural Development Ministry.[15] This cross-sectional snapshot is from a year relatively late in the sample, 2007. As such, the instrumentation for the location of flower farms becomes crucial. The public registry identifies the geographic location (municipality) of the farms as well as the size in hectares. The size variable is further broken into hectares cultivated with flowers and foliage. I categorize a municipality as having the flower status, $flower\ status_m$, if it has, at least, one flower farm cultivating a positive number of hectares, $flower\ hectares_m > 0$.

To measure the performance of the flower industry, I use three other sources. First, the UN ComTrade portal has data available for the volume and value of Colombian exports to the world. Second, the US Food

[14] I restrict the sample to females who are at least 17 years old on the survey year. The last DHS wave is from the survey year 2010, hence I can track outcomes for cohorts born up to 1993.

[15] Flower farms had to be registered for an agricultural program*: Incentivo sanitario a las flores y follaje (ISFF),* in its Spanish acronym.

and Agricultural Service (FAS)[16] has detailed volume and value information for Colombian exports coming to the US market, expanding a longer period of time than its UN counterpart. Last, there is the work put together by Marín and Rangel (2000), which combines the yearly bulletins published by the Colombian Association of Flower Growers (Asocolflores) on several production aggregates. From all sources, I retrieve the level and value of production whenever available—always measured at the national level. Since I chose to concentrate on the bilateral trade between Colombia and the US, the analysis will use the data retrieved from the Food and Agricultural Service (FAS) administration.

I should mention that, in the context of the flower markets, an international price or flower index does not exist. Given this situation, the own production decisions of Colombian growers directly influence the value that their flower exports attain in the US market. I will address the concerns about the own determination of the Colombian export value incorporating the Colombian peso exchange rate (deflated number of Colombian pesos per US dollar). The exchange rate series comes from the Colombian Central Bank, Banco de la República.

4.2 Descriptive Statistics

Table 1 presents the summary statistics for the sample of interest. In *Panel A,* I describe the individual-level characteristics by flower versus non-flower municipalities. The cohorts I study were born between 1952 and 1993. The average female in my sample is approximately 31 years old, she had her first sexual intercourse at the age of 18, was married by the age of 20 and had her first baby one year after that, by the age of 21.[17]

By age 15, approximately one quarter (24.0 percent) of the females had become sexually active; that fraction increases to 48.1 percent by age 17. This is important because an early sexual initiation might lead to an early pregnancy: whereas only 7.2 percent of females were pregnant for the first time by age 15, that figure had increased to 21.5 percent by age 17. That represents a dramatic 200 percent increase. Similarly, around 9 percent of the females in the sample had entered their first union by age 15, and 21.7 percent of them had done so by age 17. The sexual debut, first birth and first union probabilities are higher in the non-flower municipalities as compared to the flower ones.

To help visualize these numbers, in Figure 1a, I look at the evolution of the fraction of females who have been pregnant by age 15. Here I distinguish two clear periods: (i) spanning the decades 1950s and 1960s, and (ii) from 1970 onwards. As it can be seen, for the cohorts born between 1950 and the end of the 1960s decade, the fraction of females who had been pregnant by age 15 remained considerably stable at approximately 6%. Noticeably, starting with the cohorts born in the 1970s, that fraction begins to rise: by

[16] Foreign Agriculture Service, Global Agricultural Trade System (GATS), code 0795AT – fresh cut flowers.
[17] This statistic is computed imposing the restriction that the individual be at least 25 years old on the survey year. This represents the 90th percentile for the age of first pregnancy.

1985, 9.19% of females had been pregnant for the first time by age 15—a 50 percent increase.

Understanding the forces behind the timing of these events, particularly for females going through their middle adolescence (15-16) and late adolescence years (17-19), is critical to this study. With that aim, I have plotted the trends by flower suitability in Figure 2. I show the average age for sexual debut, first pregnancy, and marriage across cohorts and flower-suitable versus unsuitable municipalities from 1940 to 1985.[18] Noticeably, a strikingly similar pattern is observed across all three events: the series remain remarkably stable for the cohorts born between 1940 and 1970, and the average ages start declining after that. The early cohorts in my sample, born in the decade of the 1950s, became sexually active approximately at age 19, and were pregnant for the first time at age 22. For the later cohorts, born in the 1980s, the average age for sexual initiation had fallen to 17, and the first pregnancy happened by age 20. This corresponds to a decline of -10.5% in the sexual initiation age, as well as decline of -9.70% for the age of first pregnancy, over the course of three decades.

Continuing in Table 1, *Panel A*, 32.5 percent of the females reside in flower municipalities. Moreover, 47.2 percent migrated to the municipality where they currently reside—migration is defined as having arrived to the current municipality after the age of 10.

In the second panel of Table 1, *Panel B*, I present the municipality-level characteristics. The DHS waves covered a total of 446 municipalities. The average flower municipality in the sample cultivates approximately 74 hectares and has 17.3 flower firms operating. The geographic distribution of these municipalities can be seen in Figure 3. Two administrative departments[19] concentrate 84 percent of flower hectares: Cundinamarca and Antioquia. For a later robustness analysis it will be useful to keep in mind this geographic subsample, which is also home to 11 percent of the females interviewed. Appendix Figure A.1 shows the subsample of DHS municipalities that lie within Cundinamarca and Antioquia, displaying their flower status.

Flower municipalities are closer to the capital of the administrative department, the main market centre of the region, as well as Bogotá. These metrics are aligned with the logistics of the flower industry but they also speak about the degree of economic development of flower and non-flower nuclei. In terms of other agricultural commodities, both flower and non-flower municipalities cultivate coffee, with the former doing so more intensively. The presence of coal and gold mines is very similar across them, and non-flower municipalities have a greater presence of petrol reserves. I will interact these municipality covariates with year dummies and incorporate them to my regressions, as an attempt to capture differential trends by these characteristics. I will also add linear time trends defined at the department level.

[18] Again, in order to avoid censoring issues when computing the average age for sexual initiation and average age for first pregnancy, I condition on females being at least 25 years old in the survey year. Thus, the last birth cohort that I can measure at age 25 was born in 1985.

[19] An autonomous subdivision of the Colombian territory, higher than the municipality level

Last, *Panel C* of Table 1 presents the annual-level performance of the flower industry. I track the evolution of flower exports in terms of the level of production (stems) and the export value (millions of US dollars, deflated by an export price index) from the year 1965 to 2010. On average, the industry grew annually at a rate of 28.9 percent in value and 25.7 percent in volume. The evolution over time for the value and volume series is shown in Figure 4a. The volume and value series track each other strongly. In Figure 4b, I overlap the Colombian peso exchange rate, since the later series will constitute the basis of the instrumentation strategy. The exchange rate series closely traces the evolution of the value of exports up to the second half of the 1990s decade. As a reminder, the year 1995 marked the beginning of a somber period for the flower industry, when the US Commerce Department imposed punitive anti-dumping levies on Colombian flower producers. Since the beginning of the 2000s decade, the export value and exchange rate series became mirror images of each other.

Last, Table 2 provides summary statistics of some key differences between flower and non-flower municipalities before the takeoff of the flower industry (1965). I show the fertility outcomes for cohorts born between 1940 and 1950. Although the sample is very reduced, females in the flower industries show evidence of delayed fertility-related choices: they are slightly older at the age of sexual debut, first union and first birth; they also have a smaller number of total children. The sexual initiation, first birth and first marriage probabilities, as of age 15 and age 17, are also lower for the flower cohorts.

5 Results

I begin with the suitability assessment in Table 3, following the regression specified in Equation (3). This regression was meant to evaluate the geo-climatic suitability of a municipality to become a flower-producing center. The main regressor of interest is the *coolness* requirement. Broadly speaking, *coolness* refers to whether a municipality has a temperate climate. This is represented by an average annual temperature that lies in the range of 13 to 24 Celsius. In Columns (1) and (3), I show that *coolness* significantly affects the likelihood that the industry will take off in the municipality, as well as the number of hectares.

I consider alternative temperature requirements in Columns (2) and (4). These include: the regressor *hot*, which captures average annual temperatures above 24 Celsius, and the regressor *cold,* for average annual temperatures below 13 Celsius. Both *hot* and *cold* negatively affect the flower suitability, suggesting that more extreme climates are not flower suitable. In the companion Appendix Table A.1, the suitability regression is ran on the entire universe of Colombian municipalities, showing that the significance of the *coolness* requirement remains robust. For the remaining of the analysis, I will focus on the extensive margin of cultivation, using the flower status of a municipality.

5.1 Reduced Form Evidence

Next, I show the reduced-form relationship between the flower shocks and the timing of the different fertility-related outcomes. For that, I interact the flower suitability, *coolness*, of a municipality with a full set of year-of-birth dummies, and I proceed to regress the probability of the fertility-related *event* happening by age a on these interaction terms, always controlling for year-of-birth and municipality fixed effects. In other words, I run the following regression, Equation (6):

$$\textit{Pregnant by Age } a_{i,m,c,t} = \alpha + \textit{Coolness}_m \times \sum_{c=1952}^{1993} \beta_c d_c + \gamma_m + \lambda_c + \epsilon_{i,m,c,t} \tag{6}$$

The coefficients β_c from these interactions are graphed in Figure 5. I have chosen to display the flower-year coefficient interactions for the dependent variable "being pregnant". The pregnancy event is evaluated at the ages of 15 (top figure) and 17 (bottom figure). To aide the interpretation of the results, I overlay the value of Colombian flower exports on the year in which each birth cohort turns age a (where age a is either 15 or 17).

These two figures present the first suggestive evidence of the reduced form relationship between the flower shocks and the timing of the fertility-related events. In Figure 5a, the reduced-form interactions on pregnancy by age 15 remain considerably stable and oscillate around zero for cohorts born between 1950 to 1970; thereafter, they show a positive tendency. In Figure 5b, I evaluate the pregnancy event by age 17. Noticeably, the relationship between the flower shocks and the likelihood of first pregnancy remains considerably stable for the birth cohorts spanning the 1950s-1970s, and show a positive, if timid, trend after that.[20]

5.2 Sexual Initiation, Pregnancy and Marriage

Now I present the 2SLS regressions. First, Table 4 shows the first-stage coefficients as specified in Equation (5). The dependent variable for the first-stage is made of the interaction between the flower status of a municipality and the national performance of the flower industry. As discussed earlier, I have chosen two measures of performance: (i) the export value of flowers on the year in which the relevant cohort turns age a; (ii) the cumulative export value from the year in which a cohort turns age 10 to the age of interest a. The later cumulative value is meant to capture the total exposure from the potential onset of menarche.

To generate shocks to the value of Colombian exports, I use two instruments, each of them specific to the shock being analyzed. First, to instrument the (log) value of exports on a particular year, I use the (log) exchange rate of Colombian pesos to the US dollar on that same year. Alternatively, to instrument

[20] Both graphs in Figures 5a and 5b have the same scale to ease the visualization of the RF flower-year interactions.

the cumulative value, I compute the (log) average exchange rate prevailing during the relevant years that are being added. As explained, the flower status of a municipality will be instrumented via the *coolness* non-linear criterion.

In Table 4, Columns (1) and (2) show the first-stage for the year shocks on age 15 and age 17, respectively. In Columns (3) and (4) I present the cumulative measure of performance by age 15 and age 17. As it can be seen across all four results, the interaction of the *coolness* criterion and the exchange rate significantly affects the growth in the value of flower exports. The first-stage result reported in Column (1) suggests that a 10 percent increase in the Colombian peso exchange rate (which results in a depreciation of the peso) significantly increases the value of Colombian flower exports on that particular year by 1.09 percent (log on log) on flower suitable municipalities. The positive coefficients are aligned with the standard international trade theory, whereby a depreciated peso should encourage US consumers to purchase Colombian flowers. The coefficients remain statistically significant and positive across both age categories and the two measures of performance. Despite the instrument being highly significant, the associated F-statistic is only above the threshold of 10, as discussed by Staiger and Stock (1997), when using the aggregate measure of flower performance, in Column (2).

Having established the basis for the first-stage, I continue to present the main set of 2SLS results on Table 5 and 6, following the regressions in Equations (1) and (2), respectively. I analyze the differential impact of shocks to the flower industry on three outcomes of interest: (i) sexual initiation, (ii) being pregnant, and (ii) being married for the first time by a particular age a, where $a \in [13, 25]$. I have chosen to restrict the analysis to the age range 13 to 25 with the aim to cover both the age when females begin menstruating and the age when adolescence can be considered finished. For the sake of clarity, I reports the impact of the flower shocks at two ages: age 15 (*Panel* A) and age 17 (*Panel B*).

Table 5 shows the year-shocks, whereas Table 6 presents the cumulative measure of performance. I have already explained that the later is an alternative measure aiming to capture the total exposure to the flower industry, aggregated from age 10 to age 15, or to age 17, respectively. I first report the OLS estimates on sexual initiation, pregnancy and marriage in Columns (1), (4) and (7), respectively. The OLS coefficients show that an increase in the value of Colombian flower exports is positively associated with the likelihood that a female is sexually active, pregnant or married by ages 15 and 17.

Going back to Table 5, note that for each of the two age categories (15 and 17) and each outcome, I present the base 2SLS coefficients for the (log) year shock in Columns (2), (5), and (8). The base specification always incorporates municipality and cohort fixed effects. I then build on the base specification, incorporating differential trends by municipality characteristics in Columns (3), (6) and (9). I begin the IV analysis with the sexual initiation event. In Columns (2) and (3), it can be seen that the flower shocks significantly increased the probability that a cohort would have had sexual intercourse by age 15, and also by age 17, differentially in flower suitable municipalities. The 2SLS are all positive, statistically significant and of a higher order of magnitude than the corresponding OLS counterparts. The coefficient of 0.0682 in *Panel A*-Column (3) suggests that a 10 percent increase in the value of Colombian exports on the year in which a female turns age 15 leads to an approximate differential increase of 0.6820 percentage points (pp) in the probability of being sexually active. This translates to an increase of 2.81 % more above the mean probability over the sample period, which stands at 0.24 (24.0 percent of females in the sample have had sexual intercourse by age 15). If I assess the impact on the probability of being sexually active by age 17, a 10 percent increase in the cumulative export value from age 10 to age 17 leads to an increase of 1.037 percentage points. The results remain robust to controlling for differential trends by municipality characteristics (including the distance to the closest international airport, and an index of rural versus urban development), as well as the inclusion of regional linear time trends. Later on, I will also show that the results remain robust to two other additional checks: (i) comparing the sample of females for whom I know their migration history, and (ii) restricting my analysis to the two departments that concentrate flower production.

First intercourse initiates the exposure to pregnancy period, which I analyze next. Columns (4), (5) and (6) of Table 5 report the flower impact on the probability of being pregnant for the first time, again evaluated at age 15 (*Panel A*) and at age 17 *(Panel B)*. I find results that are very much aligned with those reported for the initiation to sexual activity: positive shocks to the flower industry increase the probability that a girl is pregnant for the first time in flower suitable municipalities significantly by age 15 and 17.

The 0.0598 coefficient on *Panel B*-Column (6) implies that a 10 percent increase in the value of Colombian flower exports will result in an increase of 0.598 percentage points (pp) in the probability that a girl in late-puberty (age 17) is pregnant. This corresponds to a 2.78% increase above the mean probability over the sample period (21.5 percent of females had been pregnant for the first time by age 17). The impact evaluated by age 15 is also positive, albeit it becomes insignificant once I control for the differential trends: a 10 percent increase in the value of exports results in a 4.85% increase in the probability that a female would be pregnant by age 15. It should be noted that the magnitude of the coefficients for the age 17 category is higher than those by age 15 in absolute terms. Nonetheless, the impact in percentage terms (relative to the sample mean of the event taking place by age a) is attenuated by the fact that the fraction of females who meet the pregnancy condition is increasing with age. In fact, sexual initiation, pregnancy and marriage are very close to being universal events in the lives of Colombian women.

To aide the interpretation of the pregnancy outcomes I have put this figure into context: the value of Colombian exports to the US grew at an average rate of 28 percent per year from 1965 to 2010. As such, the 2SLS coefficients imply a differential increase of 2.90 percentage points in the probability that a female is sexually active by age 17, and a differential increase of 1.67 percentage points (pp) in the probability she is pregnant by age 17 in flower suitable municipalities. These results are worth discussing. Previous studies conducted in the *maquila* context, the Bangladeshi ready-made garments, or the BPO centers in India, had suggested that these modern-factory type of jobs were emblematic of a changing fertility pattern for females, one that allowed them to delay childbirth. In the Colombian rose industry, I find quite the opposite results: positive flower shocks hastened the entry to motherhood. The childbearing shift to earlier ages suggest a dominance of the positive income effect, over an opposing substitution effect, in the Colombian case.

Last, Columns (7), (8) and (9) of Table 5 assess the likelihood that a female will be married by ages 15 and 17, respectively. The probability of marriage is positive but not statistically significant when evaluated at age 15. The impact turns to significant at age 17, and it shares a similar magnitude with the pregnancy coefficients. This is not surprising since the average age of inception lags the union decision very closely.

In Table 6, I repeat the same exercise, but instead of using the year-level shocks, I use the cumulative flower shocks, which are aggregated from age 10 to age 15, or to age 17, respectively. The results remain robust to using this alternative measure of performance. Age of sexual debut, childbearing and union all shifted to earlier ages in response to the burgeoning flower industry.

5.3 Resident and Migrant Subsamples

Next, I begin a series of robustness exercises. First, I conduct a separate analysis for the sample of residents and the sample of migrants. Residents are females who were already present in their current municipality before the age of 10. This threshold was established because the outcomes analyzed comprise the puberty and early adolescence years, and being able to map the municipality where the females were residing during this period is crucial to assess if they were indeed affected by the flower industry shocks or not. From the data, approximately 47.2 percent of the females moved to their current municipality at some point after they were already 10 years old—unfortunately, I cannot track where the migrants were before they arrived to their current municipality.

In Table 7, I report the 2SLS for the sexual initiation, pregnancy and marriage outcomes across residents and migrants. Again I evaluate the likelihood of these three events happening by ages 15 and 17 in *Panel A* and *Panel B*, respectively. Remarkably, the results remain highly significant and of similar magnitudes, albeit more imprecise, for the sample of residents only. Distinctly, the impact on migrants is statistically insignificant. This is not surprising, since the municipalities where the migrants spent their adolescence is unknown, and thus, I should not expect any impact of the flower industry on them.

5.4 Geographical Restrictions: Cundinamarca and Antioquia

As discussed earlier, the flower industry penetrated two administrative departments, Cundinamarca and Antioquia. These two departments concentrate up to 84 percent of flower production, measured in terms of hectares cultivated. Appendix Figure A.1 shows the subsample of DHS municipalities that lie within Cundinamarca and Antioquia, displaying their flower status. Appendix Table A.2 shows the descriptive statistics for the sample of females in Cundinamarca and Antioquia, as well as the comparison of the municipality-level characteristics within these two departments.

In Table 8, I present the 2SLS results using this geographic subsample. The relevant comparison is now across flower and non-flower municipalities that lie within Cundinamarca or Antioquia. The number of municipalities is reduced to 101, but the results remain consistent: the flower shocks accelerated the initiation to sexual activity, path to pregnancy and marriage.

5.5 Further Robustness Checks

Last, in Appendix Table A.3, I show that the results remain robust to computing the cumulative exposure to the flower industry across different age ranges: from age 6, from age 10, or from age 13.

6 Conclusions

This paper has studied the impact of expanding semi-skilled agro-industrial employment opportunities on outcomes that significantly affect the lives and economic role of young females in Colombia. Using the fresh-cut flower industry, I present evidence of how economic development, in the form of export-oriented jobs, affected their fertility timing decisions.

I offer new insights into how the transition from childhood to puberty, and early adulthood, can be shaped by international trade forces. The results that I find indicate that the increasingly available employment opportunities precipitated the entrance into early motherhood. These modern factory-type jobs, the epitome of globalization, accelerated the timing of early sexual and reproductive decisions for very young women. These results might help explain the so-called "paradox" that is observed in the case of Colombia. Despite the fact that total fertility (births per woman) has been declining over the entire period of analysis, from 6.56 births per woman observed in 1965 to 2.29 by 2013 (United Nations Population Division, 2014), this hasn't been accompanied by a parallel delay in the age for childbearing.

In the literature, increasing job opportunities for females has been shown to improve their bargaining power and their exercise of agency. In contrast to previous studies, which had found evidence of delayed responses in fertility timing and union formation, the rose industry in Colombia accelerated sexual initiation, union and motherhood. The flower exports brought along secure and permanent income earning opportunities, particularly for women. As mentioned, if children are normal goods, in principle, this should lead to increases in the demand for children, via income effects. This could also happen if females have an intrinsic desire (shaped by social and religious norms) to be early mothers, but were lacking the financial security and stability to do so. In addition to that, the increased economic and financial stability may have also contributed to erode any stigma associated with early pregnancies. Further, booming periods may have indirectly affected the perception of both present and future economic stability, thereby accelerating motherhood. Despite the fact that the new employment opportunities translate into a higher cost of female time, the opposing substitution effect was not strong enough to delay the childbearing timing. As such, my estimates imply a dominance of an income effect over a substitution effect.

Taken together, the results suggest that fertility and nuptiality timing are closely interwoven to the trade dictums, and that the direction of this relationship might be context specific. Understanding how to affect adolescent fertility patterns remains an open question that calls for further research.

References

[1] Amador, Diego, Raquel Bernal, and Ximena Peña. 2012. "The Rise in Female Participation in Colombia: Children, Education or Marital Status". Background Paper. The World Development Report 2012. World Bank.

[2] Ambrus, Steven. 1994. "International Business : U.S. Ruling a Thorn in Colombian Rose Growers' Side : Trade: Commerce Department decision imposes punitive anti-dumping levies". Los Angeles Times, October 20, 1994. Accessed June 17, 2015. http://articles.latimes.com/1994-10-20/business/fi-52664_1_colombian-rose

[3] Amin, Sajeda, Ian Diamond, Ruchira T. Naved and Margaret Newby. 1998. "Transition to Adulthood of Female Garment-Factory Workers in Bangladesh". *Studies in Family Planning*. 29:2, pp 185-200.

[4] Antman, Francisca. 2014. "Spousal Employment and Intra-Household Bargaining Power". Working Paper.

[5] Atkin, David. 2009. "Working for the Future: Female Factory Work and Child Health in Mexico". Working Paper.

[6] Atkin, David. 2012. "Endogenous Skill Acquisition and Export Manufacturing in Mexico". Working Paper.

[7] Bozon, Michel, Cecilia Gayet and Jaime Barrientos. 2009. "A Life Course Approach to Patterns and Trends in Modern Latin American Sexual Behaviour". Journal of Acquired Immune Deficiency Syndromes. 51(1).

[8] Bureau of International Labor Affairs. 2002. "Colombia: Laws Governing Exploitative Child Labor. Report". U.S. Department of Labor.

[9] Dolan, Catherine. 2007. "Assembling Flowers and Cultivating Homes: Labor and Gender in Colombia. Book Review". *Feminist Economics*. 13:2, 210-215.

[10] Duflo, Esther. 2012. "Women Empowerment and Economic Development". *Journal of Economic Literature*. 50(4), pp. 1051–1079.

[11] Elson, D. and Pearson, R. 1981. "Nimble fingers make cheap workers: An analysis of women's employment in third world export manufacturing". *Feminist Review*. 7, Spring: 87-107.

[12] Encyclopedia Britannica Online. Colombia. Retrieved 25 November, 2013, http://www.britannica.com/EBchecked/topic/126016/Colombia

[13] Figueroa, Alicia, Adriana Lima and Elizabeth McCraken. 2012. “Are Colombian Flowers Experiencing a US drought?”. Knowledge@Wharton article series. Wharton School of the University of Pennsylvania.

[14] Friedemann-Sánchez, Greta. 2006. *Assembling Flowers and Cultivating Homes: Labor and Gender in Colombia*. Lanham: Lexington Books, 2006.

[15] Heath, Rachel, and A. Mushfiq Mobarak. 2015. “Manufacturing Growth and the Lives of Bangladeshi Women”. *Journal of Development Economics*, 115, 1-15.

[16] Hotz, V. Joseph, Jacob Alex Klerman and Robert J. Willis. 1997. “The Economics of Fertility in Developed Countries”. *Handbook of Population and Family Economics*. Edited by M.R. Rosenzweig and O. Stark.

[17] International Bureau of Education (IBE). United Nations Educational, Scientific and Cultural Organization (UNESCO). 2010. *World Data on Education - Colombian Case*. Document: IBE/2010/CP/WDE/ck

[18] International Labor Office (ILO). 2006. “Colombia: Child Labor Data Country Brief”. International Program on the Elimination of Child Labor (IPEC).

[19] Jayachandran, Seema. 2015. “The Roots of Gender Inequality in Developing Countries”. Annual Review of Economics, Volume 7: Submitted. DOI: 10.1146/annurev-economics-080614-115404.

[20] Jensen, Robert. 2012. "Do Labor Market Opportunities Affect Young Women’s Work and Family Decisions? Experimental Evidence from India," *Quarterly Journal of Economics*, 127(2), p. 753-792.

[21] Jensen, Robert. 2010. “The (Perceived) Returns to Education and the Demand for Schooling". *Quarterly Journal of Economics*, 125(2), p. 515-548.

[22] Korovkin, Tanya. 2003. “Cut Flower Exports, Female Labor, and Community Participation in Highland Ecuador”. *Latin American Perspectives*, Vol. 30, No. 4, pp 18-42.

[23] Majlesi, Kaveh. 2015. “Labor Market Opportunities and Sex-Specific Investment in Children’s Human Capital: Evidence from Mexico”. Working Paper.

[24] Mammen, Kristin, and Christina Paxon. 2000. “Women’s Work and Economic Development”. *The Journal of Economic Perspectives*, 14:4, 141-164.

[25] Marín Ángel, M.J. , and J.E. Rangel Aceros. 2000. "Comercialización Internacional de Flores: Antecedentes y Evolución 1990-1999". Dissertation, Universidad Nacional de Colombia.

[26] Meier, V. 1999. "Cut-Flower production in Colombia—a major development success story for women?". *Environment and Planning*. Vol. 31, pp 273-289.

[27] Méndez, José. 1991. "The Development of the Colombian Cut Flower Industry". Working Papers on Trade Policy, WPS 660. The World Bank.

[28] Miller, Grant. 2005. "Contraception as Development? New Evidence from Family Planning in Colombia". NBER Working Paper 11704.

[29] Miller, Grant, and B. Piedad Urdinola. 2010. "Cyclicality, Mortality and the Value of Time: The Case of Coffee Price Fluctuations and Child Survival in Colombia". *Journal of Political Economy*. 118: 1, 113-155.

[30] Ministry of Agriculture and Rural Development and Asocolflores. 2008. *Colombian Grown: The Finest Quality Cut Flowers in the World*. Diseño Editorial.

[31] Molinski, Dan. "Weak Peso Waters Colombia's Garden". The Wall Street Journal. March 17th, 2014. Accessed on May 15th, 2015. http://www.wsj.com/articles/SB10001424052702303546204579439813904252966

[32] Oster, Emily, and Bryce Millett Steinberg. 2013. "Do IT Service Centers Promote School Enrollment? Evidence from India". *Journal of Development Economics*. 104, 123-135.

[33] Pun, Ngai. *Made in China: Women Factory Workers in a Global Workplace*. Duke University Press, 2005. Durham, NC.

[34] Qian, Nancy. 2008. "Missing Women and The Price of Tea in China: The Effect of Sex-Specific Earnings on Sex Imbalance". *The Quarterly Journal of Economics*. 123:3, 1251-1285.

[35] Rosero-Bixby, Luis, Teresa Castro-Martín and Teresa Martín-García. 2009. "Is Latin America Starting to Retreat from Early and Universal Childbearing?". *Demographic Research*. 20:9, 169-194.

[36] Schultz, T. Paul. 1985. "Changing World Prices, Women's Wages, and the Fertility Transition: Sweden, 1860-1910". *Journal of Political Economy*. 93:6, pp 1126-1154.

[37] Sivasankaran, Anitha. 2014. "Work and Women's Marriage, Fertility and Empowerment: Evidence from Textile Mill Employment in India". Job Market Paper.

[38] Spano, Sedra. 2004. “Stages of Adolescent Development”. ACT for Youth Upstate Center of Excellence. Cornell University.

[39] Talcott, Molly. 2004. “Gendered Webs of Development and Resistance: Women, Children, and Flowers in Bogotá”. *Signs*. 29:2, 465-489.

[40] United Nations Population Fund (UNFPA). “State of the World Population, 2014”. Accessed online on June 15th, 2015. http://www.unfpa.org/sites/default/files/pub-pdf/EN-SWOP14-Report_FINAL-web.pdf

[41] United Nations Population Fund (UNFPA). 2013. “Adolescence Pregnancy: A Review of the Evidence”. Prepared by Edilberto Loaiza and Mengjia Lang.

[42] Urrutia, Miguel. 1985. *Winners and Losers in Colombia's Economic Growth of the 1970s*. New York: Oxford University.

[43] World Health Organization (WHO). 2014. “Adolescent Pregnancy”. Fact Sheet N 364. Web Resource. Accessed on June 2014. http://www.who.int/mediacentre/factsheets/fs364/en/

Figure 1: Trends in Fertility-Related Outcomes in Colombia

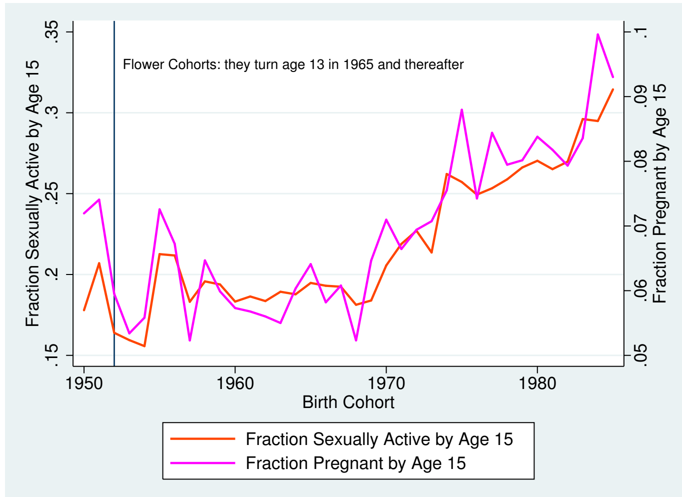


Figure 1a: Sexually Active and Pregnant by age 15

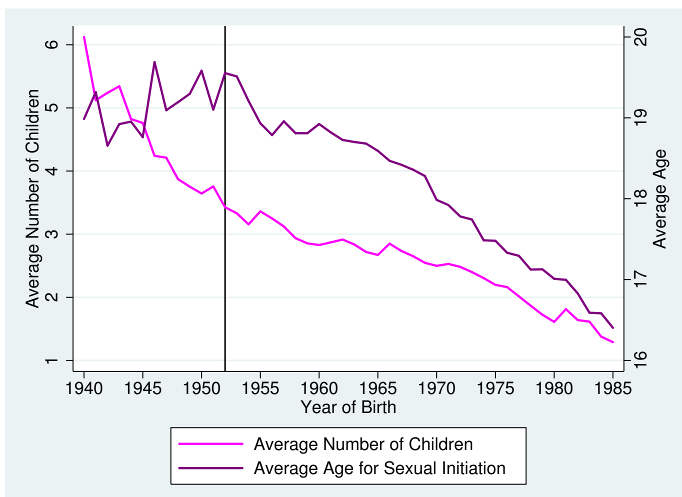
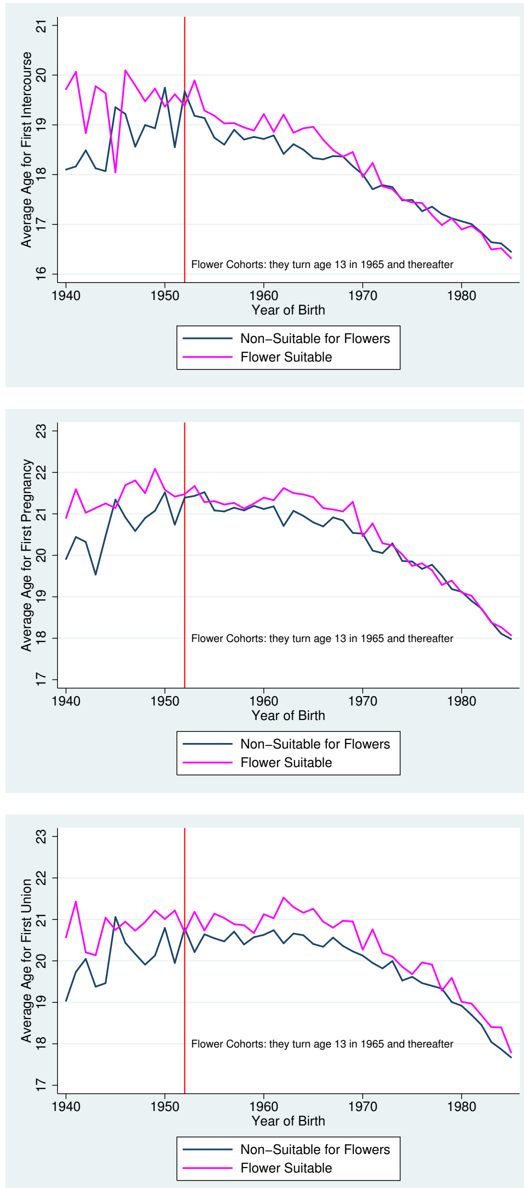


Figure 1b: Fertility and Sexual Initiation

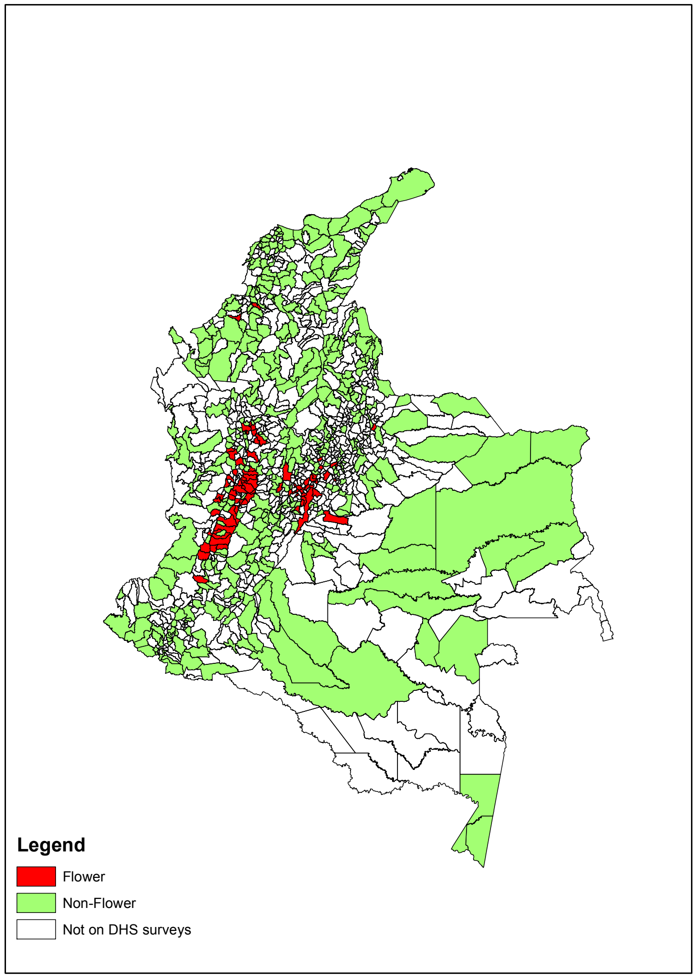
Top Figure shows two time series: (i) the fraction of females who initiatied sexual activity (left-axis), and (ii) females who had been pregnant for the first time (right-axis), by birth cohort. These two events are evaluated by age 15. I identify with a vertical line the birth cohort born in 1952. This cohort turned age 13 (puberty period) in the year 1965, which marks the first shipment of fresh-cut Colombian flowers to the US. Thus, cohorts born after 1952 reached their age of menarche in a world where the flower industry was already operating.The bottom figure shows the evolution for the average age at sexual debut and the average number of children. The average age is computed using the sample of females who are at least 25 years old on the survey year. Bottom Figure *Source:* Colombia DHS surveys 1986, 1990, 1995, 2000, 2005 and 2010.

Figure 2: Trends by Flower Suitability



Figures separately track the average age for sexual initiation, first pregnancy, and union by birth cohort and across flower suitable municipalities. I identify with a vertical line the birth cohort born in 1952. This cohort turned age 13 (puberty period) in the year 1965, which marks the first shipment of fresh-cut Colombian flowers to the US. Thus, cohorts born after 1952 reached their age of menarche in a world where the flower industry was already operating. *Source:* Colombia DHS surveys 1986, 1990, 1995, 2000, 2005 and 2010.

Figure 3: Distribution of Flower Municipalities



This figure shows the municipalities that were surveyed in any of the Colombian DHS waves (survey years: 1986, 1990, 1995, 2000, 2005 or 2010). In red, I identify the municipalities cultivating flowers as of 2007. The flower municipalities are those municipalities that have at least one flower farm, cultivating a positive number of flower hectares, *hectares* > 0. *Sources:* Shape-file from DANE; flower hectare distribution from the Ministry of Agriculture and Rural Development. Demographic and Health Surveys (DHS).

Figure 4: Performance of the Colombian Flower Industry

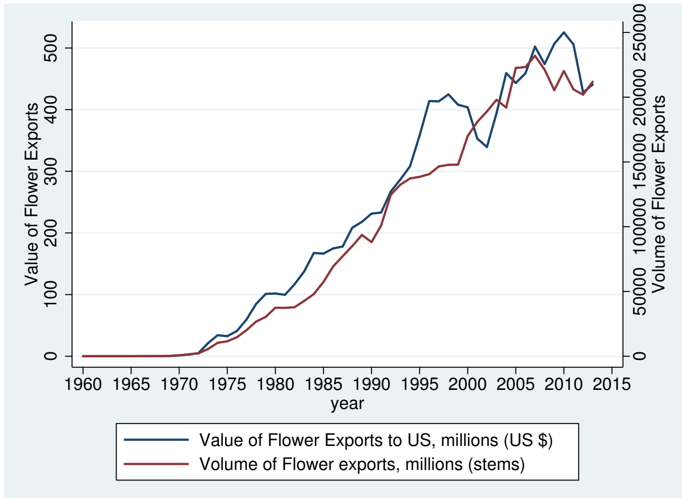


Figure 4a: Value and Volume of Flower Exports from Colombia to the US market

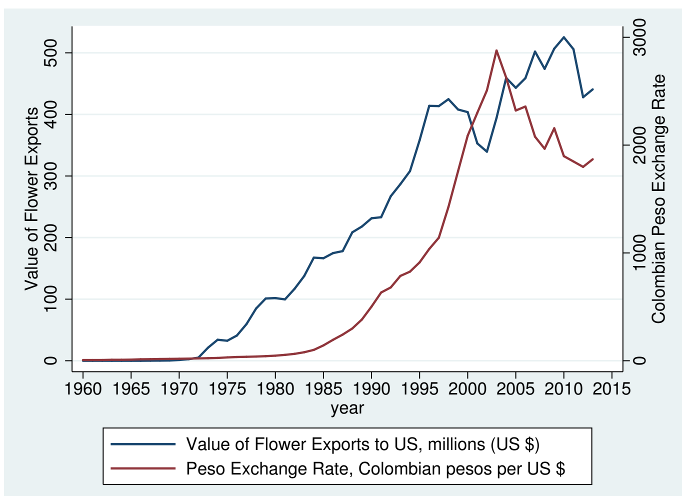


Figure 4b: Value of Exports and Exchange Rate (Colombian pesos per US dollar)

Top Figure shows the evolution of Colombian flower exports in terms of value and volume. The bottom figure overlaps the evolution of the Colombian peso exchange rate against the US dollar (number of Colombian pesos per US dollar). *Sources:* United States Department of Agriculture (USDA) - Agricultural Marketing Service for the export series. Banco de la República for the currency series.

Figure 5: Reduced-Form Evidence

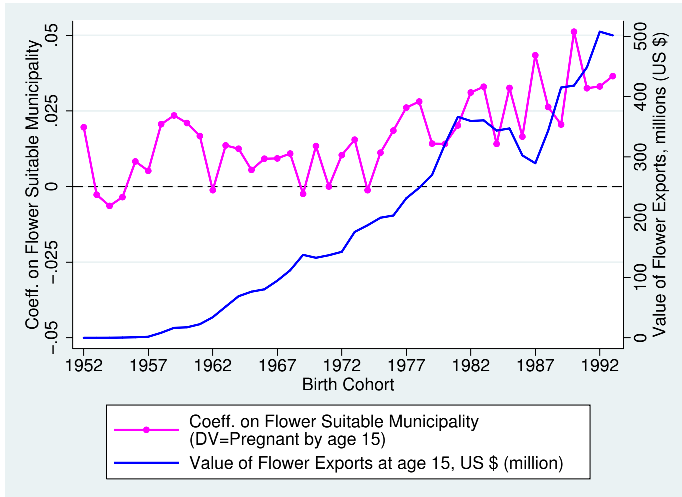


Figure 5a: Age 15

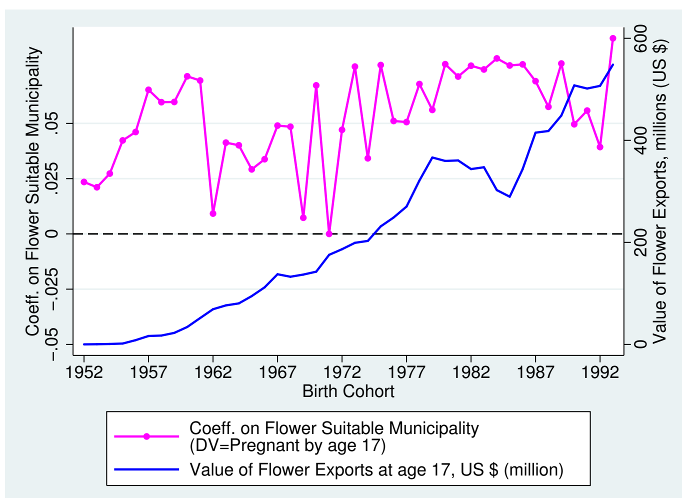


Figure 5b: Age 17

The figures show the coefficients of regressing, separately, the probability of becoming sexually active and the probability of being pregnant for the first time on a full set of year dummies interacted with the *coolness* suitability of a municipality. I control for municipality and birth year fixed effects, and add differential trends accounting for the distance to the closest international airport, and an index of rural development. I also control for linear time trends defined at the department level. The top figure shows the probabilities of the events happening by age 15 and the bottom figure by age 17. I overlap the evolution of the value of Colombian flower exports to the US marker on the year in which each birth cohort turns 15 and 17, respectively. I use birth cohorts from 1952 to 1993. *Source:* United States Department of Agriculture (USDA) - Agricultural Marketing Service for the temporal series on flower exports. Demographic and Health Surveys (DHS) for Colombia.

Table 1: Descriptive Statistics across Flower vs Non-Flower

	Non-Flower		Flower	
Panel A: Individual-Level Characteristics	Mean	SD	Mean	SD
Age	30.834	9.396	30.690	9.312
Birth Year	1973.582	10.463	1971.799	10.602
Age became sexually active	18.056	3.754	18.455	3.725
Age at first marriage	20.190	4.897	21.105	4.945
Age at first birth	21.244	4.441	21.990	4.565
Sexually active by age 15	0.253	0.435	0.212	0.409
Sexually active by age 17	0.495	0.500	0.452	0.498
Pregnant by age 15	0.081	0.272	0.053	0.223
Pregnant by age 17	0.234	0.423	0.175	0.380
Married by age 15	0.100	0.300	0.059	0.236
Married by age 17	0.241	0.428	0.165	0.371
Resides in Cundinamarca or Antioquia	0.070	0.255	0.197	0.398
Migrated after age 10	0.486	0.500	0.443	0.497
Females	78135		37679	

	Non-Flower		Flower	
Panel B: Municipality-Level Characteristics	Mean	SD	Mean	SD
Municipalities	369		77	
Flower Hectares	0	0	74.408	163.029
Coffee hectares	766.686	1608.147	1758.687	2380.470
Gold (Dummy)	0.176	0.381	0.208	0.408
Coal (Dummy)	0.103	0.304	0.104	0.307
Distance to capital of department (km)	80.427	62.126	54.464	44.948
Distance to Bogotá (km)	374.224	209.132	172.330	102.925
Distance to main market center (km)	145.067	125.026	51.017	43.631
Rurality Index	0.534	0.251	0.385	0.254

Panel C: Annual-Level Flower Variables	Mean	SD
Value of Flower Exports (US$ millions)	230.853	173.984
Growth in Value of Flower Exports	0.289	0.605
Volume of Flower Exports (stems, 1000s)	97041.833	78795.090
Growth in Volume of Flower Exports	0.257	0.432
Exchange Rate (Colombian Peso per US $)	837.036	950.075
Growth in the Exchange Rate	0.125	0.120

Note: All DHS waves. The variables for the average age for sexual initiation, first birth and marriage are defined for the sample of females who were older than 25 years old in the survey year. This represents the 90th percentile for age of first pregnancy (birth delivery).

Table 2: Individual Characteristics for Pre-Flower Cohorts 1940 - 1950

	Non-Flower			Flower		
Pre-Flower Arrival Individual Characteristics	Mean	SD	Count	Mean	SD	Count
Birth Year	1945.729	3.101	2028	1945.634	3.055	1768
Age	44.947	3.013	2028	44.821	3.084	1768
Age became sexually active	18.733	4.668	1412	19.879	5.176	1114
Age at first marriage	20.116	5.276	1891	21.077	5.477	1618
Age at first birth	21.585	4.965	1891	22.493	5.140	1636
Total children ever born	5.102	3.196	2028	3.753	2.543	1768
Sexually active by age 15	0.243	0.429	1476	0.164	0.371	1188
Sexually active by age 17	0.437	0.496	1476	0.324	0.468	1188
Pregnant by age 15	0.093	0.290	2028	0.057	0.232	1768
Pregnant by age 17	0.238	0.426	2028	0.185	0.388	1768
Married by age 15	0.127	0.333	2028	0.085	0.280	1768
Married by age 17	0.277	0.448	2028	0.210	0.408	1768

Note: Individual-level characteristics for the sample of females who were born between 1940 and 1950, prior to the advent of the flower industry (1965).

Table 3: Flower Suitability

	Flower Status		Flower Hectares	
	(1)	(2)	(3)	(4)
Coolness	0.302***		24.423***	
	(0.034)		(7.195)	
Hot		-0.308***		-24.920***
		(0.033)		(6.932)
Cold		-0.232***		-12.651
		(0.072)		(13.562)
Constant	0.030***	0.327***	1.292	25.064***
	(0.011)	(0.032)	(1.069)	(6.931)
Municipalities	446	446	446	446
R-Squared	0.159	0.160	0.028	0.028
F-Stat	77.344	42.925	11.524	7.016

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Note: robust standard errors reported in parentheses. I present the OLS results to evaluate the suitability of a municipality for flower cultivation. The outcome variables reflect both the extensive margin of flower cultivation, flower status, as well as the intensive margin, flower hectares. The flower status and flower hectares are measured at the municipality level. The flower status identifies whether a municipality is a flower-producing center or not. Hectares corresponds to the number of hectares under flower cultivation. The suitability requirement exploits a discontinuity in temperature: *coolness*. It captures whether the average annual temperature lies between 13-24 Celsius (55-75 F), deemed to be optimal for flower growth. I add a dummy *Hot* for temperatures that exceed 24 Celsius and a dummy *Cold* for temperatures that are below 13 Celsius as alternative suitable requirements. The sample includes all municipalities that were surveyed across subsequent DHS waves.

Table 4: First-Stage Results for Flower Shocks

	Flower Status *(Log) Export Value on the year you turned age a		Flower Status *(Log) Cumulative Export Value from age 10 up to age a	
	age 15	age 17	age 15	age 17
	(1)	(2)	(3)	(4)
Coolness $\times$ (Log) Exchange Rate at age 15	0.1093***			
	(0.0421)			
Coolness $\times$ (Log) Exchange Rate at age 17		0.1109***		
		(0.0343)		
Coolness $\times$ (Log) Average Exchange Rate from age 10 to 15			0.1129**	
			(0.0543)	
Coolness $\times$ (Log) Average Exchange Rate from age 10 to 17				0.1197***
				(0.0451)
Individuals	115814	115814	115814	115814
Municipalities	446	446	446	446
Years	42	42	42	42
R-Squared	0.973	0.986	0.976	0.987
F-stat	6.746	10.487	4.326	7.043

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: standard errors clustered at the municipality level are shown in parentheses. The dependent variable for the first-stage consists of the status of a municipality interacted with the (log) performance of Colombian flower exports. Measures of performance include the (log) value of exports on a given year or, alternatively, the (log) cumulative value of Colombian flower exports from the year a female turns 10 to the age of interest a. The instrument is made of the interaction of the (log) average Colombian peso exchange rate and the *coolness* requirement for flower suitability (temperature criterion between 13-24 Celsius). All specifications include municipality, year, and DHS wave fixed effects. I also control for the type of municipality (urban versus rural). I include differential trends based on municipality characteristics. For that, I interact year dummies with the closest international airport (Bogotá or Medellín), as well as with a *rurality* index. I add linear time trends at the Department level. The birth years span from 1952 to 1993. *Source:* DHS wave of 1986, 1990, 1995, 2000, 2005 and 2010.

Table 5: OLS and 2SLS for the year-shocks on age a: 15 and 17

Panel A: By age 15	Sexually Active			Pregnant			Married		
	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flower × (Log) Value at age 15	0.0144***	0.0554***	0.0682*	0.0010	0.0133*	0.0349	0.0004	0.0082	0.0345
	(0.0020)	(0.0190)	(0.0386)	(0.0011)	(0.0080)	(0.0219)	(0.0013)	(0.0070)	(0.0230)

Panel B: By age 17	Sexually Active			Pregnant			Married		
	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flower × (Log) Value at age 17	0.0293***	0.1159***	0.1037**	0.0069**	0.0361*	0.0598*	0.0030	0.0260	0.0599*
	(0.0047)	(0.0421)	(0.0481)	(0.0027)	(0.0186)	(0.0349)	(0.0026)	(0.0169)	(0.0323)
Individuals	106966	106966	106966	115814	115814	115814	115814	115814	115814
Municipalities	446	446	446	446	446	446	446	446	446
Years	42	42	42	42	42	42	42	42	42
Differential Trends			Yes			Yes			Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: standard errors clustered at the municipality level are shown in parentheses. The dependent variables include the likelihood that a female is sexually active, pregnant or married by age a, where age here refers to 15 or 17 years old. These outcomes are regressed on the interaction between the flower status of a municipality and the (log) peformance of the flower industry. Measures of performance include the (log) value of the flower exports on that particular year or the (log) cumulative value of Colombian flower exports to the US from the year a female turns 10 to the relevant age of interest a. The instrument is made of the interaction of the (log) average Colombian peso exchange rate and the *coolness* requirement for flower suitability (temperature criterion between 13-24 Celsius). All specifications include municipality, year, DHS-wave, and rurality (urban vs rural dummy) fixed effects. Further, I include differential trends based on municipality characteristics. For that, I interact year dummies with the closest international airport (Bogotá or Medellín), as well as with a *rurality* index. I add linear time trends at the Department level. The sample is made of females who are between ages 17 and 50 on the survey year. The birth years span from 1957 to 1993. *Source:* DHS wave of 1986, 1990, 1995, 2000, 2005 and 2010.

Table 6: OLS and 2SLS for the accumulated flower shocks on age a: 15 and 17

Panel A: By age 15	Sexually Active			Pregnant			Married		
	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flower × (Log) Accumulated Value	0.0118***	0.0467***	0.0820*	0.0008	0.0115*	0.0425	0.0004	0.0069	0.0379
from age 10 to 15	(0.0017)	(0.0158)	(0.0467)	(0.0009)	(0.0066)	(0.0270)	(0.0011)	(0.0057)	(0.0261)

Panel B: By age 17	Sexually Active			Pregnant			Married		
	OLS	2SLS	2SLS	OLS	2SLS	2SLS	OLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flower × (Log) Accumulated Value	0.0227***	0.0901***	0.1083**	0.0053**	0.0279**	0.0633*	0.0021	0.0199	0.0615*
from age 10 to 17	(0.0038)	(0.0317)	(0.0536)	(0.0022)	(0.0139)	(0.0380)	(0.0021)	(0.0127)	(0.0344)
Individuals	106966	106966	106966	115814	115814	115814	115814	115814	115814
Municipalities	446	446	446	446	446	446	446	446	446
Years	42	42	42	42	42	42	42	42	42
Differential Trends			Yes			Yes			Yes

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: standard errors clustered at the municipality level are shown in parentheses. The dependent variables include the likelihood that a female is sexually active, pregnant or married by age a, where age here refers to 15 or 17 years old. These outcomes are regressed on the interaction between the flower status of a municipality and the (log) peformance of the flower industry. Measures of performance include the (log) value of the flower exports on that particular year or the (log) cumulative value of Colombian flower exports to the US from the year a female turns 10 to the relevant age of interest a. The instrument is made of the interaction of the (log) average Colombian peso exchange rate and the *coolness* requirement for flower suitability (temperature criterion between 13-24 Celsius). All specifications include municipality, year, DHS-wave, and rurality (urban vs rural dummy) fixed effects. Further, I include differential trends based on municipality characteristics. For that, I interact year dummies with the closest international airport (Bogotá or Medellín), as well as with a *rurality* index. I add linear time trends at the Department level. The sample is made of females who are between ages 17 and 50 on the survey year. The birth years span from 1957 to 1993. *Source:* DHS wave of 1986, 1990, 1995, 2000, 2005 and 2010.

Table 7: 2SLS for the Comparison of Residents and Migrants

Panel A: By age 15	Sexually Active		Pregnant		Married	
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Resident	Migrant	Resident	Migrant	Resident	Migrant
	(1)	(2)	(3)	(4)	(5)	(6)
Flower × (Log) Value from age 10 to 15	0.1756*	-0.0099	0.0565	0.0246	0.0555	0.0168
	(0.0941)	(0.0429)	(0.0383)	(0.0312)	(0.0389)	(0.0285)

Panel B: By age 17	Sexually Active		Pregnant		Married	
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	Resident	Migrant	Resident	Migrant	Resident	Migrant
	(1)	(2)	(3)	(4)	(5)	(6)
Flower × (Log) Value from age 10 to 17	0.2084**	0.0191	0.1199*	0.0158	0.0850*	0.0328
	(0.0905)	(0.0507)	(0.0611)	(0.0435)	(0.0450)	(0.0420)
Individuals	57153	49794	61168	54642	61168	54642
Municipalities	440	444	440	444	440	444
Years	42	42	42	42	42	42

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: standard errors clustered at the municipality level are shown in parentheses. The dependent variables include the likelihood that a female is sexually active, pregnant or married by age a, where age a refers to 15 or 17 years old. The sample of residents is made of females who grew up (were present before the age of 10) in their current municipality. The sample of migrants is made of the females who moved passed the age of 10 to their current municipality. These outcomes are regressed on the interaction between the flower status of a municipality and the (log) peformance of the flower industry. Measures of performance include the (log) value of the flower exports on that particular year or the (log) cumulative value of Colombian flower exports to the US from the year a female turns 10 to the relevant age of interest a. The instrument is made of the interaction of the (log) average Colombian peso exchange rate and the coolness requirement for flower suitability (temperature criterion between 13-24 Celsius). All specifications include municipality, year, DHS-wave, and rurality (urban vs rural dummy) fixed effects. Further, I include differential trends based on municipality characteristics. For that, I interact year dummies with the closest international airport (Bogotá or Medellín), as well as with a *rurality* index. I add linear time trends at the Department level. The birth years span from 1952 to 1993.

Table 8: 2SLS Results for Cundinamarca and Antioquia

Panel A: By age 15	Sexually Active		Pregnant		Married	
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
Flower × (Log) Value at age 15	0.0742***		0.0354*		0.0326*	
	(0.0278)		(0.0193)		(0.0178)	
Flower × (Log) Value from age 10 to 15		0.0607***		0.0298*		0.0281*
		(0.0230)		(0.0156)		(0.0149)
Panel B: By age 17	Sexually Active		Pregnant		Married	
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)
Flower × (Log) Value at age 17	0.1191**		0.0862**		0.0684**	
	(0.0477)		(0.0353)		(0.0274)	
Flower × (Log) Value from age 10 to 17		0.0964**		0.0725**		0.0565**
		(0.0385)		(0.0295)		(0.0224)
Individuals	11369	11369	12905	12905	12905	12905
Municipalities	101	101	101	101	101	101
Years	42	42	42	42	42	42

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: standard errors clustered at the municipality level are shown in parentheses. The dependent variables include the likelihood that a female is sexually active, pregnant or married by age a, where age a refers to 15 or 17 years old. These outcomes are regressed on the interaction between the flower status of a municipality and the (log) peformance of the flower industry. Measures of performance include the (log) value of the flower exports on that particular year or the (log) cumulative value of Colombian flower exports to the US from the year a female turns 10 to the relevant age of interest a. The instrument is made of the interaction of the (log) average Colombian peso exchange rate and the coolness requirement for flower suitability (temperature criterion between 13-24 Celsius). All specifications include municipality, year, DHS-wave, and rurality (urban vs rural dummy) fixed effects. Further, I include differential trends based on municipality characteristics. For that, I interact year dummies with the closest international airport (Bogotá or Medellín), as well as with a *rurality* index. I add linear time trends at the Department level. The sample is made of females who are between ages 17 and 50 on the survey year and report residing in the adminstrative departments of Cundinamarca or Antioquia. The birth years span from 1952 to 1993. *Source:* DHS wave of 1986, 1990, 1995, 2000, 2005 and 2010.

Appendix

Table A.1: Flower Suitability - All of Colombia

	Flower Status		Flower Hectares	
	(1)	(2)	(3)	(4)
Coolness	0.192***		14.597***	
	(0.018)		(3.100)	
Hot		-0.202***		-14.902***
		(0.018)		(2.990)
Cold		-0.156***		-8.751
		(0.039)		(6.006)
Constant	0.026***	0.218***	0.704	14.976***
	(0.007)	(0.017)	(0.513)	(2.990)
Municipalities	1086	1086	1086	1086
R-Squared	0.080	0.085	0.017	0.017
F-Stat	108.117	64.065	22.164	13.118

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Note: robust standard errors reported in parentheses. OLS results to evaluate the suitability of a municipality for flower cultivation. The outcome variables reflect both the extensive margin, flower status, as well as the intensive margin of cultivation, flower hectares. The flower status and flower hectares are measured at the municipality level. The flower status identifies whether a municipality is a flower-producing center or not. Hectares corresponds to the number of hectares under flower cultivation. The suitability requirement exploits a discontinuity in temperature: *coolness*. It captures whether the average annual temperature lies between 13-24 Celsius (55-75 F), deemed to be optimal for flower growth. I add a dummy *Hot* for temperatures that exceed 24 Celsius and a dummy *Cold* for temperatures that are below 13 Celsius as alternative suitable requirements. The sample consists of all municipalities in Colombia (whether they were covered in the DHS surveys or not), for whic temperature is available.

Table A.2: Sample of females in Cundinamarca and Antioquia

	Non-Flower		Flower	
Panel A: Individual-level Variables	Mean	SD	Mean	SD
Age	30.926	9.394	30.764	9.270
Birth Year	1971.547	10.636	1971.418	10.564
Age became sexually active	18.187	3.900	18.793	3.910
Age at first marriage	20.380	5.076	21.593	5.011
Age at first birth	21.301	4.460	22.317	4.616
Sexually active by age 15	0.261	0.439	0.184	0.388
Sexually active by age 17	0.497	0.500	0.419	0.493
Pregnant by age 15	0.078	0.269	0.044	0.204
Pregnant by age 17	0.231	0.422	0.151	0.358
Married by age 15	0.098	0.298	0.044	0.204
Married by age 17	0.236	0.424	0.131	0.337
Flower municipality	0.000	0.000	1.000	0.000
Resides in Cundinamarca or Antioquia	1.000	0.000	1.000	0.000
Migrated after age 10	0.517	0.500	0.445	0.497
Females	5485		7420	

Panel B: Municipality-Level Variables	Mean	SD	Mean	SD
Municipalities	68		33	
Flower Hectares	0	0	138.585	229.669
Coffee hectares	713.260	1403.785	657.470	1816.891
Gold (Dummy)	0.382	0.490	0.091	0.292
Coal (Dummy)	0.074	0.263	0.152	0.364
Distance to capital of department (km)	95.438	67.457	63.711	38.628
Distance to Bogotá (km)	230.428	140.955	120.806	92.473
Distance to main market center (km)	92.314	63.869	50.418	31.112
Distance to closest international airport (km)	95.802	67.054	36.109	23.584
Rurality Index	0.571	0.233	0.417	0.264

Note: All DHS waves. The variables for the average age for sexual initiation, first birth and marriage are defined for the sample of females who were older than 25 years old in the survey year. This represents the 90th percentile for age of first pregnancy (birth delivery). Departments of Cundinamarca and Antioquia.

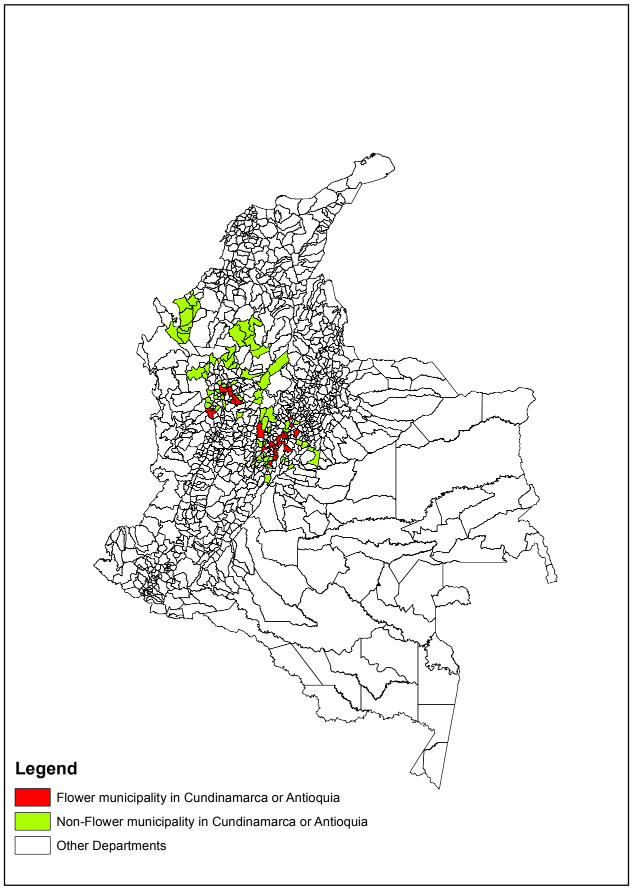
Table A.3: 2SLS for Alternative Cumulative Exposures

Panel A: By age 15	Sexually Active			Pregnant			Married		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flower × (Log) Value from 6 to 15	0.0718**			0.0354*			0.0295		
	(0.0361)			(0.0208)			(0.0198)		
Flower × (Log) Value from 10 to 15		0.0713**			0.0356*			0.0311	
		(0.0360)			(0.0210)			(0.0207)	
Flower × (Log) Value from 13 to 15			0.0667**			0.0334*			0.0307
			(0.0337)			(0.0195)			(0.0202)
Panel B: By age 17	Sexually Active			Pregnant			Married		
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Flower × (Log) Value from 6 to 17	0.0937**			0.0524*			0.0501*		
	(0.0446)			(0.0316)			(0.0294)		
Flower × (Log) Value from 10 to 17		0.0984**			0.0546*			0.0509*	
		(0.0458)			(0.0327)			(0.0302)	
Flower × (Log) Value from 13 to 17			0.1005**			0.0554*			0.0497
			(0.0457)			(0.0328)			(0.0302)
Individuals	106966	106966	106966	115814	115814	115814	115814	115814	115814
Municipalities	446	446	446	446	446	446	446	446	446
Years	42	42	42	42	42	42	42	42	42

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: standard errors clustered at the municipality level are shown in parentheses. The dependent variables include the likelihood that a female is sexually active, pregnant or married by age a, where age here refers to 15 or 17 years old. Measures of performance include the (log) cumulative value of Colombian flower exports to the US from the year a female turns 6, the year she turns 10 and the year she turns 13 to the relevant age of interest a. The instrument is made of the interaction of the (log) average Colombian peso exchange rate and the *coolness* requirement for flower suitability (temperature criterion between 13-24 Celsius). All specifications include municipality, year, DHS-wave, and rurality (urban vs rural dummy) fixed effects. Further, I include differential trends based on municipality characteristics. For that, I interact year dummies with the closest international airport (Bogotá or Medellín), as well as with a *rurality* index. I add linear time trends at the Department level.

Figure A.1: Flower municipalities in the Departments of Cundinamarca and Antioquia (surveyed in the DHS)



This figure shows the subsample of municipalities in Cundinamarca and Antioquia (which concentrate 84 percent of flowwer hectares) that were surveyed in any of the Colombian DHS waves (survey years: 1986, 1990, 1995, 2000, 2005 or 2010). Flower municipalities are identified as those municipalities that have at least one flower farm, cultivating a positive number of flower hectares, $hectares > 0$, as of 2007. Sources: Shape-file from DANE; flower hectare distribution from the Ministry of Agriculture and Rural Development. Demographic and Health Surveys (DHS).