Women's Employment,
Husbands' Economic Self-Interest and Domestic Violence

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Abstract

This paper presents evidence that providing employment opportunities to women decreases domestic violence when the husband has economic self-interest in the wife's work capacity. I exploit the government-induced rapid expansion of the coffee mills in Rwanda in the 2000s, which increased the value of coffee farmer couples' output and provided wage employment for women. Since the mill operates only during the harvest months, the husband's cost of incapacitating his wife changes within the year. This variation, in conjunction with monthly administrative records on domestic violence hospitalizations, provides a way to distinguish the incapacitation cost mechanism from the rise in women's bargaining power and household income, which are identified by multiple rounds of household survey data.

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1 Introduction

Domestic violence is an extreme form of gender inequality and a global health problem of epidemic proportions (WHO, 2013). About 1 in every 3 women worldwide have experienced physical and/or sexual violence from their partners in their lifetime (World Bank, 2015). Providing jobs to women is widely discussed as a policy in addressing the problem. Based on theories of domestic violence, on the one hand, an increase in women's income due to employment can decrease violence either via an increase in women's outside options and/or a reduction in the financial stress in the household. On the other hand, it can increase violence due to husbands' incentives to extract women's resources or through male backlash. Some existing studies provide empirical evidence for both channels. Still, these studies either focus on the effects of unearned income such as cash transfers and dowry payments (Angelucci 2008, Bobonis et al. 2013, Hidrobo et al. 2016, Haushofer et al. 2019, Bloch and Rao 2002, Calvi and Keskar 2021) or they study employment mainly as an income shock due to their source of variation and data.[1] Yet, a job is more than income. It is earning income using one's capacity to work or (health) human capital (Becker 2007, Goldin 2016), and cannot be performed if one is incapacitated, for instance, due to violence.

This paper presents evidence that providing employment opportunities to women decreases domestic violence when the husband has economic self-interest in the wife's work capacity. I provide evidence that an increase in women's outside options and their contribution to household resources also operate as mechanisms. To establish results, I use a natural experiment, the government-induced rapid expansion of the coffee mills in Rwanda in the 2000s, that affected coffee farmer couples. First, a mill opening enables the husband to sell the couple's harvest for a high premium on the international coffee market. This increases the value of the wife's capacity to do the tasks she performs as an unpaid family worker on the couple's plot. Second, a mill opening enables the wife to become a wage worker in the mill. As a result, the wife has personal earnings which she shares with the husband. Third, because the mill operates only during the harvest months, the husband's cost of incapacitating his wife based on the former two points changes within the year. This variation, in conjunction with monthly administrative records on domestic violence hospitalizations, provides a way to distinguish the incapacitation cost mechanism from the rise in women's bargaining power and household income, which is identified by multiple rounds of household survey data.

[1] These studies examine the effects of labor market shocks as a change in potential wages or likelihood of having earnings (Aizer 2010, Anderberg et al. 2016, Erten and Keskin 2021a, Erten and Keskin 2021b). Bhalotra et al. 2021 is an exception where the authors emphasize that their results on job-loss effects on domestic violence are consistent with both the loss of income and the increase in the time couples spent together. Kotsadam and Villanger 2022 runs an RCT which randomizes job offers in Ethiopia. However, the experimental design focuses on identifying the effect, not the underlying mechanisms or non-monetary features of a job.

In 2002, the Rwandan government adopted the National Coffee Strategy to shift to high-quality mill-processed coffee production to participate in the international specialty coffee market (Boudreaux, 2011). In the early 2000s, a public-private partnership project helped farmers establish cooperatives and build mills in their communities. After the project, farmers continued to build mills across the country. From 2002 to 2012, the number of mills increased from 5 to 213.[2]

A coffee mill is where coffee cherries, the harvest of the coffee tree, are processed into coffee beans for export. The context provides two critical features for identification. First, the opening of a mill creates a spatial variation. A mill serves coffee farmers, mostly couples, who reside within its catchment area, approximately a 4 km radius buffer zone around the mill. The mill has a specific catchment area because cherries will rot if not transported to a mill within a few hours of harvest. Second, a mill opening creates yearly and monthly time variations. Before a mill opening, the wife harvests the coffee cherries with the husband and then processes them at home as a female-dominated task. The husband sells the home-processed coffee in the local market for a low price as a male-dominated task and receives the income as his personal earnings. After a mill opening, the couple harvests and carries the cherries to the mill and the husband sells it to the mill for a high premium.[3] The mill demands paid labor during the harvest months, March-July, for the coffee processing tasks that its machinery cannot do. Since the tasks are female-dominated, a mill enables the wife in the catchment area to transition from an unpaid family worker in the couple's plot to a wage worker in the mill for the same tasks as before. As a result, the wife has personal earnings which she shares with the husband.[4]

To causally identify the impact of a mill opening, I first use a staggered difference-in-differences (DID) design exploiting the spatial variation, within-outside of the catchment area, and the yearly time variation, before-after a mill opening. This strategy uses data on self-reported domestic violence and labor market outcomes. Then I complement this analysis using novel monthly administrative records, the universe of hospitalizations for domestic violence. The data is from the end of the expansion period, where the mills are already built and the number of hospitals within the catchment area of a mill is fixed.[5] I use a DID event study design exploiting the same spatial variation and monthly time variation within the year. I use the beginning of the harvest season, March, as the event when the mills start to operate.

[2] In 2012, coffee accounted for nearly 20% of Rwanda's exports and 15% of its GDP (Macchiavello and Morjaria, 2020). As of 2018, there are 312 mills in the country.

[3] The husband earns a higher income from selling cherries to a mill compared to selling home-processed coffee in the local market (Macchiavello and Morjaria, 2020) since the mill-processed coffee has a higher quality compared to home-processed coffee and is sold in the international coffee market. Farmers outside the catchment areas continue to process coffee at home after a mill opening and sell their harvest in the local market for a low price.

[4] In my data, 65% of women decide how to spend their earnings jointly with their husbands, not by themselves, which supports that women share their earnings with their husbands.

[5] The data captures the years between 2012 and 2019.

Rwandan Demographic Health Surveys (DHS) provides information on couples' self-reported labor market outcomes and women's domestic violence for the past 12 months. Hospital Management Information System (HMIS) data provides the universe of monthly hospitalizations due to domestic violence. I combine data on the universe of mills using Rwanda GeoPortal and Macchiavello and Morjaria (2020). All datasets above are geocoded, which enables me to link the couples and hospitals with the mills based on the GPS coordinates. I also use an additional household survey that provides couples' individual earnings.

I find that upon a mill opening, women in the catchment areas are 15% more likely to work for cash in the past 12 months with respect to the sample mean (0.39). The probability of working in the past 12 months remains unchanged. Importantly, exposure to a mill decreases the probability of self-reporting domestic violence in the past 12 months by 29% with respect to the sample mean (0.35). There is no statistically significant change in husbands' probability of working or working for cash in the past 12 months.[6] To establish these results, I use couples residing outside the catchment areas but located within the same district with the mills as the control group. The results are robust to using another control group, the couples who reside within the donut area between 4 and 8 km from the mills. Using the additional household survey data, I also show that mill exposure increases each spouse's last daily earnings upon a mill opening.

Next, using monthly hospitalizations from the end of the expansion, where the number of hospitals within a catchment area is fixed, I test for an effect on domestic violence during the harvest months. May-July is the peak of the harvest when most coffee farmers in the catchment areas work in the mills. Using a DID event-study design, I show that it is 12% and 16% less likely for hospitals in the catchment areas to have a domestic violence patient in June and July, respectively, compared to one month before the mills' month of operation, February. There are no statistically significant changes for January, two months before the mills' month of operation, and for the post-harvest months, August-December, when mills do not operate. It is important to note that although there is no change in domestic violence hospitalizations among the hospitals in the catchment area of a mill after the harvest season relative to the pre-harvest, the post-harvest levels of hospitalizations are still lower compared to the cases from the hospitals outside of the catchment areas. The results suggest the following two points. First, there is a decline in severe domestic violence cases during the harvest months within the year when mills operate. Second, a portion of the annual decrease in self-reported domestic violence stems from the decline in domestic violence hospitalizations during the harvest season.

As a placebo test, I present effects on women's hospitalizations other than domestic violence. I find no changes. This rules out the concern that women go to a hospital less during the harvest season due to the increased opportunity cost of time. Moreover, since the results are based on the

[6] The occupation for each spouse remains unchanged.

universe of administrative data for domestic violence, they are not subject to reporting bias.

In the second part of the paper, I investigate the mechanisms behind the decline in domestic violence. I first present a conceptual framework. The husband decides whether to inflict violence and the wife decides to divorce. The level of satisfaction with the marriage is private information for each spouse. A mill opening affects violence in four ways. First, as the wife transitions to paid work, her outside option, the utility of being single, improves. This increases the probability of her initiating divorce. Second, the husband is incentivized to choose violence to extract the wife's earnings. Third, as household earnings increases either via an increase in his or the wife's earnings, the husband's marginal non-monetary benefit from violence (e.g. financial stress relief) decreases, i.e., the income effect. Fourth, as the mill operates, the husband's cost of incapacitating his wife increases. When the wife's outside option due to her job is good enough, the husband's extraction rate and his non-monetary utility from violence based on household earnings is small enough, or his cost of incapacitating his wife is high enough, violence decreases. Exposure reduction, the reduction in the time couples spend together with a mill opening, is also a plausible mechanism behind a decline in violence, but I am able to rule it out empirically.[7]

To uncover the mechanisms behind the decline in violence empirically, I first show that upon a mill opening, women in the catchment areas are more likely to make household decisions alone or jointly with their partners, including large household purchases and contraception usage.[8] This suggests that a mill opening improves women's outside options and, thus, their bargaining power in the household. Second, I show a decline in domestic violence even among couples with different occupations where the wife works in agriculture and the husband works in a non-agricultural manual job.[9] Unlike farmer couples, these couples do not work together; thus, a mill opening is not a shock to the time they are exposed to each other during work hours. Finding a decline in violence among these couples, especially similar in magnitude relative to the estimate based on the whole sample, suggests that exposure reduction is not the dominant mechanism behind the results.

Using earnings data, I also find that among the couples mentioned above, where the husband works in a non-agricultural manual job, mill exposure significantly increases the wife's earnings. However, there is no change in the husband's earnings. This shows that there is a decline in violence even among couples where an increase in household resources is only via women's paid employment, not the husband's earnings. This suggests three key points. First, women's employment is a key driver behind the decline in domestic violence in the main sample.[10] Second, given a decline in violence among couples with an increase in women's earnings only, extractive vio-

[7]Criminologists develop the theory of exposure reduction to argue that an increase in female employment may reduce domestic violence due to the decline in the time couples spend together (Dugan et al., 1999).

[8]This is compared to their husbands or someone else in the family is making the decisions for them.

[9]Plumber, construction worker, etc. Occupations do not change with a mill opening.

[10]The increase in household resources due to the husband's earnings is not the sole mechanism.

lence is not the dominant mechanism. Third, an increase in household income due to women's paid employment is also a plausible mechanism behind the results. Does women's employment affect domestic violence beyond increasing the wife's income, thus the bargaining power, and the household income?

Using consumption data, I show that one month after the harvest season, August, mill-exposed households continue to enjoy a higher consumption than the pre-harvest, plausibly due to saving harvest income derived by selling cherries to the mill and the wife's wages from the mill. Yet, in August, there is no change in the domestic violence hospitalizations compared to the pre-harvest, when mills do not operate. Plausibly, the wife's outside option in the catchment area is the same right before and after the end of harvest season since the husband knows that his wife has a job opportunity the following year.[11] These suggest that the increase in the cost of women's incapacitation when mills operate, not an income effect, drives the seasonal decline in violence hospitalizations.[12] Moreover, using data on crops, I find that in the Irish potato suitable areas where there is no increase in the value of women's capacity to work in their unpaid tasks and women mainly do not contribute to household earnings via paid work, there is no decline in violence hospitalizations during the potato harvest months when households consume more compared to pre-harvest. This further confirms that keeping women's outside options constant, when the value of the wife's capacity to work is fixed within the year, there is no change in domestic violence hospitalizations.

My results are robust to using estimators proposed in de Chaisemartin and D'Haultfœuille (2020) and Sun and Abraham (2020) that tackle heterogeneous treatment effects. I also perform robustness checks related to catchment area measurement. I use different catchment area sizes, 5 and 10 km. I show that as the buffer radius increases, the more untreated couples are counted as treated, the effects of mill exposure fade out for all main outcome variables. This rules out the concern that the couples residing right outside of the catchment area are sorting themselves into the treatment group. I also investigate the dynamic impact of a mill opening using a DID event study, exploiting the number of years couples are exposed to a mill opening. For the years before a mill opening, the coefficients are close to zero and statistically insignificant for all variables.

This study makes two main contributions. First, it presents novel empirical evidence that providing job opportunities to women decreases domestic violence when women's incapacitation due to violence is costly for the husband. It provides evidence that an increase in women's outside options and their contribution to household earnings also operate as mechanisms. To the best of my

[11] Based on the annual self-reported results, there is a difference in bargaining power between women within and outside the catchment areas. This is in line with the fact that although there is no change in violence hospitalizations among the hospitals in the catchment area of a mill after the harvest season relative to the pre-harvest, the post-harvest levels of hospitalizations are still lower compared to the cases from the hospitals outside of the catchment areas.

[12] This does not rule out that the income effect is a plausible mechanism behind the decline in non-severe domestic violence cases where women do not go to the hospital and self-report in the annual household survey.

knowledge, this is the first paper to introduce women's work capacity/labor market productivity as a channel behind the relationship between women's employment and domestic violence and to provide causal evidence to support it. A growing empirical literature on domestic violence provides evidence for the increase in women's outside options (Aizer 2010, Anderberg et al. 2016, Hidrobo et al. 2016, Haushofer et al. 2019, Adams-Prassl et al. 2023, Lowes 2023), reduction in financial stress (Angelucci 2008, Bhalotra et al. 2019, Heath et al. 2020, Arenas-Arroyo et al. 2021, Bhalotra et al. 2021), exposure reduction (Chin, 2011), extractive/instrumental violence (Bloch and Rao 2002, Eswaran and Malhotra 2011, Bobonis et al. 2013, Heath 2014, Anderson and Genicot 2015, Erten and Keskin 2018, Bhalotra et al. 2019, Calvi and Keskar 2021, Erten and Keskin 2021a, Erten and Keskin 2021b) and male backlash (Angelucci 2008, Luke and Munshi 2011, Tur-Prats 2021, Alesina et al. 2020, Guarnieri and Rainer 2021).

Second, the results add to the literature on female labor force participation (FLFP) in developing countries. Since FLFP is strikingly low in most developing countries, the literature focuses on the drivers of FLFP and the effects of interventions that can foster it. These include cultural practices, trade liberalization, residence patterns, microcredit, education, cash transfers, correcting husbands' beliefs, laws, opening bank accounts and psychosocial interventions (Alesina et al. 2013 AlAzzawi 2014, Juhn et al. 2014, Gaddis and Pieters 2017, Khanna and Pandey 2020, Angelucci et al. 2015, Banerjee et al. 2015, Keats 2018, Baird et al. 2019, Bursztyn et al. 2020, Hyland et al. 2020, Field et al. 2021, McKelway 2021). In this paper, I focus on the consequences of women's employment. Heath and Jayachandran (2017) reviews the literature on FLFP in developing countries and highlights that increased job availability for women is found to affect women's marriage, fertility and education decisions (Jensen 2012, Sivasankaran 2014, Heath and Mobarak 2015), children's health (Qian 2008, Atkin 2009) and bargaining power (Anderson and Eswaran 2009, Majlesi 2016). My results and evidence on the mechanisms shed light on how the interventions and phenomena that increase female employment in developing countries, including access to international trade, may affect women beyond their labor supply and improve their health and physical security in the household. Results also demonstrate that employment may affect women's health beyond income, via the value of work capacity, and complement Hussam et al. (2022), which provides experimental evidence that employment raises (psychosocial) well-being substantially more than cash alone.[13] On the other side of the coin, results suggest that shocks that may lead to women's unemployment, including climate change-induced weather shocks and automation, may worsen

[13] Hussam et al. (2022) focuses on the psychosocial value of employment, where I focus on women's (mental and physical) capacity to work and how it operates as a channel behind a decline in domestic violence. In Hussam et al. (2023), their pre-analysis plan in the AEA RCT registry, the authors highlight that they study the psychosocial value of employment across genders and its effects on domestic violence in their context, the Rohingya refugee camps, where there is male unemployment. They focus on how the psychosocial value of employment, not the women's capacity to work, affects the power dynamics within the household.

women's position in the household and health.

Do the results indicate that providing jobs to women decreases domestic violence in every context? Unfortunately, no. Yet, a comprehensive analysis of the mechanisms sheds light on the conditions for external validity. According to the conceptual framework, providing jobs to women decreases violence *if* the woman's threat of separation is credible and the husband benefits from women's labor market productivity. In Rwanda, divorce is a credible threat based on the laws and social norms (Sanin, 2021), and my time in the field and data suggest that the husband benefits from his wife's work capacity. Suppose a woman is not working with her husband on a family farm, provided with a job opportunity in a factory and not sharing her earnings with her husband based on social norms. Then the husband's incentive to extract the wife's earnings can either dominate or offset the gains from an increase in the woman's outside option. If divorce is not a credible threat in the context, the job will not increase the woman's outside option in the first place. These points may explain why Kotsadam and Villanger (2022) find no effects of providing factory jobs to women on physical domestic violence in Ethiopia, where the divorce rate is lower and a larger share of women decides by themselves (not jointly with their husbands) on how to use their cash earnings compared to Rwanda.[14] Thus, although a job may benefit women more than a cash transfer, a policymaker should pay attention to the following during policy design: Whether the husband has an economic self-interest in the wife's work capacity and the threat of separation is credible in the context.

The organization of the paper is as follows. Section 2 provides background information on the Rwandan coffee industry, rapid expansion of the mills and women's employment in the coffee value chain. Section 3 introduces data sources. Section 4 outlines the identifying assumptions, threats to identification and propose the identification strategy. Section 5 present the empirical results. Section 6 introduces the theoretical framework that guides the mechanisms. Section 7 uncover the mechanisms empirically. Section 8 provides robustness checks. Section 9 concludes.

2 Institutional Context

In this section, I provide background information on the coffee industry in Rwanda, rapid expansion of the mills following the agricultural reforms in the early 2000s and women's employment in the coffee value chain and the mills.

[14] These statistics are based on DHS Rwanda and Ethiopia. The social norms of each context plausibly shape the sharing rule on women's earnings.

2.1 The Coffee Industry in Rwanda

Coffee production and processing. The first two stages of the coffee value chain, cultivation and processing, are the stages of interest throughout the paper. Both stages include labor-intensive processes which affect the quality of the end product.

A coffee tree produces coffee cherries that contain coffee beans. It takes at least three to five years for a coffee tree to make cherries after it is planted. When the cherries ripen, they should be harvested (picked) by hand. The cherries do not ripen all at once, making harvesting labor-intensive. The harvest season lasts for approximately four to five months. It lasts from March to July in Rwanda and the peak of the harvest is from May to July.

After harvest, coffee needs to be processed. Processing is made up of three main tasks. The first task is cleaning, which is removing the outer layer (pulp) of the coffee beans. The coffee beans are dried under the sun on flat surfaces in the second task.[15] In the third task, the defective dried coffee beans are sorted out by hand based on their color and size, which is a labor-intensive process like harvesting.

There are two possible methods to process coffee cherries: dry and wet. In dry processing, also known as the traditional method due to being the oldest coffee processing method, all tasks are done by farmers at their homes without machinery.[16] The outcome of this process yields a low-quality product sold in the local market for a very low price.

Agricultural Reforms. In 2000, Paul Kagame came into power and prioritized economic growth to rebuild the country after the Rwandan Genocide (1994). He launched the Vision 2020 program in 2000 (Boudreaux, 2011). The program outlined a list of goals that the government aimed to achieve by 2020. One of the main goals was to transform agriculture into a high-value sector. In light of this goal, the government adopted the National Coffee Strategy in 2002, which aimed to shift to high-quality, wet-processed coffee production to participate in the international specialty coffee market (Boudreaux, 2011). At the time, 90% of the Rwandan coffee was dry-processed and thus classified as low-quality (MINAGRI and MINICOM, 2008). The government also liberalized the coffee industry and removed barriers to international trade (Boudreaux, 2011).

The reforms in the coffee industry changed the incentives of individuals in the coffee value chain. First and foremost, farmers started to have the incentive to use wet-processing rather than dry-processing since it yields a higher income (Boudreaux, 2011). Exporters compete to sell the wet-processed coffee to foreign buyers. Foreign buyers are interested in buying the Rwandan coffee since the quality increased as the coffee is now wet-processed.

[15]The dried beans are called parchment coffee.

[16]Farmers clean cherries using rocks and then dry the beans on mats (Macchiavello and Morjaria, 2020).

Expansion of the Mills. Between 2000-2006, governmental institutions collaborated with USAID, universities in Rwanda and U.S., and private sector partners under the Partnership to Enhance Agriculture in Rwanda through Linkages (PEARL) project. The project helped farmers to establish cooperatives, find loans and build mills in their communities in a few locations. After the project, farmers continued establishing cooperatives and building mills in their communities nationwide.

Figure 1 shows the expansion of the mills in Rwanda over the last decades. The expansion started after the National Coffee Strategy in 2002. Following the PEARL project, the number of mills expanded most rapidly between 2005-2010. In 2005, the total number of mills was 49. In 2011, the number quadrupled to 197. In 2018, it increased to more than 300.

Mill Suitability. There is geographical variation in mill locations. Figure 2 visualizes the spatial variation. The expansion of the mills was mostly concentrated in areas with a high number of coffee trees in 1999, before the adoption of the National Coffee Strategy in 2002.

The number one condition for mill suitability is the area with sufficient coffee trees (Schilling and McConnell, 2004). This is mainly because the harvested coffee cherries should be transported to the mills within two hours of harvest. Otherwise, they will rot (Schilling and McConnell 2004, Macchiavello and Morjaria 2020). This is why a mill has a specific catchment area and serves the coffee farmers who produce coffee close to the mill.[17]

An overwhelming majority of the country is suitable for coffee cultivation.[18] Figure A1 visualizes FAO-GAEZ coffee suitability index and confirms that the country is suitable for coffee production. Arabica coffee, the dominant plant type in Rwanda, grows best at an altitude over 1,000 meters (3,000 and 6,000 feet) and at an average temperature between 15 and 24 °C (59 and 75 °F). Nicknamed as "The Land of the Thousand Hills", Rwanda's hillsides provide the ideal conditions to cultivate coffee.

Figure 2 and Figure A1 show that over time, the number of coffee trees also increased in the coffee suitable areas that did not have coffee trees in 1999. However, the rapid expansion between 2005-2010 is concentrated mainly in regions with coffee trees already in 1999. This is because producing coffee beans takes at least 3-5 years for a newly planted coffee tree.

In Section 4.1, I investigate the determinants of a mill opening and present supporting evidence that conditional on agricultural conditions related to mill suitability, the timing and location of a mill opening are random.

[17] Most farmers carry their harvest to mills by walking.

[18] Coffee plants (*coffea*) is found in the tropical areas of Africa, South America and Asia, which is termed as "the coffee/bean belt". The belt provides the necessary conditions for the coffee plants to grow. Such conditions include specific ranges of temperature, rainfall, altitude and soil characteristics.

2.2 Women's employment in the coffee value chain and the mills

The division of labor in the coffee value chain is gendered. This holds not just for Rwanda but in coffee-producing countries in general. According to the International Trade Forum's (ITC) survey that was conducted in 15 coffee-producing ITC member countries -most of them are developing countries and Rwanda is one of them- women mostly take place in the earlier labor-intensive steps in the value chain compared to the latter stages. Survey results is reported in Table 1. Women constitute 70% of the workforce in harvesting and processing. Only 10% of them are doing sale activities like in-country trading or exporting (Scholer, 2008). Drying and sorting are female-dominated tasks and marketing and selling the product are male-dominated. As coffee transforms from a commodity into a value-added product, tasks in the coffee value chain become male-dominated (SCAA Sustainability Council, 2015).

Table 1: Women's Participation in the Coffee Value Chain in Coffee Producing Countries

Tasks in the value chain	Participation Variation (Min-Max)	Typical Participation
Fieldwork	10-90%	70%
Harvest	20-80%	70%
Sorting	20-95%	75%
In-country trading	5-50%	10%
Export	0-40%	10%
Other (certification, laboratories)	5-35%	20%

Source: International Trade Forum, 2008

In Rwanda, coffee farmers are smallholder farmers, mostly couples, and own a small plot for coffee production. Before a mill opening, the wife harvests the coffee cherries with the husband and then processes them at home as a female-dominated task. The husband sells the home-processed coffee in the local market for a low price as a male-dominated task and receives the income as his personal earnings. Although the wife works in labor-intensive stages, the wife does not have personal income, and depends on the husband financially due to the gendered division of labor in the coffee value chain.

After a mill opening, the couple harvests and carries the cherries to the mill and the husband sells it to the mill for a high premium. The husband earns a higher income from selling cherries to mills compared to selling home-processed coffee in the local market (Macchiavello and Morjaria, 2020) since the mill-processed coffee has a higher quality compared to home-processed coffee and is sold in the international coffee market.[19] Farmers outside of the catchment areas continue

[19] Macchiavello and Morjaria (2020) surveys the coffee farmers in Rwanda in 2019. The survey asks about the relative profitability of the two processing methods. 98% of the farmers reported that selling cherries to mills is more profitable than home processing.

to process coffee at home after a mill opening and sell their harvest in the local market for a low price. The mill demands paid labor during the harvest months, March-July, for the drying and sorting tasks that its machinery cannot do.[20] Since the tasks are female-dominated, the mill enables the wife to transition from being an unpaid family worker in her family plot to a wage worker in the mill for the same processing tasks as before and have personal earnings. Based on the setting, a mill opening affects women's employment in two ways. First, a mill opening increases the value of the wife's capacity to work on her tasks. Second, the mill allows the wife to work for pay outside of the home for her coffee processing tasks. Thus, she has personal earnings that she shares with the husband according to data.

In 2012, authors of Macchiavello and Morjaria (2020) surveyed the coffee farmers who sell cherries to a coffee mill in Rwanda, where the survey results confirm that a mill opening affects women and men differently. On average, a mill buys cherries from 400 farmers. 71% of the survey respondents are men, which confirms that selling cherries is a male-dominated task.[21] To provide more information on the context, 55% of the farmers that answered the survey are coffee cooperative members. 50% of the mills are owned/run by coffee farmer cooperatives. If a mill is owned/run by a cooperative, the coffee farmers in a region gathered together, established a cooperative and built a mill. Based on the numbers, and my time in the field, typically, the cooperative member farmer husband sells coffee cherries to a mill and his wife works in the mills during the harvest season, March-July.

3 Data

The paper uses three sets of data -panel of mills, individual and household level data and administrative, hospital level domestic violence data- to measure the effect of mill exposure on labor market and domestic violence outcomes.

3.1 Panel of Mills

Mills Data. I create a panel of mills with information on GPS coordinates and the year of operation of every mill in Rwanda as of 2018 by harmonizing the data from The Rwanda GeoPortal and Macchiavello and Morjaria (2020). The harmonized data also has information on the owner type

[20]Within the harvest months on a given day, multiple farmers bring their cherries to a mill. The cherries are combined and washed with the machinery in the mills. In the following days, mills demand paid labor for the female-dominated drying and sorting tasks where women can work.

[21]Based on my data, the remaining percent is in line with the share of farmer women who are married to non-farmer husbands or widows.

for most mills.[22]

Coffee Census and FAO-GAEZ Suitability Index. To study the determinants of a mill opening and construct control variables, I match the mills data with several rounds (1999, 2003, 2009, and 2015) of Rwandan Coffee Census and FAO's Global Agro-Ecological Zones (FAO-GAEZ) coffee suitability index for 1980-2010. The coffee censuses provide information on the universe of coffee trees in Rwanda at the sector level (a geographical unit with a mean area of approximately 60 km^2). The index provides a coffee suitability score for Rwanda at 9 km^2 resolution. I aggregated the index at the sector level.

Table A1 provides summary statistics. 50% of the mills are owned by cooperatives. Only 25% of them are owned by NGOs, and entrepreneurs or private companies own the remaining.[23] Mills are built in the areas where there were already coffee trees and coffee farmers in 1999, before the National Coffee Strategy in 2002. 64% of the mills are built in areas where the FAO-GAEZ coffee suitability index is either moderate, medium, or good. In Section 4.1, I provide evidence that the historical number of coffee trees and the coffee suitability index are the potential predictors of mill placement and mill placement is uncorrelated with factors that can affect the evolution of female paid employment and domestic violence rates in Rwanda. I present more details related to the panel of mills in Appendix A3.1.

3.2 Individual and Household Level Data

Rwandan Demographic Health Surveys. As a first step of my analysis, I show the impact of the expansion of the mills on paid employment using the Rwandan Demographic Health Surveys (DHS). DHS is a nationally representative, cross-section individual and household-level survey conducted in developing countries every five years. I use 2005, 2010/11, 2014/15 and 2019/2020 cycles for my analysis.[24] The surveys collect demographic and health information from women aged 15-49 and men aged 18-59. The data also provide household member information, which enables me to link couples to each other for my analysis.

The information on employment and type of earnings is collected retrospectively during the individuals' interview: individuals are asked to answer whether they have been employed for the last 12 months and, if so, whether they have worked for cash. Due to retrospective questions, DHS data enables me to observe five harvest years in total, 2004, 2005, 2010, 2014 and 2019. I

[22] Macchiavello and Morjaria (2020) covers the mills opened before 2013 only but have information on mill characteristics such as owner type of the mill. The data on mills from the Rwanda GeoPortal covers all the mills but does not have information on the owner type for every mill.

[23] These statistics are based on Macchiavello and Morjaria (2020) which studies mills that started operating before 2012.

[24] In the 2019/2020 cycle, I use 2019 observations only to avoid the results being affected by COVID-19.

create a binary variable that takes the value one if an individual worked for cash in the last 12 months. Tables A2 and A5 provide descriptive statistics for women and their husbands. 88% of women worked in the past 12 months, whereas only 39% of them worked for cash. Majority of the couples' occupation is agricultural where they are self-employed (farmers).[25]

DHS classifies domestic violence categories (physical, sexual and emotional) with respect to World Health Organization (WHO) guidelines. I create a binary variable that takes the value of one if a partnered woman experienced physical or sexual domestic violence in the last 12 months. The domestic violence variable does not include emotional violence since it is not collected in every DHS cycle during my study period. According to data, 34% of women self-reported experiencing domestic violence in the past 12 months.

The surveys also collect GPS coordinates for every cluster of households. I spatially merge the DHS data with the mills data using the GPS coordinates. Due to the random displacement (to maintain the confidentiality of respondents), rural clusters contain a minimum of 0 and a maximum of 5 kilometers of positional error. Thus, GPS displacement may lead to measurement error and bias the results (Perez-Heydrich et al., 2013). To reduce distance measurement error, I follow Perez-Heydrich et al. (2013), which suggests using a buffer distance rather than the closest distance when using a distance measure. All the distances calculated in the paper are based on a buffer distance measure. I revisit this issue in the robustness checks section.

I restricted the sample to women who are partnered (civil marriage and those living together) before the expansion of the mills to avoid changes in the marriage market matching.

Integrated Household Living Conditions Surveys. I complement my analysis using Integrated Household Living Conditions Survey (EICV). EICV is a nationally representative, cross-section individual and household-level survey that is conducted in Rwanda. I use 2005, 2011, 2013/14 and 2016/17 cycles for my analysis. The surveys collect demographic and socioeconomic information from households. I use the last daily labor income amount (cash) to investigate further the impact of the mill expansion on the labor market and uncover the mechanisms behind the effects on domestic violence. Table A8 provides descriptive statistics. On average, women earn less compared to their husbands and couples who live in mill-exposed areas earn more than those who do not.

The surveys collect the district of residence as the smallest geographical unit for each individual/household. There are, in total, 30 districts in Rwanda. I aggregate the panel of mills at the district level and merge it with individual and household-level variables for my analysis. Again, I restrict the sample to women who are partnered (civil marriage and those living together). More

[25]Tables A3, A4 and A6 provide summary statistics based on treatment status (averages for never-treated sectors, sectors before a mill opening and inside the catchment areas) which are all in line with the averages in Tables A2 and A5.

details on EICV and DHS data are available in Appendix A3.2.

3.3 Administrative Hospital Level Domestic Violence Data

To investigate the impact of providing employment opportunities to women on domestic violence, I also use confidential, administrative, geocoded data on the universe of public/district hospitals from the Rwandan Ministry of Health (MOH). Rwandan Health Management Information System (HMIS) data is a monthly district hospital-level data on hospitalizations between January 2012 to July 2019.[26]

There are, in total, 42 district hospitals in Rwanda. Due to the institutional structure of the hospitals, the data is on the universe of official domestic violence reports in the country. It collects information on the number of individuals (both women and men) who show symptoms of physical and sexual violence for different age groups (10-18, older than 18). Unfortunately, the data does not provide information on the patient's marital status. To create a measure of domestic violence, I focus on the gender-based violence reports of individuals who are older than 18 years old. This is because 70% of women over 18 are married in Rwanda.

I constructed a binary variable coded as 1 if a hospital had hospitalizations due to physical or sexual violence for women older than 18 in a month and 0 otherwise. This creates a non-self-reported measure of domestic violence. Table A7 provides descriptive statistics for the hospitals. 86% of the hospitals have hosted at least a domestic violence patient (GBV patient older than 18) in a given month. Geocoded nature of the data enables me to match this measure of domestic violence with the panel of mills. Figure 5 plots the share of hospitals that have at least one gender-based violence patient women older than 18 in a year for areas that are exposed and not exposed to a mill. Two main facts emerge from the data: On average, domestic violence hospitalizations are lower in the mill-exposed areas compared to the unexposed areas within a year and the domestic violence hospitalizations in the mill-exposed areas decreases when mills are operating. More details on the data are available in Appendix A3.3.

3.4 Measuring Exposure to Mills: Treatment and Control Groups

Throughout the paper, the treatment group consists of entities (woman/husband/hospital) who are exposed to the mills, whereas the control group consists of entities who are not. I construct two measures of exposure to the mills, being in the catchment area of a mill and mills per capita in a district. I also construct multiple control groups with respect to the measures I create.

[26]I drop the years 2016 and 2017 due to droughts in those years. I also dropped the year 2015 since there are some changes in the questions within a year.

The first mill exposure measure, being in the catchment area of a mill, is used when the outcome variables are created with geo-coded datasets (DHS and HMIS). The measure uses the GPS coordinates of the mills and DHS clusters/hospitals and calculates whether the clusters/hospitals are within the catchment area of a mill. In most cases, mills are located within a radius of 3–5 km away from the farmers (AgriLogic, 2018). On average, managers of the mills in Rwanda report that the catchment areas have a radius of approximately 4.5 km (Macchiavello and Morjaria, 2020). I created a buffer with a 4 km radius centered around the mills to construct the catchment area (treatment group). I define a DHS cluster/hospital within the catchment area of a mill if the GPS coordinate of the DHS cluster/hospital falls inside the buffer around a mill.

I consider two potential control groups in my analysis when using DHS data. The first control group consists of the DHS clusters that are outside the mills' catchment area (4 km buffer) but located within the same district as the mills. I define using this control group as the "within-district approach". An alternative control group consists of only the DHS clusters within the donut area between 4 and 8 km from the mills. Since I restrict the control group only to DHS clusters within the surface area of a donut, I define using this control group as the "donut approach". Figure 3 shows a visual representation of the treatment and the two control groups using a mill in Nyarugenge district and DHS clusters. In both maps, the treatment group is the circular area (buffer around the triangle/mill). In the left-hand-side map, which visualizes the within-district approach, everywhere outside the buffer characterizes the control group. In the right-hand-side map, which visualizes the donut approach, only the donut area constitutes the control group.

For HMIS (hospital) data, the control group consists of the hospitals outside the catchment area of the mills but located within the same province as the mills. This choice is due to the sample size and locations of the hospitals. There are only 42 hospitals in the country and most of the hospitals not in the catchment area of a mill are located outside of the same district with the mill and the donut area between 4 and 8 km from the mill. Figure 4 shows a visual representation of the treated and control hospitals. The ones in the catchment areas are treated hospitals where the ones outside (within the same province) are control hospitals. The underlying assumption I make in the hospital specification is that households within (outside of) the catchment area visit a hospital inside (outside) of the catchment area rather than the one outside (inside) due to the hospital's proximity.[27]

[27] This is a plausible assumption since the cost of visiting a hospital far away in case of a health problem is more costly compared to visiting the closer one (within the catchment area). I create 4 km buffers around the hospitals to check what percent of the buffers around the control hospitals do not intersect with mill buffers. The logic here is that if the rate of no intersection is high, then most control hospitals are far enough from the households within the catchment areas. Thus, those households within the catchment areas plausibly go to the hospitals within the catchment areas and those outside of the catchment areas go to the ones outside due to proximity. I find that 70% of the control hospital buffers do not intersect with mill buffers. In any case, if a household within the catchment area of a mill visits a hospital outside of the catchment area, this suggests that my results constitute a lower bound. There are three

The second mill exposure measure, the log of mills per capita, is used when the outcome variables are created with a non-geo-coded dataset (earnings data, EICV). The measure is the log of total number of mills in a district in a given year divided by the number of working age individuals living in the district in that year.[28]

4 Empirical Specification

This section proposes the identification strategy to estimate the causal impact of a mill opening on women's labor market outcomes and domestic violence. I use a difference-in-differences strategy that uses the differential timing of and spatial variation in a mill opening.

4.1 Identifying Assumptions and Threats to Identification

The key identifying assumption of the empirical strategy is that the average outcomes for the treatment and control groups would have parallel trends in the absence of treatment, a mill placement. A mill opening at a specific location in a given year is assumed to be uncorrelated with other determinants of changes in the outcome variables (women's labor market outcomes and domestic violence) over time (the treatment is not endogenous). The parallel trends assumption is violated if a mill placement is endogenous. This is because, in counterfactual, the areas who are exposed to the mill would have diverged anyway, regardless of the mill.

To provide suggestive evidence in favor of my identifying assumption, I estimate, at the sector level, the determinants of having the first mill during the period when mills expanded rapidly, between 2005-2010, and having a mill by the end of my sample, 2018. Firstly, I focus on the variables related to coffee cultivation, including the historical number of coffee trees and the FAO-GAEZ coffee suitability index. I also include the shares of women who are unpaid family workers, self-employed, and completed primary school at the sector level before the expansion of the mills and the percentage of men who completed primary school in the regression. This is to confirm that mill placement is uncorrelated with factors that can affect the evolution of female paid employment and domestic violence rates in Rwanda. I used the Rwanda Population and Housing Census 2002 to create the variables. I also included the total population and female population at the sector level. Unfortunately, I cannot include domestic violence rates before the expansion in the regression since domestic violence data started to be collected in 2005, after the expansion began. However, since education (women and men's) are correlated with the probability of experiencing domestic

hospitals that are not in the catchment area of a mill but are surrounded by multiple mills. I defined them as treatment hospitals. When I redefined them as control hospitals, I still observed a decline in domestic violence hospitalizations during the harvest season.

[28] Individuals aged 19-59 are selected in EICV to match the age profile in the DHS sample.

violence, including them in the regression constitutes a test on whether the placement of the mills is correlated with the evolution of domestic violence rates in Rwanda.

I also include other variables related to promoting female empowerment, including the share of women in a consensual union, polygamous marriage, without assets and the number of daughters per woman. If these variables are uncorrelated with mill placement, then it provides supporting evidence that the mills are not placed to promote female empowerment; hence, mill placement is not endogenous. Moreover, I include genocide intensity since it is also a variable that is found to impact the probability of experiencing domestic violence in Rwanda (La Mattina, 2017). It is also possible that the government or NGOs are more likely to financially support the opening of a mill in genocide intense areas to promote female empowerment, which can make the opening of a mill endogenous. District fixed effects are included in all specifications.

I report the results in Table A10. The results support the evidence that variables related to coffee, the number of coffee trees in 1999 and FAO-GAEZ coffee suitability predicts mills placement. Specifically, sectors with more coffee trees in 1999 are more likely to have their first mill between 2005-2010. Those areas are also more likely to have a mill by 2018. Similarly, sectors with a higher FAO-GAEZ coffee suitability index are more likely to have their first mill between 2005-2010. Based on the results, the historical number of coffee trees is more likely to be correlated with the rapid expansion of the mill compared to the FAO-GAEZ coffee suitability index. This is not surprising. Before the expansion, not every coffee-suitable area in Rwanda had coffee trees and it takes a minimum of 3-5 years for a coffee tree to produce coffee cherries. Thus, it is likely to observe the rapid expansion of the mills between 2005-2010 in areas with coffee trees before the expansion, like in 1999.

All variables other than the number of coffee trees in 1999 and the FAO-GAEZ coffee suitability index are statistically insignificant. Specifically, pre-expansion female unpaid employment and female, male primary education rates do not predict mill placement. None of the variables related to female empowerment is statistically significant. Genocide-intensity does not have a statistically significant impact on mill expansion. I also test the joint significance of the relationship between a mill opening and non-coffee variables. For both regressions, I cannot reject the null hypothesis (p-value=0.4954 and p-value=0.6026). These results suggest that mills are not placed to promote female empowerment. They are uncorrelated to the factors that can impact the evolution of female paid employment and domestic violence over time. Thus, conditional on mill suitability based on coffee-related variables, the opening of a mill is assumed to be random. I control for the historical number of coffee trees and FAO-GAEZ coffee suitability index in all of the specifications.

In Section 8, I also perform an event-study analysis for all of my main outcome variables that exploits the variation in the number of years couples are exposed to a mill. There is no pre-trends in outcomes.

4.2 Employment and Self-Reported Domestic Violence

In order to investigate the impact of a mill opening on women's and their husbands' outcomes, I estimate the specification below:

$$Y_{ist} = \beta_0 + \beta_1 Mill_{ist} + \mathbf{X_{ist}}\phi + \lambda_c + \omega_m + \alpha_s + \gamma_{dt} + (\mathbf{X_s} \times t)\theta + \varepsilon_{ist}. \quad (1)$$

The dependent variable Y_{ist} is the outcome of interest of woman i (or the husband of woman i), in sector s and at year t. $Mills_{ist}$ is a binary variable coded as 1 if woman/husband i at year t resides within the catchment area of a mill and zero otherwise. I have a rich set of individual controls, $\mathbf{X_{ist}}$, that includes information on women's/husbands' occupation, education, religion, number of children, marital status, age and duration of marriage, residence (rural/urban) and household wealth. I also control for partner characteristics like age, occupation and education. λ_c is the cohort fixed effects and controls for factors that vary across cohorts. As an example, compared to younger cohorts, older cohorts grew up when Rwanda did not have pro-women laws, which may affect their labor market participation and acceptance of domestic violence. ω_m is the year of marriage fixed effects. It controls for time-variant shocks to the marriage market, such as the Rwandan Genocide that is documented to affect marriage quality in Rwanda (La Mattina 2017, Sanin 2021).[29] α_s is the sector fixed effects and controls for time-invariant local observable and unobservable characteristics, such as social norms related to women's employment, domestic violence and gender roles.

γ_{dt} is the district-by-year fixed effects. This controls factors that change over time and across districts and may determine both a mill opening and female empowerment such as female political participation. As of 2008, Rwanda is the first country in the world with a female majority in parliament. The share of women in local government varies across districts and increases over time. Districts (akarere) are the geographical units with the highest tier in local government. District councils decide on local development programs within districts. As a possible concern, after an increase in female political representation in a district council, the local government may financially support cooperatives that want to open mills to promote female paid employment. District-by-year fixed effects control for such a scenario. $\mathbf{X_s}$ is a vector of baseline geographical variables at the sector level, such as the historical number of coffee trees in 1991 and the FAO-GAEZ coffee suitability index. I interact these initial conditions with linear time trends to allow their impact to vary

[29] La Mattina (2017) shows that the timing of marriage (before or after the genocide) has an impact on the probability of experiencing domestic violence in Rwanda. Sanin (2021) investigates the effect of adopting the domestic violence legislation in Rwanda in 2008, which allows women to unilaterally divorce their husbands if their husbands are violent towards them. After the law, among the women who married after the genocide, the divorce rates increased more and sexual domestic violence rates increased less in the formerly genocide-intense areas, where women are more likely to be in violent marriages. No effect is observed for women who married right before the genocide.

over time. The interaction mitigates potential omitted variable bias. This is because coffee tree presence in 1999 is correlated with mill openings after 2002 and it may also affect the evolution of female paid employment over time. I cluster standard errors at the sector level.

The main dependent variables for this specification are being employed, working for cash and experiencing domestic violence in the past 12 months. All outcomes are indicator variables. For example, working for cash in the past 12 months variable takes the value one if the respondent worked for cash in the past 12 months and 0 otherwise. Domestic violence in the past 12 months variable takes the value one if a partnered woman experienced physical or sexual domestic violence in the past 12 months and 0 otherwise. I also use dependent variables like occupations (manager, sales, agricultural self-employed, agricultural employee, skilled manual, unskilled manual) and household decision-making (whether large household purchases are decided by women alone or jointly with husband compared to the husband alone).

The coefficient of interest is β_1, which identifies the impact of a mill opening on the outcome variables. The treated group consists of woman/husband who reside in the catchment area of a mill. The control group either consists of woman/husband who do not reside in the catchment area of a mill within the same district (within district approach) or a woman/husband who resides within the donut area between 4 and 8 km from a mill (donut approach).

Balance Checks. Tables A11 and A12 examine whether predetermined covariates including women's agricultural occupation, education, religion, marriage type, age at first marriage, partner characteristics and living conditions (electricity, cement floor in the household) are balanced across treatment and control groups. I perform the test by estimating the specification given in equation 1 using each of the predetermined covariates as the dependent variable. None of the estimates are statistically significant, suggesting that the baseline characteristics are balanced across the treatment and control groups.

Placebo Test. I also perform a placebo test to show that outcome variables are balanced across treatment and control groups before a mill opening. For this test, I drop the women who reside within the catchment area of a mill in a given year (2004, 2005, 2010 and 2014) from the sample. I construct the treatment group as women who live in areas that do not have a mill yet. The areas will receive a mill and become catchment areas in the upcoming years. Thus, I am *falsely assuming* that the women who reside in those areas are exposed to a mill and in the treatment group. The control group consists of women who live in areas outside of the future catchment areas. I again use both the within-district and donut approaches. Women in both groups self-report their labor market outcomes and domestic violence experience for a given year before a mill opening. Since both groups are not exposed to a mill, I expect to see no statistical differences between them. I perform the placebo test by estimating the specification given in equation 1 using the aforementioned treatment and control groups. Table A13 reports the results. None of the estimates are statistically significant, suggesting that the outcome variables are balanced across treatment and control groups before a mill opening.

4.3 Earnings

I also test the impact of a mill on earnings (women and their partners each).[30] Unfortunately, the data on these variables is not geo-coded and the smallest geographical unit in the data is the district. Thus, to estimate the impact of the mills on those variables, I employ the empirical specification below:

$$Y_{idt} = \beta_0 + \beta_1 Mill_{idt} + \mathbf{X_{idt}}\phi + \lambda_c + \gamma_{dt} + (\mathbf{X_d} \times t)\theta + \varepsilon_{idt}. \tag{2}$$

The dependent variable, Y_{idt}, is the logarithm of the last daily labor income of partnered woman/husband i, in district d and at year t for estimating the impact on earnings. $Mills_{idt}$ is the logarithm of the total number of mills per capita in the district of residence of a woman/husband i at year t. $\mathbf{X_{idt}}$ is the same set of controls in the main specification. λ_c is the cohort fixed effects.[31] γ_{dt} is the district-by-year fixed effects. $\mathbf{X_d}$ is a vector of baseline geographical variables at the district level, including the historical number of coffee trees in 1999 and the FAO-GAEZ coffee suitability index. I interact these initial conditions with linear time trends to allow their impact to vary over time. I cluster standard errors at the district level.

The coefficient of interest is β_1, which identifies the impact of an increase in log mill per capita on the outcome variables.

4.4 Monthly Hospitalizations due to Domestic Violence

A unique feature of this paper is that I investigate the relationship between employment opportunities and domestic violence using both annual self-reported and monthly administrative data. Using the universe of monthly hospitalizations due to domestic violence in Rwanda, I test whether a mill affects domestic violence when it is in operation. This variation is based on the fact that a mill operates only during the harvest period: March-July. I use a specification at the hospital level. To estimate the impact of a mill on hospitalizations due to domestic violence, I estimate the empirical

[30] I use earnings and labor income interchangeably.

[31] I cannot control for the year of marriage fixed effects since the data does not have such information. However, I am controlling for cohort fixed effects.

specification below:

$$Y_{hdtm} = \beta_0 + \sum_{m=1}^{12} Mill_{hd} \times \beta_m \mathbb{1}[\tau = m] + \mathbf{X_{ht}}\phi + \lambda_h + \alpha_d + \sigma_m + \gamma_{pt} + (\mathbf{X_d} \times t)\theta + \varepsilon_{hdtm}. \quad (3)$$

The dependent variable Y_{hdtm} is the monthly hospitalization outcome due to domestic violence in hospital h, in district d, in year t and at event-time m. $Mills_{hd}$ is a binary variable coded as 1, if hospital h is within the catchment area of a mill and zero otherwise during the sample period, 2012-2018. Being in the catchment area of a mill stayed the same between 2012-2018 for the hospitals. Thus, $Mill_{hd}$ is a time-invariant characteristic. It is interacted with event-month dummies, $\mathbb{1}[\tau = m]$, to investigate the dynamic impact of a mill during the harvest period (March-July), the months mills operate. τ denotes the event-month. $\tau = 3$, March, represents the month the harvest period begins and mills start to operate. For $3 \leq m \leq 7$, March-July, $\tau = m$ represents the months mills operate. For $m < 3$, $\tau = m$ represents the months before a mill's month of operation. The omitted category is $\tau = -1$, February, which means that the dynamic impact of being exposed to a mill is estimated with respect to one month prior to a mill's month of operation.

$\mathbf{X_{ist}}$ is the set of hospital-level time-varying controls related to gender-based violence-specific hospital quality. It includes information on whether gender-based violence patients are referred for care to a health facility with more resources. It is a proxy for poor hospital quality. $\mathbf{X_{ist}}$ also includes information on whether gender-based violence victims are referred to the hospital by the police and community health workers. They are proxies for high hospital quality.[32] λ_h is the hospital fixed effects which control for any hospital-specific characteristic that is fixed over time like its location. α_d is the district fixed effects. The district is chosen for the level of geographical unit since the unit of observation is a district hospital. σ_m is the month fixed effects and controls for month-specific trends. γ_{dt} is the province-by-year fixed effects. I allow year fixed effects to differ by province, one unit higher than the district.[33] This way, I am comparing the hospitals who are in the catchment area of a mill to the ones that are not, within the same province. Hospitals who are not within the catchment area of a mill within the same province constitute a more accurate control group. $\mathbf{X_d}$ is the vector of district-level baseline geographical variables that interacted with linear time trends. I cluster standard errors at the district level.

The main dependent variables for this specification are whether the hospital had hospitalizations and deaths due to gender-based violence for women/men older than 18 and aged 10-18.

[32] Being a hospital that is referred to a gender-based violence victim by the police and community health workers may show that the hospital is known for the resources and knowledge related to gender-based violence cases. Moreover, referrals may also show that the hospital collaborates with the police and community health workers.

[33] Unfortunately, there is not enough observations/hospitals to have district-by-year fixed effects. Adding district-by-year fixed effects mean comparing the hospitals in the catchment area of a mill to those not within the same district. Most of the districts have only one district hospital.

Variables that focus on individuals older than 18 capture domestic violence. This is because, according to DHS and census data, the majority of the individuals who are older than 18 are married in Rwanda. Variables focusing on individuals aged 10-18 capture gender-based violence not due to a partner. Moreover, that age group does not work in the mills. Such variables are used as placebo outcomes as a robustness check.

All (violence) outcomes are indicator variables. For example, monthly hospitalizations due to gender-based violence for women older than 18 takes the value 1 if a hospital had a hospitalization due to gender-based violence for a female victim older than 18 in a given month and 0 otherwise. Dummy variables rather than the logarithm of hospitalizations are used since the number of hospitalizations for gender-based violence is low in a month (close to 1). When I perform the placebo test, when the dependent variable is hospitalizations for bone and joint disorders other than fractures, I use the logarithm of hospitalizations. This is because mean hospitalizations for such diseases are way bigger than one, 46.

The coefficients of interest are β_m's when $3 \leq m \leq 7$ (March-July). For $3 \leq m \leq 7$ and aged older than 18 category, each β_m provides the change in hospitalizations due to domestic violence within the catchment area of a mill relative to the hospitalizations that are not, within the same province, during a mill's month of operation, relative to one month before the operation. The harvest season is at its peak during $5 \leq m \leq 7$, May-July, when most farmers work in the mills. Thus, I specifically expect to see statistically significant estimates during those months. Since $m = 1$ (January) and $8 \leq m \leq 12$ (August-December) represent the months before and after the harvest season when the mills do not operate, I expect to see small and statistically insignificant estimates.

5 Results

5.1 Employment and Self-Reported Domestic Violence

I first estimate the impact of mill exposure on women's employment, type of earnings and self-reported domestic violence using equation 1. I show that a mill opening increases women's paid employment and decreases women's likelihood of experiencing domestic violence in the past 12 months.

Table 1 presents the results of estimating the impact of exposure to a mill on women's probability of working in the past 12 months, her type of earnings being cash in the past 12 months and self-reporting domestic violence in the past 12 months using different control groups. To measure mill exposure 4 km catchment area is used. The first three columns represent estimating equation 1 when the control group is defined as DHS clusters that are outside of a mill's catchment area but within the same district the mill is located (within district approach). Columns 4-6 represent estimating equation 1 when the control group consists of DHS clusters that are within the donut area between 4 and 8 km from a mill (donut approach). All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, and linear time trends interacted with baseline sector-level characteristics. The sample consists of partnered women who married before the expansion of the mills.

When within district approach is used for the control group, upon a mill opening, being exposed to a mill increases the probability of working for cash in the past 12 months by 6 percentage points (p-value$=0.002$) where the probability of working in the past 12 months remains unchanged. The estimated impact represents an increase of 15% with respect to the sample mean (0.39). Moreover, exposure to a mill decreases the probability of experiencing domestic violence in the past 12 months by 10 percentage points (p-value$=0.01$). The estimated impact represents a decrease of 29% with respect to the sample mean (0.35).

When using the donut approach, upon a mill opening, exposure to a mill increases the probability of working for cash in the past 12 months again by 6 percentage points (p-value$=0.003$) where the probability of working in the past 12 months remains unchanged. The estimated impact represents an increase of 14% with respect to the sample mean (0.44). Moreover, exposure to a mill decreases the probability of experiencing domestic violence in the past 12 months by 7 percentage points (p-value$=0.06$). The estimated impact represents a decrease of 18% with respect to the sample mean (0.38). In summary, results remain statistically significant and very similar even when the control group is restricted only to the clusters within the donut area between 4 and 8 km from a mill. There is a statistically significant increase in the probability of working for cash and a decline in the probability of experiencing domestic violence for women.[34]

Table 2 presents the results of estimating the impact of exposure to a mill on women's husbands' probability of working in the past 12 months and their type of earnings being cash in the past 12 months for both control group approaches. There is no statistically significant change in those variables. I also estimated the impact of mill exposure on women's and their husbands' occupation. It is possible that a mill opening can induce individuals to sort into the agricultural sector. Results are reported in Tables A14, A15, A16 and A17. The first two tables use the within-district approach and the last two use the donut approach. Each column represents one occupation: managers, sales, agricultural self-employed, agricultural employee and skilled and unskilled manual. For women, exposure to a mill does not induce a change in occupations. The dominant occupation is the agricultural self-employed category where approximately 80% of women have such occu-

[34] I also check alcohol consumption among husbands. DHS 2005 and 2014 ask for such information. 61% of husbands in my sample (based on DHS 2005, 2014) get drunk sometimes and 20% gets drunk very often (the rest is never drunk). The means are similar across within and outside of the catchment area. There is no change in drinking behavior based on DID using 2005 and 2014.

pation. Being a farmer constitutes an example of working as self-employed in agriculture. For husbands, there is a statistically significant increase in the sales category. However, there is no statistically significant impact of mill exposure on husbands being self-employed in the agricultural sector. Being self-employed in the agricultural sector is also the dominant occupation for husbands, where approximately 60% of the husbands have such occupation. Overall, individuals who are exposed to a mill do not sort into being self-employed in agriculture (become farmers).

According to the results, women and their husbands were already self-employed in the agricultural sector (farmers). They were already working in the past 12 months. Being exposed to a mill did not induce a shift in these variables. However, exposure to a mill changed the type of earnings of women. Women started to be paid cash for their labor in agriculture. Their husbands were already working for cash and being exposed to a mill did not change their type of earnings.

5.2 Earnings

I also estimate the impact of a mill opening on women's and their husbands' earnings using equation 2. Using earnings data, I show that a mill opening increases women's and their husbands' last daily earnings.

Table 3 presents the results of estimating the impact of a mill opening on women's and their husbands' log of last daily earnings.[35] Since EICV data is not geocoded, mill exposure is defined as the logarithm of mills per capita in a district. Columns 1-2 present the results for the whole sample. Columns 3-4 present the results among couples working in agriculture. Among all samples, 1% increase in mills per capita increases women's and their husbands' last daily earnings by 0.94% and 1.72%, respectively. Among couples working in agriculture, an increase in mills per capita also increases the log of the last daily earnings for each spouse. These results show that exposure to a mill upon a mill opening increases women's and their husband's earnings.

It should be noted that the results are based on data where I observe the labor income of women who work for pay (positive, not missing labor income). The missing labor income observations belong to women who do not work or do not work for pay. Their labor income is zero either way. As a robustness check for my results on earnings, I code the missing values as zero and transform the dependent variables using an inverse hyperbolic sine (IHS) function. Unlike in a log transformation, zeroes are defined in an IHS transformation. Table A18 presents the results. Estimates are in line with the main results.

To support the results presented in this subsection, in Table A19, I show that, among the households who do agricultural production, an increase in mills per capita also increases the log of household income derived from the total agricultural production and coffee production. I also

[35]Majority of the earnings are received daily in this context based on data. Thus, I use the last daily earnings as my dependent variable.

show that among couples working in agriculture, a 1% increase in mills per capita does not change women's log of hours worked in a week during coffee harvest months. 1% increase in mills per capita decreases the husband's log of hours worked in a week during coffee harvest months by only -0.09 percent. Table A21 reports the results.

5.3 Monthly Hospitalizations for Domestic Violence

I estimate the dynamic impact of mill exposure on monthly hospitalizations for gender-based violence using equation 3. Figure 6 plots the coefficient of the interaction terms for every month in a calendar year. Mills operate only during the harvest season, March-July. In a given year, January and February are the pre-harvest period, and May-July is the peak of the harvest when the majority of the neighboring community around the mills work in the mills. August-December is the post-harvest period. In the specification, the omitted category is February, which means that the dynamic impact of being exposed to a mill is estimated with respect to one month prior to a mill's month of operation. The figure is for women aged older than 18. Since the overwhelming majority of women aged older than 18 is married in Rwanda, I define hospitalizations for gender-based violence for women age older than 18 as domestic violence. I find that it is 10 and 14 percentage points less likely for a hospital in the catchment area of a mill to have a domestic violence patient in June and July, respectively (peak of the harvest) compared to one month before the mills' month of operation (p-value= 0.01 each). The estimated impact represents a reduction of 12% and 16%, respectively with respect to the sample mean (0.86). There is no statistically significant change in hospitalizations when mills do not operate (January, August-December).

Before moving on, one important thing to recall is that the hospitalizations results are based on the period after the rapid expansion of the mills, after 2012. In those years, there is no change in hospitalizations in the post-harvest months relative to February, one month before the harvest season. No change in hospitalizations during the post-harvest months does not mean that the hospitalizations in the catchment and non-catchment areas are the same. As seen in Figure 5 during post-harvest months, the hospitalization rates in the catchment areas are still lower compared to the rates outside of the catchment areas.

Figure A3 shows that there are no changes in hospitalizations for gender-based violence among girls aged 10-18. I do the same analysis for men and do not find any statistically significant results. I plot the results in Figure A4.[36] As seen in Figure A5, I also do not find any statistically significant change in deaths due to gender-based violence for both age groups and genders.

Placebo Test. As a placebo test, I perform the same analysis for universe of monthly hospitaliza-

[36] These results are also shown in Table A20.

tions for other diseases, bone and joint disorders other than fractures.[37] Examples of such disorders include osteoarthritis, gout, rheumatoid arthritis, lupus and bursitis. I report the results in Figure 7. I find no changes in hospitalizations for these disorders within the year, specifically during the harvest months relative to one month before the harvest season.

This rules out the concern that women may go to hospitals less during the harvest season due to the increased opportunity cost of a hospital visit. For women exposed to a mill, a day in the hospital is costly during the harvest season since it means loss of daily labor income. This can make women less likely to go to a hospital and drive the decline in hospitalizations for domestic violence during the harvest months. No change in non-domestic violence hospitalizations suggests that the decline in hospitalizations due to domestic violence is not driven by a decreased likelihood of going to a hospital during the harvest season.[38]

6 Conceptual Framework

A mill opening increases the value of the wife's capacity to work, either via the husband selling the couple's harvest to the mill for a high premium and/or the wife working in the mill for pay which she shares her earnings with the husband. Thus, the conceptual framework studies how women's paid employment and their husband's earnings affect domestic violence.

6.1 Setup

Preferences. The household consists of a wife and husband, $j \in \{w, h\}$. I assume that the preferences can be represented by the utility functions

$$U_h = yI_h + (1 - x + d\tau)I_w + d\alpha(I) + \theta_h \quad and \quad U_w = (1 - y)I_h + (x - d\tau)I_w + \theta_w - dv_w \tag{4}$$

[37] This means that broken bones and injuries are not included. Thus these hospitalizations are not related to domestic violence. I have data on these diseases for the years 2012-2015.

[38] One might argue that the group of women who have bone and joint disorders may be very old, less likely to work in the mills and thus their opportunity cost of time do not increase with the harvest season (let's say it remains the same within a year). If that is the case, no change in hospitalizations for these women is not ruling out the possible scenario for the decline in violence hospitalizations where women go to hospitals less due to the increased opportunity cost of going to a hospital. I build on medical research to tackle this argument. Medical research suggests that although osteoarthritis (OA), the most common disease in the data, becomes more prevalent as one gets older, age is not a precondition to have the disease. It is also prevalent among occupations including farmer, construction worker, miner, that are physically demanding and require individuals to use the same bones and joints regularly (Yucesoy et al., 2015). This suggests that the women who visit a hospital for bone and joint disorders and domestic violence are plausibly both working farmers who have similar opportunity costs of going to a hospital. That said, my application to receive additional non-gender-based violence hospitalizations during my sample period is approved by the Rwanda National Ethics Committee in May 2023. I am now waiting for the Rwandan Ministry of Health to approve it.

where I_j for $j \in \{w,h\}$ indicates personal earnings for the wife and husband. I is total household resources where $I = I_w + I_h$. I_w is a function of the wife's productivity in the labor market, $I_w(\rho)$, where $\rho \in (0,1)$ is the productivity rate. I assume that the wife's earnings is increasing in her productivity. Incapacitation can be thought of ρ being very close to 0, which makes I_w very close to 0. I denote $I_w(\rho)$ as I_w for notational simplicity. In my context, the husband benefits from the wife's productivity in two ways. First, the husband's earnings is a function of the wife's productivity. Second, the wife shares a portion of her earnings with him. For simplicity, I incorporate only the second way into the framework below.[39]

According to Rwandan social norms, the husband controls household income and household decision-making (ICRW 2011, Bayisenge 2010, Ya-Bititi et al. 2019). The husband keeps yI_h of his personal earnings, $y \in (0,1)$, and gives $(1-y)I_h$ of it to the wife for her expenses. The wife keeps xI_w of her personal earnings, $x \in (0,1)$, and turns $(1-x)I_w$ of it to the husband. In my data, 65% of women decide how to spend their earnings jointly with their husbands, not by themselves, which supports the model. I assume that x and y are predetermined in the beginning of the marriage. Based on the setup, the productivity of the wife affects the husband's utility.

The main difference between the husband and the wife is that the husband can extract more money than his spouse turns over to him (based on the predetermined x value) by inflicting violence. Mainly, the husband can use violence to get a bigger share of her earnings and maximize his utility from marriage. Violence decision is parametrized by $d \in \{0,1\}$. $\tau \in (0,x]$ is the extraction rate. If the husband chooses to inflict violence on his wife, $d = 1$. If he chooses not to be violent, $d = 0$. τ captures *instrumental* violence, i.e., the husband uses violence as a tool to extract resources from his wife.

The term $\alpha(I)$ denotes the husband's non-monetary utility from inflicting violence. I assume that $\alpha(I) > 0$. It captures *expressive* violence in the framework, which means that with the parameter, the benefit from domestic violence enters the husband's utility directly, not in an instrumental way (Gelles 1974, Tauchen et al. 1991). The parameter can be seen as the husband's taste for violence. It can be an intrinsic love for violence, or violence can represent a stress outlet. I assume that the husband's taste for violence is decreasing in household resources, which affects violence. Such an income effect could, for instance, stem from stress relief. In such a case, when there are more resources in the household, there is less financial stress and marginal utility from stress relief is lower. Thus violence decreases.

The term θ_j for $j \in \{w,h\}$ indicates the private level of satisfaction with the marriage for the wife and husband. As a key assumption of the model, each spouse's level of satisfaction with the marriage remains private information. θ_j follows distribution F_j with support $[\underline{\theta_j}, \overline{\theta_j}]$. $\underline{\theta_j}$ is high

[39] Again, for simplicity, I_h is not a function of his productivity since the wife's, not the husband's, incapacitation is the focus of the paper.

enough for the marriage to be intact. v_w is the disutility from violence for the wife where $v_w > 0$. U_w is decreasing in domestic violence and increasing in her and the husband's earnings and her private level of satisfaction with the marriage. U_h is increasing in his and his wife's earnings and his private level of satisfaction with the marriage.

I assume that their outside options can be represented by the utility functions

$$S_h = I_h \quad and \quad S_w = I_w. \tag{5}$$

Each spouse only enjoys her/his personal earnings as an outside option. I define the outside option as the utility of being single (divorced).[40] Due to paid employment, the wife has personal earnings to support herself financially if she initiates divorce.[41]

Timing. The husband keeps a portion of his personal income to himself and gives the remaining portion to the wife for her expenses. The wife keeps a portion of her personal income and turns the rest to her husband. The husband observes the resources he receives from his wife, $(1-x)I_w$, and either chooses to inflict violence to extract more resources from the wife, τI_w, or he chooses not to be violent and remains with $(1-x)I_w$. If he chooses to inflict violence, his utility becomes $U_h = yI_h + (1-x+\tau)I_w + \alpha_h(I_h+I_w) + \theta_h$. If he chooses not to, $U_h = yI_h + (1-x)I_w + \theta_h$. Then, the wife either chooses to divorce the husband or not. If the husband chooses to inflict violence and the wife does not get divorced, her utility becomes $U_w = (1-y)I_h + (x-\tau)I_w + \theta_w - v_w$ where $v_w > 0$. In the absence of violence, her utility becomes $U_w = (1-y)I_h + xI_w + \theta_w$ and she stays with the husband assuming $(1-y)I_h + xI_w + \theta_w > S_w$. The husband's utility is high enough to stay with the wife in the absence of violence. When they are divorced, the wife and the husband receive S_w and S_h, respectively, their individual labor market potential. To highlight again, the level of satisfaction with the marriage remains private information for each spouse throughout the marriage.

Decisions. The solution of the game between the husband and wife can be found via backward induction. The wife chooses between staying in the marriage and getting divorced from the husband, given the husband's decision to choose violence. She will leave her husband if her utility of

[40]Divorce is a credible threat in the Rwandan context. In 2008, Rwanda became the first country in Sub-Saharan Africa to criminalize all forms of domestic violence and allow women to divorce their husbands unilaterally if their husbands are violent towards them. Sanin (2021) shows that women more likely to be in violent marriages are more likely to get divorced after the law.

[41]I conceptualize the utility of being single with personal earnings only as a simplification. A paid job also has non-monetary benefits that can constitute a part of the wife's outside option. For example, due to having a job, the wife has a social network that can provide her with a place to stay when she is separated.

staying in a violent marriage is smaller than the utility of being divorced, as in

$$\underbrace{(1-y)I_h+(x-\tau)I_w+\theta_w-v_w}_{\text{Utility of being in a violent marriage}} \leq \underbrace{I_w}_{\text{Utility of being single}}. \tag{6}$$

Based on equation (6), there is a threshold value of the wife's private level of satisfaction with the marriage, $\overline{\theta_w}$, that makes her indifferent between remaining together with and being divorced from her husband. The value of $\overline{\theta_w}$ is

$$\overline{\theta_w} = (1-x+\tau)I_w-(1-y)I_h+v_w. \tag{7}$$

Recall that the cumulative distribution function of θ_w is given by F_w. Therefore, the probability of the wife divorcing her husband is $P(\theta_w \leq \overline{\theta_w}) = F_w(\overline{\theta_w})$. Observe that as I_w increases, the probability of divorce increases. This is because an increase in the wife's personal earnings is improving her outside option. Also, when I_h increases, the probability of separation decreases. This is because the wife enjoys a portion of the husband's personal earnings if she remains married.

Since the level of satisfaction with the marriage is private information, the husband chooses to inflict violence only knowing the probability that she will initiate divorce if her utility of staying together is less than her utility of being divorced. He compares the expected utility of choosing violence, EU_h, with utility of not choosing to be violent. His expected utility of inflicting violence on his wife is

$$EU_h = F_w(\overline{\theta_w})I_h+[1-F_w(\overline{\theta_w})][yI_h+(1-x+\tau)I_w+\alpha(I)+\theta_h]. \tag{8}$$

The husband chooses to be violent if

$$\underbrace{EU_h}_{\text{Expected utility of inflicting violence}} \geq \underbrace{yI_h+(1-x)I_w+\theta_h}_{\text{Utility from not inflicting violence}}. \tag{9}$$

Based on equation (9), there is a threshold value of the husband's private level of satisfaction with the marriage, $\overline{\theta_h}$, that makes the husband indifferent between choosing violence (to extract a portion of the wife's resources) and not being violent. The value of $\overline{\theta_h}$ is determined by

$$\overline{\theta_h} = (1-y)I_h-(1-x)I_w+\frac{1-F_w(\overline{\theta_w})}{F_w(\overline{\theta_w})}[\tau I_w+\alpha(I)]. \tag{10}$$

Therefore, the probability of the husband choosing violence is $P(\theta_h < \overline{\theta_h}) = F_h(\overline{\theta_h})$. In the last component of equation (10), let $R(I_w,I_h,\tau) = \frac{1-F_w(\overline{\theta_w})}{F_w(\overline{\theta_w})}$. R is the ratio of the probability of remaining married divided by the probability of being divorced (the odds of remaining married). R is decreasing in I_w, ρ and τ and increasing in I_h.[42] As I_w increases, the woman's odds of remaining married will be lower since she has a better option.[43] The last component of equation (10) shows that in a marriage, the husband gains utility from violence via extracting monetary resources from the wife, τI_w, and non-monetary benefit from violence, $\alpha(I)$. The last component of the equation also shows how the wife's productivity in the labor market affects the husband. As the wife's productivity in the labor market increases, I_w increases. The husband's utility from extracting his wife's monetary resources via violence will be higher and his non-monetary benefit from inflicting violence will be lower.

Proposition. *For a high enough I_w and ρ or small enough τ, an increase in I_w decreases domestic violence. For a large enough income effect ($|\alpha'|$), any increase in earnings (the wife's or the husband's) decreases domestic violence.*
Proof. See Appendix A5.

When the wife's outside option due to her job, I_w, is high enough, the husband's extraction rate, τ, and marginal non-monetary benefit from violence with the wife's contribution to household earnings, $\frac{\partial \alpha(I)}{\partial I_w}$, is small enough, violence decreases. Moreover, by keeping the wife's earnings constant, an increase in the husband's earnings may also reduce violence. This happens when his marginal non-monetary benefit from violence with his contribution to household earnings $\frac{\partial \alpha(I)}{\partial I_h}$, is small enough. Importantly, the proposition also highlights that violence decreases when the husband's cost of incapacitating his wife's is high enough.

Based on the theoretical framework, mill exposure can decrease domestic violence via an increase in women's outside options, an increase in household resources (either via an increase in the wife's and/or husband's earnings) and an increase in the cost of the wife's incapacitation for the husband. Although I did not incorporate exposure reduction (decline in the time couples spend together) into the model, it is also a plausible mechanism. It will also be tested in the next section.

7 Mechanisms

In this section, I disentangle the potential mechanisms behind the decline in domestic violence empirically. I provide evidence for an increase in women's outside options (thus bargaining power), increase in household resources and increase in the cost of women's incapacitation mechanisms. I also provide evidence that exposure reduction is not the dominant mechanism behind the results.

[42] See Appendix A5 for proof.

[43] On the contrary, as I_h increases, the odds of remaining married will be higher since she receives utility from the husband's income within the marriage.

Increase in Women's Outside Options. According to the family economics literature, an increase in women's outside options increases her bargaining power within the household. Using data on household decision-making, I investigate whether women's paid employment opportunities in the mills translate into an improvement in women's bargaining power. Table 4 presents the results of estimating the impact of mill exposure on household decision-decision making. I investigate three different decisions. These are making large household purchases, making decisions on own health and visiting family. The estimation captures whether women are more likely to make these decisions by themselves or jointly with their husbands compared to their husbands or someone else in the family is deciding for them. When a within-district approach is used, women who are exposed to a mill are 5 percentage points (p-value= 0.02) more likely to make decisions on large household purchases by themselves or jointly with their husbands. The estimated impact represents an increase of 7% with respect to the sample mean (0.69). There is no change in decision-making related to women's own health and visiting family. These results suggest that mill exposure improves women's say in financial decisions in the household.

I also investigate the impact of mill exposure on couple's decision-making on contraception. Table 5 presents the results. The estimation captures whether women's decision to use contraception is taken jointly with their husbands compared to alone or if their husbands decide for them. For this variable, making the decision alone is not a proxy for bargaining power. Research finds that women in Sub-Saharan Africa may use contraception covertly to respond to their husbands' desire to have more children (Ashraf et al., 2014). When the within-district approach is used, upon a mill opening, among women under the age of 40, women who are exposed to a mill are 6 percentage points (p-value= 0.07) more likely to decide to use contraception jointly with their husbands. The estimated impact represents an increase of 7% with respect to the sample mean (0.86).

Taken together, results on household decisions suggest that women's improvement in their outside options due to mill exposure also improved their bargaining power, say, in some household decisions. These results support the argument that increased women's outside options due to paid employment in the mills is a potential mechanism behind the decline in domestic violence.

Exposure Reduction. Another possible mechanism behind the decline in domestic violence can be the reduction in the time couples spend together. If women were farming in the same plot with their husbands before the expansion, starting to work in the mills for pay is a shock to the time they are exposed to their husbands and earnings. To provide evidence that exposure reduction is unlikely to drive my results, I take advantage of the information on the couple's occupations. I perform a subsample analysis. I run equation 1 using the sample of women who do not share the same occupation with their husbands. Self-employed women working in agriculture (smallholder farmers) whose husbands have skilled or unskilled manual jobs (truck drivers, plumbers, refuse workers, laborers in mining, construction and manufacturing, etc.) constitute the majority of the subsample. Those couples have different occupations, so they do not work together during working hours. Thus, women starting working in the mills presumably will not be a shock to the time couples spend together. Their exposure to each other will remain the same (no exposure during work hours). However, women's workplaces will shift to mills where they work for pay. Suppose there is a statistically significant increase in the probability of women working for cash and a decline in the probability of experiencing domestic violence in the past 12 months for this subsample. In that case, it suggests that my main result, reduction in domestic violence, is plausibly not driven by exposure reduction.

Results for women's employment and domestic violence are reported in Table 6. Only within the district approach is used due to sample size. Upon a mill opening, exposure to a mill increases the probability of working for cash in the past 12 months by 6 percentage points where the probability of working in the past 12 months remains unchanged. The estimated impact represents an increase of 20% with respect to the sample mean (0.30). Moreover, being exposed to a mill still decreases the probability of experiencing domestic violence in the past 12 months by 10 percentage points. The estimated impact represents a decrease of 29% with respect to the sample mean (0.34). The results show a statistically significant decline in the probability of experiencing domestic violence, even among women whose exposure to their husbands is presumably unaffected by the expansion. Moreover, the magnitude of the decline is also similar to the result based on the whole sample. This further confirms that exposure reduction is not necessarily the main driver of the decline in domestic violence.

There can be two possible concerns with this subsample analysis. First, women can work for so long in the mills that there is a reduction in the time couples spend together, even among these couples. Although I do not have a variable that explicitly asks women about the time they spent with their husbands, I show in Table A21 that mill exposure does not increase women's hours worked during the coffee harvest months among women working in agriculture. The second concern is that the subsample may be among couples with very educated husbands compared to the primary sample and is not representative. This is because, in the current subsample, husband occupations are non-agricultural jobs. However, according to the data, the mean number of husbands' education is 5.7 for this subsample and 4.4 for the whole sample (husbands working in agriculture is not dropped). Based on these points, using this subsample to suggest that exposure reduction is not the dominant mechanism behind my main results is valid.[44]

[44] I also further restricted the subsample to women who are farmers and married to men with non-agricultural jobs. There is a statistically significant increase in working for cash for this subsample. I still find a negative estimate for the domestic violence result. However, due to the low sample size, I do not have enough power to defend my (statistically insignificant) negative estimate.

Beyond these results, I also investigated the mean domestic violence rates for couples who work in agriculture (and presumably work together) and couples with different occupations at the baseline (before a mill opening, during the rapid expansion of the mills). They are both similar to each other (21% and 24% respectively). If exposure reduction had been a channel behind the decline in domestic violence, the data could have shown that the couples with high exposure to each other have higher baseline levels of domestic violence, which is not the case.

Increase in the Household Resources. Using earnings data, I find that among the couples where women work in agriculture and men work in non-agricultural (primarily manual) jobs, mill exposure significantly increases women's daily earnings. However, there is no statistically significant change in their husbands' earnings.[45] The magnitude is also close to 0. Results are reported in Table 7.[46] Combined with the earlier results, no effect on husbands' earnings shows that there is a decline in violence even among couples where there is an increase in household resources only via women's paid employment, not due to an increase in husbands' earnings. Moreover, the magnitude of the decline in violence is similar (11 percentage points, 0.34 mean) to the result based on the whole sample (10 percentage points, 0.35 mean). This suggests three key points. First, women's employment is a key driver behind the decline in domestic violence in the main sample. The increase in household resources due to the husband's earnings is not the sole mechanism. Second, given a decline in violence among couples with an increase in women's earnings only, extractive violence is not the dominant mechanism. Third, an increase in household income due to women's paid employment is also a plausible mechanism behind the results.

For this subsample of couples, given that the increase in household resources is due to women's paid employment, the decrease in domestic violence can also be due to an increase in women's bargaining power. This is because the increase in women's earnings increases the household resources and women's outside options. Ideally, to provide direct evidence for the increase in household re-

[45] It should also be noted that the increase in women's earnings for these couples is bigger than the increase for the overall sample, where most of the couples are both farmers. The reason is as follows. Women who are married to men with non-agricultural manual jobs are plausibly earning income from both selling coffee cherries to the mill and working in the mill as a wage worker (or earning from selling cherries only, which still means earning a higher amount of money compared to working in the mill only). This confirms that among the farmer couples, money earned by selling coffee is the husband's money.

[46] For this subsample, no change in husbands' earnings is plausible. Although mills may demand paid labor from men with non-agricultural occupations (construction workers to build a mill, technicians to repair a mill), the expansion is primarily a (persistent) shock to individuals working in agriculture. It is valid to ask what women married to non-farmer men were doing before the expansion. According to DHS data, in 2004 and 2005, 59% of those women reported agricultural self-employed as their occupation before the expansion. 61% of those self-employed are unpaid workers before the expansion. This suggests that they were subsistence farmers that did not use cash crops. To understand the effect of a mill opening on them better, I use the information on crops and find that the share of farmer women who have coffee in their family plots increases with mill expansion over the years. However, the share of farmer women who have beans in their plots do not change over time. This suggests that those women were not having coffee on their plots before, but they planted coffee trees with the expansion.

sources mechanism, there should exist a group with an increase in the household resources keeping women's outside options fixed. Suppose there is a decline in domestic violence in such a case. In that case, that will directly show that the increase in household resources is a plausible mechanism behind the decrease in domestic violence. Couples with an increase in the husband's earnings and no change in the wife's earnings constitute a plausible group. Couples at the baseline, before the rapid expansion of the mills in the country, are plausible candidates for this. Presumably, those couples process coffee at home where the wife has no personal earnings and the husband's earnings increase during the harvest season due to selling home-processed coffee.

In Appendix A4.1, I exploit the variation in the timing (month) of answering DHS domestic violence questions in Rwanda at the baseline to provide complementary evidence that the increase in household resources is a potential mechanism behind the decline in violence in my main results. In summary, I find the following results for the couples who lived in the areas with no mills in 2005, before the rapid expansion of the mills. Women who answered the DHS survey during the harvest months self-reported experiencing less domestic violence in the past 12 months than women who answered during non-harvest months. Only a small portion of each group (approximately 20%) reported working for cash, although all reported working in the past 12 months. Although the result is not causal and based on the assumption that both the women who answered the survey during the harvest and non-harvest months are equally likely to have recall bias, there is a statistically significant difference between the domestic violence rates of the two groups. This suggests that the domestic violence rates are lower even when there is no change in the wife's earnings -thus her outside option- but an increase in the husband's earnings. This suggests that the increase in household resources is a potential mechanism behind the main results.

However, in both groups, farmer couples at the baseline and couples after the expansion where the wife is a farmer and the husband works in a non-agricultural manual job, the wife uses her capacity to work. Moreover, the husband benefits from this capacity. In the former group, the husband's earnings is a function of the wife's productivity. In the latter group, the wife shares a portion of her earnings with the husband. Does a mill opening affect domestic violence beyond increasing the wife's income (thus her bargaining power) or the household income; via an increase in the cost of women's incapacitation for the husband? Next section shows that it does.

Increase in the Cost of Women's Incapacitation. Using consumption data, I show that one month after the harvest season, August, mill-exposed households continue to enjoy a higher consumption than the pre-harvest, plausibly due to saving harvest income derived by selling cherries to the mill and the wife's wages from the mill. Yet, in August, there is no change in the domestic violence hospitalizations compared to the pre-harvest, when mills do not operate. Figure 8 plots the results.

What is driving the seasonal decline in domestic violence hospitalizations? Higher consumption in August combined with no change in violence hospitalizations compared to the pre-harvest suggests that an income effect is not driving the seasonal decline. Plausibly, the wife's outside option in the catchment area is the same right before and after the end of harvest season since the husband knows that his wife has a job opportunity the following year. Since the husband sells the couple's harvest to a mill for a high premium and the wife works for pay only during the harvest season, the value of the wife's capacity to work and the husband's cost of incapacitating the wife increase during this period. These suggest that the increase in the cost of women's incapacitation when mills operate drives the seasonal decline in violence hospitalizations.

To further provide evidence for this channel, I exploit the variation in the suitability of the Irish potato (dominantly a male cash crop) in Rwanda. I find that in the Irish potato suitable areas where there is no increase in the value of women's capacity to work in their unpaid tasks and women mainly do not contribute to household earnings via paid work, there is no decline in violence hospitalizations during the potato harvest months when households consume more compared to the pre-harvest. Figure A11 plots the results. This further confirms that keeping women's outside options constant, when the value of the wife's capacity to work is fixed within the year, there is no change in domestic violence hospitalizations.

It should be highlighted that the evidence for the increase in the cost of women's incapacitation mechanism does not negate the evidence for the increase in women's outside options and the household resources channels shown via the household surveys. First, hospitalizations are severe domestic violence cases. Results supporting the incapacitation cost mechanism do not rule out that the income effect is a plausible mechanism behind the decline in non-severe domestic violence cases where women do not go to the hospital and self-report in the annual household survey. Second, recall that the hospitalizations data captures between 2012-2019 and being in the catchment area of a mill did not change for the hospitals within that period. Thus, hospitalization results capture the monthly change in hospitalizations within the year among the hospitals in the catchment areas relative to the monthly change in hospitalizations among the hospitals outside the catchment areas once the mills are built (do not capture the effect of a mill opening like the household surveys). As seen in Figure 5, hospitals that are in the catchment area of a mill have lower domestic violence rates to begin with before the harvest season compared to the hospitals that are outside of the catchment area of a mill. This suggests that compared to the areas outside of a mill, within the catchment areas, women's paid employment increases women's outside options and household resources and thus leads to lower levels of domestic violence. Keeping women's outside options fixed within the year, areas exposed to a mill experience a decline in severe violence cases (hospitalizations) during the harvest season due to the increase in the cost of women's incapacitation.

Mechanisms and Women's Employment. My analysis suggests that the decline in violence is driven by the increase in women's outside options (bargaining power), the increase in household resources and the increase in the cost of women's incapacitation. There is a decline in domestic violence even among couples where there is an increase in household resources only via women's paid employment, not due to an increase in husbands' earnings. Combined with the fact that the increase in women's bargaining power and the cost of women's incapacitation mechanisms are only active via women's employment, this suggests that the decrease in domestic violence in driven by women's employment. Moreover, evidence supporting the cost of women's incapacitation mechanism suggests that women's employment decreases domestic violence beyond the wife's and household income, via the capacity to work/labor market productivity.[47]

It is also important to note that since there is a decline in domestic violence even among couples where there is an increase in household resources only via women's paid employment, extractive violence is not the dominant mechanism behind the results. However, evidence supporting the incapacitation cost mechanism shows that domestic violence decreases when the husband has economic self-interest in the wife's work capacity. This suggests that the husband's violence decision is strategic, not a result of a loss of control (Card and Dahl, 2011). Thus, this novel channel also speaks to the husband's incentives behind inflicting domestic violence.[48]

8 Robustness Checks

8.1 Dynamic Impact of Mill Exposure and Pre-Trends

I also estimate the impact of a mill opening using an event-study specification. The specification exploits the variation in years when individuals are exposed to a mill. The results provide insights into the dynamics of the effects, and the impact of a mill in the short and long-run. Moreover, estimates during the years before mill exposure constitute a test for the parallel trends assumption. I estimate the dynamic impact of a mill opening with the event study specification below:

$$Y_{istk} = \beta_0 + \sum_{k=-3}^{6} Mill_{is} \times \beta_k \mathbb{1}[\tau = k] + \mathbf{X_{ist}}\phi + \lambda_c + \omega_m + \alpha_s + \gamma_{dt} + (\mathbf{X_s} \times t)\theta + \varepsilon_{istk}. \tag{11}$$

[47]Research suggests that employment has psychosocial benefits (Hussam et al., 2022). In this context, the non-monetary value of earning personal income (confidence, dignity, etc.) and having a social network (coworkers in the mills) are such potential benefits. Although they plausibly affect the decline in domestic violence, unfortunately, I am not able to quantify them with my data. Yet, both channels are active via women's work and I show that women's employment plausibly drives the decline in domestic violence in my context. Beyond that, I provide evidence which suggests that women's employment can decrease violence via the value of women's work capacity.

[48]Although I find a decline in domestic violence, my context is not ideal to comment on male backlash since majority of the women report earning less than their husbands. Thus, working in the mill does not necessarily threaten the breadwinner gender role of the husband.

The dependent variable Y_{istk} is the outcome of interest of woman i (or the husband of woman i), in sector s, in year t and at event-time k. $Mills_{is}$ is a binary variable coded as 1 if woman/husband i resides within the catchment area of a mill and zero otherwise by the end of the sample, 2014. It is interacted with event-year dummies, $\mathbb{1}[\tau = k]$, to investigate the dynamic impact of a mill opening. τ denotes the event-year. $\tau = 0$ represents mill's year of operation. For $k > 0$, $\tau = k$ represents k years after a mill's opening. For $k < 0$, $\tau = k$ represents k years before a mill's year of operation. The omitted category is $\tau = -1$, which means that the dynamic impact of being exposed to a mill is estimated with respect to one year prior to a mill opening. $\mathbf{X_{ist}}$ is the same set of controls in the static empirical specification. λ_c is the cohort fixed effects. ω_m is the year of marriage fixed effects. α_s is the sector fixed effects. γ_{dt} is the district-by-year fixed effects. $\mathbf{X_s}$ is a vector of baseline geographical variables interacted with linear time trends. I clustered standard errors at the district level. The main dependent variables for this specification are being employed, working for cash and experiencing domestic violence in the past 12 months.

The coefficients of interest are β_ks when $k \geq 0$. For $k \geq 0$, each β_k provides the change in outcomes for the individuals who are exposed to a mill relative to the individuals who are not within the same district, k years after a mill opening, relative to one year before a mill's year of operation. Since $k < 0$ represents the years before a mill opening, I expect to see small and statistically insignificant estimates for such β_ks when $k < 0$. If so, such estimates will constitute supportive evidence in favor of the parallel trends assumption.

Figure 9 presents the results from estimating equation 11 (event-study specification). It plots the coefficient of the interaction term for 3 years before and 6 years after a mill opening. I use the within district approach to have balanced number of observations every time period. The dynamic results are mostly in line with the static estimates. I find a statistically significant decrease in the probability of experiencing domestic violence in the past 12 months right after a mill opening. Exposure to a mill opening also increases women's probability of working for cash starting from right after a mill opening. There is no change in women's probability of working. I need to note that number of women who are in the treatment group is lower for the event times 1, 2 and 3 compared to the remaining event times. This is because the number of mill openings are not balanced across the 2000s and I have the DHS data cycles for specific years. This can plausibly be the reason why the coefficients at event times 1, 2 and 3 are statistically insignificant for the working for cash variable although they are positive.

I should also note that there is no statistically significant decline in violence at event times 4, 5 and 6, although women are more likely to work for cash in these years relative to one year before a mill opening. The number of observations is not low compared to other years for these event times. This may suggest that over the years, the dynamics within the household can change after a mill opening: The wife can start not sharing her earnings with the husband or not doing unpaid tasks for the husband, which can deactivate the incapacitation cost mechanism and create conflict.

Figure 10 plots the coefficient of the interaction terms for the same specification for husbands. As expected, there is no change in probability of working and working for cash in the past 12 months right after a mill opening. I need to note that there is a statistically significant decline in the husband's probability of working only at event time 2. For working for cash variable, the estimates for event times 1 and 2 are also much bigger than 0 compared to the remaining event times, although insignificant. This is plausibly due to the lower number of observations at event times 1, 2 and 3 based on my data and the imbalance in the mill expansion.

For all variables, the coefficients are close to zero and statistically insignificant for the years before a mill opening. Thus, the estimates constitute evidence in favor of the parallel trends assumption. All results are also shown in Tables A22 and A23.

I also estimate the impact of a mill in a district using an event-study specification and wages data. The specification exploits the variation in years when individuals are exposed to a mill in a district. Figure A6 plots the results. The estimates are in line with my main results and there is no pre-trends. Given that a district is a larger geographical area compared to a catchment area or a sector, the increase in women wages are slow, yet this is in line with the mean number of mills in a district as shown in Figure A7.

8.2 Role of Variation in Treatment Timing

Goodman-Bacon (2021) demonstrates that twoway fixed effects difference-in-differences (TWFEDD) estimator is a weighted average of all possible 2x2 DD estimators that compare timing groups to each other. Under time-varying treatment effects, TWFEDD estimates a weighted average treatment effect with *negative weights* (Borusyak and Jaravel 2018, de Chaisemartin and D'Haultfœuille 2020, Sun and Abraham 2020, Callaway and Sant'Anna 2020, Goodman-Bacon 2021) which biases the results. This occurs when the later-treated group uses the earlier-treated group as a control. Goodman-Bacon (2021) highlights that specifically the units treated near the beginning or the end of the panel can get more weight as controls than treatments, which is always the case in designs without untreated units. I do not expect this to be a major concern in my context. I have untreated units and out of the 312 mill openings as of 2018, around 20 percent opened near the beginning or the end of the panel. 54% of the mills opened between 2005-2010. To formally analyze the 2x2 DD comparisons and weights, I perform the Goodman-Bacon (2021) decomposition.[49] The decomposition calculates the weights of each type of 2x2 DD comparison and how it contributes to the TWFEDD estimate. I find that 75-78% of the TWFEDD estimate for labor market outcomes (working for pay, working cash) and domestic violence in the past 12 months is derived from Treat-

[49] I implement the decomposition following Goodman-Bacon (2021) and based on bacondecomp STATA package.

ment vs. Never Treated comparisons. Earlier Group Treated vs. Later Group Control and Later Group Treatment Control each have 0.03 weights and do not contribute much to the TWFEDD estimate as expected. The weight for the Treated vs. Already Treated comparison is only 0.17.

I also follow the test proposed by de Chaisemartin and D'Haultfœuille (2020), which enables researchers to understand when treatment effect heterogeneity would be a serious concern for the validity of their estimates.[50] de Chaisemartin and D'Haultfœuille (2020) recommends researchers to calculate both the weights and the ratio of the TWFE estimate divided by the standard deviation of the weights. If many weights are negative, and if the ratio is not very large, then treatment effect heterogeneity would be a serious concern for the validity of the estimate.[51] For the working for pay, cash and experiencing domestic violence in the past 12 months outcomes, I find that 90%, 90% and 93% of my treatment effects receive positive weights, respectively where the remaining receive negative weights. I also calculate the ratios based on my estimates and the standard errors of the weights and they are sufficiently high. Thus, given that approximately only 7% of the weights are negative and the ratios are sufficiently high, treatment effect heterogeneity is not a concern for the validity of my estimates. For a complete robustness check, I estimate my results using the estimator proposed in de Chaisemartin and D'Haultfœuille (2020) that gives valid results even if the treatment effect is heterogeneous over time and across groups. I plot the estimation results for main results in Figure A8.[52] As expected, the estimates are very similar to my main results.[53]

Sun and Abraham (2020) demonstrates that in event study designs with variation in treatment timing across units, the coefficient on a given lag or lead can be contaminated from other periods. Pre-trends can arise from heterogeneity of the treatment effects as well. As a robustness check for my event study results, I perform the alternative estimation method proposed in Sun and Abraham (2020) that is free from such contamination.[54] The event study results from this method is reported in Figure A9 and very similar to my main event study results.

8.3 Measuring the Catchment Area

8.3.1 Using Different Buffer Radii for the Catchment Area

I use a 4 km radius buffer around a mill throughout the paper to construct the treatment group. I also experiment with multiple radii to construct the treatment group using within the district approach

[50] My calculations are based on twowayfeweights STATA package.

[51] If that ratio is close to 0, that estimate and the average treatment effect can be of opposite signs even under a small and plausible amount of treatment effect heterogeneity. This is the case where treatment effect heterogeneity would be a serious concern for the validity of that estimate.

[52] The results are based on didmultiplegt STATA package.

[53] The weights and the results in Figure 10 are based on within district approach. The results are also robust and similar when donut approach is used.

[54] The results are based on eventstudyinteract STATA package.

for the control group. I show that my results fade out as the radius of the catchment area increases, meaning more DHS clusters that are not treated become a part of the treatment group. Tables A24 and A25 presents the results using DHS data. This rules out the concern that the households right outside of the catchment area are sorting themselves into the treatment group.

If coffee farmers who reside outside the catchment areas bring their coffee cherries to the mills, the cherries will rot by the time they arrive. Thus, the husbands will not earn from selling cherries to the mills. Yet, women can walk all the distance and request a job in the mills since mills do not prohibit women from working there as wage workers. There are two potential reasons why I do not observe this in my data. First, the paid jobs in the mills are in short supply. There are not enough jobs for both the coffee farmer women who reside within the catchment area as well as the women who reside outside. However, it is also possible that women who live within the catchment areas can hire women who are just outside to work for them in the mills.

Suppose women in the catchment areas may work in the mills for three days a week and hire the women outside on the fourth day with the money they earned from working previously. If that scenario happens, women outside of the catchment areas will be treated by the mills. This brings us to the second potential reason why I do not observe this in my data. The wage in the mills is likely lower than the woman's reservation wage outside the catchment area. The woman farmer who is outside is processing coffee at home and the husband sells the processed coffee in the domestic market. Thus, she contributes to agricultural production in the household. She also contributes to home production by performing subsistence farming (wheat for bread etc.) for household consumption. It is plausible that the wage in the mills is not high enough to compensate the total of the money she receives from her husband for her contribution to the household's agricultural production and her contribution to the home production. In contrast, a household in the catchment area can afford to buy food from the market rather than the woman producing it via home production every day. This is because the husband earns more from selling cherries to the mill than from selling home-processed coffee in the local market. This is another way of saying that in the catchment area, the household income without women's paid work is high enough (plausibly due to husbands' earnings from the mills) for the women not to perform subsistence farming every day, do work in the mills for long hours and bring more money to the household.

This robustness check also alleviates the concern regarding the random displacement of DHS clusters and measurement error. The results are weakly significant when 5 km buffer radius is used and there is no effect when the radius is 10 km. As the buffer radius increases, there is a gradual fading of the results. This suggests that the 4 km buffer radius is a valid measure for the catchment area and I am not picking up an effect only due to the displacement of DHS clusters. Yet, it is still possible for the results to have measurement error when I use 4 km as the buffer radius. This is because the rural clusters contain a maximum of 5 kilometers of positional error, which is higher than the 4 km buffer radius. A DHS cluster initially not in the catchment area can be in the catchment area due to the random displacement. Yet, I am still picking up an effect on women's paid employment and domestic violence with a 4 km buffer radius and randomly displaced DHS clusters. Thus, the results constitute a lower bound for the effect and if I have precise coordinates for the clusters, I would likely observe larger effects.

9 Conclusion

This paper presents evidence that providing employment opportunities to women decreases domestic violence when the husband has economic self-interest in the wife's work capacity.

I do my analysis in two steps. First, I provide causal evidence that the government-induced rapid expansion of the coffee mills in Rwanda in the 2000s increased women's paid employment, earnings of women and their husbands and decreased domestic violence. For identification, I perform two strategies with two sources of domestic violence data, self-reports and novel administrative records on the universe of monthly hospitalizations. Second, I investigate the mechanisms behind the results both with a conceptual framework and data. I present evidence for three mechanisms on how women's employment can decrease domestic violence: an increase in women's outside options, their contribution to household earnings and an increase in the husband's cost of incapacitating the wife. The last mechanism stems from the fact that a mill opening increases the value of women's work capacity in two ways. First, it enables the husband to sell the couple's harvest for a high premium in the international coffee market. This increases the value of the wife's capacity to work for the tasks she performs as an unpaid family worker in the couple's plot. Second, a mill opening enables the wife to become a wage worker in the mill. Thus, the wife has personal earnings which she shares with the husband.

As for policy implications, my results suggests that in a context where the threat of separation is credible and the wife's labor market productivity benefits her husband either via the structure of the employment or sharing within the household (which is a function of the social norms in the context), providing job opportunities to women has more potential to decrease domestic violence compared to a cash transfer. My results also suggest that in contexts where the conditions above exist, phenomena that lead to women's unemployment, such as climate change-induced weather shocks and automation, can negatively affect women's health and position in the household.

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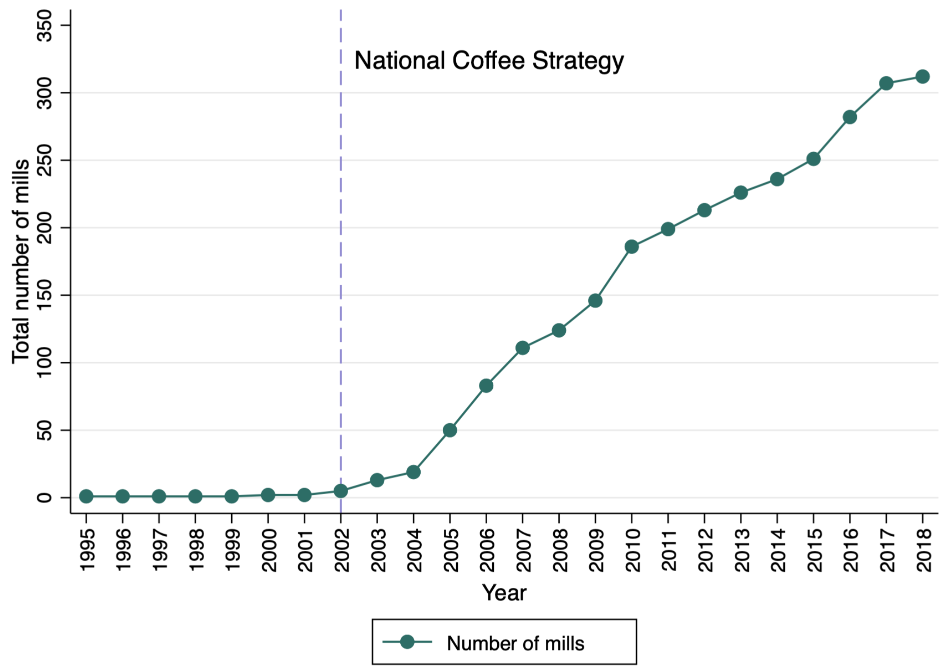
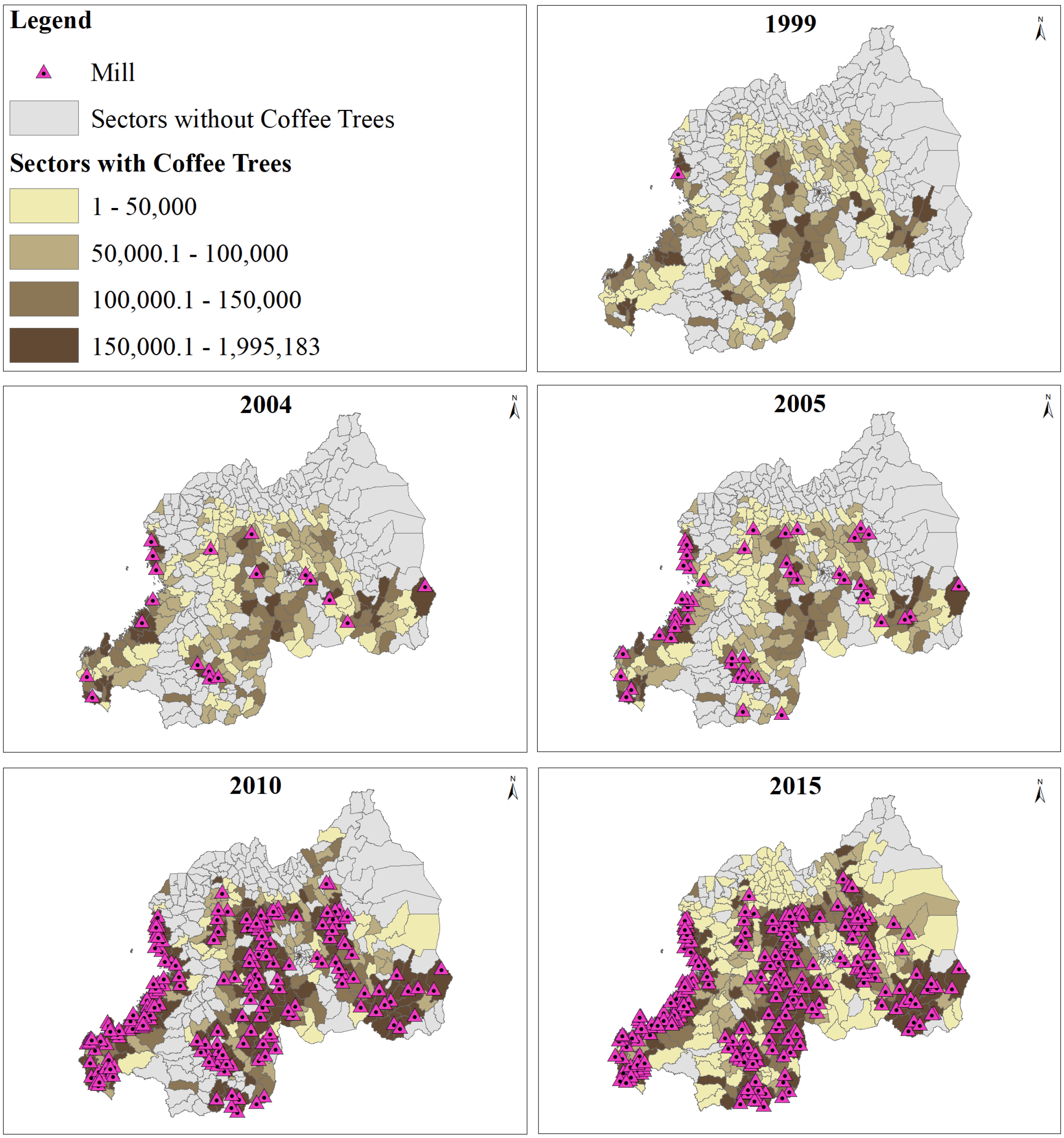
Figure 1: Mill Expansion in Rwanda



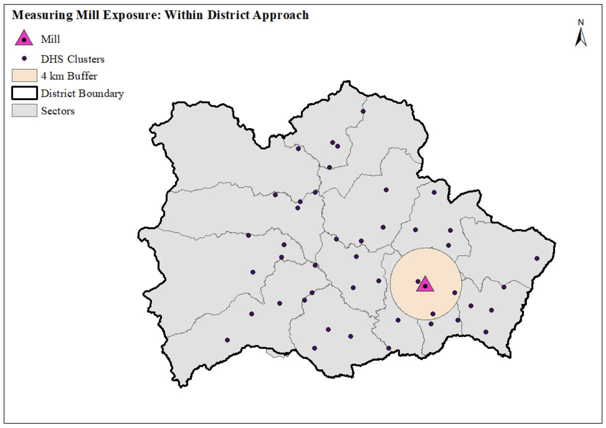
Source: Rwandan Coffee Censuses, Rwanda GeoData and Macchiavello and Morjaria (2020) Data.

Figure 2: Expansion of Mills in Rwanda



Notes: The maps are constructed by combining data on mills, The Rwandan Coffee Census 1999, 2003, 2009 and 2015, The Rwandan GeoPortal spatial data on sector boundaries.

Figure 3: Visualization of the Treatment and Control Groups using Nyarugenge District: Within District and Donut Approach



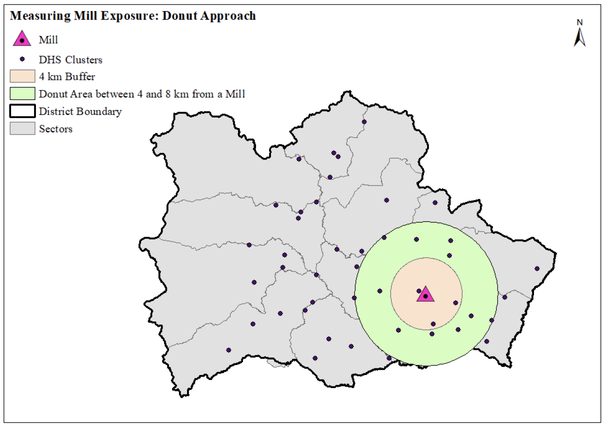


Figure 4: Visualization of the Treated and Control Hospitals

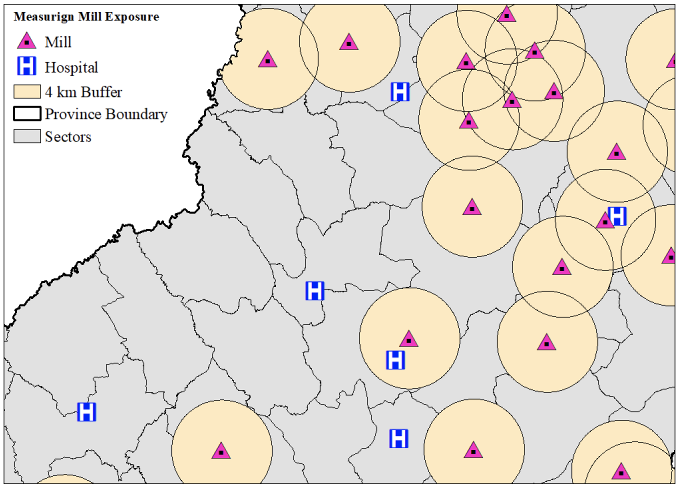
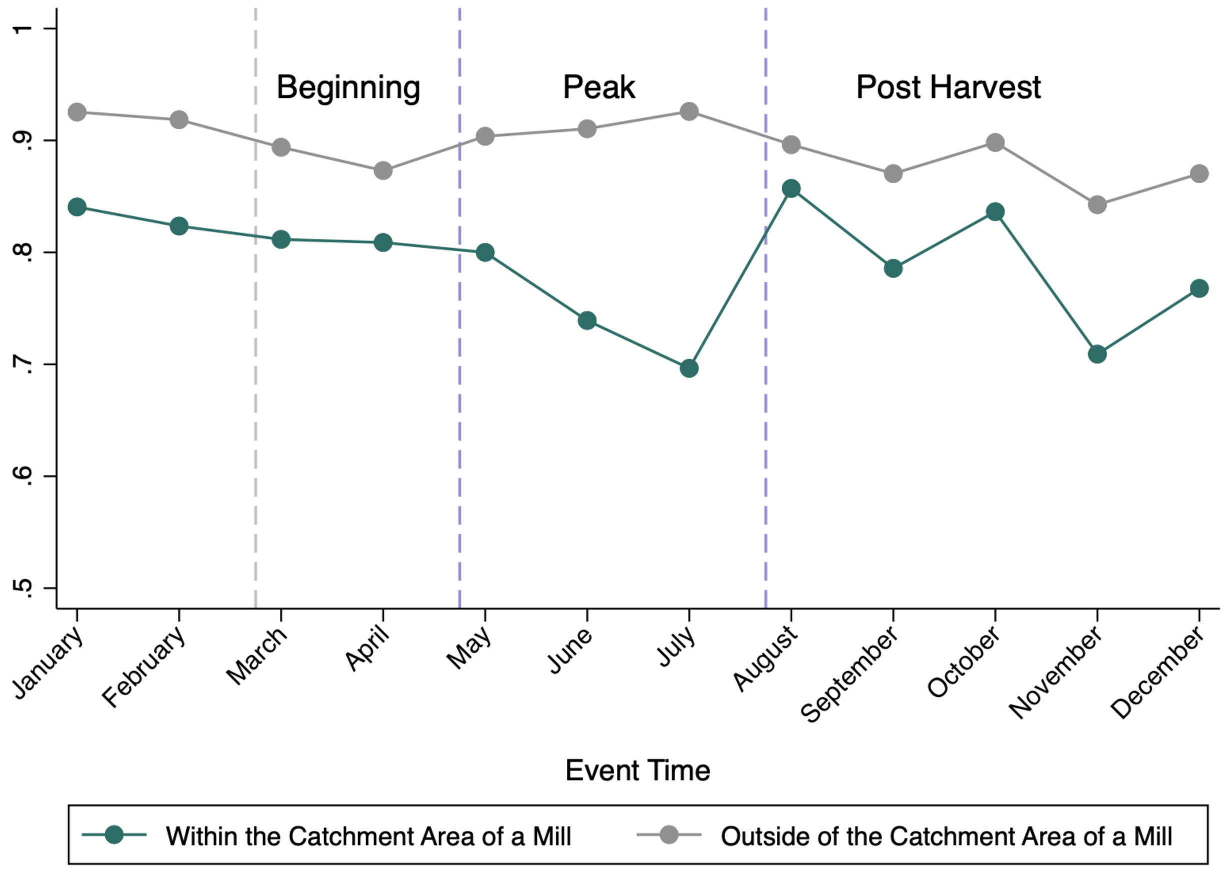
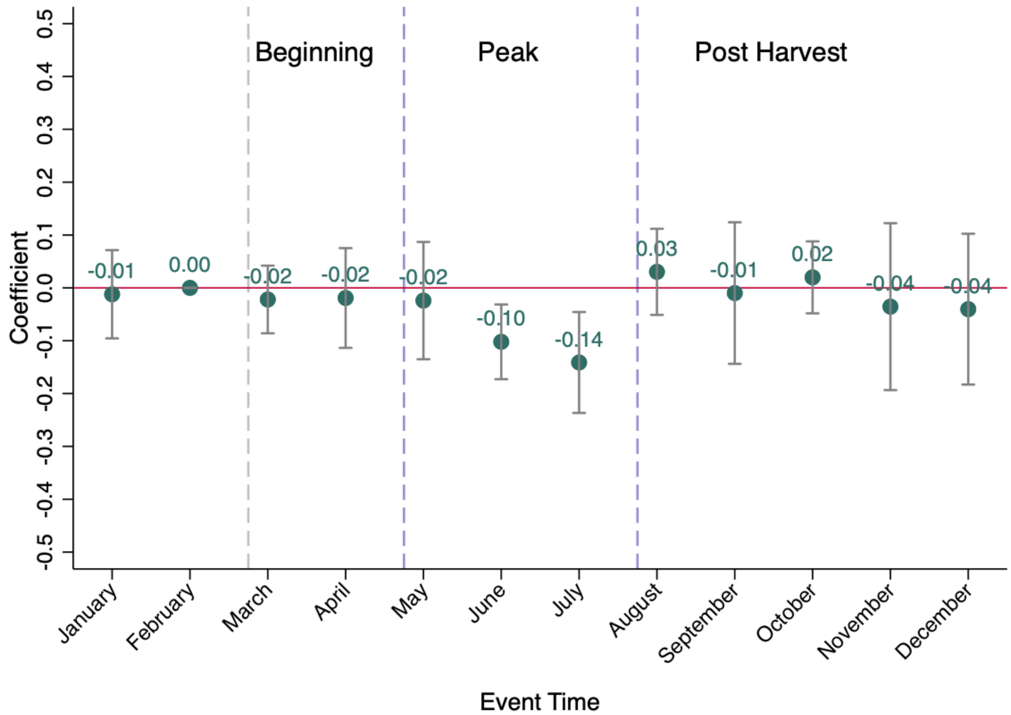


Figure 5: Mean Hospitalizations for Domestic Violence within the Year (Women)



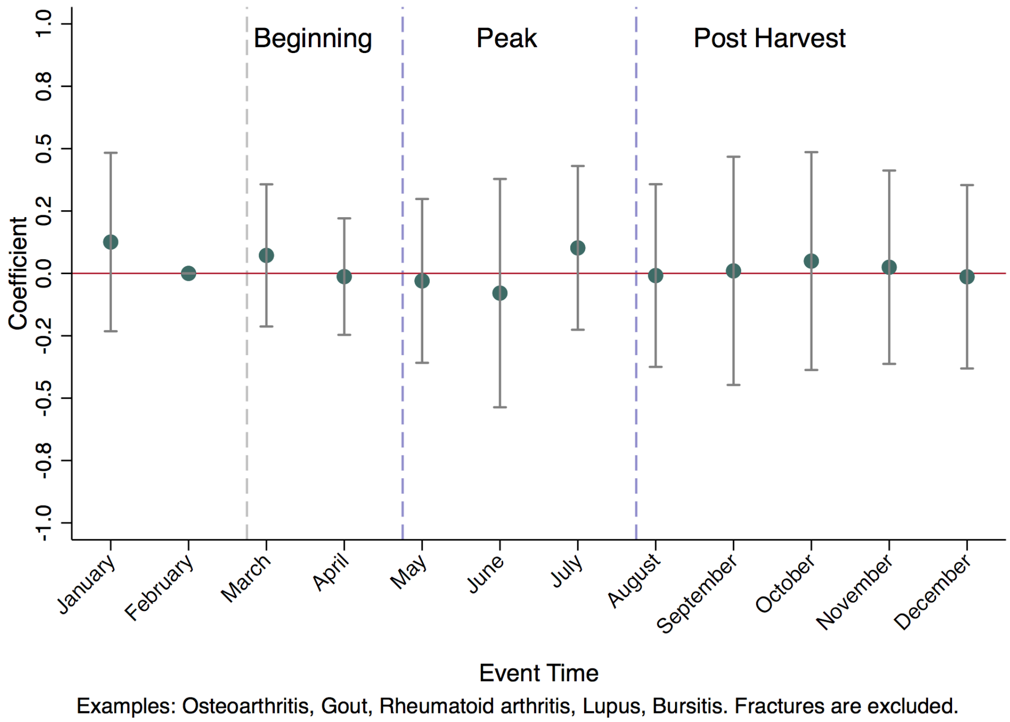
Notes: This figure shows the raw means for hospitalizations for women older than 18 within the year.

Figure 6: Dynamic Impact of a Mill Opening on Hospitalizations for Domestic Violence (Women)



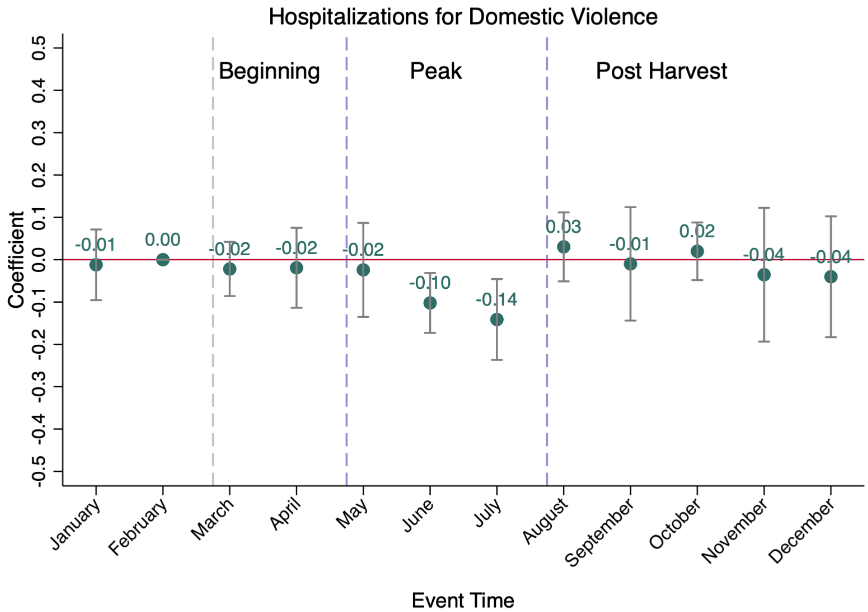
Notes: Robust standard errors clustered at the district level. Estimation include hospital controls, hospital fixed effects, district fixed effects, province-by-year fixed effects, linear time trends interacted with baseline district level characteristics. 4 km catchment area is used. *** p<.01, ** p<.05, * p<.1

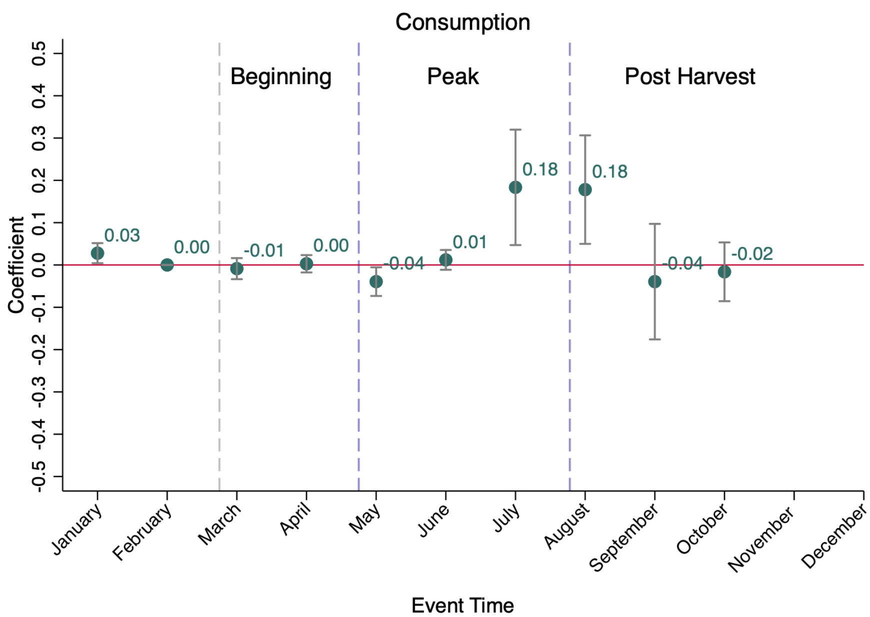
Figure 7: Dynamic Impact of a Mill Opening on Log Hospitalizations for Bone and Joint Disorders other than Fractures (Women)



Notes: Dependent variable is in logs. Fractures (broken bones) are not included. Examples of bone and joint disorders include osteoarthritis, gout, rheumatoid arthritis, lupus, bursitis. Robust standard errors clustered at the district level. Estimations include hospital controls, hospital fixed effects, district fixed effects, province-by-year fixed effects, linear time trends interacted with baseline district level characteristics. 4 km catchment area is used. *** p<.01, ** p<.05, * p<.1

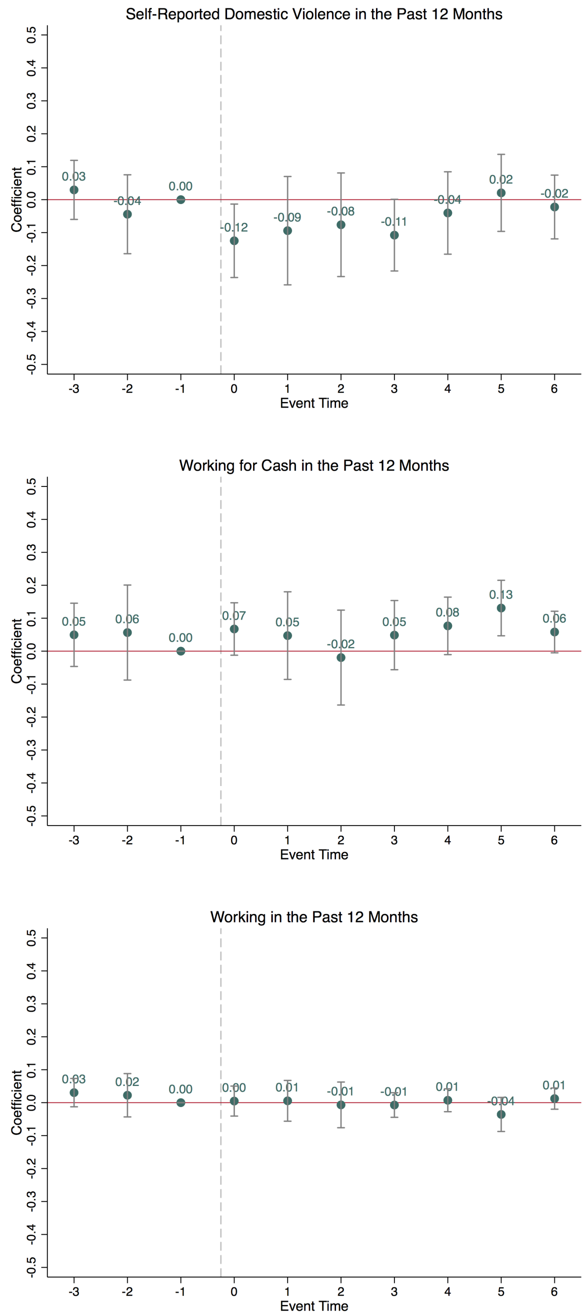
Figure 8: Monthly Hospitalizations for Domestic Violence and Consumption





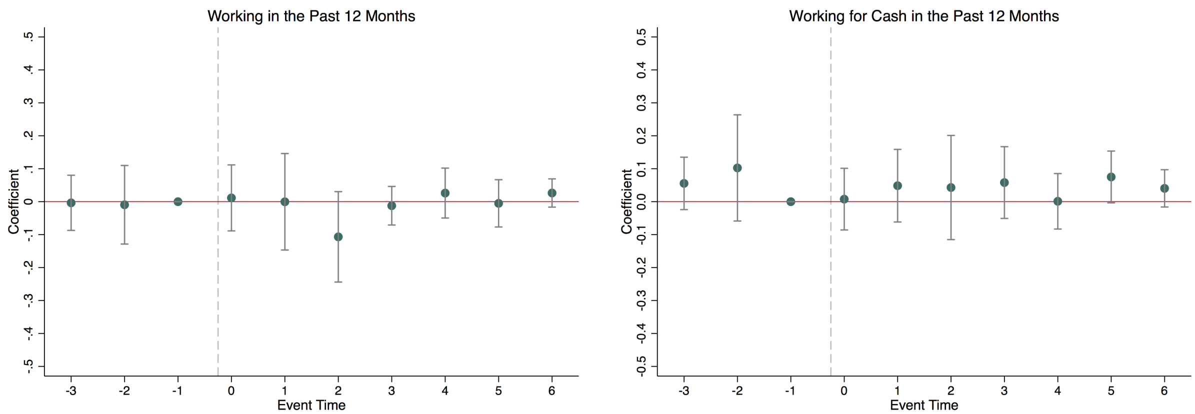
Notes: Robust standard errors clustered at district level both for the hospitalizations and consumption. Hospital estimation include hospital controls, hospital fixed effects, district fixed effects, province-by-year fixed effects, linear time trends interacted with baseline district level characteristics. 4 km catchment area is used. Consumption estimation include individual controls, cohort fixed effects, district-by-year fixed effects, linear time trends interacted with baseline district level characteristics. Sample consists of couples who married before the expansion of the mills and have agricultural occupations. *** p<.01, ** p<.05, * p<.1

Figure 9: Dynamic Impact of a Mill Opening on Self-Reported Domestic Violence, Women's Type of Earnings and Employment in the Past 12 Months



Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All variables are measured for the past 12 months. 4 km catchment area is used. Within district approach is used. *** p<.01, ** p<.05, * p<.1

Figure 10: Dynamic Impact of a Mill Opening on Husbands' Employment and Type of Earnings in the Past 12 Months



Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partners of women in the first specification. All variables are measured for the past 12 months. 4 km catchment area is used. *** p<.01, ** p<.05, * p<.1

Table 1: Effect of Mill Exposure on Women's Employment, Type of Earnings and Self-Reported Domestic Violence in the Past 12 Months

	Within District			Donut		
	(1) Work	(2) Cash Work	(3) Domestic Violence	(4) Work	(5) Cash Work	(6) Domestic Violence
Mill	-0.00	0.07***	-0.10***	-0.00	0.06***	-0.07*
	(0.01)	(0.02)	(0.03)	(0.01)	(0.02)	(0.04)
Observations	10154	9068	3609	5409	4853	1830
Dependent variable mean	0.88	0.39	0.35	0.88	0.44	0.38

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All dependent variables are measured for the past 12 months. The catchment areas is constructed by buffers around the mills with a 4 km radius. *** p<.01, ** p<.05, * p<.1

Table 2: Effect of Mill Exposure on Husband's Employment and Type of Earnings in the Past 12 Months

	Within District		Donut	
	(1) Work	(2) Cash Work	(3) Work	(4) Cash Work
Mill	-0.00	0.03	-0.01	0.04
	(0.02)	(0.02)	(0.02)	(0.04)
Observations	4342	3790	2317	2110
Dependent variable mean	0.87	0.81	0.91	0.82

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of the husbands of the women in the sample. All dependent variables are measured for the past 12 months. The catchment areas is constructed by buffers around the mills with a 4 km radius. *** $p<.01$, ** $p<.05$, * $p<.1$

Table 3: Effect of Mill Exposure on Log of Last Daily Earnings

	All Sample Log of Last Daily Earnings		Occupation: Agriculture Log of Last Daily Earnings	
	(1) Wife	(2) Husband	(3) Wife	(4) Husband
Log of Mills per capita in the District	0.94***	1.72***	1.12***	1.71***
	(0.15)	(0.15)	(0.15)	(0.17)
Observations	4948	10055	4192	7237
Dependent variable mean	6.60	7.02	6.39	6.68

Notes: Robust standard errors clustered at the district level are in parentheses. All estimations include individual controls, cohort fixed effects, district-by-year fixed effects, linear time trends interacted with baseline district level characteristics. Sample consists of partnered women (and their husbands) who married before the expansion of the mills. Since EICV is not geocoded, the mill variable is log of mills per capita in a district in a given year. In Columns 3-4, the sample consists of women and their husbands who reported their occupation as agricultural. *** p<.01, ** p<.05, * p<.1

Table 4: Effect of Mill Exposure on Household Decision Making: Woman Alone or Jointly with Husband

	Within District			Donut		
	(1) Large HH Purchases	(2) Own Health	(3) Family Visit	(4) Large HH Purchases	(5) Own Health	(6) Family Visit
Mill	0.05**	0.03	0.02	0.04*	0.01	-0.00
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	10154	10154	10154	5409	5409	5409
Dependent variable mean	0.69	0.74	0.82	0.71	0.75	0.82

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All dependent variables are coded as 1 if the decision is taken by women alone or jointly with their husbands and zero otherwise. Otherwise category includes husband only or someone else. The survey question on household decisions changed significantly over the data cycles. in 2005, the question asks "Who has the final say on decision x?" After 2005, the question is "Who usually decides on x". The answer option "Respondent and other" is also discontinued in 2010 and 2014 rounds. To make a comparable variable, I create the variable based on whether the woman had a say in the decision, either alone or jointly. 4 km catchment area is used. *** p<.01, ** p<.05, * p<.1

Table 5: Effect of Mill Exposure on (Modern) Contraception Decision-Making: Joint between Couples, Woman Only, Husband Only

	Within District			Donut		
	(1) Joint	(2) Wife	(3) Husband	(4) Joint	(5) Wife	(6) Husband
Mill	0.06*	-0.04	-0.02	0.06*	-0.03	-0.03
	(0.03)	(0.03)	(0.02)	(0.03)	(0.03)	(0.02)
Observations	2638	2638	2638	1506	1506	1506
Dependent variable mean	0.87	0.10	0.04	0.88	0.09	0.03

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women younger than 40 who married before the expansion of the mills. 4 km catchment area is used.. *** p<.01, ** p<.05, * p<.1

Table 6: Effect of Mill Exposure on Women's Employment, Type of Earnings and Self-Reported Domestic Violence in the Past 12 Months: Couples with Different Occupations

	Within District		
	(1) Work	(2) Cash Work	(3) Domestic Violence
Mill	-0.00	0.06*	-0.10*
	(0.02)	(0.03)	(0.06)
Observations	4804	3614	1579
Dependent variable mean	0.73	0.30	0.34

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. For the exposure reduction robustness check, the sample is restricted to women who are not working with their husbands. The restriction is made based on the occupation of women and their husbands. All dependent variables are measured for the past 12 months. 4 km catchment area is used. *** p<.01, ** p<.05, * p<.1

Table 7: Effect of a Mill Opening on Log of Last Daily Earnings: Couples with Different Occupations

	Couples with Different Occupations	
	(1) Woman's Log of Last Daily Earnings: Agriculture	(2) Husband's Log of Last Daily Earnings: Non-Agriculture
Log of Mills per capita in the District	2.78***	-0.42
	(0.68)	(0.91)
Observations	2291	1089
Dependent variable mean	5.08	7.51

Notes: Robust standard errors clustered at the district level are in parentheses. All estimations include individual controls, cohort fixed effects, district-by-year fixed effects, linear time trends interacted with baseline district level characteristics. Sample consists of couples who married before the expansion of the mills and have different occupations. Women report their occupation as agricultural where the husbands report their occupation as non-agricultural. Non-agricultural occupations mostly consist of manual (unskilled and skilled) jobs. Since EICV is not geocoded, the mill variable is log of total number of mills per capita in the district in a given year. *** p<.01, ** p<.05, * p<.1

Online Appendix

for "Women's Employment, Husbands' Economic Self-Interest and Domestic Violence"

by Deniz Sanin

A1 Additional Tables

A1.1 Additional Tables for Section 3: Data

Table A1: Summary Statistics of Mills

	Mean	Std. Dev.
Panel A: Mill Level Characteristics		
Owner: Cooperative	0.50	0.50
Owner: NGO	0.25	0.43
Opened after National Coffee Strategy in 2002	0.99	0.08
Opened between 2005-2010	0.54	0.50
Opened between 2010-2018	0.40	0.49
Panel B: Sector Level Characteristics		
Number of coffee farmers in 1999	696.54	437.48
Log Coffee Trees in 1999	11.50	0.56
Log Coffee Trees in 2003	11.59	0.60
Log Coffee Trees in 2009	12.90	0.77
Log Coffee Trees in 2015	13.12	0.94
FAO-GAEZ Coffee Suitability Index for Coffee: Marginal	0.36	0.48
FAO-GAEZ Coffee Suitability Index for Coffee: Moderate-Good	0.64	0.48
Panel C: Spatial Characteristics		
Sector Area in km^2	54.57	26.32
District Area in km^2	877.11	304.92

Notes: Mill level characteristics are from the Rwanda GeoPortal and Macchiavello and Morjaria (2020). Data on coffee trees and farmers are from the coffee censuses. FAO-GAEZ Suitability Index categories are based on FAO-GAEZ's suitability categories. Aggregate crop suitability is (1) Very high when index $>$ 8500; (2) High when 7000 $<$ index $\leq$ 8500; (3) Good when 5500 $<$ index $\leq$ 7000; (4) Medium when 4000 $<$ index $\leq$ 5500; (5) Moderate when 2500 $<$ index $\leq$ 4000; (6) Marginal when 1000 $<$ index$\leq$ 2500; (7) Very marginal when 0 $<$ index $\leq$ 1000; and (8) Not suitable when index $=$ 0. The continuous index is at 9 km^2 resolution. I aggregate the index at the sector level and classify the sector level index based on FAO's suitability categories. Spatial characteristics are the author's calculations using spatial maps by the Rwanda GeoPortal via ArcGIS software.

Table A2: Summary Statistics for Women: DHS Women's Recode

	All		Not Exposed to a mill		Exposed to a mill	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: Main dependent variables						
Worked in the past 12 months	0.88	0.33	0.88	0.33	0.88	0.32
Worked for cash in the past 12 months	0.39	0.49	0.36	0.48	0.45	0.50
Experienced domestic violence in the past 12 months	0.34	0.47	0.34	0.47	0.37	0.48
Panel B: Controls						
Husband lives in the house	0.88	0.32	0.88	0.32	0.87	0.33
Husband's age	42.64	9.79	42.36	9.81	43.47	9.67
Husband's Occupation: Agricultural	0.70	0.46	0.69	0.46	0.71	0.45
Husband's education in years	4.34	3.75	4.34	3.80	4.34	3.59
Occupation: Agricultural	0.75	0.43	0.74	0.44	0.77	0.42
Marital status: Married	0.74	0.44	0.71	0.45	0.80	0.40
Monogamy (No other wives)	0.89	0.31	0.88	0.32	0.92	0.27
Number of unions: One	0.84	0.37	0.84	0.37	0.85	0.36
Age at first marriage	19.85	3.31	19.73	3.28	20.19	3.38
Years since marriage	16.72	6.45	16.56	6.50	17.21	6.27
Education in years	4.00	3.53	3.90	3.57	4.29	3.40
Muslim	0.02	0.13	0.02	0.14	0.01	0.11
Christian	0.96	0.19	0.96	0.19	0.97	0.17
Has children aged 5 and under	0.75	0.43	0.76	0.43	0.72	0.45
Type of residence: Rural	0.84	0.37	0.83	0.38	0.86	0.35
Household has a radio	0.62	0.49	0.61	0.49	0.63	0.48
Household's main floor material is cement	0.17	0.38	0.17	0.38	0.17	0.38
Household has electricity	0.14	0.34	0.13	0.34	0.15	0.36
Household wealth is above the median	0.51	0.50	0.51	0.50	0.51	0.50
Observations	12300		9209		3091	

Notes: Sample consists of partnered women who married before the expansion of the mills. "Exposed to the mill" represents being in the catchment area of a mill. Catchment area radius is 4 km.

Table A3: Summary Statistics for Women based on Treatment Status: 2005 DHS Women's Recode (Before Rapid Expansion/Baseline)

	Never Treated Sector Level		Before Treatment Sector Level	
	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: Main dependent variables				
Worked in the past 12 months	0.83	0.37	0.84	0.36
Worked for cash in the past 12 months	0.18	0.39	0.19	0.40
Experienced domestic violence in the past 12 months	0.22	0.42	0.22	0.41
Panel B: Controls				
Husband lives in the house	0.89	0.31	0.86	0.34
Husband's age	41.03	9.67	41.91	9.55
Husband's Occupation: Agricultural	0.71	0.45	0.82	0.38
Husband's education in years	4.25	3.90	3.66	3.32
Occupation: Agricultural	0.72	0.45	0.79	0.41
Marital status: Married	0.61	0.49	0.70	0.46
Monogamy (No other wives)	0.86	0.34	0.88	0.33
Number of unions: One	0.83	0.37	0.83	0.38
Age at first marriage	19.65	3.36	19.92	3.28
Years since marriage	14.99	6.83	15.53	7.06
Education in years	3.58	3.61	3.58	3.24
Muslim	0.02	0.15	0.02	0.13
Christian	0.96	0.21	0.97	0.17
Has children aged 5 and under	0.85	0.36	0.82	0.38
Type of residence: Rural	0.80	0.40	0.87	0.34
Household has a radio	0.53	0.50	0.54	0.50
Household's main floor material is cement	0.15	0.35	0.10	0.31
Household has electricity	0.07	0.25	0.03	0.16
Household wealth is above the median	0.51	0.50	0.46	0.50
Observations	2348		1123	

Notes: Sample consists of partnered women who married before the expansion of the mills. "Treatment" represents a mill opening. Since a mill serves only to its catchment area, after treatment is at the catchment area level rather than the sector level. Catchment area radius is 4 km.

Table A4: Summary Statistics for Women based on Treatment Status: 2005, 2010, 2014 DHS Women's Recode

	Never Treated Sector Level		Before Treatment Sector Level		After Treatment Catchment Area Level	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: Main dependent variables						
Worked in the past 12 months	0.88	0.33	0.86	0.34	0.88	0.32
Worked for cash in the past 12 months	0.36	0.48	0.32	0.47	0.45	0.50
Experienced domestic violence in the past 12 months	0.34	0.47	0.29	0.45	0.37	0.48
Panel B: Controls						
Husband lives in the house	0.89	0.32	0.86	0.35	0.87	0.33
Husband's age	42.20	9.70	42.27	10.08	43.47	9.67
Husband's Occupation: Agricultural	0.67	0.47	0.81	0.39	0.71	0.45
Husband's education in years	4.51	3.95	3.84	3.30	4.34	3.59
Occupation: Agricultural	0.72	0.45	0.81	0.39	0.77	0.42
Marital status: Married	0.70	0.46	0.73	0.45	0.80	0.40
Monogamy (No other wives)	0.88	0.33	0.89	0.32	0.92	0.27
Number of unions: One	0.84	0.36	0.82	0.38	0.85	0.36
Age at first marriage	19.65	3.30	19.94	3.21	20.19	3.38
Years since marriage	16.54	6.45	15.93	6.80	17.21	6.27
Education in years	3.95	3.69	3.77	3.22	4.29	3.40
Muslim	0.02	0.14	0.01	0.12	0.01	0.11
Christian	0.96	0.20	0.97	0.17	0.97	0.17
Has children aged 5 and under	0.76	0.43	0.81	0.39	0.72	0.45
Type of residence: Rural	0.81	0.40	0.90	0.30	0.86	0.35
Household has a radio	0.62	0.49	0.58	0.49	0.63	0.48
Household's main floor material is cement	0.19	0.39	0.12	0.33	0.17	0.38
Household has electricity	0.15	0.36	0.04	0.19	0.15	0.36
Household wealth is above the median	0.52	0.50	0.48	0.50	0.51	0.50
Observations	6997		1660		3091	

Notes: Sample consists of partnered women who married before the expansion of the mills. "Treatment" represents a mill opening. Since a mill serves only to its catchment area, after treatment is at the catchment area level rather than the sector level. Catchment area radius is 4 km.

Table A5: Summary Statistics for Husbands: DHS Couple's Recode

	All		Not Exposed to a mill		Exposed to a mill	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: Main dependent variables						
Worked in the past 12 months	0.88	0.33	0.87	0.33	0.90	0.30
Worked for cash in the past 12 months	0.80	0.40	0.79	0.41	0.83	0.38
Panel B: Controls						
Husband lives in the house	0.99	0.07	1.00	0.07	0.99	0.08
Wife's Age	36.46	6.84	36.19	6.88	37.31	6.68
Wife's Occupation: Agricultural	0.74	0.44	0.74	0.44	0.77	0.42
Wife's Education in years	3.92	3.42	3.84	3.46	4.17	3.28
Occupation: Agricultural	0.61	0.49	0.60	0.49	0.66	0.48
Marital status: Married	0.77	0.42	0.75	0.44	0.84	0.36
Monogamy (No other wives)	0.95	0.22	0.94	0.23	0.96	0.19
Number of unions: One	0.77	0.42	0.76	0.43	0.78	0.42
Age at first marriage	23.70	4.42	23.54	4.43	24.17	4.36
Years since marriage	17.41	7.20	17.27	7.26	17.83	7.01
Education in years	4.33	3.67	4.32	3.70	4.38	3.55
Muslim	0.02	0.14	0.02	0.15	0.01	0.11
Christian	0.95	0.21	0.95	0.22	0.96	0.20
Has children aged 5 and under	0.77	0.42	0.78	0.42	0.75	0.43
Type of residence: Rural	0.84	0.37	0.83	0.38	0.87	0.34
Household has a radio	0.64	0.48	0.63	0.48	0.65	0.48
Household's main floor material is cement	0.17	0.37	0.17	0.37	0.17	0.38
Household has electricity	0.13	0.34	0.13	0.33	0.15	0.36
Household wealth is above the median	0.53	0.50	0.53	0.50	0.54	0.50
Observations	5105		3854		1251	

Notes: Sample consists of the partners of women in Table A5. "Exposed to the mill" represents being in the catchment area of a mill. Catchment area radius is 4 km.

Table A6: Summary Statistics for Husbands based on Treatment Status: DHS Couple's Recode

	Never Treated Sector Level		Before Treatment Sector Level		After Treatment Catchment Area Level	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: Main dependent variables						
Worked in the past 12 months	0.88	0.32	0.78	0.41	0.90	0.30
Worked for cash in the past 12 months	0.82	0.38	0.69	0.46	0.83	0.38
Panel B: Controls						
Husband lives in the house	1.00	0.07	1.00	0.05	0.99	0.08
Wife's Age	36.17	6.84	35.71	6.95	37.31	6.68
Wife's Occupation: Agricultural	0.72	0.45	0.78	0.41	0.77	0.42
Wife's Education in years	3.91	3.61	3.88	3.18	4.17	3.28
Occupation: Agricultural	0.58	0.49	0.62	0.49	0.66	0.48
Marital status: Married	0.74	0.44	0.76	0.43	0.84	0.36
Monogamy (No other wives)	0.94	0.23	0.95	0.22	0.96	0.19
Number of unions: One	0.77	0.42	0.75	0.43	0.78	0.42
Age at first marriage	23.53	4.51	23.98	4.42	24.17	4.36
Years since marriage	17.30	7.12	16.47	7.59	17.83	7.01
Education in years	4.52	3.87	3.94	3.31	4.38	3.55
Muslim	0.03	0.16	0.01	0.11	0.01	0.11
Christian	0.95	0.23	0.96	0.20	0.96	0.20
Has children aged 5 and under	0.77	0.42	0.84	0.37	0.75	0.43
Type of residence: Rural	0.81	0.40	0.88	0.33	0.87	0.34
Household has a radio	0.64	0.48	0.61	0.49	0.65	0.48
Household's main floor material is cement	0.19	0.39	0.12	0.33	0.17	0.38
Household has electricity	0.16	0.37	0.04	0.19	0.15	0.36
Household wealth is above the median	0.55	0.50	0.50	0.50	0.54	0.50
Observations	3151		858		1251	

Notes: Sample consists of the partners of women in Table A5. "Treatment" represents a mill opening. Since a mill serves only to its catchment area, after treatment is at the catchment area level rather than the sector level. Catchment area radius is 4 km.

Table A7: Summary Statistics for Hospitals: HMIS

	All		Not Exposed to a mill		Exposed to a mill	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Panel A: Main dependent variables						
Has a GBV Patient: Women aged older than 18	0.86	0.35	0.90	0.31	0.79	0.41
Has a GBV Patient: Women aged 10-18 yrs	0.89	0.31	0.92	0.27	0.84	0.37
Has a GBV Patient: Men aged older than 18	0.35	0.48	0.38	0.49	0.30	0.46
Has a GBV Patient: Men aged 10-18 yrs	0.24	0.43	0.26	0.44	0.21	0.40
Death due to GBV: Women aged older than 18	0.03	0.16	0.03	0.17	0.03	0.16
Death due to GBV: Women aged 10-18 yrs	0.01	0.09	0.01	0.10	0.01	0.07
Death due to GBV: Men aged older than 18	0.01	0.11	0.01	0.11	0.02	0.13
Death due to GBV: Men aged 10-18 yrs	0.00	0.07	0.00	0.06	0.01	0.09
Panel B: Breakdown of dependent variables in numbers						
Patients w. physical GBV symptoms: Women aged older than 18	4.81	6.83	5.63	7.81	3.42	4.25
Patients w. sexual GBV symptoms: Women aged older than 18	2.00	2.45	2.34	2.70	1.41	1.76
Patients w. physical GBV symptoms.: Women aged 10-18 yrs	0.45	1.21	0.51	1.27	0.33	1.08
Patients w. sexual GBV symptoms: Women aged 10-18 yrs	7.44	7.71	8.08	7.78	6.53	7.58
Panel C: Controls						
Patient is referred to the hospital by police	0.86	0.35	0.88	0.32	0.80	0.40
Patient is referred to the hospital by community health worker	0.34	0.48	0.39	0.49	0.28	0.45
Patient is referred for care to higher level health facility	0.12	0.33	0.14	0.35	0.11	0.31
Observations	2251		1450		747	

Notes: GBV stands for gender based violence. Variables in Panel A and C are dummy variables. Panel B reports the monthly hospitalizations for GBV. Variables reported in Panel B are used to construct the "has a GBV patient" dummy variable for a specific age group. "Patient" in Panel C is a gender based violence patient. Sample consists of hospitals. HMIS is a panel data. There are 42 hospitals which are observed for every month for 3 years. Thus, the number of observations is a product of the number of hospitals, 12 and 3. "Exposed to the mill" represents being in the catchment area of a mill. Catchment area radius is 4 km.

Table A8: Summary Statistics for Couples: EICV

	All		Not Exposed to a mill		Exposed to a mill	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Women's last daily earnings, in Rwandan francs	1477.89	5487.39	1176.30	4690.03	1515.43	5577.95
Husbands' last daily earnings, in Rwandan francs	2197.96	5476.13	1976.69	6416.94	2225.48	5347.33
Panel B: Controls						
Husband is not absent in the past 12 months	0.74	0.44	0.72	0.45	0.75	0.44
Husband's age	35.79	11.40	34.51	11.37	35.94	11.40
Husband's Occupation: Agricultural	0.79	0.41	0.78	0.41	0.79	0.41
Husband's Education: No education	0.11	0.31	0.10	0.30	0.11	0.31
Husband's Education: Incomplete primary	0.53	0.50	0.52	0.50	0.53	0.50
Husband's Education: Primary completed	0.24	0.43	0.23	0.42	0.24	0.43
Husband's Education: More than primary	0.15	0.36	0.16	0.37	0.15	0.35
Household size	4.63	2.29	3.96	2.56	4.71	2.24
Occupation: Agricultural	0.92	0.27	0.94	0.25	0.92	0.27
Marital status: Married monogamous	0.83	0.37	0.76	0.43	0.84	0.37
Marital status: Married polygamous	0.03	0.17	0.04	0.20	0.03	0.17
Education: No education	0.12	0.32	0.15	0.36	0.11	0.32
Education: Incomplete primary	0.56	0.50	0.54	0.50	0.56	0.50
Education: Primary completed	0.22	0.42	0.17	0.37	0.23	0.42
Education: More than primary	0.14	0.34	0.13	0.34	0.14	0.35
Children in the HH aged 5 and under	0.67	0.47	0.55	0.50	0.68	0.47
Type of residence: Rural	0.84	0.37	0.83	0.37	0.84	0.37
Household's main floor material is cement	0.19	0.39	0.16	0.37	0.20	0.40
Household has electricity	0.17	0.38	0.15	0.36	0.18	0.38
Observations	26789		2828		23961	

Notes: Sample consists of partnered women who presumably married before the expansion of the mills. Year of marriage is not collected in EICV. In order to construct the sample of women who partnered before the expansion of the mills (as in DHS), I took the cohorts of women I observe in DHS. EICV is not geocoded. Thus, "Exposed to the mill" represents having a mill in the district. District is a 800 km^2 area.

Table A9: Summary Statistics for Couples based on Treatment Status: EICV

	Never Treated District Level		Before Treatment District Level		After Treatment District Level	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Women's last daily earnings, in Rwandan francs	1229.07	5278.48	893.53	1858.53	1515.43	5577.95
Husbands' last daily earnings, in Rwandan francs	2113.06	7386.12	1286.44	1802.72	2225.48	5347.33
Panel B: Controls						
Husband is not absent in the past 12 months	0.68	0.46	0.79	0.41	0.75	0.44
Husband's age	33.88	11.30	35.70	11.70	35.94	11.40
Husband's Occupation: Agricultural	0.80	0.40	0.75	0.43	0.79	0.41
Husband's Education: No education	0.10	0.30	0.15	0.35	0.11	0.31
Husband's Education: Incomplete primary	0.53	0.50	0.46	0.50	0.53	0.50
Husband's Education: Primary completed	0.23	0.42	0.24	0.43	0.24	0.43
Husband's Education: More than primary	0.15	0.36	0.14	0.35	0.15	0.35
Household size	4.70	2.29	1.97	2.09	4.71	2.24
Occupation: Agricultural	0.96	0.19	0.90	0.29	0.92	0.27
Marital status: Married monogamous	0.81	0.39	0.67	0.47	0.84	0.37
Marital status: Married polygamous	0.03	0.18	0.05	0.22	0.03	0.17
Education: No education	0.14	0.34	0.22	0.41	0.11	0.32
Education: Incomplete primary	0.57	0.49	0.46	0.50	0.56	0.50
Education: Primary completed	0.15	0.36	0.20	0.40	0.23	0.42
Education: More than primary	0.13	0.34	0.11	0.31	0.14	0.35
Children in the HH aged 5 and under	0.69	0.46	0.18	0.39	0.68	0.47
Type of residence: Rural	0.86	0.35	0.81	0.39	0.84	0.37
Household's main floor material is cement	0.14	0.34	0.18	0.38	0.20	0.40
Household has electricity	0.17	0.38	0.09	0.28	0.18	0.38
Observations	1906		1362		23961	

Notes: Sample consists of partnered women who presumably married before the expansion of the mills. Year of marriage is not collected in EICV. In order to construct the sample of women who partnered before the expansion of the mills (as in DHS), I took the cohorts of women I observe in DHS. EICV is not geocoded. Thus, "Treatment" represents a mill opening in the district. District has on average 800 km^2 area.

A1.2 Additional Tables for Section 4: Empirical Specification

Table A10: Sector Level Baseline Characteristics that Predict Mill Opening

	(1) First Mill in 2005-10	(2) Mill by 2018
Log Coffee Trees in 1999	0.03***	0.04***
	(0.01)	(0.01)
FAO-GAEZ Coffee Suitability Index	0.07*	0.03
	(0.04)	(0.04)
Log Population in 2002	-0.10	-0.14
	(0.49)	(0.49)
Log Female Population in 2002	0.07	0.20
	(0.49)	(0.49)
Share of Self-Employed Women in 2002	0.27	0.17
	(0.55)	(0.54)
Share of Unpaid Worker Women in 2002	0.00	0.44
	(0.58)	(0.58)
Share of Primary-Educated Women in 2002	1.45	1.38
	(1.09)	(1.08)
Share of Primary-Educated Men in 2002	-0.14	-0.40
	(1.20)	(1.19)
Number of daughters per Woman in 2002	-0.22	-0.13
	(0.22)	(0.22)
Share of Women in a Consensual Union in 2002	-1.20	-0.57
	(0.78)	(0.77)
Share of Women in a Polygamous Marriage in 2002	0.17	-1.80
	(1.94)	(1.94)
Share of Women without Assets in 2002	0.32	0.02
	(0.57)	(0.57)
Genocide Intensity Index at the Commune Level	-0.02	-0.04
	(0.04)	(0.03)
District FE	✓	✓
Number of Observations	348	348
Dependent variable mean	0.26	0.39
Adjusted R^2	0.24	0.39

Notes: FAO-GAEZ coffee suitability and genocide intensity index are both standardized. The data is at the sector level. *** p<.01, ** p<.05, * p<.1

Table A11: Balance Check: Within District Approach

	Husband		Women		
	(1) Occupation: Agricultural	(2) Education in Years	(3) Occupation: Agricultural	(4) Education in Years	(5) Civil Marriage
Mill	0.00	0.03	-0.00	0.01	-0.01
	(0.02)	(0.14)	(0.02)	(0.13)	(0.02)
Observations	10413	10413	10413	10413	10413
Dependent variable mean	0.69	4.35	0.74	4.03	0.74
	Women		Household		
	(1) Age at: First Marriage	(2) Religion: Christian	(3) Residence: Rural	(4) Cement Floor	(5) Electricity
Mill	0.02	-0.00	0.03	0.01	0.02
	(0.05)	(0.01)	(0.02)	(0.01)	(0.01)
Observations	10413	10413	10413	10413	10413
Dependent variable mean	19.89	0.97	0.83	0.18	0.14

Notes: Robust standard errors clustered at the sector level are in parentheses. 4 km catchment area is used for the treatment group. Within district approach is used for the control group. The estimates are based on DHS data and estimated with the main specification presented in Section 5.2.1
*** p<.01, ** p<.05, * p<.1

Table A12: Balance Check: Donut Approach

	Husband		Women		
	(1) Occupation: Agricultural	(2) Education in Years	(3) Occupation: Agricultural	(4) Education in Years	(5) Civil Marriage
Mill	-0.01	-0.08	0.01	-0.07	-0.02
	(0.02)	(0.15)	(0.02)	(0.16)	(0.02)
Observations	5283	5283	5283	5283	5283
Dependent variable mean	0.68	4.47	0.74	4.40	0.79
	Women		Household		
	(1) Age at: First Marriage	(2) Religion: Christian	(3) Residence: Rural	(4) Cement Floor	(5) Electricity
Mill	0.00	-0.00	0.04	0.01	0.02
	(0.06)	(0.01)	(0.03)	(0.01)	(0.01)
Observations	5283	5283	5283	5283	5283
Dependent variable mean	20.16	0.96	0.81	0.21	0.17

Notes: Robust standard errors clustered at the sector level are in parentheses. 4 km catchment area is used for the treatment group. Donut approach is used for the control group. The estimates are based on DHS data and estimated with the main specification presented in Section 5.2.1 *** p<.01, ** p<.05, * p<.1

Table A13: Placebo Test: Outcome Variables Before a Mill Opening

	Within District			Donut		
	(1) Work	(2) Cash	(3) Violence	(4) Work	(5) Cash	(6) Violence
Mill	0.02	0.03	0.06	0.01	0.02	0.05
	(0.02)	(0.03)	(0.05)	(0.01)	(0.04)	(0.06)
Observations	7314	6455	2651	3533	3534	1494
Dependent variable mean	0.87	0.56	0.34	0.98	0.55	0.35

Notes: Robust standard errors clustered at the sector level are in parentheses. 4 km catchment area is used for the treatment group. The estimates are based on DHS data and estimated with the main specification presented in Section 5.2.1 *** p<.01, ** p<.05, * p<.1

A1.3 Additional Tables for Section 5: Results

Table A14: Effect of Mill Exposure on Women's Occupation: Within District Approach

	(1) Managers	(2) Sales	(3) Agricultural Self-Employed	(4) Agricultural Employee	(5) Manual Skilled & Unskilled
Mill	0.00	-0.01	-0.01	0.01	0.01
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)
Observations	9262	9262	9262	9262	9262
Dependent variable mean	0.03	0.07	0.77	0.06	0.05

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All dependent variables are measured for the past 12 months. Catchment area radius is 4 km. Within district approach is used for the control group. *** p<.01, ** p<.05, * p<.1

Table A15: Effect of Mill Exposure on Husbands' Occupation: Within District Approach

	(1) Managers	(2) Sales	(3) Agricultural Self-Employed	(4) Agricultural Employee	(5) Manual Skilled & Unskilled
Mill	0.00	0.03*	-0.04	0.01	0.00
	(0.01)	(0.01)	(0.03)	(0.02)	(0.03)
Observations	3789	3789	3789	3789	3789
Dependent variable mean	0.05	0.05	0.61	0.08	0.18

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partners of women in the first specification. All dependent variables are measured for the past 12 months. Catchment area radius is 4 km. Within district approach is used for the control group. *** p<.01, ** p<.05, * p<.1

Table A16: Effect of Mill Exposure on Women's Occupation Donut Approach

	(1) Managers	(2) Sales	(3) Agricultural Self-Employed	(4) Agricultural Employee	(5) Manual Skilled & Unskilled
Mill	0.00	-0.01	-0.01	0.01	0.01
	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)
Observations	4962	4962	4962	4962	4962
Dependent variable mean	0.03	0.07	0.75	0.07	0.05

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All dependent variables are measured for the past 12 months. Catchment area radius is 4 km. Donut approach is used for the control group. *** $p<.01$, ** $p<.05$, * $p<.1$

Table A17: Effect of Mill Exposure on Husbands' Occupation: Donut Approach

	(1) Managers	(2) Sales	(3) Agricultural Self-Employed	(4) Agricultural Employee	(5) Manual Skilled & Unskilled
Mill	0.01	0.03*	-0.04	0.00	0.01
	(0.01)	(0.02)	(0.03)	(0.02)	(0.03)
Observations	2107	2107	2107	2107	2107
Dependent variable mean	0.05	0.06	0.62	0.07	0.17

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partners of women in the first specification. All dependent variables are measured for the past 12 months. Catchment area radius is 4 km. Donut approach is used for the control group. *** p<.01, ** p<.05, * p<.1

Table A18: Effect of a Mill Opening on Women's Last Daily Earnings using Inverse Hypberbolic Sine Transformation for the Dependent Variables

	IHS of Women's Last Daily Earnings	
	(1) All Sample	(2) Occupation: Agriculture
Log of Mills per capita in the District	3.55***	3.77***
	(0.24)	(0.26)
Observations	18176	17375
Dependent variable mean	6.60	6.39

Notes: Robust standard errors clustered at the district level are in parentheses. All estimations include individual controls, cohort fixed effects, district-by-year fixed effects, linear time trends interacted with baseline district level characteristics. Since EICV is not geocoded, the mill variable is log of mills per capita in a district in a given year. In Column 2, the sample consists of women who reported their occupation as agricultural. *** p<.01, ** p<.05, * p<.1

Table A19: Effect of a Mill Opening on Household Agricultural Production

	Log of Household Income from	
	(1) Total Agricultural Production	(2) Coffee Production
Log of Mills per capita in the District	3.88***	1.40*
	(0.22)	(0.72)
Observations	17151	2026
Dependent variable mean	10.49	9.53

Notes: Robust standard errors clustered at the district level are in parentheses. All estimations include individual controls, cohort fixed effects, district-by-year fixed effects, linear time trends interacted with baseline district level characteristics. Since EICV is not geocoded, the mill variable is log of mills per capita in a district in a given year. *** p<.01, ** p<.05, * p<.1

Table A20: Effect of Mill Exposure on Hospitalizations for Gender Based Violence

	Women		Men	
	(1) Older than 18	(2) Younger than 18	(3) Older than 18	(4) Younger than 18
Mill x Month 1	-0.01	-0.05	0.02	-0.06
	(0.04)	(0.06)	(0.04)	(0.06)
Mill x Month 2	0.00	0.00	0.00	0.00
	(.)	(.)	(.)	(.)
Mill x Month 3	-0.02	-0.11*	-0.10*	-0.04
	(0.03)	(0.06)	(0.06)	(0.07)
Mill x Month 4	-0.02	-0.01	-0.05	0.04
	(0.05)	(0.04)	(0.07)	(0.06)
Mill x Month 5	-0.02	-0.03	-0.04	-0.00
	(0.05)	(0.06)	(0.04)	(0.06)
Mill x Month 6	-0.10***	-0.08	0.01	-0.01
	(0.03)	(0.05)	(0.08)	(0.07)
Mill x Month 7	-0.14***	-0.03	0.10	0.01
	(0.05)	(0.06)	(0.08)	(0.07)
Mill x Month 8	0.03	-0.03	0.11	0.01
	(0.04)	(0.08)	(0.07)	(0.08)
Mill x Month 9	-0.01	0.01	0.05	0.01
	(0.06)	(0.09)	(0.07)	(0.08)
Mill x Month 10	0.02	-0.03	0.02	-0.05
	(0.03)	(0.06)	(0.06)	(0.08)
Mill x Month 11	-0.04	-0.02	-0.03	0.02
	(0.08)	(0.07)	(0.07)	(0.05)
Mill x Month 12	-0.04	0.03	0.00	0.04
	(0.07)	(0.07)	(0.09)	(0.07)
Observations	1927	1927	1712	1926
Dependent variable mean	0.86	0.89	0.33	0.25

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include hospital controls, hospital fixed effects, district fixed effects, province-by-year fixed effects, linear time trends interacted with baseline district level characteristics. Omitted categeory is the hospitalizations in Month 2, February. Catchment area radius is 4 km. *** p<.01, ** p<.05, * p<.1

Table A21: Effect of Mill Exposure on Log of Hours Worked in a Week During Coffee Harvest Months among Couples Work in Agriculture

	Log of Hours Worked in a Week During Coffee Harvest Months among Couples Work in Agriculture	
	(1) Wife	(2) Husband
Log of Mills per capita in the District	0.02	-0.09**
	(0.04)	(0.04)
Observations	4878	5477
Dependent variable mean	3.04	3.34

Notes: Robust standard errors clustered at the district level are in parentheses. All estimations include individual controls, cohort fixed effects, district-by-year fixed effects, linear time trends interacted with baseline district level characteristics. Sample consists of partnered women (and their husbands) who married before the expansion of the mills. Since EICV is not geocoded, the mill variable is log of mills per capita in a district in a given year. *** p<.01, ** p<.05, * p<.1

A1.4 Additional Tables for Section 8: Robustness Checks

Table A22: Effect of Mill Exposure on Women's Employment and Type of Earnings

	Work Variables	
	(1)	(2)
	Work	Cash
Mill x Event Time -3	0.03	0.05
	(0.02)	(0.05)
Mill x Event Time -2	0.02	0.06
	(0.03)	(0.07)
Mill x Event Time -1	0.00	0.00
	(.)	(.)
Mill x Event Time 0	0.00	0.07*
	(0.02)	(0.04)
Mill x Event Time 1	0.01	0.05
	(0.03)	(0.07)
Mill x Event Time 2	-0.01	-0.02
	(0.04)	(0.07)
Mill x Event Time 3	-0.01	0.05
	(0.02)	(0.05)
Mill x Event Time 4	0.01	0.08*
	(0.02)	(0.04)
Mill x Event Time 5	-0.04	0.13***
	(0.03)	(0.04)
Mill x Event Time 6	0.01	0.06*
	(0.02)	(0.03)
Observations	8522	8786
Dependent variable mean	0.88	0.60

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All variables are measured for the past 12 months. Ommitted categeory is Event Time -1, 1 year before a mill opening. Catchment area radius is 4 km. *** p<.01, ** p<.05, * p<.1

Table A23: Effect of Mill Exposure on Self-Reported Domestic Violence

	(1) Domestic Violence
Mill x Event Time -3	0.03
	(0.05)
Mill x Event Time -2	-0.04
	(0.06)
Mill x Event Time -1	0.00
	(.)
Mill x Event Time 0	-0.12**
	(0.06)
Mill x Event Time 1	-0.09
	(0.08)
Mill x Event Time 2	-0.08
	(0.08)
Mill x Event Time 3	-0.11*
	(0.06)
Mill x Event Time 4	-0.04
	(0.06)
Observations	4634
Dependent variable mean	0.34

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All variables are measured for the past 12 months. Omitted category is Event Time -1, 1 year before a mill opening. Catchment area radius is 4 km. *** p<.01, ** p<.05, * p<.1

Table A24: Effect of Mill Exposure on Women's Employment, Type of Earnings and Self-Reported Domestic Violence in the Past 12 Months for Different Catchment Area Sizes

	4 km			5 km			10 km		
	(1) Work	(2) Cash	(3) Violence	(4) Work	(5) Cash	(6) Violence	(7) Work	(8) Cash	(9) Violence
Mill	-0.00	0.06***	-0.09***	-0.01	0.04*	-0.06*	-0.01	-0.02	0.01
	(0.01)	(0.02)	(0.03)	(0.01)	(0.02)	(0.04)	(0.01)	(0.02)	(0.04)
Observations	10471	9321	3692	10471	9321	3692	10471	9321	3692
Dependent variable mean	0.87	0.58	0.35	0.87	0.58	0.35	0.87	0.58	0.35

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All dependent variables are measured for the past 12 months. Catchment areas are constructed by buffers around the mills where 4, 5 and 10 km represent buffer radius. *** p<.01, ** p<.05, * p<.1

Table A25: Effect of Mill Exposure on Household Decision Making: Woman Alone or Jointly with Husband

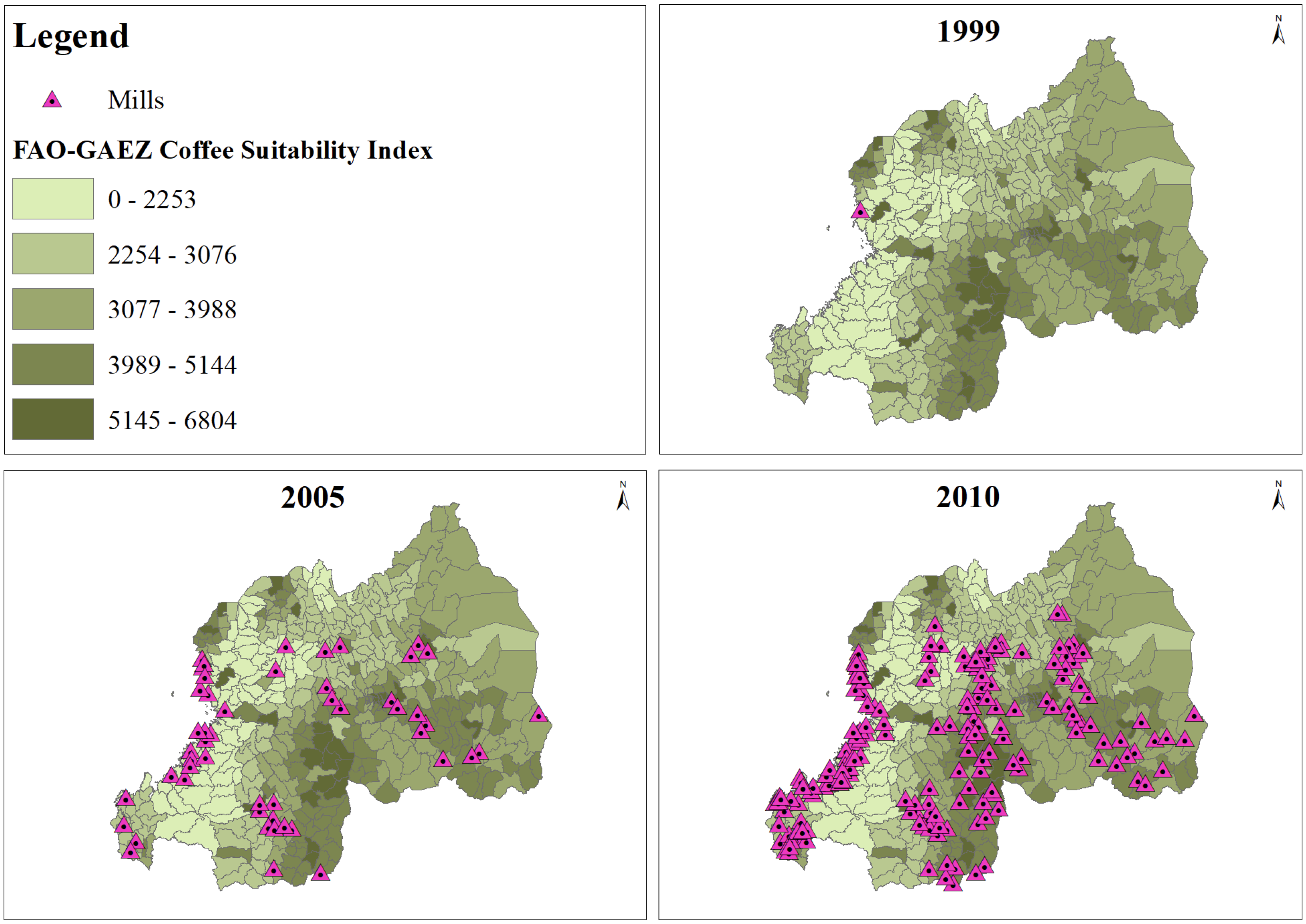
	4 km			5 km			10 km		
	(1) Large HH Purchases	(2) Own Health	(3) Family Visit	(4) Large HH Purchases	(5) Own Health	(6) Family Visit	(7) Large HH Purchases	(8) Own Health	(9) Family Visit
Mill	0.05**	0.02	0.01	0.04*	0.00	0.01	0.03	0.02	0.02
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	10471	10471	10471	10471	10471	10471	10471	10471	10471
Dependent variable mean	0.69	0.74	0.82	0.69	0.74	0.82	0.69	0.74	0.82

Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include individual controls, cohort fixed effects, year of marriage fixed effects, sector fixed effects, district-by-year fixed effects, linear time trends interacted with baseline sector level characteristics. Sample consists of partnered women who married before the expansion of the mills. All dependent variables are coded as 1 if the decision is taken by women alone or jointly with their husbands and zero otherwise. Otherwise category includes husband only or someone else. The survey question on household decisions changed significantly over the data cycles. in 2005, the question asks “Who has the final say on decision x?” After 2005, the question is “Who usually decides on x”. The answer option “Respondent and other” is also discontinued in 2010 and 2014 rounds. To make a comparable variable, I create the variable based on whether the woman had a say in the decision, either alone or jointly. Catchment areas are constructed by buffers around the mills where 4, 5 and 10 km represent buffer radius. *** p<.01, ** p<.05, * p<.1

A2 Additional Figures

A2.1 Additional Figures for Section 2: Institutional Context

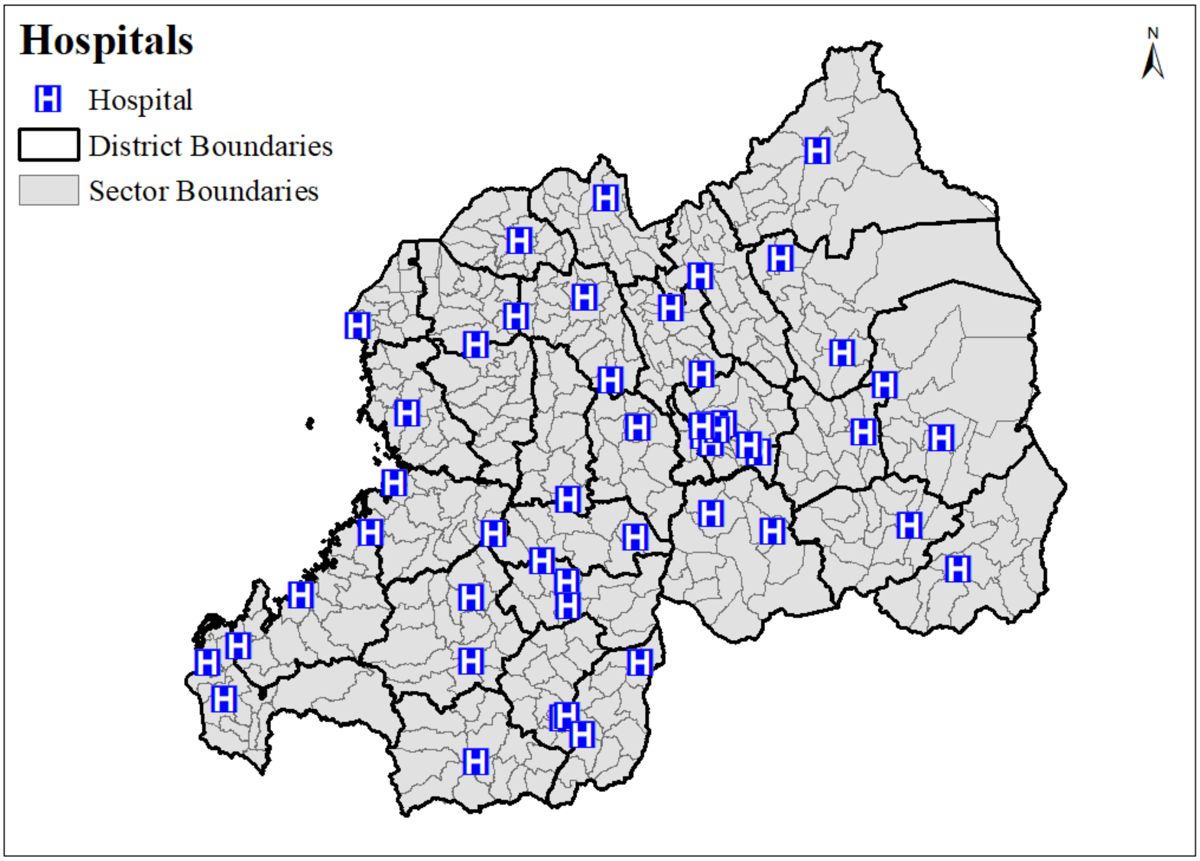
Figure A1: FAO-GAEZ Coffee Suitability Index and Expansion of Mills in Rwanda



Notes: The maps are constructed by combining data on mills, FAO-GAEZ Coffee Suitability Index, The Rwandan GeoPortal spatial data on sector boundaries.

A2.2 Additional Figures for Section 3: Data

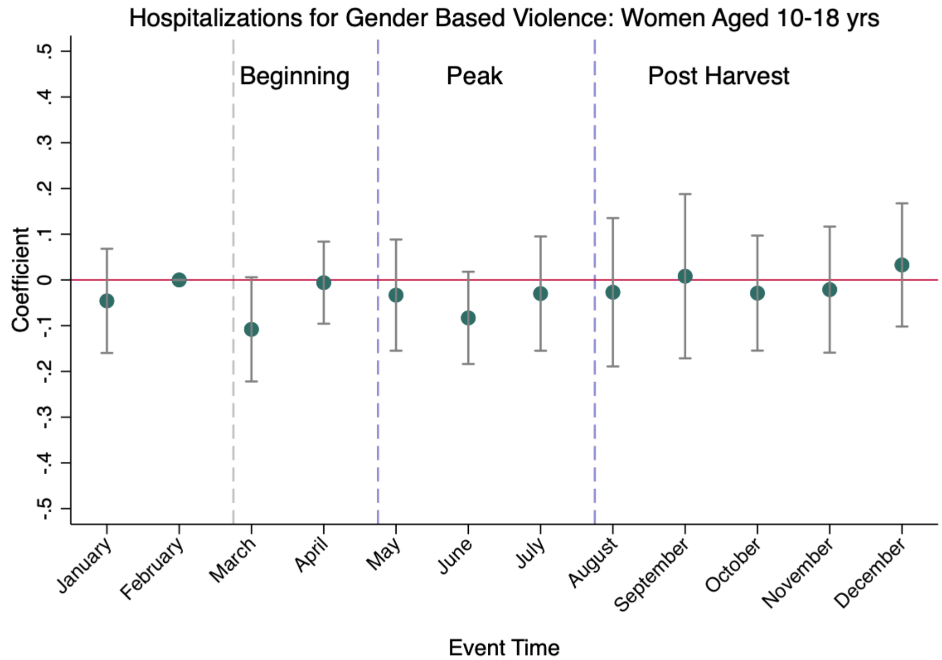
Figure A2: Hospitals in Rwanda



Notes: The map is constructed by combining HMIS data with the GPS coordinates of the hospitals provided by the Rwanda Ministry of Health.

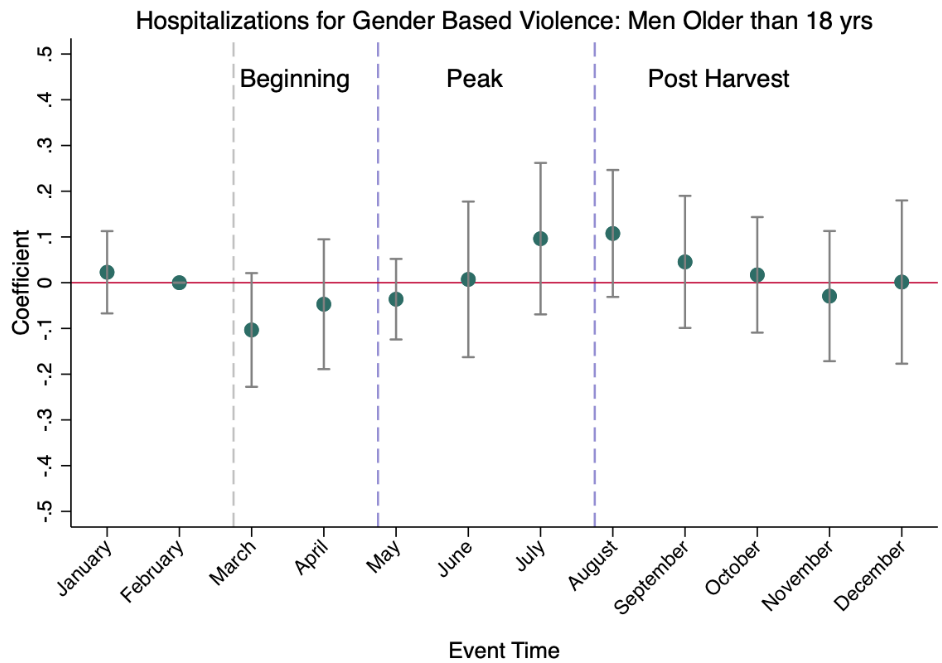
A2.3 Additional Figures for Section 5: Results

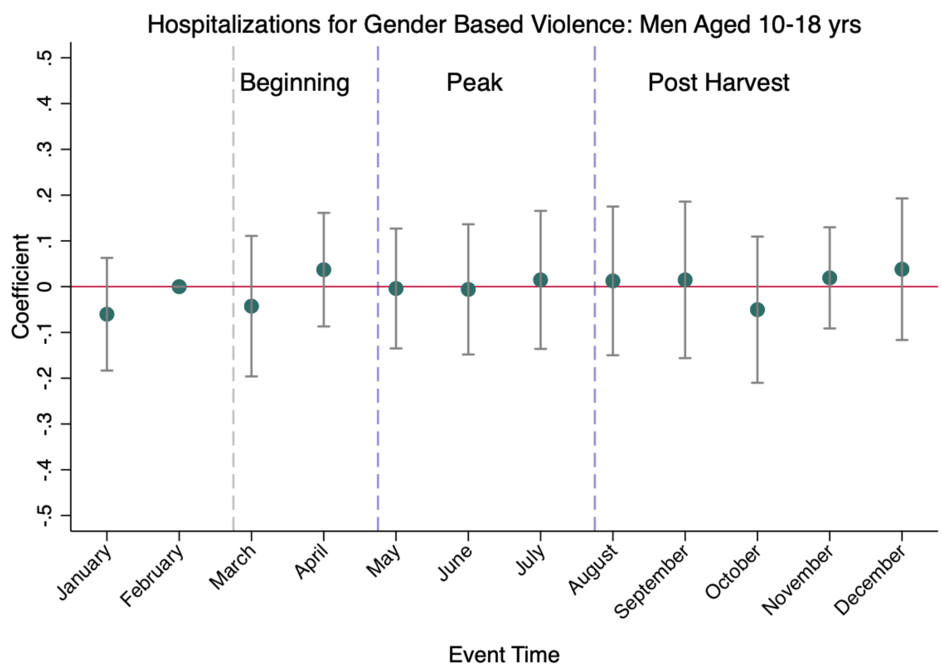
Figure A3: Dynamic Impact of a Mill Opening on Hospitalizations for Gender Based Violence (Women 10-18)



Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include hospital controls, hospital fixed effects, district fixed effects, province-by-year fixed effects, linear time trends interacted with baseline district level characteristics. 4 km catchment area is used. *** p<.01, ** p<.05, * p<.1

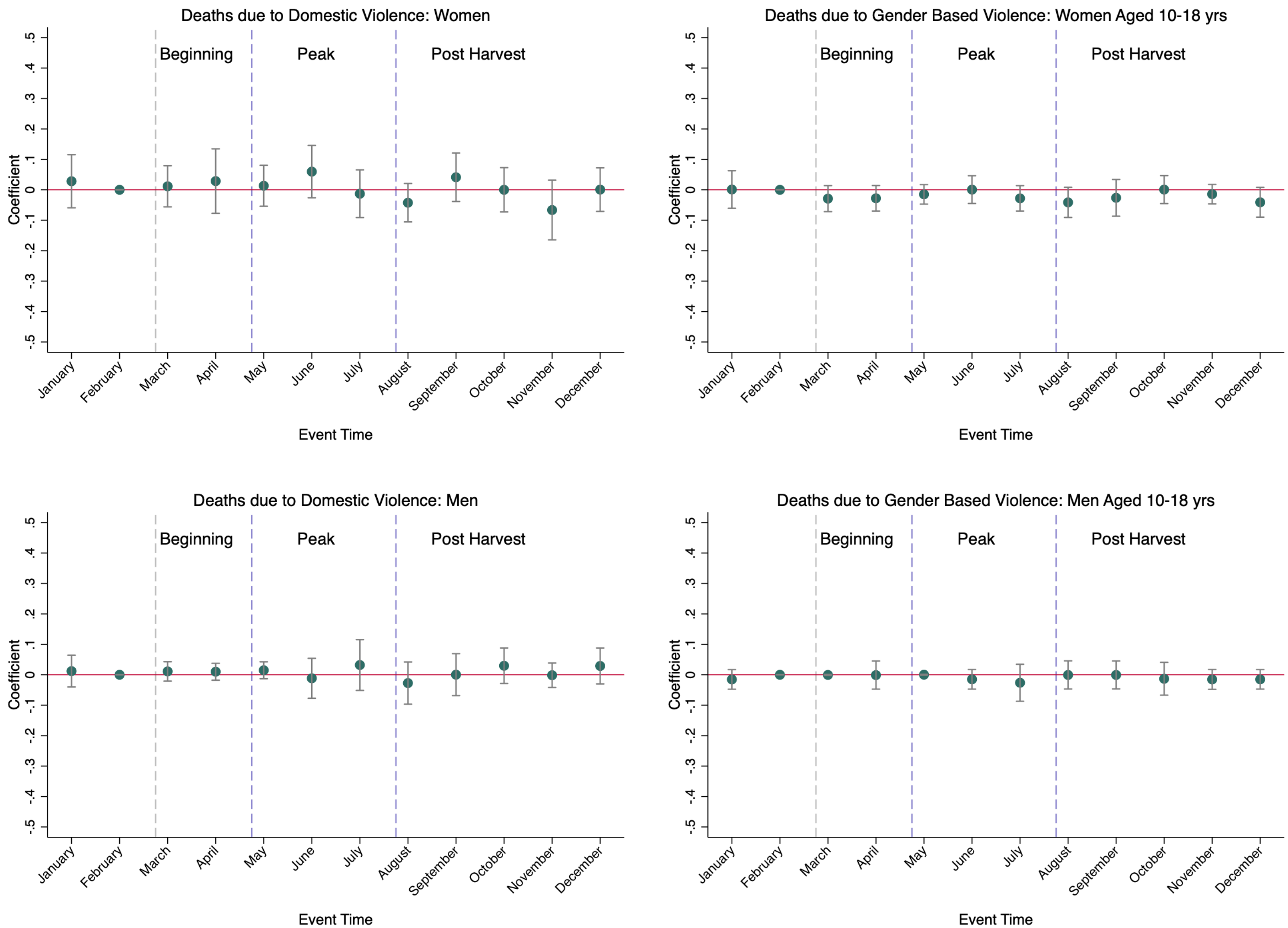
Figure A4: Dynamic Impact of a Mill Opening on Hospitalizations for Gender Based Violence (Men)





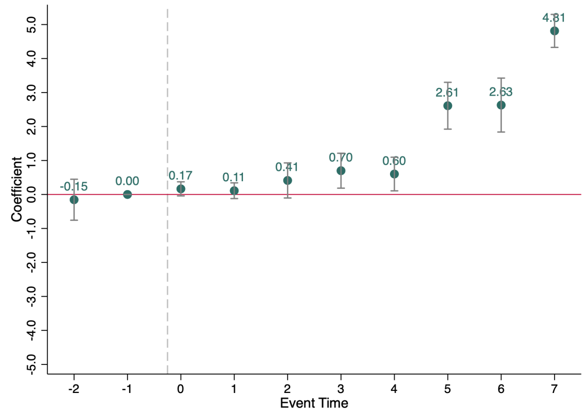
Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include hospital controls, hospital fixed effects, district fixed effects, province-by-year fixed effects, linear time trends interacted with baseline district level characteristics. 4 km catchment area is used. *** p<.01, ** p<.05, * p<.1

Figure A5: Dynamic Impact of a Mill Opening on Deaths due to Gender Based Violence (Women and Men)



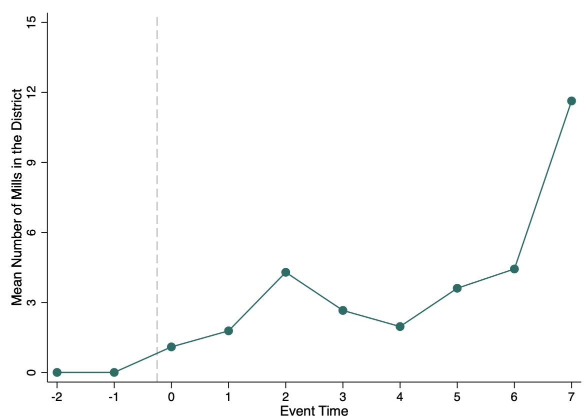
Notes: Robust standard errors clustered at the sector level are in parentheses. All estimations include hospital controls, hospital fixed effects, district fixed effects, province-by-year fixed effects, linear time trends interacted with baseline district level characteristics. Catchment area radius is 4 km.. *** p<.01, ** p<.05, * p<.1

Figure A6: Dynamic Impact of a Mill on Inverse Hyberbolic Sine of Women's Last Daily Wages



Notes: Robust standard errors clustered at the district level are in parentheses. All estimations include individual controls, cohort fixed effects, district fixed effects, district-by-year fixed effects, linear time trends interacted with baseline district level characteristics. *** p<.01, ** p<.05, * p<.1

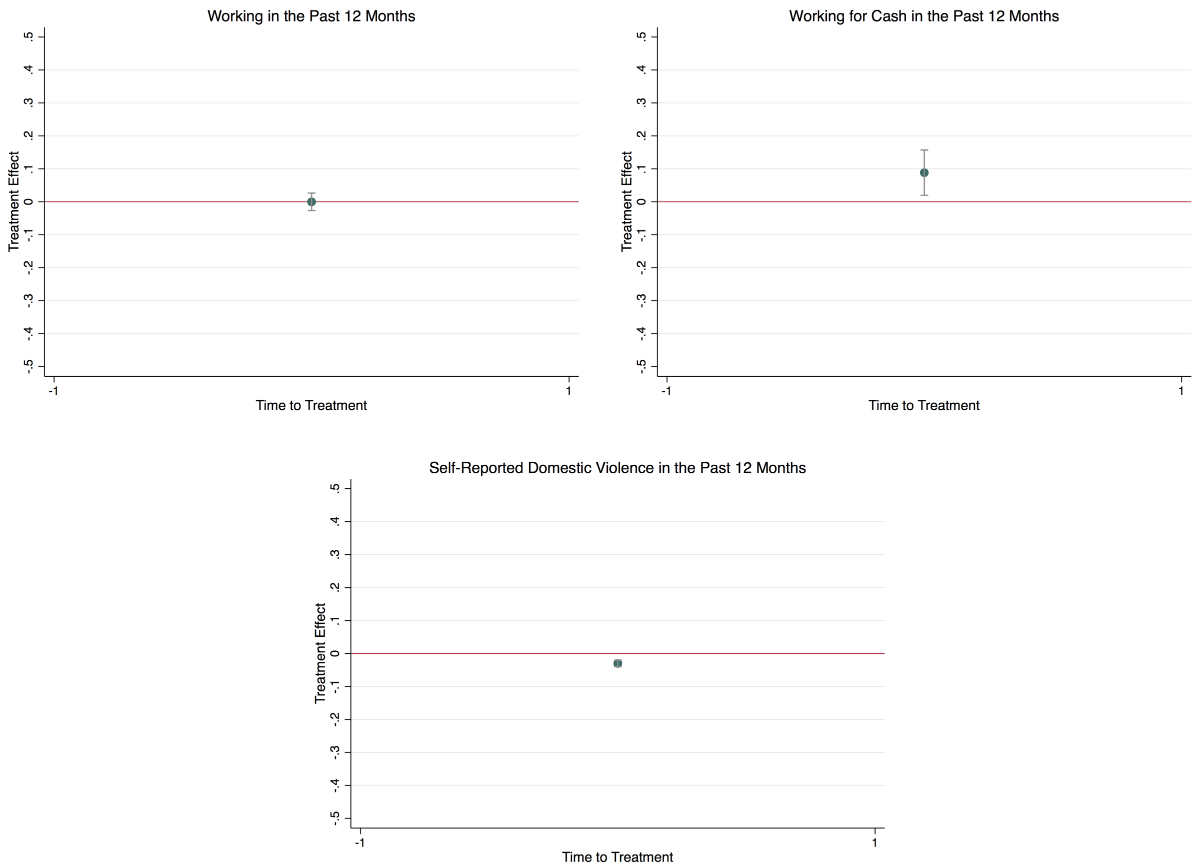
Figure A7: Mean Number of Mills in a District by Event-Time



Notes: Only the districts that has at least one mill by the end of the sample is included.

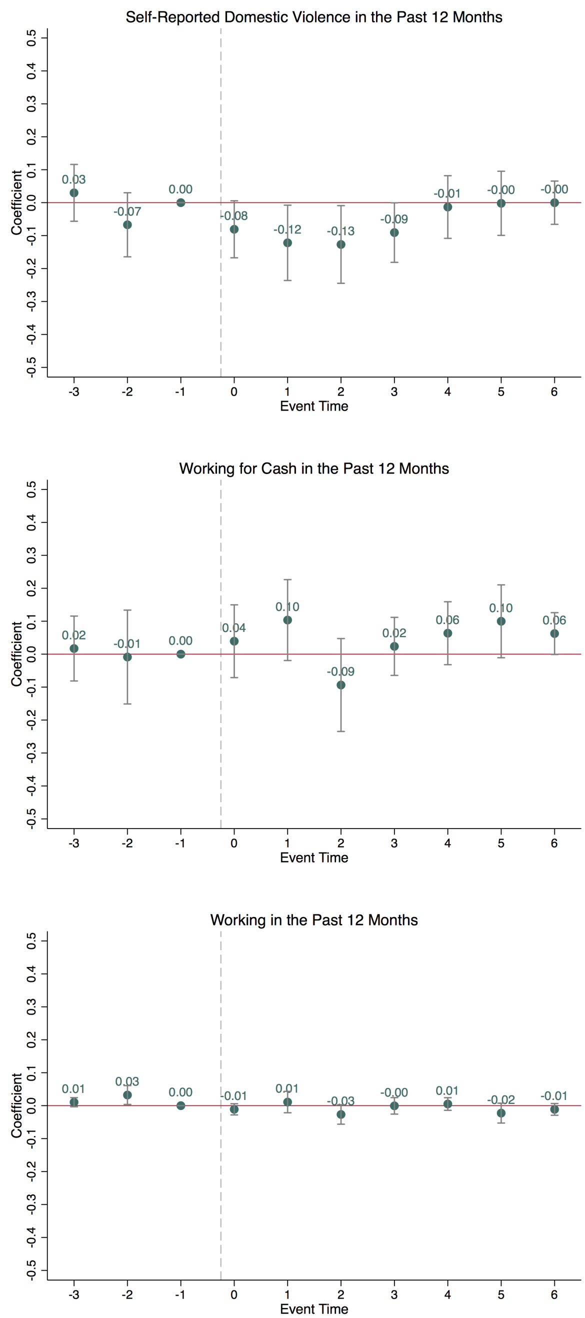
A2.4 Additional Figures for Section 8: Robustness Checks

Figure A8: Impact of a Mill Opening on Women's Employment, Type of Earnings and Self-Reported Domestic Violence in the Past 12 Months using de Chaisemartin and D'Haultfœuille (2020)



Notes: Sample consists of partnered women who married before the expansion of the mills. All variables are measured for the past 12 months. 4 km catchment area is used. Within district approach is used.

Figure A9: Dynamic Impact of a Mill Opening on Women's Employment, Type of Earnings and Self-Reported Domestic Violence in the Past 12 Months using Sun and Abraham (2020)



Notes: Sample consists of partnered women who married before the expansion of the mills. All variables are measured for the past 12 months. 4 km catchment area is used. Within district approach is used.

A3 Data Sources

A3.1 Panel of Mills

First, I complement the mills data with spatial data by The Rwanda GeoPortal. The portal provides maps of different geographical boundaries like sector, district and province. There are 416 sectors, 30 districts and 5 provinces in Rwanda. The mean area of each is approximately 58.4 km^2, 810 km^2 and 5552 km^2. According to 2002 Rwandan Population and Housing Census, average sector population is 1959 where average female population at the sector level is 1024. Average district population is 27698 where average female population at the district level is 14499.

The final panel of mills have information on a mill's location at different levels (including the exact GPS coordinates), number of coffee trees in the sector the mill is located for different years and FAO-GAEZ coffee suitability score. The data also has information on mill characteristics and spatial features of the location of the mill including presence of water bodies, road network, area etc.

A3.2 Individuals and Household Level Data

Rwandan Demographic Health Surveys. DHS asks whether women are paid "cash only" or "cash and in-kind". Field surveys suggest that mills provide clothing, in-kind benefits to women working in the mills beyond giving a daily wage. Thus, I create my cash variable based on both women working for cash only and cash and in-kind rather. Thus, I create my cash variable based on women working for both cash and in-kind rather than cash only. According to the data, occupations that pay cash-only wages for women are dominantly non-agricultural (managers in Kigali, sales etc.). Upon a mill opening, I find statistically significant changes in the probability of working for cash when I define the variable as women working for both cash and in kind. However, there is no change in the probability of working for cash upon a mill opening when I define the variable as women working for cash only. This further confirms that working for "cash and in-kind" correctly captures the type of earnings of the women who work in the mills. I perform the same exercise for husbands. There is no change in husbands' working for cash behavior for both definitions which confirms that the expansion did not affect men's earning type.

The domestic module is prepared with respect to WHO guidelines "Putting Women First: Ethical and Safety Recommendations for Research on Domestic Violence against Women" World Health Organization, 2001. DHS randomly selects one women per household for the module. Thus, the number of women who have information for domestic violence will always be less than the number of women who answered the women's questionnaire. The module asks partnered women whether they experience physical, sexual or emotional violence in the last 12 months by their partners. Since emotional violence questions are not asked in the 2010/11 cycle, I use physical and sexual domestic violence in my analysis. Physical domestic violence consists of being pushed, shaken, thrown something at, slapped, kicked, dragged, strangled, burnt and sexual domestic violence consists of physically forced into unwanted sex and perform sexual acts.

I also exploit variables related to household-decision making to analyze the relationship between exposure to mills and women's bargaining power within the household. DHS asks women whether they make certain decisions alone, jointly with their husband or the decisions are made for her by their husbands or someone else. Such decisions include decisions regarding large household purchases, women's own health and women visiting their own family.

DHS data allows me to observe the outcome variables for 2004, 2005, 2010, 2014 and 2019. The 2005 cycle was collected in February-July 2005, the 2010/11 cycle was collected in September 2010-March 2011, 2014/15 cycle was collected in November 2014-April 2015 and 2019/20 cycle was collected in November 2019-July 2020. Given that the harvest season runs from April to July and key variables captures individuals' experience in the past 12 months, 2005 data cycle contains information on both 2004 and 2005 harvest season. The 2010/11 cycle contains information on 2010 harvest season, the 2014/15 cycle provides information on 2014 harvest season and the 2019/20 cycle provides information on 2019 harvest season. Thus, DHS data enables me to observe 5 harvest years in total, 2004, 2005, 2010, 2014 and 2019.

Integrated Household Living Conditions Surveys. Since EICV does not provide information on the year of marriage, unfortunately, I cannot restrict the sample to couples who married before the expansion. However, I include cohort fixed effects in my specifications that can provide a control for the year of marriage. Moreover, I restrict the sample to individuals who are in the same age groups with the DHS data.

A3.3 Administrative Hospital Level Domestic Violence Data

District hospitals constitute the overwhelming majority of the hospitals (47 in total) in the country.[1] The remaining 5 hospitals are either referral and teaching hospitals. Referral hospitals are located either in Kigali (capital) or urban areas, have the latest technology and provide care under the public national health insurance system if a district hospital or health clinic refers a current patient to visit a referral hospital. Thus, they do not constitute a first stop for a patient. Teaching hospitals focus on medical research.

Figure A2 visualizes the hospitals on a map. The district hospitals have gender based violence centers in them which aim to combat gender based violence. These centers, also known as the

[1] Given that there are in total 30 districts, some districts have more than one district hospital.

Isange One Stop Centers (IOSCs), are state institutions which provide medical, police and legal help for gender based violence victims under one roof and are free of charge. By combining all services under one roof, MOH, Rwanda National Police, the Ministry of Justice (MOJ) and the Ministry of Gender and Family Promotion (MIGEPROF) aim to ease the reporting process of gender based violence victims. Sviatschi and Trako (2021) finds that such centers in Peru reduced gender-based violence and increased human capital investments in children, raised children's enrollment, attendance, and test scores.

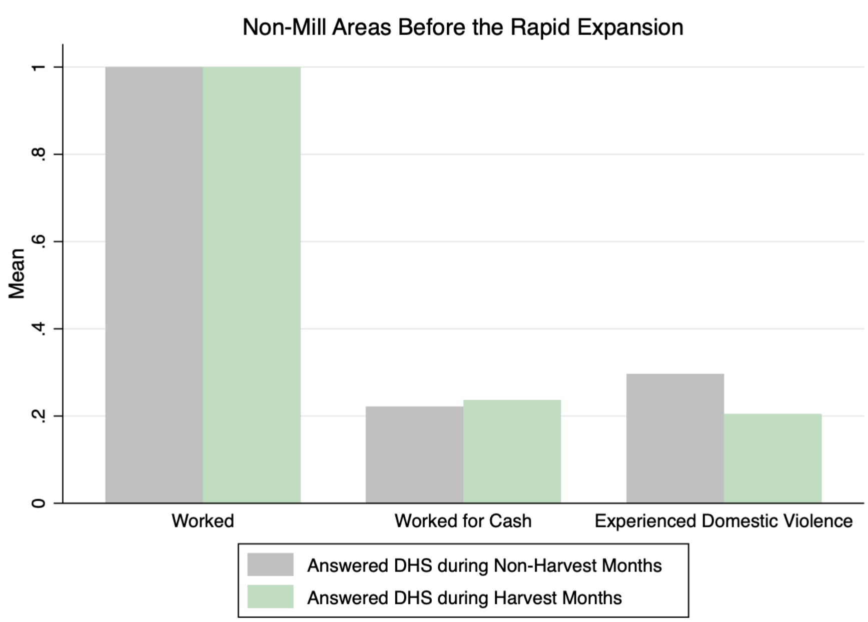
A4 Supplementary Results for Mechanisms

A4.1 Increase in the Household Resources Mechanism

DHS asks for the month of the interview for every respondent. Originally, the domestic violence questions are asked about women's domestic violence experiences in the past 12 months. However, if we assume recall bias for the respondents who answered the survey during non-harvest and those who answered during non-harvest months, a difference in outcomes across these groups approximates the difference in women's domestic violence experience across the months.

According to data, among married women working in agriculture, the rate of working and working for cash are similar across the harvest and non-harvest months. Working for cash is much lower compared to working, which confirms the fact that women are unpaid family workers in large numbers. However, the rate of domestic violence is lower among the women who answered DHS during the harvest months, when the money from the coffee sales flows into the household. Figure A10 visualizes the differences. The domestic violence rates are statistically different across harvest and non-harvest months. Although these graphs do not report causal estimates, it suggests that the increase in household resources is a plausible mechanism behind the main results.

Figure A10: Women's Employment, Type of Earnings and Self-Reported Domestic Violence during Non-Harvest and Harvest Months

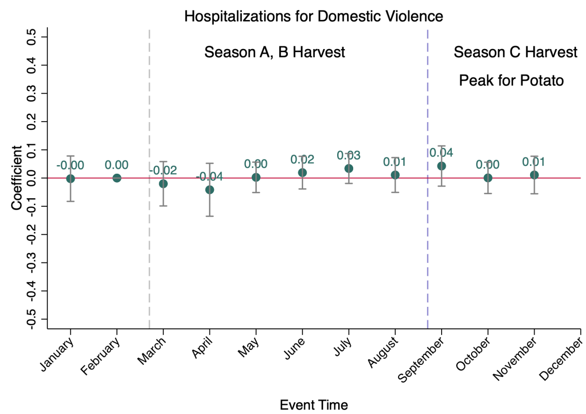


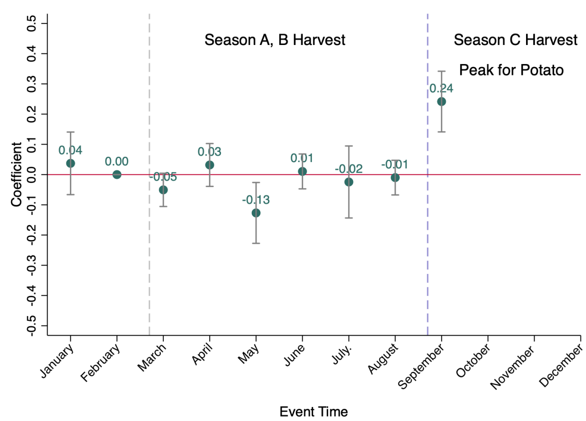
Notes: The bar graph shows the raw means for each variable. For the domestic violence variable, 95% confidence intervals for non-harvest and harvest months are [0.20, 0.39] and [0.18, 0.23] respectively.

A4.2 Increase in the Cost of Women's Incapacitation Mechanism

In Rwanda, there are 3 harvesting seasons, Season A, B and C where each season corresponds to certain crops (NISR, 2021). Irish potato's harvest season starts in late February (can be harvested during Season A and B) where the peak season is in September and October (Season C).

Figure A11: Monthly Hospitalizations for Domestic Violence and Consumption in Potato Suitable Regions





Notes: Robust standard errors clustered at district level both for the hospitalizations and consumption. Hospital estimation include hospital controls, hospital fixed effects, district fixed effects, province-by-year fixed effects, linear time trends interacted with baseline district level characteristics. 4 km catchment area is used. Consumption estimation include individual controls, cohort fixed effects, district-by-year fixed effects, linear time trends interacted with baseline district level characteristics. For the consumption estimation, sample consists of couples who married before the expansion of the mills, have agricultural occupations and are producing potato. *** p<.01, ** p<.05, * p<.1

A5 Proofs

The probability of the husband choosing violence is

$$F_h(\overline{\theta_h}) = F_h\Bigg[(1-y)I_h - (1-x)I_w + R(I_w, I_h, \tau)[\tau I_w + \alpha(I)]\Bigg] \tag{1}$$

where $R(I_w, I_h, \tau) = \frac{1-F_w(\overline{\theta_w})}{F_w(\overline{\theta_w})} = (F_w[(1-x+\tau)I_w - (1-y)I_h + v)])^{-1} - 1$. R is the ratio of the probability of remaining married divided by the probability of being separated (odds of remaining married). R is decreasing in I_w and τ and increasing in I_h as shown below.

$$\frac{\partial R(I_w, I_h, \tau)}{\partial I_w} = -F_w(.)^{-2} f_w(.)[1-x+\tau]\rho < 0. \tag{2}$$

$$\frac{\partial R(I_w, I_h, \tau)}{\partial I_h} = -F_w(.)^{-2} f_w(.)[-(1-y)] > 0. \tag{3}$$

$$\frac{\partial R(I_w, I_h, \tau)}{\partial \tau} = -F_w(.)^{-2} f_w(.) I_w < 0. \tag{4}$$

For simplicity, I took the derivatives as if I_w is a constant since the sign of the derivatives won't change even if I take I_w as $I_w(\rho)$ based on my assumptions and chain rule. Suppose $I_w(\rho) = I_w\rho$. Then $\frac{\partial R(I_w, I_h, \tau)}{\partial \rho} = -F_w(.)^{-2} f_w(.)[1-x+\tau]I_w < 0$. Thus, R is also decreasing in ρ.

I do comparative statics on $\overline{\theta_h}$ below to capture how the probability of the husband choosing violence, $F_h(\overline{\theta_h})$, changes with respect to an increase in I_w and I_h.

A5.1 Increase in I_w

For simplicity, first, I took the derivatives as if I_w is a constant since the sign of the derivatives won't change even if I take I_w as $I_w(\rho)$ based on my assumptions and chain rule. I will relax this at the end of the comparative statics.

$$\frac{\partial \overline{\theta_h}}{\partial I_w} = -(1-x) + \frac{\partial R(I_w, I_h, \tau)}{\partial I_w}[\tau I_w + \alpha(I)] + \Big[\tau + \frac{\partial \alpha(I)}{\partial I_w}\Big] R(I_w, I_h, \tau) \tag{5}$$

$$= -(+) + (-)[+] + [(+) + (-)](+) \tag{6}$$

The derivative cannot be signed (even if $\alpha(I) = \frac{\partial \alpha(I)}{\partial I_h} = 0$, in the absence of an income effect).

The second derivative below also cannot be signed and thus $\frac{\partial \overline{\theta_h}}{\partial I_w}$ is not monotonic in I_w.

$$\frac{\partial^2 \overline{\theta_h}}{\partial I_w^2} = \frac{\partial^2 R(I_w, I_h, \tau)}{\partial I_w^2}[\tau I_w + \alpha(I)] + 2\tau \frac{\partial R(I_w, I_h, \tau)}{\partial I_w},$$

where $\frac{\partial^2 R(I_w,I_h,\tau)}{\partial I_w^2} = 2F_w(.)^{-3} f_w(.)(1-x+\tau) f_w(.)[1-x+\tau] + f'_w(.)[1-x+\tau]^2[-F_w(.)^{-2}]$.

The limit of $\frac{\partial \overline{\theta_h}}{\partial I_w}$ when I_w goes to infinity is as follows.

$$\lim_{I_w \to +\infty} \frac{\partial \overline{\theta_h}}{\partial I_w} = -(1-x) + \lim_{I_w \to +\infty} \frac{\partial R(I_w, I_h, \tau)}{\partial I_w}[\tau I_w + \alpha(I)] + \lim_{I_w \to +\infty} \left[\tau + \frac{\partial \alpha(I)}{\partial I_w}\right] R(I_w, I_h, \tau). \quad (7)$$

$\lim_{I_w \to +\infty} \frac{\partial \overline{\theta_h}}{\partial I_w} = -\infty$ because $\frac{\partial R(I_w,I_h,\tau)}{\partial I_w} < 0$ and $\lim_{I_w \to +\infty} R(I_w, I_h, \tau) = \lim_{I_w \to +\infty} \frac{1-F_w(\overline{\theta_w})}{F_w(\overline{\theta_w})} = 0$. Thus, $\frac{\partial \overline{\theta_h}}{\partial I_w} < 0$ when I_w is high enough.

$\frac{\partial \overline{\theta_h}}{\partial I_w}$ is also not monotonic in τ and $\alpha(I)$ since $\frac{\partial^2 \overline{\theta_h}}{\partial I_w \partial \tau} = \frac{\partial^2 R(I_w,I_h,\tau)}{\partial I_w \partial \tau}[\tau I_w + \alpha(I)] + I_w \frac{\partial \kappa(I_w,I_h,\tau)}{\partial I_w} + R(I_w, I_h, \tau) + \frac{\partial R(I_w,I_h,\tau)}{\partial \tau}\left[\tau + \frac{\partial \alpha(I)}{\partial I_w}\right]$ and $\frac{\partial^2 \overline{\theta_h}}{\partial I_w \partial \alpha(I)} = \frac{\partial R(I_w,I_h,\tau)}{\partial I_w} + R(I_w, I_h, \tau)$. $\frac{\partial \overline{\theta_h}}{\partial I_w}$ is also negative when τ is small enough and $\frac{\partial \alpha(I)}{\partial I_w}$ is small enough (income effect is large enough).

$$\lim_{\tau \to 0} \frac{\partial \overline{\theta_h}}{\partial I_w} = -(1-x) + \lim_{\tau \to 0} \frac{\partial R(I_w, I_h, \tau)}{\partial I_w}[\tau I_w + \alpha(I)] + \lim_{\tau \to 0} \left[\tau + \frac{\partial \alpha(I)}{\partial I_w}\right] R(I_w, I_h, \tau) < 0. \quad (8)$$

$$\lim_{\frac{\partial \alpha(I)}{\partial I_w} \to -\infty} \frac{\partial \overline{\theta_h}}{\partial I_w} = -(1-x) + \lim_{\frac{\partial \alpha(I)}{\partial I_w} \to -\infty} \frac{\partial R(I_w, I_h, \tau)}{\partial I_w}[\tau I_w + \alpha(I)] + \lim_{\frac{\partial \alpha(I)}{\partial I_w} \to -\infty} \left[\tau + \frac{\partial \alpha(I)}{\partial I_w}\right] R(I_w, I_h, \tau) < 0. \quad (9)$$

Suppose I_w is not a constant and $I_w(\rho) = I_w \rho$. $\frac{\partial \overline{\theta_h}}{\partial I_w}$ is also negative when ρ is high enough and if $\tau \to 0$ or $I_w \to +\infty$ or $\frac{\partial \alpha(I)}{\partial I_w} \to -\infty$. This captures that when the husband's cost of incapacitating his wife is high enough, he is less likely to inflict violence.

$$\lim_{\rho \to 1} \frac{\partial \overline{\theta_h}}{\partial I_w} = -(1-x)\rho + \lim_{\rho \to 1} \frac{\partial R(I_w, I_h, \tau)}{\partial I_w}[\tau I_w \rho + \alpha(I)] + \lim_{\rho \to 1} \left[\tau \rho + \frac{\partial \alpha(I)}{\partial I_w}\right] R(I_w, I_h, \tau) < 0 \quad (10)$$

if $\tau \to 0$ or $I_w \to +\infty$ or $\frac{\partial \alpha(I)}{\partial I_w} \to -\infty$.

A5.2 Increase in I_h

$$\frac{\partial \overline{\theta_h}}{\partial I_h} = (1-y) + \frac{\partial R(I_w, I_h, \tau)}{\partial I_h}[\tau I_w + \alpha(I)] + \left[\frac{\partial \alpha(I)}{\partial I_h}\right] R(I_w, I_h, \tau) \tag{11}$$

$$= (+) + (+)[+] + [-](+) \tag{12}$$

If $\alpha(I) = \frac{\partial \alpha(I)}{\partial I_h} = 0$ (in the absence of an income effect), $\frac{\partial \overline{\theta_h}}{\partial I_h} > 0$. An increase in husband's earnings increases violence in the household. This is because now the increase in household resources channel (e.g. stress relief) is no longer playing a role in violence and an increase in his earnings increases the benefit of marriage for the wife. Thus, she will less likely to leave when she experiences domestic violence. These make the husband more likely to inflict violence on his wife. $\frac{\partial \overline{\theta_h}}{\partial I_h} < 0$ when $\frac{\partial \alpha(I)}{\partial I_h}$ is small enough (the income effect is large enough) as in

$$\lim_{\frac{\partial \alpha(I)}{\partial I_h} \to -\infty} \frac{\partial \overline{\theta_h}}{\partial I_h} = (1-y) + \lim_{\frac{\partial \alpha(I)}{\partial I_h} \to -\infty} \frac{\partial R(I_w, I_h, \tau)}{\partial I_h}[\tau I_w + \alpha(I)] + \lim_{\frac{\partial \alpha(I)}{\partial I_h} \to -\infty} \left[\frac{\partial \alpha(I)}{\partial I_h}\right] R(I_w, I_h, \tau) < 0. \tag{13}$$